Chapter 2.1.0: RARE PLANT STABILIZATION PLAN STATUS

General Rare Plant Issues

This section includes a discussion on the taxon status, genetic storage, outplanting and threats for each rare plant taxa covered by the MIP. The requirements for stabilization are to achieve a stable number of mature plants, have a population structure which can maintain that number of mature plants, obtain full genetic storage, and control all observed threats at each MFS PU. This will be done by implementing Population Unit (PU) and Management Unit (MU) management at all of the 'Manage for Stability' PUs. The most current list of the MFS PUs were proposed in the 2006 Status Report. Management designation changes discussed at last years IT meeting have been incorporated in this year report. In addition, NRS have included a Stabilization Plan for *Gouania vitifolia* that was found to require stabilization by the 2007 Mākua Military Reservation Biological Opinion from the USFWS. General rare plant issues are discussed below followed by 27 Species Status Summaries for each of the MIP taxa and the Stabilization Plan from *Gouania vitifolia*.

Propagation infrastructure

NRS has been working with NARS on the construction of an additional shade-house at the Pahole Mid-elevation Nursery. The frame and ground work is largely complete and NRS expect to have the shade cloth attached and benches and irrigation infrastructure complete in the next year. NRS has continued to work with State NARS Horticulturist, Doug Okamoto, on projects at the Pahole Mid-Elevation Nursery and on stock from Pahole NAR. Mr. Okamoto has been extremely valuable in providing assistance in maintaining stock and providing expertise on propagation and outplanting. He has been maintaining critical stock from the Pahole NAR at the Pahole Mid-Elevation Nursery and at Lyon Arboretum. NRS continue to use two plant growth chambers at the Schofield baseyard for germination and early stage propagation.

Research Issues

Research issues related to propagation and threats are discussed in detail in Chapter 5 Research Activities and in the Species Status Summary for each taxon. NRS had identified several propagation research projects in the last year. In particular, methods to produce seed from greenhouse collections of *Dubautia herbstobatae, Viola chamissoniana,* and *Schiedea obovata* were to be studied. These projects were successful in determining pollination techniques and producing viable seeds from hand-pollination and these methods will be utilized for producing propagules for meeting genetic storage goals in the coming years. In addition, research on determining the best collection and storage techniques for *Cyanea superba* subsp. *superba* showed that mature seeds which are collected and dried can be germinated and stored with greater success than previously observed collections.

Living Collections

NRS has identified several MIP taxa that would benefit from having a living collection of plants for genetic storage, propagation, and threat control research. In the last year, NRS began preliminary discussions with Office of Hawaiian Affairs (OHA) about expanding sites at Waimea Botanical Garden. During a site visit, potential planting sites for several taxa were discussed and a proposal will be submitted to OHA in January 2008, once the transfer of management from the Audubon Society is complete. This site can be used to hold stock from

PUs where threat control is not yet in place, produce propagules for genetic storage and conduct propagation research.

Monitoring

NRS was unable to fill the Monitoring Program Manager Position. In the next year, NRS will contract Jim Jacobi (USGS Botanist) to address monitoring issues, develop monitoring protocols, oversee implementation of sampling methods, and begin analysis.

In the absence of a Monitoring Manger NRS was involved in a limited number of projects including the three discussed below. First, intensive monitoring of *Sanicula mariversa* to begin to collect demography data and develop Population Viability Analysis (PVA) models for the species to better guide management (see Chapter 2.1.23). Second, the deployment of weather stations at *Phyllostegia kaalaensis* reintroduction sites to measure micro site variation and begin to collect environmental data that may be important for developing future reintroduction plans (see Chapter 2.1.20). Finally, this year NRS began a trial vegetation mapping project for Mākua Military Reservation with help from the Jim Jacobi and Stephen Ambagas, of USGS. The two objectives of this project are to prepare a detailed vegetation map focused on the northwestern section of the Mākua Action Area and conduct a pilot study using very high resolution multi-spectral imagery to map the distribution and abundance of selected native and alien plant species in Kahanahāiki and ʻŌhikilolo management units. The vegetation mapping will follow methodologies developed by S. Ambagis and J. Jacobi and will utilize the object-based classification software eCognition with IKONOS and QuickBird satellite imagery as well as very high resolution digital image data. This data is collected with a multi-spectral camera mounted on a helicopter to be flown over Mākua Valley.

In March of this year, high resolution (15-20cm) imagery was collected with a multi-spectral camera and other equipment brought here from the mainland. Unfortunately, the weather was not optimal for collecting data and many of the areas covered are not useful because of cloud shadow. To supplement this data lower resolution Quickbird (MS 2.6m) and IKONOS (MS 4m) data will need to be used in more areas than initially planned. The imagery has been processed and S. Ambagis is looking at it along with the Quickbird data. S. Ambagis is working on coming up with spectral signatures for the different plant species that could be identified in the images. NRS is assisting by collecting ground data on areas identified by S. Ambagis. In August 2007 a meeting was held to go over some possible signature areas and to confirm these sites with NRS knowledge of the ground in those areas. NRS and USGS-BRD continue to move forward with this project, and are planning to use it to stratify monitoring plot placement in the near future. NRS are interested in other very high-resolution imaging systems currently being developed that can be deployed in Hawaiʻi such as the project being led by Dr. Greg Asner of the Carnegie Institute (Asner et al. 2007).

Stabilization Strategy

This is the third year that NRS has used the stabilization strategy for designing rare plant management. The new stabilization species *Gouania vitifolia* was analyzed with the strategy described previously (OANRP 2006) and a draft stabilization plan is included here (Chapter 2.1.12).

Example of Species Status Summary

The species status summary outlines all PU work conducted for each of the 28 MIP taxa. Each species summary has the same format. Each section is explained in detail in the example below:

Requirements for Stability: This section defines requirements for reaching stability for each taxon.

- 3 Population Units (PUs) are designated for all species. However, for species meeting the following criteria 4 PUs have been designated:
  - with presence in both Makua Action Area (AA) and Schofield AA (Example: *Plantago princeps*)
  - for species occurring in the high fire threat area of the Makua AA (Example *Chamaesyce celastroides*)
  - for taxa that have no extant wild PUs and therefore rely completely on reintroduction for stability (Example *Cyanea superba*)
- [25-100] reproducing individuals in each PU (justification based on the number of individuals, average life span, life form, and other factors from the final MIP)
- Threats controlled: may include fences, weed control, arthropod and rodent control
- Complete genetic representation of all PUs in storage: may include nursery living collections, seed storage, and tissue culture storage
- Expedited Stabilization: (5 or 10 yrs) Expedited Stabilization is required for 12 species identified in the 2007 Biological Opinion (BO). Expedited stabilization actions will not begin until NRS receive the additional funding needed to accomplish these new goals.

How many of the 4 MFS PUs have stable numbers of mature individuals?	How many of the 4 MFS PUs have had *in situ* recruitment?	How many of the 4 MFS PUs have full genetic storage?	How many of the 4 MFS PUs are protected from ungulates?	How many MFS PUs that need reintroductions have been initiated?
2/4	3/4	1/4	1/4	0/2

This table provides a general overview of progress on the stabilization of the MFS PUs for each species. The second and fifth questions have changed slightly to reflect shorter term assessments of the long term goals outlined in the 20 year MIP plan.

Taxon-Level Discussion

The taxon-level discussion covers the topics below related to taxon status:

- Are any of the threats controlled for all or any of the PUs? Is there a trend in threat levels at the PU that warrant a management change?
- Does the taxon or any of its' PUs have stable numbers of reproducing individuals? Stable population structure?
- Are any of the PUs in need of reintroduction or augmentation? If so, has this begun? How is it going?
- Are there significant propagation or genetic storage issues?
- Are there new taxonomy issues?
- General prognosis for the taxon given current threat control trends.

Example 'Taxon Status' Table

Table 2.1.2a Taxon Status Summary

Action Area: In

TaxonName: Cenchrus agrimonioides var. agrimonioides TaxonCode: CenAgrAgr

Population Unit Name	Management Designation	Current Mature (Wild)	Current Immature (Wild)	Current Seedling (Wild)	Current Augmented Mature	Current Augmented Immature	Current Augmented Seedling	NRS Mature 2006	NRS Immature 2006	NRS Seedling 2006	Total Mature	Total Immature	Total Seedling	Population Trend Notes
Kahanahaiki and Pahole	Manage for stability	81	11	7	227	30	2	311	47	31	**308**	**41**	**9**	Some reintroductions have died in the last year.
	Total for Taxon:	81	11	7	227	30	2	311	47	31	**308**	**41**	**9**	

Action Area: Out

TaxonName: Cenchrus agrimonioides var. agrimonioides TaxonCode: CenAgrAgr

Population Unit Name	Management Designation	Current Mature (Wild)	Current Immature (Wild)	Current Seedling (Wild)	Current Augmented Mature	Current Augmented Immature	Current Augmented Seedling	NRS Mature 2006	NRS Immature 2006	NRS Seedling 2006	Total Mature	Total Immature	Total Seedling	Population Trend Notes
Central Ekahanui	Manage for stability	30	3	16	52	1	0	86	3	16	**82**	**4**	**16**	Some reintroductions have died in the last year.
Makaha and Waianae Kai	Manage for stability	12	0	0	0	0	0	14	0	0	**12**	**0**	**0**	This is a real decline due to ungulate impacts.
South Huliwai	Genetic Storage	21	0	0	0	0	0	21	0	0	**21**	**0**	**0**	No monitoring in the last year.
	Total for Taxon:	63	3	16	52	1	0	121	3	16	**115**	**4**	**16**	

This table displays the current status of the wild and outplanted plants in each PU and the 2006 population estimates for comparison. The extant PUs are grouped into those in and out of the AA, and new PUs established via reintroductions.

Mākua Population Unit Name: PUs' names are based on decisions made at the January 2006 MIT meeting. Only PUs designated to be Manage for Stability (MFS) or Genetic Storage (GS) are shown in the table. Other PUs with No Management designations are not monitored or managed and will not be reported. Reintroductions for stability or storage which have not yet begun are shown in the table with zeros for population numbers.

Management Designation: The Management Designation for each PU is based on decisions made at the January 2006 MIT meeting. Naturally occurring PUs are either MFS or GS. In the case where reintroduction is going to be used to reach stability the designation is Manage Reintroduction for Stability. The 'manage as a propagule source' that was used in the 2006 Status update has been eliminated. This designation was used to identify PUs from which stock would be used for reintroduction into other sites. In most cases, PUs that had this designation have been labeled as GS and the intent of the previous designation is preserved. When four MFS PUs are designated the justification is given in the discussion.

Current Mature, Immature, Seedling (Wild): The first three columns reflect the most up to date population estimates of the wild plants in each PU. In most cases these numbers are generated from NRS monitoring data, but data from the O'ahu Plant Extinction Prevention Program (PEP) and State NARS staff are used for some PUs. The current estimates reported may have changed from last year if new monitoring data was taken or if the PUs have been split or merged since the last reporting period. If no additional monitoring was conducted in the last year, the estimate given in the 2006 Status Report is used.

Current Augmented Mature, Immature, Seedling: The second set of three columns display the numbers of individuals NRS and partner agencies have outplanted into each PU. In most cases, the number represents augmentations into the existing PU rather than reintroductions of genetic stock from that PU into other areas. While most augmentations of a PU will be from genetic stock from that PU, there are exceptions discussed in the text.

NRS Mature, Immature and Seedling 2006: NRS reports the ***sum** of the number of wild and outplanted* mature, immature plants and seedlings observed, as reported in the *Taxon Status* Table for each PU in the 2006 MIP Status Report. For new populations discovered since the 2006 MIP Status Report, this column is left blank. If a PU was split, thus creating a new population division, a zero is used in order to distinguish it from entirely new PUs which are left blank.

Total Mature, Immature, Seedling: The sum of the current numbers of Wild and Augmented plants in each PU. This number will be used to determine if each PU has reached the goal for the number of mature individuals required for stability. These three columns should be compared with the NRS 2006 estimates to determine the trend for each PU in the last year.

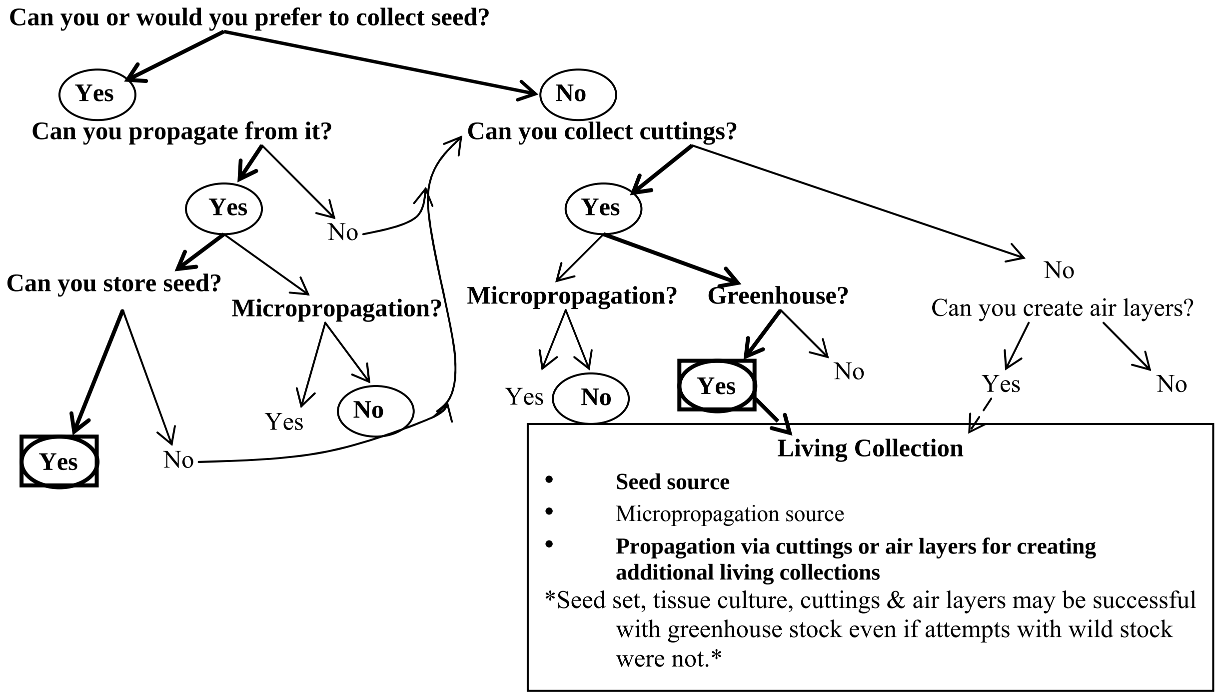
Population Trend Notes: Comments on the general population trend of each PU is given here. This may include notes on whether the PU was monitored in the last year, a brief discussion of the changes in population numbers from the 2006 numbers to the current ones, and some explanation of whether the change is due to new plants being discovered in the same site, a new site being found, reintroductions or augmentations that increased the numbers or fluctuations in the numbers of wild plants. In some cases where the numbers have not changed, NRS has monitored the PU and observed no change. In other cases when the PU has not been monitored, the number from 2006 is used.

Propagation and Genetic Storage

This section provides an overview of propagation and genetic storage issues. In most cases, seed storage is the preferred genetic storage technique; as it is the most cost-effective method, requires the least amount of maintenance once established, and captures the largest amount of genetic variability. For taxa that do not produce enough mature seed for collection and testing, micropropagation is considered the next best genetic storage technique. The maintenance of this storage method is continual, but requires much less resources and personnel than establishing a living collection. For those taxa that do not produce seed that can be stored and cannot be established in micropropagation, a living collection of plants in the greenhouse or an *inter-situ* site is the least preferred genetic storage option. This is because these plant collections are the least secure and most expensive and time consuming method. The format includes the table and flow chart shown below, followed by brief text discussions of collection, propagation, seed storage research and genetic storage. Extensive information for these fours sections was provided in the 2006 Status Report that summarized propagation and genetic storage progress to date. If there was no new information for this year, the 2006 Status Report has been cited for background information.

1) At this time, what is the preferred propagation technique?	**2) At this time, what is the preferred genetic storage technique?**	**3) Has a successful storage method been determined?**	**4) Are additional steps required for obtaining enough seed such as pollination study or greenhouse collections?**
Seed, cutting, or airlayer (may differ between goal – reintroduction vs. living collection)	Seed, Micropropagation (seed or vegetative), Living Collection	Yes or No	What must occur if enough seed can not be collected from founders for genetic storage

Prioritizing Genetic Storage & Propagation Techniques



Ex: *Cenchrus agrimonioides* var. *agrimonioides*

This chart appears in all of the 28 taxon sections. As a template, it is identical in all taxon sections and uses bold lines, circles, bold text and text boxes to illustrate issues unique to each taxon. The questions this chart addresses are:

- What propagation methods have been tested?
- What genetic storage methods have been tested?
- What are the preferred propagation and genetic storage methods?
- What still needs to be tested?
- What is the order in which propagation and genetic storage methods should be tested?

The chart navigates through these complex issues by posing a series of “Yes” or “No” questions which illustrate the process of determining the most efficient way to collect propagules and store material. The first question is “Can you or would you prefer to collect seed?” Many taxa in the MIP can be easily propagated from cuttings and seeds (i.e. *Cenchrus agrimonioides var. agrimonioides*.), and the preferred propagation technique for purposes other than genetic storage, such as reintroductions, may be different than the preferred propagation technique for genetic storage. All propagation techniques that have been tested for either purpose are displayed. Only the preferred technique for genetic storage is indicated as the most appropriate course of action. The arrows are used to identify which propagation and storage techniques have been tested. When a technique has been tested, the arrows are bold. If the answers have been determined, the “Yes” or “No” response is circled.

For example with *C. agrimonioides* shown in the example chart above. All bold arrows indicate the actions NRS are actively pursuing. The question, “Can you store seed?” has been tested because the “Yes” is circled indicating that it has been determined that seed can be stored. There is also an arrow leading to the “Can you collect cuttings?” question indicating that NRS has and does collect cuttings. “No” is circled at the end of this arrow indicating that clonal propagation may be preferred for certain instances and is possible. If the technique has been tried but not answered, neither the ‘Yes’ or ‘No’ is circled. If the current preferred genetic storage method has been determined the ‘Yes’ under that question is boxed. For the example above, seed storage is the preferred technique and the ‘Yes’ is boxed. There are also arrows leading to micropropagation ending in a circled ‘No’, indicating that this technique has been tried and at the present time it is not feasible. If some or all founders for a species are maintained via living collection, the propagule preference for establishing this living collection is shown by the bold arrows leading to the “Living Collection” text box from a circled and boxed ‘Yes’. The bold text in the “Living Collection” box indicates what type of propagule the living collection will be used to produce. For *C. agrimonioides* living collections are used for generating seed as well as cuttings for reintroductions as well as additional storage. For some taxa, additional text boxes have been added to aide in the explanation of certain conclusions or specify circumstances for a particular decision. The text boxes are placed in the chart at the location to which they comment.

