

Report for the
Ecosystem Management Program
Pōhakuloa Training Area,
Island of Hawai`i
July 2003 to December 2005

U.S. Army Garrison, Hawai`i
Pōhakuloa Training Area
P.O. Box 4607
Hilo, HI 96720

December 2006

Report for the Ecosystem Management Program Pōhakuloa Training Area, Island of Hawai`i July 2003 to December 2005

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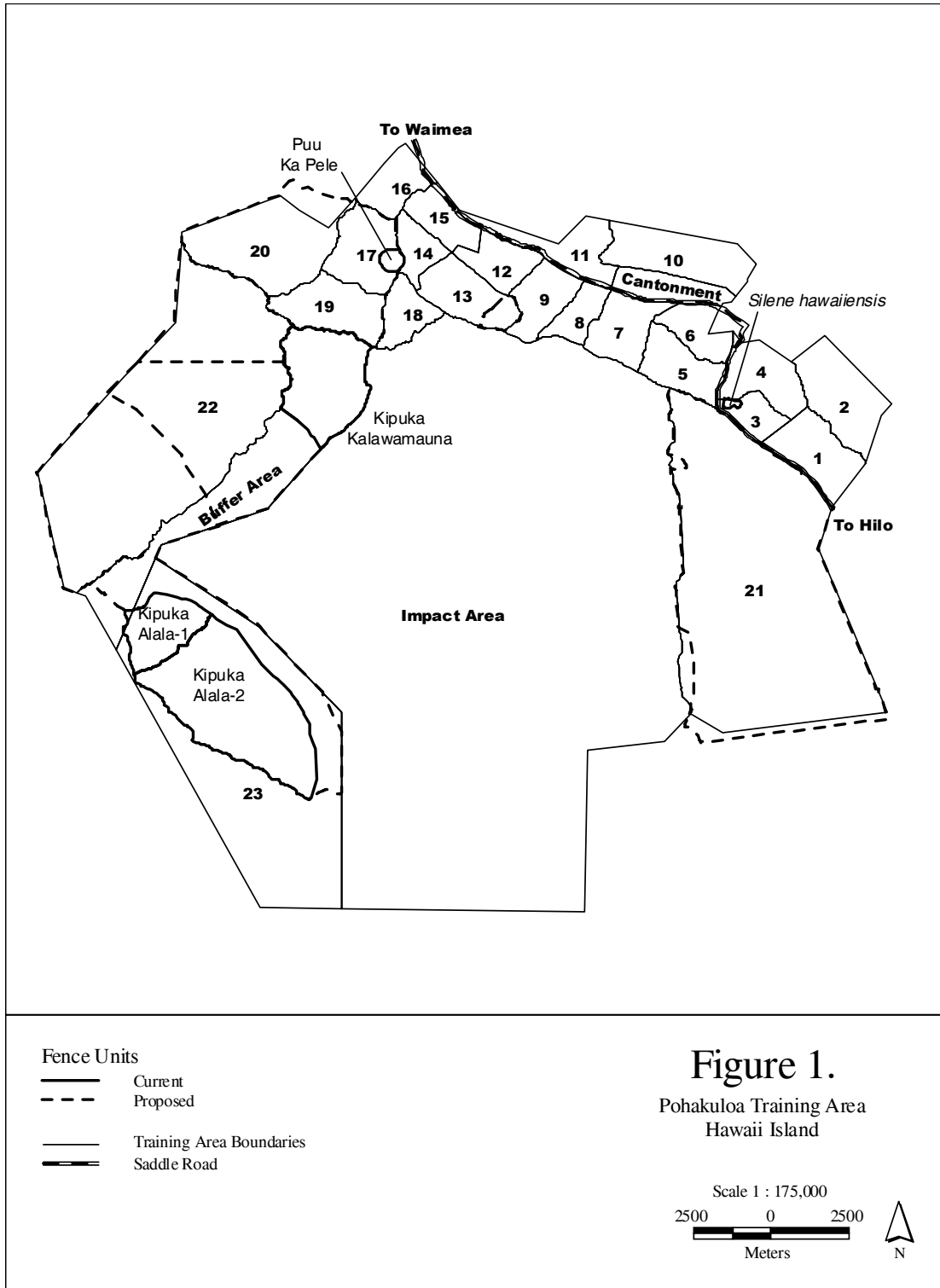
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MANAGEMENT SUMMARY

This summary provides brief descriptions of significant results of natural resource projects and tasks performed by the Natural Resources Staff (NRS) of the Center for Environmental Management of Military Lands (CEMML), Colorado State University stationed at Pōhakuloa Training Area (PTA) (Figure 1). The report covers the time frame of July 1, 2003 to December 31, 2005. Recommendations for further management actions based on these results are also provided.



SPECIES SPECIFIC GOALS – RARE PLANT MONITORING, MANAGEMENT, PROPAGATION, AND OUTPLANTING

SUMMARY

Effort focused on the reidentification of previously recorded Priority Species-1 locations during previous reporting periods. This has been completed and pilot studies have begun to assess the implementation of Population Viability Analysis (PVA) protocols for the highest priority species. Approximately 983.75 personnel hours were spent on monitoring during the reporting period, July 1, 2003 to December, 31, 2005. In 2005 approximately 5,273 plants were monitored using existing PVA protocols. At this point conclusions on species trends cannot be made because a comprehensive monitoring has not been implemented. The data collected to this date will be used to assess the monitoring needs to ensure the monitoring program has the appropriate scientific and statistical rigor.

One important point that continues to be illustrated is the impacts of ungulates on federally listed plant species. Plants protected within emergency exclosures or large-scale fence units showed lower incidence of damage than did those outside of protective fencing. Plants within exclosures and fence units may be impacted by insects, rodents, birds, or Judas animals. This emphasizes the need for the large-scale fence units to protect federally listed species as well as their habitat.

Asplenium peruviana var. insulare

Monitoring: Reidentification of previously recorded locations continues for this species, therefore, a monitoring program has not been initiated for the species. Once surveys have been completed the monitoring needs of the species can be properly addressed.

Monitoring Recommendations: Complete reidentification of previously recorded locations and implement a monitoring program.

Management: *A. peruviana var. insulare* is found in Intensive Management Units (IMU) 33, 34, 35, 36, 38, and 39. Management Actions focused on reidentifying the cave locations in which the species is found.

Management Recommendations: IMU's 33, 34, and 35 are found within Kīpuka `Alalā and weed control within the cave entrances should be conducted. IMU's 36, 38, and 39 are not found within large-scale fence units. Fence units are important to prevent damage to the plants from ungulates that frequently use caves for shelter.

Propagation and Outplanting: Genetic storage and propagation are being conducted in conjunction with the Center for the Conservation and Research of Endangered Wildlife and Lyon Arboretum Micropropagation Facility, Hawai'i.

Propagation and Outplanting Recommendations: Developed propagation facility protocols for receiving micropropogated plants.

Haplostachys haplostachya

Monitoring: Preliminary monitoring has been implemented. This information can be used to properly design a monitoring program for the species.

Monitoring Recommendations: Implement a comprehensive monitoring program for the species based upon preliminary data.

Management: *H. haplostachya* is found in IMU's 4, 6, 10, and 44. No management other than preliminary monitoring has been implemented

Management Recommendations: Fountain grass is present in all locations and requires control. Only IMU 44 is found within a large-scale fence unit. Ungulates are a threat to this species and large-scale fence units and ungulate removal are essential for the long-term viability of the species.

Propagation and Outplanting: Approximately 20,000 seeds are stored that were collected from four of the five sites at PTA. Only one outplanting has occurred because this is one of our most abundant listed plant species and is a PS-5.

Propagation and Outplanting Recommendations: Ensure seed collections are representative of all sites. Expand outplanting for the species to sites within and outside of PTA.

Hedyotis coriacea

Monitoring: Reidentification of previously recorded individuals was completed during the last reporting period ending June 30, 2003. At that time there were a total of 84 known individuals. Surveys within IMU recorded additional individuals bringing the total known individuals to 155. Only one of these individuals is a seedling, the first confirmed recording since this species has been closely managed. Many of these individuals have been protected from ungulates for several years and other species have responded favorably to the increased precipitation of recent years. This raises the question of why there has been a lack of reproduction in this species.

Monitoring Recommendations: Continue to monitor the species annually with particular attention paid to documenting any regeneration.

Management: *H. coriacea* is found in IMU 11, 18, 19, 20, 21, 29, and 30. Emergency exclosures have been erected and weed control has been implemented for all known *H. coriacea* in their IMU. *H. coriacea* sites in IMU 18 and portions of sites in IMU 19, 30, and 30 are found within large-scale fence units.

Management Recommendations: Solicit, coordinate, or implement studies to determine the cause(s) for its lack of regeneration. Continue to provide support for the fencing program at PTA. Continue to survey suitable habitat for the species. Large-scale fence units are vital to the long-term protection of the species. *H. coriacea* plants in IMU's 11, 19, and 20 form a continuous distribution and the IMU should be merged and managed as a single IMU.

Propagation and Outplanting: Approximately 4,000 seeds from six of eight sites are in storage. One hundred two individuals have been outplanted during the reporting period.

Propagation and Outplanting Recommendations: Ensure all individuals are sufficiently represented in collections, seed storage, and outplanting.

Neraudia ovata

Monitoring: Monitoring and surveys has recorded a large increase in the number of individuals known. There are now 14 known adults and 122 juveniles. At the end of the last reporting period there were six adults and approximately 15 juveniles known. This is an increase of 133% and 713% respectively. The rains of recent years have benefited this species.

Monitoring Recommendations: Continue annual monitoring of the species as an important part of threat assessment.

Management: *N. ovata* is found in IMU's 14, 15, and 24. This is one of the most intensively managed species at PTA. Surveys, emergency exclosures, weed control, and rodent control for this species is considerable.

Pennisetum setaceum has been brought under control for this species but *Kalanchoe tubiflora* is becoming an increasing problem. Ungulates have largely been prevented from damaging the known individuals. However, they continue to degrade the habitat. Unfortunately rodents became a problem in 2004. They were controlled using 225 bait boxes stocked with rodenticide. **Management**

Recommendations: Continue weed and rodent control. *Kalanchoe tubiflora* is a persistent threat in IMU 24 and control efforts should be tailored to address this species.

Management Recommendations: Weed control efforts targeting *Kalanchoe tubiflora* should be implemented. Support large-scale fencing to protect this species and its habitat from ungulate damage. Support the process to obtain FDA approval for the aerial distribution of rodenticide. Continue with rodent control to prevent damage to young plants. Large-scale fence units are necessary for the recovery of this species.

IMU's 14 and 15 were established around one and two individuals respectively. Surveys have found additional locations. The two IMU's should be merged and expanded to incorporate all known locations within the site.

Propagation and Outplanting: Approximately 17,000 seeds are stored. Twelve of the naturally occurring adults are represented in the greenhouse. To facilitate genetic transfer, an effort to have both male and female plants from each founder has been made. One hundred fifty-two individuals have been outplanted at PTA. Outplants have been provided to Hawai'i Volcanoes National Park and private botanical gardens.

Propagation and Outplanting Recommendations: Obtain male and female representation of natural plants for greenhouse specimens. Improve founder representation at outplantings outside of PTA.

Portulaca sclerocarpa

Monitoring: New locations continue to be recorded during surveys and other management actions. Threats to the species at PTA are limited. The species may be at the upper limits of its distribution at PTA and this may explain the low number of known locations and number of individuals.

Recommendations: Continue annual monitoring of known locations to track trends. Continue to survey suitable habitat for new locations.

Management: *P. sclerocarpa* is confirmed in IMU's 11, 24, 28, 29, and 30. It is typically a secondary species managed for in these IMU's. Higher priority species are the main focus of management.

Recommendations: Proceed with management of these IMU's with higher priority species in which *P. sclerocarpa* is found as would occur according to the IMU priority.

Propagation and Outplanting: Seed collection has been successful, all known sites are represented. Approximately 25,000 seeds, mostly from greenhouse plants, are in storage. Outplanting to date has not been successful.

Recommendations: Improve collections from natural sites. Propagate outplantings from greenhouse plants until outplanting requirements are better understood.

Schiedea hawaiiensis

Monitoring: Although not a listed species, *S. hawaiiensis* is one of our rarest plants and is only known from a single natural site. Monitoring for this species provides another opportunity to assess the threats to the remaining plants.

Monitoring Recommendations: Continue annual monitoring to ensure threats are being addressed.

Management: Plants at the natural site continue to struggle. Management continues to focus on rodent control, weed control, and ungulate exclusion. Vigilance is required to ensure the remaining plants in the natural group are not impacted by rodents or ungulates.

Management Recommendations: Large-scale fencing will reduce the threats to the remaining natural plants. Continued rodent control is required to ensure the survival of the natural plants.

One IMU is identified for the single natural occurrence of the species. Rodent and weed control is conducted on a regular basis for the species. The seven naturally occurring juveniles and three adults are protected by an emergency enclosure.

Propagation and Outplanting: Four individuals are being cultivated in the greenhouse for seed collection. Approximately 10,000 seeds are in storage. One hundred eighteen individuals have been outplanted at six sites.

Propagation and Outplanting Recommendations: Utilize seed from field grown plants and rotate greenhouse stock to improve genetic representation.

Silene hawaiiensis

Monitoring: Preliminary PVA monitoring has been implemented. The preliminary data can be used to design a comprehensive monitoring program for the species.

Monitoring Recommendations: Design and implement a comprehensive monitoring program.

Management: *S. hawaiiensis* is found in IMU's 1, 2, 3, 11, 18, 29, 37, and 38. Weed control specific for this species is conducted in IMU 3 where a large-scale fence unit protects thousands of plants. Low numbers of plants are found within the Kīpuka `Alalā and Kīpuka Kālawamauna Fence Units.

Management Recommendations: The majority of plants are found on the eastern side of the installation and are not protected by large-scale fence units. Browse is consistently recorded on plants found during surveys and monitoring. Large-scale fence units are necessary to protect the species and its habitat.

Propagation and Outplanting: Approximately 500 seed representing two sites and greenhouse propagated specimens has been stored.

Propagation and Outplanting Recommendations: Augment seed collection with unrepresented sites.

Silene lanceolata

Monitoring: Location and plant numbers have increased due to a combination of favorable weather patterns, weed control, and ungulate control. The known number of plants at PTA is higher now than previously recorded.

Monitoring Recommendation: Design and implement a comprehensive monitoring program for the species. More than half the IMU's in which the *S. lanceolata* is found are not protected by large-scale fence units. Field observations and monitoring indicate that sites from which ungulates have been excluded have flourished to a greater degree than have those sites that are not protected. Large-scale fence units, as required in the *Biological Opinion of the U.S. Fish and Wildlife Service for Routine Military Training and Transformation of the 2nd Brigade 25th Infantry Division (Light) U.S. Army Installations, Island of Hawai'i* (USFWS 2003), are important for the long-term viability of the PTA populations.

Management: *S. lanceolata* is actively managed in IMU 5, 11, 13, 16, 17, 18, 24, and 31. Surveys, emergency exclosures, and weed control have been the management focus in these IMU's. In addition, the species is found in IMU's 25 and 27 where management does not occur at this time.

Management Recommendations: Maintain weed control in areas where it has been initiated and expand weed control to include locations that have not had weed control conducted. A large portion of the plants found at PTA are not within large-scale fence units. This species is heavily impacted by ungulate browse.

Propagation and Outplanting: Approximately 20,000 seeds have been collected from greenhouse, outplanted, and natural individuals. Two hundred fifty-eight plants have been outplanted at eight sites.

Propagation and Outplanting Recommendations: Expand seed collection to ensure all sites are represented and establish outplanting sites outside of PTA.

Solanum incompletum

Monitoring: Survey efforts have recorded new locations and natural recruitment was recorded during monitoring.

Monitoring Recommendations: Continue to monitor the species annually to detect any negative impacts that may occur.

Management: *S. incompletum* are found within IMU's 13 and 24. Surveys, emergency exclosure construction, weed control, and rodent control were conducted to identify and protect this species from threats. In addition to *Pennisetum setaceum*, *Kalanchoe tubiflora* is a serious weed control issue. *K. tubiflora*, unlike *P. setaceum*, is difficult to prevent from continuously invading weed control buffers. Preventative rodent control is being conducted with this species in conjunction with *Neraudia ovata*. Individual plants have been protected from ungulates; however, they continue to degrade the habitat of this species.

Management Recommendations: The continued presence of ungulates in the habitat of the species is a key factor in the recovery of the species. Large-scale fence units are required to halt habitat degradation by ungulates. Concerted effort should be made to control *K. tubiflora* outside of weed control buffers in an effort to prevent its spread.

Propagation and Outplanting: Seed collection has occurred from all but one known location. However, most of the 20,000 seeds in storage are from plants at one location. Approximately 959 individuals have been outplanted. However, there are few founders as source material. Few of the known plants have produced seed.

Propagation and Outplanting Recommendations: Increase diversity of seed collections and outplantings when the opportunity arises.

Spermolepis hawaiiensis

Monitoring: Rains of previous years resulted in a tremendous flush of plants from the seed bank. The rains facilitated surveys for this species. Prior to 2004 there hadn't been enough recruitment to conduct surveys. Monitoring for this annual species was not implemented.

Monitoring Recommendations: Conduct surveys for this annual and ephemeral species during favorable weather conditions. Develop monitoring protocols for this annual species, if they are appropriate.

Management: *S. hawaiiensis* has been confirmed, through surveys, in IMU 32. No other management actions have been conducted for the species. The plants found in IMU 32 are sufficiently protected within the Kīpuka `Alalā Fence Unit.

Management Recommendations: Continue to conduct cursory inspections of known locations to determine if conditions may be favorable to conduct broader surveys to map the distribution of the species.

Propagation and Outplanting: Several thousand seed from natural and greenhouse plants are stored at PTA. No recruitment has resulted from outplanting. Seed provided to Hawai`i Volcanoes National Park has been increased to 28,000 that will be used for a seed broadcast experiment.

Propagation and Outplanting Recommendations: Experiment with seed broadcasting to determine requirements for establishing self sustaining sites.

Stenogyne angustifolia

Monitoring: No monitoring was conducted for this species because of its abundance and the monitoring problems its clonal nature presents.

Monitoring Recommendations: Conduct preliminary PVA monitoring for the species to develop a comprehensive monitoring program.

Management: *S. angustifolia* is found in several IMU's on the western side of PTA. Plants continue to be recorded during surveys and other management actions. Weed control is not conducted specifically for this species due to its low Priority Species-5 ranking. It does, however, benefit from management actions conducted for other species such as *Silene lanceolata*. Competition with invasive grasses may not impact this species as much as others. *S. angustifolia* is common in vegetation types in which the native *Eragrostis atropioides* is abundant. Previous field observations tended to support the idea that the species was not browsed heavily by ungulates. However, recent observations within fence units, which have been established for several years, indicate that the species is in fact impacted by ungulates. Browse is not commonly observed for the species because, it is now believed, plants are up-rooted and completely consumed by ungulates. No management is conducted specific for the species. It benefits from general surveys and management actions targeting higher priority species.

Management Recommendations: Recent field observations tend to indicate that large-scale fence units would have positive impacts to the species, perhaps more so than weed control. Large-scale fence units would prevent damage to the species and reduce degradation of its habitat.

Propagation and Outplanting: Seed from natural sites, outplanting sites, and greenhouse plants are in storage. Approximately 141 individuals have been outplanted at PTA and Hawai`i Volcanoes National Park, with more planned.

Propagation and Outplanting Recommendations: All outplanted individuals are clones of one plant. Investigations should be conducted to determine germination requirements. Future vegetative propagation should include a variety of individuals collected from the field to increase genetic diversity and probability of long-term survival of the species.

Tetramolopium arenarium ssp. arenarium

Monitoring: Intensive monitoring is conducted annually for this species. Based on monitoring results, improved weather conditions combined with weed control has benefited the species.

Monitoring Recommendations: Assess the PVA monitoring protocols to include the use of sub-sampling to more efficiently monitor the species.

Management: New locations are frequently found within the weed control buffers. The extensive buffer is being expanded to encompass more habitat and plants as they are recorded. Emergency exclosures are erected as new locations are found. However, these measures are temporary and provide no benefit to the habitat.

Management Recommendations: Continue weed control and expand control buffers as appropriate. The habitat of the species is impacted by the presence of a herd of goats. The herd of 50-100 individuals is consistently seen within the weed control buffers and surrounding area. They threaten to trample or browse any unrecorded and unprotected plants. Large-scale fence units and ungulate control are vital for

continued existence of the species, which is known only from a single site. *T. arenarium ssp. arenarium* is impacted by ungulates from trampling and occasional browse. Feral goats are consistently found within IMU 8. Large-scale fence units are necessary to protect the species from ungulates and reduce the degradation of the habitat. Wildfire is a serious threat to the species. Implementation of fire breaks and fuel management is essential to the protection of this species.

Propagation and Outplanting: Approximately 1,500 seeds are in storage. Sources include natural plants and outplanting sites. Forty-two individuals have been outplanted at PTA, all have reached reproductive maturity.

Recommendations: Increase collections from all natural locations. Establish outplanting sites outside of PTA.

Tetramolopium sp. 1

Monitoring: *Tetramolopium sp. 1* is another of the extremely rare but unlisted species found at PTA. This species like many others at PTA has become more abundant with the favorable weather conditions. Weed control has been effective in reducing competition from invasive species. Monitoring has been implemented and will continue annually. One of the two sites is found within the Kīpuka `Alalā Fence Units. The other is protected by an emergency enclosure.

Recommendations: Continue monitoring on an annual basis.

Management: Weed control has been implemented in IMU 12 and 31 where sites are found.

Recommendations: The plants at one of the sites are protected by an emergency enclosure. Large-scale enclosures are vital to the long-term survival of *T. sp. 1* and protection of its habitat. Continued weed control is important to reduce competition for *T. sp. 1*, which is only known from PTA. A large-scale fence unit is needed for the long-term viability of the species at PTA.

Propagation and Outplanting: Approximately 3,000 seed is in storage from two extant and two extirpated sites, in addition to three outplanting sites.

Recommendations: Determine viability of seed collected from extirpated sites. Establish outplanting sites outside of PTA.

Zanthoxylum hawaiiense

Monitoring: A monitoring program has not been designed for this species. The distribution at PTA hasn't been determined, making the implementation of a comprehensive monitoring program not possible. In addition, the monitoring protocols will have to take into account the dioecious nature of the species.

Recommendations: Design a monitoring program to address the challenges this species presents to management.

Management: Management of this species is perhaps the most problematic of those found at PTA. Factors affecting this species includes invasive species, rodents, and ungulates. Management of this species has focused on determining its distribution at PTA in an effort to prioritize future management actions. Surveys within IMU's 7, 9, 23, 25, 26, 27, and suitable habitat have been conducted.

Recommendations: Continue with surveys in suitable habitat to identify areas of high concentration. Following surveys reevaluate the IMU's identified for the management of the species and determine where management would be best targeted. Implement or coordinate a study to determine the factions impacting the regeneration of the species.

Propagation and Outplanting: Approximately 700 seeds from five individuals are contained in the collection. Sixteen plants are located at five outplanting sites.

Recommendations: With the increased number of individuals found during recent surveys, the seed collection should be expanded to include a greater number of founders. Establish outplanting site outside of PTA.

The status of each listed plant species is summarized in Table 1. The numbers reported are summaries of monitoring and survey information and are therefore comprehensive.

Table 1. Summary of federally listed endangered, threatened, and rare plant densities at PTA.

Scientific Name	Sites Number	IMU	Number of Individuals	Natural or Outplanted	Fence Status	Surveyed 2003-2005	Monitored Group
<i>Asplenium peruviana</i> var. <i>insulare</i> (E)	Aspper 01	33	33-35	Natural	Present	X	
	Aspper 02	-	1-10	Natural	Present		
	Aspper 03	-	2	Natural	Present		
	Aspper 04	34	202-482	Natural	Present	X	
	Aspper 05	36	148	Natural	Future		
	Aspper 06	11	40	Natural	Future		
	Aspper 07	11	1	Natural	Future		
	Aspper 08	39	1	Natural	None	X	
	Aspper 09	38	72-130	Natural	Future	X	
<i>Haplostachys haplostachya</i> (E)	Haphap 04	5, 6	127	Natural	Present/ Future	Partial	X
	Haphap 05	8	708-813	Natural	Future	X	X
	Haphap 07	4	1621-2003	Natural	Future	X	X
	Haphap 08	10	24	Natural	Future	X	X
	Haphap 13	12, 16, 17, 18, 44	7660-9180	Natural	Present	X	X
	Haphap 16	-	230-332	Natural	None	X	

Scientific Name	Sites Number	IMU	Number of Individuals	Natural or Outplanted	Fence Status	Surveyed 2003-2005	Monitored Group
<i>Hedyotis coriacea</i> (E)	Hedcor 01	18	5	Natural	Present	X	X
	Hedcor 02	11	27	Natural	Future*	X	X
	Hedcor 03	21	9	Natural	Future*	X	X
	Hedcor 04	22	5	Natural	Future*	X	X
	Hedcor 05	29	12	Natural	Present	X	X
	Hedcor 06	12	1	Natural	Present	X	X
	Hedcor 07	19/20	8	Natural	Future*	X	X
	Hedcor 09	29	1	Natural	Future*	X	X
	Hedcor 10	30	86	Natural	Present/ Future*	X	X
	Hedcor (Pu`u Huluhulu)	201	10-100	Outplanted	Present	N/A	X
Hedcor (Koai`a Tree Sanctuary)	202	10-100	Outplanted	Present	N/A	X	
<i>Neraudia ovata</i> (E)	Nerova 01	24	115	Natural	Future*	X	X
	Nerova 02	14	21	Natural and Outplanted	Present/ Future*	X	X
	Nerova (KKOP01)	206	4	Outplanted	Present	N/A	X
	Nerova (KKOP06)	211	2	Outplanted	Present	N/A	X
	Nerova (SHOP01)	213	4	Outplanted	Future*	N/A	X
	Nerova (Kohala)	215	12	Outplanted	Present	N/A	X
	Nerova (TA 23)	202	16	Outplanted	Present	N/A	X
	Nerova (^Owe`owe)	204	25	Outplanted	Present	N/A	X
	Nerova (Pu`u Huluhulu)	201	35	Outplanted	Present	N/A	X
	Nerova (Pu`u Wa`a wa`a)	205	46	Outplanted	Present	N/A	X
	Nerova (HAVO)		168	Outplanted	Unknown	N/A	

Scientific Name	Sites Number	IMU	Number of Individuals	Natural or Outplanted	Fence Status	Surveyed 2003-2005	Monitored Group
<i>Portulaca sclerocarpa</i> (E)	Porscl 01	11	0	Natural	Future		X
	Porscl 04	TA22	7	Natural	Future		X
	Porscl 06	29	5	Natural	Future		X
	Porscl 08	24	2	Natural	Future		Partial
	Porscl 10	14	2	Natural	Future		X
	Porscl 12	19	3	Natural	Present		X
	Porscl 14	30	2	Natural	Present		X
	Porscl (KKOP05)	210	?	Outplanted	Present	N/A	
	Porscl (Koai`a Tree Sanctuary)	202	5	Outplanted	Present	N/A	
<i>Silene hawaiiensis</i> (T)	Silhaw 01	37	36-75	Natural	Future	Partial	X
	Silhaw 02	38,40	368-386	Natural	Future	Partial	
	Silhaw 03	1,2	648-657	Natural	Future		X
	Silhaw 04	30	1	Natural	Future		
	Silhaw 05	-	1	Natural	Future		
	Silhaw 06	-	3	Natural	Future		
	Silhaw 12	-	0	Natural	None	X	
	Silhaw 17	3	390	Natural	Present		X
	Silhaw 19	-	181-1030	Natural	None		
	Silhaw 20	37	6-60	Natural	None		
	Silhaw 21	-	44	Natural	Future		
	Silhaw 22	40	5	Natural	Future	Partial	
	Silhaw 23	40	5	Natural	Future	Partial	
	Silhaw 26	12	129	Natural	Future		X
	Silhaw 29	29	86	Natural	Future	Partial	X

Scientific Name	Sites Number	IMU	Number of Individuals	Natural or Outplanted	Fence Status	Surveyed 2003-2005	Monitored Group
<i>Silene lanceolata</i> (E)	Sillan 01	5	15	Natural	Future*		X
	Sillan 02	-	2	Natural	Future		
	Sillan 04	13	561-563	Natural	Future*	X	X
	Sillan 06	12	296	Natural	Present		X
	Sillan 07	16	1097	Natural	Present	X	X
	Sillan 08	8	52	Natural	Future*	X	X
	Sillan 10	18	1494	Natural	Present	X	X
	Sillan 11	11	108	Natural	Future*		
	Sillan 13	25	177	Natural	Future*	X	
	Sillan 14	27	65	Natural	Future*	X	X
	Sillan 15	31	6551-6806	Natural	Present	X	X
	Sillan 16	-	45	Natural	Present	X	
	<i>Solanum incompletum</i> (E)	Solinc 01	24	75	Natural	Future*	X
Solinc 02		13	4	Natural	Future*		X
Solinc (KKOP04)		209	32	Outplanted	Present	N/A	X
Solinc (KKOP06)		211	13	Outplanted	Present	N/A	X
Solinc (KAOP)		214	105	Outplanted	Present	N/A	X
Solinc (Pu`u Huluhulu)		201	339	Outplanted	Present	N/A	X
Solinc (`Owe`owe)		204	218	Outplanted	Present	N/A	X
Solinc (Pu`u Wa`awa`a)		202	180	Outplanted	Present	N/A	X
Solinc (Koai`a Tree Sanctuary)		204	72	Outplanted	Present	N/A	X
<i>Spermolepis hawaiiensis</i> (E)	Spehaw 03	32	4834-5268	Natural	Present	X	X
	Spehaw 06	TA 23	2	Natural	Future		

Scientific Name	Sites Number	IMU	Number of Individuals	Natural or Outplanted	Fence Status	Surveyed 2003-2005	Monitored Group
<i>Stenogyne angustifolia</i> (E)	Steang 02	10,11,12,,21	374-379	Natural	Future	Partial	
	Steang 03	23,25,26	18	Natural	Future	X	
	Steang 06	TA 23	1	Natural	Present		
	Steang 08	29,30	9-12	Natural	Future	X	
	Steang 11	8	309-433	Natural	Future	X	
	Steang 12	11,13,14,18, 21	1201-1562	Natural	Present	Partial	
<i>Tetramolopium arenarium</i> (E)	Tetare 01	8	600		Future*	X	X
	Tetare 02	12	1		Future*	X	X
<i>Zanthoxylum hawaiiense</i> (E)	Zanhaw 09	9,23,24,25,26,27	211	Natural	Future	X	
	Zanhaw 10	29,30	5	Natural	Future	X	
	Zanhaw 11	Range 11	1	Natural	None		
	Zanhaw 17	13,23	124	Natural	Future	X	
	Zanhaw 18	7	2	Natural	None		

* Currently protected by emergency exclosures.

The Intensive Management Unit (IMU) program was developed as a management tool to focus limited resources in an effort to maximize the effects of management actions. IMU's were identified in areas of high natural resource value, include is the quality of habitat as well as the rarity of species. Management is conducted with the ecosystem in mind and not focused on a particular species.

Management of an IMU begins with surveying to determine what resources there are to be managed and where that management is best targeted. Following surveys the threats to the species in the IMU are assessed, prioritized, and implemented. The control of invasive plant species is important in the management of listed species. Systematic weed control is conducted so that a weed control buffer is created around the listed or rare plants. Within the buffer all alien plant species are controlled by hand clearing, chemically through the use of herbicides, and mechanically using weed whackers. Rodents heavily impacted some of the rare and listed plant species during the reporting period. They appeared to be seeking moisture from the plant stems. Rodents were controlled using an approved traps and rodenticide. Another important threat to the species found at PTA is ungulates. Small-scale emergency exclosures are constructed around individual plants or plant clusters as a measure to prevent ungulate damage until large-scale fence units have been completed and ungulates removed. The visual and physical barrier is usually sufficient protection, although ungulates could penetrate the emergency exclosures.

Propagation and outplanting are necessary objectives toward the goal of achieving stability and sustainability for PTA's listed species. The three areas of focus to meet these objectives have been genetic storage, germination and propagation tests, and rare plant reintroduction and augmentation.

The ultimate goal of the PTA Outplanting Program is to increase the abundance of its rare species to avoid wide scale loss due to catastrophic events such as wildfire or volcanic eruptions. PTA houses 80-100% of all the genetic material for nine of its twelve listed species. The current outplanting sites are used to validate site selection and planting techniques, to maintain field stock and seed sources, and when successful, as permanent reintroductions.

Except for three species (*Neraudia ovata*, *Tetramolopium arenarium* ssp. *arenarium*, and *Schiedea hawaiiensis*) augmentation of naturally occurring populations has not been undertaken in order to avoid any unanticipated negative impacts on the natural population.

Table 2 provides a summary of all Management Actions and outplanting that has occurred in the IMU's during the reporting period. Each IMU is discussed in detail in their respective sections of the report.

Table 2. Summary of Management Actions by IMU.

IMU	Plant Surveys	Acres	Weed Control						Rodent Control			Fencing	Monitoring Hours	Outplanting		
			Weed Whacking Hours	Hand Clearing Hours	Spray Hours	Acres	Goal Trips per Year	Trips per Reporting	% Trips Completed	Hours	Acres			Goal Trips per Year	Trips per Reporting	% Trips Completed
IMU 1/ IMU 2 All Species <i>Silene hawaiiensis</i>	184	2,450												75		
IMU 3 <i>Silene hawaiiensis</i>				12	74	37	1	3	120					51		
IMU 4 All Species <i>Haplostachys haplostachya</i> <i>Silene hawaiiensis</i> <i>Stenogyne angustifolia</i>	44	106												44		
IMU 5 All Species <i>Haplostachys haplostachya</i> <i>Silene lanceolata</i>	2	0.5		15	6	91.5	1.2	3	6	100			24	10		
IMU 6 All Species <i>Haplostachys haplostachya</i>	24	44												12		

IMU	Plant Surveys	Acres	Hours	Weed Control					Rodent Control			Fencing	Monitoring Hours	Outplanting		
				Weed Whacking Hours	Hand Clearing Hours	Spray Hours	Acres	Goal Trips per Year	Trips per Reporting	% Trips Completed	Hours			Acres	Goal Trips per Year	Trips per Reporting
IMU 7 <i>Zanthoxylum hawaiiense</i>					39	1	2	3	75							
IMU 8 All Species <i>Haplostachys haplostachya</i> <i>Silene lanceolata</i> <i>Stenogyne angustifolia</i> <i>Tetramolopium arenarium ssp. arenarium</i>	136	1,100			16	17	1					5	13			
				308	163	1,085	37	4	11	138		87	162			
IMU 9 All Species <i>Zanthoxylum hawaiiense</i>			103													
IMU 10 All Species <i>Haplostachys haplostachya</i>			60										29			

IMU	Plant Surveys	Acres	Hours	Weed Control					Rodent Control			Fencing Hours	Monitoring Hours	Outplanting		
				Weed Whacking Hours	Hand Clearing Hours	Spray Hours	Acres	Goal Trips per Year	Trips per Reporting	% Trips Completed	Hours			Acres	Goal Trips per Year	Trips per Reporting
IMU 11																
All Species	84	86														
<i>Asplenium peruviana insulare</i>																
<i>Hedyotis coriacea</i>				16	80	10	2	5	100			32	22			
<i>Portulaca sclerocarpa</i>																
<i>Silene lanceolata</i>												12	3			
<i>Stenogyne angustifolia</i>																
<i>Tetramolopium sp. 1</i>					6	0.5	2	1	100			19	13			
IMU 12																
All Species	72	73		58	25											
<i>Haplostachys haplostachya</i>																
<i>Hedyotis coriacea</i>					1.5	55	0.6	4					0.5			
<i>Silene hawaiiensis</i>													6			
<i>Silene lanceolata</i>					135	3	4						39			
<i>Stenogyne angustifolia</i>																
<i>Tetramolopium arenarium</i>					24	1	4					12	0.3			

IMU	Plant Surveys		Weed Control							Rodent Control				Fencing	Monitoring	Outplanting		
	Hours	Acres	Weed Whacking Hours	Hand Clearing Hours	Spray Hours	Acres	Goal Trips per Year	Trips per Reporting	% Trips Completed	Hours	Acres	Goal Trips per Year	Trips per Reporting	% Trips Completed	Emergency Enclosure Hours	Hours	Planting Hours	Watering Hours
IMU 13																		
All Species	108	217												6				
<i>Silene lanceolata</i>			17	20	66	11	4	5	83					116		12		
<i>Solanum incompletum</i>			9	4	35	5	4	5	83	6	1	5	4	4		1		
<i>Stenogyne angustifolia</i>																		
<i>Zanthoxylum hawaiiense</i>																		
IMU 14																		
All Species	66	88																
<i>Neraudia ovata</i>			38	8	120	5	4	11	110	37	1	5	5	100	30	0.5		
<i>Portulaca sclerocarpa</i>																4		
IMU 16																		
All Species	47	43																
<i>Haplostachys haplostachya</i>				10												24		
<i>Silene lanceolata</i>			110	43	286	14	4	7	70							152		
<i>Stenogyne angustifolia</i>																		

IMU	Plant Surveys	Acres	Weed Control						Rodent Control			Fencing Hours	Monitoring Hours	Outplanting		
			Weed Whacking Hours	Hand Clearing Hours	Spray Hours	Acres	Goal Trips per Year	Trips per Reporting	% Trips Completed	Hours	Acres			Goal Trips per Year	Trips per Reporting	% Trips Completed
IMU 18																
Unspecified species	87	175														
<i>Hedyotis coriacea</i>			20		36	2.5	2	4	100				5			
<i>Silene lanceolata</i>			6	2	113	5.2	2	6	120				135			
<i>Stenogyne angustifolia</i>																
IMU 19/20																
All Species	96	148														
<i>Hedyotis coriacea</i>					60	7.5	2	3	100				16	2		
IMU 21																
All Species	26	64														
<i>Hedyotis coriacea</i>					36	4	2	2	100				3.5	14		
<i>Stenogyne angustifolia</i>																
IMU 22																
All Species	15	50														
<i>Hedyotis coriacea</i>					28	4.1	2	2	100				1.5	8		
IMU 23																
All Species	41	143														
<i>Zanthoxylum hawaiiense</i>																

IMU	Plant Surveys		Weed Control						Rodent Control					Fencing	Monitoring	Outplanting		
	Hours	Acres	Weed Whacking Hours	Hand Clearing Hours	Spray Hours	Acres	Goal Trips per Year	Trips per Reporting	% Trips Completed	Hours	Acres	Goal Trips per Year	Trips per Reporting	% Trips Completed	Emergency Enclosure Hours	Hours	Planting Hours	Watering Hours
IMU 24																		
All Species	129	239		74	95					115					9	20		
<i>Neraudia ovata</i>			10	43	158	13	6	13	87	126	15	6	6	100	47			
<i>Portulaca sclerocarpa</i>																		
<i>Solanum incompletum</i>			31	22	95	5.6	6	13	87	29	5	6	6	100	2			
<i>Zanthoxylum hawaiiense</i>																		
IMU 25																		
All Species	81	247														1		
<i>Portulaca sclerocarpa</i>																		
<i>Silene lanceolata</i>																		
<i>Stenogyne angustifolia</i>																		
<i>Zanthoxylum hawaiiense</i>																		
IMU 26																		
All Species	85	306								133	86	21	21	100				
<i>Stenogyne angustifolia</i>																		
<i>Zanthoxylum hawaiiense</i>																		

IMU	Plant Surveys	Acres	Weed Control					Rodent Control			Fencing Hours	Monitoring Hours	Outplanting	
			Weed Whacking Hours	Hand Clearing Hours	Spray Hours	Acres	Goal Trips per Year	Trips per Reporting	% Trips Completed	Goal Trips per Year			Trips per Reporting	% Trips Completed
IMU 27 All Species <i>Silene lanceolata</i> <i>Zanthoxylum hawaiiense</i>	131	388		34	119									
IMU 28 <i>Portulaca sclerocarpa</i>	1	0.5										1		
IMU 29 All Species <i>Hedyotis coriacea</i> <i>Portulaca sclerocarpa</i> <i>Silene hawaiiensis</i> <i>Stenogyne angustifolia</i>	232	375								10	0.8	4	25	
IMU 30 All Species <i>Hedyotis coriacea</i> <i>Portulaca sclerocarpa</i> <i>Silene hawaiiensis</i> <i>Stenogyne angustifolia</i> <i>Zanthoxylum hawaiiense</i>	292			57	5	2	2	67		141	21	2		

IMU	Plant Surveys	Acres	Weed Control						Rodent Control			Fencing	Monitoring Hours	Outplanting		
			Weed Whacking Hours	Hand Clearing Hours	Spray Hours	Acres	Goal Trips per Year	Trips per Reporting	% Trips Completed	Hours	Acres			Goal Trips per Year	Trips per Reporting	% Trips Completed
IMU 31 All Species <i>Silene lanceolata</i> <i>Tetramolopium sp. 1</i>	160	100	44	62	73	2.5	4	5	63					29		
IMU 32 All Species <i>Silene lanceolata</i> <i>Spermolepis hawaiiensis</i> <i>Stenogyne angustifolia</i>	104	300												2		
IMU 33 <i>Asplenium peruviana var. insulare</i>	15															
IMU 34 <i>Asplenium peruviana var. insulare</i>	15															
IMU 35 <i>Asplenium peruviana var. insulare</i>	25															
IMU 36 <i>Asplenium peruviana var. insulare</i>																
IMU 37 <i>Silene hawaiiensis</i>														10		

IMU	Plant Surveys		Weed Control						Rodent Control				Fencing	Monitoring	Outplanting			
	Hours	Acres	Weed Whacking Hours	Hand Clearing Hours	Spray Hours	Acres	Goal Trips per Year	Trips per Reporting	% Trips Completed	Hours	Acres	Goal Trips per Year	Trips per Reporting	% Trips Completed	Emergency Enclosure Hours	Hours	Planting Hours	Watering Hours
IMU 38																		
All Species	36	300																
<i>Asplenium peruviana</i> var. <i>insulare</i>	50																	
<i>Silene hawaiiensis</i>																		
IMU 39																		
<i>Asplenium peruviana</i> var. <i>insulare</i>	9	10																
IMU 40																		
<i>Silene hawaiiensis</i>	55	322																
IMU 41																		
<i>Schiedea hawaiiensis</i>			2	1	9	2.2	3	2	67	16	1	12	10	83	1	1.5		
IMU 44																		
<i>Haplostachys haplostachya</i>																18		
<i>Silene lanceolata</i>																		
Rare Plants Outside of IMU																		
All Species	208	739																
<i>Passiflora mollissima</i>																		
Survey/Control	212	420																
Russian Thistle Control	5	3		30	2,269	356												

IMU	Plant Surveys Hours	Acres	Weed Control					Rodent Control				Fencing Hours	Emergency Enclosure Hours	Monitoring Hours	Outplanting		
			Weed Whacking Hours	Hand Clearing Hours	Spray Hours	Acres	Goal Trips per Year	Trips per Reporting	% Trips Completed	Hours	Acres				Goal Trips per Year	Trips per Reporting	% Trips Completed
IMU 100 Bird Surveys	246																
IMU 101 Nēnē	166																
IMU 102 `Io	133																
IMU 103 `Ope`ape`a	162																
IMU 104 `Elepaio	31							232	14	12	25	83		100			
IMU 105 Ungulates	165																
IMU 106 Pueo														5			
IMU 107 Ants	180																
IMU 108 <i>Rhyncogonus stellaris</i>	56																
IMU 200 (Interpretive Garden)			36										5				
IMU 201 (Pu`u Huluhulu) <i>Solanum incompletum</i>			114	63	1	4	4	100					349	40	192	40	
IMU 202 (Koai`a Tree Sanctuary)			37	126	3	4	6	100						36	144	78	
IMU 203 (Waimea)															2		
IMU 204 (`Owe`owe)			8	41	1	4	3	75						10	75	23	
IMU 205 (Pu`u Wa`awa`a)				29	1	4	2	100					40		70	21	

IMU	Plant Surveys	Acres	Weed Control					Rodent Control				Fencing	Monitoring Hours	Outplanting			
			Weed Whacking Hours	Hand Clearing Hours	Spray Hours	Acres	Goal Trips per Year	Trips per Reporting	% Trips Completed	Hours	Acres			Goal Trips per Year	Trips per Reporting	% Trips Completed	Emergency Enclosure Hours
IMU 206 (KKOP01, KKOP02) <i>Neraudia ovata</i> <i>Schiedea hawaiiensis</i>			2	25	1	2	4	100	16	1	12	9	75	9	10	9	
IMU 208 (KKOP03)				24	3.8	2	2	100							10		
IMU 209 (KKOP04) <i>Solanum incompletum</i>			34	29	120	4	4	4	100						15	29	28
IMU 210 (KKOP05) <i>Tetramolopium arenarium</i>				185											27	144	66
IMU 211 (KKOP06) <i>Neraudia ovata</i> <i>Solanum incompletum</i> <i>Tetramolopium arenarium</i>			15	39	128	2	4	8	100						22	83	32
IMU 212 (KKOP07)			25	14	50	0.5	3	2	67						5	66	10
IMU 213 (SHOP01) <i>Neraudia ovata</i> <i>Schiedea hawaiiensis</i>															8	6	6

IMU	Plant Surveys	Acres	Hours	Weed Control			Rodent Control					Fencing	Monitoring	Outplanting				
				Weed Whacking Hours	Hand Clearing Hours	Spray Hours	Acres	Goal Trips per Year	Trips per Reporting	% Trips Completed	Trips per Reporting			Goal Trips per Year	Acres	Hours	Emergency Enclosure Hours	Planting Hours
IMU 214 (KAOP01) <i>Neraudia ovata</i> <i>Schiedea hawaiiensis</i> <i>Solanum incompletum</i>				113	156		4	8	100	22	2	12	6	50	20	12	85	23
IMU 215 (KAOP02) <i>Neraudia ovata</i>				9											8	9	2	
IMU 216 (TAOP02) <i>Tetramolopium arenarium</i>															10	25	23	
IMU 217 (Northern <i>Neraudia</i>) <i>Neraudia ovata</i>																36	3	

SPECIES SPECIFIC GOALS – RARE ANIMAL SURVEYS AND MONITORING

`Elepaio

Monitoring and Surveys: This species continues to struggle at PTA. One to two juveniles have been produced each year since 2004, but survival past fledging stage is unknown.