Collection: This section describes the best propagules for collection based on success rate and availability.

Propagation: Results from a variety of propagation methods and the relative success with each is summarized in this section.

Seed Storage Research: The status of seed storage research is summarized here. Germination rates from different storage regimes are reported. Ongoing collaborative research with the USDA National Center for Genetic Resources Preservation (NCGRP) focuses on determining seed storage classifications for the Hawaiian flora and creating germination and storage protocols for the taxa studied. This project was initiated following observations by NRS that seeds from many taxa in the Campanulaceae family could not survive -18C storage temperature, but retained good storage longevity at 4C. Research with NCGRP identifies lipid composition as a possible reason for the inability to tolerate -18C storage (Volk *et al.* 2006). If some of the lipids within the seed have a freezing point around -18C, then storage at this temperature may cause cellular damage due to continual phase changes. Lipid analyses of *Delissea subcordata* seed indicate that this taxon may possess some of these lipids. Careful examination of storage trends have revealed that over 40 Hawaiian taxa with substantial storage data (over two years of storage) have shown good storage potential at 24C and 4C but not at -18C. Over half of these are from the Campanulaceae family, and many more species of *Cyanea* have less than two years of storage data, yet some are already showing the same trend). The strategy for all MIP and OIP species is this family is to test both -80C and -150 (lN2 (liquid nitrogen)). Theoretically, if lipid composition is hindering -18C storage, storing seeds below the phase change range will prolong viability longer than at higher temperature above the range (*ie.* 4C). NRS has acquired access to a -80C freezer on the University of Hawai’i at Mānoa campus. Testing has already been initiated on several species within the family Campanulaceae in order to determine if storage viability will be extended further at this temperature than the current 4C. Testing will continue as seed becomes available.

Genetic Storage: This section includes the preferred genetic storage method or current research and steps underway to determine the most applicable method. For species with substantial seed storage data, a schedule may be proposed for how frequently seed bank collections will need to be refreshed to maintain genetic storage goals. This schedule is solely based on storage potential for the species, and other factors such as threats and plant health must be applied in order to recalculate how frequent refresher collections need to occur for a particular plant. Viability trends for seeds in storage cannot be extrapolated because viability rarely has been observed to decline at a steady rate. Therefore, the frequency of refresher collections cannot exceed the number of years a taxon has been tested, and the frequency will constantly be adjusted to reflect the most current storage data. However, for a taxon that has shown little to no decrease in viability after a period of time, this length of time is obviously shorter than necessary to maintain genetic storage goals. For example, *Delissea subcordata* shows no decrease in viability after five years. NRS would not have to re-collect every five years as the number of viable seeds in storage would not have yet begun to drop. But since a storage trend cannot be predicted, it is impossible to select an appropriate collection frequency greater than five years. Therefore, the recommended frequency remains five years.

Example 'Genetic Storage Summary' Table

	# of Potential Founders			Partial Storage Status			Storage Goals Met
Population Unit Name	Current Mature	Current Imm.	NumWild Dead	# Plants >= 10 in Seedbank	# Plants >=1 Microprop	# Plants >=1 Army Nursery	# Plants that Met Goal
Cenchrus agrimonioides var. agrimonioides							
Central Ekahanui	30	3	1	15	0	26	6
Kahanahaiki and Pahole	71	11	15	47	0	35	29
Makaha and Waianae Kai	14	0	0	0	0	14	5
South Huliwai	21	0	0	11	0	9	6
				Total # Plants w/ >=10 Seeds in Seedbank	**Total # Plants w/ >=1 Microprop**	**Total # Plants w/ >=1 Army Nursery**	**Total # Plants that Met Goal**
				73	0	84	46

This table shows the status of NRS's and partner agencies' (including TNC, Honolulu Board of Water Supply (BWS), PEP and the State NARS) collections.

<u>Number of Potential Founders</u>: This column lists the current live immature and mature plants which have been collected from or may be collected from in the future and the number of dead plants from which collections were made in the past. Immature plants are included as founders for all taxa because of database limitations, but they can only serve as founders for some taxa. For example, for *Hibiscus brackenridgei*, cuttings can be taken from immature plants for propagation. In comparison, for *S. mariversa,* cuttings are not taken and seeds are the primary propagule used in collecting for genetic storage. Therefore, the number of potential founders for *S. mariversa* is over-estimated. 'Manage reintroduction for stability' PUs may be on this list but have zero potential founders because the stock is coming from another PU.

Partial Storage Status: According to the plant stabilization plans, for taxa where seed storage is the preferred genetic storage method, up to 50 seeds should be collected from each of up to 50 plants per population. Since the MIP is in the early stages of implementation, NRS felt it was important to show how many plants are part of the way to reaching this goal. The table displays the number of plants for which >10 seeds are in storage. This column does not show the total number of seeds in storage; in some cases thousands of seeds have been collected from one plant. The goal for vegetative collections is a minimum of three clones per plant in either the Lyon Micropropagation Lab or the Army or Pahole Mid-elevation Nursery. Plants with one or more plant in either the Lyon Micropropagation Lab or the nursery are reported here.

Storage Goals Met: This column displays the total number of plants per PU that have met the MIP collection goals. The plant is included if it has 50 seeds in storage, or three clones in micropropagation or three in the nursery. For some PUs, the number of founders has increased in the last year, therefore; it is feasible that NRS could be farther from reaching our collection goals than last year.

Unique Species Observations

Any unique features of a taxon's morphology, phenology, ecology, or pollination biology observed by NRS are discussed here. Post-fire observations for relevant species are also discussed in this section. If there is no new information for a taxon, this section is not included.

Outplanting Issues

Observations of outplantings conducted by NRS or partner agencies are discussed here. Where outplantings have not been attempted, a discussion is included about future plans and possible challenges. Among the topics included are: outplanting site selection; optimal plant size for outplanting, outplanting success rates, post-outplanting care conducted, time to maturity and establishment of any F1 individuals. A brief overview of any outplantings conducted in the last year are included. Where informative a 'Founders Represented in Outplantings' table is included along with a discussion of founder-related issues. In most cases, zeros in the table indicate that no reintroductions have been attempted with founders from that PU.

Example 'Founders Represented in Outplanting' Table

TaxonName: Alectryon macrococcus var. macrococcus **TaxonCode: Alemacmac**

Total Num Plants based upon Plants that have been numbered

MakuaPopulationUnitName	Management Designation	Number of Founders	Number of Founders Represented
Central Kaluaa (to Central Waieli)	Manage for stability	55	0
Kahanahaiki to West Makaleha	Manage for stability	46	0
Makaha	Manage for stability	22	0
Makua	Genetic Storage	17	2
South Mohiakea	Genetic Storage	6	0
Waianae Kai	Genetic Storage	5	0
	Total for Taxon:	151	2

Number of Founders = Number of Mature, Immature, and Dead founder plants.
Number of Founders Represented = Number of founder plants represented in reintroductions.

Research Issues
For many of the taxa, stability is limited by a lack of adequate threat control techniques. For these threats, NRS will support further research into discovering and implementing control methods. For example, NRS is currently supporting research of black twig borer and slug control methods. For some taxa, research about pollination biology or seed storage methods is recommended. Pertinent research needs for each taxon are recognized, and any on-going research is described. Most discussion of ongoing research is in Chapter 5, Research Activities.

Surveys
A summary of surveys that have targeted each taxon in the last year is given in this section. In addition, a brief summary of future survey plans is included. If no new surveys were conducted for a particular taxon, then this section is not included.

Taxon Threats
Threats to the taxon and progress in controlling these threats are discussed in this section. Possible threats include weeds, ungulates, invertebrates, fire, slugs and trampling. Problematic weed species for the taxon are cited.

Population Unit Level Discussion
In this section, the threat table is displayed and the status of each of the population units is discussed. This section is split into two parts, with the MFS PUs discussed first then the other PUs.

Example 'Population Unit Threat Control Summary' Table

Action Area: In

TaxonName: Alectryon macrococcus var. macrococcus

MakuaPopulationUnitName	ManagementDesignation	Protected from Ungulates	Weeds Managed	Rats Controlled
Kahanahaiki to West Makaleha	Manage for stability	Partial	Partial	No
Makua	Genetic Storage	No	Partial	No
South Mohiakea	Genetic Storage	No	No	No

Action Area: Out

TaxonName: Alectryon macrococcus var. macrococcus

MakuaPopulationUnitName	ManagementDesignation	Protected from Ungulates	Weeds Managed	Rats Controlled
Central Kaluaa (to Central Waieli)	Manage for stability	Partial	Partial	Partial
Makaha	Manage for stability	No	Partial	Partial
Waianae Kai	Genetic Storage	No	No	No

This table shows the status of NRS's threat control efforts at each PU. The 'Population Unit' and 'Management Designation' columns are the same as in the 'Taxon Status' table above. 'Partial' designations are explained within the PU discussions. For 'Manage reintroduction for stability' PUs, threat control conducted before and after planting is reported. This approach demonstrates where effort is being spent and what threats are being controlled. NRS anticipate that monitoring data will replace much of this information and improve this aspect of our reporting. Also, the database threat table does not indicate in any way if the threat is actually a concern for the taxon or PU. For example, many rare plant taxa are not threatened by rats.

<u>Protected from Ungulates</u>: ‘Yes’ is entered into the column if all of the individuals in the PU are fenced or otherwise protected from ungulates by natural barriers. If some of the individuals are still at risk from ungulates, it is recorded as ‘partial’.

<u>Weeds managed</u>: In most areas, NRS conduct weed management on a PU scale. ‘Yes’ is entered into this column if weed management has been conducted specifically for this taxon around the entire PU. ‘Partial’ is entered into the column if weed control has been conducted around a portion of the PU, or habitat-level weed management has been conducted in the vicinity of the PU. An explanation is included in the PU discussions. ‘No’ indicates that NRS are not currently controlling weeds at the PU. An explanation for this is included in the text within PU discussions for MFS PUs.

<u>Rats controlled</u>: ‘Yes’ is entered into this column if a rat bait and snap trap grid is set up around the entire PU. ‘Partial’ means rat control is in place for a portion of the PU, or is in place for another species in the vicinity of the PU. For most taxa receiving rat control, a table summarizing rat bait and snap trapping data is included. ‘No’ may indicate that either rats are not considered a threat to the taxon or that NRS are not currently controlling rats at the PU. If ‘Partial’ or ‘No’ values are given, an explanation is included in the PU discussions for ‘manage for stability’ PUs.

‘Manage for Stability’ PUs

Each ‘manage for stability’ PU is discussed and any large changes in population estimates or other management designation from the Makua IP Addendum are explained. Management efforts at the PU are discussed, including any collections, augmentations, fencing, and rat control or weeding in the vicinity of the PU.

Other PUs

In this section, the other PUs with Genetic Storage or Manage Reintroduction for Storage designations are discussed. The Manage Reintroduction for Storage designation does not appear in the Taxon Status Table as this designation is only used to manage stock from PUs already designated as either MFS or GS. Management efforts at the PU are discussed, including any collections, augmentations, fencing, and rat control or weeding in the vicinity of the PU. Extirpated PUs will be discussed for two years and after that will no longer be discussed.

2.1.1 *Alectryon macrococcus* var. *macrococcus*

Requirements for stability
- 4 Population Units (PUs)
- 50 reproducing individuals in each PU (long-lived perennial with reproductive problems)
- Stable population structure
- Threats controlled
- Complete genetic representation of all PUs in storage

How many of the 4 MFS PUs have stable numbers of mature individuals?	How many of the 4 MFS PUs have had *in situ* recruitment?	How many of the 4 MFS PUs have full genetic storage?	How many of the 4 MFS PUs are protected from ungulates?	How many of the MFS PUs that need reintroductions have been initiated?
2/4	2/4	0/4	1/4	2/4

Taxon-Level Discussion
This taxon has four MFS PUs because it is in both the MMR and SBW AAs. Two PUs, Mākaha and Central Kaluaʻā to Central Waiʻeli PUs both exceed the required stabilization target number of mature individuals, however, most of the trees are in poor condition, due primarily to the damaging effects of the black twig borer (BTB) (*Xylosandrus compactus*). Additionally, very few seedlings have ever been seen, and immature plants are very rare. In a few of the PUs there are trees that appear healthy and do not have major damage from the BTB impacts. NRS has collected mature fruit from only eight trees in the last eight years.

Major Highlights/Issues for Year 3
- A large-scale Management Unit fence around the Mākaha PU was completed, protecting the largest population of this taxon.
- NRS revisited every known population within the Central Kaluaʻā to Central Waiʻeli PU and installed air layers on all plants with suitable stock (see Figure 2.1.1.a).
- 17 trees were air layered in the Central Kaluaʻā PU in the last year. 1 successful air layer was collected, and 16 potential air layers still remain developing on the trees.
- Eight mature fruit were collected from the Mākua PU and rat baiting was initiated around the population this year to protect the fruit from rat predation.

Plans for Year 4
- Continue to air layer individuals from MFS PUs.
- NRS plan to have BTB researchers examine individuals that appear unaffected by BTB.
- NRS plan to conduct BTB research using ethanol traps as an alternative to verbanone (see Research Chapter 5).
- NRS will continue to pursue a formal relationship with Botanical Gardens to determine suitable *inter-situ* living collection sites.
- Conduct a trial outplanting in Central Kaluaʻā to Central Waiʻeli PU with air layered

plants in a gulch bottom similar to the successful *Flueggea neowawraea* outplanting in Kahanahāiki.

- Conduct thorough surveys of the Mākaha PU to accurately assess the population numbers.

Figure 2.1.1a *Alectryon macrococcus* air layer in Kalua‘ā wrapped with chicken wire for protection form rat predation

Table 2.1.1a Taxon Status Summary

Action Area: In

TaxonName: Alectryon macrococcus var. macrococcus **TaxonCode: AleMacMac**

Population Unit Name	Management Designation	Current Mature (Wild)	Current Immature (Wild)	Current Seedling (Wild)	Current Augmented Mature	Current Augmented Immature	Current Augmented Seedling	NRS Mature 2006	NRS Immature 2006	NRS Seedling 2006	Total Mature	Total Immature	Total Seedling	Population Trend Notes
Kahanahaiki to West Makaleha	Manage for stability	37	4	0	0	4	0	37	8	0	37	8	0	No monitoring in the last year.
Makua	Manage for stability	33	0	0	0	0	0	33	0	0	33	0	0	A thorough census found no change in population numbers in the last year.
South Mohiakea	Genetic Storage	5	0	0	0	0	0	5	0	0	5	0	0	One additional plant died in the last year.
	Total for Taxon:	75	4	0	0	4	0	75	8	0	75	8	0	

Action Area: Out

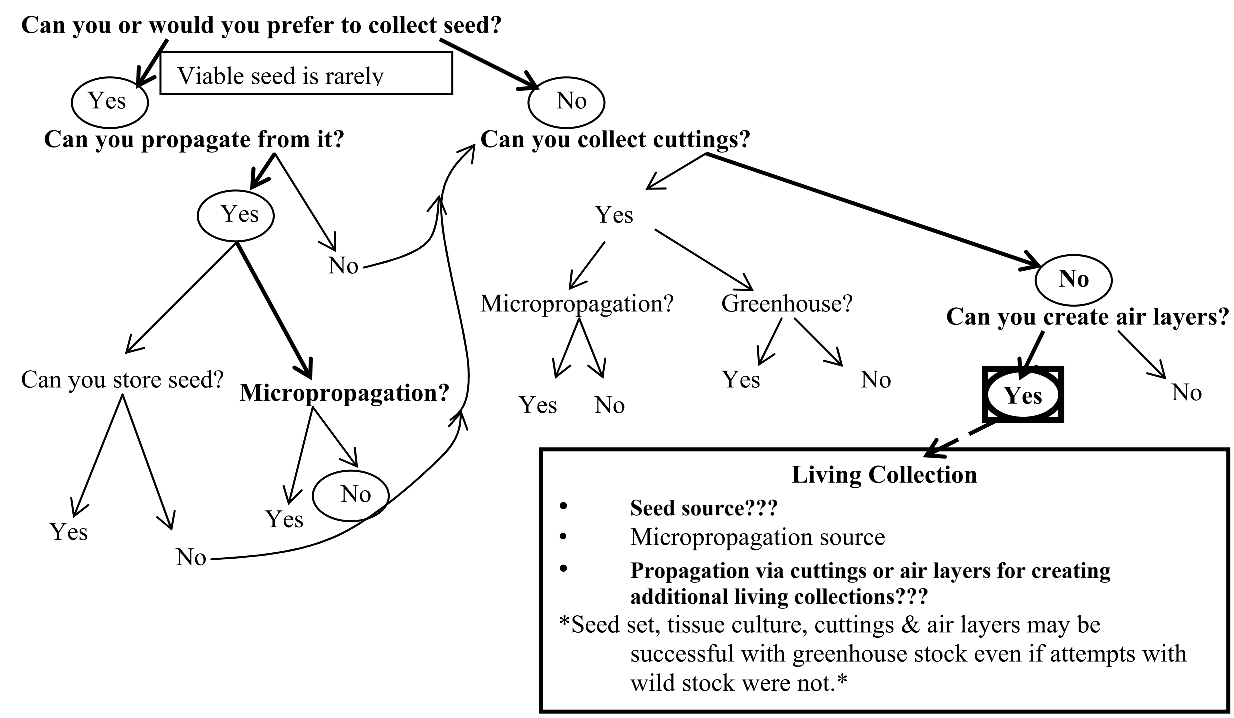
TaxonName: Alectryon macrococcus var. macrococcus **TaxonCode: AleMacMac**

Population Unit Name	Management Designation	Current Mature (Wild)	Current Immature (Wild)	Current Seedling (Wild)	Current Augmented Mature	Current Augmented Immature	Current Augmented Seedling	NRS Mature 2006	NRS Immature 2006	NRS Seedling 2006	Total Mature	Total Immature	Total Seedling	Population Trend Notes
Central Kaluaa to Central Waieli	Manage for stability	52	1	1	0	8	0	53	9	1	52	9	1	A thorough census showed one less live tree than previously known
Makaha	Manage for stability	63	5	2	0	0	0	63	5	2	63	5	2	Population numbers remained the same
Waianae Kai	Genetic Storage	6	0	0	0	0	0	6	0	0	6	0	0	No monitoring in the last year.
	Total for Taxon:	121	6	3	0	8	0	122	14	3	121	14	3	

Propagation and Genetic Storage

1) At this time, what is the preferred propagation technique?	2) At this time, what is the preferred genetic storage technique?	3) Has a successful storage method been determined?	4) Are additional steps required for obtaining enough seed?
Seed (when available), and air layers	Living Collection	No	Yes; research & living collections?