Management: Approximately 241 hours have been spent controlling rodents and surveying for birds around nests.

Recommendations: Survey the periphery of known territories for young birds. Continue rodent and cat control in and around known `elepaio territories. Coordinate banding of the remaining birds for identification purposes.

`Io, Hawaiian Hawk

Monitoring and Surveys: There are no known resident birds to be monitored. Surveys have not detected birds, however, they are sporadically observed during other management activities.

Recommendations: Complete surveys in Training Areas 1-4 and 22 in 2006 in compliance with the 2003 Biological Opinion.

Nene, Hawaiian Goose

Monitoring and Surveys: No monitoring was conducted because there are no known resident populations at PTA. No nēnē were observed during surveys that were timed to take advantage of flocking activity, yet they are infrequently observed at PTA. Although there hasn't been a resident population detected, it is unclear how the birds observed are utilizing PTA.

Recommendations: Evaluate survey methods to ensure they are adequate to detect nene at the level at which they are seen during non-survey times. Integrate sightings with a database and GIS to understand habitat use. Coordinate with applicable agencies on the movements of banded nene.

`Ua`u, Dark-rumped Petrel

Monitoring and Surveys: No monitoring or surveys were conducted during the reporting period.

Recommendations: Additional ground based surveys, if required, should focus on suitable habitat, use night vision equipment, and suitable blisters, cracks, and caves should be examined for bones and carcasses.

Discuss with monitoring experts and the USFWS the efficacy of using marine radar in the surveys for `ua`u at PTA. This may not be the most effective and appropriate method considering the density of birds, limited resources, and high cost of employing marine radar.

`Ōpe`ape`a, Hawaiian Hoary Bat

Monitoring and Surveys: Tree roosting bat species are notoriously difficult to census and or monitor. However, a survey protocol was established at PTA to detect presence/absence in various habitat types. Two survey periods totaling 50 nights each detected bats throughout PTA. A preference was shown for dense woodland habitat during the spring 2005 surveys, but no significant difference in habitat use was detected during the winter 2005 surveys.

Recommendations: Develop a more statistically rigorous survey protocol with increased sample size. Capture and radio tag bats to determine roosting habitat use at PTA. `

CHAPTER 1: SPECIES SPECIFIC GOALS

1.1 INTRODUCTION SPECIES SPECIFIC GOALS

The rare plant monitoring programs and the rare animal survey and monitoring programs are designed to provide information that will lead towards an increased understanding of the species at PTA. The information gained from these programs is incorporated into the management actions identified for Intensive Management Units (IMU) with the goal of improved management of the species and habitat.

1.2 INTRODUCTION – RARE PLANT MONITORING

Due to PTA's land use history and isolation, access to the area has been limited. As a result PTA harbors unique ecosystems and vegetation. For example, PTA is one of the largest intact sub-alpine dryland forests remaining in the state. Not only is the ecosystem itself rare but so are many of its components. For example, at PTA there are eleven endangered species, one threatened species, and eleven species of concern, including one undescribed species. Six of these plant species are found only at PTA and two species are found at PTA and one or two other locations in the state.

A Priority Species (PS) list was developed to prioritize monitoring and management actions. *Schiedea hawaiiensis* and *Tetramolopium* sp. 1 are the only PS-1 plants, which are not federally listed. These species of concern are included because *S. hawaiiensis* has less than 20 naturally occurring individuals and *T. sp. 1* has less than 100 known individuals. Therefore, they receive the highest priority for management actions. The Priority Species list has been defined and species assigned as follows.

Priority Species of Pōhakuloa Training Area

Priority Species-1 (PS-1) – Plant species with fewer than 500 individuals and/or 5 or fewer populations remaining statewide.

<i>Hedyotis coriacea</i> (E)	<i>Schiedea hawaiiensis</i> (SOC)
<i>Neraudia ovata</i> (E)	<i>Tetramolopium arenarium</i> ssp. <i>arenarium</i> (E)
<i>Solanum incompletum</i> (E)	<i>Tetramolopium</i> sp. 1 (SOC)

Priority Species-2 (PS-2) – Plant species with 500 - 1,000 individuals and/or 6 - 10 populations remaining statewide.

<i>Asplenium fragile</i> var. <i>insulare</i> (E)	<i>Zanthoxylum hawaiiense</i> (E)
<i>Silene lanceolata</i> (E)	

Priority Species-3 (PS-3) – Plant species with 1,000 – 2,000 individuals and/or 10 - 20 populations remaining statewide.

<i>Festuca hawaiiensis</i> (SOC)	<i>Portulaca sclerocarpa</i> (E)
----------------------------------	----------------------------------

Priority Species-4 (PS-4) – Plant species with 2,000 – 5,000 individuals and/or 20 - 40 populations remaining statewide.

<i>Eragrostis deflexa</i> (SOC)

Priority Species-5 (PS-5) – Plant species with more than 5,000 individuals and/or more than 40 populations remaining state wide.

<i>Chamaesyce olowaluana</i> (SOC)	<i>Portulaca villosa</i> (SOC)
<i>Cystopteris douglasii</i> (SOC)	<i>Silene hawaiiensis</i> (T)
<i>Dubautia arborea</i> (SOC)	<i>Spermolepis hawaiiensis</i> (E)
<i>Exocarpos gaudichaudii</i> (SOC)	<i>Stenogyne angustifolia</i> (E)
<i>Haplostachys haplostachya</i> (E)	<i>Tetramolopium consanguineum</i> ssp. <i>leptophyllum</i> (SOC)
<i>Melicope hawaiiensis</i> (SOC)	

The term population is one that is often difficult to define in practical terms. Several of the species at PTA are found in isolated clusters of plants, which occupy only a fraction of the species' historic range. Other species' distributions are restricted to PTA; although there are a large absolute number of individuals. Due to the differences in the distribution of species, they cannot easily be broken into populations on spatial terms. The most effective means of defining a population is through genetic information that is largely lacking for the species found at PTA. Therefore, the term population is used infrequently in the following text. The term "site" is used to roughly identify aggregations of plants as being associated for biotic, abiotic, and management reasons. The term "location" is used to describe the individual plants or clusters of plants within a site. The location is the unit that is used for mapping purposes and each has a coordinate associated with it. The term "individual" describes a single representative of a particular species. There is one to many individuals at a given location and one to many locations in a site.

MONITORING METHODS

Monitoring units are belt transects with a base stake and end stake identifying the beginning and end of the plot. Extending a measuring tape between the base and end stakes delineates the centerline of the plot. The belt is typically five meters wide, two and a half meters on either side of the centerline. The length of the belt varies depending on the distribution of the plants at the site being monitored. However, it is typically 10 meters long.

Once laid out, the locations of all rare plants within the belt are mapped. This is accomplished using an x- and y-coordinate system. The distance along (y-axis) and out (x-axis) from the meter tape is determined and recorded in meters.

Information collected on each plant consists of height, phenological state, age class, reproductive structure count, vigor, and presence of animal damage. The height or length of the longest stem of the plant is measured in centimeters or meters and is measured from the base of the plant to the apical meristem of the longest portion of the plant.

The phenological state is classified as: Vegetative, not currently flowering or fruiting; Reproductive, viable flowers are present on the plant; Fruiting, fruit is present on the plant from the most recent flowering event.

A seedling is a plant with apparently functional cotyledons present. A juvenile is classified as a plant that has lost its cotyledons or if present they are apparently non-functional and it has not flowered. An adult is a plant that has flowered in its lifetime, regardless of its current phenological state.

The vigor of the plant is classified as healthy when the plant is producing new leaves, most living leaves are green, and the plant is generally robust and thriving. The vigor is moderate when the plant is producing fewer new leaves, the living leaves are not quite as green as compared to a healthy plant, and the plant is viable but not as robust or thriving to the extent that a healthy plant is. The vigor is poor when the plant is producing few, if any, new leaves. Those leaves present may be pale green and/or the edges are brown. In some species the leaves may have little chlorophyll and be red with photo-protective pigments.

Browse is classified as no browse when no parts of the plant have been consumed by ungulates. Browse is indicated by portions of the plant showing signs of being consumed by ungulates. Browse is further classified as recent browse when the browsed portions of the plant have not healed over. In addition, the browsed portions may be white and there is no new growth above the browsed portions. The browsed portion of the plant having healed over indicates old browse and there is new growth above the browsed portions.

1.2.1 - *Asplenium peruviana* var. *insulare*, Fragile fern

INTRODUCTION

Asplenium peruviana var. *insulare* (PS-2) is federally listed as endangered and is found throughout PTA in caves and skylights. There are 39 known locations with varying numbers of individuals at each. Many of the locations were mapped by CSU botanists and some have never been revisited to verify location accuracy and presence or absence of *A. p. var. insulare*.

METHODS

PTA staff has revisited *A. p. var. insulare* IMU's in training area 23 and 21 to check on population health and to survey for additional populations. Additional surveys have identified more populations in other IMU's. Caves with suitable conditions for *A. p. var. insulare* were recorded for possible outplanting. The criteria used for cave selection was suitable temperature, light and humidity. Regardless of the surface vegetation and climatic conditions, caves often have distinct microclimates compared to the surface. Twenty five suitable caves were found and recorded. No monitoring is being conducted for this species.

RESULTS

No monitoring was conducted during the reporting period. Population estimates for *A. p. var. insulare* have increased over early surveys conducted in the early 1990's but that is due in part to the increased surveys conducted by PTA Natural Resources Staff. This has resulted in the discovery of previously unrecorded populations throughout PTA. Recent wetter than average years may also have contributed to the increase in the population and it remains to be seen if the current population can sustain itself through drier periods.

MANAGEMENT RECOMMENDATIONS

Monitoring should be conducted to assess the health of known populations and determine the impact of non-native weeds increasing in caves. There are numerous recorded locations that have not been visited in years some of them old CSU points. These sites should be revisited to get a current picture of the population at PTA.

1.2.2 - Honohono, *Haplostachys haplostachya*, Hawaiian mint

INTRODUCTION

Haplostachys haplostachya (PS-5) is federally listed as endangered and is considered one of the more abundant listed species found at PTA. In the past, no systematic monitoring has been initiated for this species. In 2005, the goal was to monitor the populations identified in the Implementation Plan as a first step in implementing a PVA monitoring program for the species. There are six different IMU's that contain *H. haplostachya* populations. Six sites were monitored in IMU's 4, 6, 10, 17 and 44.

METHODS

Base stake points were randomly selected from the GIS. Most transects were from 10-30 meters long. For each IMU, the goal was to have at least five transects with and five transects without plants. The reproductive status, age class, vigor and if the plant showed signs of browse were recorded.

METHODS

Monitoring followed the Population Viability Analysis (PVA) protocols.

RESULTS

Table 1.2.2-1. Monitoring results for *Haplostachys haplostachya*.

Site	IMU	Transects	Hours	Juveniles	Adults	Browse
04	6	20	12.0	234	94	0%
05	10	10	28.5	12	16	19%
07	4	15	44.0	197	42	36%
13	44	30	41.5	147	225	1%

DISCUSSION

This was the first year of data collection utilizing PVA protocols. No population trends will be available until another monitoring cycle is completed. The data collection this year is the first step in determining the amount and type of data necessary to build a reliable PVA model for this species. It is anticipated that

additional monitoring plots will need to be established in following years to have enough data for the PVA to function properly.

Monitoring results do provide information on beneficial effects of large-scale fencing. Sites 04 (IMU 6) and 13 (IMU 44) are found within the Pu`u Ka Pele and Kīpuka Kālawamauna Fence Units respectively. These fence units have been protecting *H. haplostachya* since 1981 and 1998 respectively. Little to no browse was recorded on these plants. Sites 05 (IMU 10) and 07 (IMU 04) are unprotected. Site 07 is located in an area that is heavily used by goats and browse recorded on 36% of plants monitored.

MANAGEMENT RECOMMENDATIONS

Controlling *Pennisetum setaceum*, a species that increase fuel loads, is important to preserve the diversity of native communities and would allow for population expansion. Monitoring data indicate that ungulates negatively impact this species. The fencing identified in the 2003 Biological Opinion will be important in preventing negative impacts to the species from ungulates.

1.2.3 - Kio`ele, *Hedyotis coriacea*, Leather-leaf sweet-ear

INTRODUCTION

H. coriacea (PS-1) is federally listed as endangered with only 153 individuals known. Other than the sites at PTA there is only a single plant known from Maui, unfortunately, that plant may have died in recent years.

There are nine sites of *H. coriacea* identified at PTA. Since the December 2002 Annual Report, site names have changed from a letter to a numbering system (site A is now site 1, site B is now site 2, etc.)

Habitat management, comprehensive monitoring and new surveys have been the major focus of effort in regard to *H. coriacea* for the past two and a half years. Surveys were conducted in areas of suitable habitat based on existing known plants to locate previously unrecorded individuals. Monitoring occurred for all previously and newly recorded individuals in 2005. New plants, not already within a large-scale fence unit, were protected by emergency exclosures.

METHODS

Each *H. coriacea* is monitored individually without the use of monitoring transects. Monitoring follows PVA protocols.

RESULTS

There are currently 153 live *H. coriacea* plants at PTA. Ninety-four new plants have been recorded since July 1, 2003. Monitoring results are summarized in Table 1.2.3-1. The largest population currently consists of 87 individuals located in IMU 30 along the northern boundary of the Kīpuka `Alalā-1 Fence Unit. The smallest population consists of a single isolated individual. Over the course of 2.5 years, 15 individuals have been recorded as 'dead'. Reproductive individuals account for 59.9% of the total plants. Recent ungulate browse was not recorded on any plants, which were all protected by emergency exclosures. In 2003 and 2004, hours spent monitoring were not tracked in the management action log.

Table 1.2.3-1. Monitoring results for *Hedyotis coriacea* conducted in 2003-2004.

Site	IMU	Juveniles	Adults
01	18	0	4
02	11	1	22
03	21	2	7
04	22	0	5
05	29	2	6
06	12	0	1
07	19/20	0	3
09	29	0	1
10	30	11	19

In 2005, one plant in population 01 was observed with rodent damage to the foliage. One new plant was found in population 05 with recent browse damage. Two new plants were found in population 10 with recent browse damage. All known plants within the emergency exclosures did not have recent browse damage from ungulates.

Table 1.2.3-2. Monitoring results for *Hedyotis coriacea* conducted in 2005.

Site	IMU	Hours	Juveniles	Adults
01	18	5	0	5
02	11	22	4	23
03	21	14	0	10
04	22	8	0	5
05	29	0.75	0	12
06	12	-	0	1
07	19/20	2	0	8
09	29	0.75	0	1
10	30	21	2	84

DISCUSSION

Site 07 consisted of three plants in two locations when the IMU's were identified. The two locations were placed in IMU's 19 and 20. Surveys and monitoring recorded new locations that shows the plants of Sites 02 and 07 (IMU's 11, 19, and 20) form a continuous distribution. Three of the 31 individuals are protected by the Kīpuka Kālawamauna Fence Unit; the remaining individuals are protected by emergency exclosures.

Site 08 consists of a single location identified by CSU personnel in the 1990's. Attempts to re-identify this location have not been successful. The habitat is markedly different from that of other *H. coriacea* locations and there may have been an error in the original data. This location will be removed from the database.

Data indicates an increase in the number of plants; however this is a result of increased survey efforts rather than natural recruitment. In 2005 the first seedling of *H. coriacea* was recorded since this species was discovered at PTA in the early 1990's. The lack of natural recruitment is troublesome. It indicates that the species is not sustaining itself. In addition, propagation efforts have produced limited results. Collected seed seems to have low viability and many propagated seedlings do not attain size suitable for outplanting. The low seed viability may be due to a loss of an insect pollinator.

MANAGEMENT RECOMMENDATIONS

Recommendations include large-scale fencing of all known populations, surveying areas with suitable habitat, investigate techniques to improve natural recruitment, and monitor invasive weeds around known populations and control as needed.

1.2.4 - *Neraudia ovata*, Spotted nettle bush

INTRODUCTION

Neraudia ovata (PS-1) is federally listed as endangered and occurs at two sites (Site 01 in IMU 24 and Site 02 in IMU 14/15) at PTA. General habitat for this species includes *Metrosideros* Treeland on `a`ā flows and *Myoporum* Shrubland on pāhoehoe.

METHODS

Monitoring follows the Population Viability Analysis (PVA) protocols. Plants were individually monitored without the use of transects due to the low number of individuals.

RESULTS

A total of 31.5 personnel hours were spent monitoring *N. ovata* individuals. Fourteen new locations of *N. ovata* at Site 01 and two new locations at Site 02 were recorded within this reporting period. Live individuals of *N. ovata* at PTA total 136. Of this total, 14 are adult plants. Nine of the 14 adult individuals were recorded at new sites during this reporting period. See Table 1.2.4-1 below for a current population status summary for *N. ovata*. Because all plants are within emergency exclosures, no ungulate browse was observed on the plants.

Table 1.2.4-1. Monitoring results for *Neraudia ovata*.

Site	IMU	Juveniles	Adults	Site	IMU	Juveniles	Adults
0101	24	4	0	0115*	24	0	0
0102	24	0	0	0116*	24	1	0
0103	24	8	0	0117*	24	0	1
0104	24	5	1	0118*	24	1	0
0105	24	3	1	0119*	24	12	0
0106	24	0	0	0120*	24	1	0
0107	24	1	0	0121*	24	1	0
0108	24	11	1	0122*	24	1	0
0109	24	0	1	0123*	24	1	0
0110*	24	43	0	0201	15	0	0
0111*	24	3	1	0202	15	0	1
0112*	24	8	3	0203*	14	6	1
0113*	24	1	0	0204*	Outside 14	0	0
0114*	24	1	0	0205*	Outside 14	10	3
Totals						122	14

*New locations recorded during reporting period.

DISCUSSION

The number of *Neraudia ovata* adults has increased from six at the last reporting period to a current total of fourteen. The number of juveniles at each site fluctuates based on changes in seasonal precipitation. For example, one juvenile was recorded at new site 0115 in February of 2005 and was found dead during monitoring in September of 2005. Little to no regeneration had been recorded prior to fall of 2004. The recording of new individuals during surveys and the regeneration taking place has been extremely encouraging. These positive results come at a time when plants at other sites on the Island have

disappeared and plants at PTA are aging. Most exciting was the regeneration from the seed bank under mother plants that have been dead for five to seven years.

In 2004 rodents were found to be chewing the stems of the juvenile *N. ovata*. It appeared that they were doing so to obtain water within the plants. To address this impact, snap traps and a rodent control grid was put in place (See Section 2.3.24).

All known individuals of *N. ovata* are currently protected with emergency enclosures and have active weed and rodent control. In the absence of large-scale fence units, feral ungulates continue to degrade the habitat of this species.

MANAGEMENT RECOMMENDATIONS

Recommendation is for continued monitoring of all current and former *Neraudia ovata* locations to determine recruitment activity. Continued weed and rodent control is also recommended.

The construction of large-scale fence units and the subsequent removal of ungulates are essential for the protection of habitat for this species.

1.2.5 - Po`e, *Portulaca sclerocarpa*, Hard-fruit purslane

INTRODUCTION

The relative abundance of *Portulaca sclerocarpa* (PS-3) is greater outside of PTA. Sixteen locations have been re-identified from old CSU data or newly recorded at PTA. Three locations previously recorded by CSU have not been re-identified despite survey efforts. A comprehensive monitoring of all known locations was implemented in 2005.

RESULTS

Monitoring specifically for *P. sclerocarpa* was not initiated until 2005 because it is a PS-5 species and other species with higher rankings have taken priority. Population monitoring occurred when biologists were working in proximity to the plants. In 2003, three sites were visited and a total of 5 plants were monitored (Table 1.2.5-1). In 2004, two populations were visited and a total of three plants were monitored. In 2005, an attempt to locate all previously known locations was made. Because of confusion in assignments, population 08 was the only population that was partially monitored. No browse was seen on any of the plants during monitoring during the contract period.

Table 1.2.5-1. Monitoring results for *Portulaca sclerocarpa*.

	Site	Hours	Juveniles	Adults
2003	06	-	0	2
	08	-	0	1
	14	-	0	2
2004	08	-	0	1
	12	-	1	2
2005	01	3	0	0
	04	1	3	4
	05	1	0	0
	06	5	0	5
	08	-	0	2
	10	4	2	3
	12	2	0	3
	14	-	0	2

DISCUSSION

Evans *et al.* (2002) reported 26 known individuals found at eight locations with four unconfirmed locations still to visit. These data represented known individuals but monitoring for all locations had not been implemented. Monitoring in 2005 was the first comprehensive monitoring of all known sites. Because all known sites were not visited each year, it is difficult to determine how the population has responded during the reporting period. Browse has not been recorded for any of the plants monitored, so the cause of the low numbers is unknown at this point.

MANAGEMENT RECOMMENDATIONS

Monitoring of known locations will continue annually.

1.2.6 - *Schiedea hawaiiensis*

INTRODUCTION

Although *Schiedea hawaiiensis* (PS-1) is not federally listed, the extremely low numbers of this species makes its protection critical. Presently there is only one known natural population. The natural population is in IMU 41 and there are two outplanted populations in IMU 18. The natural population is found in a *Metrosideros* Treeland on `a`ā substrate. Primary threats to this species include browsing impacts by ungulates, rodents, and possibly birds. The plants in this population are surrounded by a razor wire barricade two rolls deep to prevent ungulates from reaching the plants. In addition a two-acre rodent bait grid was established around the plants to control the rodent population. Smaller, wire mesh cages have also been constructed and placed around individual plants to prevent further rodent impacts.

METHODS

Plants are monitored individually using PVA protocols.

RESULTS

The number of naturally occurring individuals has increased marginally in recent years. Plants have continued to be impacted by rodents. It is thought that the rodents are seeking water from the stems of the plants.

Table 1.2.6-1. Monitoring results for *Schiedea hawaiiensis*.

	Hours	Juveniles	Adults	Rodent Damage
2005	1	7	3	60%

DISCUSSION

Recent monitoring indicates that the number of individuals has increased since the last monitoring in 2002; although population numbers are increasing they remain extremely low. The addition of new juveniles indicates that recruitment is still occurring at the site. However, priority should be placed on the continued propagation and outplanting of this species. Signs of recent browse continue to be recorded; the cause is believed to be rodents. A two-acre rodent control grid was established to reduce rodent impacts on the surviving plants.

MANAGEMENT RECOMMENDATIONS

Monitoring is necessary to assess the population and ensure that threats are detected and addressed. Surveys should be conducted to locate unrecorded individuals. Maintenance of the rodent bait grid is also necessary to prevent rodents from damaging plants. A large-scale fence unit should be constructed to protect the only remaining natural population.

1.2.7 - *Silene hawaiiensis*, Hawaiian catchfly

INTRODUCTION

In 2005, a PVA monitoring program was established for *Silene hawaiiensis* (PS-5). Five sites in five IMU's were selected to be monitored. Because *S. hawaiiensis* has a population of greater than 500 hundred individuals, random sampling techniques were used to assess the population.

METHODS

To establish monitoring plots within the selected populations, 15% of the known plant points in the GIS database were randomly selected for sampling. If there were less than five plants within 13 meters of the GPS location, a plot was established and each individual plant tagged and mapped for identification. If there were more than five plants located within 13 meters from the GPS location, two to five 30-meter long transects were established for each plot. For each plant the height, age class, reproductive status, vigor and the presence of browse was recorded as well as its location along the transects.

RESULTS

In 2005, a total of five populations were visited. Over 167 hours were spent to establish and monitor 73 transects. A total of 549 adults and 283 juveniles were monitored.

Table 1.2.7-1. Monitoring results for *Silene hawaiiensis*.

IMU	Site	Transects	Hours	Juveniles	Adults	Browse
2	Silhaw 03	34	75	213	147	83%
3	Silhaw 17	25	51	43	347	0%*
12	Silhaw 26	0	6	0	0	-
29	Silhaw 29	7	25	27	26	0%
37 (Range 8)	Silhaw 01	7	10	4	29	2.5%

* Population is fenced.

DISCUSSION

Because 2005 was the first year of data collection for the PVA, no population trends will be available until another monitoring cycle is completed. The data collection this year is the first step in determining the amount and type of data necessary to build a good PVA model for this species. It is anticipated that additional monitoring plots will need to be established in following years to have enough data for the PVA to function properly.

MANAGEMENT RECOMMENDATION

Continue developing PVA model for *S. hawaiiensis* and establish additional monitoring plots as needed. Because individuals in population 26 in IMU 12 can no longer be located, a new population should be selected and monitored during the next monitoring cycle.

Plants are consistently observed to have been browsed by ungulates. Little regeneration is recorded when monitored. Large scale fence units are necessary to prevent this species and its habitat from being degraded by ungulates.

INTRODUCTION – RANGE 8

The *S. hawaiiensis* population in IMU 37 (Range 8) was monitored as required by a Section 7 consultation with the U.S. Fish and Wildlife Service. This population has been monitored annually since 1997. The Army is required to protect known locations of *S. hawaiiensis* on Range 8 from damage resulting from maintenance and use of the range.

METHODS

Each known location was monitored using PVA protocols and searched for new individuals.

RESULTS

There has been a steady decline in the number of individuals at Range 8 since monitoring began in 1997 (Table 1.2.7-2). Only 31 individuals were located during this year's monitoring representing 31% of the population from 1997. Although there are fewer individuals, the average height of plants that have been present since 1997 has increased (Table 1.2.7-2). Damage from ungulate browse has decreased from 1997 (Table 1.2.7-2).

Table 1.2.7-2 Monitoring results for *Silene hawaiiensis* at Range 8.

	1997	1999	2000	2001	2002	2003	2005
Average Height (cm)*	17.6	14.5	14.4	9.8	12.7	6.1	23.8
Number of Individuals**	101	105	96	61	61	31	31
Percent Damage***	75.3	87.0	71.9	75.0	6.0	0	3.0

* The average height of plants present during all four years.

** Total number of individuals present during that year's monitoring.

***Percentage of plants with signs of being damaged.

DISCUSSION

Past work by Evans *et al.* (2002) has shown a steady decline in average plant height in relation to presence of Mouflon and feral sheep near Range 8. The average plant height declined through 2003 despite a slight increase in 2002. The average height decreased 65% between 1997 and 2003. The PTA Range Maintenance division constructed wire cages to protect individual plants on the range in 2004. As a possible result, monitoring in 2005 indicated a change in a trend that had been observed. The average height of plants, which had been declining dramatically between 1997 and 2003, showed a 74% increase in the average height. The protective cages may have allowed the individuals to increase in height.

Although, on average, individual plants are taller than in previous years, the total number of individuals remains low. A total of 31 individuals were monitored in 2005, which is only 31% of the plants present in 1997. The PTA Range Maintenance division also constructed rock berms around each grouping or individual plant locations to protect the plants from bullet strikes as required by the 1996 Biological Opinion. The likelihood of damage to plants from bullet strikes was discussed and dismissed by Schnell *et al.* (2003). By constructing these berms, suitable habitat was covered and is no longer available for seedling recruitment and population expansion. With the protection from the browsing pressure, the plants may be able to grow larger, but the long term stability of this population will depend on the number of individuals increasing.

MANAGEMENT RECOMMENDATIONS

Continue to monitor the population at Range 8 as required by the Biological Opinion issued in 1996. Continue to search for new plants and protect them as needed. Examine the wire cages and determine if another fencing design would work better for the plants and allow the military a realistic training environment. Reposition the berms, over time, so they do not fall within the plant locations and occupy less of the area the plants need for expansion. Continue to monitor the populations identified and select another population to replace IMU 12 where no plants were found. The monitoring data should be assessed to determine the number of monitoring plots necessary to achieve the proper power for reliable statistical analysis.

Unprotected plants continue to be impacted by ungulates. Large-scale fencing is the most appropriate measure to protect individual plants and the habitat in which they are found.

1.2.8 - *Silene lanceolata*, Lance-leaf catchfly

INTRODUCTION

Silene lanceolata (PS-2) has several sites throughout northern and western PTA in several IMU's and plant communities. Sites are found within IMU's 5, 8, 11, 12, 13, 16, 17, 18, 25, 27, 30 and 31. Included plant communities are: *Dodonaea* Mixed Shrubland, Dense *Dodonaea* Shrubland, Open *Dodonaea* Shrubland, Open *Metrosideros* Treeland with sparse shrub understory, Open *Metrosideros* Treeland with dense shrub understory, Intermediate *Metrosideros* Mixed Treeland, Sparse *Metrosideros* Treeland, *Myoporum-Sophora* Mixed Shrubland and *Styphelia* Mixed Shrubland (Shaw and Castillo 1997). The species occurs on both `a`ā and pāhoehoe flows of varying ages. The extent of the *S. lanceolata* population has been determined through rare plant surveys and rare plant monitoring. Surveying provides a fairly accurate count depending on the size of the population discovered (larger populations are estimated due to time constraints), while monitoring provides a very accurate count. Rare plant monitoring is conducted annually on selected populations.

METHODS

Transects have been established to record and monitor individual plants over an extended period. Monitoring follows the Population Viability Analysis (PVA) protocols.

RESULTS

Table 1.2.8-1. Monitoring results for *Silene lanceolata*.

	Transects	Effort Hours	Juveniles	Adults	Browse
2004	41	3	1633	163	.0002%
2005	44	2	2535	431	.0005%

DISCUSSION

Survey and monitoring data suggest the population is flourishing. Known numbers have quadrupled since the early 1990's (Shaw 1997). Many factors contribute to these increases. Higher precipitation over the past two years that followed six years of drought, and is believed to be part of a long-term trend of wet and dry years. Intensive surveys of rare plant habitat have increased the number of recorded locations. Fencing, weed control, and ungulate control activities have helped the species recover. Low browsing totals suggests large-scale fence units have prevented ungulate browse within monitored sites.

Although the number of *S. lanceolata* locations and individuals are high and the species appears to be viable and healthy, this it will remain a species of high priority. Continued monitoring is necessary to track the health of the population. The main concern is how the population will react to drier weather. The 2005 precipitation levels are reduced and higher mortality of seedlings and juveniles has resulted. This will likely be reported during monitoring in the next reporting period. If long-term weather trends continue to provide higher precipitation the population may continue to flourish, but if dry weather returns, management becomes even more crucial to sustaining a healthy population.

Over half of the IMU's where this species exists remain unprotected by large-scale fence units and ungulates are a serious threat. Emergency exclosures are erected around plant locations in these IMU's, while proven effective; they offer only limited and short-term protection. Furthermore, our emergency exclosures offer no protection to surrounding habitat necessary for the long-term survival of the species.

MANAGEMENT RECOMMENDATIONS

In addition, surveys to record new locations in areas of northern and western PTA should be conducted. Specifically south and southeast of IMU 13 and west and southwest of IMU 5 where locations have been previously recorded but new surveys have not yet been conducted.

Large-scale fence units followed by ungulate removal across northern and western PTA are essential as *S. lanceolata* is "very palatable to feral ungulates, which have decimated populations of this species" (Shaw

1997). This species is also negatively impacted by fire. Therefore, the completion and implementation of a fire management plan is necessary to minimize this threat.

1.2.9 - *Pōpolo kū mai, Solanum incompletum*

INTRODUCTION

Solanum incompletum (PS-1) is federally listed as endangered. This plant occurs at two sites; Site 01 in IMU 24 and Site 02 in IMU 13. General habitat for this species includes Open *Metrosideros* Treeland on `a`ā flows and *Myoporum* Shrubland on pāhoehoe flows.

METHODS

Monitoring of each *S. incompletum* within Sites 01 and 02 occurs on an annual basis. Data collected follows the monitoring guidelines outlined in Section 1.2.

RESULTS

A total of 14.5 personnel hours were spent monitoring *S. incompletum* sites. Eight of the 42 adult individuals were recorded at new locations during the reporting period. Table 1.2.9-1 summarizes the monitoring results of *S. incompletum*. All known plants are protected by emergency exclosures and no recent ungulate browse was recorded.

Table 1.2.9-1. Monitoring results for *Solanum incompletum*.

Site	IMU	Juveniles	Adults	Total Plants
0101	24	22	16	38
0102	24	1	1	2
0103	24	0	6	6
0104	24	0	1	1
0105	24	0	1	1
0106	24	0	5	5
0107	24	0	1	1
0108*	24	1	1	2
0109*	24	12	7	19
0201	13	1	3	4
Totals		37	42	79

* New locations found during reporting period.

DISCUSSION

Site 0109 was a significant find during surveys in February 2005. There are currently nineteen individuals at this location.

All known individuals of *S. incompletum* are currently protected with emergency exclosures and have active weed and rodent control. In the absence of large-scale fence units, feral ungulates continue to degrade the habitat for this species.

MANAGEMENT RECOMMENDATIONS

Rodent and weed control will continue for *Solanum incompletum* Site 01 and Site 02 to reduce these introduced species' impacts. The last monitoring of Site 02 in September 2005 indicated all live plants were stressed and required water. Recommendation is for continued monitoring of these plants during weed control activities to determine if supplemental water is needed.

Ungulates heavily impact individuals of this species in the absence of the emergency exclosures. The construction of large-scale fence units and the subsequent removal of ungulates are essential for the protection and recovery of this species and its habitat.

1.2.10 - *Spermolepis hawaiiensis*, Hawaiian parsley

INTRODUCTION

Spermolepis hawaiiensis is categorized as a PS-5. The life cycle of this annual species seems to be dependent upon favorable weather conditions. The species has not been detected at PTA in large numbers for its status to be properly assessed until 2004. Surveys were conducted in the spring of 2004 to roughly determine its abundance and distribution.

METHODS

PVA protocols will not be used to monitor this annual species. Due to its annual life cycle a monitoring technique that relies on following individuals through time will not be appropriate. Locations recorded in IMU 32, in 2004 were revisited quarterly to determine if conditions had been favorable for germination and the continuation of its life cycle.

RESULTS

Previously recorded points were revisited on a quarterly basis in 2005 and no individuals were found.

DISCUSSION

Weather conditions may not have been adequate for germination and regeneration.

MANAGEMENT RECOMMENDATIONS

Revisit previously recorded locations to assess presence/absence. If plants are detected then surveys are to be conducted in adjacent, unsurveyed areas to further determine distribution of the species. There is the need for weed control for this species. It is recommended that it be implemented in accordance with its PS-5 ranking.

1.2.11 - *Stenogyne angustifolia*, Creeping mint

INTRODUCTION

Stenogyne angustifolia (PS-5) is federally listed as endangered and is widely distributed throughout PTA in various habitats. Although considered one of the more abundant listed species, its distribution is believed to be restricted to PTA (Wagner *et al.* 1990).

METHODS

No monitoring program has been established for *S. angustifolia*. Plants are recorded during rare plant surveys of the IMU's.

RESULTS

There are currently more than 1300 *S. angustifolia* at over 400 different locations known at PTA. It is one of the most abundant listed plant species found at PTA. Over 900 new plants at more than 300 new locations were identified during surveys conducted since July 1, 2003. Additionally, surveys conducted in 2004 and 2005 reconfirmed healthy plants at 28 previously recorded locations.

Locations of *S. angustifolia* are distributed throughout western PTA in Training Areas 17, 18, 19, 22, and 23. The densest concentrations of plants lie in IMU's 10, 12, and 18 in Training Area 22. *S. angustifolia* are most closely associated with *Dodonaea* Mixed Shrubland and Open *Metrosideros* Treeland Sparse with dense shrub understory.

DISCUSSION

It was previously thought that plants were little affected by ungulates due to a lack of browse being recorded when plants were found during surveys and other management actions. Field observations in recent years may indicate a greater impact by ungulates than previously believed. Field observations suggest that browse is not observed because plants are completely consumed by ungulates. These conclusions may be supported by the abundance of plants found within large-scale fence units and relative scarcity of plants found outside of fence units.

MANAGEMENT RECOMMENDATIONS

It is recommended that monitoring for this species be initiated to establish baseline data for tracking changes.

Large-scale fence units, such as those required by the 2003 Biological Opinion, will have positive impacts to the species.

1.2.12 - Mauna Kea pamakani, *Tetramolopium arenarium* ssp. *arenarium*

INTRODUCTION

Tetramolopium arenarium ssp. *arenarium* is categorized as PS-1. This endangered species is found within the Kīpuka Kālawamauna Endangered Plant Habitat. The population is restricted to IMU 8 and single individual in IMU 12. Plant locations are protected by emergency exclosures.

METHODS

Monitoring transects are spaced five meters apart and are designed to monitor every plant within the site. PVA protocols are used in monitoring this species.

RESULTS

The number of plants monitored increased between 2004 and 2005 (Table 1.2.12-1). There was a decrease in the amount of browse recorded.

Table 1.2.12-1. Monitoring results for *Tetramolopium arenarium* ssp. *arenarium*.

	Transects	Hours	Juveniles	Adults	Browse
2004	28	39	3	14	11%
2005	28	123	526	73	3%

DISCUSSION

The rains of the past two years have had positive effects on this species. There was a large population increase between 2004 and 2005. The intensive monitoring, utilizing PVA protocols, accounts for the increase in effort over 2004. The monitoring in 2005 represent a more than eight fold increase in the number of individual plants monitored. PVA protocols are still in development. No conclusions about the viability of the population can be reached at this time.

New plants continue to be found outside the fenced areas, but within the weed control buffers. As these new plants are discovered they are protected emergency exclosures. It is likely that plants have sprouted beyond the weed control buffers especially in locations where adults once existed but haven't been protected yet.

Browse decreased between monitoring cycles due to the construction of emergency exclosures around unprotected plants. Browse damage to this species is relatively uncommon but does occur. The two IMU where the species is found are unprotected. There is a herd of feral goats that are consistently found within IMU 8 and, more importantly, within the weed control perimeters. The goats continue to have detrimental affects on the habitat of *T. a. ssp. arenarium*. In addition, the emergency exclosures provide limited protection and no protection of the habitat necessary for the long-term survival of the species. Therefore, it is essential for the survival of the species that its habitat is protected by large-scale fence units and the ungulates removed.

MANAGEMENT RECOMMENDATIONS

The monitoring will continue on an annual basis. Protect new plants found within the established weed control perimeters with emergency exclosures and incorporate them into annual monitoring as appropriate. Survey a 10m band around the control perimeters, to ensure as many plants as possible are protected. Construct large-scale fence units and remove ungulates.

1.2.13 - *Tetramolopium* sp. 1, Tooth-leaf *pamakani*

INTRODUCTION

Although *Tetramolopium* sp. 1 (PS-1) is not listed it is only known from two sites at PTA. The site in IMU 11, in Training Area 22, is found in the Open *Metrosideros* Treeland. The site in IMU 31, in Training Area 23, is described as a mix of three distinct vegetation types, *Myoporum-Sophora* Mixed Shrubland, *Styphelia* Mixed Shrubland, and Dense *Dodonaea* shrubland (Shaw and Castillo 1997). Although this species is not browsed by ungulates the sites are protected by an emergency exclosure and the Kīpuka `Alalā Fence Unit, respectively, to prevent damage from trampling. The other major threats to *T. sp. 1* are competition with alien plant species, primarily *Pennisetum setaceum* and *Senecio madagascariensis*.

METHODS

All individuals are monitored along transects spaced five meters apart. Data is collected according to PVA protocols.

RESULTS

Table 1.2.13-1. Monitoring results for *Tetramolopium* sp. 1.

	Site	Hours	Juveniles	Adults	Browse
2004	3	15	829	5	0%
2005	3	28.5	687	60	0%
2005	4	13	222	52	4%

DISCUSSION

Conclusions about population trends for this species are difficult to make due to inconsistent monitoring. The number of plants at Site 04 increased between monitoring but there was a four-year span between monitoring while site 03 was monitored in 2004 and 2005 and showed a decline in numbers. It is possible that if site 04 was monitored in 2004 it would have shown a decline in 2005.

MANAGEMENT RECOMMENDATIONS

Consistent monitoring is necessary to get an accurate picture of population trends. Weed control should be continued to prevent competition with non-native plant species and reduce fuel loads within and outside exclosures.

1.2.14 - A`e, *Zanthoxylum hawaiiense*, Hawaiian yellow wood

INTRODUCTION

Zanthoxylum hawaiiense (PS-2) is federally listed as endangered. The population is scattered throughout west-central to northwestern PTA. The species is found in IMU's 07, 09, 11, 13, 14, 15, 23, 24, 25, 26, 27, 29, 30 and many areas in between. Plant communities in which it is found are Open *Metrosideros* Treeland with sparse shrub understory, Open *Metrosideros* Treeland with dense shrub understory, Sparse *Metrosideros* Treeland, *Myoporum-Dodonaea* Shrubland and *Myoporum* Shrubland (Shaw and Castillo 1997). The species occurs on both `a`ā and pāhoehoe flows of varying ages.

METHODS

Monitoring has not been implemented for this species. An understanding of the distribution of this species is incomplete. Accurately determining the distribution through surveys was a higher priority. Once completed a comprehensive monitoring program will be implemented.

RESULTS

Surveys have resulted in an increase in the number of known individuals to 465; though it is certain that more exist in areas not yet surveyed. The population is widely scattered with approximately 80% of plant locations as solitary individuals.

DISCUSSION

Plant locations previously recorded by CSU are inaccurate serving only as distributional information, making the use of the locations for monitoring of the species impractical. These distributions identify suitable habitat in which surveys are conducted to update and obtain more accurate location information. The extent of the population has been identified through rare plant surveys. Once the distribution of the species is better known management actions can be implemented, including weed, rodent, and ungulate control as well as monitoring.

The biggest concern in the management of this species is its lack of reproduction. Aside from only a few known juveniles, the population consists of mature adults. This is of concern for the future of this species. Several factors are hypothesized, including ungulate browse, seed predation by rodents and insects, and to a lesser extent invasive weed competition. Thus, the population, though much larger than previously estimated, is not considered healthy and viable.