Prioritizing Genetic Storage & Propagation Techniques



Collection: This year, an additional 20 trees were air layered. A total of seven air layers have been collected, and half survived. Average success rate is 16% for this taxon, but many air layers are still alive in the field (26 installed, seven collected, three died in greenhouse, eight died in field, eight remain alive in field).

Propagation: refer to OANRP 2006

Seed Storage Research: refer to OANRP 2006

Genetic Storage: Air layering for living collection remains the best genetic storage option at this time. An additional founder has been added to the Army Nursery's living collection this year from the Central Kalua'ā to Central Wai'eli PU.

Table 2.1.1b Genetic Storage Summary

Population Unit Name	# of Potential Founders: Current Mature	# of Potential Founders: Current Imm.	# of Potential Founders: NumWild Dead	Partial Storage Status: # Plants >= 10 in Seedbank	Partial Storage Status: # Plants >=1 Microprop	Partial Storage Status: # Plants >=1 Army Nursery	Storage Goals Met: # Plants that Met Goal
Alectryon macrococcus var. macrococcus							
Central Kaluaa to Central Waieli	52	1	0	0	0	1	0
Kahanahaiki to West Makaleha	37	4	0	0	0	0	0
Makaha	63	5	0	0	0	0	0
Makua	33	0	0	0	1	1	1
South Mohiakea	5	0	0	0	0	0	0
Waianae Kai	6	0	0	0	0	0	0
				Total # Plants w/ >=10 Seeds in Seedbank	**Total # Plants w/ >=1 Microprop**	**Total # Plants w/ >=1 Army Nursery**	**Total # Plants that Met Goal**
				0	1	2	1

Unique Species Observations

The fruit of *A. macrococcus* from Mākua is remarkably smaller than the fruit from the other PUs **(see Fig 2.1.1.b).** The Mākua population produces small fruit that is comparable to the Kauai *A. macrococcus* var. *macrococcus* (J. Lau pers. comm.). The Mākua trees were observed to be fruiting and flowering in August of 2007, and baiting was reinitiated in an effort to secure fruit collection of this unique population.

Figure 2.1.1b Mākaha *Alectryon macrococcus* with characteristic large fruit and smaller Mākua fruit

Outplanting Issues

NRS would like to try a new planting site that is similar to the reintroduction site where *Flueggea neowawraea* are currently thriving in Kahanahāiki. NRS believe that *A. macrococcus* may respond similarly and hope that this taxon will also achieve vigorous growth to help out-pace the BTB. NRS installed air layers in South Mohiākea and Honouliuli for future reintroduction in Honouliuli.

Research Issues
Refer to Chapter 5.1 for detailed discussion of BTB research. NRS aim to study which factors are contributing to the high productivity and good health of the fruiting trees in Mākaha and Mākua. Such investigations may include research on pollinators, soil nutrient differences, and whether the plants are cross-pollinating or self-pollinating. *Inter situ* sites such as botanical gardens should be considered as potential sites for conducting research.

Given the large scale declines of this taxon, fertilization of remaining trees should be explored to possibly increase vigor and reproduction potential. Plants that are stressed are in general more susceptible to BTB impacts. NRS Research Specialist will conduct a fertilizing trial to address this issue.

Surveys
NRS focused surveying efforts in the Central Kalua‘ā to Central Wai‘eli PU as this population seems to be severely declining. NRS conducted 14 surveys in which they revisited all of the known plant populations in the PU. This year, surveys and monitoring trips will continue to be emphasized to update numbers of this taxon. NRS will seek to obtain stock for reintroduction within the fenced MU in Kalua‘ā. NRS plans to make collections from outlier plants in all of the MFS pupulations. NRS will discuss priorities for collection with this year's IT.

Taxon Threats
The most serious threat to *A. macrococcus* is the BTB. All trees of this taxon are being affected by the BTB to some degree. Less than 10% of trees in both the Kahanahāiki to West Makaleha and Central Kalua‘ā (to Central Wai‘eli) MFS populations are considered 'healthy' by NRS. Most often, 'poor' trees have little or no remaining canopy due to BTB damage, but rather consist of few basal suckers that are also continually attacked by BTB. NRS is beginning to attempt to control the BTB on *in situ* trees by using experimental treatments. See Chapter 5 for further discussion.

Additional threats include rats and invertebrates that prey on the seeds of this taxon and reduce seed viability and germination. NRS conducts rat baiting around trees in Mākaha and Central Kalua‘ā in conjunction with ‘Elepaio management. NRS also reactivated a bait grid around the small fruited population in Lower Mākua this year. Baiting will likely allow for greater fruit production; more fruit can be collected for seed storage trials as well as left to encourage on-site germination. *A. macrococcus* is also susceptible to ungulate browse, and weeds pose ecosystem-level threats for this species.

Population Unit Level Discussion

Table 2.1.1c Population Unit Threat Control Summary

Action Area: In

TaxonName: Alectryon macrococcus var. macrococcus

PopulationUnitName	ManagementDesignation	Protected from Ungulates	Weeds Managed	Rats Controlled
Kahanahaiki to West Makaleha	Manage for stability	Partial	Partial	No
Makua	Manage for stability	Partial	Partial	No
South Mohiakea	Genetic Storage	No	No	No

Action Area: Out

TaxonName: Alectryon macrococcus var. macrococcus

PopulationUnitName	ManagementDesignation	Protected from Ungulates	Weeds Managed	Rats Controlled
Central Kaluaa (to Central Waieli)	Manage for stability	Partial	Partial	Partial
Makaha	Manage for stability	No	Partial	Partial
Waianae Kai	Genetic Storage	No	No	No

Manage for Stability PUs

Kahanahāiki to West Makaleha: No monitoring was conducted in this PU in the past year. Very few of the trees have ever been observed flowering and fewer still have been observed with mature fruit. In this PU, greater than 75% of the trees show a significant amount of BTB damage. All of the Pahole trees and some of the Kahanahāiki trees are fenced, while none of the Upper Kapuna or West Makaleha trees are fenced. Weed control has only occurred around the Kahanahāiki reintroductions. Many of the other sites in this PU are heavily degraded.

Central Kalua'ā to Central Wai'eli: This past year NRS visited all of the known populations in this PU and installed 21 air layers on a total of 17 trees. One air layer was successful and was brought back to the nursery and 16 are still developing on the trees. The trees with air layers will be revisited this coming year. Very few of the trees have ever been observed flowering and fewer have been observed with mature fruit. In this PU, more than 55 percent of the trees show a significant amount of damage from the BTB. A thorough census found many dead trees. This decline isn't evident in the current number of live trees as shown in the taxon status table, since thorough monitoring in the past year found that previous numbers were under estimated.

There are additional areas in northern Wai'eli that have not been visited and NRS believe that more individuals will be discovered. Efforts will be made this year to install more air layers in this area in an effort to secure more stock for outplanting within the fenced MU in Kalua'ā. In order to boost founder numbers for this outplanting, stock from populations from elsewhere in Honoluliuli, such as 'Ēkahanui, will be reintroduced in this PU. Additionally, stock from air layered plants in South Mohiākea will be added to this reintroduction as there are no other closer managed wild sites for this stock.

Mākaha: Mākaha is by far the richest and healthiest of all *A. macrococcus* sites. A large-scale MU fence encompassing this PU was completed this year. Preliminary counts suggest that more than half of the known plants in the valley are included within the fence. The status table reflects the number from the most current count, which is not a complete assessment of the PU. Future surveys scheduled for the upcoming year will undoubtedly result in additional plants and the final count will almost certainly contain more than the originally estimated 75 mature trees. Much of the habitat in this PU is intact. NRS will consider rat baiting around known *A. macrococcus* sites if fruit damage is observed.

Mākua: NRS was unsuccessful at obtaining viable air layered stock from this PU over the past year, however eight mature fruit were collected in August 2007. A rat bait grid was reactivated this year to facilitate a more current collection of this small fruited population. Six bait stations and 12 snap traps were set and will be restocked every eight weeks during the fruiting stage. Four mature trees were observed to be reproductive, three with flowers and one with mature fruit.

Other PUs

South Mohiākea: NRS has observed a significant decline of the known trees in the last couple of years. NRS continue to find rat predated fruit around these trees, however, controlling rats with bait requires frequent re-stocking and this is not feasible given access restrictions. NRS have air layered five plants in this PU this year. This stock will be outplanted in Kaluaʻā when ready.

Waiʻanae Kai: The status table reflects the number from the most current count, which is not a complete assessment of the PU. There were no additional actions in the last year.

***Inter situ* sites**: A few trees remain at Waimea Audubon Center and NRS assists Waimea staff with monitoring and drenching quarterly with the systemic insecticide Merit ®. The trees appear to be healthy. NRS will continue to pursue a formal relationship with OHA to determine suitable *inter-situ* living collection sites at the Waimea Audubon Center.

2.1.2 *Cenchrus agrimonioides* var. *agrimonioides*

Requirements for Stability

- 3 Population Units (PUs)
- 50 reproducing individuals in each PU (short-lived perennial)
- Stable population structure
- Threats controlled
- Complete genetic representation of all PUs in storage

How many of the 3 MFS PUs have stable numbers of mature individuals?	How many of the 3 MFS PUs have had *in situ* recruitment?	How many of the 3 MFS PUs have full genetic storage?	How many of the 3 MFS PUs are protected from ungulates?	How many MFS PUs that need reintroductions have been initiated?
2/3	3/3	0/3	1/3	2/3

Taxon Level Discussion

Stabilization measures are proceeding successfully for this taxon. Ungulates and weeds are the most significant threats and there are proven control methods for both. Two of the three MFS PUs have stable numbers of mature individuals. Management of the the Mākaha Subunit I fence is complete so NRS can begin reintroducing Wai'anae Kai and Mākaha PU stock. This stock is well represented *ex situ*. Reintroductions of this taxon continue to be successful and genetic storage and propagation are straight-forward. This taxon is the first of the MIP species to approach stability and thus is a good example to examine long-term stability trends and seed dispersal limiting factors.

Major Highlights/Issues Year 3

- Obtained permission for additional planting site within Pahole Gulch.
- Clarified outplanting founder targets and founder representation issues within sub-sites in PUs with IT.
- Conducted weed control at Pahole wild site.
- Significant weed contamination of greenhouse plants destined for outplanting resulted in minimal reintroductions of this taxon.
- Began balancing founders at MMR-E according to the Kahanahāiki to Pahole PU planting strategy presented in the 2006 report.
- Completed construction of Makaha Subunit I MU fence.

Plans for Year 4

- Continue implementing Kahanahāiki to Pahole PU planting strategy presented in 2006 report.
- Initiate reintroduction in Mākaha Subunit I.
- Use the Mākaha reintroduction for propagules from the Mākaha to Wai'anae Kai PU.
- Begin collecting data necessary to conduct a population viability analysis for *C. agrimonioides*. Use this data to determine a target population structure for maintaining stable numbers.

Table 2.1.2a Taxon Status Summary

Action Area: In

TaxonName: Cenchrus agrimonioides var. agrimonioides **TaxonCode: CenAgrAgr**

Population Unit Name	Management Designation	Current Mature (Wild)	Current Immature (Wild)	Current Seedling (Wild)	Current Augmented Mature	Current Augmented Immature	Current Augmented Seedling	NRS Mature 2006	NRS Immature 2006	NRS Seedling 2006	Total Mature	Total Immature	Total Seedling	Population Trend Notes
Kahanahaiki and Pahole	Manage for stability	81	11	7	227	30	2	311	47	31	**308**	**41**	**9**	Some reintroductions have died in the last year.
	Total for Taxon:	81	11	7	227	30	2	311	47	31	**308**	**41**	**9**	

Action Area: Out

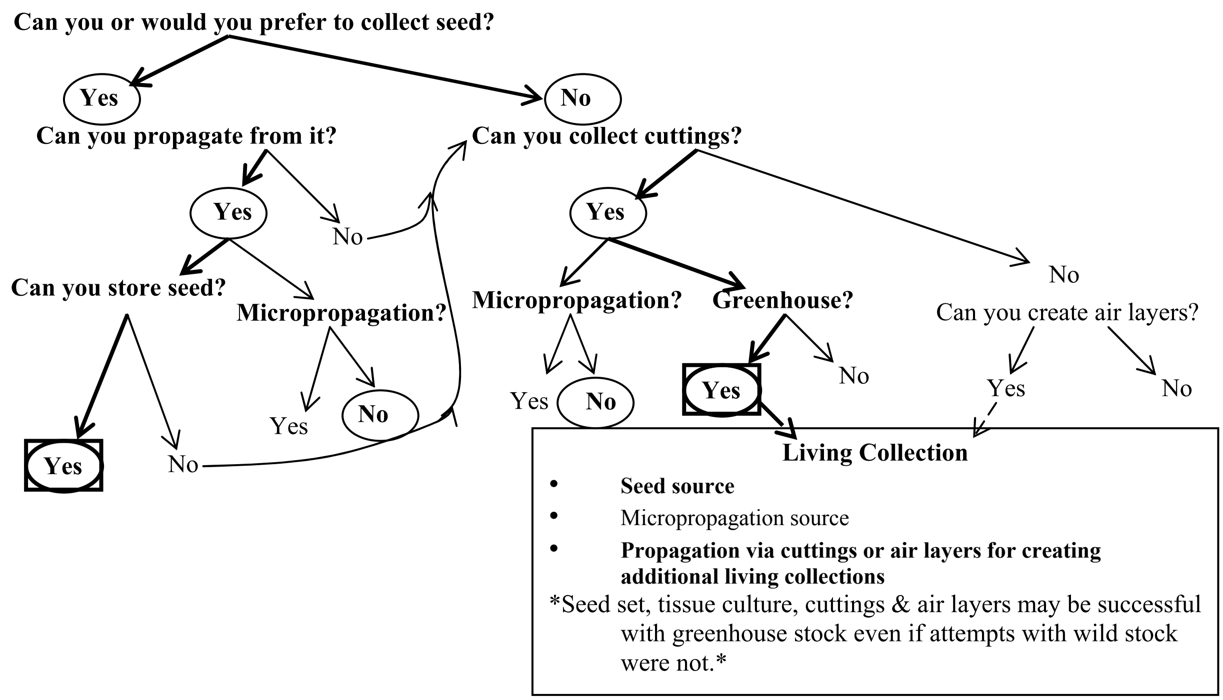
TaxonName: Cenchrus agrimonioides var. agrimonioides **TaxonCode: CenAgrAgr**

Population Unit Name	Management Designation	Current Mature (Wild)	Current Immature (Wild)	Current Seedling (Wild)	Current Augmented Mature	Current Augmented Immature	Current Augmented Seedling	NRS Mature 2006	NRS Immature 2006	NRS Seedling 2006	Total Mature	Total Immature	Total Seedling	Population Trend Notes
Central Ekahanui	Manage for stability	30	3	16	52	1	0	86	3	16	**82**	**4**	**16**	Some reintroductions have died in the last year.
Makaha and Waianae Kai	Manage for stability	12	0	0	0	0	0	14	0	0	**12**	**0**	**0**	This is a real decline due to ungulate impacts.
South Huliwai	Genetic Storage	21	0	0	0	0	0	21	0	0	**21**	**0**	**0**	No monitoring in the last year.
	Total for Taxon:	63	3	16	52	1	0	121	3	16	**115**	**4**	**16**	

Propagation and Genetic Storage

1) At this time, what is the preferred propagation technique?	2) At this time, what is the preferred genetic storage technique?	3) Has a successful storage method been determined?	4) Are additional steps required for obtaining enough seed?
Cuttings for living collection & reintroductions	Living collection and seed	No, but all necessary tests have been initiated	Collect seed from living collections & reintroductions for genetic storage

Prioritizing Genetic Storage & Propagation Techniques



Collection: refer to OANRP 2006

Propagation: refer to OANRP 2006

Seed Storage Research: One small collection stored dry at -18C showed no signs of aging after 4.5 years, though sample size is very low for itse viability tests. Large collections set up for testing will be assayed in 2009 to determine viability after five years of storage in multiple conditions. Observations of germination of stored seeds for propagation have indicated that seeds germinate slowly over time and may be subject to dormancy that would skew storage results if seeds were simply dormant rather than dead. In general, seed collections from any wild stock may have very high variability in terms of viability. Initial viability tests conducted on this taxon should be larger, tested for a longer amount of time, and investigated for dormancy. NRS will continue to study germination and storage for this taxon with collections already at the Army Seed Conservation Lab and from mixed greenhouse stock.

Genetic Storage: NRS plans to collect seed from the living collection once space permits. Adequate separation of population sites is required to ensure no mixing occurs. A recollection time table has yet to be established for this taxon.

Table 2.1.2b Genetic Storage Summary

	# of Potential Founders			Partial Storage Status			Storage Goals Met
Population Unit Name	Current Mature	Current Imm.	NumWild Dead	# Plants >= 10 in Seedbank	# Plants >=1 Microprop	# Plants >=1 Army Nursery	# Plants that Met Goal
Cenchrus agrimonioides var. agrimonioides							
Central Ekahanui	30	3	1	13	0	22	4
Kahanahaiki and Pahole	81	11	23	48	0	23	27
Makaha and Waianae Kai	12	0	1	0	0	11	4
South Huliwai	21	0	1	10	0	12	5
				Total # Plants w/ >=10 Seeds in Seedbank	**Total # Plants w/ >=1 Microprop**	**Total # Plants w/ >=1 Army Nursery**	**Total # Plants that Met Goal**
				71	0	68	40

Unique Species Observations

This taxon often forms new plants via ramets. Ramet reproduction is significant when looking at the longevity of an individual plant. In some cases, parent plants at reintroductions senesced and died but clones of those individuals persist as ramets nearby. Ramet formation in essence extends the “life-expectancy” of a parent plant. In general, ramets form off of mature parent plants, thus the ramet is also mature and immediately can contribute to the sexual reproduction underway within the population.

The seeds of this taxon have burrs, which suggest that an animal vector may have functioned as a dispersal agent. Prior to fencing within the Pahole and Kahanahāiki PU, plant distribution seemed to follow pig trails. Currently, distribution seems to follow human trails along fencelines and management trails.

Outplanting Issues

Most reintroductions last year were halted due to growing media contamination. Many *C. agrimonioides* destined for reintroductions were heavily contaminated with the weed *Oxalis corniculata*. Although this weed already occurs in all of the destination MUs, NRS decided not to conduct the plantings. NRS chose to be conservative in case other weed contaminants not already at the destination site were present. The infestation was so heavy that instead of weeding the pots, NRS took new cuttings and started new plants. The postponed plantings included adding founders to the Kahanahāiki to Pahole and ‘Ēkahanui PU reintroductions and establishing a new planting in Mākaha. These plantings will go forward this winter. The only reintroduction of this taxon that occurred in this reporting period was into the Kahanahāiki MMR-E site. A total of eight outplants were added to the site.

Table 2.1.2c Founders Represented in Outplantings

TaxonName: Cenchrus agrimonioides var. agrimonioides **TaxonCode: CenAgrAgr**

Total Num Plants based upon Plants that have been numbered

PopulationUnitName	Management Designation	Number of Founders	Number of Founders Represented
Central Ekahanui	Manage for stability	34	18
Kahanahaiki and Pahole	Manage for stability	115	63
Makaha and Waianae Kai	Manage for stability	13	0
South Huliwai	Genetic Storage	22	15
	Total for Taxon:	**184**	**96**

Number of Founders = Number of Mature, Immature, and Dead founder plants.
Number of Founders Represented = Number of founder plants represented in reintroductions.

The reintroduction success rate with this taxon continues to be high. The numbers of founders increases each year as this taxon is relatively short-lived and new plants are often discovered when wild sites are monitored.

Last year, the IT had extensive discussions about how best to balance founders for this taxon. The recommendation from the IT was to use between 10-50 founders for reintroductions. Striving for 50 is ideal. The IT also felt that as long as plantings are conducted within 1,000 meters of each other, NRS can assume genetic communication is occurring between them. Therefore, there is no need to represent all 50 founders at each sub-site within a PU unless it is outside the 1,000 meter distance.

Research Issues

Since this taxon is the closest to stability, NRS would like to use it as a case study for conducting population viability modeling. NRS propose collecting the additional monitoring data necessary as input for an appropriate model. NRS will consult experts in this area for assistance.

Surveys

No surveys specifically targeting this taxon have been conducted in the last year. However, new plants were found in known populations, and NRS continue to survey around known PUs for more plants during regular management work.

Taxon Threats

The major threats to *C. agrimonioides* var. *agrimonioides* are ungulates and weeds. Alien grasses compete with this taxon and serve to increase fuels that may carry fire into native habitats. *C. agrimonioides* responds positively to removal of alien canopy trees such as *Psidium cattleianum*. In the last year, NRS observed mouse predation on inflorescence stems in a Pahole reintroduction. This is the second time rodent predation has been observed on this taxon. Mice were more abundant this year than in years past. Perhaps when population numbers are higher, mice begin using novel food sources.

Population Unit Level Discussion

Table 2.1.2d Population Unit Threat Control Summary

Action Area: In

TaxonName: Cenchrus agrimonioides var. agrimonioides

PopulationUnitName	ManagementDesignation	Protected from Ungulates	Weeds Managed	Rats Controlled
Kahanahaiki and Pahole	Manage for stability	Partial	Partial	Partial

Action Area: Out

TaxonName: Cenchrus agrimonioides var. agrimonioides

PopulationUnitName	ManagementDesignation	Protected from Ungulates	Weeds Managed	Rats Controlled
Central Ekahanui	Manage for stability	Partial	Partial	No
Makaha and Waianae Kai	Manage for stability	Partial	Partial	No
South Huliwai	Genetic Storage	No	Yes	No

Manage for Stability PUs

Kahanahāiki and Pahole: NRS have a long history of managing this taxon in the Kahanahāiki gulch portion of the PU but have only recently begun working with stock from Pahole gulch and reintroduction sites in Pahole. Ultimately, the goal is to connect sites within these two gulches through strategic reintroductions and threat management.

Kahanahāiki: Figure 2.1.2a illustrates the distribution of wild and outplanted *C. agrimonioides* var. *agrimonioides* across the Maile flats portion of Kahanahāiki gulch. One new wild plant was discovered approximately 100 meters away from the nearest known individual. It is likely that this plant is an F2 plant from the F1 progeny near the C-ridge corner of the SW Quad. These C-ridge plants likely arose from the MMR-E reintroduction. This is the first observation of a possible F2 plant being mature. It also shows how this taxon is slowly spreading out from reintroduction sites across the appropriate habitat in Maile flats and in many cases following human foot trails. Refer to Figure 2.1.2a.

Map removed, available upon request

Figure 2.1.2a Kahanahāiki reintroduction expansion

Pahole: In the last year, NRS weeded the largest wild site of this taxon. The habitat at this site is very intact and has good restoration potential. There is room for *C. agrimonioides* to expand up and down the ridge. The new reintroduction established with 30 plants in the 2005-2006 planting year is a success. So far, NRS have observed 100% survivorship. NRS will work with NARS to determine planting at a new site between the existing reintroductions along the Pahole Rim. NRS may outplant onto a ridge where there is appropriate habitat between Gulches 4 and 5.

Mākaha and Wai‘anae Kai: This population was heavily impacted by feral pigs in 2006. All of the plants were browsed. Vandalism is a concern for this PU. A population of *Cyanea longiflora* nearby was fenced last year and immediately after, both the fence and plants were vandalized. NRS do not recommend fencing or flagging the wild *C. agrimonioides* in this PUs for fear they will suffer the same fate as the *C. longiflora*. The monitoring conducted by NRS during this reporting period found two fewer plants than had been previously observed. Pig sign is still heavy in the area. All the plants observed were in poor or moderate health.

Currently, this PU is well-represented *ex situ*(11 of 13 founders) and plants are mature in the greenhouse. Other *C. agrimonioides* stock is also housed at the same facility making it impractical to collect pure seed for storage from greenhouse plants. NRS will make seed collections from this stock once it is outplanted, and in effect isolated, in the new Mākaha fence this winter.

Central ‘Ēkahanui: All of the wild plants within this PU are in Central ‘Ēkahanui but the reintroductions conducted thus far are in South ‘Ēkahanui. For simplicity sake, NRS will change the name of this PU to ‘Ēkahanui to reduce confustion. NRS outplanted *C. agrimonioides* into the ‘Ēkahanui Subunit I fence but the habitat available within is limited. Thus, NRS have reintroduced just outside and north of the fence. The pig sign in this area is very low. The South ‘Ēkahanui reintroduction was not supplemented this year due to weed contamination in plants. NRS observed 100% survivorship of the *C. agrimonioides* planted in the 2005-2006 season despite the fact that over half of the reintroduced plants are outside the pig fence. Overall, plants reintroduced in ‘Ēkahanui are not as robust as plants in the Kahanahaiki and Pahole PU. This may indicate that planting sites are marginal. Nonetheless, NRS are learning about light and habitat preferences of the ‘Ēkahanui stock.

NRS expected the ‘Ēkahanui Subunit II exclosure to be complete by now. Materials procurement and vandalism challenges have slowed the timeline for completion. Once it is finished, much more habitat will be available for use in reintroducing this taxon. The habitat that this fence will protect overlaps with site characteristics of Kahanahaiki to Pahole PU sites. NRS will apply lessons learned from the Kahanahāiki to Pahole in designing the initial plantings in this PU. The outplanting strategy remains unchanged from what was presented in last year’s report. NRS plan to establish two new nodes of reintroduced plants each with 100 total individual representing two replicates each of 50 founders. NRS may proceed with some reintroductions prior to fence completion if suitable habitat that is not susceptible to pig damage can be located.

Other PUs

South Huliwai: Additional collections were secured from this PU in the last year. This stock will be added to the Central ‘Ēkahanui PU reintroductions. Ungulate activity was not detected at this PU and this PU remains unfenced.

2.1.3 *Chamaesyce celastroides* var. *kaenana*

Requirements for Stability

- 4 Population Units (PU)
- 25 reproducing individuals in each population (long-lived perennial)
- Stable population structure
- Threats controlled
- Complete genetic representation of all PUs in storage

How many of the 4 MFS PUs have stable numbers of mature individuals?	How many of the 4 MFS PUs have had *in situ* recruitment?	How many of the 4 MFS PUs have full genetic storage?	How many of the 4 MFS PUs are protected from ungulates?	How many MFS PUs that need reintroductions have been initiated?
3/4	4/4	0/4	4/4	N/A

Taxon Level Discussion
Due to the high fire threat to this species at Mākua Military Reservation (MMR), four PUs of *Chamaesyce celastroides* var. k*aenana* are designated as Manage for Stability (MFS). These are Puaʻakanoa, Mākua, Kaʻena to Keawaʻula (Kaʻena) and Kaʻena (East of Alau). The first two of these PUs are within the MMR Action Area (AA) and the latter two are outside the AA on lands owned by the State. NRS have observed *in situ* recruitment of seedlings and juvenile plants at all four MFS PUs. There should be no need for reintroduction or augmentation at any of the PUs. Collection of mature seed for genetic storage has begun at all of the MFS PUs and all of the other Genetic Storage (GS) PUs within the MMR AA. Fire is the most challenging threat to this species and plants in the Puaʻakanoa PU were burned in a fire in August 2007 (see Puaʻakanoa Fire Report Appendix I). Another fire in August 2007 at Kaʻena Point came within 45 meters of the East of Alau PU. Weed and fuel control is underway at three of the four MFS PUs.

Major Highlights/Issues for Year 3

- The August 2007 fire on MMR spread into the Puaʻakanoa PU, damaging but not killing two of the 170 known plants.
- The August 2007 fire near Kaʻena Point came within 45 meters of the Kaʻena (East of Alau) PU but did not damage any plants.
- NRS collected seed for genetic storage from over one-hundred plants in six PUs.

Plans for Year 4

- Prioritize genetic storage collections from the MFS PUs and all other PUs within the AA.
- Continue to facilitate research on *Chamaesyce* by the UH Botany Department.
- Develop weed and fuel control plans for the Puaʻakanoa PU and continue control at the other three MFS PUs.
- Focus monitoring efforts on locating and determining survivorship of smaller size classes.

Table 2.1.3a Taxon Status Summary

Action Area: In

TaxonName: Chamaesyce celastroides var. kaenana TaxonCode: ChaCelKae

Population Unit Name	Management Designation	Current Mature (Wild)	Current Immature (Wild)	Current Seedling (Wild)	Current Augmented Mature	Current Augmented Immature	Current Augmented Seedling	NRS Mature 2006	NRS Immature 2006	NRS Seedling 2006	Total Mature	Total Immature	Total Seedling	Population Trend Notes
Kaluakauila	Genetic Storage	6	4	0	0	0	0	6	4	0	**6**	**4**	**0**	Monitoring showed no change in the last year.
Makua	Manage for stability	89	45	20	0	0	0	89	45	20	**89**	**45**	**20**	Monitoring showed no change in the last year.
North Kahanahaiki	Genetic Storage	177	0	0	0	0	0	177	0	0	**177**	**0**	**0**	No monitoring in the last year.
Puaakanoa	Manage for stability	160	10	0	0	0	0	160	10	0	**160**	**10**	**0**	Monitoring showed no change in the last year.
	Total for Taxon:	432	59	20	0	0	0	432	59	20	**432**	**59**	**20**	

Action Area: Out

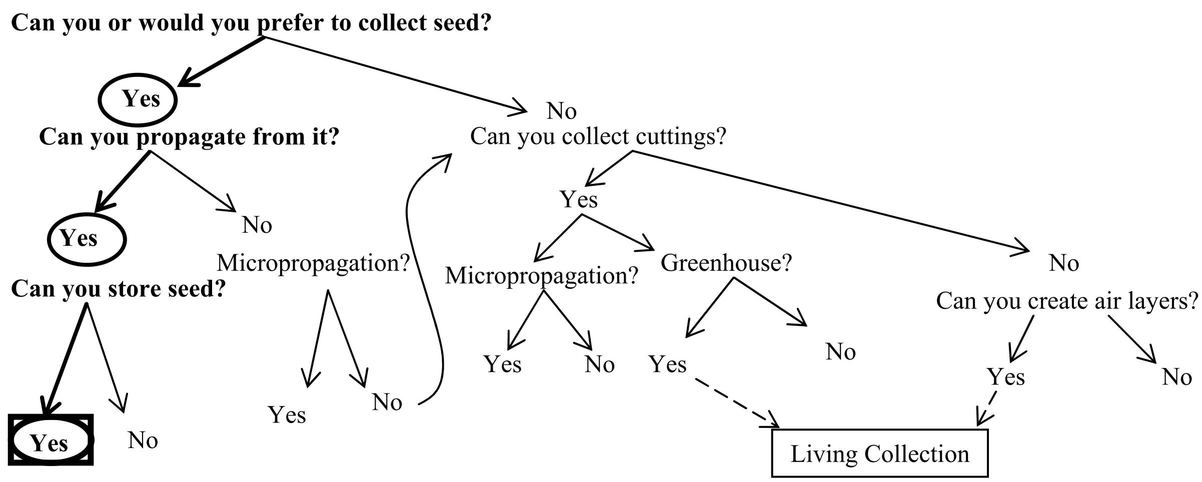
TaxonName: Chamaesyce celastroides var. kaenana TaxonCode: ChaCelKae

Population Unit Name	Management Designation	Current Mature (Wild)	Current Immature (Wild)	Current Seedling (Wild)	Current Augmented Mature	Current Augmented Immature	Current Augmented Seedling	NRS Mature 2006	NRS Immature 2006	NRS Seedling 2006	Total Mature	Total Immature	Total Seedling	Population Trend Notes
East Kahanahaiki	Genetic Storage	2	0	0	0	0	0	2	0	0	**2**	**0**	**0**	Monitoring showed no change in the last year.
Kaena (East of Alau)	Manage for stability	21	4	20	0	0	0	21	4	20	**21**	**4**	**20**	Monitoring showed no change in the last year.
Kaena and Keawaula (Kaena)	Manage for stability	300	0	0	0	0	0	300	0	0	**300**	**0**	**0**	Monitoring showed no change in the last year.
Kaena and Keawaula (Keawaula)	Genetic Storage	47	1	2	0	0	0	56	2	2	**47**	**1**	**2**	A thorough census of the known sites found less plants in the last year
Waianae Kai	Genetic Storage	33	0	0	0	0	0	33	0	0	**33**	**0**	**0**	No monitoring in the last year.
	Total for Taxon:	403	5	22	0	0	0	412	6	22	**403**	**5**	**22**	

Propagation and Genetic Storage

1) At this time, what is the preferred propagation technique?	2) At this time, what is the preferred genetic storage technique?	3) Has a successful storage method been determined?	4) Are additional steps required for obtaining enough seed?
Seed	Seed	Yes	No

Prioritizing Genetic Storage & Propagation Techniques



Collection: refer to OANRP 2006

Propagation: refer to OANRP 2006

Seed Storage: refer to OANRP 2006

Genetic Storage: Seed is currently being collected from Mākua, Ka'ena and East of Alau PUs. Genetic storage goals should be met for these three PUs by the end of this or next fruiting season.

Figure 2.1.3a Bagging immature fruit for seed collection of *Chamaesyce celastroides*

Table 2.1.3b Genetic Storage Summary

Population Unit Name	# of Potential Founders			Partial Storage Status			Storage Goals Met
	Current Mature	Current Imm.	NumWild Dead	# Plants >= 10 in Seedbank	# Plants >=1 Microprop	# Plants >=1 Army Nursery	# Plants that Met Goal
Chamaesyce celastroides var. kaenana							
East Kahanahaiki	2	0	0	1	0	0	0
Kaena (East of Alau)	21	4	0	11	0	0	10
Kaena and Keawaula (Kaena)	300	0	0	35	0	0	32
Kaena and Keawaula (Keawaula)	47	1	0	22	0	0	13
Kaluakauila	6	4	0	1	0	0	0
Makua	89	45	4	58	0	1	46
North Kahanahaiki	177	0	1	9	0	0	7
Puaakanoa	160	10	0	7	0	0	2
Waianae Kai	33	0	0	0	0	0	0
				Total # Plants w/ >=10 Seeds in Seedbank	**Total # Plants w/ >=1 Microprop**	**Total # Plants w/ >=1 Army Nursery**	**Total # Plants that Met Goal**
				144	0	1	110

Unique Species Observations
No new observations have been made.

Outplanting Issues
No outplantings have been conducted with this taxon.

Research Issues
There are no additional research issues to report.

Surveys
There were no additional surveys in the last year.

Taxon Threats
There were no additional threats observed in the last year.

Population Unit Level Discussion

Table 2.1.3c Population Unit Threat Control Summary

Action Area: In

TaxonName: Chamaesyce celastroides var. kaenana

PopulationUnitName	ManagementDesignation	Protected from Ungulates	Weeds Managed	Rats Controlled
Kaluakauila	Genetic Storage	Yes	No	No
Makua	Manage for stability	Yes	Yes	No
North Kahanahaiki	Genetic Storage	Yes	No	No
Puaakanoa	Manage for stability	Yes	No	No

Action Area: Out

TaxonName: Chamaesyce celastroides var. kaenana

PopulationUnitName	ManagementDesignation	Protected from Ungulates	Weeds Managed	Rats Controlled
East Kahanahaiki	Genetic Storage	Yes	No	No
Kaena (East of Alau)	Manage for stability	Yes	Yes	No
Kaena and Keawaula (Kaena)	Manage for stability	Yes	Yes	No
Kaena and Keawaula (Keawaula)	Genetic Storage	Yes	No	No
Waianae Kai	Genetic Storage	Partial	No	No

Manage for Stability PUs

Mākua: NRS has conducted census surveys of this PU several times since 2001 and have not observed any change in population estimates in the last year. The number of immature plants has increased since 2001 and NRS continue to tag newly mature plants. This site is easier to survey than other PUs because it is small and not too steep. In addition, the large mature plants are not clustered too closely together and the smaller plants can be counted easier than at other PUs. Seedlings continue to be observed in the wet season and some do survive into the juvenile size class. Although NRS has been effective at removing alien grasses and greatly reducing fuels, the threat of fire remains. NRS has been collecting mature seed for genetic storage from plants in this PU since 2001. There are 46 plants that have over 50 seeds in storage and NRS will likely meet the genetic storage goal of storing 50 seeds from 50 plants in the coming year. Monitoring efforts will focus on locating and determining survivorship of smaller size classes.