MANAGEMENT RECOMMENDATIONS

There is relatively little known about this species other than its habit and characteristics. Therefore increased research is needed to find answers to best manage this species. Two projects are in the planning phase. One involves determining the sex of individual of *Z. hawaiiense* individuals, which is a dioecious species. The sex can only be determined during reproductive and fruiting phases. Surveying existing individuals at the appropriate time of year will enable us to sex individuals to determine likely areas where regeneration will be possible.

The second will be a research project to determine impediments to regeneration and determine what management actions will be required to promote regeneration. Combinations of fencing, weed and rodent control will be investigated. An insect study will be initiated to determine their impacts on the seed bank. In addition, increased focus on seed collection and propagation in the greenhouse to promote higher success rates will be highly beneficial.

The large-scale fence units required by the 2003 Biological Opinion will be of great benefit to the species. It will remove one of the factors believed to be preventing the species from regenerating (i.e. ungulate browse).

The current management strategy is to continue surveying appropriate plant communities where surveys have not yet occurred. This will determine the extent of the population. Then a density analysis will be performed to best determine population centers and where efforts are to be focused to control the many threats to this species and conduct research projects.

1.3 INTRODUCTION TO RARE ANIMAL SURVEYS AND MONITORING

The rare and endangered animals surveys are designed to provide basic understandings of which species are present and if present which habitats they occupy and utilize. Information gathered will be utilized to determine and guide management strategies for enhancing habitats and populations of these species. Because each species requires different monitoring techniques, the specific method uses is found with each species. Generally, monitoring and surveying for rare or birds with low population numbers are conducted using electronic calls broadcast over an amplifier (bullhorn). These calls are played for a predetermined time and distances. Visual and auditory surveys were conducted for the Hawaiian hoary bat.

1.3.1 - `Elepaio, *Chasiempis sandwichensis*

INTRODUCTION

Two pairs of `Elepaio are known from Kīpuka `Alalā in Training Area 23 at PTA. The pairs are both located in *Mamane/Naio* Forest. The two territories are separated by approximately one kilometer. These are the last two pairs known from PTA. This is down from 35 birds banded in 1996 and 1998. Only one bird of the two remaining pairs was banded, therefore there was a 97% decrease of banded birds in 2005.

METHODS

Birds were located using recorded `elepaio calls broadcast over a speaker. Electronic calls were used as little as possible to avoid undue agitation to the breeding birds. Once the birds were found they were visually followed for as long as possible. Observations regarding nesting, mating, and young were noted.

RESULTS

Fledging birds were seen with each pair during the 2004 breeding season. Approximately 24 hours were spent tracking the adult birds in Sites 1 and 3 while restocking the rodenticide in the rodent control grids. In 2005 a juvenile was observed in Site 3. Approximately seven hours were spent tracking the adult birds in Sites 1 and 3 while restocking the rodenticide in the rodent grid. There was no response to broadcast calls in Site 2 in 2004 and 2005. Site 02 has not been occupied since 2001.

Table 1.3.1-1. Monitoring results
for `Elepaio juveniles.

	2004	2005
Site 1	1	0
Site 3	1-2	1

DISCUSSION

The 2004 breeding season was the first confirmed successful `elepaio reproduction at PTA. It is unclear how many offspring the pair at Site 3 produced. In Site 3, a fledging bird was seen on June 4, 2004. The observer was unclear if two juveniles were present. On July 12, 2004 adults were again observed feeding a juvenile. This juvenile had downy plumage, indicating a much younger bird than was previously seen supporting the assumption of two juveniles in Site 3. The juveniles in Site 3 were not observed again in 2004.

The pair at Site 1 also produced a juvenile that was observed once on June 19, 2004. Subsequent attempts to locate the juvenile in 2005 failed. The juvenile may have moved from the parental territory edge or the bird did not have a strong response to the adult male call that was used for sampling.

In 2005, an adult at Site 3 was observed feeding a fledging bird on July 7. The young bird was able to fly but was still downy. The juveniles from 2004 were not seen in 2005 in or around the edges of the Site 3 territory.

Juveniles were not seen within Site 1 in 2005. Because birds fledged in 2004, it was possible they were still near the adult breeding territory. Therefore, approximately three hours were spent searching for 2005 hatch years and young from 2004 on the southern edge of the Site 1 territory. No juveniles were found.

It is difficult to assess the `elepaio population because only one of the four remaining birds is banded. It is assumed that the birds found on the same territories over the past three years are the same birds. With the addition of offspring from these pairs over the past two years, it will become more difficult to determine the identity of the birds, because of a lack of identification bands.

MANAGEMENT RECOMMENDATIONS

Because the last two breeding seasons have produced young birds, it is recommended that surveys at the edges of the territories take place in 2006. Continue rodent and cat control in and around nesting areas. If possible, coordinate banding the remaining birds for identification purposes.

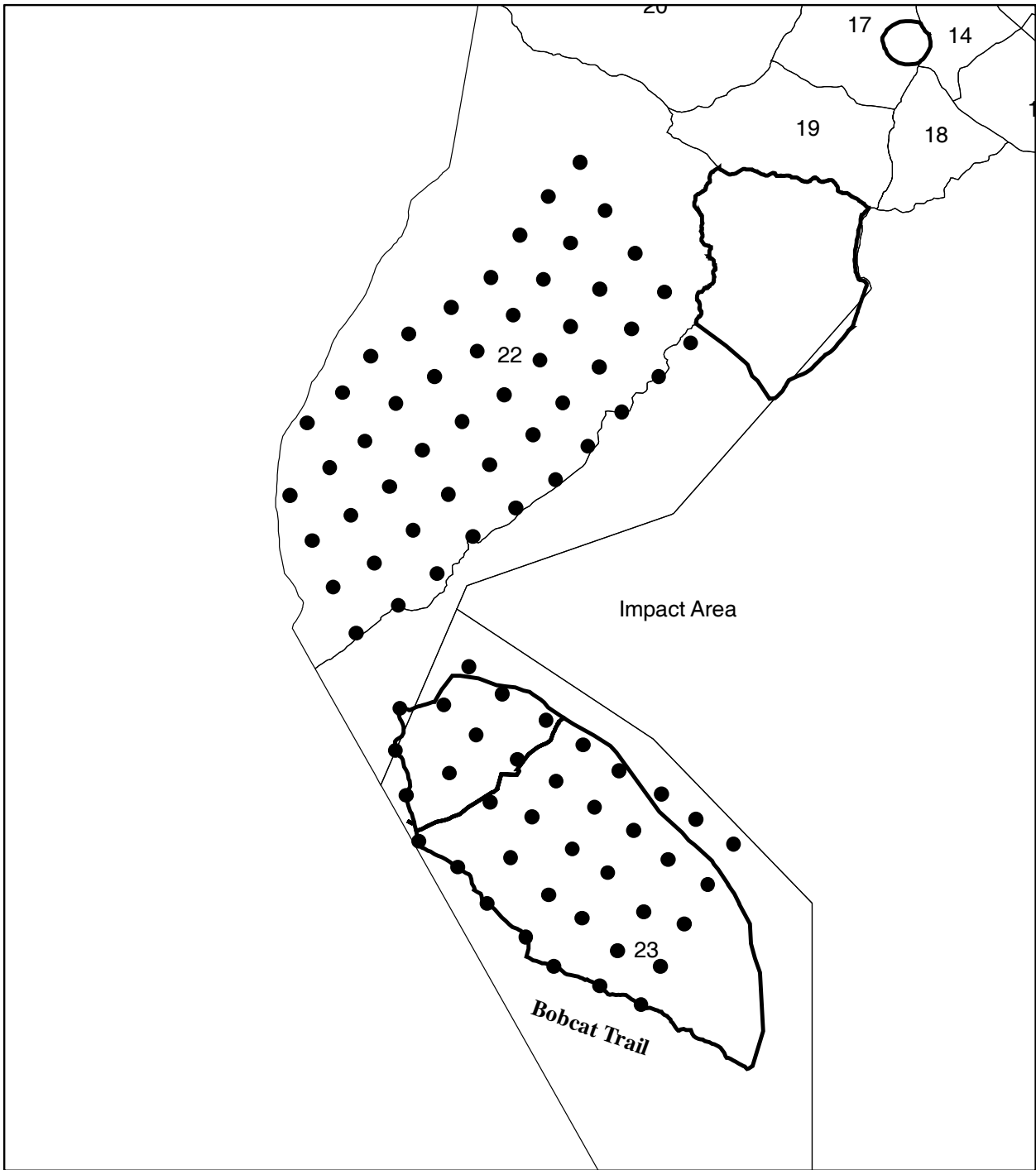
1.3.2 - `Io, Hawaiian Hawk, *Buteo solitarius*

INTRODUCTION

Historically the `io has been sighted at PTA; however no nests have been recorded. The `io breeding season begins in late March and continues through early October. `Io tend to respond well to recorded call play backs during pre-breeding and breeding periods (Klavitter 2000). Playbacks have been successful in many different habitats across the island from December through March and June (Klavitter 2000). Surveys were conducted quarterly to locate any resident birds and determine the periods of `io use at PTA.

METHODS

Transects were established 800 meters apart with station spaced at 800-meter intervals (Figure 1.3.2-1). This maximizes the amount of territory surveyed as well as prevents surveyor overlap of `io territories (Klavitter, 2000). Surveys were conducted under clear skies and low wind conditions to maximize sound transmission and detection. During the surveys wind speed, cloud cover and rain were recorded. Juvenile and adult calls were broadcasted for a total of 10 minutes at each survey station. The survey station, location, time, approximate distance from the bird, weather conditions, and type of activity (soaring, perched etc.) were recorded when birds were detected.



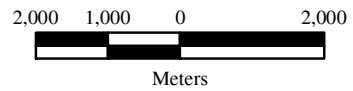
Io Surveys

- Io survey point
- Fence Units

Figure 1.3.2-1

Io Survey Points

Scale 1 : 100,000



RESULTS

An ʻio was seen for 3 consecutive days in Training Area 23. Survey transects were created in Training Area 23 to document presence and absence of ʻio in compliance with the 2003 Biological Opinion.

No birds were observed during quarterly surveys in Training Area 23 during 2005. A total of 133 personnel hours over 17 survey days were conducted. In Training Area 23, a juvenile hawk was seen in November 2005 perching in a tree. This sighting was not made during the formal survey. The bird was unbanded and had light colored (light phase) plumage.

Table 1.3.2-1. ʻIo sightings during reporting period.

Date	TA	Birds
2003	23	1
2005	23	1

MANAGEMENT RECOMMENDATIONS

Establish and survey transects in Training Areas 1-4 and 22 in 2006 in attempts to detect the sporadic use of the area. Create a rare animal sighting database and include a GIS component to analyze any potential ʻio habitat preferences. To increase the confidence of inferring ʻio absence from the study areas use statistical probability tests.

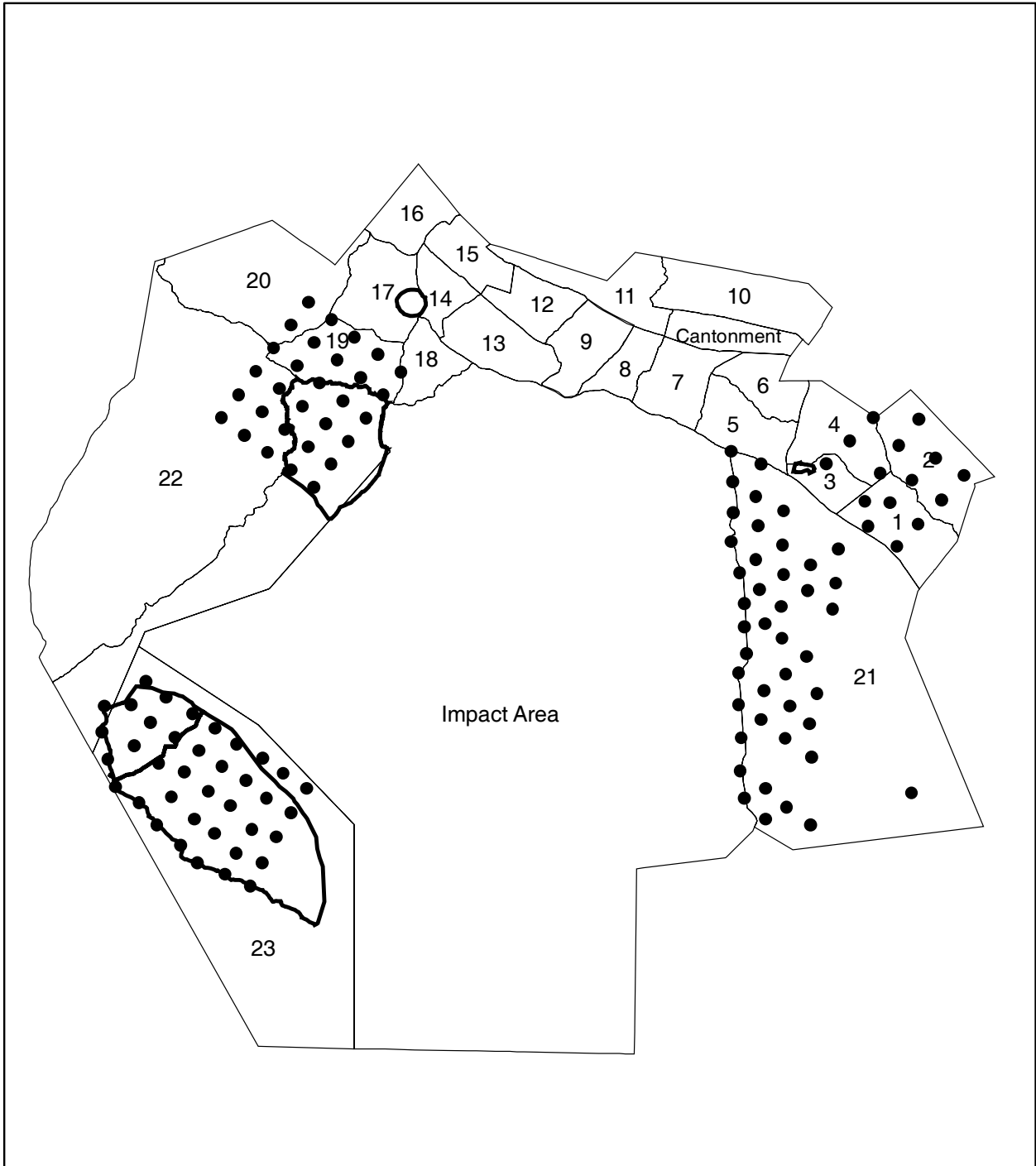
1.3.3 - Nēnē, Hawaiian Goose, *Branta sandvicensis*

INTRODUCTION

The Hawaiian goose (Nēnē), *Branta sandvicensis* has no known resident populations at PTA. Infrequent sightings have been reported on PTA, including banded birds indicating they are from one of the managed populations outside of PTA. Nēnē are known to use habitat types that occur on PTA including high-elevation sparsely vegetated lava flows and open native alpine shrubland and woodlands. Surveys to evaluate nēnē use on PTA are required in the PTA Biological Opinion (USFWS 2003).

METHODS

Nēnē surveys were conducted in four study areas where the majority of nēnē sightings have historically occurred (Training Areas 1-4, 19, 21, 22 and 23). Nēnē flocking activity increases during the pre-breeding season (October to November) and the post-breeding season (May to July). Timing of the surveys coincided with these seasons and surveys began in the spring of 2005. A two-method approach was used to determine nēnē locations. The first method placed observers on high vantage points to observe nēnē departing or returning to roosting locations. The second method incorporated transects spaced 800 meters apart with stations positioned at 800 meter intervals. Observers broadcasted recorded nēnē calls for three minutes followed by two minutes of observation with and without binoculars. The cycle was then repeated once for a total of ten minutes of observation. Data on weather conditions, sightings or calls heard were recorded.



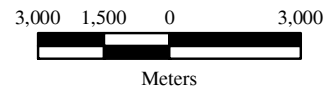
Nene Surveys

- Nene survey point
- Fence Units

Figure 1.3.3-1

Nene Survey Points

Scale 1 : 165,000



RESULTS

Approximately 166 personnel hours were expended over 20 days to complete two cycles of the nēnē surveys. Survey results are reported in Table 1.3.3-1.

Table 1.3.3-1. Survey results for Nēnē.

	Hours	Nēnē
<i>B. sandvicensis</i>	166	0

More than 59 nēnē birds were sighted at PTA or near the eastern boundary during the report period, despite no nēnē being detected during surveys. Most of the sightings took place from May to October.

Table 1.3.3-2 Summary of Nēnē sighting at PTA.

Date	Training Area	Number of Nēnē
June, 2004	22	6
July, 2004	23	4
August, 2004	21	5
February, 2005	22	4
February 18, 2005	5	1
May 23, 2005	19	10
June 4, 2005	Cantonment	*
June 9, 2005**	-	4
July 9, 2005**	-	6
August 10, 2005	23	6-7
August 30, 2005	23	2
September 21, 2005	21	5
October 22, 2005	21	3
October 25, 2005	21	5

* The birds were heard and not seen

** These sightings took place just east of PTA, near the boundary.

Table 1.3.3-3. Leg-band combinations recorded from Nēnē sightings.

Date	Training Area	Band Color	Band Letters
July, 2004	23	White	NP
		Red	LU
February 18, 2005	5	Red	XY
October 22, 2005	21	Red	ZY
		Black	LL
		Black	DL
October 25, 2005	21	Green	121
		Green	122
		Green	123
		White	JB

DISCUSSION

It is unclear how nēnē are using PTA. Birds have been seen at PTA in a variety of habitats. In February 2005, a young male that hatched at Hakalau National Wildlife Refuge (HNWR), was found in a grassy kīpuka near the Saddle Road in Training Area 5. The bird stayed in the general area for about two weeks. PTA NRS has not been able to obtain information whether this bird has been sighted back at HNWR. Band combinations have been obtained for other individuals, but information on the birds has been difficult to obtain because the State database of nēnē band combinations is disorganized. It would be beneficial to develop a relationship with the HNWR biologist to collaborate on band and bird information. It is clear from comparing survey results to incidental sightings that the surveys are inadequate. The numbers of birds utilizing PTA are unknown. The number is assumed to be small and the survey methods may not be able to pick up low numbers of birds that sporadically utilize the area. It appears from the survey results that there is not a resident or breeding population of nēnē at PTA.

MANAGEMENT RECOMMENDATIONS

Surveys over broad landscapes have not yielded any beneficial information for management of nēnē at PTA. Examine survey protocols to determine if adjusting sampling frequency may result in positive detections. To better understand how nēnē birds are utilizing PTA, preferred habitat use, frequency, and times of year is essential. From the sightings data it appears that nēnē frequent specific training areas, but the training areas are geographically large and it is unclear if they frequent the same locations within the training areas. Using radio transmitters and radio receivers to track nēnē movements may be useful to begin to understand how nēnē birds are using PTA's resources. This method would be more efficient because personnel time is focused on the birds instead of surveying large areas that are sporadically used. Also, the data generated would begin to illuminate how nēnē birds are using PTA, which is the first step in understanding how to manage the habitat for this endangered species.

Create a database for rare animal sightings and incorporate nēnē sightings into GIS to determine if there are usage patterns. Partner with the PTA Range Maintenance and Range Control divisions to make reporting nēnē sightings easy and reliable. Try to get more reliable band combinations and find the most expedient method for obtaining information on those birds. Join the nēnē working group and begin to establish working relationships with the nēnē managers on the island. Begin to set the ground work for a possible joint nēnē radio telemetry study with the nēnē working group.

1.3.4- `Ua`u, Petrel, *Petrodroma phaeopygia sandwichensis*

INTRODUCTION

In 1995, Cooper *et al.* conducted a marine radar survey for sea birds and bats at PTA. This was the first formal survey for `ua`u at PTA and covered most of the installation. Three of the survey points on the eastern side of PTA were sampled again in 2000. In 1997, 1998, 2003, over-night surveys were conducted for `ua`u in the southern portion of Training Area 23 above 7,500 foot elevation. Each survey was conducted over two nights and three days.

The 2003 Biological Opinion requires that surveys for `ua`u using marine radar be initiated at PTA, in conjunction with U.S. Fish and Wildlife Service, by 2005. However, marine radar is not suitable for use at PTA due to the low density of birds.

MANAGEMENT RECOMMENDATIONS

Additional ground based surveys, if required, should focus on suitable habitat. Night vision equipment should be used to survey for nesting birds. During the daylight surveys suitable blisters, cracks, and caves should be examined for bones and carcasses

Discuss with monitoring experts and the USFWS the efficacy of using marine radar in the surveys for `ua`u at PTA. This may not be the most effective and appropriate method considering the density of birds, limited resources, and high cost of employing marine radar.

1.3.5 - Forest Bird Population Monitoring

INTRODUCTION

PTA NRS has been conducting annual avian surveys since 1998. This data set is designed to identify trends in bird populations and to be compatible with state-wide efforts. Protocols used and data collection follow guidelines set forth by the Hawaii Forest Bird Interagency Database Project (HFBIDP) (Web site <http://biology.usgs.gov/pierc/HFBIDPSite/HFBIDPHome.htm>).

METHODS

A total of 15 bird population monitoring transects have been established in Kīpuka `Alalā, the Palila Critical Habitat and Training Area 22 (Figure 1.3.5-1). Counting stations are located along the transects every 150 meters. The counting method is based on the U.S. Fish and Wildlife Service Hawaiian Forest Bird variable circular-plot (VCP) survey methods (Scott et al. 1986). Counts at each station are conducted for six minutes between 0545 and 1100 hours. Every bird of each species heard or seen is recorded. The distance to every bird detected is recorded in meters. Weather conditions are also noted.

Surveys were conducted in December 2003, 2004 and 2005. Four primary counters, Lena Schnell, Darryl York, Lance Tominaga and Aubrey Kelly conducted the surveys. Counts were not conducted on days when the weather was not within established guidelines.

RESULTS

No trend results are available at this time for the 2003 to 2005 data.

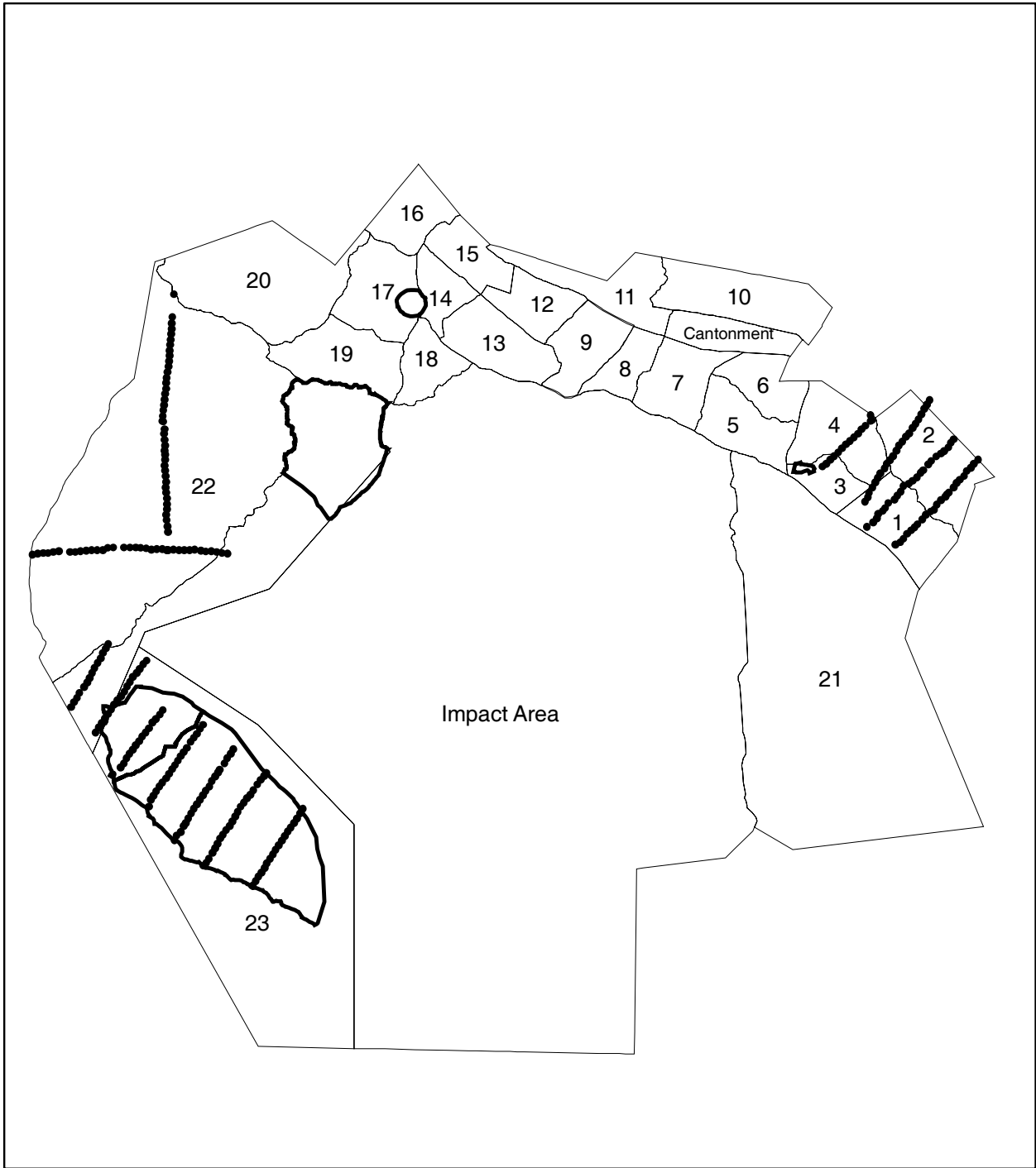
DISCUSSION

The data collected in 2003 was entered into a database that only runs on Windows 1995 and no machines with that operating system are functional to run the analysis. Following direction from the HFBIDP, data collected in 2004 and 2005 was not entered into the old database. A new database was developed in 2006 and 75% of the data from 2004 and 2005 has been entered into the new database. Ninety-five percent of the data from 1998 to 2003 has been converted to the new database.

Biologists that have experience with the statistical program “Distance” have recently been hired and tasked with providing a trend analysis which will be ready by 2006.

MANAGEMENT RECOMMENDATIONS

Finish entering data and converting old data to into the new HFBIDP database format. Conduct trend analysis using “Distance” on data from 1998 to 2005.



Annual Bird Surveys

- Bird survey transect station
- Fence Units

Figure 1.3.5-1

Annual Bird Survey Points

Scale 1 : 165,000

3,000 1,500 0 3,000



Meters



1.3.6 - `Ōpe`ape`a, Hawaiian Hoary Bat, *Lasiurus cinereus semotus*

INTRODUCTION

The Hawaiian Hoary Bat is endemic to the State of Hawai`i where it is the only extant, native terrestrial mammal. It has been documented historically on the islands of Hawai`i, Maui, Moloka`i, O`ahu, Kaua`i, and possibly Kaho`olawe. It is now resident only on Hawai`i, Maui, and Kaua`i. Current and historical population numbers are unknown for the bat, but the species is believed to have declined over the past 100 years. The bat population at PTA is an unknown proportion of the subspecies' distribution, for which there are no abundance estimates. The primary factor limiting recovery is thought to be habitat loss, primarily the availability of roosting sites; suitable roosting habitat is particularly important to pregnant and lactating females and non-volant young.

The goal of this project was to make a preliminary assessment of presence or absence of Hawaiian Hoary bats in various habitat types throughout PTA. Data collected during these surveys will help to develop standardized survey and monitoring techniques for the determination of bat abundance, distribution, and roosting habitat associations as required by the 2003 Biological Opinion.

METHODS

Presence/absence surveys were conducted at 50 predetermined locations from May-June 2005 and again from November-December 2005. Vegetation types at PTA were grouped into 5 broad categories (i.e., grassland, open shrubland, dense shrubland, open woodland, and dense woodland). The number of survey locations in a vegetation grouping is proportional to the total area of PTA that is composed of each vegetation grouping.

During the 2.5-hour detection period (one hour before sunset to 1.5 hours after sunset) observers visually scanned the sky and simultaneously listened for auditory detections with a bat detector. Auditory detections consisted of bat calls, (i.e., the ultrasonic train of licks emitted by bats as they forage or commute).

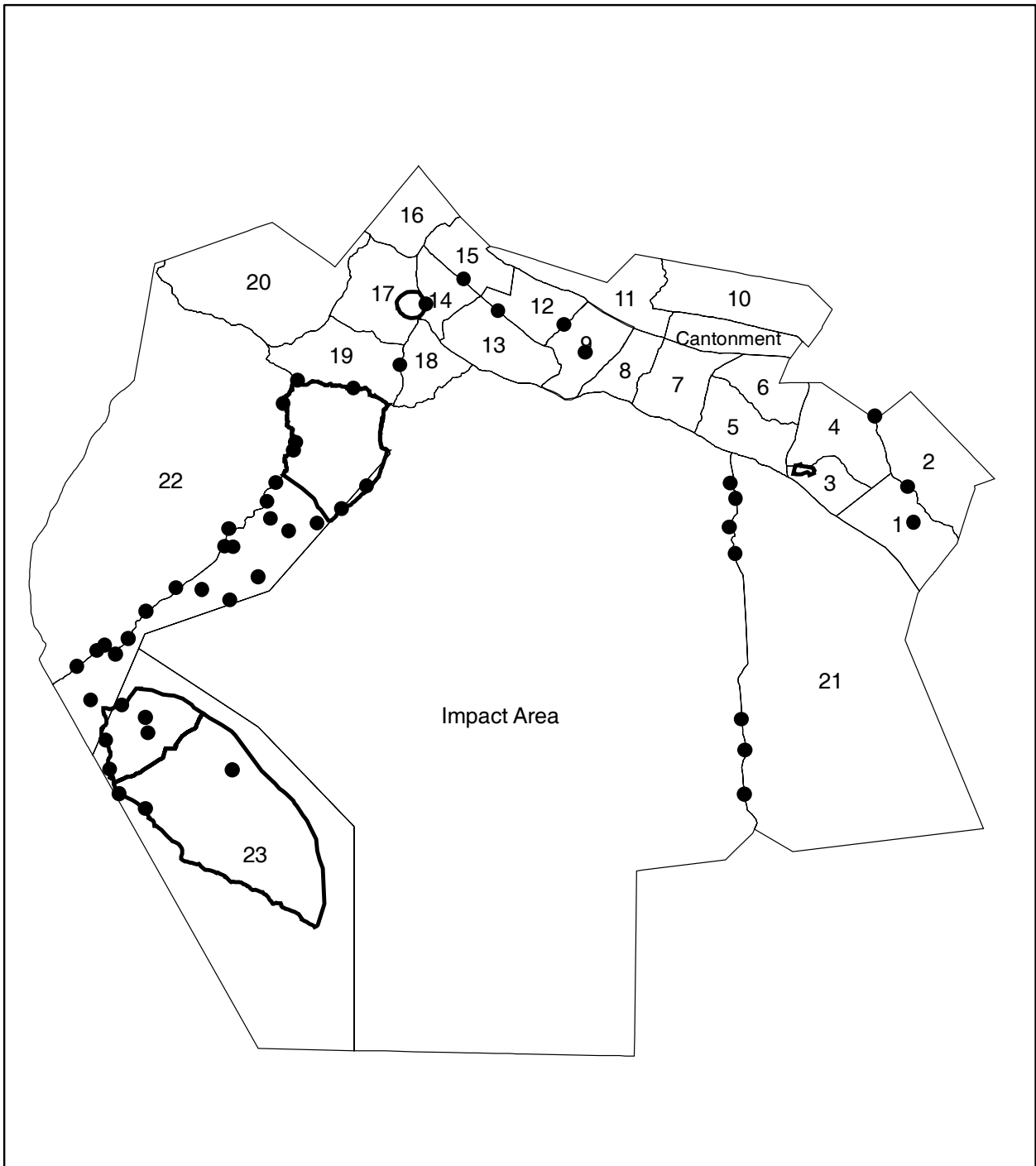
The frequency of observations within the five vegetation grouping was calculated to determine use of each. Preference was demonstrated for a vegetation grouping when bats were detected in greater proportion than the vegetation grouping is available throughout PTA. Four categories of preference were defined: 1) selection; habitat used more than expected by chance, 2) proportional use; habitat used in proportion to its availability, 3) low use; habitat used less than expected by chance, and 4) avoidance; habitat not used.

RESULTS

Results from the summer survey demonstrated a preference for dense woodland habitat types that occur on PTA, as was expected from previous survey results. The data from the winter survey did not detect a significant difference in habitat preference. Woodlands comprise 53% of PTA and degradation of this habitat by ungulates, invasive weed species, and wildfire could be detrimental to the long-term survival of bats at PTA. Pregnant or lactating females and non-volant young would be especially vulnerable to habitat degradation. In the future, woodland habitat will be the focus of survey and monitoring efforts. We will continue to monitor for bat activity on a semi-annual basis and it is hoped we can determine if the bat population on PTA is stable over the long-term.

MANAGEMENT RECOMMENDATIONS

Develop more statistically rigorous techniques to collect information regarding habitat use. Automating data collection equipment and techniques will be incorporated into the project.



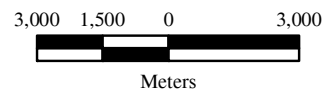
Bat Surveys

- Bat survey point
- Fence Units

Figure 1.3.6-1

Hawaiian Hoary Bat Surveys

Scale 1 : 165,000



1.3.7 - *Rhyncogonus stellaris*

INTRODUCTION

The genus, *Rhyncogonus* is restricted to the Pacific (Polynesia) region and no longer exists on adjacent continental areas (G.A. Samuelson 2003). All species are flightless; therefore, it is probable they were transported here via migratory birds. Since they lack wings they may be more vulnerable to alien predators. Adults are leaf chewers while larvae are associated with the roots of their host plant. They are robust, heavy-bodied insects ranging from 10-18 millimeters long (G.A. Samuelson 2003). They tend to associate with a narrow range of plants, usually confined to specific plant communities such as *Chenopodium oahuense* dominated communities.

Rhyncogonus stellaris was first collected in 1939 (G.A. Samuelson 2003). Historically the native weevil was found in the North Kona and South Kohala districts along the coastal lowlands. Alien predators and habitat disturbances may have been detrimental to the species. Currently, their range seems to be restricted to PTA. *Rhyncogonus* species are typically active throughout the day and night. However, Hawaiian species seem a little more elusive (Claridge 2004). In 2002, Peter Oboyski found two individuals in Training Area 22. In 2004, Jon Giffin found an individual on *Chenopodium oahuensis* in Training Area 19. Little is known about its habitat requirements and distribution at PTA or other areas. Other potential host-plants and ecological use patterns for *R. stellaris* are unknown (Hawai'i Natural Heritage Program 1998).

The limited distribution and risk of fire are management concerns *R. stellaris*. The species is currently only known from the Kīpuka Kālawamauna Endangered Plant Habitat. This is a fire prone habitat that portions of are manage for rare plant species.

METHODS

Eight study sites were established within the *Dodonaea* Mixed Shrubland at 1580 meters elevation. These are similar characteristics to those in which an individual of *R. stellaris* was collected in 2004. All individual *C. oahuensis* and *Dodonaea viscosa* within a 150 meter radius of the road at each study site were surveyed. All surveys were conducted during early morning hours or at dusk. Each site was visited 1-2 times per month. The collections were made using cotton beat sheets and a collection net. A sieve was used to sample the vegetation, leaf litter and soil. Surveys were conducted from March 2004 to September 2005.

RESULTS

A total of 18 individuals were found in August 2004 through September 2004 at Site 2 (Table 1.3.7-1). The weevils were observed in the crown of *C. oahuensis* during early morning hours between 8:30 and 9:30 am.

On August 16, 2004, one male *R. stellaris* was found in Training Area 19 inside gate two near Kona highway. On August 24, 2004, one female, one male, and one mating pair were recorded between 8:30 and 9:30 am. All weevils were found amongst the crown of the *C. oahuensis* exposed and easily visible. What appeared to be one male and one female were collected for closer examination. The male measured 0.9 centimeters and the female 1.1 centimeters. *Sida falax*, *D. viscosa*, *C. oahuensis*, and moist cotton balls were placed inside an observation container with the weevils. They were observed eating the *Chenopodium oahuensis*. On August 30, 2004 four more individuals were found. On September 9, 2004 one mating pair and six individuals were found. On October 10, 2004, one more single *R. stellaris* was found. These were the last observed individuals and or mating pairs. A sample was sent to G.A. Samuelson and the identification as *R. stellaris* was confirmed.

Table 1.3.7-1. Survey results for *Rhyncogonus stellaris*.

Site	Training Area	Mating Pairs	Females	Males
1	19	0	0	0
2	19	4	6	2
3	9	0	0	0
4	13	0	0	0
5	17	0	0	0
6	17	0	0	0
7	19	0	0	0
8	19	0	0	0

DISCUSSION

There are several possible reasons for why the weevil has not been collected at the other seven sites and or why they have not been observed since last year in Site 2. First, the other sites exhibit increased signs of habitat disturbance. Such as, the invasion of fountain grass, *Pennisetum setaceum*, and *Tagetes minuta*. Second, the native shrubs in the other seven sites, particularly the *C. oahuensis*, have a smaller leaf surface potentially from water stress. As a result of taking monthly rain gauge data for a year from each site; Site 2 received the highest monthly average of 0.3 centimeters.

A potential threat or competitor, *Asynonychus godmanii*, was observed at all of the study sites on the same host plant, *C. oahuensis*. *A. godmanii* is an introduced weevil species. *A. godmanii* may out-compete *R. stellaris* for resources since both species share host plants. This additional stressor could be detrimental to the *R. stellaris* population at PTA. Non-native insects tend to be opportunistic and exhibit a “weed like quality in such that, they have the ability to generate large populations in a short amount of time and are efficient at gathering scarce resources, as a result, it makes them better competitors than their native counterparts” (Oboyski *et al.* 2001).

MANAGEMENT RECOMMENDATIONS

Increase the sampling to include more sites with in the *Chenopodium oahuense* vegetation type. Continue to sample different potential host plants to gain more knowledge on *R. stellaris*' habitat distribution within PTA. Expand survey range of known population site with hopes of discovering insights on its habits and /or life cycle. Survey and control for other potentially devastating predators such as the Argentine Ant, *Linepithema humile*. Control for invasive weeds by creating a buffer around Site 2. Construct firebreak to protect habitat as required by 2003 Biological Opinion.

CHAPTER 2: MANAGEMENT ACTIONS

2.1 INTRODUCTION TO MANAGEMENT ACTIONS

The Intensive Management Unit (IMU) program was developed as a management tool to focus limited resources in an effort to maximize the effects of management actions. IMU's were identified (Figures 2.1-1 to 2.1-5) in areas of high natural resource value, include is the quality of habitat as well as the rarity of species. Management is conducted with the ecosystem in mind and not focused on a particular species.

Management of an IMU begins with surveying to determine what resources there are to be managed and where that management is best targeted. Surveys for rare plants are conducted utilizing a flagless transect technique developed by the Natural Resources Staff at PTA. This technique utilizes GIS tools to create a series of precisely spaced waypoints at the beginning and end of a virtual transect, spaced a specified distance apart, and set at a specific directional heading. The transects are spaced ten meters apart for the smaller and more solitary species; 15-20 meters apart for more common or denser species; 20 meters apart for tree species. Transects are then loaded into GPS units for field use. Together the GIS and GPS enable the surveyor to know very accurately the area of their survey responsibility. This prevents surveyor overlap minimizing the over or under surveying of an area. The result is a comprehensive survey.

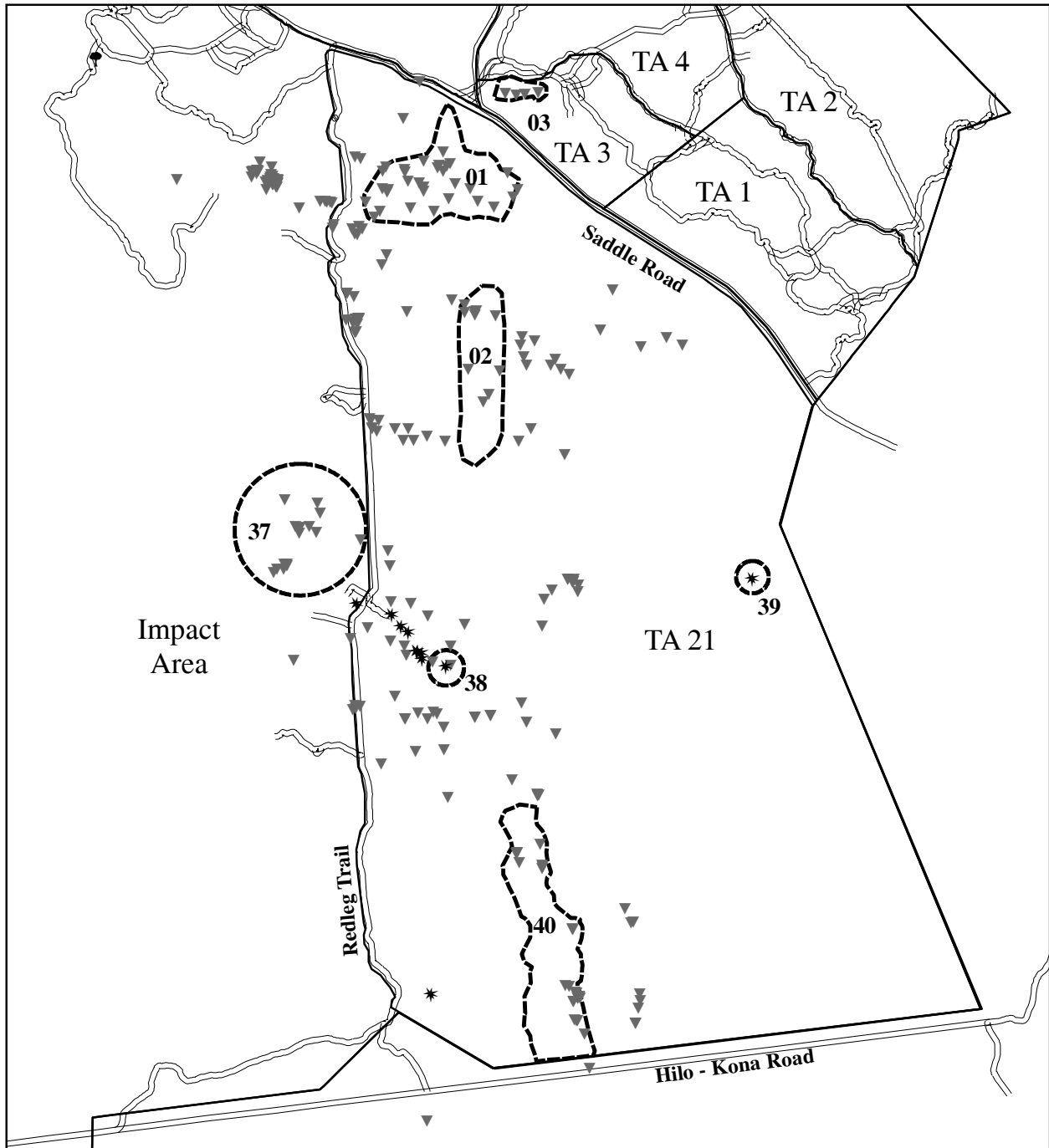
The summary tables found in each of the IMU subsections in Chapter 2 report the number of plants found as a result of surveys during the reporting period in the Newly Recorded columns. Numbers reported in the Currently Known columns combines data recorded during the reporting period as well as data previously recorded by PTA Natural Resources Staff. This is the minimum number of plants in the identified locations. Monitoring data for *Haplostachys haplostachya*, *Silene lanceolata*, and *Tetramolopium arenarium ssp. arenarium* may indicate there are more individuals in the area than were found during surveys.

Following surveys the threats to the species in the IMU are assessed, prioritized, and implemented. The control of invasive plant species is important in the management of listed species. Once surveys have identified listed or rare plant locations weed control perimeters are created in the GIS. The perimeters created are a radius of 25-50 meter around the highest priority species in the IMU. In the field the perimeter is established using flagging. Then, systematic weed control is conducted so that a weed control buffer is created around the listed or rare plants. Within the buffer all alien plant species are controlled by hand clearing, chemically through the use of herbicides, and mechanically using weed whackers.