Ka'ena and Keawa'ula (Ka'ena): This PU contains a very dense group of an estimated 300 mature plants over about four acres. It is within the Ka'ena Natural Area Reserve and ungulates are not a threat. There is substantial recruitment of juvenile and seedling plants. However the size and density of this PU makes monitoring the population structure each year an overwhelming and potentially damaging task. To avoid damaging the brittle plants, NRS have not and will not conduct a yearly census of this PU as the number is well over the target number of 25 mature individuals. NRS has stored over 50 seeds from 32 mature plants so far. NRS conducts extensive weed control at this site. Fire is not as large of a threat compared with other PUs due to the lack of sufficient fuels in the wind-swept strand vegetation. In the coming year, NRS will plan to complete genetic storage goals for at least 50 plants and monitoring efforts will focus on locating and determining survivorship of smaller size classes.

Ka‘ena (East of Alau): This PU is located near Ka‘ena Point on State-owned land, but is outside of the Ka‘ena Natural Area Reserve. NRS has been monitoring and conducting weed control at this PU since 2004 and there was no change in population size or distribution observed in the last year. There is no alien grass in the area immediately surrounding the plants and they are not threatened by ungulates. NRS has stored at least 50 seeds collected from ten of the 21 mature plants in this PU and will work on securing the remainder in the coming year. NRS have been conducting weed control at this PU and will continue in the coming year. A fire at the end of Farrington Highway near Ka‘ena Point in August 2007 burned within 45 meters of this PU (Figure 2.1.3b). For more information on this fire and NRS involvement see the Ka‘ena Fire Report attached as Appendix III. In the coming year, monitoring efforts will focus on locating and determining survivorship of smaller size classes and collecting seed to meet the genetic storage goals for all of the known mature plants.

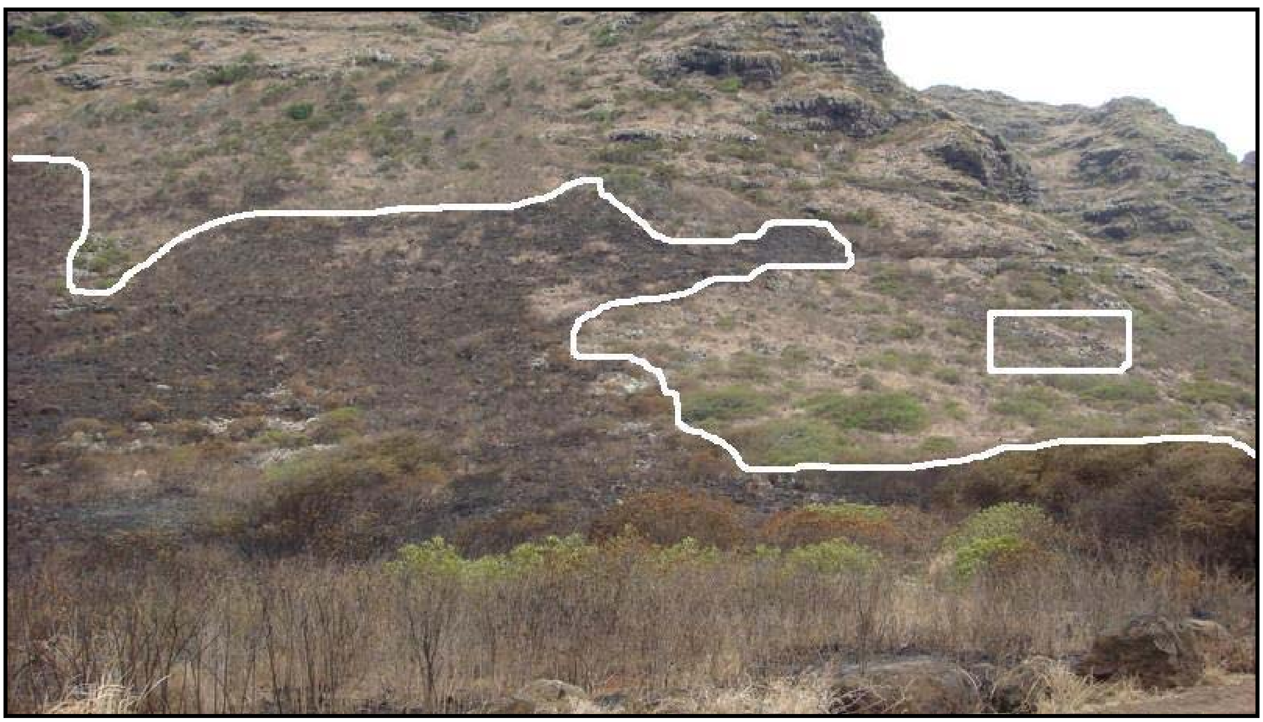


Figure 2.1.3b The western front of the August 2007 fire (outlined above) came within 45 meters of the plants inside the small square (outlined on the right).

Pua‘akanoa: This PU is located on the cliffs above Farrington Highway north of the main valleys of MMR. There are several sites within this PU and NRS has been monitoring the accessible sites, but others are on remote cliffs and may be difficult to reach. NRS has begun collections of mature seed for genetic storage. There are seeds stored from seven plants do far and there are more than 50 seeds stored from two plants. A fire that started along Farrington

Highway burned into this PU on August 10, 2007 (Figure 2.1.3c). For more information on this fire see the Pua'akanoa Fire Report attached as Appendix I. The fire badly damaged one juvenile plant (Figure 2.1.3d) and singed a few branches of another large mature plant. Much of the native habitat surrounding the plants was burned in the nearly 20 acre fire. The juvenile plant that burned will be monitored in the coming year to determine if it died from the fire and the mature plant is expected to recover. In the coming year, NRS will continue to collect mature seed for genetic storage and will focus on locating and determining survivorship of smaller size classes and collecting seed to meet the genetic storage goals for all of the known mature plants. In addition, NRS will begin to develop a plan to control weeds and fuels at this PU in the coming year.

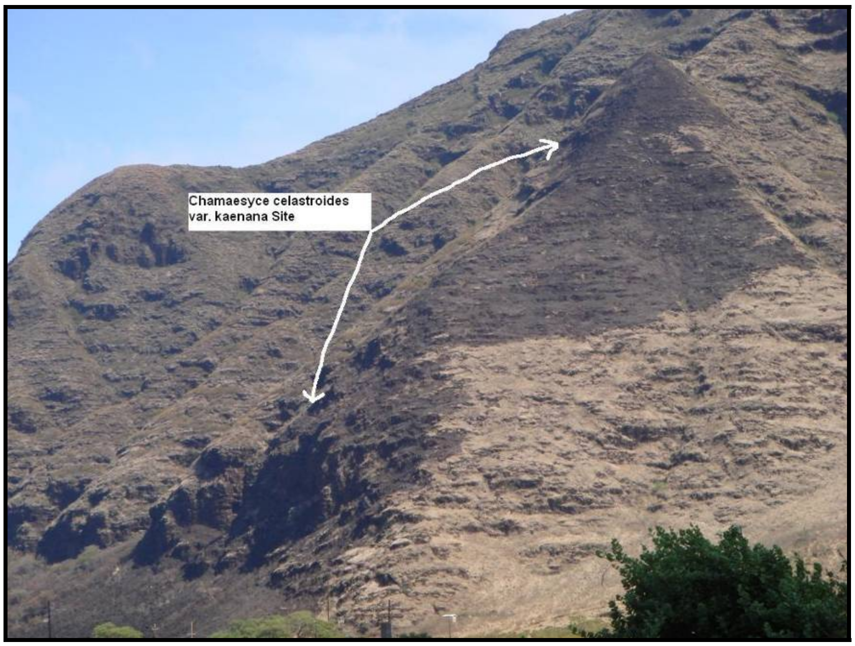


Figure 2.1.3c The August 2007 fire at MMR burned close to sites with plants in the Pua‘akanoa PU.

Figure 2.1.3d Juvenile plant burned by the fire

Other PUs

Kaluakauila: There are two sites in this PU and both are on MMR, north of the main valleys. This PU is highly threatened by fire and plants were damaged by fire in July 2006. The larger of the two sites has five mature and three juvenile plants and was visited several times in the last year to collect seed for genetic storage. Observations of that site showed no change in population structure. The smaller site has one mature and one juvenile plant and both were damaged in the fire of July 2006. Ungulates are not a threat to these plants and weed control is not needed to collect for genetic storage. In the coming year, NRS will continue to collect seed for genetic storage and monitoring efforts will focus on locating and determining survivorship of smaller size classes.

North Kahanahāiki: There have been no NRS actions in the last year. In the coming year, NRS will visit this PU to collect for genetic storage.

East Kahanahāiki: There are two mature plants in this PU and it is in a remote area of MMR. NRS has been monitoring and collecting from these plants since 2000. The site burned in 2003 and both plants were damaged but survived. The plants are not threatened by ungulates and weed control is not needed to collect for genetic storage. NRS has stored seed collected from one of the two plants and will continue to monitor and collect in the coming year.

Ka'ena and Keawa'ula (Keawa'ula): This PU is within the Ka'ena Point State Park and several separate sites with plants are known. NRS conducted census surveys of these sites in the last year and have revised the population estimates. Collections of seed have been stored from 22 plants so far and at least 50 seeds have been stored from 13 mature plants. The plants are not threatened by ungulates and weed control is not needed to collect for genetic storage. NRS will collect again from this PU in 2008.

Wai'anae Kai: Plants in this PU are spread across large cliffs in Wai'anae and population estimates were first made with binocular and helicopter surveys in 2002. Most plants occur in sites where weeds and goats are not a direct threat, but plants have been burned in the past and there is no ungulate management in this area. NRS monitored most of the PU in June 2005 and no change in numbers was observed. In the coming year, NRS will conduct helicopter and ground surveys in order to determine if seed collection for genetic storage can be done and if any other management is needed in order to collect for genetic storage.

2.1.4 *Chamaesyce herbstii*

Requirements for Stability

- 3 Population Units (PUs)
- 25 reproducing individuals in each PU (long-lived perennial)
- Stable population structure
- Threats controlled
- Complete genetic representation of all PUs in storage
- Expedited Stabilization (10 years)

How many of the 3 MFS PUs have stable numbers of mature individuals?	How many of the 3 MFS PUs have had *insitu* recruitment?	How many of the 3 MFS PUs have full genetic storage?	How many of the 3 MFS PUs are protected from ungulates?	How many MFS PUs that need reintroductions have been initiated?
1/3	1/1	0/1 (only 1 *in situ* PU)	1/3	0/3

Taxon Level Discussion

The only remaining *in situ* Population Unit (PU), Kapuna to Pahole, falls within the Makua Action Area (AA), and will be Managed for Stability (MFS). Since an initial decline after the MIP was finalized, numbers of plants in this PU have stabilized. Stability goals for numbers of reproducing individuals were met for this PU. Onsite recruitment is observed in this PU, and reintroduction survivorship is high. Ongoing weed control is conducted throughout the PU targeting larger ecosystem altering weeds such as *Schinus terebinthifolius* and *Psidium cattleianum*. Over the next year NRS will continue to assist the State with the completion of the Kapuna subunit II and IV fences which will include all of the plants currently unprotected in the Kapuna to Pahole PU. The other two MFS populations, Makaha and West Makaleha PU, are both outside of the AA. These populations will be established via reintroduction for management for stability. The Mākaha fence was finished this year and NRS began a reintroduction of this taxon there this year. The West Makaleha fence, on state land, is pending a Right of Entry Permit between the Army and the State.

This year, *Chamaesyce herbstii* has been designated by the US Fish and Wildlife Service as an "expedited stabilization species" in which the taxon should be stabilized in ten years. This designation requires that two of the three MFS populations be outside of the AA, as they are currently designated. Weed control, fire management, and monitoring must be ongoing and any cooperative agreements needed to conduct management must be in place. NRS will continue to try to reach stability goals first in the Kapuna to Pahole PU as it is the only *in situ* PU. However, NRS believe that establishing a founder population via reintroduction is possible to do in a short amount of time. There is an observed two to three year turn around of seed collection from wild plants to mature plants in outplantings. This bodes very well for this species as achieving stabilization within ten years.

NRS are also assisting with a UH student researcher, Maggie Sporck, who is looking to study physiology, morphology, anatomy and composition of leaves and stems for each taxon in the Hawaiian *Chamaesyce* radiation. This work will be complemented by Dr. Cliff Morden who will conduct DNA-based phylogeny and population genetics research on *C. herbstii* as well as two other *Chamaesyce* species. M. Sporck is pursuing a permit to access to Pahole NAR to collect leaves and stems from 5-15 *C. herbstii* individuals. NRS support this combined research and suggest that collections be made from reintroduced individuals, however the ultimate decision for collection will be based on whether or not she is given a permit by the State to conduct such research.

Major Highlights/Issues Year 3

- Fence construction is finished in Mākaha and reintroduction has begun.
- Fence construction has begun around the remaining unprotected portions of the Kapuna to Pahole PU.
- High levels of survivorship in Kapuna to Pahole PU reintroductions have been observed.
- The Kapuna to Pahole PU reached goals for numbers of reproducing individuals.
- Collections continued to be made across the Kapuna to Pahole PU in the last year. These have been used to grow plants for outplanting and genetic storage.
- Augmentation continued in the Kapuna to Pahole PU.
- Species designated as Expedited for Stability in 10 years.

Plans for Year 4

- Continue to collect from founders in the Kapuna to Pahole PU for supplementing the augmentation.
- Continue to balance founders in the Pahole augmentation until 50 founders are represented.
- Complete the Kapuna subunit III and IV fences.
- Continue to balance the Mākaha reintroduction until 50 founders are represented.
- Push for expedited processing of the Right of Entry Permit with the State so that West Makaleha fence construction may begin.

Table 2.1.4a Taxon Status Summary

Action Area: In

TaxonName: Chamaesyce herbstii **TaxonCode: ChaHer**

Population Unit Name	Management Designation	Current Mature (Wild)	Current Immature (Wild)	Current Seedling (Wild)	Current Augmented Mature	Current Augmented Immature	Current Augmented Seedling	NRS Mature 2006	NRS Immature 2006	NRS Seedling 2006	Total Mature	Total Immature	Total Seedling	Population Trend Notes
Kapuna to Pahole	Manage for stability	49	12	0	18	45	0	51	35	1	**67**	**57**	**0**	37 plants were reintroduced in 2007
	Total for Taxon:	49	12	0	18	45	0	51	35	1	**67**	**57**	**0**	

Action Area: Out

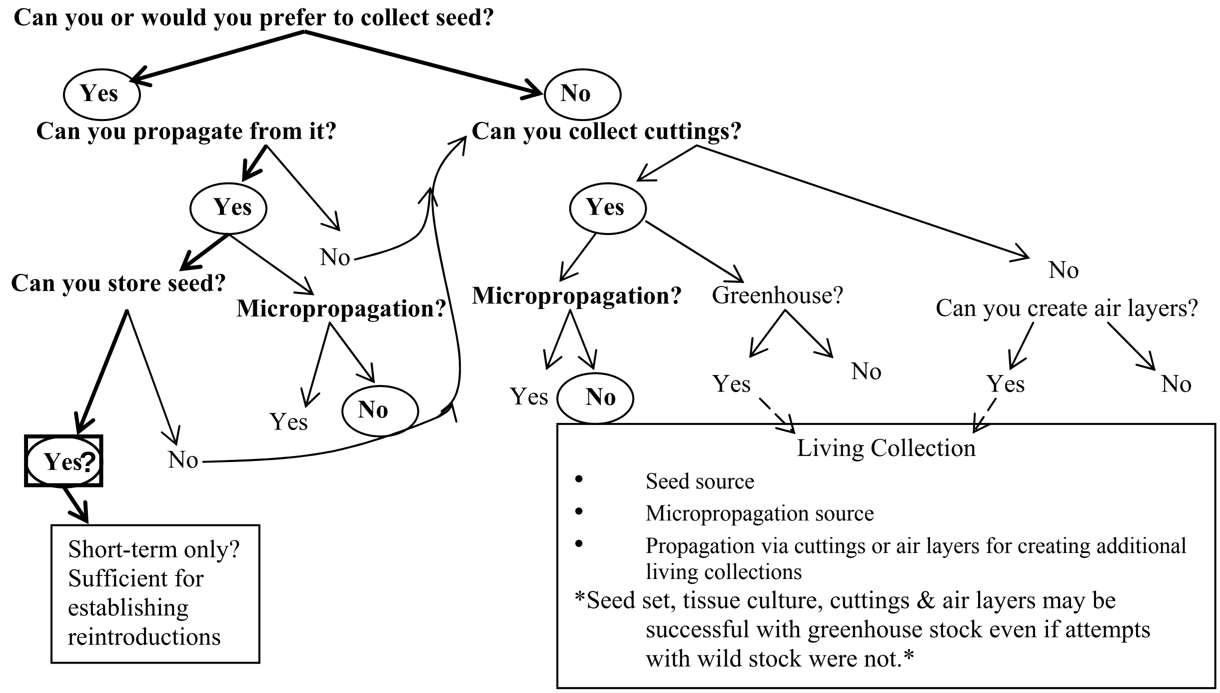
TaxonName: Chamaesyce herbstii **TaxonCode: ChaHer**

Population Unit Name	Management Designation	Current Mature (Wild)	Current Immature (Wild)	Current Seedling (Wild)	Current Augmented Mature	Current Augmented Immature	Current Augmented Seedling	NRS Mature 2006	NRS Immature 2006	NRS Seedling 2006	Total Mature	Total Immature	Total Seedling	Population Trend Notes
Makaha	Manage reintroduction for stability	0	0	0	0	22	0	0	0	0	**0**	**22**	**0**	24 plants were reintroduced in 2007
West Makaleha	Manage reintroduction for stability	0	0	0	0	0	0	0	0	0	**0**	**0**	**0**	To be reintroduced when the MU fence is complete
	Total for Taxon:	0	0	0	0	22	0	0	0	0	**0**	**22**	**0**	

Propagation & Genetic Storage

1) At this time, what is the preferred propagation technique?	2) At this time, what is the preferred genetic storage technique?	3) Has a successful storage method been determined?	4) Are additional steps required for obtaining enough seed?
Seed	Undetermined (seed for the short-term)	No	Yes – need to collect from reintroductions

Prioritizing Genetic Storage & Propagation Techniques



Collection: refer to OANRP 2006

Propagation: refer to OANRP 2006

Seed Storage Research: refer to OANRP 2006. Now that plants in the Pahole reintroduction are mature, seed will be collected from them for storage testing.