Hand clearing is conducted within one meter of listed or rare plants. Chemical control is conducted using glyphosphate products and/or Garlon products. No chemical control is conducted within one meter of the listed or rare plants to prevent accidental overspray. Chemical control is only conducted during favorable weather conditions. Once plants have been killed using chemical control they are mechanically removed using gas powered weed whackers. Weed control efforts in an IMU requires an initial herbicide treatment to establish the weed control buffer followed by quarterly maintenance of the buffer. A species such as *P. setaceum* requires two to three years to completely control within the buffer. Other species such as *Senecio madagascariensis* requires constant retreatment with little chance of maintaining a buffer free of the species.

Rodents heavily impacted some of the rare and listed plant species during the reporting period. They appeared to be seeking moisture from the plant stems. Rodents were controlled using J.T Eaton's® Molasses bait blocks with peanut butter flavorizer. The active ingredient is diphacinone at 0.005%. All bait blocks were placed in secured bait stations that have been approved by the USFWS. The bait boxes were placed in a grid pattern; boxes were spaced 25 meters apart, and the grid was centered on the rare and listed plant species.

Another important threat to the species found at PTA is ungulates. Small-scale emergency exclosures are constructed around individual plants or plant clusters as a measure to prevent ungulate damage until large-scale fence units have been completed and ungulates removed. The fences are typically constructed by placing a two foot piece of rebar in the ground and sliding a four foot piece of pipe over the rebar. The fence fabric, typically four foot orange construction fencing, is secured to the pipe using ultraviolet light resistant zip ties. The visual and physical barrier is usually sufficient protection, although ungulates could penetrate the emergency exclosures.



Plant Locations

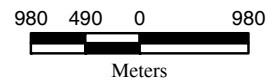
- * *Asplenium peruviana var. insulare*
- ▼ *Silene hawaiiensis*

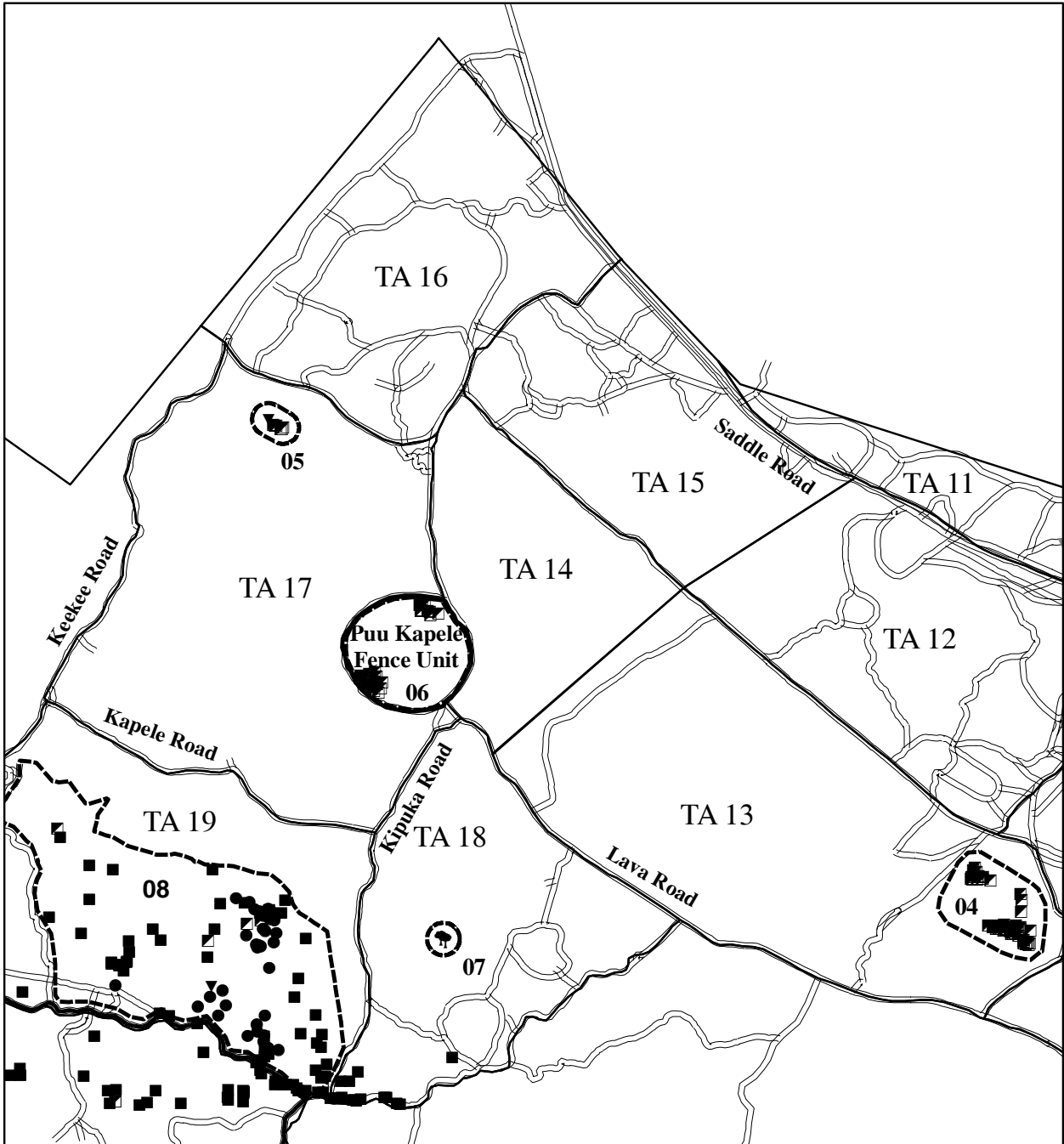
-  IMU Boundary
-  Roads

Figure 2.1-1

Locations of
IMU's 01, 02, 03, 37, 38, 39 and 40.

Scale 1 : 65,000



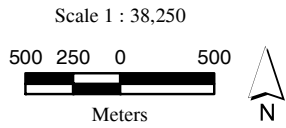


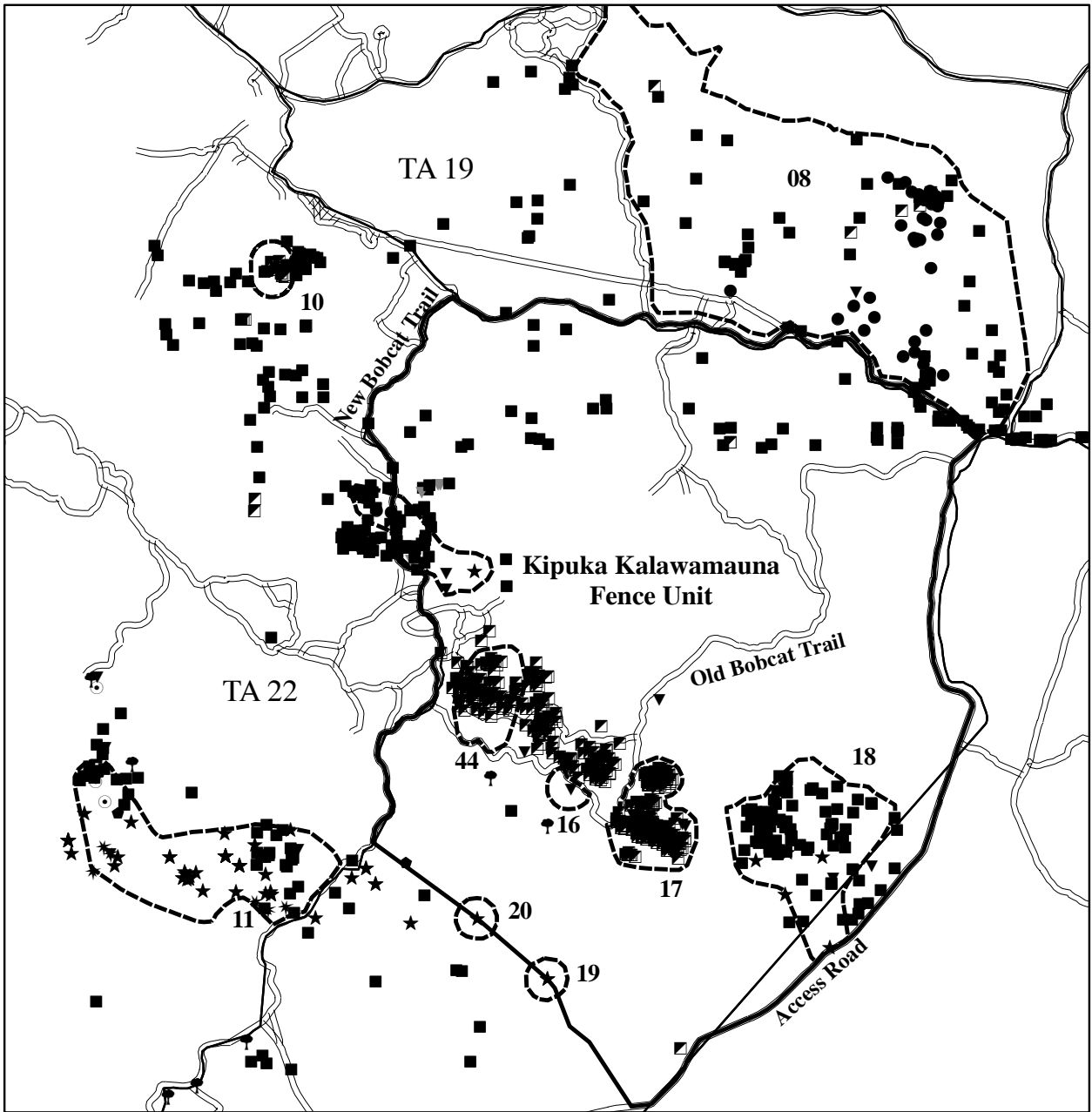
Plant Locations

- ▣ *Haplostachys haplostachya*
- ▼ *Silene lanceolata*
- *Stenogyne angustifolia*
- *Tetramolopium arenarium*
- ▲ *Zanthoxylum hawaiiense*

- Roads
- ▭ Fence
- - - IMU Boundary

Figure 2.1-2
Locations of IMU's 04, 05, 06, 07 and 08.





Plant Locations

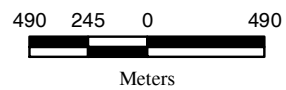
- ▣ *Haplostachys haplostachya*
- ★ *Hedyotis coriacea*
- *Portulaca sclerocarpa*
- ▼ *Silene hawaiiensis*
- ▽ *Silene lanceolata*
- *Stenogyne angustifolia*
- *Tetramolopium arenarium*
- *Tetramolopium sp. 1*
- † *Zanthoxylum hawaiiense*

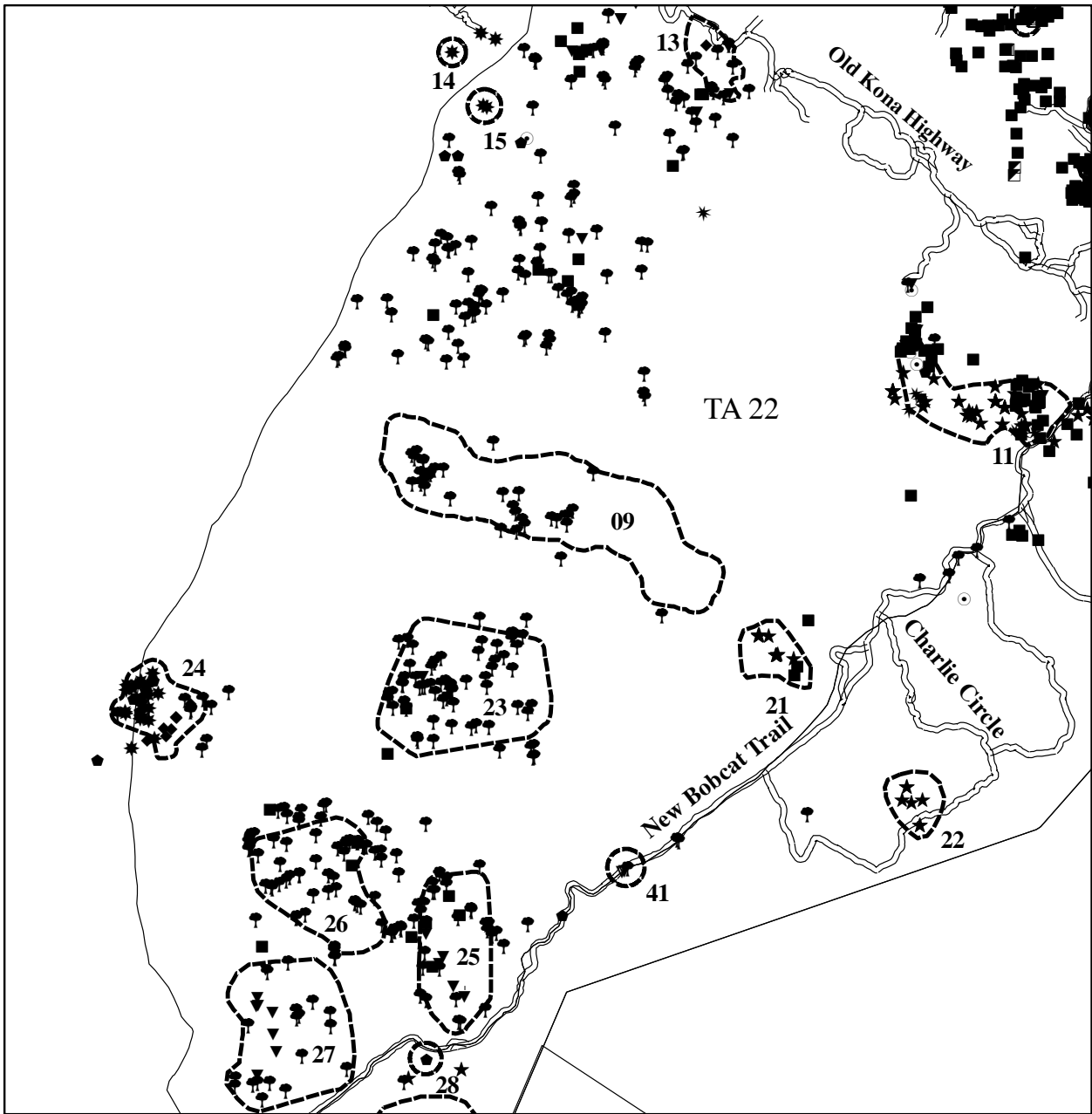
- Roads
- ▭ Fence
- ⊞ IMU Boundary

Figure 2.1-3

Locations of IMU's
08, 10, 11, 12, 16, 17, 18, 19, 20 and 44.

Scale 1 : 30,000





Plant Locations

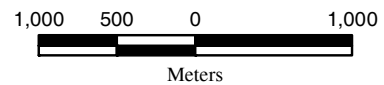
- * *Asplenium peruviana* var. *insulare*
- ▣ *Haplostachys haplostachya*
- ★ *Hedyotis coriacea*
- * *Neraudia ovata*
- ◆ *Portulaca sclerocarpa*
- ▼ *Schiedea hawaiiensis*
- ▼ *Silene lanceolata*
- ◆ *Solanum incompletum*
- *Stenogyne angustifolia*
- *Tetramolopium* sp. 1
- † *Zanthoxylum hawaiiense*

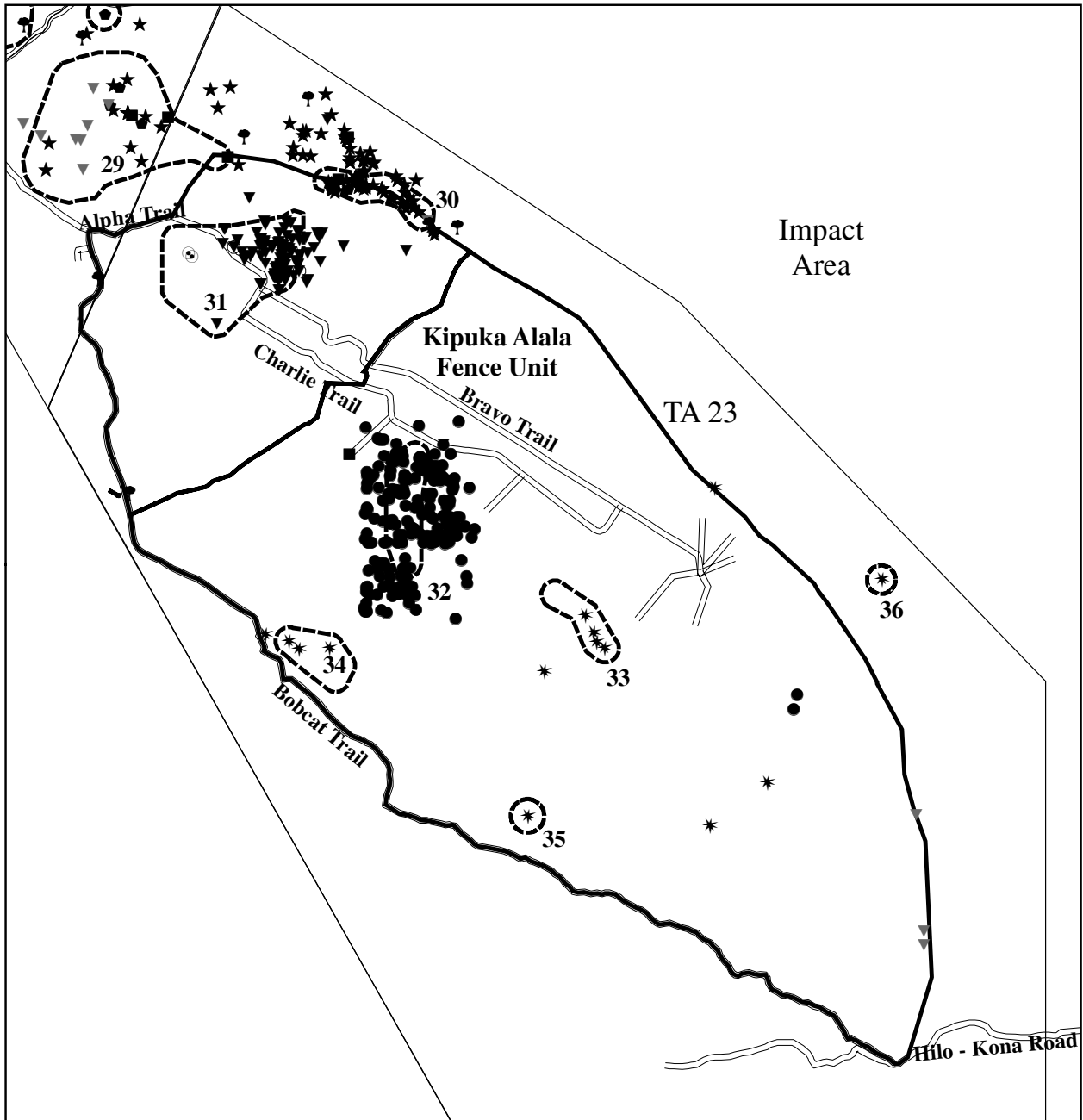
- == Roads
- ▭ IMU Boundary

Figure 2.1-4

Locations of IMU's 09, 11, 13, 14, 15, 21, 22, 23, 24, 25, 26, 27, 28 and 41.

Scale 1 : 46,000





Plant Locations

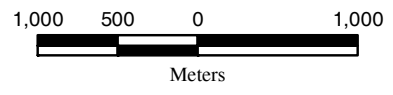
- * *Asplenium peruviana* var. *insulare*
- ★ *Hedyotis coriacea*
- *Portulaca sclerocarpa*
- ▼ *Silene hawaiiensis*
- ▽ *Silene lanceolata*
- *Spermolepis hawaiiensis*
- *Stenogyne angustifolia*
- *Tetramolopium* sp. 1
- † *Zanthoxylum hawaiiense*

- IMU Boundary
- Fence
- Roads

Figure 2.1-5

Locations of IMU's 29, 30, 31, 32, 33, 34, 35 and 36.

Scale 1 : 45,000



2.2 MANAGEMENT ACTIONS BY INTENSIVE MANAGEMENT UNIT

2.2.1 - IMU 1, 2, 38, 40

INTRODUCTION

Training Area 21, located on the east side of PTA, is an important area for military training, natural resources and cultural resources. Two federally listed plant species are found in Training Area 21. They are the threatened *Silene hawaiiensis*, categorized as a PS-5, and the endangered *Asplenium peruviana var. insulare*, categorized as a PS-2. There is a high concentration of *S. hawaiiensis* in this training area that is impacted by feral ungulates. *A. peruviana var. insulare* is restricted to the caves at PTA due to the increased moisture and lower temperatures in the caves compared to the surface.

Following the issuance of the 2002 Biological Assessment (USAG 2002) and the Biological Opinion (USFWS 2003), fence units were identified to protect *S. hawaiiensis* within Training Area 21 (Redleg Trail). In addition, the Biological Opinion stipulated that 20 caves occupied by or suitable for *A. peruviana var. insulare* are to be protected. The USFWS based the locations of fence units on the most current data; however, the data were collected during the 1990's and were therefore out-dated. In addition, the surveys of the area were not comprehensive. A survey of T.A. 21, in which IMU's 1, 2, 38, and 40 are found, needed to be conducted to ensure fence units were placed in the most biologically appropriate areas.

Table 2.2.1-1. Summary of Management Actions conducted in IMU 1, 2, 38, 40.

	Hours	Acres
Plant Surveys		
IMU 1 and 2	184	2,450
IMU 38	86	300
IMU 40	55	322

RARE PLANT SURVEYS AND PROTECTION

Rare plant surveys were conducted in and around IMU's 1, 2, 38, and 40 in TA 21 during July and August of 2004 (Table 2.2.1-1). Transects were spaced 100 meters apart, average width surveyed was 10-15 meters, and approximately 233.5 kilometers were surveyed.

The coarse surveys were designed to determine the current distribution of *S. hawaiiensis* in an effort to identify the most suitable locations for large-scale fence units and estimate the population size. In addition, caves occupied by or suitable for *A. peruviana var. insulare* would be included in recommendations for large-scale fence units.

Twenty-five caves were identified during surveys as suitable for *A. p. var. insulare* were recorded. This exceeds the 20 caves required by the Biological Opinion.

During the surveys *S. hawaiiensis* was recorded (Table 2.2.1-2) within vegetation types classified as *Metrosideros* Treeland and *Styphelia-Dodonaea* Shrubland.

Table 2.2.1-2. Survey results for *Silene hawaiiensis* recorded in IMU's 1, 2, 38, and 40.

	Newly Recorded		Currently Known	
	Locations	Plants	Locations	Plants
<i>S. hawaiiensis</i>				
IMU's 1 and 2	91	217	111	648-657
IMU's 38 and 40	88	340	88	368-386

Recorded locations of *A. p. var. insulare* have increased from surveys conducted in the early 1990's by CSU. Increased survey activity by PTA Natural Resources Staff has resulted in the discovery of previously unrecorded locations throughout PTA. Increased precipitation during the past two years may have contributed to the increase in the number of individuals being recorded. It is not certain if the current increases can be sustained through drier periods.

The Biological Opinion identified 347 hectares (860 acres) for fence units; these protected all of the 65 known locations *S. hawaiiensis* identified prior to the 2004 surveys. No information is available to determine how many plants were found at these locations. During the 2004 surveys 160 locations were identified, only 56 of the locations were found within the fence units identified in the BO. This constitutes 35% of the known locations.

In addition, only 10 of the caves identified as being occupied by or as suitable for *A. peruviana var. insulare* during 2004 surveys were within the fence units identified in the BO. To this date 11 caves have been identified as being occupied and 15 were identified as being suitable. Furthermore, only 4% of the 300 caves identified during archaeological surveys, and therefore potential *A. peruviana var. insulare* habitat, were found within the fence units identified in the Biological Opinion.

A 4,960 hectare (12,256 acre, perimeter of 46.7 kilometers, 28 miles) fence unit that encompasses all of Training Area 21 would provide protection for all recorded locations of listed species as well as any habitat that may be suitable for *A. peruviana var. insulare*.

The fence units would protect all known archaeological resources in Training Area 21. The southern most portion (118 ha, 292 ac) that protects all of Pu'u Koli and surrounding features is State lands. Agreements would have to be reached if this portion is to be included in the project.

A fence unit encompassing Training Area 21 would provide for additional control of unauthorized access to PTA. The large fence may have less impact on training than other options. In addition, this alignment would place 77% of the fencing along roadsides reducing per unit fencing costs.

WEED CONTROL

Pennisetum setaceum is found in the area but is not a management threat at this time. No weed control was conducted during the reporting period.

INTRODUCED ANIMAL SURVEYS AND CONTROL

No introduced animal surveys or control were conducted during the reporting period for this species.

MANAGEMENT RECOMMENDATIONS

Increased monitoring should be conducted to better assess the viability of known populations. Non-native plant species encroaching in to caves could be competing with *A. p. var. insulare* for limited space, water, or nutrients and may need to be controlled. Long term vegetation monitoring will indicate the level of threat posed by weeds.

The IMU boundaries for IMU 1, 2, 38, and 40 were drawn using outdated data; therefore, the IMU boundaries should be redrawn to best focus future management efforts around the highest concentrations of plants. The most biologically appropriate and logistically feasible fencing alignment would be to fence all of Training Area 21.

2.2.2 - IMU 3

INTRODUCTION

The 33-acre IMU in Training Area 3, located in the northeastern portion of PTA, is protected by the large-scale *Silene hawaiiensis* Fence Unit (SHFU). The SHFU protects a dense population of *S. hawaiiensis* found in a *Styphelia-Dodonaea* shrubland on a pāhoehoe flow. The shrubland is surrounded by an older ash/soil substrate vegetated by a degraded *Sophora-Myoporum* Shrubland and a barren `a`ā flow.

Management actions within the IMU during the reporting period consisted of weed control (Table 2.2.2-1).

Table 2.2.2-1. Summary of Management Actions conducted in IMU 3.

	Hours	Acres	Gallons
Weed Control	74	37	140.5

RARE PLANT SURVEYS AND PROTECTION

No plant surveys were conducted in this IMU. Semi-annual fence inspections are conducted to ensure the integrity of the fence unit.

INTRODUCED ANIMAL SURVEYS AND CONTROL

No introduced animal surveys or control were conducted within the IMU.

WEED CONTROL

Weed control is focused within the SHFU. *S. hawaiiensis* are found on the pāhoehoe where weed densities are low and *Pennisetum setaceum* has been essentially eliminated. The majority of weed control occurs within eight acres of the ash/soil portion of the *Sophora-Myoporum* shrubland and is focused on introduced annual and short-lived perennial grass species as well as perennial broadleaved species. The 37.3 acres treated over the reporting period represents six treatments of 9-15 acres per treatment (Table 2.2.2-2).

Table 2.2.2-2. Summary of weed control conducted in IMU 3.

	Hours	Acres	Gallons
Hand Clearing	12	-	-
Spraying	74	37	140.5

MANAGEMENT RECOMMENDATIONS

S. hawaiiensis is categorized as a Priority Species-5. Therefore, this IMU receives management attention two or three times each year. Due to the limited attention it is recommended that the semi-annual weed control be synchronized to target the grass species prior to their flowering and seed set. This would prevent the seed bank of the weed species from being continually replenished.

2.2.3 - IMU 4

INTRODUCTION

Located in Training Area 13, IMU 4 encompasses 74.5 acres. The IMU is not fenced for ungulates but has been removed from military training activities and is encircled by a “people fence” consisting of a single strand of barbed wire. A large population of *Haplostachys haplostachya* is located inside this IMU. The only Management Actions conducted were plant surveys (Table 2.2.3-1).

Table 2.2.3-1. Summary of Management Actions conducted in IMU 4.

	Hours	Acres
Plant Survey	44	106

RARE PLANT SURVEYS AND PROTECTION

Surveys were conducted from July 2004 to March 2005 in and around the IMU. Browse was recorded on 35-38% of plants found during surveys.

Table 2.2.3-1 Results of rare plant surveys conducted in IMU 4.

	Newly Recorded		Currently Known	
	Locations	Plants	Locations	Plants
<i>H. haplostachya</i>	42	995-1,070	54	1,621-2003

WEED CONTROL

No weed control was conducted during the reporting period.

INTRODUCED ANIMAL SURVEYS AND CONTROL

No animal surveys or control were conducted during the reporting period.

MANAGEMENT RECOMMENDATIONS

Weed control is needed in the IMU. However, this species and IMU are of lower priority. Weed control will be conducted following successful weed control for higher priority species and IMU's.

More than one third of the *H. haplostachya* found during surveys were being impacted by ungulates.

There is a large herd of goats that is consistently observed crossing between the Impact Area and IMU 4. A large-scale fence unit and ungulate removal is needed to protect this species and habitat; in addition, it is a requirement of the Biological Opinion.

2.2.4 - IMU 5

INTRODUCTION

IMU 5 is 13 acres in a Mixed *Dodonaea* Shrubland (Shaw and Castillo 1997) in Training Area 17 off of Ke`eke`e Road. *Silene lanceolata* (PS-2) is the species of highest priority. There is also a *H. haplostachya* (PS-5) site found in IMU 5.

Table 2.2.4-1. Summary of Management Actions conducted in IMU 5.

	Hours	Acres
Emergency Enclosures	24	-
Plant Survey	2	0.5
Weed Control	113	1.2

RARE PLANT SURVEYS AND PROTECTION

Plant surveys were conducted within IMU 5 prior to this reporting period, during which no locations other than the known *S. lanceolata* and *H. haplostachya* locations were reidentified. An emergency enclosure was constructed around the *S. lanceolata* prior to this reporting period and the site consisted of approximately 15 individuals. In 2004, there were 49 individuals. In 2004, an emergency enclosure measuring approximately 0.4 acres was erected to protect the *S. lanceolata* from ungulate threats. In May

2005, the site contained 55 individuals; though 31 were in poor health due to one individual's poor herbicide spraying practices. Two months later much of the population was confirmed dead.

Table 2.2.4-2. Results of rare plant surveys conducted in IMU 5.

	Newly Recorded		Currently Known	
	Locations	Plants	Locations	Plants
<i>S. lanceolata</i>	1	55	1	10-15

WEED CONTROL

Weed control is performed on 1.2 acres, with a goal of visiting this IMU three times per year. During the reporting period through repeated spraying and removal of dead material, the equivalent of 9.5 acres was managed for weeds (Table 2.2.4-3).

Table 2.2.4-3. Summary of weed control conducted in IMU 5.

	Hours	Acres	Gallons
Hand Clear	6	-	-
Spraying	92	1.2	131
Weed Whacking	15	1.2	-

INTRODUCED ANIMAL SURVEYS AND CONTROL

No animal surveys or control were conducted during the reporting period.

MANAGEMENT RECOMMENDATIONS

Continue weed control and monitoring to ensure the survival of the *S. lanceolata* population. The 220 acres surrounding the IMU should be re-surveyed to determine if the wet weather during the past two years has resulted in regeneration of old or new locations of *S. lanceolata*. Finally, the *H. haplostachya* population should be surveyed to determine its extent.

S. lanceolata is protected by an emergency enclosure. However, the *H. haplostachya* in the surrounding area are not. Because this is a portion of the Parker Ranch, Keamuku Parcel it is not open to public hunting. There is a large herd of ungulates that are impacting the habitat in the area. Should this parcel become part of PTA it is important for a large-scale fence unit to be constructed to protect both species and their habitat.

The construction and maintenance of fire management access roads and associated vegetation control corridors are important to prevent wildfire from impacting the IMU and is an important provision of the Biological Opinion.

2.2.5 - IMU 6

INTRODUCTION

The 105-acre *H. haplostachya* site on Pu`u Ka Pele was fenced in 1981. Management Actions during the reporting period consisted of plant surveys (Table 2.2.5-1).

Table 2.2.5-1. Summary of Management Actions conducted in IMU 6.

	Hours	Acres
Plant Survey	24	44

RARE PLANT SURVEYS AND PROTECTION

Surveys focused in areas where plants were previously recorded to delimit the distribution of the plants to better facilitate rare plant monitoring.

Table 2.2.5-2. Results of rare plant surveys conducted in IMU 6.

	Newly Recorded		Currently Known	
	Locations	Plants	Locations	Plants
<i>H. haplostachya</i>	17	114	21	127

WEED CONTROL

No weed control was conducted in this IMU due to efforts being focused on higher priority species and IMU’s.

INTRODUCED ANIMAL SURVEYS AND CONTROL

No animal surveys or control were conducted or are needed. The fence units was constructed more than 20 years a go and is ungulate free.

MANAGEMENT RECOMMENDATIONS

Weed control is needed to reduce competition and fire threat to the site. Weed control will be implemented according to species and IMU priorities.

The fire management access roads and associated vegetation control corridors are important for this IMU as discussed in the previous section.

2.2.6 - IMU 7

INTRODUCTION

IMU 7 is located within Training Area 18, east of Kīpuka Road and encompasses eight acres. Two individuals (one male and one female) of *Zanthoxylum hawaiiense* are present within the unit. The IMU boundary crosses three plant community types: *Dodonaea*-Mixed Shrubland, *Myoporum-Dodonaea* Shrubland, and Open *Dodonaea* Shrubland.

RARE PLANT SURVEYS AND PROTECTION

No plant surveys or protection were conducted during the reporting period.

WEED CONTROL

The established weed control buffers in IMU 7 encompass 1.0 acres, with a goal of visiting this IMU 3 time per year. Weed control completed totaled 3.5 acres during the reporting period. Due to the low incidence of weeds within this IMU it may be possible to reduce the trips per year to one or two.

Table 2.2.6-1 Summary of Management Actions conducted in IMU 7.

	Hours	Acres	Gallons
Spray	39	1	48.0
Weed Whacking	10	1	-

INTRODUCED ANIMAL SURVEYS AND CONTROL

No animal surveys or control were conducted during the reporting period for this species.

MANAGEMENT RECOMMENDATIONS

Continued weed control within designated *Zanthoxylum hawaiiense* buffer areas is recommended. Conduct additional plant surveys to cover the entire 8.0 acres of the IMU is also recommended.

2.2.7 - IMU 8

INTRODUCTION

The 520 acre IMU is found within the *Dodonaea* Mixed Shrubland of the Kīpuka Kālawamauna Endangered Plant Habitat. This IMU is within Training Area 19 in the northwestern portion of the Installation. Federally listed species within the IMU include *Haplostachys haplostachya* (PS-5), *Silene lanceolata* (PS-2), *Stenogyne angustifolia* (PS-5), and *Tetramolopium arenarium ssp. arenarium* (PS-1). This IMU contains the last remaining viable population of *T. arenarium ssp. arenarium*.

Management actions for the IMU and surrounding area consisted of plant surveys, emergency enclosure construction, and weed control (Table 2.2.7-1).

Table 2.2.7-1. Summary of Management Actions conducted in IMU 8.

	Hours	Acres
Plant Surveys	136	1,100
Emergency Enclosures	92	-
Weed Control	1,589	38

RARE PLANT SURVEYS AND PROTECTION

Listed species found within the IMU are impacted by ungulates through trampling and browsing of individual plants and the degradation of the habitat through trampling and browsing of common native species. From July 2004 to March 2005 the portion of the Kīpuka Kālawamauna Endangered Plant Habitat bounded by Ka Pele Road, Kīpuka Road, Old Bobcat Trail, New Bobcat Trail, Old Kona Highway, and Ke`eke`e Road was surveyed for federally listed plant species. This was an area far greater than the designated IMU. The goal was to determine the distribution of the extremely rare *T. arenarium var. arenarium* to ensure the proper management of the species. Transects in suitable habitat were spaced 50m apart and a total of 78 kilometers were surveyed. The most significant result of the surveys was the expansion of the distribution of *T. a. ssp. arenarium* and the recording of one *S. lanceolata* location (Table 2.2.7-2).

Table 2.2.7-2. Results of rare plant surveys conducted in IMU 8.

	Newly Recorded		Currently Known	
	Locations	Plants	Locations	Plants
<i>H. haplostachya</i>	2	11	7	708-813
<i>S. lanceolata</i>	1	7	1	52
<i>S. angustifolia</i>	96	448-555	247	892-1121
<i>T. a. ssp. arenarium</i>	13	84-104	27	600

T. a. ssp. arenarium and *S. lanceolata* are high priority species and are impacted by ungulates. *T. a. ssp. arenarium* is indirectly impacted by ungulates through trampling. *S. lanceolata* is directly impacted by ungulates through browsing. Therefore, locations of either species with several individuals are protected with emergency enclosures when they are found (Table 2.2.7-3).

Table 2.2.7-3. Summary of emergency exclosures constructed in IMU 8.

	Exclosures	Hours
<i>S. lanceolata</i>	1	5
<i>T. a. ssp. arenarium</i>	15	87

WEED CONTROL

This IMU was the first to have comprehensive and large-scale weed control conducted. Weed control has focused on *T. a. ssp. arenarium*. Fifty-meter weed control buffers have been established around plant locations as they are found. There are 37 acres under active weed control for *T. a. ssp. arenarium*. Over the past 2.5 years approximately 1,586 personnel hours were spent on weed control activities in this IMU. These included hand clearing around individual plants, spraying, and weed whacking (Table 2.2.7-3). To illustrate the level of effort, there are 2040 hours in a personnel year.

Table 2.2.7-3. Summary of weed control conducted in IMU 8.

	Hours	Acres	Gallons
<i>S. lanceolata</i>			
Hand Clear	16	-	-
Spray	17	1	39
<i>T. a. ssp. arenarium</i>			
Hand Clear	163	-	-
Spray	1,085	37	1764
Weed Whacking	308	37	-

As a result of weed control efforts, and improved rainfall, native species and *T. a. ssp. arenarium* are regenerating within the control area. These control efforts are vital to provide space for regeneration of native and listed species. Regeneration of non-listed native species is important for habitat restoration that will enhance regeneration of *T. a. ssp. arenarium*.

Weed control efforts are directed, in part, towards the reduction of the fire threat to this species. Although *P. setaceum* is a fire promoting species, the *Dodonaea* Mixed Shrubland in which *T. a. ssp. arenarium* is found is inherently fire prone. This vegetation type experienced devastating wildfires from the 1994 and 1999 Pu`u Anahulu/Kīpuka Kālawamauna fires.

INTRODUCED ANIMAL SURVEYS AND CONTROL

No animal surveys or control were conducted within the IMU.

MANAGEMENT RECOMMENDATIONS

Due to the positive impacts of weed control on this species the untreated perimeters of the control areas will be surveyed for *T. a. ssp. arenarium* and the control perimeters expanded to account for the any newly recorded individuals.

The completion and implementation of a fire management plan is essential for improving protection of this species from wildfire.

Large-scale fence units and the removal of ungulates is the most effective way to eliminate this impact to listed species and their habitat.

2.2.8 - IMU 9

INTRODUCTION

IMU 9 is located in Training Area 22 and is 355 acres in size. The predominant plant community is Intermediate *Metrosideros* Mixed Treeland with fringe communities including *Myoporum* Shrubland and

Sparse *Metrosideros* Treeland to Open *Metrosideros* Treeland with dense shrub understory. Table 2.2.8-1 summarizes the Management Actions during the reporting period.

Table 2.2.8-1. Summary of Management Actions conducted in IMU 9.

	Hours	Acres
Plant Surveys	103	270

RARE PLANT SURVEYS AND PROTECTION

Prior to the reporting period 20 individuals were recorded during surveys in the western portion of the IMU. Fifty-four kilometers of rare plant surveys were conducted along transects spaced at 20 meter intervals during the reporting period. Table 2.2.8-2 summarizes the results of rare plant surveys conducted within IMU 9.

Table 2.2.8-2. Results of rare plant surveys conducted in IMU 9.

	Newly Recorded		Currently Known	
	Locations	Plants	Locations	Plants
<i>Z. hawaiiense</i>	15	20	27	30

There were no *Z. hawaiiense* locations reidentified in the vicinity of two locations previously recorded by CSU. The *S. angustifolia* location previously recorded by CSU was not reidentified. The plants at this location, recorded 10-15 years ago, may have been extirpated by ungulates or age.

WEED CONTROL

No weed control was conducted.

INTRODUCED ANIMAL SURVEYS AND CONTROL

No animal surveys or control were conducted during the reporting period for this species.

MANAGEMENT RECOMMENDATIONS

Concentric circle surveys should be conducted around two locations during future management actions. *Z. hawaiiense* is a dioecious species. The sex of individual plants should be recorded during surveys or monitoring for use during seed collection.

A study is currently being designed to determine the effects of fencing, rodent control, and weed control on recruitment of *Z. hawaiiense*.

2.2.9 - IMU 10

INTRODUCTION

This IMU encompasses 11 acres northwest of Kīpuka Kālawamauna Fence Unit in Training Area 22. It is found within the Kīpuka Kālawamauna Endangered Plant Habitat. The *Dodonaea* Mixed shrubland is a naturally fire prone habitat, regardless of the presence of *P. setaceum*. It contains ample standing fuels from common native species. Management Actions in the IMU consisted of rare plant surveys (Table 2.2.9-1).

Table 2.2.9-1. Summary of Management Actions conducted in IMU 10.

	Hours	Acres
Plant Survey	60	76

RARE PLANT SURVEYS AND PROTECTION

Approximately 25 kilometers were surveyed and locations of *H. haplostachya* and *S. angustifolia* were recorded during surveys in the IMU (Table 2.2.9-2).

Table 2.2.9-2 Results of rare plant surveys conducted in IMU 10.

	Newly Recorded		Currently Known	
	Locations	Plants	Locations	Plants
<i>H. haplostachya</i>	10	24	10	24
<i>S. angustifolia</i>	20	45	22	47

WEED CONTROL

No weed control was conducted during the reporting period. Weed control effort was focused on higher priority species and IMU’s.

INTRODUCED ANIMAL SURVEYS AND CONTROL

No animal surveys and control were conducted during the reporting period. However, browse was recorded on plants found during surveys and monitoring.

MANAGEMENT RECOMMENDATIONS

Weed control should be implemented following its implementation for higher priority species. A large-scale fence unit followed by ungulate removal, as identified in the Biological Opinion, would protect listed species from ungulate damaged. Fire management assets, also identified in the Biological Opinion, would reduce the threat of fire to the listed species found in IMU 10.

2.2.10 - IMU 11

INTRODUCTION

Located west of New Bobcat Road in Training Area 22, IMU 11 is predominately Open *Metrosideros* Treeland on a pāhoehoe flow. It has a total acreage of 120 acres. *Hedyotis coriacea* and *Tetramolopium sp. I* have the highest priority in the IMU, but listed plants *Asplenium peruviana var. insulare*, *Portulaca sclerocarpa*, *Silene lanceolata*, and *Stenogyne angustifolia* are also recorded within the IMU.

Management Actions conducted in the IMU are summarized in Table 2.2.10-1.

Table 2.2.10-1. Summary of Management Actions conducted in IMU 11.

	Hours	Acres	Gallons
Plant Survey	84	86	–
Emergency Exclosures	63	–	–
Weed Control	102	10	83

RARE PANT SURVEYS AND PROTECTION

Surveys were conducted in 2003 and 2004 to locate unrecorded individuals. Surveys in 2003 covered a linear distance of approximately 33 kilometers. Surveys in 2004 were expanded and covered a linear distance of approximately 48 kilometers. Surveys were conducted beyond the IMU boundary in suitable habitat. New plants were located during surveys, monitoring, and weed control activities (Table 2.2.10-2).

Table 2.2.10-2. Results of rare plant surveys conducted in IMU 11.

	Newly Recorded		Currently Known	
	Locations	Plants	Locations	Plants
<i>A. p. var. insulare</i>	3	4	6	41
<i>H. coriacea</i>	2	2	25	27
<i>P. sclerocarpa</i>	-	-	1	1
<i>S. lanceolata</i>	2	65	3	72
<i>S. angustifolia</i>	30	58	33	68
<i>T. species 1</i>	-	-	1	28

This IMU has a sizable number of *H. coriacea* that are protected by separate and small-scale emergency exclosures. Approximately 63.5 hours have been spent building emergency exclosures in IMU 11 (Table 2.2.10-3) during the reporting period. All *H. coriacea* in IMU 11 are protected by 20 emergency exclosures, seven being built prior to the contract period.

Table 2.2.10-3. Summary of emergency exclosures constructed in IMU 11.

	Exclosures	Hours
<i>H. coriacea</i>	13	32.25
<i>T. sp. 1</i>	1	19.00
<i>S. lanceolata</i>	1	12.25

WEED CONTROL

Much of this IMU is open pāhoehoe flow that is not yet dominated by *Pennisetum setaceum*. Access is uncomplicated and weed invasion is easily managed. Weed control was conducted centering on *H. coriacea* and *T. sp. 1* in IMU 11 during 2005 (Table 2.2.10-4). Twenty-five meter weed control buffers have been established for nine of the sixteen of the *H. coriacea* locations for a total of 10 acres. The current weed control buffers were treated four times during the reporting period. Weed control was initiated late in 2005 for *T. sp. 1* and the location was treated once.

Table 2.2.10-4. Summary of weed control conducted in IMU 11.

	Hours	Acres	Gallons
<i>H. coriacea</i>			
Spray	80	10	76.5
Weed Whacking	16	10	-
<i>T. sp. 1</i>			
Spray	6	1	6.5

INTRODUCED ANIMAL SURVEYS AND CONTROL

There were no introduced animal surveys conducted during the reporting period.

MANAGEMENT RECOMMENDATIONS

Surveys in this and adjacent IMU's 19 and 20 revealed that the plants within the three IMU's form a relatively continuous distribution. The plants within the three IMU's will be managed together and the IMU's merged into IMU 11. There is additional suitable habitat outside of the IMU and further surveys have the potential to expand the known distribution of *H. coriacea* in this IMU.

Weed control buffers need to be increased by five acres to include locations that have not had weed control conducted.

The six species found in the IMU are directly or indirectly impacted by ungulates through browsing or trampling by ungulates. In addition, ungulates degrade the habitat these species depend on. Large-scale fence units are necessary for the protection of these species and their habitat.

2.2.11 - IMU 12

INTRODUCTION

IMU 12 is 31 acres split between two distinct plant communities and a majority of the IMU is within the Kīpuka Kālawamauna Fence Unit (KKFU). *Hedyotis coriacea* and *Silene lanceolata* occur in an Open *Metrosideros* Treeland with sparse understory (Shaw and Castillo 1997). *Dodonaea* Mixed Shrubland (Shaw and Castillo 1997) occurs within and outside the KKFU. *Tetramolopium arenarium ssp. arenarium* is present in this vegetation type outside the KKFU, but within an emergency enclosure. *Stenogyne angustifolia* occurs in both plant communities. *Haplostachys haplostachya* and *Silene hawaiiensis* were once believed to be located within the IMU, but are no longer known to exist.

Table 2.2.11-1. Summary of Management Actions conducted in IMU 12.

	Hours	Acres
Plant Surveys	72	73
Emergency Enclosures	12	-
Weed Control	299	32

RARE PLANT SURVEYS AND PROTECTION

Rare plant surveys within this IMU utilized the Flagless Transect Technique (PTA 2003). Ten-meter spacing between transects was used to attain complete coverage. New locations of *S. angustifolia*, *S. lanceolata*, and *T. a. ssp. arenarium* were recorded (Table 2.2.11-2). Three previously recorded *T. a. ssp. arenarium* and two *H. haplostachya* locations were not reidentified during surveys. When monitoring was to be implemented at the *S. hawaiiensis* site later in 2005 no plants were found.

Table 2.2.11-2. Summary of rare plant surveys conducted in IMU 12.

	Newly Recorded		Currently Known	
	Locations	Plants	Locations	Plants
<i>H. coriacea</i>	0	0	1	0*
<i>S. angustifolia</i>	60	248	73	295-320
<i>S. hawaiiensis</i>	0	0	1	0*
<i>S. lanceolata</i>	1	6	2	296
<i>T. a. ssp. arenarium</i>	1	1	1	1

* The only plants at the known location died, but are maintained in the database to monitor regeneration.

Protection of *S. lanceolata* and *H. coriacea* is provided by the KKFU. *H. coriacea* has an additional emergency enclosure with a three meter perimeter. An emergency enclosure with a 20 meter perimeter protects *T. a. ssp. arenarium*, found outside the KKFU.

Table 2.2.11-3. Fencing conducted in IMU 12.

	Exclosures	Hours
<i>T. a. ssp. arenarium</i>	1	12

WEED CONTROL

Weed control has expanded over the past 2.5 years and currently encompasses six acres, with a goal of visiting this IMU four times per year. During the reporting period, through repeated maintenance sprays and weed whacking, the equivalent of 32 acres has been treated. Since expansion, the annual goal has been to retreat the IMU four times per year. To date, weed control efforts have met the goal for this IMU.

Table 2.2.11-4. Summary of weed control conducted in IMU 12.

	Hours	Acres	Gallons
Hand Clearing	2	-	-
Spraying	239	6	507
Weed Whacking	58	6	-

INTRODUCED ANIMAL SURVEYS AND CONTROL

No animal surveys or control were conducted during the reporting period.

MANAGEMENT RECOMMENDATIONS

Tetramolopium arenarium ssp. arenarium has been recorded from this area prior to and following the Pu`u Anahulu/Kīpuka Kālawamauna Fires in 1994 and 1999. Surveys should be conducted to record any locations that may regenerate. In addition, the *Silene hawaiiensis* location that previously consisted of more than 100 individuals should be revisited periodically to determine if the plants regenerate. Weed control around *S. lanceolata* has been important in the regeneration of the species and common natives in this IMU and should continue.

2.2.12 - IMU 13

INTRODUCTION

IMU 13 consists of 140 acres of open *Metrosideros* Treeland. This IMU contains one of only two *Solanum incompletum* populations, a large *Silene lanceolata* population, and *Zanthoxylum hawaiiense* that is part of the plants distributed throughout the *Metrosideros* forest on the west side of PTA. Management actions conducted in the IMU are summarized in Table 2.2.12-1.

Table 2.2.12-1. Summary of Management Actions conducted in IMU 13.

	Hours	Acres
Plant Surveys	108	217
Emergency Exclosures	126	-
Rodent control	6	1
Weed Control	151	16

RARE PLANT SURVEYS AND PROTECTION

Approximately 217 acres were surveyed in IMU 13. Listed species recorded during the surveys are summarized in Table 2.2.12-2. Other species recorded included *Alphitonia ponderosa*, *Melicope hawaiiensis*, and *Pittosporum terminalioides*. Although these species are not federally listed, they are rare at PTA.

Table 2.2.12-2. Results of rare plant surveys conducted in IMU 13.

	Newly Recorded		Current Locations	
	Locations	Plants	Locations	Plants
<i>S. lanceolata</i>	17	551-553	18	561-563
<i>S. incompletum</i>	1	5	1	5

Emergency exclosures were erected around *S. incompletum* and *S. lanceolata* locations (Table 2.2.12-3). Priority was given to those locations with the greatest number of plants. The single *S. incompletum* and the largest *S. lanceolata* locations have been protected with emergency exclosures.

Table 2.2.12-3. Emergency exclosures constructed in IMU 13.

	Exclosures	Hours
<i>S. lanceolata</i>	9	116
<i>S. incompletum</i>	1	4
Species unspecified		6

WEED CONTROL

Twenty-five and fifty meter weed control buffers are maintained around *S. lanceolata* and *S. incompletum* respectively. The 6.5 acres of established weed control buffers are treated four times per year. Weed control conducted in the IMU is summarized in Table 2.2.12-4.

Table 2.2.12-4. Summary of weed control conducted in IMU 13.

	Hours	Acres	Gallons
<i>S. lanceolata</i>			
Hand clear	20	-	-
Spray	66	11	113.5
Weed whacking	17	11	-
<i>S. incompletum</i>			
Hand clear	4	-	-
Spray	35	5	136
Weed Whacking	9	5	-

INTRODUCED ANIMAL SURVEYS AND CONTROL

Rodent control was conducted around *S. incompletum*. A grid with bait stations placed 25 meters apart was established and covers approximately 1.5 acres with the goal to rebait the grid six times a year. Rodent damage has not been recorded on this species. However, a rodent control grid was put in place to ensure that no damage would occur to this extremely rare species.

Table 2.2.12-5. Summary of rodent control conducted in IMU 13.

	Hours	Acres	Pounds
<i>S. incompletum</i>	6	1.5	10.25

MANAGEMENT RECOMMENDATIONS

Once *Pennisetum setaceum* is controlled within existing 25-meter weed control buffers they should be expanded by ten meters until a buffer of 50 meters is achieved. Survey of the surrounding area will continue to further determine the distribution of listed species so that management actions can be properly prioritized and implemented. Ungulates continue to degrade the habitat of these listed species. Large-scale fencing is needed to prevent damage to listed species and their habitat. *Z. hawaiiense* regeneration is also impacted by rodents. Studies previously discussed to determine the management actions needed to encourage regeneration of the species may be useful in this IMU.

2.2.13 - IMU 14 and 15

INTRODUCTION

IMU’s 14 and 15 were designated for the management of two and one *Neraudia ovata*, respectively. They are managed in conjunction. Originally, these IMU’s was thought to fall within PTA’s boundary. During the reporting period the PTA boundary was correctly identified. The IMU is actually found on State lands within the Pu`u Anahulu Game Management Area just west of the PTA boundary. The PTA Natural Resources Office has invested a significant effort in the protection of the species in the IMU and will continue to manage the IMU. Management Actions are summarized in Table 2.2.13-1.

Table 2.2.13-1. Summary of Management Actions conducted in IMU 14 and 15.

	Hours	Acres
Plant Surveys	66	88
Emergency Exclosures	30	-
Rodent Control	37	1
Weed Control	166	5

RARE PLANT SURVEYS AND PROTECTION

In 2005, 88 acres were surveyed and a total of ninety transects was completed. Listed species found during surveys are summarized in Table 2.2.13-2. During the surveys *Alphitonia ponderosa*, *Melicope hawaiiensis*, and *Pittosporum terminalioides* were recorded. Although these species are not federally listed, they are rare at PTA.

Table 2.2.13-2 Results of rare plant surveys conducted in IMU 14 and 15.

	Newly Recorded		Current Locations	
	Locations	Plants	Locations	Plants
<i>N. ovata</i>	1	13	3	21
<i>P. sclerocarpa</i>	2	3	3	5

Thirty hours we spent to erect emergency exclosures around two *N. ovata* locations found during the reporting period. The construction of a ten acre fence unit was funded by the U.S. Fish and Wildlife Service to protect the original two *N. ovata* locations.

Table 2.2.13-3. Fencing conducted in IMU 14.

	Exclosures	Hours
<i>N. ovata</i>	2	30

WEED CONTROL

Weeds are controlled in approximately five acres surrounding the *N. ovata* that are found at three disjunct locations. Weed control efforts are summarized in Table 2.2.13-4.

Table 2.2.13-4. Summary of weed control conducted in IMU's 14 and 15.

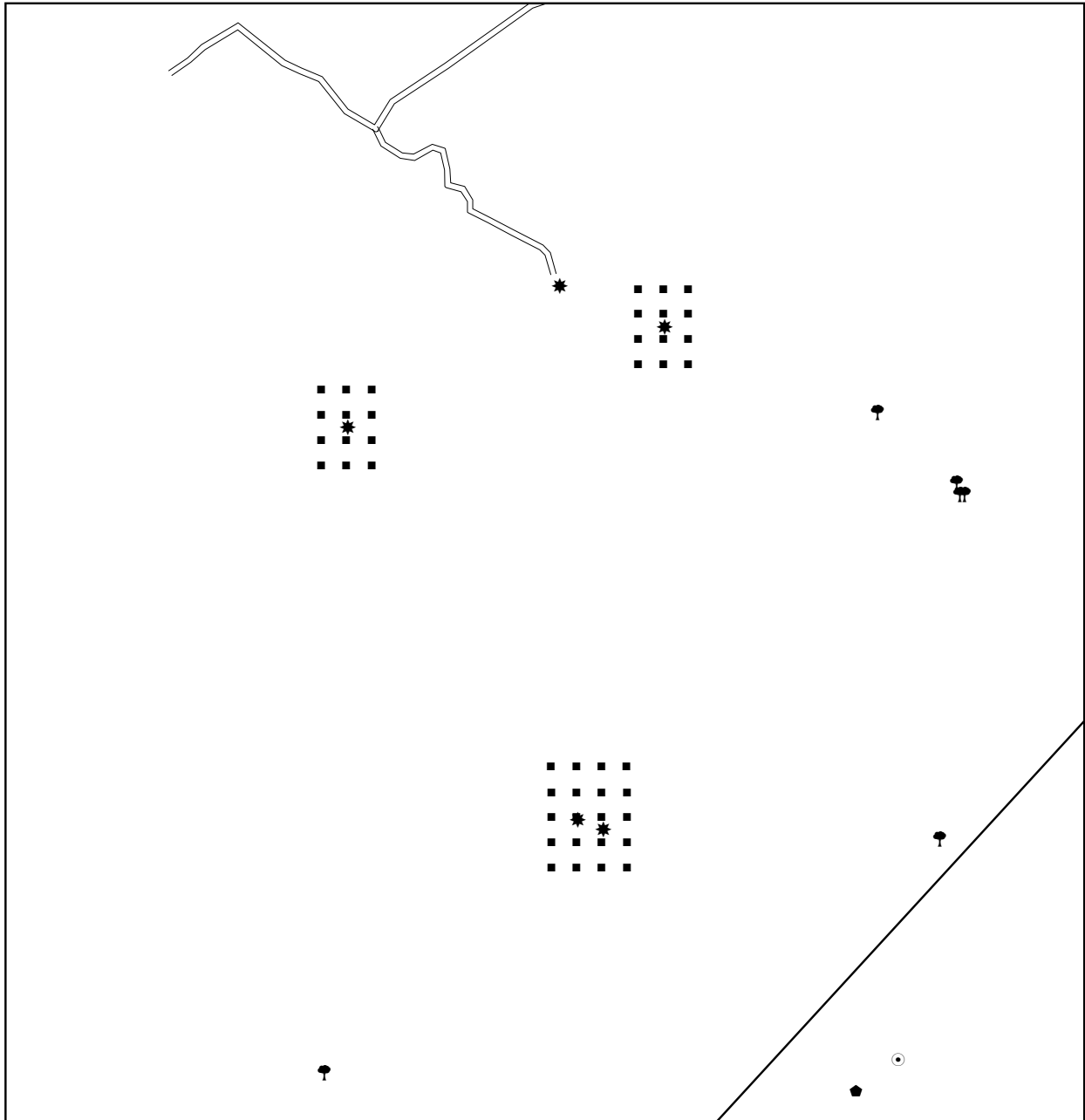
	Hours	Acres	Gal.
Hand clear	8	-	-
Spray	120	5	232
Weed Whacking	38	5	-

INTRODUCED ANIMAL SURVEYS AND CONTROL

Rodent control was expanded in 2005. Three rodent control grids were established for all live *N. ovata* in the IMU's. The control grids protect approximately four acres. The goal was to rebait the rodent control grids six times a year. In 2005, the area was visited eight times specifically to re-bait the boxes.

Table 2.2.13-5. Summary of rodent control conducted in IMU's 14 and 15.

	Hours	Acres	Pounds
Rodent Control	37	4	128



Rodent Control

- Rodent Bait Boxes

Plant Locations

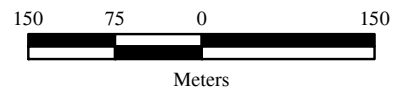
- * *Neraudia ovata*
- ◆ *Portulaca sclerocarpa*
- ⊙ *Tetramolopium sp. 1*
- 🌳 *Zanthoxylum hawaiiense*

- ▭ Fence
- == Fire Break trails

Figure 2.2.13-1

IMUs 14 and 15 Rodent Control
Bait Box Grid

Scale 1: 6,250



WEED CONTROL

Weeds are controlled in approximately five acres surrounding the *N. ovata* that are found at three disjunct locations. Weed control efforts are summarized in Table 2.2.13-6.

Table 2.2.13-6. Summary of weed control conducted in IMU's 14 and 15.

	Hours	Acres	Gallons
Hand clear	7.75	-	-
Spray	120	5	232
Weed Whacking	38	5	-

INTRODUCED ANIMAL SURVEYS AND CONTROL

No introduced animal surveys or control were conducted during the reporting period.

MANAGEMENT RECOMMENDATIONS

IMU's 14 and 15 were originally identified when only two *N. ovata* locations were known and the IMU's were centered on them. The IMU's should be merged and redrawn to incorporate a newly recorded plant location, outplanting efforts, and construction of a ten acre fence unit. The plant locations and the fence unit should be managed together. Only one of the three locations is protected by a permanent fence unit. Two additional 10-acre fence units should be constructed around the other locations that are currently protected by emergency exclosures. Coordination with the USFWS for funding and State offices for fence construction will be required if the fence units are to be constructed.

2.2.14 - IMU 16 and 17

INTRODUCTION

IMU's 16 and 17 are 42 acres located within an Open *Dodonaea* Shrubland inside the Kīpuka Kālawamauna Fence Unit (KKFU). *Silene lanceolata* is the species of highest priority in this IMU. *Haplostachys haplostachya* and *Stenogyne angustifolia* also occur within the IMU. Monitoring has recently begun for *H. haplostachya*.

Table 2.2.14-1. Summary of Management Actions conducted in IMU's 16 and 17.

	Hours	Acres
Plant Surveys	47	43
Weed Control	449	53

RARE PLANT SURVEYS AND PROTECTION

Rare plant surveys within this IMU utilized the Flagless Transect Technique (PTA 2003). Ten meter spacing between transects was used to attain complete coverage. Results of the surveys included eight new locations of *S. lanceolata* totaling approximately 100 individuals and 181 locations of *H. haplostachya* totaling 7,254 individuals. Old population data on *H. haplostachya* showed 29 populations of 1,854 individuals. The old survey data had few data points that were not specific in the amount of area or the number of plants they represented. To avoid confusion and data overlap, the current population is based entirely upon the more precise data of the 2005 surveys. *S. angustifolia* occurs in only two locations within this IMU, suggesting the site contains suitable habitat, though the species is not common. Protection for these *S. angustifolia* locations is provided by the KKFU.

Table 2.2.14-2. Results of rare plant surveys conducted in IMU's 16 and 17.

	Newly Recorded		Currently Known	
	Locations	Plants	Locations	Plants
<i>H. haplostachya</i>	181	6358-7358	207	7660-9180
<i>S. lanceolata</i>	7	78	9	1,097
<i>S. angustifolia</i>	1	1	1	1

WEED CONTROL

Weed control has been expanded over the past 2.5 years and currently encompasses 14 acres. During the reporting period, through repeated maintenance spraying and removal of dead material, the equivalent of 53 acres has been treated. A total of 449 hours was spent on weed control during the reporting period. The annual goal has been to retreat the IMU four times per year. This IMU is our leading example of the benefits a plant community can reclaim when weed control is maintained. The results are substantial when compared to surrounding areas where there is no weed control.

Table 2.2.14-3. Summary of weed control conducted in IMU's 16 and 17.

	Hours	Acres	Gallons
<i>H. haplostachya</i>			
Hand Clear	10	-	-
<i>S. lanceolata</i>			
Hand clear	53	-	-
Spray	286	43	446
Weed Whacking	110	10	-

INTRODUCED ANIMAL SURVEYS AND CONTROL

No animal surveys or control were conducted during the reporting period.

MANAGEMENT RECOMMENDATIONS

Continue weed control and population monitoring for the listed species in this IMU. Additionally, rare plant surveys should be conducted to the north and west of Old Bobcat Trail where the plant community is similar and locations were previously recorded.

2.2.15 - IMU 18

INTRODUCTION

IMU 18 is located in TA 22 inside the Kīpuka Kālawamauna Fence Unit and is primarily a Sparse *Metrosideros* Treeland with native shrub understory. This IMU was created primarily for *Hedyotis coriacea* and *Silene lanceolata*, but *Haplostachys haplostachya*, *Silene hawaiiensis* and *Stenogyne angustifolia* are also present. Management actions began in 2003 and are summarized in Table 2.2.16-1.

Table 2.2.15-1. Summary of Management Actions conducted in IMU 18.

	Hours	Acres
Plant Surveys	87	175
Weed Control	177	7.7

RARE PLANT SURVEYS AND PROTECTION

Approximately 175 acres and 54.5 kilometers of transects were surveyed for rare plants. Seventeen of the total hours were spent surveying old CSU *Hedyotis coriacea* locations using a concentric circle search method. Total area covered surveying for *H. coriacea* was 23 acres for a linear distance of 9 kilometers. Species located during the plant surveys were *H. coriacea*, *S. lanceolata*, and *S. angustifolia*. All new plant locations were within the KKFU so additional fencing was not necessary.

Table 2.2.15-2. Results of rare plant surveys conducted in IMU 18.

	Newly Recorded		Currently Known	
	Locations	Plants	Locations	Plants
<i>H. coriacea</i>	4	4	5	5
<i>S. lanceolata</i>	1	12	5	1,494
<i>S. angustifolia</i>	78	146-185	91	189-245

WEED CONTROL

Twenty-five meter weed control buffers have been established for all *H. coriacea* and *S. lanceolata* locations. Weed control work in this area was first conducted in early 2003 prior to the reporting period and is one of the oldest control areas at PTA. Total area under control for both species is 6 acres. Weed control included hand clearing around individuals, spraying herbicide, and weed whacking. The area was retreated twice a year during the reporting period, meeting the weed control goals for the IMU. The success of weed control efforts has resulted in the decrease in time for retreatment and area retreated.

Table 2.2.15-3. Summary of weed control conducted in IMU 18.

	Hours	Acres	Gallons
<i>H. coriacea</i>			
Spray	36	2.5	51.5
Weed Whacking	20	2.5	-
<i>S. lanceolata</i>			
Hand Clear	2	-	-
Spray	113	5.2	184
Weed Whacking	6	5.2	-

INTRODUCED ANIMAL SURVEYS AND CONTROL

No introduced animal surveys or control was conducted within this IMU.

MANAGEMENT RECOMMENDATIONS

Maintenance of the weed control buffers should continue. The frequency will be reduced to one treatment per year.

2.2.16 - IMU 19 and 20

INTRODUCTION

These IMU's are located on the southern boundary of the Kīpuka Kālawamauna Fence Unit (KKFU). IMU's 19 and 20 were originally established separately, however, they are managed together. These two IMU's are 7.6 and 7.4 acres respectively. They were originally established to manage three *H. coriacea* individuals. Surveys of suitable habitat in the surrounding area identified several more plant locations (Table 2.2.16-2). The proximity of *H. coriacea* sites within these IMU's to those of IMU 11 forms a continuous distribution. *Portulaca sclerocarpa* and *Stenogyne angustifolia* are also found within this

IMU. There is one old *Haplostachys haplostachya* point recorded by CSU that has not been reconfirmed. Outplanting site KKOP03 is discussed in section 3.7.

Table 2.2.16-1. Summary of Management Actions conducted in IMU's 19 and 20.

	Hours	Acres	Gallons
Plant Survey	96	148	–
Emergency Exclosures	16	–	–
Weed Control	60	7.5	47.5
Seed Collection	4	–	–

RARE PANT SURVEYS AND PROTECTION

Surveys were conducted in October 2004. Approximately 38 acres and 15.5 kilometers of transects were surveyed. An additional 145 acres and 59 kilometers of transects outside the KKFU were surveyed between December 2004 and February 2005. New plants were located during surveys as well as during monitoring and weed control activities (Table 2.2.16-2).

Table 2.2.16-2. Results of rare plant surveys conducted in IMU's 19 and 20.

	Newly Recorded		Currently Known*	
	Locations	Plants	Locations	Plants
<i>H. coriacea</i>	7	7	9	10
<i>P. sclerocarpa</i>	1	2	1	2
<i>S. angustifolia</i>	6	19	8	22

*Currently known locations and plants includes data from surveys and monitoring.

Approximately sixteen personnel hours were spent to erect emergency exclosures around the newly recorded *H. coriacea*.

WEED CONTROL

These IMU's are on an open pāhoehoe flow that is not yet dominated by *Pennisetum setaceum*. Twenty-five meter weed control buffers were established around each *H. coriacea*. The IMU's were treated twice in 2005. The *P. setaceum* in this area is sparse and has a low impact on competition and fuel loads. Therefore, the area was not followed up with weed whacking.

Table 2.2.16-3. Summary of weed control conducted in IMU's 19 and 20.

	Hours	Acres	Gallons
Spray	60	7.5	47.5

INTRODUCED ANIMAL SURVEYS AND CONTROL

There were no introduced animal surveys conducted during the reporting period.

MANAGEMENT RECOMMENDATIONS

Surveys of suitable habitat should be conducted identify the complete distribution of *H. coriacea*.

The IMU's 19, and 20 should be merged into IMU 11 and the plants managed a single distribution. *H. coriacea* and the other species recorded in the IMU are impacted by ungulates. Large-scale fence units are necessary for the protection of listed species and their habitat.

2.2.17 - IMU 21

INTRODUCTION

Located west of New Bobcat Trail in Training Area 22, this IMU is predominantly Open *Metrosideros* Treeland on a pāhoehoe flow. *Hedyotis coriacea* is the main focus of management, but *Stenogyne angustifolia* is also present. Management Actions conducted in IMU 21 are summarized in Table 2.2.17-1.

Table 2.2.17-1. Summary of Management Actions conducted in IMU 21.

	Hours	Acres	Gallons
Plant Survey	26	64	-
Emergency Exclosures	3.5	-	-
Weed Control	36	4	18

RARE PLANT SURVEYS AND PROTECTION

Twenty-one kilometers of transects were surveyed in February of 2005 covering an area of 52 acres. Survey results are reported in Table 2.2.17-2.

Table 2.2.17-2. Results of plant surveys conducted in IMU 21.

	Newly Recorded		Currently Known	
	Locations	Plants	Locations	Plants
<i>H. coriacea</i>	1	1	8	9
<i>S. angustifolia</i>	3	4	3	4

Approximately 3.5 hours were expended to erect one emergency exclosure for the newly recorded *H. coriacea*. Emergency exclosures total four, with three being constructed prior to the contract period.

WEED CONTROL

Much of this IMU is open pāhoehoe flow that is not yet dominated by *Pennisetum setaceum*. Weed invasion is easily managed. Twenty-five meter weed control buffers have been established for *H. coriacea* in this IMU. The current area identified for active weed management is two acres to be treated twice per year. *P. setaceum* in this area is sparse and has a low impact on competition and fuel loads and was not cut following spraying.

Table 2.2.17-3. Summary of weed control conducted in IMU 21.

	Hours	Acres	Gallons
Spray	36	2	18

INTRODUCED ANIMAL SURVEYS AND CONTROL

There were no introduced animal surveys or control conducted during the reporting period.

MANAGEMENT RECOMMENDATIONS

Because suitable habitat exists beyond areas already surveyed, surveys should be expanded to determine the distribution of *H. coriacea* in the area. The most recent surveys recorded only one new *H. coriacea* and this location does not support a large population of rare plants. Therefore, expansion of surveys has a lower priority in this area than others.

P. setaceum is easily controlled in this area. Maintenance sprays in the IMU should be conducted once per year.

H. coriacea in the IMU are protected only by emergency exclosures. Large-scale fence units are needed to protect the species and its habitat from the negative impacts of ungulates.

2.2.18 - IMU 22

INTRODUCTION

Located in the Charlie Circle area in Training Area 22, this IMU is predominantly Open *Metrosideros* Treeland on a pāhoehoe flow. No other listed species other than *H. coriacea* are recorded within this IMU. Management Actions in the IMU consisted of plant surveys, fencing, and weed control (Table 2.2.18-1).

Table 2.2.18-1. Summary of Management Actions conducted in IMU 22.

	Hours	Acres	Gallons
Plant Survey	15	50	–
Emergency Exclosures	1.5	–	–
Weed Control	28	3	18

RARE PLANT SURVEYS AND PROTECTION

Twenty kilometers of transects were surveyed in February 2005 covering an area of 50 acres. Survey results are summarized in Table 2.2.18-2.

Table 2.2.18-2. Results of rare plants surveys conducted in IMU 22.

	Newly Recorded		Currently Known	
	Locations	Plants	Locations	Plants
<i>H. coriacea</i>	1	1	5	5

One emergency exclosure was erected in 2005 to protect the newly recorded plant. Approximately 1.5 hours were expended in its construction. All known plants are protected by five emergency exclosures, with four being constructed prior to the contract period.

WEED CONTROL

Much of this IMU is open pāhoehoe flow that is not yet dominated by *P. setaceum* and weed invasion is easily managed. In 2005, 25 meter weed control buffers were established around all known *H. coriacea* locations. The IMU was treated twice in 2005. Weeds in this area are sparse and have low impact on competition and fire fuel load. Therefore, the weed control buffers were not followed up with weed whacking.

Table 2.2.18-3. Summary of weed control conducted in IMU 22.

	Hours	Acres	Gallons
Spray	28	3	18

INTRODUCED ANIMAL SURVEYS AND CONTROL

There were no introduced animal surveys or control conducted during the reporting period.

MANAGEMENT RECOMMENDATIONS

Habitat suitable to support *H. coriacea* extends beyond the area surveyed and is recommended for future surveys. However, additional surveys in this area are not a high priority as only one *H. coriacea* was found during the most recent survey.

Due to the sparse cover of *P. setaceum* weed control can be conducted on an annual basis.

H. coriacea is heavily impacted by ungulates. Large-scale fence units, as identified in the 2003 Biological Opinion (USFWS 2003), are necessary for the long term protection of the species.

2.2.19 - IMU 23

INTRODUCTION

IMU 23 is located in Training Area 22 and has an area of 227 acres. The predominant plant community types are Intermediate *Metrosideros* Mixed Treeland and Open *Metrosideros* Treeland with sparse shrub understory. Sparse *Metrosideros* Treeland and *Myoporum-Dodonaea* Shrubland are present within the IMU to a lesser degree.

Table 2.2.19-1. Summary of Management Actions conducted in IMU 23.

	Hours	Acres
Plant Surveys	41	143

RARE PLANT SURVEYS AND PROTECTION

Surveys transects were spaced at 20 meter intervals. Thirty-one individuals of *Zanthoxylum hawaiiense* were located bringing the total to 33 confirmed individuals in IMU 23 (Table 2.2.19-2).

Table 2.2.19-2 Results of rare plant surveys conducted in IMU 23.

	Newly Recorded		Currently Known	
	Locations	Plants	Locations	Plants
<i>Z. hawaiiense</i>	28	31	30	33

Previously collected data from Colorado State University indicates 18 additional *Zanthoxylum hawaiiense* and one *Stenogyne angustifolia* location within the boundaries of the IMU.

WEED CONTROL

No weed control was conducted during the reporting period.

INTRODUCED ANIMAL SURVEYS AND CONTROL

No animal surveys or control were conducted during the reporting period.

MANAGEMENT RECOMMENDATIONS

An additional 173 acres within and surrounding the western portion of the IMU will be surveyed to verify previously recorded locations and to locate new individuals. This will complete the surveys for the entire IMU.

A study is currently being designed to determine the effects of fencing, rodent control, and weed control on recruitment of *Z. hawaiiense*.

2.2.20 - IMU 24

INTRODUCTION

IMU 24 is located in Training Area 22 on the western boundary of PTA east of the 1859 lava flow. The IMU is in Open *Metrosideros* Treeland with sparse shrub understory with kīpuka of *Myoporum* shrubland

and *Myoporum-Dodonaea* shrubland. IMU 24 consists of 87 acres of habitat in these plant communities. Rare plant species present within the IMU are *Neraudia ovata*, *Portulaca sclerocarpa*, *Solanum incompletum*, and *Zanthoxylum hawaiiense*.

Table 2.2.20-1. Summary of Management Actions conducted in IMU 24.

	Hours	Acres
Plant Surveys	129	239
Emergency Exclosures	58	-
Weed Control	531	14
Rodent Control	270	27

RARE PLANT SURVEYS AND PROTECTION

In response to finding an additional *N. ovata* location during management actions on the western `a`ā flow in IMU 24, surveys were conducted in June 2004 to cover an area of 15 acres between *N. ovata* locations 0105 and 0119. Four new *N. ovata* locations were found as a result of these surveys. In addition, rare plant surveys using the Flagless Transect Survey method (PTA, 2003) were conducted in late 2004 and early 2005 and covered an area of 124 acres. Total linear distance surveyed was 26 kilometers. New locations and individuals of *N. ovata*, *P. sclerocarpa*, *S. incompletum*, and *Z. hawaiiense* were found (Table 2.2.20-2).

Table 2.2.20-2. Results of rare plant surveys conducted in IMU 24.

	Newly Recorded		Currently Known	
	Locations	Plants	Locations	Plants
<i>N. ovata</i>	14	79	23	115
<i>P. sclerocarpa</i>	3	4	5	2*
<i>S. lanceolata</i>	1	6	1	6
<i>S. incompletum</i>	2	21	9	75
<i>Z. hawaiiense</i>	7	7	10	11

*Two of the five locations were not monitored.

Protection for newly recorded individuals of *N. ovata*, *S. lanceolata*, and *S. incompletum* included 58 personnel hours of constructing emergency exclosures around individual plants or clusters of plants.

Emergency exclosures for *N. ovata* now total 18, with nine erected prior to the contract period.

Emergency exclosure for *S. incompletum* now total 8, with 6 erected prior to the contract period.

Table 2.2.20-3. Fencing conducted in IMU 13.

	No. Exclosures	Hours
<i>N. ovata</i>	2	47
<i>S. incompletum</i>	2	2
Unspecified species		9

WEED CONTROL

All known individuals of *N. ovata* and *S. incompletum* have weed control buffers with active weed control by hand, mechanical, and chemical methods (Table 2.2.20-3). Weed control has been expanded over the past 2.5 years and currently encompasses sixteen acres.

Table 2.2.20-4. Summary of weed control conducted in IMU 24.

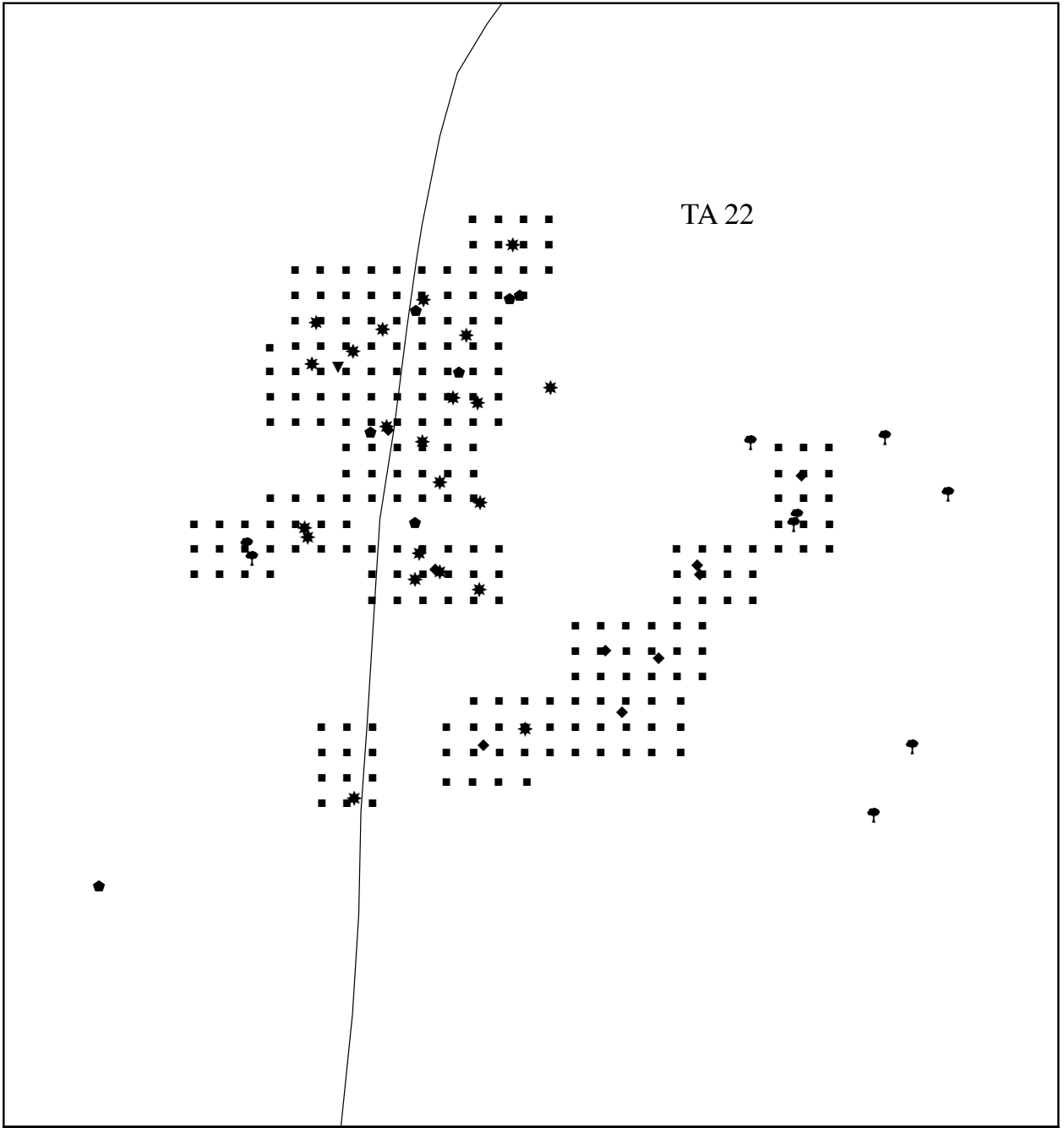
	Hours	Acres	Gallons
<i>N. ovata</i>			
Hand Clear	43	-	-
Spray	158	11	267
Weed Whacking	10	11	-
<i>S. incompletum</i>			
Hand Clear	22	-	-
Spray	97	3	171.5
Weed Whacking	31	3	-
Unspecified species			
Hand Clear	74	-	-
Spray	96	-	117

INTRODUCED ANIMAL SURVEYS AND CONTROL

An extensive rodent control grid was established to protect the *N. ovata* and *S. incompletum* populations in November 2004 to decrease the rodent population that was causing severe damage to juvenile *N. ovata*. Rodents were gnawing away at the base of the stems of the *N. ovata* juveniles to obtain water. The plants were being felled as a result of the damage. It seemed prudent to include *S. incompletum* in the grid due to the damage to *N. ovata*. Initially, the rodent control grid consisted of 260 bait stations placed 25 meters apart. Once the rodent population was no longer impacting *N. ovata* the grid was strategically reduced to 175 bait stations and the equivalent of four blocks are maintained in the bait stations on a bi-monthly schedule. Currently, there are 175 bait boxes in IMU 24. The rodent control grid was rebaited ten times since the initiation of control.

Table 2.2.20-5. Summary of rodent control conducted in IMU 24.

	Hours	Acres	Pounds
<i>N. ovata</i>	126.0	19.0	332
<i>S. incompletum</i>	29.0	8.0	142



TA 22

Rodent Control

- Rodent Bait Boxes

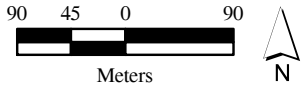
Plant Locations

- * *Nerandia ovata*
- *Portulaca sclerocarpa*
- ▼ *Silene lanceolata*
- ◆ *Solanum incompletum*
- ♣ *Zanthoxylum hawaiiense*

Figure 2.2.20-1

IMU 24 Rodent Control
Bait Box Grid

Scale 1 : 6,000



MANAGEMENT RECOMMENDATIONS

Due to the remote location of IMU 24, the current weed control goal of treating sixteen acres six times a year needs to be re-evaluated. Management Actions are conducted during camping trips. Personnel and equipment are flown in by helicopter. Logistical and weather factors frequently preclude conducting a maintenance spray of the entire weed control perimeters. In addition, differences in previous control effort and vegetation types allow for weed control efforts to be reprioritized. Plant locations on the less vegetated `a`ā flow will be treated every four months, or three times per year. Plant locations within the kīpuka where there is a greater density of weeds will be treated every two months, or six times per year.

A heavy infestation of *Pennisetum setaceum* occurs in the *Myoporum-Dodonaea* Shrubland of IMU 24. A high fire threat exists in this area due to several past drought years followed by two recent years of higher precipitation. Plans for a 29 acre fire break within this habitat type are being discussed. Hours previously allocated to maintenance spray within the weed control buffers could be used for maintenance within the new fire break boundaries.

Rodent control is necessary to prevent the type of damage to the young plants as was seen in 2004. Bait stations will need to be maintained at four blocks per station and the stations checked every two months to ensure the rodent population doesn't increase.

Survey for *Zanthoxylum hawaiiense* in the Open *Metrosideros* Treeland habitat in three square kilometers surrounding the current boundary of IMU 24 will be conducted during 2006.

A study is currently being designed to determine the effects of fencing, rodent control, and weed control on recruitment of *Z. hawaiiense*.

2.2.21 - IMU 25

INTRODUCTION

IMU 25 is 228 acres in size and located in Training Area 22 in an Intermediate *Metrosideros* Mixed Treeland. Federally listed species in IMU 25 include *Zanthoxylum hawaiiense*, *Silene lanceolata*, and *Stenogyne angustifolia*.

Table 2.2.21-1. Summary of Management Actions conducted in IMU 25.

	Hours	Acres
Plant Survey	81	247

RARE PLANT SURVEYS AND PROTECTION

In 2005 approximately 50 kilometers of transects spaced at 20 meter intervals were surveyed. Table 2.2.21-2 summarizes the survey results.

Table 2.2.21-2. Results of rare plants surveys conducted in IMU 25.

	Newly Recorded		Currently Known	
	Locations	Plants	Locations	Plants
<i>S. lanceolata</i>	4	177	4	177
<i>S. angustifolia</i>	5	13	5	13
<i>Z. hawaiiense</i>	31	46	37	52

Two attempts were made to reidentify the single *Portulaca sclerocarpa* location recorded on a previous Colorado State University survey. Four personnel hours were expended and the location was not reidentified. During the surveys of the IMU *Pittosporum terminalioides*, *Exocarpos gaudichaudii*, and *Festuca hawaiiensis* were found. Although these species are not federally listed, they are rare at PTA and their locations are recorded when found.

WEED CONTROL

No activity conducted.

INTRODUCED ANIMAL SURVEYS AND CONTROL

No activity conducted.

MANAGEMENT RECOMMENDATIONS

A study is currently being designed to determine the effects of fencing, rodent control, and weed control on recruitment of *Z. hawaiiense*.

2.2.22 - IMU 26

INTRODUCTION

IMU 26 is located in Training Area 22 and covers an area of 244.6 acres. The plant community types within the IMU are Intermediate *Metrosideros* Mixed Treeland and Open *Metrosideros* Treeland with sparse shrub understory. Rare plants present within IMU 26 are *Stenogyne angustifolia* and *Zanthoxylum hawaiiense*.

Table 2.2.22-1. Summary of Management Actions conducted in IMU 26.

	Hours	Acres
Plant Surveys	85	306
Rodent Control	332	12

RARE PLANT SURVEYS AND PROTECTION

Transects surveyed in April 2004 were spaced 20 meters apart and covered a distance of 62 kilometers.

Table 2.2.22-2. Results of rare plants surveys conducted in IMU 26.

	Newly Recorded		Currently Known	
	Locations	Plants	Locations	Plants
<i>S. angustifolia</i>	1	1	1	1
<i>Z. hawaiiense</i>	60	70	60	70

WEED CONTROL

No activity conducted.

INTRODUCED ANIMAL SURVEYS AND CONTROL

Bait station grids were established in IMU 26 during this reporting period as part of a rodent control study. Effort is summarized in Table 2.2.22-3. The rodent control study conducted in the IMU is discussed in 5.2.5.

Table 2.2.22-3. Summary of rodent control in IMU 26.

	Hours	Acres	Pounds
<i>Z. hawaiiense</i>	331.5	279	437

MANAGEMENT RECOMMENDATIONS

Additional surveys are planned for 2006 to complete surveys of the Intermediate *Metrosideros* Mixed Treeland community shared by IMU's 23, 25, and 26. Additional *Zanthoxylum hawaiiense* found in the

northwest portion of the community may require dissolving the current boundaries of the IMU's mentioned above and designating the boundaries of the *Metrosideros* Mixed Treeland plant community as a management unit.