Genetic Storage: Seed from four additional founders have been collected. These seeds will be propagated for reintroduction stock. Several other founders were also collected again for the Mākaha reintroduction. NRS will continue to make collections from wild plants until reintroductions are complete.

Table 2.1.4b Genetic Storage Summary

Population Unit Name	# of Potential Founders: Current Mature	Current Imm.	NumWild Dead	Partial Storage Status: # Plants >= 10 in Seedbank	# Plants >=1 Microprop	# Plants >=1 Army Nursery	Storage Goals Met: # Plants that Met Goal
Chamaesyce herbstii							
Kapuna to Pahole	49	12	4	19	0	13	8
				Total # Plants w/ >=10 Seeds in Seedbank	**Total # Plants w/ >=1 Microprop**	**Total # Plants w/ >=1 Army Nursery**	**Total # Plants that Met Goal**
				19	0	13	8

Unique Species Observations

There have been no new observations in the last year.

Outplanting Issues

NRS initiated augmentation in the fenced portion of the Pahole PU in February of 2006, and continued to augment this site this year. Following the suggestion of the State, NRS is planting in gaps between existing wild plants. As of the last monitoring this August there is a 97% survivorship and 26% of the 61 plants alive have already reached maturity at the reintroduction. NRS plan to continue to balance this reintroduction as more collections from founders are made. The ultimate goal is to represent 50 founders with two plants each to result in a mostly continuous distribution of plants across the area. This same goal is set for the Mākaha and West Makaleha reintroductions to be managed for stability.

Research Issues

Research on seed storage needs to be conducted.

Surveys

No surveys were conducted specifically for this taxon in the last year. However, NRS continued to find new plants in Pahole at known sites during weed control and regular population monitoring. NRS have also been active in areas with appropriate habitat for this species and always keep an eye out while conducting other tasks, particularly in the Northern Wai‘anae Mountains.

Taxon Threats

No new threats other than pigs in the Pahole exclosure have been identified this year. NRS are working very actively with NARS to remove the pigs from this exclosure.

Population Unit Level Discussion

Table 2.1.4c Population Unit Threat Control Summary

Action Area: In

TaxonName: Chamaesyce herbstii

PopulationUnitName	ManagementDesignation	Protected from Ungulates	Weeds Managed	Rats Controlled
Kapuna to Pahole	Manage for stability	Partial	Partial	No

Action Area: Out

TaxonName: Chamaesyce herbstii

PopulationUnitName	ManagementDesignation	Protected from Ungulates	Weeds Managed	Rats Controlled
Makaha	Manage reintroduction for stability	Yes	Partial	No
West Makaleha	Manage reintroduction for stability	No	No	No

Manage for Stability PUs

Kapuna to Pahole: The number of individuals in the final MIP was based on counts by the NARS specialist between 1991 and 1999. Based on extensive monitoring in the PU during the last few years and discussions with the NARS Specialist, it is clear that this species has declined greatly in numbers in the last five years. However, declines have leveled off, and stable numbers of mature plants exist. Additionally, a few new immatures and a few seedlings have been found over the last few years. NRS worked diligently in the last couple years to collect seed from founders that will be used for outplanting and storage trials. NRS will continue to balance founders at the augmentation established last year. With such high survivorship so far in outplantings, and a wild population with stable numbers of mature individuals, stability for this population will be contingent on recruitment. Collections from all wild plants completely represented in augmentations and reintroductions will not be conducted; wild seed will be left on site to encourage *in situ* germination. However, once the reintroduced plants become mature, they may be used as a source for seeds for genetic storage and testing and to produce plants for Mākaha and West Makaleha PUs. NRS weeded several times throughout the augmentation and wild sites this year and found another five immature plants.

Pigs have been in the Pahole fence for over a year and a half, and while weeding the *C. herbstii* augmentation site, pigs were seen running throughout the area. NRS are actively snaring pigs out of the exclosure.

Mākaha: Kapuna to Pahole founders were used to initiate reintroduction in Mākaha this year. Due to several contracting issues over the last year, the Mākaha fence was not completed when this species was outplanted this year. NRS had planned for an earlier finish date, and therefore had plants ready for outplanting. NRS built a temporary plastic fence around the site, and planted 24 plants. Unfortunately, pigs got in to the temporary fence and dug out plants, and browsed most others. A total of six deaths resulted from this breech. The Mākaha Subunit I fence is now finished, and NRS will not use plastic fencing in areas of high pig activity again.

West Makaleha: Kapuna to Pahole founders will be used to reintroduce plants to West Makaleha, pending the Right of Entry permit with the State and the completion of the fence. When a clear timeline is established for the fence construction, NRS can begin developing a reintroduction strategy.

2.1.5 *Cyanea grimesiana* subsp. *obatae*

Requirements for Stability

- 4 Population Units (PUs)
- 100 reproducing individuals in each PU (short-lived perennial with large fluctuations in population size and recent history of decline)
- Stable population structure
- Threats controlled
- Complete genetic representation of all PUs in storage

How many of the 4 MFS PUs have stable numbers of mature individuals?	How many of the 4 MFS PUs have had *in situ* recruitment?	How many of the 4 MFS PUs have full genetic storage?	How many of the 4MFS PUs are protected from ungulates?	How many of the MFS PUs that need reintroductions have been initiated?
0/4	2/4	3/4	3/4	3/4

Taxon Level Discussion

While the PUs with single plants have remained stable, a few plants died at the two PUs with multiple plants (see PU discussions). Emphasis with this taxon has been on augmentation and rat control at populations where damage has been observed. None of the PUs have over 100 mature individuals and there is still limited recruitment at two wild sites. In order to address this issue, development of a slug control technique is a priority. The overall prognosis for this taxon remains unclear as so much hinges on this research, which is discussed in Chapter 5.

Major Highlights/Issues Year 3

- Supplemental plantings were conducted at existing reintroduction sites within three PUs adding a total of 24 new plants.
- Initiated a reintroduction with nine plants from the KAL-A stock (the “type” locale for this taxon) at a new site in North Kaluaʻā.

Plans for Year 4

- Refresh genetic storage collections every four to five years until testing results indicate otherwise.
- Continue to balance founders at reintroduction sites. Try to acquire seed for storage and additional propagation from PAH-A-2 in order to maximize wild Pahole founders.
- Prepare PAH-B-1 stock for reintroduction. After mature, collect seed for use in additional reintroductions and storage.
- Implement the first augmentation at the West Makaleha portion of the Pahole to West Makaleha PU.
- Expand the Puʻu Palikea MU fence to include more *C. grimesiana* habitat for use in additional augmentations.
- Continue to augment reintroductions at ʻĒkahanui and Kaluaʻā.
- Create a new reintroduction site at Pāhole.

- Continue reintroduction with KAL-A stock from the South Kaluaʻā. “type” locale for this taxon at the new site in North Kaluaʻā.
- NRS will collect another voucher of the soft-bodied scale from affected plants in the Palikea PU for further identification and monitor the damage. Initial identification suggest the scale may be native, but the sample was not in ideal condition. If the scale is an alien then NRS will consider control options.
- Continue slug control research (see chapter 5.2)
- Fence Mākaha PU, continue to collect seed for storage, and began propagation for future reintroductions.

Table 2.1.5a Taxon Status Summary

Action Area: In

TaxonName: Cyanea grimesiana subsp. obatae TaxonCode: CyaGriOba

Population Unit Name	Management Designation	Current Mature (Wild)	Current Immature (Wild)	Current Seedling (Wild)	Current Augmented Mature	Current Augmented Immature	Current Augmented Seedling	NRS Mature 2006	NRS Immature 2006	NRS Seedling 2006	Total Mature	Total Immature	Total Seedling	Population Trend Notes
Pahole to West Makaleha	Manage for stability	6	0	9	19	8	0	31	3	8	**25**	**8**	**9**	1 mature and 1 immature wild plants died last year. A new seedling was observed at a wild site. Additional plants were added to augment the PU.
	Total for Taxon:	6	0	9	19	8	0	31	3	8	**25**	**8**	**9**	

Action Area: Out

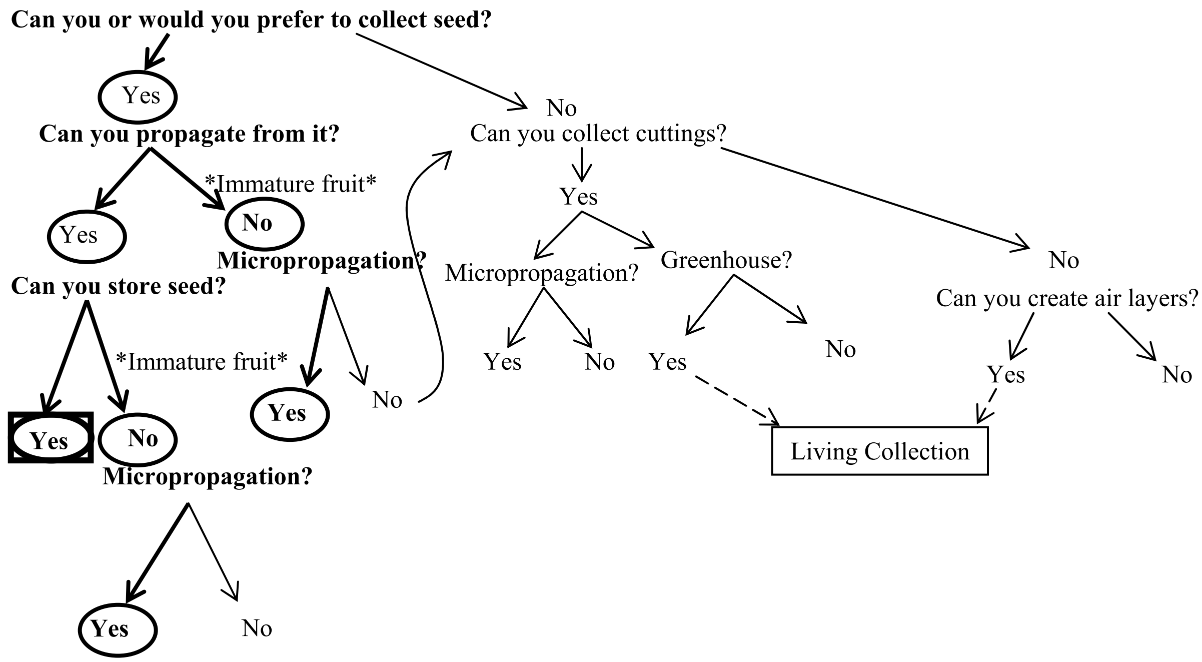
TaxonName: Cyanea grimesiana subsp. obatae TaxonCode: CyaGriOba

Population Unit Name	Management Designation	Current Mature (Wild)	Current Immature (Wild)	Current Seedling (Wild)	Current Augmented Mature	Current Augmented Immature	Current Augmented Seedling	NRS Mature 2006	NRS Immature 2006	NRS Seedling 2006	Total Mature	Total Immature	Total Seedling	Population Trend Notes
Central Kaluaa	Manage for stability	1	0	0	18	30	0	23	33	0	**19**	**30**	**0**	The wild plant has been observed in the last year and is healthy. Additional plants were added to the existing reintroduction, and some reintroduced plants died.
Makaha	Manage for stability	1	0	0	0	0	0	1	0	0	**1**	**0**	**0**	This plant has been observed in the last year and is healthy
North branch of South Ekahanui	Genetic Storage	0	0	0	23	14	0	21	18	0	**23**	**14**	**0**	The wild plants died in 2000. Decline in TNC reintroduction due to tree fall. One plant added to reintroduction
Palikea (South Palawai)	Manage for stability	7	11	10	64	14	0	54	30	20	**71**	**25**	**10**	Slight decline in wild population, see discussion for seedling count declines
Palikea Gulch	Genetic Storage	0	1	0	0	0	0	0	1	0	**0**	**1**	**0**	This plant has been observed in the last year, new shoot growing from base
South Kaluaa	Genetic Storage	0	0	0	9	8	0	11	7	0	**9**	**8**	**0**	The wild plant died in 2005. An additonal outplanting was created and some reintroduced plants died this year
	Total for Taxon:	9	12	10	114	66	0	110	89	20	**123**	**78**	**10**	

Propagation & Genetic Storage

1) At this time, what is the preferred propagation technique?	**2)** At this time, what is the preferred genetic storage technique?	**3)** Has a successful storage method been determined?	**4)** Are additional steps required for obtaining enough seed?
Seed	Seed	Yes	No

Prioritizing Genetic Storage & Propagation Techniques



Collection: refer to OANRP 2006

Propagation: refer to OANRP 2006

Seed Storage Research: Extensive storage testing for many other species of *Cyanea* has indicated that seeds of this genus cannot be stored at -18C. All collections have consequently been stored at 4C, at which no aging has been detected for at least four years. Collaborative research is ongoing with NCGRP to understand why they can not be kept at -18C. The first hypothesis to be tested will be that the transition state for the majority of lipids present in the seed is around -18C. Therefore, storage at this temperature would cause a continual phase change between the defrosting cycles of the freezer. This cyclical freezing and melting of lipids would damage cell walls and cause seed death. Theoretically, temperatures below -18C may age seeds slower than 4C and may possibly be preferred storage temperature. With seeds collected from Pahole and ʻĒkahanui reintroductions this past year, testing was established for -80C. More seed will be collected for -150C (lN2) testing at NCGRP. NRS will continue to store at 4C until a better protocol has been established.

Genetic Storage: As mentioned in the Pahole to West Makaleha PU discussion, there is only one outplanted individual representing one of the dead Pahole founders. This founder is represented in no other way. Once viable seed is collected from this individual, genetic storage goals will have been met for this taxon.

Table 2.1.5b Genetic Storage Summary

	# of Potential Founders			Partial Storage Status			Storage Goals Met
Population Unit Name	Current Mature	Current Imm.	NumWild Dead	# Plants >= 10 in Seedbank	# Plants >=1 Microprop	# Plants >=1 Army Nursery	# Plants that Met Goal
Cyanea grimesiana subsp. obatae							
Central Kaluaa	1	0	0	1	0	1	1
Makaha	1	0	0	1	0	0	1
North branch of South Ekahanui	0	0	2	1	2	0	2
Pahole to West Makaleha	6	0	3	8	0	8	8
Palikea (South Palawai)	7	11	2	12	5	4	12
Palikea Gulch	0	1	0	0	0	0	0
South Kaluaa	0	0	1	1	0	1	1
				Total # Plants w/ >=10 Seeds in Seedbank	**Total # Plants w/ >=1 Microprop**	**Total # Plants w/ >=1 Army Nursery**	**Total # Plants that Met Goal**
				24	7	14	25

Unique Species Observations
Refer to OANRP 2006

Outplanting Issues
Reintroduced plants across the Wai‘anae Mountains demonstrate a survivorship rate of 67%, a decline from the previous year’s rate of 75%. Tree fall contributed to one death in ‘Ēkahanui and 12 reintroduced plants died in Central Kalua‘ā. NRS reported a rapid die off of TNCH reintroduced plants in Central Kalua‘ā as well, although the cause is unknown. Supplemental plantings into existing reintroduction sites were conducted within the last year (see the following PU discussions for details). Rat control is conducted to protect reintroductions in sites where rat predation has been observed. Recruitment at reintroductions has not yet been observed. NRS continue to work to develop slug control techniques in order to address seedling predation issues at wild and reintroduced sites (See Chapter 5.2).

Table 2.1.5c Founders Represented in Outplantings

TaxonName: Cyanea grimesiana subsp. obatae **TaxonCode: CyaGriOba**

Total Num Plants based upon Plants that have been numbered

PopulationUnitName	Management Designation	Number of Founders	Number of Founders Represented
Central Kaluaa	Manage for stability	1	1
Makaha	Manage for stability	1	0
North branch of South Ekahanui	Genetic Storage	2	1
Pahole to West Makaleha	Manage for stability	9	6
Palikea (South Palawai)	Manage for stability	20	5
Palikea Gulch	Genetic Storage	1	0
South Kaluaa	Genetic Storage	1	1
	Total for Taxon:	35	14

Number of Founders = Number of Mature, Immature, and Dead founder plants.
Number of Founders Represented = Number of founder plants represented in reintroductions.

Research Issues

Slug research continues to be the highest priority research topic related to *C. grimesiana*. See Chapter 5.2 for a discussion on slug research.

Surveys

No surveys have be conducted for this taxon during this reporting period.

Taxon Threats

The soft bodied scale that was mentioned in last year's report has not been identified. This scale has been observed by TNCH staff since at least 2000. It is negatively impacting outplantings and wild plants at the Palikea PU by feeding on leaf tissue, however the impact seems to be minimal as both the wild and reintroduced plants are healthy. NRS will collect another voucher for identification and continue to monitor for any increase in impact. If the scale is confirmed as an alien then NRS will consider control options.

Population Unit Level Discussion

Manage for Stability PUs

Pahole to West Makaleha: The NARS Specialist monitors the wild populations of this PU within Pahole NAR. The Pahole populations have been fenced since 1997. Breaches in the fence have occurred although no damage has occurred to these populations (see chapter 1.4 for discussion). There is stock representing five founders from Pahole sites (Table 2.15e). Approximately fourteen plants of Pahole stock will be used to supplement the Pahole snail exclosure reintroduction site this winter. Collections were made from the Pahole reintroduction to secure stock from PAH-B-1 in seed storage. The one individual representing PAH-A-2 did not flower last year but did flower this year and immature fruit are currently developing. NRS will continue to secure stock from B1 and A2 and add this lineage to the reintroduction site.