A study is currently being designed to determine the effects of fencing, rodent control, and weed control on recruitment of *Z. hawaiiense*.

2.2.23 - IMU 27

INTRODUCTION

IMU 27 encompasses 230 acres southwest of IMU's 25 and 26 on the adjoining Open *Metrosideros* Treeland with sparse shrub understory in Training Area 22. Locations for *Silene lanceolata*, *Stenogyne angustifolia*, and *Zanthoxylum hawaiiense* have been recorded in IMU 27.

Table 2.2.23-1. Summary of Management Actions conducted in IMU 27.

	Hours	Acres
Plant Survey	34	269
Weed Survey	34	119

RARE PLANT SURVEYS AND PROTECTION

Approximately 54 kilometers of transects spaced 20 meters apart were surveyed in April 2005. Plants recorded during surveys are summarized in Table 2.2.23-2. One *Z. hawaiiense* was located in 2004. Data for two locations of *Stenogyne angustifolia* in IMU 27 were recorded on previous Colorado State University surveys. However, no locations were recorded during recent surveys. Plants may have been extirpated due to age or ungulates.

Table 2.2.23-2 Results of rare plants surveys conducted in IMU 27.

	Newly Recorded		Currently Known	
	Locations	Plants	Locations	Plants
<i>S. lanceolata</i>	8	65	8	65
<i>Z. hawaiiense</i>	19	19	22	23

WEED CONTROL

Kalanchoe tubiflora is a management concern because of its invasive nature. It is currently being controlled in IMU 24 to the northwest of this IMU. Two locations of *K. tubiflora* were observed in IMU 27 during rare plant surveys in April 2005. Concern for its spread throughout similar habitat prompted surveys to determine its distribution in IMU 27. Transects at 60 meter intervals were surveyed to map locations of this species within the IMU. Twenty-four kilometers of transects were surveyed which covered approximately 119 acres. Two additional locations of *K. tubiflora* were found during the surveys. All known locations were treated with herbicide.

INTRODUCED ANIMAL SURVEYS AND CONTROL

No activity conducted.

MANAGEMENT RECOMMENDATIONS

The need for additional surveys in IMU 27 will be evaluated. Due to the small habit of the plant and its tendency to camouflage with the terrain, tighter survey lines will allow for better representation of the distribution of *K. tubiflora* within the IMU. The need for a species specific weed control program for *K. tubiflora* at PTA will be determined in the future.

Additional plant surveys are planned for 2006 in the Open *Metrosideros* Treeland north of IMU 27 and south of IMU 24 to determine the distribution of *Z. hawaiiense* in this area.

2.2.24 - IMU 28

INTRODUCTION

IMU 28 is a single population of *Portulaca sclerocarpa* located on the edge of a Sparse *Metrosideros* Treeland (Shaw and Castillo 1997) in the southernmost section of Training Area 22 near Training Area 23.

Table 2.2.24-1. Summary of Management Actions conducted in IMU 28.

	Hours
Plant Surveys	1

RARE PLANT SURVEYS AND PROTECTION

Results of the rare plant surveys are summarized in Table 2.2.24-2. No other species were recorded. The IMU was established for the *P. sclerocarpa* location and no other listed species were recorded. The low number of plants at the location may be due to ungulates.

Table 2.2.24-2. Results of rare plants surveys conducted in IMU 28.

	Currently Known	
	Locations	Plants
<i>P. sclerocarpa</i>	1	1

WEED CONTROL

No weed control activity was conducted due to the lack of weed species.

INTRODUCED ANIMAL SURVEYS AND CONTROL

No animal surveys or control were conducted during the reporting period.

MANAGEMENT RECOMMENDATIONS

Monitor the population on an annual basis. An emergency exclosure should be erected to eliminate the threat of ungulate browse. This IMU should be merged with and the *P. sclerocarpa* managed as part of IMU 29.

2.2.25 - IMU 29

INTRODUCTION

Located west of the Kīpuka `Alalā Fence Unit in Training Area 23, IMU 29 is predominantly Open *Metrosideros* Treeland. It has a total of 240 acres. *Hedyotis coriacea* is the management priority in this IMU; also recorded within the IMU are the listed species *Portulaca sclerocarpa*, *Silene hawaiiensis*, *Stenogyne angustifolia* and *Zanthoxylum hawaiiense*.

Table 2.2.25-1. Summary of Management Actions conducted in IMU 29.

	Hours	Acres
Plant Survey	232	375
Emergency Exclosures	10	-

RARE PLANT SURVEYS AND PROTECTION

IMU 29 supports two *H. coriacea* sites. Surveys were conducted from December 2004 to January 2005 covering approximately 152 kilometers were surveyed covering approximately 375 acres. New plants were recorded during surveys as well as during monitoring and weed control activities (Table 2.2.25-2). As a result of surveys in the vicinity of IMU’s 29 and 30, it was found that the distribution of *H. coriacea* is nearly continuous between the two IMU’s. Two CSU recorded locations for *Z. hawaiiense* lie in the area surveyed; however they were not reidentified during surveys.

Table 2.2.25-2. Results of rare plant surveys conducted in IMU 29.

	Newly Recorded		Currently Known	
	Locations	Plants	Locations	Plants
<i>H. coriacea</i>	7	7	12	13
<i>P. sclerocarpa</i>	1	1	3	4
<i>S. hawaiiensis</i>	1	1	8	86
<i>S. angustifolia</i>	2	2	2	2
<i>Z. hawaiiensis</i>	0	0	1	1

Ten hours were expended erecting ten emergency exclosures around newly recorded *H. coriacea*. All known *H. coriacea* plants are protected with emergency exclosures.

WEED CONTROL

Access to this IMU is over rough `a`ā making management of the IMU difficult. No weed control has been implemented in this IMU. *P. setaceum* infestation is low in this IMU and is of lower priority compared to other IMU’s.

INTRODUCED ANIMAL SURVEYS AND CONTROL

No introduced animal surveys or control was conducted during the reporting period.

MANAGEMENT RECOMMENDATIONS

Ungulates are a threat to all the species recorded in the IMU. Emergency exclosures have been erected to protect individual or small clusters of *H. coriacea*. This is a temporary measure and large-scale fence units must be constructed to protect other species and their habitat.

2.2.26 - IMU 30

INTRODUCTION

Located on the northern boundary of the Kīpuka `Alalā Fence Units in Training Area 23, the vegetation type in this IMU is predominantly Open *Metrosideros* Treeland on a pāhoehoe flow and encompasses 42 acres. *Hedyotis coriacea* is the priority species in this IMU, *Portulaca sclerocarpa* and *Stenogyne angustifolia* are found in the IMU as well.

Table 2.2.26-1. Summary of Management Actions conducted in IMU 30.

	Hours	Acres	Gallons
Plant Survey	292	236.5	–
Emergency Exclosures	141	–	–
Weed Control	57	12.5	31

RARE PLANT SURVEYS AND PROTECTION

Surveys were conducted between May 2004 and December 2004, 96 kilometers of transects were surveyed covering approximately 236.5 acres. New plants were recorded during surveys, monitoring, and weed control activities (Table 2.2.26-2).

Table 2.2.26-2. Results of rare plants surveys conducted in IMU 30.

	Newly Recorded		Currently Known	
	Locations	Plants	Locations	Plants
<i>H. coriacea</i>	61	62	74	84
<i>P. sclerocarpa</i>	1	3	1	3
<i>S. hawaiiensis</i>	0	0	1	1
<i>S. lanceolata</i>	1	3	1	3
<i>S. angustifolia</i>	2	2	3	7-10
<i>Z. hawaiiensis</i>	3	3	4	4

The distribution of *H. coriacea* in IMU 30 extends well beyond the current IMU boundary. Results from surveys in this and the adjacent IMU 29 show that the plants in the two IMU's form a continuous distribution.

Approximately 141 hours were expended in the construction of 39 emergency exclosures. All known *H. coriacea* are either within the Kīpuka `Alalā Fence Units or protected by small scale emergency exclosures.

WEED CONTROL

Currently five acres of weed control buffers have been identified for implementation. The remoteness of the site has hindered weed control efforts. In addition the plants are distributed over a large area. Water must be flown in by helicopter to facilitate weed control. Approximately 20% of the buffers have been implemented. *P. setaceum* densities are low in the IMU and it is a low priority IMU for weed control.

Table 2.2.26-3. Summary of weed control conducted in IMU 30.

	Hours	Acres	Gallons
Spray	57	5	57

INTRODUCED ANIMAL SURVEYS AND CONTROL

There have been no introduced animal surveys or control conducted during the reporting period.

MANAGEMENT RECOMMENDATIONS

Expand the IMU boundary to encompass all known *H. coriacea* locations. Implement weed control throughout the IMU as higher priority weed control is accomplished in other IMU's. Construct large-scale fence units to provide large-scale protection for plants currently only protected by emergency exclosures.

2.2.27 - IMU 31

INTRODUCTION

IMU 31 is located in the Kīpuka `Alalā-1 Fence Unit in Training Area 23. It has three vegetation types, *Myoporum-Sophora* Mixed Shrubland, *Styphelia* Mixed Shrubland, and Dense *Dodonaea* Shrubland. The IMU occupies 154 acres and was designated for the management of *Silene lanceolata* (PS-2) and *Tetramolopium sp. 1* (PS-1).

Management actions conducted in the IMU consisted of rare plant surveys and weed control (Table 2.2.27-1).

Table 2.2.27-1. Summary of Management Actions conducted in IMU 31.

	Hours	Acres
Plant Surveys	160	100
Weed Control	396	16

RARE PLANT SURVEYS AND PROTECTION

Rare plant surveys conducted in the IMU and adjoining areas resulted in the discovery of numerous new locations of *S. lanceolata*. Locations of *Festuca hawaiiensis* and *Eragrostis deflexa* were also recorded.

Table 2.2.27-2. Results of rare plants surveys conducted in IMU 31.

	Newly Recorded		Currently Known	
	Locations	Plants	Locations	Plants
<i>S. lanceolata</i>	63	6551-6806	63	6551-6806
<i>T. sp. 1</i>	-	-	2	748

Surveys conducted in IMU 31 indicate the distribution *S. lanceolata* is far more extensive than previously known. From field observations the population appears healthy with all age classes represented.

WEED CONTROL

Weed control for *T. sp. 1* was initiated in 2004, with a goal of visiting the 2.5 acre control area four times a year. Weed control for *S. lanceolata* has been problematic in this area due to dense native vegetation. Approximately 5.4 acres are currently under control, with a goal of visiting the control areas four times a year.

Table 2.2.27-3. Summary of weed control conducted in IMU 31.

	Hours	Acres	Gallons
<i>S. lanceolata</i>			
Hand Clear	137	-	-
Spray	80	5.4	83
<i>T. sp 1</i>			
Hand Clear	62	-	-
Spray	73	2.5	78
Weed Whacking	44	2.5	-

INTRODUCED ANIMAL SURVEYS AND CONTROL

Ungulate surveys were conducted through out the Kīpuka `Alalā Fence Units in October of 2005 to assess activity levels. Surveys focused on feral pigs as it is believed that the Kīpuka `Alalā-1 Fence Unit is free of sheep. Recent pig sign was observed in the IMU and elsewhere in the fence unit. A strategic baiting plan is being developed by USDA Wildlife Services and PTA NRS to try and trap the remaining pigs in the fence unit. Remaining pigs will be removed using traps and ground hunts once animals are habituated to bait sites.

MANAGEMENT RECOMMENDATIONS

Because of the extensive distribution of *S. lanceolata*, the patchiness of the weeds and the dense native vegetation, a systematic approach to the weed control needs to be developed to ensure maximum coverage of the area with as little damage to the native vegetation as possible. Most of the *S. lanceolata* locations in the IMU are in thickly vegetated areas that are comprised, almost entirely of native plants. Weed control should be carefully planned to minimize the impacts to native vegetation.

Complete the removal of feral and Judas animals from the fence unit following the breeding season.

2.2.28 - IMU 32

INTRODUCTION

IMU 32 is located within the Kīpuka `Alalā-2 Fence Unit in Training Area 23. The habitat found in the IMU is *Myoporum-Sophora* Shrubland. The primary species within the IMU is *Spermolepis hawaiiensis*. This is a Priority Species-5 and is of low priority for management actions.

Table 2.2.28-1. Summary of Management Actions conducted in IMU 32.

	Hours	Acres
Plant Surveys	104	300

RARE PLANT SURVEYS AND PROTECTION

Rare plant surveys were initiated in March 2004 following improved rainfall. This was the first time surveys were conducted due to many years of low rainfall and the annular nature of this species. Although *S. hawaiiensis* is a PS-5 it was important to take advantage of the regeneration from the improved weather conditions and to conduct surveys to determine the distribution of the species. Transects were spaced 20 meters apart. Plant locations were recorded with GPS units. When bands of plants were located points were collected at approximately 10-meter intervals. Approximately 86.2 kilometers of transects were surveyed. The number of locations (Table 2.2.28-2) recorded dramatically increased from previous data.

Table 2.2.28-2. Results of rare plant surveys conducted in IMU 32.

	Newly Recorded		Currently Known	
	Locations	Plants	Locations	Plants
<i>Spe. hawaiiensis</i>	207	4,834-5,268	207	4,834-5,268

This IMU is found within the Kīpuka `Alalā-2 Fence Unit. Ungulates are actively controlled within the fence unit and no other protection efforts were made for this species.

INTRODUCED ANIMAL SURVEYS AND CONTROL

Ungulate surveys were conducted within the Kīpuka `Alalā Fence Units and are summarized in Section 2.3.4.

MANAGEMENT RECOMMENDATIONS

In addition to being a PS-5, *S. hawaiiensis* is also an annual. Monitoring and weed control will not be conducted specifically for this species. Surveys for this *S. hawaiiensis* in suitable habitat adjacent to the IMU should be conducted to further delimit the distribution.

Continue with ungulate control efforts to ensure the species is not impacted by browsing.

2.2.29 - IMU 33

INTRODUCTION

Located in the Kīpuka `Alalā-2 Fence Unit in Training Area 23, IMU 33 is categorized as *Myoporum-*

Sophora shrubland and covers 35 acres. The IMU was designated for the management of *Asplenium peruviana* var. *insulare* which are found in caves and skylights that occur in the area. Currently, *A. peruviana* var. *insulare* is the only protected species found in the IMU.

Table 2.2.29-1. Summary of Management Actions conducted in IMU 33.

	Hours
Plant Surveys	15

RARE PLANT SURVEYS AND PROTECTION

Surveys within the IMU focused on accessible lava tubes. All known plants in the area have been found in caves and skylights. Surveys conducted during the reporting period sought to identify new locations. Cave surveys consisted of entering skylights within the tube system that is occupied by *A. peruviana* var. *insulare* and following the tube system to locate additional skylights. No new locations were recorded, but previously recorded locations were reidentified (Table 2.2.29-2).

Table 2.2.29-2. Results of rare plants surveys conducted in IMU 33.

	Newly Recorded		Currently Known	
	Locations	Plants	Locations	Plants
<i>A. p. var. insulare</i>	0	0	5	33-35

WEED CONTROL

No weed control was conducted.

INTRODUCED ANIMAL SURVEYS AND CONTROL

Ungulate surveys were conducted through out the Kīpuka `Alalā Fence Units in October of 2005 to assess activity levels. Surveys focused on feral pigs as USDA personnel have two Judas (radio collared) rams in the unit that can be used to locate other sheep in the Kīpuka `Alalā-2 Fence Unit. No recent pig sign was observed in the IMU but sign was seen within the fence unit. A strategic baiting plan is being developed by USDA wildlife and PTA Natural Resources Staff to trap the remaining pigs in the fence unit. Ground and aerial hunts will be conducted using the radio collared rams to remove the remaining sheep in the fence unit. Most accessible caves in the area show signs of past ungulate impacts threatening the remaining *A. p. var. insulare*.

MANAGEMENT RECOMMENDATIONS

Increased precipitation during the past two years may have contributed to the increase in the number of individuals being recorded. It is not certain if the current increases can be sustained through drier periods. Non-native plant species encroaching in to caves could be competing with *A. p. var. insulare* for limited space and nutrients and may need to be controlled. Long term vegetation monitoring will indicate the threat level posed by invasive plant species. The completion of ungulate removal from the unit will remove the threat of damage from browsing or trampling.

2.2.30 - IMU 34

INTRODUCTION

The IMU is located in the Kīpuka `Alalā-2 Fence Unit in Training Area 23. The 41 acre IMU contains a mixture of *Myoporum-Dodonaea* shrubland and sparse *Metrosideros* Treeland (Castillo 1997). The IMU was designated for the protection of *A. p. var. insulare* which are found in caves and skylights that occur

in the area. *A. p. var. insulare* is the only protected species found in the IMU.

Table 2.2.30-1. Summary of Management Actions conducted in IMU 34.

	Hours
Plant Surveys	15

RARE PLANT SURVEYS AND PROTECTION

Surveys within the IMU focused on accessible lava tubes. All known plants in the area have been found in caves and skylights. Surveys conducted during the reporting period sought to reidentify previously recorded locations and identify new locations. Cave surveys only extended as far back in the cave as light conditions could support *A. p. var. insulare*. It is unknown how many plants were recorded during previous surveys conducted by CSU. Recent surveys results are summarized in Table 2.2.30-2. The wide range in the estimated number of individuals is due to the small size and immaturity of many of the plants, positive identification wasn't always possible.

Table 2.2.30-2. Results of rare plants surveys conducted in IMU 34.

	Newly Recorded		Currently Known	
	Locations	Plants	Locations	Plants
<i>A. p. var. insulare</i>	3	80-180	4	202-482

WEED CONTROL

No weed control was conducted.

INTRODUCED ANIMAL SURVEYS AND CONTROL

See section under IMU 33.

MANAGEMENT RECOMMENDATIONS

See Management Recommendations in IMU 33.

2.2.31 - IMU 35

INTRODUCTION

Located in the Kīpuka `Alalā-2 Fence Unit in Training Area 23, IMU 35 is categorized as *Myoporum-Sophora* shrubland and covers 7.9 acres. The IMU was designated for the protection of *A. p. var. insulare* which are found in caves and skylights that occur in the area. Currently, *A. p. var. insulare* is the only protected species found in the IMU.

Table 2.2.31-1. Summary of Management Actions conducted in IMU 35.

	Hours
Plant Surveys	25

RARE PLANT SURVEYS AND PROTECTION

Surveys within the IMU focused on accessible lava tubes. All known plants in the area have been found in caves and skylights. Surveys conducted during the reporting period sought to reidentify previously

recorded locations and identify new locations. Cave surveys only extended as far back in the cave as light conditions could support *A. p. var. insulare*. It is unknown how many plants were recorded during previous surveys conducted by CSU. Surveys conducted during the reporting period recorded plants (Table 2.2.31-2).

Table 2.2.31-2. Results of rare plants surveys conducted in IMU 35.

	Currently Known	
	Locations	Plants
<i>A. p. var. insulare</i>	1	11-21

WEED CONTROL

No weed control was conducted.

INTRODUCED ANIMAL SURVEYS AND CONTROL

See section under IMU 33.

MANAGEMENT RECOMMENDATIONS

See section under IMU 33 for management recommendations.

2.2.32 - IMU 36

INTRODUCTION

No work was done in this IMU during the reporting period. IMU 36 is located in Training Area 23 outside the fenced units and was created because of *A. peruviana* found in the area. The habitat is categorized as Sparse *Metrosideros* Treeland (Shaw and Castillo 1997) and covers an area of approximately 8 acres. This IMU needs to be revisited to confirm that *A. peruviana* still exists at the site.

2.2.33 - IMU 37

INTRODUCTION

IMU 37 is located at Range 8 on Red Leg Trail. *Silene hawaiiensis* is the only listed species found within this IMU. Range 8 is an active live-fire range used mostly for machine gun qualification. In conjunction with the Army Biologist, the Range Maintenance personnel constructed rock berms to protect the plants from military impacts in 2004. Unfortunately the berms covered habitat that previously supported plants. Low wire cages were also constructed and placed over the plants to protect them from ungulate browse. The plants have been monitored annually since 1997, in accordance with a 1996 Biological Opinion issued by the U.S. Fish and Wildlife Service. Monitoring has shown a steady decline in the population (see section 1.2.7).

WEED CONTROL

No weed control was conducted in this IMU.

INTRODUCED ANIMAL SURVEYS AND CONTROL

No introduced animal control was conducted in this IMU.

DISCUSSION

As discussed in Section 1.1.7, past work by Evans *et al.* (2002) showed a steady decline in average plant height in relation to presence of Mouflon and feral sheep near Range 8. The PTA Range Maintenance division constructed wire cages to protect some of the individual plants on the range in 2004. The protective cages were important in the vegetative recovery of the individual plants protected by the wire cages.

The 1996 Biological Opinion required the placement of rock berms to protect the plants from bullet strikes as However, the likelihood of damage to plants from bullet strikes was discussed and dismissed by

Schnell *et al.* (2003). Unfortunately, Range Maintenance's conscientious efforts were not well directed by a previous Army Biologist. In their efforts to comply with the BO they placed the berms in such a way as to do more damage than good. As a result berms were placed within plant groupings and suitable habitat was covered and is no longer available for seedling recruitment and population expansion. Ironically, in an effort to protect the plants from impacts due to military training damage was done through the attempts to protect the plants.

MANAGEMENT RECOMMENDATIONS

The wire cages put in place by Range Maintenance should be examined to determine if another fencing design would be more appropriate for the protection of the population and allow the military a realistic training environment. Large-scale fencing is the most appropriate measure to protect the population at Range 8 and the habitat in which it is found. The population cannot continue if its habitat is not protected. In addition, unprotected plants continue to be impacted by ungulates. The berms, over time, should be repositioned so they do not fall within the plant populations and occupy less of the area the plants need for expansion.

2.2.34 - IMU 39

INTRODUCTION

Located in Training Area 21, IMU 39 has an area of 7.9 acres. The area is classified as barren lava (Castillo 1997) and was designated as an IMU because of a single cave with *A. peruviana var. insulare*. This site was first recorded by CSU.

Table 2.2.34-1. Summary of Management Actions conducted in IMU 39.

	Hours	Acres
Plant Surveys	9	10

RARE PLANT SURVEYS AND PROTECTION

Surveys were conducted in the IMU to verify the original CSU record for *Asplenium peruviana* in the area. A cave believed to be the one recorded by CSU was found by the presence of rock pile located at the top of a nearby hill. Although the cave was suitable habitat there were no *A. peruviana* individuals present and the cave floor was covered by weeds.

Table 2.2.34-2 Results of rare plant surveys in IMU 39.

	Newly Recorded		Currently Known	
	Locations	Plants	Locations	Plants
<i>A. p. var. insulare</i>	0	0	1	0

WEED CONTROL

No weed control was conducted.

INTRODUCED ANIMAL SURVEYS AND CONTROL

No introduced animal surveys or control was conducted.

MANAGEMENT RECOMMENDATIONS

Visit the site once a year to look for recruitment. After four years if no plants are present, reassess the status of the IMU.

2.2.35 - IMU 41

INTRODUCTION

Located just off of New Bobcat Trail in Training Area 23, IMU 41 encloses the only known, natural population of *Schiedea hawaiiensis*. The IMU has an area of approximately two acres and is described as Sparse *Metrosideros* Treeland (Shaw and Castillo 1997). The remaining plants are encircled by a razor-wire ungulate enclosure and three of the plants are covered by a smaller wire mesh cage to prevent bird damage. Management within the IMU includes weed and rodent control, fencing, and monitoring.

Table 2.2.35-1. Summary of Management Actions conducted in IMU 41.

	Hours	Acres
Emergency Enclosures	1	-
Weed Control	12	4.3
Rodent Control	16	1

RARE PLANT SURVEYS AND PROTECTION

A total of one hour was spent erecting emergency enclosures around the two surviving adults. It is thought that rodents may be responsible for the damage seen on *S. hawaiiensis*. Besides the adults a number of juveniles were present indicating recruitment.

WEED CONTROL

Weed control is conducted on approximately one acre with a goal of visiting the site three times a year. This year the IMU has been visited three times, twice to spray and once to weed whack. In addition, hand clearing around individuals in the fence was conducted in conjunction with other weed control efforts.

Table 2.2.35-2. Summary of weed control conducted in IMU 41.

	Hours	Acres	Gallons
Hand Clearing	1	-	-
Spraying	9	2.2	6
Weed whacking	2	2.2	-

INTRODUCED ANIMAL SURVEYS AND CONTROL

A rodent control grid has been established around the population to prevent damage to the plants. The grid of rodent bait boxes covers a two-acre area surrounding the population. Rodent control during the reporting period has taken 11.5 hours and used 79.75 lbs of rodenticide.

MANAGEMENT RECOMMENDATIONS

Continue weed and rodent control. The surrounding area should be surveyed for additional plant locations. This would require the support of Explosive Ordinance Disposal personnel.

2.2.36 -IMU 44

INTRODUCTION

IMU 44 is located in Training area 22 along new Bobcat road. The IMU encompasses about 25 acres. There is one population of *Haplostachys haplostachya* inside which include nineteen individuals. The only management activity in this IMU has been the monitoring of these individuals.

RARE PLANT SURVEYS AND PROTECTION

No surveys have been conducted.

WEED CONTROL

No weed control has been conducted.

INTRODUCED ANIMAL SURVEYS AND CONTROL

No Introduced animal surveys or control has been completed.

MANAGEMENT RECOMMENDATIONS

It is recommended to initiate surveys to delineate the *H. haplostachya* population within the IMU and to begin weed control around the existing population.

2.2.37 - RARE PLANT SURVEYS OUTSIDE OF IMU

INTRODUCTION

IMU 99 is a general IMU category for areas where management actions are performed which do not occur within an existing IMU. In general, these will be rare plant surveys to find old points and to survey previously un-surveyed areas to find new rare plant locations.

Table 2.2.37-1. Summary of Management Actions conducted outside of established IMU's.

	Hours	Acres
Plant Surveys	208	739

RARE PLANT SURVEYS AND PROTECTION

Rare plant surveys in areas outside of designated IMU have occurred in three areas. The concentric circle technique (PTA 2003) was used to locate old *Silene lanceolata* locations in Training Area 20. Of the four locations surveyed, no *S. lanceolata* were discovered.

Secondly, 345 acres in 83 hours were surveyed using a flagless transect technique (PTA 2003) in Training Area 22 near PTA's western boundary south of IMU's 13, 14 and 15. Twenty meter spacing between transects was used. During these surveys, 63 *Zanthoxylum hawaiiense* and 3 *Stenogyne angustifolia* were found (Table 2.2.XX-2). Also found were three listed species of concern *Melicope hawaiiensis*, *Festuca hawaiiensis* and *Exocarpos gaudichaudii*; as well as unlisted, rare and endemic species *Alphitonia ponderosa*, *Hedyotis terminalis* and *Pittosporum terminalioides*.

Table 2.2.37-2. Results of rare plants surveys conducted in IMU 99.

	Newly Recorded		Currently Known	
	Locations	Plants	Locations	Plants
<i>S. angustifolia</i>	3	3	3	3
<i>Z. hawaiiense</i>	61	63	61	63

Third, 386 acres in 119 hours were surveyed in Training Areas 7 and 8. The land was proposed to be utilized for military purposes. Various spacing, from 20 to 40 meters depending upon the terrain and plant community, was used to attain coverage. No rare or listed plants were found.

No protection for plants relocated during these surveys has occurred.

WEED CONTROL

No activity conducted.

INTRODUCED ANIMAL SURVEYS AND CONTROL

No animal surveys or control were conducted during the reporting period.

MANAGEMENT RECOMMENDATIONS

Continue exploring areas outside of IMU's for old plant points and areas not previously surveyed. Continue tasks as directed by the military to ensure military training activities have a minimal impact on rare plant populations.

2.2.38 - `Elepaio

INTRODUCTION

Two areas in Training Area 23 are managed for `elepaio. Both sites are located on the same `a`a flow approximately 1 kilometer distant. (For detail on population surveys and monitoring see section 1.3.1.) Rodents are controlled year-round in the `elepaio territories. At Site 1, there are 25 bait stations covering approximately 10 acres. At Site 3, the 32 bait stations from the 2004 breeding season were expanded to 56 bait stations during the 2005 breeding season. The controlled area at Site 3 expanded from four to eight acres. The yearly goal is to treat the two sites once a month.

INTRODUCED ANIMAL SURVEYS AND CONTROL

A total of 232 hours were spent to distribute 343 pounds of rodenticide in the two `elepaio territories during the reporting period. Repeat treatments in the territories resulted in 322 total acres treated. In 2004, the area of the combined territories was 14 acres. Each territory was visited monthly and 100% of our yearly goal was met. In 2005, the area of the combined territories was 18 acres. Each territory was visited monthly and 100% of our yearly goal was met.

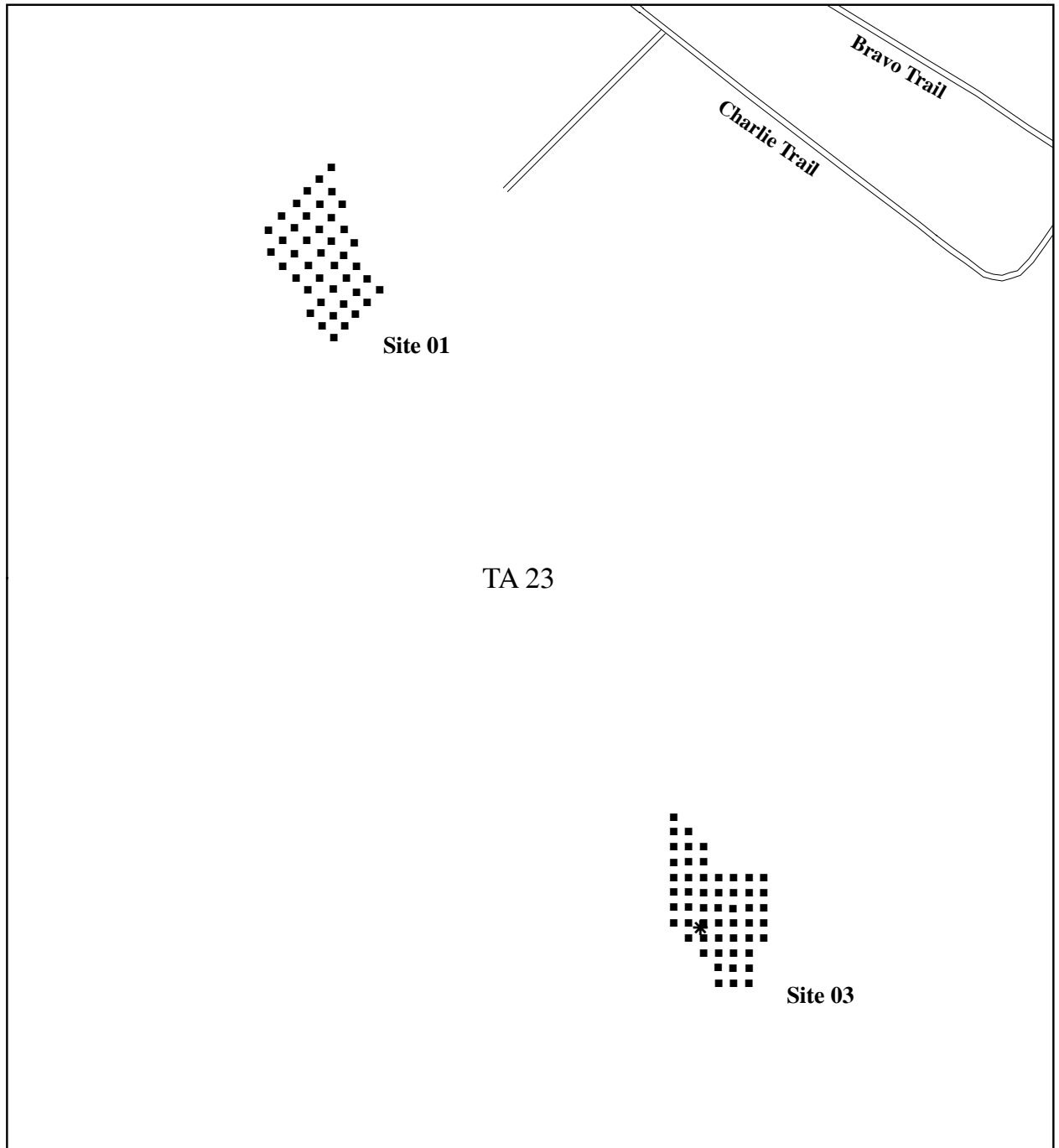
Introduced small-mammal predator trapping was conducted by USDA in 2004 and 2005. Traps were positioned road-side along the road network in Training Area 23. Both cats and mongoose were captured (Table 2.2.38-1).

Table 2.2.38-1 Summary of predator control conducted for `Elepaio.

	Rodent Control			Predator Trapping (USDA)	
	Hours	Acres	Pounds	Cats	Mongoose
2004	92	14	87	No Data	No Data
2005	140	14	256	16	6

MANAGEMENT RECOMMENDATIONS

Successful reproduction was observed for the first time at PTA during the 2004 and 2005 breeding seasons. Because predators pose a direct threat to nesting success, predator control should continue around all active `elepaio nesting territories.



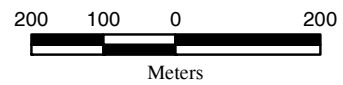
Rodent Control

- Rodent Bait Boxes
- * Elepaio nesting site
- == Roads

Figure 2.2.38-1

Rodent Control Grid
for Elepaio Sites.

Scale 1 : 10,000



2.2.39 - Pueo

INTRODUCTION

Pueo, *Asio flammeus sandwichensis*, is one of two raptors endemic to Hawai'i. Sightings of pueo at PTA have increased. Sightings were relatively uncommon in the late 1990's, but since 2003 pueo have been detected during the annual bird surveys and regularly seen in various parts of PTA. Data on pueo at PTA is limited and their habitat needs and natural history are not known.

MONITORING

In 2004, two pueo nests were located in Training Areas 1 and 2. Both nests were located within 500 meters of the new Saddle Road construction. The nest in Training Area 1 was discovered on November 30, 2004. The adult flew out of the grass and upon inspection of the area the nest was discovered with two warm eggs. On December 6, 2004, the nest was monitored from a nearby road and when it was determined that the adult was not on the nest, predator control for the nesting area was established (see following section for details). The nest was monitored for three weeks, but an adult was never seen on the nest again and the eggs were cold at each observation. It was determined that the nest failed.

On December 2, 2004 the nest in Training Area 2 was discovered when an owl flew out of the grass. Upon inspection of the area a nest was discovered with one egg. The egg was cold to the touch. The nest was visited twice in December and adults were never observed on the nest and the eggs remained cold hence monitoring was terminated.

On December 9, 2004 a fledging pueo was observed in the middle of Ka'ena Road in Training Area 1. The young bird was still downy and did not attempt to fly as the vehicle approached. This pueo was within one kilometer of the failed pueo nest in Training Area 1.

INTRODUCED ANIMAL SURVEYS AND CONTROL

Around the nest in Training Area 1, four cat traps were placed 100 meters from the nest and baited with cat food on December 6, 2004. The traps were checked every 24 hours and closed over the weekend. No cats were caught; three mongooses were caught and removed. The traps were removed from the area on February 1, 2005.

Six bait boxes stocked with diphacinone bait blocks were placed 50 meters ringing the nest. Each bait station had eight blocks for a total of 6 pounds.

MANAGEMENT RECOMMENDATIONS

Very little is known about pueo at PTA. Annual bird surveys are inadequate to determine the distribution and habitat preferences for this native bird. Developing and implementing survey protocols would help determine the status of this native species at PTA. If additional nests for this species are discovered, predator control will immediately be implemented.

2.3 ALIEN SPECIES SURVEYS AND CONTROL OUTSIDE OF IMU

INTRODUCTION

Introduced animals and plants cause a variety of disruptions in the native ecosystem. Controlling and minimizing impacts to the native ecosystem from some of these introduced species is important in preserving native habitats and ecosystem function at PTA. Surveys and control were conducted for one ant species and two plant species. Because these species are generally widespread, they cannot be contained in a single Intensive Management Unit.

2.3.1 - *Linepithema humile*, Argentine Ant

INTRODUCTION

Exotic ants, specifically, Argentine ants (*Linepithema humile*) are a proven threat to native insects. "Most ants are generalist predators and scavengers, deriving most of their pertinacious nutrition from insect prey." (Oboyski *et al.* 2001). *Rhyncogonus* as a genus evolved on the islands without wings and thus may be "especially vulnerable to ant invasions" (Oboyski *et al.* 2001). Ants were found at 7 of the 8 study sites established for *Rhyncogonus stellaris* in 2004. Surveys were designed to determine the presence/absence

of ants, especially the Argentine ant (*Linepithema humile*), within or around selected *R. stellaris* study sites. Ant surveys were not conducted around Sites 4 and 5 in Training Area 17 because of the distance of these sites from the others.

METHODS:

Surveys were conducted at each of the three *R. stellaris* study sites. Surveys consisted of six transects with six bait stations spaced 20 meters apart, for a total of 36 bait stations. A 3" x 5" index card with a tuna and honey mixture was placed at each bait station. The cards were left for one hour, following which, ant species present on the card and around the station were recorded.

RESULTS

Two species of ants were recorded during surveys (Table 2.3.1-1). In addition all surveyed sites had ants present.

Table 2.3.1-1. Results of ant surveys at *Rhyncogonus stellaris* sites.

Site	Training Area	Species	Stations
1	19	<i>Cardiocondyla venustula</i>	23
2	19	<i>Cardiocondyla venustula</i>	12
3,4	9	<i>Cardiocondyla venustula</i>	2
		<i>Linepithema humile</i>	18
7	19	<i>Cardiocondyla venustula</i>	11
		<i>Linepithema humile</i>	3
8	19	<i>Linepithema humile</i>	12

DISCUSSION:

Site eight is near the north east corner of Kīpuka Kālawamauna. The presence of Argentine ants at this site is of concern because it is near to Site one where *R. stellaris* has been found. Sites seven and three/four are in disturbed areas near Pu`u Ka Pele and Pu`u Ahi. *R. stellaris* was not found in or near these two areas.

MANAGEMENT RECOMMENDATIONS

Control efforts should be concentrated in and around Site eight. There is an out planting site not far from Site one which is overrun with Argentine Ants. Additional survey transects have been created in an effort to determine the distribution which will provide guidance for control efforts.

The new transects will provide survey coverage of a much larger area. Depending on the distribution of ants, the opportunity to experiment with different ant baits may arise. For example, it was determined that seven weeks of continuous exposure to boric acid was needed to eliminate *L. humile* queens (Krushelnycky *et al.* 2004).

2.3.2 - *Passiflora mollissima*

INTRODUCTION

Passiflora mollissima (Banana poka) is a plant species designated as noxious weed for eradication or control purposes by the Hawai`i Department of Agriculture. This species is a woody climber that utilizes both self- and cross-fertilization. *P. mollissima* flowers throughout the year and produces an abundant amount of fruit. Flowers have exposed stamens, which favors cross-pollination by insects. If cross-pollination does not occur, each flower later pollinates itself through movement of the stigmas to touch the stamens. In its native habitat, it is thought to be pollinated by hummingbirds and large bees. Peak flowering occurs in the dry season in both Hawai`i and South America, though *P. mollissima* exhibits continuous growth and reproduction. The life span of *P. mollissima* plants may exceed 20 years. Seeds are dispersed by frugivorous animals, principally feral pigs (*Sus scrofa*) in Hawai`i. Rooting activities of

pigs also provide a fertile medium for seedling growth and create an environment with low competition. Birds aid in long distance dispersal to isolated areas. Dispersal of the seed by birds and feral pigs makes control measures difficult (Starr 2003).

P. mollissima is native to the Andes of South America. It grows wild in the upper montane forest above 2000 m (6,562 ft). The climate can be described as cool-warm, temperate, moist-wet, 500-2000 mm (20-79 in) precipitation per year, and temperatures ranging from 43-64 degrees F. There, populations of *P. mollissima* are only about two or three plants per hectare; flowers and fruits are predated by numerous insects. In Hawai'i, *P. mollissima* is a problem in mesic forest, 850-2,225 m (2,789-7,300 ft), where it overgrows native trees and is distributed by feral pigs and other animals. The vine may climb a neighbor tree, extending its branches to the ground. In open areas the vine will spread across the ground preventing regeneration of native flora. *P. mollissima* alters the structure and composition of the forest additionally impacting endangered endemic forest birds (Starr 2003).

PTA Natural Resources Staff noticed a rising number of *P. mollissima* in the Kīpuka `Alalā Fence Units (KAFU). Known to be an invasive threat at lower elevation and in more precipitous climates, this alien plant poses a threat to flora and fauna at PTA. A proactive approach to *P. mollissima* control was implemented August through November 2005. Surveys specifically designed to document the number of plants and extent of the *P. mollissima* distribution was conducted. Herbicide treatment was carried out at the time of record. Results from the weed survey are summarized in Table 2.3.2-1. Additional *P. mollissima* points were recorded in KAFU during 2005 ungulate surveys and nene surveys. These areas were not herbicide treated.

Table 2.3.2-1. Summary of survey and control efforts for *Passiflora mollissima*.

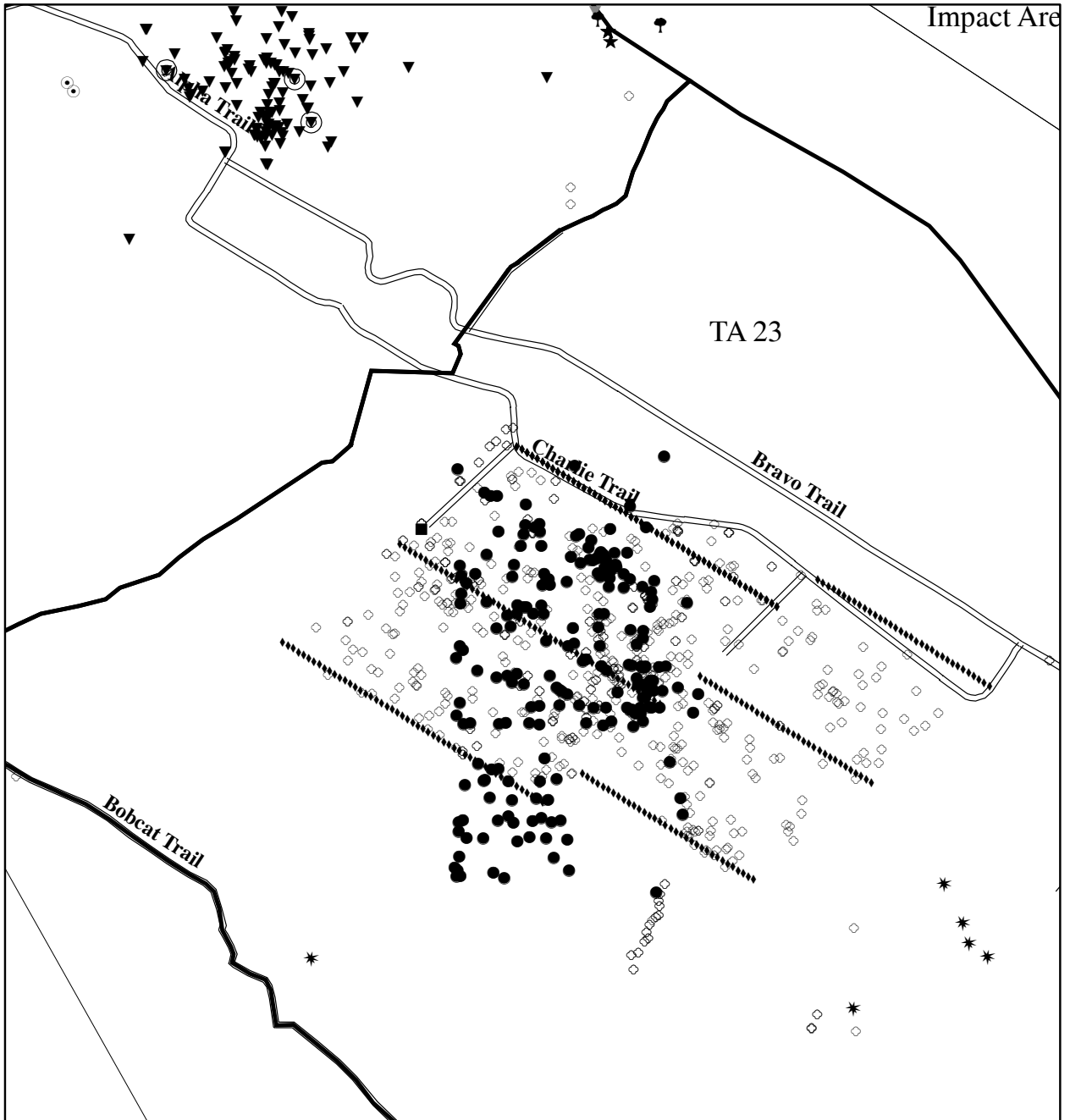
	Hours	Acres	Sites	Plants Treated
Survey	212	420	514	2,500

METHODS

Transects ran 1000 x 5 meter sections through sometimes thick vegetation. A total of 85 transects were surveyed and *P. mollissima* plants were treated along these transects; linear distance 85 kilometers. Waypoints were marked with handheld GPS units and loaded into ArcMap to display distribution area and to generalize the quantity of plants within the survey area. Treatment was by 'cut stump' method, cutting the stems nearest the root possible and treating each cut end with a dropper of 100% Garlon 3A solution. Points recorded during surveys not specific to *P. mollissima* control were not treated with herbicide.