Table 2.1.5d Population Unit Threat Control Summary

Action Area: In

TaxonName: Cyanea grimesiana subsp. obatae

PopulationUnitName	ManagementDesignation	Protected from Ungulates	Weeds Managed	Rats Controlled
Pahole to West Makaleha	Manage for stability	Yes	Partial	Partial

Action Area: Out

TaxonName: Cyanea grimesiana subsp. obatae

PopulationUnitName	ManagementDesignation	Protected from Ungulates	Weeds Managed	Rats Controlled
Central Kaluaa	Manage for stability	Yes	Yes	Partial
Makaha	Manage for stability	No	Partial	Partial
North branch of South Ekahanui	Genetic Storage	Yes	Partial	Partial
Palikea (South Palawai)	Manage for stability	Yes	Yes	Yes
Palikea Gulch	Genetic Storage	Yes	No	No
South Kaluaa	Genetic Storage	Yes	Yes	Yes

Table 2.1.5e Propagation Status of Pahole Founders

Stock Source for existing augmentation (PAH-D)	Founder plant #	Comments
Pahole (PAH-A)	2	Founder only represented as one plant in reintroduction. Founder is dead in wild. Collect seed as soon as plant matures to secure stock and balance with rest of founders.
	3	Propagation underway for planting this winter
	4	Propagation underway for planting this winter
Pahole (PAH-B)	1	Founder only represented in reintroduction. Founder is dead in wild. Plants are mature and have been collected from this past October/November to secure stock and to balance founders in reintroduction in future.
	2	Propagation underway for planting this winter

NRS manage, monitor, and conduct rat and weed control within the West Makaleha exclosure of this PU. The population has been fenced since 2001 and is monitored quarterly to ensure that it remains pig-free. Rat control data is shown in Table 2.15f. Bait stations and snap traps are maintained approximately every six weeks. No rat damage has been observed on plants since May 2002.

Table 2.1.5f West Makaleha *Cyanea grimesiana* subsp. *obatae* rat control data

Year	# of Bait Stations	Amount of Bait Available	Amount of Bait Taken	% Bait Taken	# of Rats Trapped	# of Snap Traps	# of Site Visits
2002	8	292	120	41%	25	15	6
2002 - 2003	8	696	463	67%	26	16	7
2003 - 2004	8	1008	693	69%	42	16	8
2004 - 2005	8	1001	322	32%	43	16	10
2005 - 2006	8	695	376	54%	42	16	6
2006-2007	8	298	209	42%	34	16	5

NRS planned to augment the West Makaleha site this year, but the plants were not ready. NRS have stock from five founders. Only three of these remain in the wild, as two more died within the past year, possibly due to slug damage. Four founders have representation in seed storage and one is represented as a single small plant in the greenhouse. *In-situ* recruitment does occur at this site; as many as 7 seedlings have been seen at one time, however none have ever lived to become immature. An experimental fruit smearing effort began in fall 2006 utilizing excess fruit from plants that have met collection goals for seed storage. Fruits are smeared at two sites apart from the wild mature plants and flagged. The sites are then monitored on return visits for germination and survivorship. NRS have observed germination from the smeared fruit.

Palikea (South Pālāwai*):* This site is now managed predominantly by NRS due to changes in TNCH staffing. The population was fenced in 2000 and is ungulate free. Native ferns and shrubs dominate the understory while the canopy is alien dominated (see chapter 9.4). Rat control has been underway since 2002. NRS maintain a rat baiting grid of 18 bait stations and 21 snap traps (table 2.15g). The grid is maintained monthly and also serves to protect native *Achatinella mustelina* populations in the area.

Table 2.1.5g Palikea *Cyanea grimesiana* subsp. *obatae* and *Achatinella mustelina* rat control data

Year	# of Bait Stations	Amount of Bait Available	Amount of Bait Taken	% Bait Taken	# of Rats Trapped	# of Snap Traps	# of Site Visits
2004 - 2005	18	2151	525	24%	49	18	11
2005 - 2006	18	1887	626	33%	36	21	10
2006 - 2007	20	2122	697	33%	36	26	11

In the previous year, NRS hired a fencing crew to construct planned MIP fences. Expanding the existing fence at Palikea is a top priority. However, construction has been delayed but should be completed by the summer of 2008. TNCH staff and NRS have conducted several augmentations over the past four years. Currently there is limited space in the existing exclosure, but eight plants were added this year to the reintroduction in order to balance founders. More supplemental plantings will occur after the fence expansion is complete. Seed has been germinated in preparation for this planting, and founders will be balanced with the existing augmentation. There was a slight decline in the wild population, and the lower number of seedlings is a result of a shift in monitoring methodology. This year NRS only counted seedlings that had reached a size where they were more distinguishable from the ferns that also inhabit the small wet cliff where the wild population occurs.

Central & North Kaluaʻā: This PU consists of a single wild founder and one reintroduced population, both located within the Kaluaʻā subunit I fence. The reintroduction was initiated in the winter of 2004-2005, supplemented in the winter of 2005-2006 with six plants, and again this year with seven plants. Some of the previously plantings have died. However, plants from the initial reintroduction have matured and are producing fruit. No recruitment at either the wild or reintroduced sites has been observed, even though the wild plant produces copious amounts of fruit.

Mākaha: The single plant in this PU was discovered in 2005, and is currently unfenced. NRS began rat baiting (table 2.15h) while it fruited and collected two fruit in 2005, however no viable seed was produced. NRS baited again this year and collected six mature fruits. Weeds have been controlled within a two meter radius of the plant. NRS plan to erect a PU fence with the permission of BWS. In the upcoming year an additional fence (subunit II) will begin construction in Mākaha (see chapter 2.1). Within the next two years, or as stock becomes available, two reintroduction sites using stock from this plant will be created. One will use pure stock of this plant while the second will mix Mākaha stock with plants from West Makaleha.

Table 2.1.5h Mākaha *Cyanea grimesiana* subsp. *obatae* and *Achatinella mustelina* rat control data

Year	# of Bait Stations	Amount of Bait Available	Amount of Bait Taken	% Bait Taken	# of Rats Trapped	# of Snap Traps	# of Site Visits
2005 - 2006	2	64	17	27%	3	4	2
2006 - 2007	2	98	37	38%	5	4	3

Other PUs

North Branch of South ʻĒkahanui: This PU lies within the ʻĒkahanui subunit I fence and is comprised of two reintroductions of EKA-A stock. In prior years NRS collected fruit from the first reintroduction of this stock (EKA-B). This reintroduction was conducted by TNCH using mixed ʻĒkahanui and Kaluaʻā stock. Collection of pure ʻĒkahanui seed from this mixed population was done by ensuring that none of the Kaluaʻā plants were in flower at the same time or by removing developing inflorescences. The ʻĒkahanui stock used in this reintroduction was collected from the last remaining EKA-A individual by TNCH staff in 1999. Stock from a previous collection by John Obata is currently stored at Lyon Arboretum Micropropagation Lab. This collection was described as being from one of eight plants, so the possibility that this stock is from a different plant from the TNCH collection is rather high. This stock almost perished in the lab as the last remaining culture was in poor health and was recalcitrant to sub-culturing. However, a subculture was created and now the stock is abundant in the lab. Pure stock of the EKA-A population is considered valuable because they have corollas unlike any other populations of this taxon and previous genetic analysis also highlighted significant genetic differences (Crooker, 2004).

In the winter of 2004-2005, a pure ‘Ēkahanui reintroduction was initiated with 33 outplants from the seed collected from the EKA-B reintroduction. They have matured, produced fruit, and are thriving. This winter only one individual was added to the reintroduction because the rest of the stock was not ready. However, additional plants will be added this winter when they reach the appropriate outplanting size. NRS are waiting for the completion of the subunit II fence (see chapter 9.2) to initiate an additional reintroduction site. This additional reintroduction will consist of a mix of stock from the TNCH EKA-A collection and the stock at Lyon Arboretum Micropropagation Lab. Once enough seed is secured for genetic storage, no further reintroduction effort will be necessary. However, NRS will continue to conduct management in the area as this PU overlaps with other IP taxa.

Palikea Gulch: This PU consists of one immature plant within a small fence. NRS have monitored the plant since February 1999. It is still small and immature, although it has grown an appreciable amount in the past year. A large log lies above the plant, and the plant has begun to grow around the log. The plant also produced a new side shoot, which may be collected in the coming months as it has its own roots. No rat predation has been observed. NRS will continue to monitor this plant for signs of reproduction.

Figure 2.1.5a Palikea gulch plant with new side shoot

South Kalua‘ā: The last remaining South Kalua‘ā PU plant died in the Fall of 2005. However, seed stock and reintroduced plants exist from this PU. This PU is morphologically most like the type specimen of this taxon. TNCH outplanted stock from this KAL-A plant near the KAL-B founder before the KAL-B plant was discovered. Cross pollination between the KAL-A outplanted stock and the wild KAL-B individual may have occurred. However, a geographically separated population, which was recommended by the IT, was established this year within the North Kalua‘ā subunit II fence with nine plants. 13 more plants are being propagated for outplanting in the winter of 2007-2008. However, only one plant is currently large enough for planting. Furthermore, the KAL-A stock that TNCH planted in a mixed reintroduction with EKA-A stock (see North Branch of South ‘Ēkahanui PU discussion) is an additional seed source that can be isolated, collected from, and used in future reintroduction efforts.

2.1.6 *Cyanea longiflora*

Requirements for Stability:

- 3 Population Units (PUs)
- 75 reproducing individuals in each PU (short-lived perennial with fluctuating population numbers and trend of local decline)
- Threats controlled
- Complete genetic representation of all PUs in storage
- Expedited Stabilization (10 years)

How many of the 3 MFS PUs have stable numbers of mature individuals?	How many of the 3 MFS PUs have had *in situ* recruitment?	How many of the 3 MFS PUs have full genetic storage?	How many of the 3 MFS PUs are protected from ungulates?	How many of the MFS PUs that need reintroductions have them all completed?
0/3	3/3	0/3	2/3	0/3

Taxon Level Discussion

There are three Manage for Stability (MFS) Population Units (PU) for this taxon. Kapuna to West Makaleha and Pahole PUs are inside the Action Area (AA), and Makaha and Waianae Kai PU is outside the AA. Fenced off from ungulates the longest, the Pahole PU contains the largest number of plants of all size classes. Seedlings have been observed in all PUs. While most plants are found in habitats with high native species composition, *Cyanea longiflora* habitat is threatened by weeds such as *Psidium cattleianum* and *Clidemia hirta*. NRS weeded throughout sections of all PUs this year. The first reintroduction of this taxon was conducted in an exclosure near wild plants in West Makaleha and survivorship there is high. Currently, these reintroduced plants are the only individuals of this taxon that are fenced in the Kapuna to West Makaleha PU. Three *ex situ* plants near the West Makaleha exclosure occur on a steep slope and are topographically protected from ungulates. This year NRS finally secured genetic representation of all three of these plants that are reached on rappel. All other known plants in this PU will benefit from the completion of the Kapuna subunit III and IV fences currently under construction.

All known plants within the Mākaha and Waianae Kai PU are now all fenced. A small fence was completed around the plants prior to the completion of the Mākaha subunit I fence this year. Unfortunately, plants within this smaller fence were subject to vandalism. Plant heads were snapped off two tagged mature plants. See taxon threats for further discussion of this issue. NRS weeded around the population this year and found another seedling. Stock collected from this population will be outplanted into an augmentation site within the new Mākaha MU fence.

This year the Fish and Wildlife Service designated *C. longiflora* as a species “Expedited for Stabilization” in 10 years. This designation requires that in addition to three PUs managed *in situ*, one PU outside the action area must be rushed for stabilization in 10 years. The Mākaha and Wai‘anae Kai PU was selected for this effort. Given the low numbers of wild mature plants currently in the PU, stability goals will be challenging to meet in this timeframe for this PU. The

Makaha subunit II Management Unit fence will encompass appropriate habitat for reintroduction of this taxon. This fence is proposed for construction in year five.

Major Highlights/Issues Year 3

- A small fence was constructed around the Mākaha and Waianae Kai plants encompassing all plants.
- Blatant vandalism occurred in Spring of this year, after the smaller Mākaha fence was built; the stems of two mature tagged plants were deliberately snapped.
- The Mākaha subunit I fence was finished this year (vandalism experienced during construction).
- Collected from third of three founders from West Makaleha.
- West Makaleha reintroduction 83% survivorship since 2005.
- Species Expedited for Stabilization in 10 years.
- Collected from new founders in Keawapilau Gulch in the Kapuna to West Makaleha PU.

Plans for Year 4

- Continue to augment West Makaleha until balance 3 founders, with 10 representatives of each.
- Assist NARS with completion of the Kapuna subunit III and IV fences this year.
- Work with NARS to develop an augmentation strategy for Pāhole.

Table 2.1.6a Taxon Status Summary

Action Area: In

TaxonName: Cyanea longiflora TaxonCode: CyaLon

Population Unit Name	Management Designation	Current Mature (Wild)	Current Immature (Wild)	Current Seedling (Wild)	Current Augmented Mature	Current Augmented Immature	Current Augmented Seedling	NRS Mature 2006	NRS Immature 2006	NRS Seedling 2006	Total Mature	Total Immature	Total Seedling	Population Trend Notes
Kapuna to West Makaleha	Manage for stability	23	16	4	0	19	0	28	28	0	**23**	**35**	**4**	Five mature plants died and four new seedlings were found while monitoring
Pahole	Manage for stability	50	63	22	0	0	0	49	39	13	**50**	**63**	**22**	Additional mature and immature plants were observed in known sites
	Total for Taxon:	73	79	26	0	19	0	77	67	13	**73**	**98**	**26**	

Action Area: Out

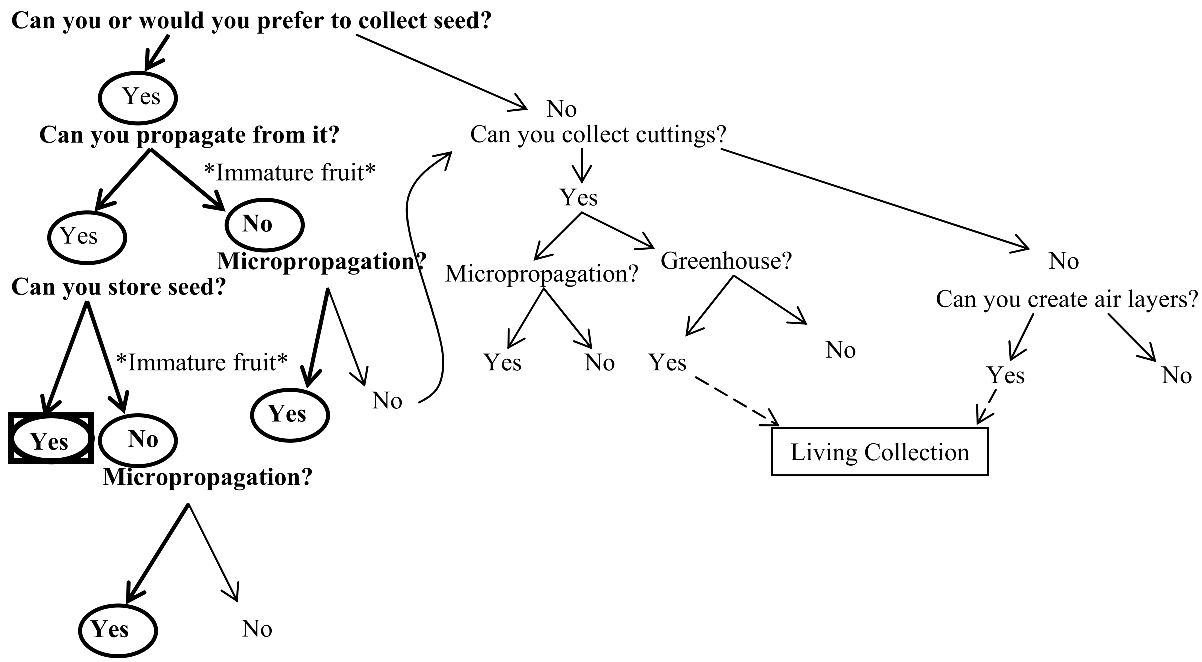
TaxonName: Cyanea longiflora TaxonCode: CyaLon

Population Unit Name	Management Designation	Current Mature (Wild)	Current Immature (Wild)	Current Seedling (Wild)	Current Augmented Mature	Current Augmented Immature	Current Augmented Seedling	NRS Mature 2006	NRS Immature 2006	NRS Seedling 2006	Total Mature	Total Immature	Total Seedling	Population Trend Notes
Makaha and Waianae Kai	Manage for stability	3	5	2	0	0	0	3	6	4	**3**	**5**	**2**	Mature plants died/were killed; immatures became mature; two seedlings remain
	Total for Taxon:	3	5	2	0	0	0	3	6	4	**3**	**5**	**2**	

Propagation and Genetic Storage

1) At this time, what is the preferred propagation technique?	2) At this time, what is the preferred genetic storage technique?	3) Has a successful storage method been determined?	4) Are additional steps required for obtaining enough seed?
Seed	Seed	Yes	No

Prioritizing Genetic Storage & Propagation Techniques



Collection: refer to OANRP 2006

Propagation: refer to OANRP 2006

Seed Storage: Plants flowered in the greenhouse this year. If fruit mature; this seed will be used to test a new storage treatment (dry, -80C) to see if this treatment slows the aging process in seeds more than at 4C (see 2.00 Seed Storage). Until results indicate otherwise, banked seeds are stored refrigerated at 20% relative humidity. No aging has been detected at these conditions after four years.

Genetic Storage: Collections have been made from five new plants in the Kapuna to West Makaleha PU. NRS will continue to store seed to meet genetic storage goals.

Table 2.1.6b Genetic Storage Summary

Population Unit Name	# of Potential Founders: Current Mature	Current Imm.	NumWild Dead	Partial Storage Status: # Plants >= 10 in Seedbank	# Plants >=1 Microprop	# Plants >=1 Army Nursery	Storage Goals Met: # Plants that Met Goal
Cyanea longiflora							
Kapuna to West Makaleha	23	16	0	14	1	3	14
Makaha and Waianae Kai	3	5	2	3	1	1	2
Pahole	50	63	5	27	1	2	27
				Total # Plants w/ >=10 Seeds in Seedbank	**Total # Plants w/ >=1 Microprop**	**Total # Plants w/ >=1 Army Nursery**	**Total # Plants that Met Goal**
				44	3	6	43

Outplanting Issues

Due to the fact that plants are found on both ends of the range within the Kapuna to West Makaleha PU, there will be two separate reintroductions on either side of this PU. In February 2005, NRS outplanted 23 immature *C. longiflora* in West Makaleha from two of three nearby founders. So far 19 have survived, and most are healthy. The plants initially experienced some slug damage, but none has been since this first observation. NRS will continue to balance stock at this reintroduction until there are ten representatives of each of the three founders. Stock from the Keawapilau Gulch and Kapuna Gulch sites will be used for augmentation in either the Kapuna subunit III or IV fence for the 2008/2009 winter outplanting.

Research Issues

There are no new research issues associated with this taxon this year.