RESULTS

A variety of reproductive adults along with juveniles and seedling recruitment were recorded. A total of 514 *P. mollissima* sites were identified during surveying. Many sites identified multiple healthy plants, primarily reproductive adults. In some areas numerous seedlings and juveniles surrounded adult plants. Adult plants were flowering and fruiting. Points recorded spanned an elevation gradient of 1600 – 2175 meters (5280 – 7177.5 feet).

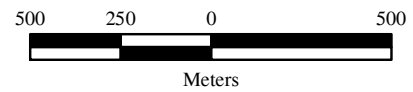


Plant Locations

- ◇ *Passiflora mollisima*
- * *Asplenium peruviana* var. *insulare*
- ▼ *Silene hawaiiensis*
- ▼ *Silene lanceolata*
- *Spermolepis hawaiiensis*
- ⊙ *Tetramolopium* sp. 1
- ◆ Transect points
- Roads
- ▭ Fence

Figure 2.3.2-1
Passiflora mollisima Surveys and Control

Scale 1 : 20,000



DISCUSSION

P. mollissima is considered a major threat in other habitat types, but the extreme dry climate and elevation at PTA has been generally considered unsuitable for invasion by this plant species. However, the number of plants identified during surveys indicates that this weedy species is viable in the habitat provided at PTA. Given its tendency to take over vegetation at lower elevation and in wetter climates, this species may pose a real threat to ecological management at PTA. The Kīpuka `Alalā Fence Units are largely considered ungulate-free which benefits controlling the spread of *P. mollissima*. However, it is unclear the role native and alien birds may have in spreading this weedy species at PTA. Just beyond the targeted survey area, a group of *P. mollissima* points were recorded during ungulate surveys suggesting that, should survey area be expanded, many more *P. mollissima* points would be found. Due to the number of fruits observed during surveys, it is likely that a large seed bank exists. *P. mollissima* locations at PTA are also in close proximity to the only known nesting sites at PTA for `elepaio (*Chasiempis sandwichensis*).

MANAGEMENT RECOMMENDATIONS

Completed survey areas should be monitored for re-sprouts. Locations should be re-visited within one year to ensure complete kill of plants and to treat seedlings before plant numbers have a chance to bounce back. Continued monitoring of the plant numbers and dispersal is recommended. To reduce personnel hours, transect swath could be widened after initial control measures. Future physical and chemical controls should focus on outlying plants that may provide new foci for dispersal. Survey/control area should be expanded south of completed *P. mollissima* surveys, accessible via Old Bobcat Trail on the south side of Kīpuka `Alalā Fence Unit. Fence areas not yet infested with *P. mollissima* to prevent dispersal by feral pigs.

2.3.3 - *Salsola kali*, Russian thistle

INTRODUCTION

Russian thistle, *Salsola kali*, has been a persistent problem at PTA since 1995. The main control areas are located in the northern portion of the training area in locations heavily used by the military. Russian thistle control is a top priority because this invasive species quickly spreads to cover large open areas. The control program is designed to prevent dense infestation that would make training difficult as well as to prevent the species from invading natural areas and impacting rare species.

METHODS

Weekly surveys for plants were made in portions of the area infested with Russian thistle (Northern PTA). Plants discovered were either hand pulled and left in the area or sprayed depending on the density of plants. Various herbicides with the active ingredient glyphosphate were used in 2% solution and applied using backpack sprayers when plant densities were high. Global Position Units (GPS) were used to record the edges of the infestation in each training area and transferred to the Geographic Information System (GIS) to document the extent of the population and to facilitate work assignments.

WEED CONTROL

In 2003, one to two people were scheduled approximately once per week to control thistle. With the addition of several staff in late 2003, three to five people were scheduled once week in 2004 and 2005. Thistle has infested approximately 365 acres. The yearly goal is to treat these 365 acres approximately four times per year. In 2003, because of limited staffing, 45% of this target goal was achieved. In 2004 and 2005, 109% and 97% of the target goal was achieved respectively. During the reporting period a total of 2,270 hours were spent surveying for and controlling Russian thistle. The 365 acres were repetitively treated and approximately, 1,598 gallons of herbicide were applied.

Table 2.3.3-1. Summary of Russian thistle control.

	Hours	Spraying Acres	Gallons	Hand Clear Hours	Survey Hours
2003	150	365	96	11	1.5
2004	1009	365	723	19	0
2005	1111	365	779	1	4.5

DISCUSSION

PTA NRS has been controlling Russian thistle since 1996. A contractor was utilized in the late 1990s to treat large infestations in Training Areas 15 and 16. Due to persistence and continual monitoring the current population has not reached the densities that were present in the late 1990s.

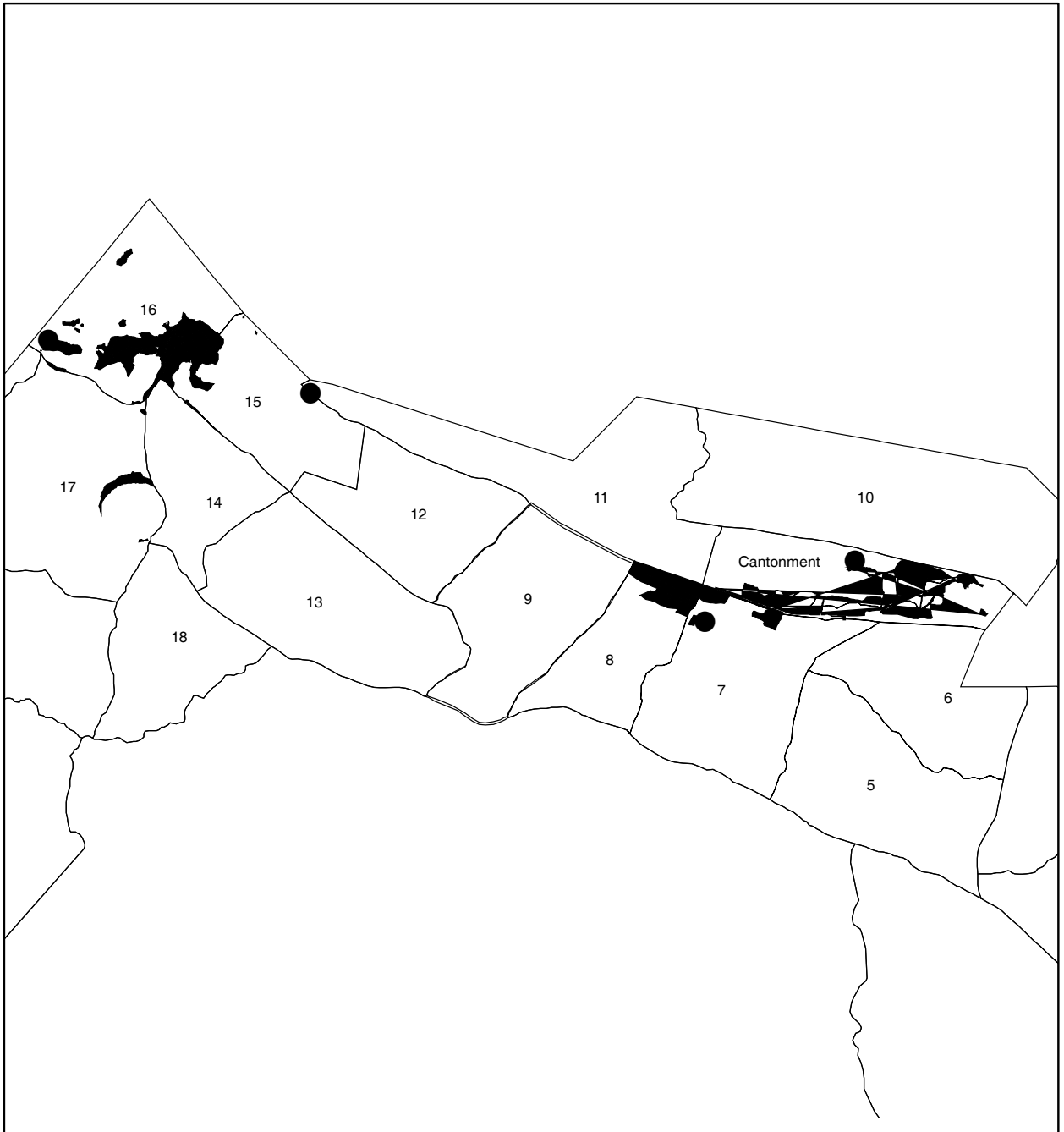
As the PTA NRS staff increased in size, more time and effort has been dedicated to eradicating this weed. The goal is to reach each control site before the plants have time to mature and set seed; a task that is proving to be difficult even at current levels of effort. As the seed bank is exhausted, the population should begin to decline and eventually cease to exist.

To increase control efficiency and efficacy, the 365 acres were divided into standardized control areas and given identifiers. Prior to this demarcation, it was difficult to determine where surveys and control had been conducted. By having set control areas, ensuring each site was visited regularly through out the year became easier. Methods to sweep known control sites have also improved.

New sites were discovered in cantonment along the new Saddle Road alignment. These populations were aggressively treated to prevent the spread of thistle along the new Saddle Road. In Training Area 15, plants were reported from outside the known distribution. The plants were treated and the area searched.

MANAGEMENT RECOMMENDATIONS

Continue at current control efforts for Russian thistle. Provide the weed crew with GPS units to improve area coverage. Conduct surveys outside the known thistle areas for population expansion or new populations. Work with Federal Highways Association to survey along the alignment for the new Saddle Road for infestations of Russian thistle.



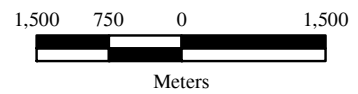
Plant Locations

- Salsola kali* Control Areas
- Training Area boundary

Figure 2.3.3-1

Salsola kali Control Areas

Scale 1 : 75,000



2.3.4 - Ungulate Tracking

INTRODUCTION

Feral ungulates pose one of the most severe threats to native habitats and endangered species populations at PTA. Ungulates impact native plant habitats through their browsing and trampling of native areas as well as being vectors for weed dispersal. Feral sheep and goats are the most numerous ungulates at PTA and pose the greatest threat, but feral pigs also pose a significant threat. By their digging, pigs can open large areas where suitable soil is present, which uproots and tramples native plants and allows weeds to become established. Public archery hunting is allowed at PTA during weekends and State holidays when it doesn't conflict with military training or bird hunting season (November through January). The public hunting program does not provide enough pressure to adequately control introduced ungulates at PTA (Site PTA Report)

Currently, of the four fence units at PTA only two are ungulate free, the *Silene hawaiiensis* and Pu`u Ka Pele Fence Units. The Kīpuka Kālawamauna (KKFU) and Kīpuka `Alalā Fence Units (KAFU) are believed to still have ungulates. Exact numbers of animals within the fence units is difficult to derive because the animal numbers are low and they are difficult to locate. The following estimates are based on the fence unit size, time spent in the areas, and recent animal sightings. Less than five sheep are believed to be within the KKFU including one ewe with a radio transmitter collar. KKFU is believed to be pig-free. Less than 10 sheep and/or goats are believed to be left within the KA-1 and KA-2 Fence Units including two ewes and one nanny with radio transmitter collars. It is believed that 10-20 pigs within KA-2 Fence Unit, but that KA-1 Fence Unit is pig-free. USDA Wildlife Services has had the animal contract to remove all ungulates from these areas since the fences were constructed.

RESULTS

Table 2.3.4-1 Summary of Management Actions conducted for IMU 105.

	Hours	Acres
Ungulate Surveys	135	430
Training for Surveys	30	-

INTRODUCED ANIMAL SURVEYS AND CONTROL

Data collected from the surveys provided the first baseline data of feral pig activity in the Kīpuka `Alalā Fence Units. The activity appeared to be concentrated with in areas with soil where digging could be observed.

MANAGEMENT RECOMMENDATIONS

Begin feral pig control program in KA-2 FU. First, establish baiting stations where pig sign was discovered during recent surveys. Once pigs are habituated to bait sites, begin trapping. Coordinate through Colorado State University to obtain permission to conduct feral ungulate control. Monitor animals with radio transmitters through the rut in 2006 to determine if other animals are present within the fence units. If the animals remain solo through the rut, remove the animals with the radio transmitters.

CHAPTER 3: PROPAGATION AND OUTPLANTING

3.1 INTRODUCTION

Propagation and outplanting are necessary objectives toward the goal of achieving stable and sustainable populations for PTA's listed species. The three areas of focus to meet these objectives have been genetic storage, germination and propagation tests, and rare plant reintroduction and augmentation.

Genetic Storage: Seed collection protocols developed by the Center for Plant Conservation (CPC 1991) and the Mākua Implementation Team (US Army, Hawai'i 2002) were followed. These protocols include: 1.) collect from 50 individuals per population when possible; 2.) for populations with less than 50 individuals, collect from all individuals; 3.) collect approximately 20% of seed on existing plants unless there are less than 10 individuals remaining and the population is declining precipitously, in which case more seed may be collected in order to preserve genetic material.

Germination and Propagation Tests: Germination and propagation tests were continued for *Hedyotis coriacea*, *Neraudia ovata*, *Solanum incompletum*, and *Schiedea hawaiiensis*. These tests complement work already completed and will work towards completing PTA propagation protocols for all listed species.

Rare Plant Reintroduction and Augmentation: The introduction of rare plant populations to sites within and outside of PTA's boundaries via outplanting was begun. The species and numbers outplanted were determined by general guidelines in the Scope of Work, site characteristics and greenhouse stock. Augmentation was most often implemented through site management such as fencing, weeding and rodent control.

3.2 GENETIC STORAGE

INTRODUCTION

Seeds provide a storehouse for genetic diversity. Propagule collection and protective storage are essential components of rare plant conservation. Two methods of germplasm preservation (seeds and standard plantings) are utilized by PTA's Natural Resources Staff (NRS) for conserving listed species.

METHODS

Seeds: Most field collections occur during other management actions (monitoring or surveying). Effort is made to collect from as many individuals as possible following Center for Plant Conservation guidelines (CPC 1991). Several species are maintained in the greenhouse for seed collection because of difficulties in obtaining field collections. Seeds are catalogued by species, date, location and founder. They are stored in sealed polyethylene bags in a refrigerator at 5°C and 23% relative humidity. Seed viability and storage testing are incorporated into propagation efforts.

Plantings: NRS manages outplanting sites for genetic storage as well as reintroduction. In addition Hawai'i Volcanoes National Park (HVNP) has received plants, cuttings, and seeds of PTA stock for three species that had been extirpated there. This genetic material will serve their reintroduction efforts and will provide genetic storage outside of PTA as a safeguard against catastrophic events.

3.2.1 - *Asplenium peruviana* var. *insulare*

Spores: Sporulating fronds from 17 individuals collected from two sites (51 and 52) make up the collection. Dr. Valerie Pence at the Center for the Conservation and Research of Endangered Wildlife at the Cincinnati Zoo and Botanical Garden is conducting spore storage studies.

Plantings: Nellie Sugii of Lyon Arboretum Micropropagation Facility reports 200 sporophytes ready for delivery during the next reporting period (Sugii, pers. comm.). This group represents at least four PTA locations.

MANAGEMENT RECOMMENDATIONS

Develop greenhouse protocol for receiving sporophytes from laboratory. Select possible outplanting sites. Develop outplanting protocol.

3.2.2 - *Haplostachys haplostachya*

Seeds: Four of five sites are represented in storage. Approximately 20,000 seeds are contained in the collection.

Plantings: Six individuals, most in poor condition, are found at one outplanting site.

MANAGEMENT RECOMMENDATIONS

Augment seed collection to improve sampling of natural occurrences. Establish outplanting sites within and outside of PTA.

3.2.3 - *Hedyotis coriacea*

Seeds: Approximately 4,000 seeds from six of the eight sites at PTA (38 individuals) are represented in storage from collections made from 2002-2005. The two sites not in the seed collection (04 and 09) are represented in at least one of the outplanting sites.

Plantings: Currently four outplanting sites contain 102 plants representing all of the eight founder sites from PTA. Forty-two of the plants are adults.

MANAGEMENT RECOMMENDATIONS

Collect seeds from sites 04 and 09 if available during the next reporting period, as well as from other sites that are under-represented in the collection. Add individuals of unrepresented founders to outplanting sites as they become available.

3.2.4 - *Neraudia ovata*

Seeds: In an effort to improve genetic diversity and seedling vigor, twenty-two individuals representing twelve founders are cultivated in the rare plant propagation facility to facilitate pollen transfer. Except for three individuals (0107, 0109, and 0117), each founder is represented by both a male and female specimens. Seed collection has begun from ten of these individuals. Approximately 17,000 seeds are in storage.

Plantings: A total of 152 plants at nine outplanting sites (with at least four founders at each site) are managed by NRS. Twenty two plants are located at four PTA outplanting sites and 130 individuals are on lands managed by the State. Thirty-six plants, representing ten founders, have been given to HVNP for reintroduction into the park. HVNP reports 168 clones have been planted at three sites and 100 more individuals are in propagation (Belfield pers. comm.). Fourteen plants, representing six founders, were given to Amy Greenwell Botanical Garden to aid in a reintroduction effort on lands owned by Queen Lili`uokalani Trust. One of the plants represents the last remaining genetic stock for the Kaloko population.

MANAGEMENT RECOMMENDATIONS

Complete representation of all founders in the greenhouse. Complete founder representation at HVNP as individuals become available. Now that seed is more abundant, provide seed to HVNP for restoration efforts. Complete founder representation at two other outplanting sites on the west side of the island to avoid wide scale loss due to catastrophic events. Prepare an outplanting plan to provide to relevant state agencies to facilitate off-site outplanting on State lands.

3.2.5 - *Portulaca sclerocarpa*

Seeds: Seeds from all known PTA sites are represented in the collection. The vast majority of seed is collected from RPPF specimens because of the small size of the natural population at PTA.

Approximately 25,000 seeds are in storage.

Plantings: Outplanting has not been successful. Three individuals in poor condition remain at two outplanting sites.

MANAGEMENT RECOMMENDATIONS

Continue collections from natural sites when available. Propagate outplanting stock only from RPPF grown seed until a better understanding of outplanting requirements has been gained.

3.2.6 - *Schiedea hawaiiensis*

Seeds: Only one adult plant remains in the wild and does not produce much seed. Four individuals are cultivated in the RPPF for seed collection. Approximately 10,000 seeds are in storage.

Plantings: Six outplanting sites contain 118 plants. Outplants are susceptible to insect and scale damage and browsing by game birds.

MANAGEMENT RECOMMENDATIONS

Rotate stock in the RPPF that is used for seed collection. Utilize field grown seed when possible for RPPF stock as well as outplanting.

3.2.7 - *Silene hawaiiensis*

Seeds: Seeds in storage represent sites 01 and 17 and RPPF grown stock. Approximately 500 seeds are in the collection.

Plantings: No outplanting has been conducted for this species due to its relative abundance at PTA.

MANAGEMENT RECOMMENDATIONS

Augment seed collection to increase sampling of natural occurrences at sites 03 and 29.

3.2.8 - *Silene lanceolata*

Seeds: The collection includes seeds from the RPPF, four natural PTA locations, and three outplanting sites and total approximately 20,000 seeds.

Plantings: Eight outplanting sites contain 258 plants representing genetic stock from Training Areas 22 and 23.

MANAGEMENT RECOMMENDATIONS

Augment seed collection to increase representation of natural occurrences. Establish outplanting site outside of PTA.

3.2.9 - *Solanum incompletum*

Seeds: Approximately 20,000 seeds are in storage from all but one of the ten *S. incompletum* locations (0109). Almost all of those seeds are from two RPPF grown individuals (founder 0101). Three individuals representing locations 0102 and 0106 have recently been added to the greenhouse collection to improve diversity.

Plantings: NRS manages 959 plants at seven outplanting sites. Three PTA outplanting sites contain 150 individuals. The remaining 809 individuals are located on State lands at four different sites. Three locations (eight individuals) are represented; the vast majority being from location 0101.

MANAGEMENT RECOMMENDATIONS

Increase genetic diversity in both the seed collection and outplantings. Some of the natural occurrences contain only one individual making seed collection very difficult. Location 0103 contains six adults but fruit is rarely produced on these plants. Propagules, when available from these problematic locations, should be maintained in the RPPF to facilitate seed collection.

3.2.10 - *Spermolepis hawaiiensis*

Seeds: Approximately 300 seeds from five individuals in Kīpuka `Alalā in addition to several thousand seeds from RPPF specimens are the sources of the PTA seed in storage. PTA RPPF grown seed was given to HVNP during this reporting period for reintroduction into the park and they report approximately 28,000 seeds collected from their greenhouse (Belfield pers. comm.).

Plantings: NRS has attempted two outplantings of this species, with no recruitment to date. HVNP is conducting broadcasting experiments at three sites. Results will be available during the next reporting period.

MANAGEMENT RECOMMENDATIONS

Broadcast experiments at sites with different substrates and moisture regimes may provide insight into some of the requirements for establishing this species. Predation of seedlings by arthropods should be given consideration.

3.2.11 - *Stenogyne angustifolia*

Seeds: Approximately 350 seeds from natural occurrences in Training Areas 19 and 22, two outplanting sites and the RPPF make up the seed collections.

Plantings: Two outplanting sites contain 73 individuals. HVNP received cuttings from the specimen plant in the PTA greenhouse for reintroduction into the park. They report 68 plants at one site and 140 more under cultivation in the greenhouse (Belfield pers. comm.).

MANAGEMENT RECOMMENDATIONS

All outplanted individuals at HVNP and PTA sites are clones of one plant. More work in understanding dormancy characteristics and germination requirements for this species is needed in order to increase genetic diversity at outplanting sites. For this to be accomplished much more seed will be needed.

3.2.12 - *Tetramolopium arenarium ssp. arenarium*

Seeds: Approximately 1,500 seeds are in storage from four locations and two outplanting sites.

Plantings: Three outplanting sites contain 42 individuals. All have reached reproductive status, but outplants appear to be much shorter lived than adult plants in the natural population.

MANAGEMENT RECOMMENDATIONS

Augment seed collection to increase sampling of natural occurrences. Make collections from outplanting sites to augment seed from natural occurrences. Establish outplanting site outside of PTA.

3.2.13 - *Zanthoxylum hawaiiense*

Seeds: Approximately 700 seeds from five individuals are contained in the collection.

Plantings: Sixteen plants are located at five outplanting sites. Growth has been slow at the PTA sites, but seems more promising at the DOFAW's Pu`u Wa`awa`a site where water may be less limiting.

MANAGEMENT RECOMMENDATIONS

With the increased number of individuals found during recent surveys, the seed collection should now reflect a larger sample. Difficulties with germination should continue to be addressed in order to increase outplantings. Establish outplanting sites outside of PTA.

3.2.14 - *Eragrostis deflexa*

Seeds: Approximately 800 seeds from greenhouse stock are in storage.

Plantings: Three outplanting sites contain 97 plants from greenhouse grown seed.

MANAGEMENT RECOMMENDATIONS

Augment seed collection to increase sampling of natural occurrences. Increase the number outplants at the Pu`u Huluhulu site. Establish outplanting at Pu`u Wa`awa`a, if permitted by the State.

3.2.15 - *Tetramolopium sp. 1*

Seeds: Collections have been made from both of the actively managed sites (03 and 04). There is also seed in storage that was collected in 1998 from sites 01 and 02. These sites are considered extirpated. Seed from three outplanting sites are included in the collection. Approximately 3,000 seeds are in storage.

Plantings: Two outplanting sites at PTA contain over 300 plants.

MANAGEMENT RECOMMENDATIONS

Test viability of 1998 collections from locations 01 and 02. Establish outplanting site outside of PTA.

3.3 GERMINATION AND PROPAGATION

INTRODUCTION

To successfully propagate a species, a thorough understanding of its seed dormancy characteristics, its mating system, and its possible reliance on insects or animals for dissemination of pollen and/or seeds is critical. This information is not available for most of PTA's rare plants. In addition to this lack of biological and horticultural information, small population size may reduce seed set, seed viability, germination percentage, and overall seedling vigor (Ellstrand and Elam 1993). This situation is further exacerbated by the intraspecific diversity often exhibited by Hawaiian plants (Wagner *et al.* 1990) and the variable environmental conditions that can affect plant fecundity (Baskin and Baskin 2001).

The methods, results, and recommendations presented here should be regarded as preliminary findings. Due to the large number of variables noted above, it would be unwise to extrapolate these initial results to all populations of these species or even to particular harvests. Many more trials may be necessary to determine a germination protocol for each species. Propagation by cuttings has been attempted when seed germination has proven problematic. Because seeds are unique genetic entities that may exhibit enhanced ecological adaptability efforts have been concentrated on seed germination trials.

Propagation efforts and future restoration activities will benefit greatly from a more thorough understanding of the life history characteristics, the reproductive biology and the ecology of these vulnerable species. It is hoped the findings reported here will serve as a guide for the direction of future inquiries.

3.3.1 - *Asplenium peruviana* var. *insulare*

Propagation of this species is conducted at Lyon Arboretum Micropropagation Facilities. Lyon's Nellie Sugii and Dr. Valerie Pence at the Cincinnati Zoo and Botanical Garden both report good germination of the spores.

3.3.2 - *Haplostachys haplostachya*

Propagation efforts for this species have yielded little success. The physiological requirements to break dormancy are not yet understood. Work will continue with these species during the next reporting period.

3.3.3 - *Hedyotis coriacea*

Seeds are surface sown on perlite/vermiculite (1:1). Time to germination (2-4 weeks) seems to be shortened when temperatures are warmer. Germination occurs in a flush over several days. Germination percentage has been variable (30-80%). Seedlings are very small and growth is extremely slow. Only 5-10% of the seedlings reach outplanting size (4" pots) after approximately 12 months.

This unusually high seedling mortality may be a possible explanation for the absence of recruitment in the field. At PTA the lack of recruitment may be explained by the inhospitable substrate (pāhoehoe) and the harsh environmental conditions, including frost and long periods of drought. However NRS at Makua also reports a similar absence of juveniles for *Hedyotis degeneri* var. *degeneri*. Further research on life history traits and reproductive biology would be helpful in determining the causes of low fecundity.

MANAGEMENT RECOMMENDATIONS

This species may benefit from propagation at a mid-elevation site where temperatures are more moderate.

3.3.4 - *Neraudia ovata*

Germination treatments have included water soak (varying from 2 hours to 2 days), chemical scarification with gibberellic acid-3 (GA-3) at various concentrations, mechanical scarification, stratification, dry heat at 80°C and germination in soil from the field site. In the end, patience is a necessary component of the process. Seeds germinate sporadically over several years.

Lauren Weisenberger at the Lyon Arboretum Seed Storage Laboratory is experimenting with sowing the seeds on agar and storing them in the dark for six months to a year. This technique has worked well for *Neraudia angulata* (Weisenberger, pers. comm.). Results will be available in the next reporting period.

Cuttings have been successful although they do not increase the lack of genetic diversity this species is experiencing. It is hoped that germination success and seedling vigor will increase now that twelve founders are represented in the greenhouse to facilitate pollen transfer and seed collection. Propagules are ready for outplanting in 8-12 months.

MANAGEMENT RECOMMENDATIONS

Continue with germination trials. Now that larger quantities of seed can be collected in the greenhouse, seeds can be sent to Lyon Arboretum Seed Storage Laboratory for seed storage testing.

3.3.5 - *Portulaca sclerocarpa*

Seeds germinate readily. Seeds are surface sown on vermiculite/perlite (1:1). Germination usually begins in three weeks. Plants are ready for outplanting in 6-8 months.

3.3.6 - *Schiedea hawaiiensis*

A 6-8 month after-ripening period before planting is recommended for this species (Weller pers. comm.). Seeds are surface sown on perlite/vermiculite (1:1). Germination has taken from 3-8 weeks. Germination percentage ranges from 2-47%. Seedlings are ready for outplanting in 6-8 months.

Germination success is very erratic with this species, necessitating large numbers of seed to produce a few plants. Three individuals are kept in the greenhouse to facilitate seed collection which is difficult in the field because of the dehiscent seed capsules, small seed size, extended fruiting period and `a`ā substrate.

MANAGEMENT RECOMMENDATIONS

Continue with germination trials, experimenting with different media, temperatures and scarification.

3.3.7 - *Silene hawaiiensis*

Only one trial has been done with this species. No pretreatment seems necessary. Germination occurred within 2-3 weeks and germination percentage was 84%. However seedlings lacked vigor and transplant survival was only 16%. More trials would be needed to determine if this is characteristic of this species. No outplantings have been done with this species.

3.3.8 - *Silene lanceolata*

Halward and Shaw (1996) report varying germination responses. In general, they recommend an after-ripening period of at least 40-60 days. Seeds are soaked in water for one hour and surface sown on vermiculite/perlite (1:1). Germination in the greenhouse usually begins in 10-20 days. Germination percentages range from 16-54%. Plants are ready for outplanting in 6-8 months.

3.3.9 - *Spermolepis hawaiiensis*

Seeds sown in vermiculite/perlite (1:1) emerge in 20-25 days. Germination percentages for field grown seed averaged 90%. Plants under cultivation in the greenhouse recruit themselves continuously throughout the year without regard to season.

3.3.10 - *Solanum incompletum*

Solanum incompletum proved to be the big surprise of 2005! After four years, numerous trials, and over 4,000 seeds sown, almost 700 *Solanum incompletum* germinated in 2005, twice the number germinating in the three previous years combined. Seed flats of the previous years trials had been left to dry out for eight months and when they were rewetted in April 2005 germination began within two weeks. Seeds collected from 1998-2005 germinated. Seed trials began in 2002, 2003, 2004, and 2005 all produced seedlings. Germination percentages were still low, about 18% overall, but encouraging nonetheless. Trays were again dried out this winter and will be rewetted in the spring to determine if seeds might respond to this kind of episodic treatment. Carol Baskin of the University of Kentucky, who has also been testing germination requirements for this species, reports a similar flush in germination after a drying and rewetting experiment (Baskin pers. comm.).

Prior to this year, GA-3 at 375 ppm had been found to stimulate germination in some trials (Yoshinaga pers. comm.). Dr. Baskin also reported that germination was greater at cooler temperatures (15° C day/ 6° C night) in her experiments. In light of this information, seeds are usually soaked in GA-3 for 48 hours and trials are begun in the winter. Seeds are germinated on moistened paper towels or perlite/vermiculite (1:1). Germination can begin after two weeks and continue sporadically over an extended period of several years. Germination percentages range from 0-90%. Once seedlings germinate, they are ready for outplanting in 6-8 months.

MANAGEMENT RECOMMENDATIONS

More work will be necessary to gain a better understanding of the germination requirements of this species. Cooperative efforts with Lyon Arboretum Seed Storage Laboratory and Carol Baskin will be continued.

3.3.11 - *Stenogyne angustifolia*

Propagation efforts for this species have yielded little success. The physiological requirements to break dormancy are not yet understood. Work will continue with these species during the next reporting period.

3.3.12 - *Tetramolopium arenarium* ssp. *arenarium* and *Tetramolopium* sp. 1

No special germination requirements seem necessary for these species. Seeds are soaked in water for one hour prior to surface sowing on vermiculite/perlite (1:1). Seeds usually germinate within 8-10 days. Germination percentages range from 15-72%. These species are susceptible to aphids. Plants are ready for outplanting in 6-8 months.

3.3.13 - *Zanthoxylum hawaiiense*

Propagation of this species continues to be problematic. Seeds are often without embryos. Sporadic germination occurs over an extended period of several years at very low percentages. More work will be done with this species. Seed collection from some of the recently discovered locations will be helpful.

3.3.14 - *Eragrostis deflexa*

No special treatment is needed for this species. Surface sow seeds on vermiculite/perlite (1:1). Germination usually begins in 10-14 days. Germination percentages are usually very high. Plants are ready for outplanting in 6-8 months.

3.4 REINTRODUCTION AND AUGMENTATION

INTRODUCTION

The ultimate goal of rare plant reintroduction at PTA is to increase population abundance in order to avoid wide scale loss due to catastrophic events such as wildfire or volcanic eruptions. PTA houses 80-100% of all the genetic material for nine of its twelve listed species. The sense of urgency to protect these species has necessitated reintroduction to begin with limited biological, horticultural, and historical knowledge. The current outplanting sites are used to validate site selection and planting techniques, to maintain field stock and seed sources, and when successful, as permanent reintroductions.

Except for three species (*Neraudia ovata*, *Tetramolopium arenarium* ssp. *arenarium*, and *Schiedea hawaiiensis*) augmentation has not been undertaken in order to avoid any unanticipated negative impacts on the natural population. Until more knowledge and experience in outplanting has been gained, the preferred strategy is site management (including fencing, weeding, and rodent control). Augmentation was undertaken for the three above mentioned species at locations where the natural population was down to one individual and the risk of total loss was deemed greater than possible negative impacts from outplanting.

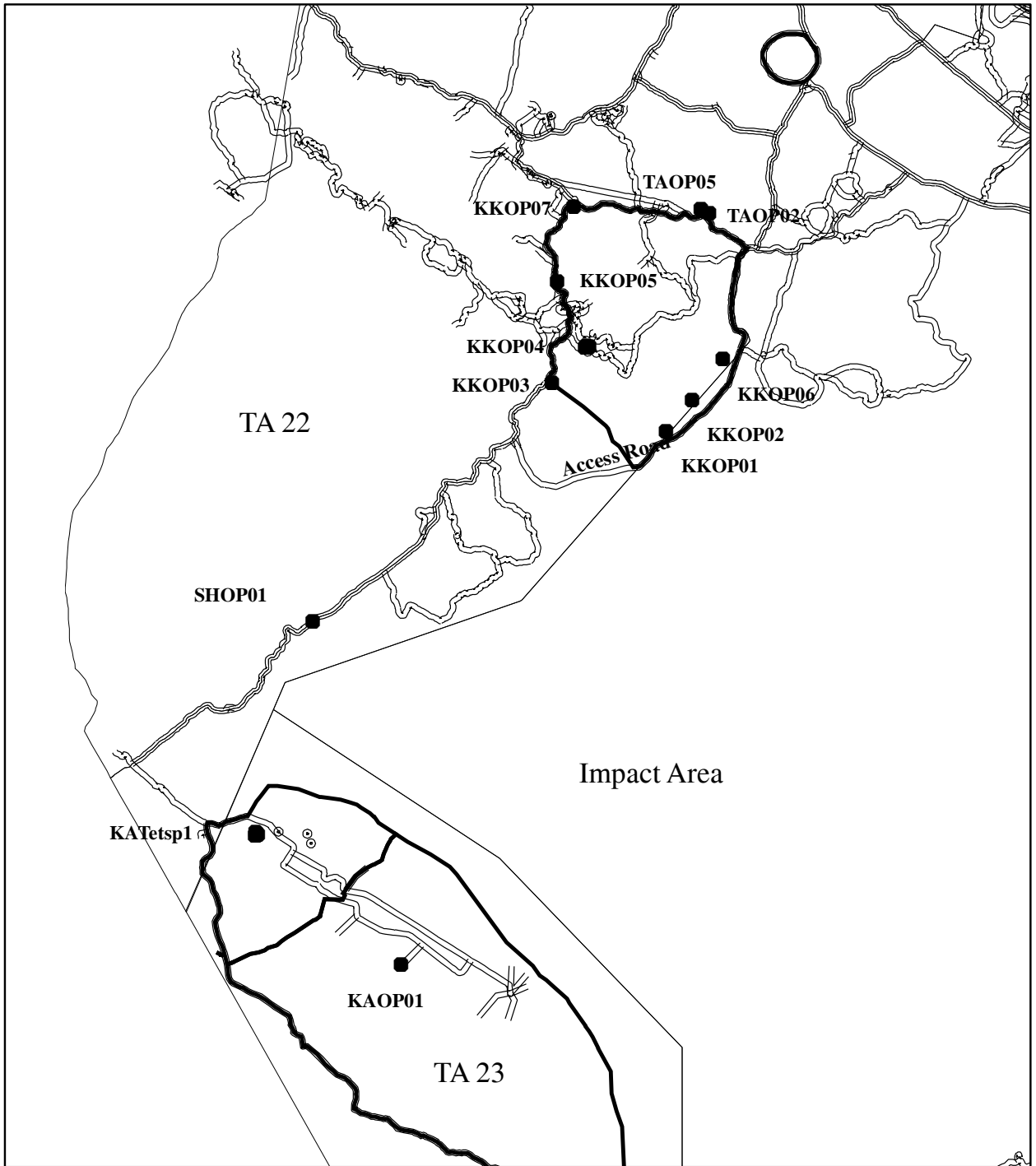
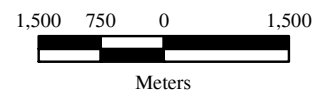


Figure 3.4-1
Outplanting Site Locations

Scale 1 : 86,500



METHODS

Site selection: Several factors influence site selection including historical distribution, habitat preference, and the availability of sites outside of PTA dedicated to long term conservation. Although many of these species are found only at PTA, they have a much broader historical range which includes wide variations in elevation, substrate and community types. Therefore site selection is not limited to the substrates or community types of the extant populations.

Site preparation: Fences are erected if ungulates are still a threat. Weed control is begun several months prior to outplanting. Rodent control is initiated prior to planting at sites that will house *Schiedea hawaiiensis*.

Planting time: Outplanting usually occurs from September through November to take advantage of the seasonal rains.

Propagules: Only propagules grown in the PTA greenhouse are used for outplanting. Plants are grown in accordance with guidelines described in the Rare Plant Outplanting Plan for Pōhakuloa Training Area (Gleason, 2003). Effort is made to balance genetic composition and improve genetic diversity whenever possible. Sites are used for multiple species. Minimum target population for each species is 100.

Watering: Plants receive one gallon of water at planting time, .5 gallons once a week for the next two weeks, and .5 gallons two weeks after that. Supplemental watering is usually not necessary.

Maintenance: Weed control within the site and around the perimeter is scheduled on a quarterly or semiannual basis depending on the site. Because many of the sites are in degraded habitat, weed control is an ongoing endeavor. Common natives are sometimes planted to reduce negative impacts of erosion or to enhance the habitat.

Monitoring: Plants are monitored for threats, at least quarterly, more often when sites are newly planted. Monitoring for phenology, vigor, browse, and survival is conducted after twelve months, and annually thereafter. Plants are numbered so that cohorts may be followed. The survival percentages reported below reflect only plants that have been in the ground for at least twelve months.

RESULTS

Sixteen outplanting sites are currently under NRS management. Twelve are at PTA and four are on State lands managed by Division of Forestry and Wildlife (DOFAW). Except for *Asplenium peruviana* var. *insulare* and *Silene hawaiiensis* all of PTA's listed species have been outplanted. Since 2002, 3200 plants have been outplanted. Of these, 89% are listed as endangered or species of concern. Overall survival at all sites combined averages 62.5% for plants in the ground at least twelve months. Individual site averages and species survival are discussed below.

3.4.1 - Sites TAOP02 and TAOP05 (IMU 216)

INTRODUCTION

These outplanting sites are located in Training Area 19, in enclosures that were constructed for the natural population of *Tetramolopium arenarium* ssp. *arenarium*. At the time of outplanting (2002-2003), one adult and two juveniles remained in TAOP05 and none remained in TAOP02. The sites were used to augment the natural population of *T. a.* ssp. *arenarium* and to gather information on the outplanting requirements of *Spermolepis hawaiiensis*, *Vigna wahuensis*, and *Eragrostis deflexa*.

Plant community: *Dodonaea* Mixed Shrubland

Substrate: Rocky outcrops with ash deposits on old Mauna Kea flows

Elevation: 1668 meters

MANAGEMENT ACTIONS

Except for outplanting and monitoring, management actions at these sites were conducted as part of the larger fencing and weed control efforts for the natural population of *Tetramolopium arenarium* ssp. *arenarium* and are reported as part of IMU 8. *Pennisetum setaceum* has been replaced with *Senecio madagascariensis* throughout this location and poses a severe threat to recruitment for both natural and

outplanted individuals as well as the plant community as a whole. *S. madagascariensis* is controlled at outplanting sites within the designated weed control perimeter.

Table 3.4.1-1. Summary of Management Actions conducted in TAOP02 and TAOP05.

	Hours
Outplanting	48
Monitoring	10

RESULTS

Overall survival at these sites averaged 32%, due in part to the annual life span of *Spermolepis hawaiiensis* and some loss of *Tetramolopium arenarium* ssp. *arenarium* to ungulates. *Spermolepis hawaiiensis*, *Tetramolopium arenarium* ssp. *arenarium* and *Eragrostis deflexa* have all reached reproductive status at this site. No recruitment has been noted for *Spermolepis hawaiiensis* although this may not be unusual for this species which can be absent from the field for several years at a time at PTA. Eight *Tetramolopium arenarium* ssp. *arenarium* seedlings were noted during the 2005 monitoring, but it is not possible to ascertain if they are from the natural seedbank or the result of outplanting. After four years, twelve *Eragrostis deflexa* seedlings were noted in December 2005. Table 3.4.1-2 shows survival by species.

Table 3.4.1-2. Summary of outplanting in TAOP02 and TAOP05.

	Planted	Surviving	Survival	Recruitment
<i>S. hawaiiensis</i>	16	0	0%	0
<i>T. a. ssp. arenarium</i>	31	6	19%	8
<i>V. wahuensis</i>	11	1	9%	0
<i>E. deflexa</i>	48	26	54%	12
Common natives	2	2	100%	0

MANAGEMENT RECOMMENDATIONS

Continue monitoring recruitment to gain more information about seed bank dynamics, viability and longevity for these species. Control *S. madagascariensis* within the weed control perimeter at the outplanting site.

3.4.2 - Site KKOP07 (IMU 212)

INTRODUCTION

KKOP07 is located at the northwest corner of the Kīpuka Kālawamauna Fence Unit. The site of a previous fire, it was planted in 2004 with *Silene lanceolata* and will be utilized in 2006 for *Tetramolopium arenarium* ssp. *arenarium*.

Plant community: *Dodonaea* Mixed Shrubland

Substrate: Rocky outcrops with ash deposits on old Mauna Kea flows

Elevation: 1550 meters

MANAGEMENT ACTIONS

Pennisetum setaceum, *Senecio madagascariensis*, *Tagetes minuta* and *Verbesina encelioides* are the target species for weed control at this site. Predation by alien game birds has necessitated plastic cages around *Silene lanceolata* and *Chamaesyce olowaluana*.

Table 3.4.2-1. Summary of Management Actions conducted in KKOP07.

	Hours	Acres	Gallons
Outplanting	75.5	-	-
Monitoring	105	-	-
Weed Control	89	40.5	107

RESULTS

Overall survival at this site averaged 88%. Table 3.4.2-2 shows survival by species.

Table 3.4.2-2. Summary of outplanting conducted in KKOP07.

Species	Planted	Surviving	Survival	Recruitment
<i>S. lanceolata</i>	26	24	92%	0
<i>C. olowaluana</i>	19	17	89%	0
Common natives	47	40	85%	0

MANAGEMENT RECOMMENDATIONS

Utilize as outplanting site for *Tetramolopium arenarium* ssp. *arenarium*.

Remove all ungulates from Kīpuka Kālawamauna Fence Unit.

3.4.3 - Site KKOP05 (IMU 210)

INTRODUCTION

Before wildfire burned across this rocky hillside along the western edge of Kīpuka Kālawamauna Fence Unit, this site was the location of part of the natural population of *Tetramolopium arenarium* ssp. *arenarium*. This site is also home to a large occurrence of *Stenogyne angustifolia* growing above and on the hillside. The site was planted in 2003.

Plant community: *Dodonaea* Mixed Shrubland

Substrate: Rocky outcrops with ash deposits on old Mauna Kea flows

Elevation: 1555 meters

MANAGEMENT ACTIONS

Senecio madagascariensis is a major threat to this plant community. Because of the dense native vegetation hand clearing is the preferred method of weed control. The steep slope and size of the site, coupled with the large occurrence of *Stenogyne angustifolia* make this a formidable task. Because this outplanting site is within the natural population, only hand weeding around the plants is reported. Other weed control management is reported in Section 2.2.8.

Table 3.4.3-1. Summary of Management Actions conducted in KKOP05.

	Hours	Acres
Outplanting	210	-
Monitoring	26.5	-
Weed Control	185	4

RESULTS

After two years, average survival at this site is 68%. Like many of the other outplanting sites, mortality stabilized somewhat after the first twelve months. During the last monitoring, 94% of the plants recorded in 2004 were found again in 2005. Recruitment was noted by only *T. arenarium* ssp. *arenarium*.

Table 3.4.3-2. List of outplanted species and survival in KKOP05.

Species	Planted	Surviving	Survival	Recruitment
<i>H. haplostachya</i>	10	6	60%	0
<i>P. sclerocarpa</i>	6	1	16%	0
<i>S. lanceolata</i>	125	116	93%	0
<i>T. arenarium</i>	96	33	34%	11
<i>C. olowaluana</i>	35	34	97%	0
Common natives	30	16	53%	0

MANAGEMENT RECOMMENDATIONS

Test protocol for powdery mildew control on the remaining individuals of outplanted *Haplostachys haplostachya*. This problem is fairly widespread in the field and warrants more careful monitoring. Utilize the large occurrence of *Stenogyne angustifolia* as a propagule source for future outplantings.

Try to time weed control efforts before seed set whenever possible. Extreme care should be taken when hand clearing because of the density of the native community and the relatively steep slope of the site.

3.4.4 - Site NOOP01 (IMU 217)

INTRODUCTION

This site at PTA's western boundary lies within a ten acre enclosure on state land that was funded by USFWS. It contained two individuals of *Neraudia ovata*, only one of which is presently extant. Establishment of the site was contracted to Pono Pacific; a 10-acre fence unit, water catchment and irrigation systems were installed, and 169 common natives were outplanted at this site. PTA NRS outplanted 37 plants in November 2005.

Plant community: Open *Metrosideros* Treeland with sparse shrub understory

Substrate: Mauna Loa `a`ā

Elevation: 1375 meters

MANAGEMENT ACTIONS

Outplanting of eight *Neraudia ovata* was undertaken within the 25m weed control buffer zone that had been established around the remaining wild individual. Augmentation was deemed necessary at this site because the death of the male specimen prevents fruit set on the remaining female. Five males and three females were planted. Outside of the enclosure 29 common natives were planted to control dust during helicopter operations. These were enclosed in plastic cages to deter ungulate browse. Because the outplanting is in close proximity to the natural plants, the weed control was reported for the natural population (Section 2.2.14)

Table 3.4.4-1. Summary of Management Actions for NOOP01.

	Hours	Acres	Gallons
Outplanting	33	-	-

MANAGEMENT RECOMMENDATIONS

It may be a few years before the *N. ovata* outplants reach reproductive status. Cuttings should be taken from the remaining adult in the interim to conserve this genetic material.

3.4.5 - Site KKOP04 (IMU 209)

INTRODUCTION

This site consists of four separate locations within close proximity to each other, north of Old Bobcat Trail in the Kīpuka Kālawamauna Fence Unit. Survival at this site has been higher than average. However, with moisture as the limiting factor, growth is slow and no recruitment has been noted since the 2003 outplanting.

Plant community: *Myoporum* Shrubland

Substrate: Pāhoehoe with scattered soil pockets under tree canopy

Elevation: 1585 meters

MANAGEMENT ACTIONS

Pennisetum setaceum control has given way to invasion by *Senecio madagascariensis*. *Chenopodium oahuense* and *Sophora chrysophylla* are also making a comeback. Ungulates remaining in the Kīpuka Kālawamauna Fence Unit still pose a threat. Therefore *Solanum incompletum* at this site has been enclosed.

Table 3.4.5-1. Summary of Management Actions conducted in KKOP04.

	Hours	Acres	Gallons
Outplanting	57	-	-
Monitoring	15	-	-
Weed Control	183	114	223

RESULTS

Overall survival at this site averaged 80%. Table 3.4.5-2 shows survival by species.

Table 3.4.5-2. Summary of outplanting conducted in KKOP04.

Species	Planted	Surviving	Survival	Recruitment
<i>S. incompletum</i>	32	32	100%	0
<i>T. sp 1</i>	66	48	73%	0
Common natives	11	7	64%	0

MANAGEMENT RECOMMENDATIONS

Site may be used as a propagule source for *Tetramolopium* sp 1. Conduct seed trials to determine viability and vigor since no recruitment has been noted.

Comparison of monitoring data of *Solanum incompletum* with reproductive data from other sites may give a better understanding of the tolerances and water requirements for this species.

3.4.6 - Sites KKOP01 and KKOP02 (IMU 206)

INTRODUCTION

These two sites were among the earliest outplanting sites (2002) chosen for *Schiedea hawaiiensis*. Quantities of propagules were very limited at that time and the size of these outplanting sites reflect this. Both sites are along the eastern side of Kīpuka Kālawamauna Fence Unit, about 100m off Access Road. KKOP01 contains fourteen *Schiedea hawaiiensis* and four *Neraudia ovata*, representing four founders (two female/two male). KKOP02 has two *Schiedea hawaiiensis*. Although both sites are within the fence unit, ten of the original fifteen *Schiedea hawaiiensis* outplanted and all of the *Portulaca sclerocarpa* were

lost to ungulates within a few months of planting. Emergency fencing within the fence unit was erected at both sites.

Plant community: Open *Metrosideros* Treeland with sparse shrub understory

Substrate: Mauna Loa `a`ā and pāhoehoe with scattered soil pockets

Elevation: 1650 meters

MANAGEMENT ACTIONS

In addition to weed control, these sites receive routine rodent control because of the *Schiedea hawaiiensis* and *Neraudia ovata* outplantings there.

Table 3.4.6-1. Summary of Management Actions conducted in KKOP01 and KKOP02.

	Hours	Acres	Gallons	Pounds
Outplanting	12	-	-	-
Monitoring	9	-	-	-
Weed Control	27	1	54.5	-
Rodent Control	29	18	-	47.5

RESULTS

Overall survival at this site averaged 49%. Table 3.4.6-2 shows survival by species.

Table 3.4.6-2. Summary of outplanting conducted in KKOP01 and KKOP02.

Species	Planted	Surviving	Survival	Recruitment
<i>N. ovata</i>	4	4	100%	0
<i>P. sclerocarpa</i>	7	0	0%	0
<i>E. deflexa</i>	4	1	25%	2
<i>S. hawaiiensis</i>	26	16	62%	0
Common natives	2	0	0%	0

MANAGEMENT RECOMMENDATIONS

These sites are very small and offer little room for expansion because of the pāhoehoe substrate.

Notwithstanding, they may provide a source for propagule collection for *Neraudia ovata* in the future, although growth appears slow. Seed collection from *Schiedea hawaiiensis* may help to increase genetic diversity in this impoverished taxon. Continue with weed and rodent control efforts.

3.4.7 - Site KKOP06 (IMU 211)

INTRODUCTION

Located about 200m off Access Road on the eastern side of Kīpuka Kālawamauna Fence Unit this site is in a *Myoporum* shrubland but seems to be a remnant of *Chamaesyce olowaluana* Treeland. Plantings were done in 2003 and 2004.

Plant community: *Myoporum* Shrubland

Substrate: Rocky outcrops with scattered soil pockets

Elevation: 1665 meters

MANAGEMENT ACTIONS

Since weed control has been initiated at the outplanting site, there have been many *Chamaesyce olowaluana* and *Dodonaea viscosa* seedlings emerging. Ants, including Argentine ants, infest the area and ant control will be initiated.

Table 3.4.7-1. Summary of Management Actions conducted in KKOP06.

	Hours	Acres	Gallons
Outplanting	124	-	-
Monitoring	25	-	-
Weed Control	136	2	156

RESULTS

Overall survival at this site averaged 64%. *Silene lanceolata* appears to be the species most suited to the site. Although all *Tetramolopium arenarium* ssp. *arenarium* outplants reached reproductive status, they have been short-lived with no recruitment noted. This phenomenon has been noted at other *T. a.* ssp. *arenarium* outplanting sites and may indicate potential difficulties in reestablishing this species. Table 3.4.7-2 shows survival by species.

Table 3.4.7-2. Summary of outplanting conducted in KKOP06.

Species	Planted	Surviving	Survival	Recruitment
<i>H. coriacea</i>	20	14	70%	0
<i>N. ovata</i>	3	2	66%	0
<i>S. lanceolata</i>	59	55	93%	5
<i>S. incompletum</i>	14	13	93%	0
<i>T. arenarium</i>	48	3	6%	0
<i>Z. hawaiiense</i>	2	2	100%	0
<i>C. olowaluana</i>	32	23	72%	0
Common natives	6	6	100%	0

MANAGEMENT RECOMMENDATIONS

Increase number of *Silene lanceolata* at site by 20-50 individuals. Initiate ant control. Several of the species planted at the site are adversely affected by ants and the scale insects they cultivate, notably *Hedyotis coriacea*, *Neraudia ovata*, and *Solanum incompletum*.

3.4.8 - Site KKOP03 (IMU 208)

INTRODUCTION

KKOP03 was created for the 2003 Spring Enrichment Program of Imi Pono No Ka `Aina. Students learned about outplanting techniques and native flora. A second phase of planting was done during the summer of 2003. Most plants were common natives but the site does contain four *Zanthoxylum hawaiiense*.

Plant community: Open *Metrosideros* Treeland with sparse shrub understory

Substrate: Pāhoehoe with scattered soil pockets

Elevation: 1600 meters

MANAGEMENT ACTIONS

Outplanting at this site was completed before this reporting period. Because the substrate is pāhoehoe, weed control is only necessary semi-annually.

Table 3.4.8-1. Summary of Management Actions conducted in KKOP03.

	Hours	Acres	Gallons
Monitoring	10	-	-
Weed Control	24	4	27.5

RESULTS

Overall survival at this site averaged 42%. Table 3.4.8-2 shows survival by species.

Table 3.4.8-2. Summary of outplanting conducted in KKOP03.

Species	Planted	Surviving	Survival	Recruitment
<i>H. coriacea</i>	5	3	60%	0
<i>P. sclerocarpa</i>	4	0	0%	0
<i>Z. hawaiiense</i>	5	4	80%	0
Common natives	41	16	39%	0

MANAGEMENT RECOMMENDATIONS

The plant community at this site is interestingly diverse and in fairly good condition and benefits from weed control efforts which should be continued. The site is adjacent to natural occurrences of *Portulaca sclerocarpa* and *Hedyotis coriacea* and may be utilized for augmentation of these species in the future.

3.4.9 - *Tetramolopium* sp. 1 Exclosure (IMU 215)

INTRODUCTION

A fenced exclosure is located within the northwestern section of Kīpuka `Alalā Fence Unit. This site provides safe haven from the ungulates still present within the larger fence unit. *Neraudia ovata* was planted in 2004 and 2005. Twelve plants (six males and six females) represent seven founders. Adequate moisture appears to be the limiting factor. Growth and vigor are moderate. Although plants had reached reproductive status in the greenhouse prior to outplanting, all reverted to vegetative status in the field. Many have dropped leaves in response to drought stress. This is typical of other outplanting sites with similar environmental conditions.

Plant community: *Myoporum*- *Sophora* Mixed Shrubland

Substrate: Pāhoehoe with scattered soil pockets

Elevation: 1675 m

MANAGEMENT ACTIONS

Spraying and weed whacking for this site has been reported with IMU 31 totals. Weed control in Table 3.4.9-1 reflects hand clearing activities.

Table 3.4.9-1. Summary of Management Actions conducted in the *Tetramolopium* sp. 1 Exclosure.

	Hours
Outplanting	11
Monitoring	8
Weed Control	9

RESULTS

Overall survival at this site averaged 88%. Table 3.4.9-2 shows survival by species.

Table 3.4.9-2. Summary of outplanting conducted in the *Tetramolopium* sp. 1 enclosure.

Species	Planted	Surviving	Survival	Recruitment
<i>N. ovata</i>	12	12	100%	0
Common natives	4	2	50%	0

MANAGEMENT RECOMMENDATIONS

Manage as genetic storage for *Neraudia ovata*.

3.4.10 - Site KAOP01 (IMU 32 IMU 214)

INTRODUCTION

This site is made up of four locations within close proximity in southeastern Kīpuka `Alalā Fence Unit. It was established in 2002 and has been planted every year since.

Plant community: *Myoporum-Sophora* Shrubland with a forb understory

Substrate: Mauna Loa `a`ā, pāhoehoe, and ash deposits

Elevation: 1850 meters

MANAGEMENT ACTIONS

Each location is enclosed with emergency fencing to protect it from the few remaining ungulates within the fence unit. Rodent control is maintained to safeguard *Schiedea hawaiiensis* and *Solanum incompletum*. Alien game birds may also be contributing to predation on *Schiedea hawaiiensis* so small plastic cages surround these plants. *Pennisetum setaceum* and *Ehrharta stipoides* are the predominant alien grass species managed with *Senecio madagascariensis* becoming increasingly abundant. Numerous other alien weeds are present at this site in smaller numbers.

Table 3.4.10-1. Summary of Management Actions conducted in KAOP01.

	Hours	Acres	Gallons	Pounds
Outplanting	108	-	-	-
Fencing	20	-	-	-
Monitoring	12	-	-	-
Weed Control	269	2	188.5	-
Rodent Control	22	2	-	67

RESULTS

Overall survival since establishment of this site averages 59%. The *Tetramolopium* sp. 1 that were outplanted in 2003 have exhibited above average survival (84%) and encouraging recruitment (>200 seedlings). *Solanum incompletum* also appears suited to this site, with some individuals attaining heights of 2m. Winter frosts have been the cause of mortality for *Silene lanceolata*, although four seedlings were noted during the last monitoring period. Table 3.4.10-2 shows survival by species. Total does not reflect 2005 outplanting of forty two *Solanum incompletum*.

Table 3.4.10-2. Summary of outplanting conducted in KAOP01.

Species	Planted	Surviving	Survival	Recruitment
<i>C. olowaluana</i>	12	9	75%	0
<i>F. hawaiiensis</i>	4	2	50%	0
<i>Sch. hawaiiensis</i>	30	18	60%	0
<i>S. lanceolata</i>	75	3	4%	4
<i>S. incompletum</i>	67(42) ¹	63	94%	0
<i>S. angustifolia</i>	3	2	66%	Vegetative Reproduction
<i>Spe. hawaiiensis</i>	16	0	0%	*
<i>T. sp. 1</i>	70	59	84%	>200
Common natives	33	27	82%	0

¹Numbers in parentheses indicate 2005 outplantings not yet monitored for survival.

*Some recruitment in 2004; none in 2005.

MANAGEMENT RECOMMENDATIONS

Removal of all ungulates from the fence unit will permit expansion of this site. Soil pockets are scattered and the necessity of secondary fencing make expansion impractical.

3.4.11 - Site SHOP01 (IMU 213)

INTRODUCTION

This site was first planted in 2002 as the first *Schiedea hawaiiensis* outplanting. Just off Access Road in Training Area 22, the site is adjacent to the location of the only wild group of *Schiedea hawaiiensis* remaining. Seven *Schiedea hawaiiensis* were planted along with four *Zanthoxylum hawaiiensis*. A small amount of *Schiedea hawaiiensis* seed was broadcast at that time.

Plants were healthy and reproductive when they were monitored in July, 2003 and seed was collected. In September, 2003, all *Schiedea hawaiiensis* plants had mysteriously disappeared from the site. The concertina wire surrounding the plants was not in disarray so as to suggest ungulate activity. One *Zanthoxylum hawaiiense* also disappeared and the enclosure surrounding that individual was wide open. The cause of the disappearance has never been ascertained. In June, 2004 eighteen seedlings, presumably from the broadcast seed were noted. Twelve survived in November, 2005 but were being browsed. It is not certain whether game birds, rodents, or insects are the cause of the browse. Rodent control is part of the ongoing management actions at the site.

Four *Neraudia ovata* (two males and two females) representing four founders were planted in 2004. They have shown the most growth of all *Neraudia ovata* outplanted at PTA to date. Like most of the *Neraudia ovata* outplanted, these plants have reverted from reproductive to vegetative status since outplanting.

Plant community: Sparse *Metrosideros* Treeland

Substrate: Interface of Mauna Loa `a`ā and pāhoehoe

Elevation: 1560 meters

MANAGEMENT ACTIONS

Weed control and rodent control have been reported as part of IMU 41 activities. Two acres are managed for rodents at this site. Plants continue to be browsed. It is possible that game birds are also the cause of damage.

Table 3.4.11-1. Summary of Management Actions conducted in SHOP01.

	Hours
Outplanting	12
Monitoring	8

RESULTS

Overall survival at this site averaged 53%. Table 3.4.11-2 shows survival by species.

Table 3.4.11-2. Summary of outplanting conducted in SHOP01.

Species	Planted	Surviving	Survival	Recruitment
<i>N. ovata</i>	4	4	100%	0
<i>Z. hawaiiense</i>	4	3	75%	0
<i>S. hawaiiensis</i>	7	0	0%	12
Common natives	2	2	100%	0

MANAGEMENT RECOMMENDATIONS

Manage as genetic storage for *Neraudia ovata*.

3.4.12 - Pu`u Huluhulu (IMU 201)

INTRODUCTION

The outplanting site at Pu`u Huluhulu in 2002 marked the beginning of PTA outplantings on State lands managed by the Division of Fish and Wildlife (DOFAW). There have been a total of 818 plants outplanted. This is the highest elevation outplanting site managed by NRS. A small planting is located on the east side (location 01) of the pu`u, with the majority of planting occurring on the southwestern slope.

Pu`u Huluhulu was the site of the last known historical reference to *Solanum incompletum* in 1949. It was the site of the first outplanting for this species.

Plant community: Koa/Mamane Montane Dry Forest

Substrate: Mauna Kea cinder

Elevation: 2050m

MANAGEMENT ACTIONS

Fencing of the perimeter of Kīpuka Pu`u Huluhulu was done in conjunction with DOFAW during this reporting period. DOFAW provided fencing materials and NRS provided labor. Dominant weed species controlled include *Senecio mikanioides*, *Stellaris media* and several grasses. *Stenogyne angustifolia* and *Eragrostis deflexa* were outplanted to help stabilize the hillside from erosion.

Table 3.4.12-1. Summary of Management Actions conducted at Pu`u Huluhulu.

	Hours	Acres	Gallons
Outplanting	232	-	-
Fencing	349	-	-
Monitoring	40	-	-
Weed Control	177	1	91

RESULTS

Overall survival since establishment of this site averages 56%. After three years the first sign of recruitment for *Schiedea hawaiiensis* was noted at the east site (01) during the December 2005 monitoring. This is the first recruitment of *S. hawaiiensis* at any NRS outplanting site. Ironically although these plants were among the first outplanted they appear much less vigorous than plants at the other sites.

Table 3.4.12-2. Summary of outplanting conducted at Pu`u Huluhulu.

Species	Planted	Surviving	Survival	Recruitment
<i>E. deflexa</i>	73(9) ¹	37	51%	3
<i>F. hawaiiensis</i>	4	2	50%	0
<i>H. Haplostachys</i>	(6) ¹	-	-	-
<i>H. coriacea</i>	75	18	24%	0
<i>N. ovata</i>	22(20) ¹	15	68%	0
<i>Sch. hawaiiensis</i>	61	41	67%	2
<i>S. lanceolata</i>	33	15	45%	0
<i>S. incompletum</i>	176(196) ¹	143	81%	0
<i>Spe. hawaiiensis</i>	(3) ¹	-	-	-
<i>S. angustifolia</i>	30(47) ¹	24	80%	Vegetative Reproduction
<i>T. sp. 1</i>	49	0	0%	0
<i>V. wahuensis</i>	6	0	0%	0
<i>Z. hawaiiense</i>	2	1	50%	0
Common natives	8	5	63%	5

¹ Numbers in parentheses indicate 2005 outplantings not yet monitored for survival.

MANAGEMENT RECOMMENDATIONS

Hedyotis coriacea is perhaps beyond its elevational range. No further planting of this species is planned at this site. Introduce *Tetramolopium arenarium ssp. arenarium* into this site in 2006.

3.4.13 - Koai`a Tree Sanctuary (IMU 202)

INTRODUCTION

Located about five miles from Waimea on the north side of Kohala Mountain Road, this parcel is one of the last remnants of Koai`a forest. Wind and aridity pose problems for this site. This site was planted in 2003 and 2004 along the southeast side of the fence unit.

Plant community: Koai`a Dry Forest

Substrate: Fine silt loam

Elevation: 1040 meters

MANAGEMENT ACTIONS

Pennisetum clandestinum, *P. setaceum*, and *Senecio madagascariensis* are the dominant aliens controlled. Because *P. clandestinum* becomes almost dormant during the dry season, control of this grass has been accomplished much more easily than at a wetter site. Common natives have been planted to provide a windbreak and to reduce soil erosion.

Table 3.4.13-1. Summary of Management Actions conducted in the Koai`a Tree Sanctuary.

	Hours	Acres	Gallons
Outplanting	222	-	-
Monitoring	36	-	-
Weed Control	163	3	102

RESULTS

Overall survival since establishment of this site averages 65%. *Hedyotis coriacea* and *Schiedea hawaiiensis* have adapted well to the dry windy conditions. Almost all of the *Tetramolopium sp. 1* outplants died after the first year, but they did reach reproductive status. And recruitment, although weak, is visible.

Table 3.4.13-2. Summary of outplanting conducted at the Koai`a Tree Sanctuary.

Species	Planted	Surviving	Survival	Recruitment
<i>H. coriacea</i>	63	48	76%	0
<i>N. ovata</i>	16	16	100%	0
<i>N. breviflorum</i>	6	6	100%	0
<i>P. sclerocarpa</i>	59	2	3%	0
<i>S. lanceolata</i>	27	20	74%	0
<i>S. incompletum</i>	78	72	92%	0
<i>V. wahuensis</i>	7	0	0%	0
<i>B. micrantha</i>	5	5	100%	0
<i>C. olowaluana</i>	6	5	83%	0
<i>E. deflexa</i>	31	30	97%	0
<i>Sch. hawaiiensis</i>	40	31	76%	0
<i>T. sp. 1</i>	69	1	1%	41
Common natives	122	106	87%	0

MANAGEMENT RECOMMENDATIONS

Future plantings should be done in areas that have some northeastern exposure. Too much protection from the wind seems to limit the amount of mist that reaches the plants. During dry spells the mist may be the only source of moisture.

3.4.14 - `Owe`owe (DOFAWIMU 204)

INTRODUCTION

This ten acre enclosure near the 27 mile marker on Hwy 19 is the lowest elevation outplanting site to date. It is one of three ten acre enclosures constructed by USFWS on state lands. A small planting was done in 2004 (66 plants) and again in 2005 (227 plants).

Plant community: Lama (*Diospyros*) Forest

Substrate: Hualālai `a`ā

Elevation: 632 meters

MANAGEMENT ACTIONS

Pennisetum setaceum is the dominant alien in this community with *Nicotiana glauca* making a very aggressive appearance. Weed control efforts have centered around the immediate planting areas though

more wide scale control is needed. Ants and scale insects have been noted on *Neraudia ovata* and *Hedyotis coriacea* and treated with appropriate insecticides.

Table 3.4.14-1. Summary of Management Actions at `Owe`owe.

	Hours	Acres	Gallons
Outplanting	98	-	-
Monitoring	10	-	-
Weed Control	49	5.1	85

RESULTS

Overall survival since establishment of this site averages 95%. Table 3.4.14-2 shows survival by species.

Table 3.4.14-2. Summary of outplanting conducted at `Owe`owe.

Species	Planted	Surviving	Survival	Recruitment
<i>H. coriacea</i>	23	22	96%	0
<i>N. ovata</i>	16(10) ¹	15	94%	0
<i>S. lanceolata</i>	(15) ¹	-	-	-
<i>S. incompletum</i>	16(202) ¹	16	100%	0
<i>B. micrantha</i>	6	6	100%	0
Common natives	5	4	80%	0

¹ Numbers in parentheses indicate 2005 outplantings not yet monitored for survival.

MANAGEMENT RECOMMENDATIONS

Increase numbers of *Hedyotis coriacea* and *Silene lanceolata*. Introduce one of the *Tetramolopium* species to this site. Explore techniques to control *Nicotiana glauca* that is becoming abundant within the enclosure.

3.4.15 - Pu`u Wa`awa`a (DOFAW IMU 205)

INTRODUCTION

This recently completed 70 acre enclosure at the top of the Pu`u Wa`awa`a cone is reclaimed pasture land. There are remnants of `Ōhi`a forest with scattered mamane, pāpala kēpau, and several other natives. The understory is *Pennisetum clandestinum*. Two locations were chosen. The lower site is under the `Ōhi`a canopy. The upper site is open canopy with a few mamane trees. The state has planted several thousand koa seedlings to date. Planting by NRS was done in October, 2005.

Plant community: *P. clandestinum* pasture land with remnant `Ōhi`a forest

Substrate: Fine sandy loam

Elevation: 1112m

MANAGEMENT ACTIONS

Emergency fencing around individual *Neraudia ovata* was necessary soon after planting in order to protect the plants from wild turkeys which were denuding the plants and injuring the stems. Some may not recover but all were enclosed. Control of the *P. clandestinum* here will be more problematic because of the higher rainfall. Grass was sprayed and left in place rather than cleared to minimize erosion and to discourage invasion by other aliens. Spraying the perimeter of the sites will be scheduled quarterly and adjusted as needed.

Table 3.4.15-1. Summary of Management Actions conducted in Pu`u Wa`awa`a.

	Hours	Acres	Gallons
Outplanting	91	-	-
Fencing	40	-	-
Weed Control	29	1	60

RESULTS

A list of the species planted is shown in Table 3.4.15-2.

Table 3.4.15-2. Summary of outplanting conducted in Pu`u Wa`awa`a.

Species	Planted
<i>N. ovata</i>	46
<i>S. lanceolata</i>	11
<i>S. incompletum</i>	180
<i>Z. hawaiiense</i>	6
Total	243

MANAGEMENT RECOMMENDATIONS

This site appears well suited to many of our species in respect to elevation and moisture requirements. Many PTA species are known from the historical record of this area. Continue expanding our plantings here with the hope of some successful permanent reintroductions.

3.5 MANAGEMENT RECOMMENDATIONS

There are several recommendations that have been reiterated many times throughout this report which are also pertinent to these issues of propagation and outplanting. The new fence units that will be initiated in 2006 will greatly aid all conservation efforts by protecting native habitat in addition to individual species. However the effectiveness of the fence units will be compromised if ungulates are not removed in a timely manner. This will eliminate the need for emergency exclosures within fence units and expand outplanting options.

Completion and implementation of a fire management plan will provide much needed protection. In addition fire breaks facilitate access to certain remote areas that require management actions.

Weed control, although perhaps the least glamorous of management actions, is at the foundation of all ecosystem management and restoration efforts. Given PTA's remote location the number of alien weed species is astonishing and new invaders arrive regularly. Efforts by the Army to minimize the risk of alien plant dispersal during maneuvers would lessen one source of this influx. Vigilance on the part of NRS to new and established threats will remain necessary. Outplanting sites will require ongoing weed control if recruitment and ultimate sustainability is to be possible.

Partnerships with the State and other landowners that allows for reintroductions of federally listed species on their lands should be continued and expanded. Limited distribution is the major threat to most of PTA's rare plants. These species would benefit from the establishment of geographically discrete locations not only to avoid loss due to catastrophe but also to take advantage of habitats and environmental conditions that may be more suitable for renewed vigor and future sustainability. The Army would benefit by sharing stewardship of these species with agencies that have conservation as their primary focus.

It is difficult to gauge success in the short term, especially for species with seeds that require several years to germinate and several more years to produce offspring. Continued experimentation and commitment are essential to the process. Hawaiian endemics are renowned for their adaptability. It is this trait that will be needed if they are to overcome their present difficulties. It is also a trait that those entrusted with their conservation would be wise to emulate.

CHAPTER 4: SUPPORT OF THE BIOLOGICAL ASSESSMENT AND OPINION

4.1 INTRODUCTION

The Biological Assessment (USAG 2002) and Biological Opinion (USFWS 2003) identified areas of PTA that are to be protected by large-scale fence units. There are several issues to be addressed to prepare for fence construction. The issues include: determination of fence lines, property boundary determination and surveys, natural and cultural resource surveys, renegotiation of state lease agreements, writing and publishing an Environmental Assessment, and funding a budget for materials, supplies, and personnel. These issues must be addressed by appropriate personnel and agencies or departments within CEMML, the State of Hawai'i, and the US Army Garrison – Hawai'i.

4.2 ISSUES ADDRESSED BY CEMML

CEMML, as a contracted agency, is limited in the issues it can address related to conducting large-scale fencing. Within CEMML's authority or responsibility are the determination of fence lines, determining property boundaries from state and federal agency surveys, surveying of the proposed fence lines for federally listed plant and animal surveys as well as archaeological resources, and once funded, providing materials, supplies, and personnel.

4.2.1 Determination of Fence Lines

Listed plant locations and sites to be protected were identified during consultations between the US Fish and Wildlife Service and Natural Resource Managers representing PTA. The plant locations and habitat identified for protection were addressed in the Biological Assessment (USAG-HI PTA 2002) and Biological Opinion (USFWS 2003).

From those documents Natural Resource Managers coordinated with Cultural Resource Managers to prepare preliminary routes for the fence lines (Figure 4.2.1-1). In May 2004 a survey in Training Area 22 and 23 was conducted along the boundary of these training areas and the Impact Area. Further surveys awaited the finalization of the Environmental Assessment (EA).

4.2.2 Preparation of a Programmatic Environmental Assessment

The CEMML staff was tasked by the Army Biologist with the preparation of an EA for the construction of large-scale fence units for the west, north, and east side of the Installation. During the reporting period the document was brought to a draft status and awaited contributions by the Cultural Resources Staff.

4.3 ISSUES REMAINING TO BE ADDRESSED

4.3.1 Fence Line Surveys

Once a finding for the EA has been issued surveys for natural and cultural resources can be conducted. Surveys can be addressed the Natural and Cultural Resource Managers at PTA.

4.3.2 Property Boundaries

The PTA boundary with neighboring landowners is uncertain. The boundary needs to be clarified to ensure that the fence units once constructed are within the borders of PTA and not encroaching on neighboring lands. Natural Resources Managers at PTA can propose resolution of this issue but ultimately the decision to proceed has to be made by the Garrison's Real Estate Office.

4.3.3 Lease Agreements

Training Areas 1-20 as well as portions of 21 and 22 are state lease land. The lease agreement between the State of Hawai'i and the US Army is pre-dates the Endangered Species Act and does not provide for the placement of permanent structures, such as large-scale fence units.

There are important listed plants found on the lands leased from the State of Hawai'i. The current lease, negotiated in 1965, does not allow for the construction of large-scale fence units. Resolution of this issue is important to proceed with the provisions of the BA and BO. Lease agreements must be renegotiated by the State of Hawai'i and the Garrison's Real Estate Office.

4.3.4 Funding of the Fencing Program

Funding of a fencing program is of extreme importance as well. Without proper funding the provisions of the BA and BO cannot be satisfied by the established timelines. Funding for this will have to be provided by the Garrison through DPW and eventually to CEMML.

4.4 RECOMMENDATIONS

Clear time-lines for the completion of large-scale fence units and ungulate removal were provided in the BO. Fence units are required to be completed by December of 2008 and ungulate removal by December of 2010. Failure to meet these time-lines has the potential to expose the Army to litigation from third party organizations and negatively impact the training mission at PTA. Therefore, the fencing program should be given the highest priority to ensure the training mission continues.

CHAPTER 5: RESEARCH PROJECTS

5.1 INTRODUCTION

5.2.1 - *Pennisetum setaceum*

INTRODUCTION

Pennisetum setaceum is a very invasive weed and one of the most critical threats to rare plant habitat at PTA. It alters ecosystems by out competing native flora for the limited nutrients available and creating a fire regime where there is not one historically. Native species have no natural defense against its aggressive growth and regeneration rates, and are not fire adaptive as fountain grass is. Areas on PTA devastated by wildfires in 1994 and 1999 are now predominately *Pennisetum* grasslands (Shaw and Castillo 1997) with scattered and shrinking pockets of native flora. Therefore, a majority of weed control practices involve eradicating this invasive grass. Prior to this research project, the standard method for eradication was to cut the grass to stimulate growth followed up with applying herbicide at an appropriate stage of regrowth on a later date. However, constant regeneration of *P. setaceum* and having to re-visit sites multiple times for further herbicide applications limits overall productivity. Conducting research on this species is critical in finding more efficient methods to control the continued spread and threat to the survival of rare and endangered plants here at PTA. Additionally, higher efficiency equates to more restored habitat.

Table 5.2.1-1 Summary of Management Actions
for *Pennisetum setaceum* research.

	Hours
Weed Control	34.5
Monitoring	74.5

METHODS

The initial research project started in April 2004 and ran through July 2005; and was located at the southwestern base of Pu`u Leilani in Training Area 18. Research focused on finding the most efficient method for controlling *P. setaceum* by comparing various eradication methods. The highest priority was to compare spraying initially versus cutting initially. Sixty-eight plots measuring 25 square meters were set up to compare 16 different combinations of eradication methods, including light vs. heavy spraying, high vs. low cutting and 1% vs. 2% glyphosphate herbicide application. Also, timing of cutting and spraying by 25%, 35% and 50% regeneration is factored into creating 16 combinations. Four plots were designated for each method for statistical power. Plots were visited regularly over the course of the study period and data collected on mortality and regeneration. Spraying and cutting were performed based upon the study protocol.

RESULTS

Table 5.2.1-2 Results of *Pennisetum setaceum* control trials.

Method	Avg. Time/Plot (min:sec)	Avg. Time to Regeneration
Initial spray	6:40	7.5 months
Initial spray, Cut dead material	13:54	4.5 months
Initial low cut, Heavy spray @ 35% Regeneration	21:39	7 months
Initial high cut, Heavy spray @ 35% Regeneration	13:18	4.5 months
Initial high cut, Heavy spray @ 25% Regeneration	12:31	5.5 months

Table 5.2.1-2 compares the results of the five most successful treatments in terms of providing complete kill and longest time for regeneration to occur. The other methods were not considered for various reasons. Timing to apply herbicide at 50% regeneration took too long, as regeneration had gone to seed and many plots never attained that goal. Applying a 1% concentration of glyphosate herbicide did not provide complete kill. Finally, heavy spraying was much more effective than light spraying.

DISCUSSION

The research provided both positive and incomplete results. The positive result was discovering that initially spraying does work effectively in our dry climate. This is the practice believed to be most effective by many agencies in Hawai'i for controlling *P. setaceum*. Prior to this research study, the belief was that the climate at PTA is too dry and the plants not green enough to effectively intake the herbicide. The findings resulted in altering the method for eradicating *P. setaceum* to initial herbicide application followed up by cutting dead material. This allows for greater flexibility in planning and scheduling. The incomplete results were that the research project was initially designed for long-term monitoring and management. The microclimate where the research was conducted appears to be one of the driest on all of PTA, resulting in regeneration rates much lower than in a majority of our IMU's. Therefore, the research here is not representative for long-term management for all of PTA.

MANAGEMENT RECOMMENDATIONS

Because regeneration occurred in all methods for eradication during this study, the focus of *P. setaceum* research has now shifted to understanding why regeneration occurs within the species. Currently, a research study is being developed to monitor the root systems of *P. setaceum* to see if plants are not completely dying or if remaining dead plant material provides an ideal setting for new seedlings.

5.2.2 - IMU Monitoring

INTRODUCTION

The primary management action implemented for PTA's highest priority plant species is weed control, focusing on *Pennisetum setaceum*. This project was intended to supplement the data gained through the rare plant monitoring program. The goal is to monitor the effects of *P. setaceum* control in IMU's around natural populations of priority plant species. Monitoring will focus on determining habitat change within the weed control area specifically looking at changes in vegetation cover, species diversity, and woody species densities.

METHODS

Monitoring was conducted using 10 x 25-meter plots as in the Kīpuka `Alalā Vegetation Monitoring Program (KAVMP) (Jacobi 2001). One treatment plot was placed within one randomly selected *P. setaceum* managed area per vegetation type. Plots were located 10 meters from the southern most edge of and within the *P. setaceum* managed area and were oriented to the north. A control plot was established in an untreated area 100 meters south of the management plot, assuming it is still within the same habitat type.

Plots were established using three 25-meter transects spaced five meters apart. The start and end of each transect are marked with rebar painted blue and blue flag. Transects are numbered one through three from the east to west. The plot was further subdivided into ten, 5 x 5-meter subplots. All plot locations have been recorded with a GPS.

Photo points were established at each monitoring plot. Photo points 25 meters apart were established using the center transect of the monitoring plot. Photos were taken from the start and end of the central transect towards the opposite direction. Photo points are retaken at every monitoring interval.

Species Diversity: All plant species within the plot or within five meters of the plot perimeter were identified and recorded. Species found only outside the plot were indicated on the data sheet.

Understory Species Cover and Ground Cover: Species cover, up to two meters in height, was sampled using the pole-intercept method at 0.5-meter increments along the transect. Ground cover was recorded using the KAVMP categories with the addition of category for dead *P. setaceum*.

Woody Species Counts: Woody plant counts were conducted for the ten, 5 x 5 meter subplots. Only

individuals with a stem height of at least five centimeters were counted. Individuals were recorded using the stem length classes and protocols as those used for the KAVMP. Only individuals rooted within the subplot were counted. If a species is rooted on the dividing line between subplots the monitor determined in which subplot the greater percentage of the plant is rooted and the plant will be counted in that subplot. The same method was used in determining if a plant was in the plot.

RESULTS

Table 5.2.3-1 IMU Monitoring Project.

Year	Sites	Plots	Hours
2004/5	4	8	81

Species diversity varied between vegetation types with no noticeable difference between control and treatment plots. There was a distinct difference in *P. setaceum* cover for all plots. This result was expected as it is the species targeted during weed control. Control plots averaged 32% live *P. setaceum* cover compared with 9.5% in treatment plots. There was no difference in cover of any of the other species encountered in the plots. Woody species counts didn't show a difference in any one species between control and treatment plots. As the woody species are slower growing than grasses and herbaceous species there is an expected delay in the response to weed control. Additional monitoring will provide a better understanding of what affect weed control has on the habitat utilized by our managed rare species.

MANAGEMENT RECOMMENDATIONS

This project is intended to supplement rare species monitoring and is intended to assess habitat changes related to Management Actions. To this point, there is no statistically difference between the control and treatment plots. The data will be able to indicate changes in the vegetation over time between the control and treatment areas. Monitoring should be repeated annually in the spring or summer to accurately identify the annual plants.

5.2.5 - Education and Volunteers

INTRODUCTION

Public outreach and education are an important component of natural resource work. PTA has been involved in a unique partnership with the U.S Fish and Wildlife Service and the U.S. National Park Service to provide educational programs to the public through Imi Pono No Ka `Aina. In addition to activities lead by Imi Pono No Ka `Aina, PTA has hosted several community groups for service and learning projects and PTA staff has attended public forums to disseminate information regarding our natural resource program.

DISCUSSION

During the reporting period Imi Pono No Ka `Aina coordinated with PTA NRS to conduct summer and spring enrichment programs, teacher workshops and county fair and Earth Day displays. Summer programs were conducted in 2003, 2004 and 2005 and 63 children from around the island participated. Each summer group spent the night at PTA. Nineteen children were involved in the spring enrichment programs in 2004 and 2005. The children learned about scientific drawing, leaf morphology, plant classification, native vs. invasive species and lessons regarding the uniqueness of endemic species of Hawai`i. Groups also participated in service projects involving hand clearing weed from around listed plant species.

Three invasive species Teacher's Workshops were held during the reporting period. A total of 43 teachers attended the three classes. Teachers learned how to identify weed species using a simplistic key, make scientific drawings, compare intact and invaded habitats, and how to use pole intercept methods to determine community structure. Teachers also participated in hand clearing around listed plant species.

In conjunction with the Imi Pono No Ka `Aina partners, PTA NRS attended to the displays at the County Fairs. In 2003, three PTA NRS spent a total of twelve hours entertaining questions from the public and

being entertained by the public's comments regarding natural resources. In 2004, 15 PTA NRS spent 30 hours staffing the public display. Also, in 2004 one PTA NRS assisted at an Earth Day display at University of Hawai'i, Hilo. Information regarding PTA natural resources and our program were disseminated to the UH Hilo students.

PTA NRS has also hosted various community groups. The Hilo Community College has made two trips to PTA bringing a total of 14 students to learn about the environment and to assist in hand clearing weeds from around *S. lanceolata* in Training Area 23.

In 2005, PTA NRS established two permanent vegetation sampling teaching plots in Training Area 22. These plots are designed to monitor the vegetation inside a weed control buffer and in surrounding uncontrolled vegetation. Our first group to use the teaching plots was Hilo High School Junior Greenpeace in 2005. Five students and two adults learned about vegetation sampling techniques and they plan to return to continue the monitoring over several years.

To continue outreach to the general public, PTA NRS lead Earth Day tours in Training Area 22 in 2004 and 2005. Two tours of 10 people were conducted through the 'Ōhi'a forest each year. People were shown *S. lanceolata*, *H. coriacea*, *S. angustifolia*, and common native plants. Tours were guided through weed control areas to high light PTA NRS management efforts.

Table 5.2.5-1 Summary of public education and outreach activities.

Event	Date	Staff Hours	Group Type	Number of People
Summer Program	7/21/03	12	Students	12
County Fair	9/18/03 to 9/21/03	32	Public Outreach	
Teacher Workshop	3/13/04	18	Teachers	15
Spring Program	3/31/04	8	Students	7
Teacher Workshop	4/24/04	18	Teachers	11
K`āū Summer Program	7/12/04	16	Students	3
Summer Program	7/14/04	16	Students	25
County Fair	9/16/04 to 9/19/04	320	Public Outreach	
Earth Day Booth	4/22/04	6	Public Outreach	
Earth Day Tours	4/22/04	8	Public	20
HCC Service Trip	11/6/04	18	Students	8
HCC Service Trip	3/19/05	12	Students	6
Spring Program	3/23/05	16	Students	12
Teachers Workshop	4/2/05	24	Teachers	17
Earth Day Tours	4/22/05	16	Public	20
Summer Program	6/29/05	8	Students	23
Hilo High Jr. Greenpeace Club	11/12/05	12	Students and Teachers	7
Totals		600		186

RECOMMENDATIONS

Imi Pono No Ka `Aina is an integral part of the public outreach program at PTA. Continued support for this program is essential for continuing to involve the school-aged segment of our community. Expand opportunities within the community for volunteer and educational groups. Continue with public outreach activities such as Earth Day tours to allow the public to witness the management activities and endangered species PTA NRS and the Army are working to protect.

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