Taxon Threats

Slugs continue to be an observed problem for this taxon, however ongoing slug research has offered a few potential means of controlling this threat in a rare plant population (Chapter 5.2).

Population Unit Level Discussion

Table 2.1.6c Population Unit Threat Control Summary

Action Area: In

TaxonName: Cyanea longiflora

PopulationUnitName	ManagementDesignation	Protected from Ungulates	Weeds Managed	Rats Controlled
Kapuna to West Makaleha	Manage for stability	Partial	Partial	Partial
Pahole	Manage for stability	Yes	Partial	No

Action Area: Out

TaxonName: Cyanea longiflora

PopulationUnitName	ManagementDesignation	Protected from Ungulates	Weeds Managed	Rats Controlled
Makaha and Waianae Kai	Manage for stability	Yes	Partial	No

Manage for Stability PUs:

Pāhole: This year NRS monitored and counted all known plants in this PU. Most of these plants occur in a relatively continuous band of steep, ferny, north facing slopes about 30 meters below Pāhole rim. This population appears healthy, with plants of all size classes present. NRS conducted careful weed control throughout this population this year. NRS continued to collect fruit from all unrepresented plants this year, however, very few plants had fruit. This may have been due to the fact that many plants while for the most part were healthy, were water-stressed. Many *C. longiflora* plants were dropping leaves, and associated species such as ferns and mosses throughout the habitat were dried and droopy.

Kapuna to West Makaleha: This PU encompasses three gulches: Kapuna, Keawapilau and West Makaleha. In the last year, NRS have monitored all known sites in this PU and collected from all the founders that produced fruit. This PU will be augmented with stock grown from these collections once adequate habitat is fenced. NRS are expected to finish the Kapuna fence by the end of this year. This will provide protection for a single individual in Kapuna, as well as future outplanting sites. The wild plants in the West Makaleha portion of this PU are not directly threatened by ungulates, however, the surrounding habitat is not yet secure. This species was reintroduced for the first time within a small fenced exclosure near the wild plants in West Makaleha in early 2006. This reintroduction currently represents two of the three founders. The third founder was collected from for the first time this year and stock is being grown out to add to this reintroduction.

Mākaha and Wai‘anae Kai: The smaller Mākaha fence that encompasses the only extant leeward population of *C. longifolia* is very conspicuous as it runs right along the Kumaipo Trail. It has obviously drawn negative attention to the plants. NRS are shocked at this vandalism to the plants and continue to participate in outreach projects that target the community. NRS work with Bruce Koebele of Ka‘ala Farms and Waianae High School Students on natural resource projects in the fenced exclosure in Mākaha, and are currently working with community hunters to hunt pigs out of the exclosure. These efforts, along with focus on the issue by two new outreach and education focused NRS staff, will hopefully help prevent future problems in this area.

Weed control was conducted this year with care not to radically increase light levels in the understory. All tags and flags were moved off individual plants and placed nearby to avoid a repeat occurrence of vandalism. Augmentation will be pursued in the Makaha subunit II fence proposed for year five.

2.1.7 *Cyanea superba* subsp. *superba*

Requirements for Stability

- 4 Population Units (PUs)
- 50 reproducing individuals in each PU (long-lived perennial with a history of precipitous decline, extirpated in the wild, and extremely low genetic variability)
- Threats controlled
- Complete genetic representation in storage of all PUs
- Expedited stabilization (five yrs)

How many of the 4 MFS PUs have stable numbers of mature individuals?	How many of the 4 MFS PUs have had *in situ* recruitment?	How many of the 4 MFS PUs have full genetic storage?	How many of the 4 MFS PUs are protected from ungulates?	How many MFS PUs that need reintroductions have been initiated?
2/4	0/4	1/1 (only one *in situ* PU)	3/4	0/4

Taxon Level Discussion

As with other MIP taxa, NRS have determined that a fourth MFS PU is needed to meet stabilization goals. The primary reason for a fourth MFS is that all wild individuals are now dead and a fourth MFS PU will increase the odds of success given that all four MFS PUs will be established solely by reintroductions. NRS have the necessary tools to overcome many of the threats that this taxon faces. The major challenge with this taxon is overcoming the lack of recruitment. NRS have never seen recruitment in the wild, either at the wild site or at reintroduction sites. Many of the reintroduction sites have been established for many years and have produced copious amounts of seed without any germination. NRS believe that this is largely due to predation by introduced slugs and feel that development of a management tool for this threat is critical to the stabilization of this species. The 2007 BO requires that three *C. superba* PUs attain numerical stability outside the Action Area (AA). This is a topic that NRS would like to discuss with the IT as there have only been four PUs identified, two of which are in the AA. To meet this requirement an additional PU would have to be identified outside of the AA. This would result in five PUs for *C. superba* as the two in the AA are already established. The establishment of additional off site PUs will also be problematic for this species. While propagation has started for Mākaha, the first offsite PU, no propagation has begun for Makaleha, the second offsite PU, as there is no assurance that fencing will be complete with out an MOU with the state. Until an MOU is in place, a fencing plan can not be developed, until there is a fencing plan plants should not be germinated. In addition to the offsite PUs expedited stabilization requires; weed control, fire management and monitoring must be ongoing at all the MFS PUs within this time frame.

Major Highlights/Issues Year 3

- The fencing in Mākaha is complete and NRS will begin reintroduction in Mākaha this year.

- The last remaining F_1 individual from founder MMR-A-2 was not collected from in the last year as NRS had planned. The infructescence aborted.
- NRS analyzed survivorship data this year to better understand the population dynamics.
- NRS are considering reintroducing staggered age classes by staggering propagation times.
- The 2007 BO was issued by FWS requires five year expedited stabilization

Plans for Year 4

- NRS plan to begin seed plot experiments this spring to investigate impacts of controlling slugs on seedlings recruitment.
- NRS will attempt to collect seed from the last remaining MMR-A-2 founder. Presently, this stock is unrepresented in the seed bank and reintroductions.
- NRS plan to continue collection, propagation, and reintroduction efforts with the eventual goal of establishing balanced populations with the greatest possible genetic diversity.

Figure 2.1.7a Flowering *Cyanea superba* subsp. *superba*

Table 2.1.7a Taxon Status Summary

Action Area: In

TaxonName: Cyanea superba subsp. superba — **TaxonCode: CyaSupSup**

Population Unit Name	Management Designation	Current Mature (Wild)	Current Immature (Wild)	Current Seedling (Wild)	Current Augmented Mature	Current Augmented Immature	Current Augmented Seedling	NRS Mature 2006	NRS Immature 2006	NRS Seedling 2006	Total Mature	Total Immature	Total Seedling	Population Trend Notes
Kahanahaiki	Manage for stability	0	0	0	19	92	0	17	108	0	19	92	0	Two plants have become mature in the last year and a few more immature plants have died
	Total for Taxon:	0	0	0	19	92	0	17	108	0	19	92	0	

Action Area: Out

TaxonName: Cyanea superba subsp. superba — **TaxonCode: CyaSupSup**

Population Unit Name	Management Designation	Current Mature (Wild)	Current Immature (Wild)	Current Seedling (Wild)	Current Augmented Mature	Current Augmented Immature	Current Augmented Seedling	NRS Mature 2006	NRS Immature 2006	NRS Seedling 2006	Total Mature	Total Immature	Total Seedling	Population Trend Notes
Central and East Makaleha	Manage reintroduction for stability	0	0	0	0	0	0	0	0	0	0	0	0	This reintroduction will begin when the MU fence is complete
Makaha	Manage reintroduction for stability	0	0	0	0	0	0	0	0	0	0	0	0	This reintroduction will begin in the end of 2007
Pahole to Kapuna	Manage reintroduction for stability	0	0	0	72	68	0	72	84	0	72	68	0	Many of these plants became mature in the last year
	Total for Taxon:	0	0	0	72	68	0	72	84	0	72	68	0	

Table 2.1.7a Taxon Status Summary

Action Area: In

TaxonName: Cyanea superba subsp. superba   TaxonCode: CyaSupSup

Population Unit Name	Management Designation	Current Mature (Wild)	Current Immature (Wild)	Current Seedling (Wild)	Current Augmented Mature	Current Augmented Immature	Current Augmented Seedling	NRS Mature 2006	NRS Immature 2006	NRS Seedling 2006	Total Mature	Total Immature	Total Seedling	Population Trend Notes
Kahanahaiki	Manage for stability	0	0	0	19	92	0	17	108	0	19	92	0	Two plants have become mature in the last year and a few more immature plants have died
	Total for Taxon:	0	0	0	19	92	0	17	108	0	19	92	0	

Action Area: Out

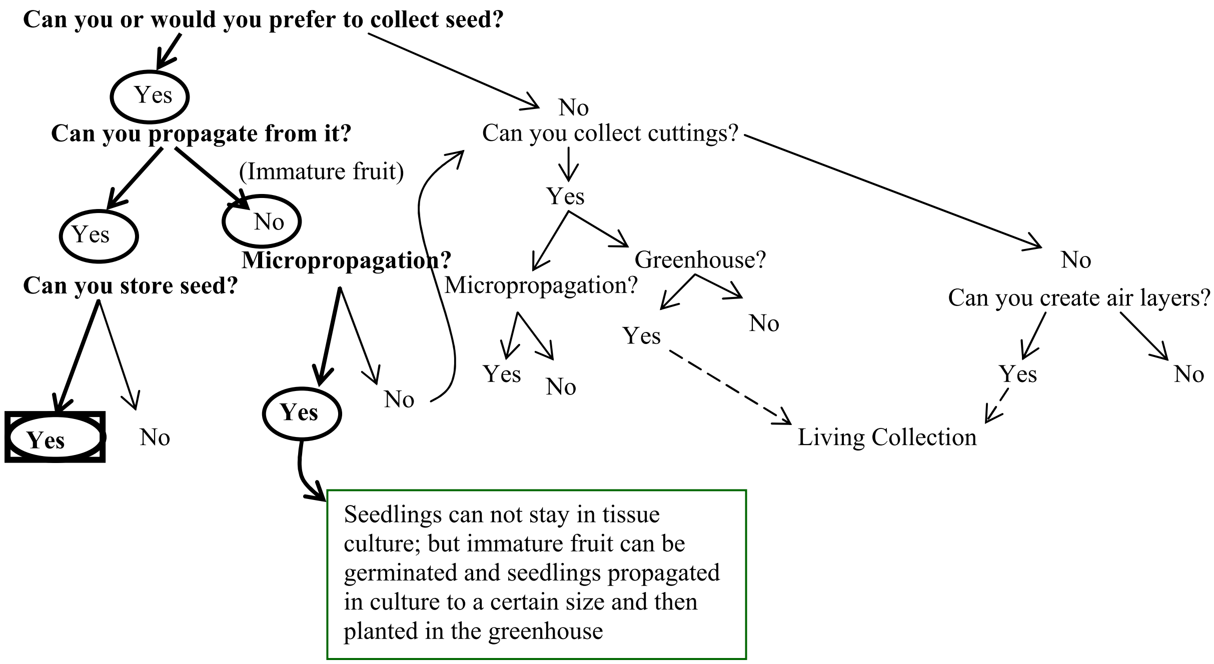
TaxonName: Cyanea superba subsp. superba   TaxonCode: CyaSupSup

Population Unit Name	Management Designation	Current Mature (Wild)	Current Immature (Wild)	Current Seedling (Wild)	Current Augmented Mature	Current Augmented Immature	Current Augmented Seedling	NRS Mature 2006	NRS Immature 2006	NRS Seedling 2006	Total Mature	Total Immature	Total Seedling	Population Trend Notes
Central and East Makaleha	Manage reintroduction for stability	0	0	0	0	0	0	0	0	0	0	0	0	This reintroduction will begin when the MU fence is complete
Makaha	Manage reintroduction for stability	0	0	0	0	0	0	0	0	0	0	0	0	This reintroduction will begin in the end of 2007
Pahole to Kapuna	Manage reintroduction for stability	0	0	0	72	68	0	72	84	0	72	68	0	Many of these plants became mature in the last year
	Total for Taxon:	0	0	0	72	68	0	72	84	0	72	68	0	

Propagation and Genetic Storage

1) At this time, what is the preferred propagation technique?	2) At this time, what is the preferred genetic storage technique?	3) Has a successful storage method been determined?	4) Are additional steps required for obtaining enough seed?
Seed	Seed	Yes	No

Prioritizing Genetic Storage & Propagation Techniques



Collection: Collection methods were fine-tuned this past fruiting season to pinpoint the best collection time and handling protocols to maximize seed quality and storage potential. Prior to this past season, the majority of fruit were collected by suspending weed mats underneath the fruiting plants and allowing the fruit to mature and drop onto the mats. This method reduced the number of immature fruit collected (unless fruit aborted), but time delays between maturation to fruit drop, as well as fruit drop to collection time may have damaged seeds. Average initial germination rates for collections via this method were low and highly variable. Seeds of this species may not tolerate prolonged exposure to ambient temperatures and humidity while still in the fleshy fruit. This year, in response to both highly variable initial and storage viability germination rates, fruit were picked off the plant when fruit began to turn orange, and inside pulp was ripe (red) and seeds appeared mature (seed coats were shiny, seeds at full size) (Fig.2.1.7b). Initial germination rates were high and consistent with this method. One of these picked collections was tested separately and exposed to ambient conditions for three days, then processed and sown. None of these seeds germinated, supporting the hypothesis that seeds lose viability when exposed to ambient conditions while inside the fruit (Table 2.1.7b). Fruit will therefore not be collected in mats and will continue to be picked and handled as they were this year, and processed quickly.

Figure 2.1.7b *Cyanea superba* fruit

Propagation: refer to OANRP 2006

Seed Storage Research: Extensive, high-quality collections were made from reintroductions this past fruiting season. Following testing strategies designed by ongoing collaborative research between NRS and the National Center for Genetic Resources Preservation (NCGRP), seeds entered tailored storage tests at new temperatures in attempt to determine if temperatures below -18C will maintain seed viability longer than 4C (see 2.00 for lipid research details). Seeds can not be stored at -18C, but have good storage longevity at 4C. Theoretically, seeds should age slower at even lower temperatures. Therefore, -80C and -150C (lN2) are being tested for this taxon. Similar to initial germination results, storage tests have been highly variable in the past. NRS hopes that, by reducing collection error in storage viability results, these new storage trials will provide the information necessary to determine the best storage conditions for this taxon.

Genetic Storage: refer to OANRP 2006

Table 2.1.7b Mean germination of *Cyanea superba* by collection & handling method

Collection	Fruit Harvest	Fruit Store Temp (prior to processing)	Mean Germ	P
Dec 2006	Picked	4C	0.72	0.000
Dec 2006	Picked	Room temp	0.00	
Prior to 2006	Fell off plant into net	Field temp	0.27	0.000

Table 2.1.7c Genetic Storage Summary

	# of Potential Founders			Partial Storage Status			Storage Goals Met
Population Unit Name	Current Mature	Current Imm.	NumWild Dead	# Plants >= 10 in Seedbank	# Plants >=1 Microprop	# Plants >=1 Army Nursery	# Plants that Met Goal
Cyanea superba subsp. superba							
Kahanahaiki	0	0	6	3	3	3	3
				Total # Plants w/ >=10 Seeds in Seedbank	**Total # Plants w/ >=1 Microprop**	**Total # Plants w/ >=1 Army Nursery**	**Total # Plants that Met Goal**
				3	3	3	3

Unique Species Observations

No unique observations were made by NRS in the past year.

Outplanting Issues

Reintroductions will balance the four Kahanahāiki founders. NRS will continue to balance the existing reintroductions in the Kahanahāiki and Pahole PU with stock from all available founders. However, no wild collected stock is available from two of the four original founders to balance these sites. For these two founders, F_2 plants will be used so that Kahanahāiki and Pahole to Kapuna PUs will be established with both F_1 and F_2 plants. The other two PUs (Mākaha and Central and East Makaleha) will be established with all F_2 stock grown from the first two reintroductions. These F_2 plants will be grown from as many reintroduced F_1 founders as possible to maximize potential genetic variation. Mākaha reintroduction will begin in the next year, however NRS do not expect habitat scale fencing in Makaleha to begin for several years and will not begin propagation until appropriate.

Table 2.1.7d is an example of how the original founders can be used to select the necessary stock for balancing founders at existing sites and establishing new reintroduction sites at Mākaha and Central and East Makaleha PUs using all four founders.

Table 2.1.7d Propagation Plans for Mākaha and Makaleha Reintroductions

Original Founder	**Current representation:**	**Plan to balance existing sites:**	**Makaha and Makaleha Reintroduction sites: Goal of 100 plants using 25 individuals from each founder**
MMR-A-2	Single F_1 planted in Kahanahāiki in 2005 will likely be collected from this year for the first time	Use seed from the single F_1 plant to balance one site in each of the Pahole and Kahanahāiki PUs with F_2 plants	Propagate with the goal of having 25 plants from the single F1 founder in Kahanahāiki
MMR-A-3	52 F_1 plants in Pahole and Kahanahaiki	Now germinating seeds from the wild that were stored at Lyon	Propagate with the goal of having 25 plants from 25 different F1 founders in Kahanahāiki and Pahole
MMR-A-4	160 F_1 plants in Pahole and Kahanahāiki	Now germinating seeds from the wild that were stored at Lyon	Propagate with the goal of having 25 plants from 25 different F1 founders in Kahanahāiki and Pahole
MMR-A-10	19 F_1 plants in Kapuna	Now germinating seed from the 19 F_1 plants to balance one site in each of the Pahole and Kahanahāiki PUs with F_2 plants	Propagate with the goal of having 25 plants from 25 different F1 founders in Kapuna

Additional outplanting issues are summarized below:

- The maximum number of F_1 founders should be used to provide the seed stock for future F_2 reintroductions, thus maximizing possible genetic variation.
- Given the very low amount of genetic variation, F_2 individuals at existing sites are not expected to differ significantly from F_1 individuals.

- Reintroductions that have only F_1 stock from one founder have value as 'safety net' sites in case other reintroductions fail as living collections of unmixed stock. These sites also provide propagule material for slug control research and offer more data on life history. The are two sites in Kapuna that were planted by the State will be utilized in this way.
- The MMR-A-10 site in Kapuna may be mixed in the future as feasible after the establishment of other balanced reintroductions.

In addition to the Army's efforts with this taxon, the State of Hawai'i has reintroduced this taxon with success into the Pahole NAR over the last ten years and TNC has also conducted reintroductions at two sites using excess planting material.

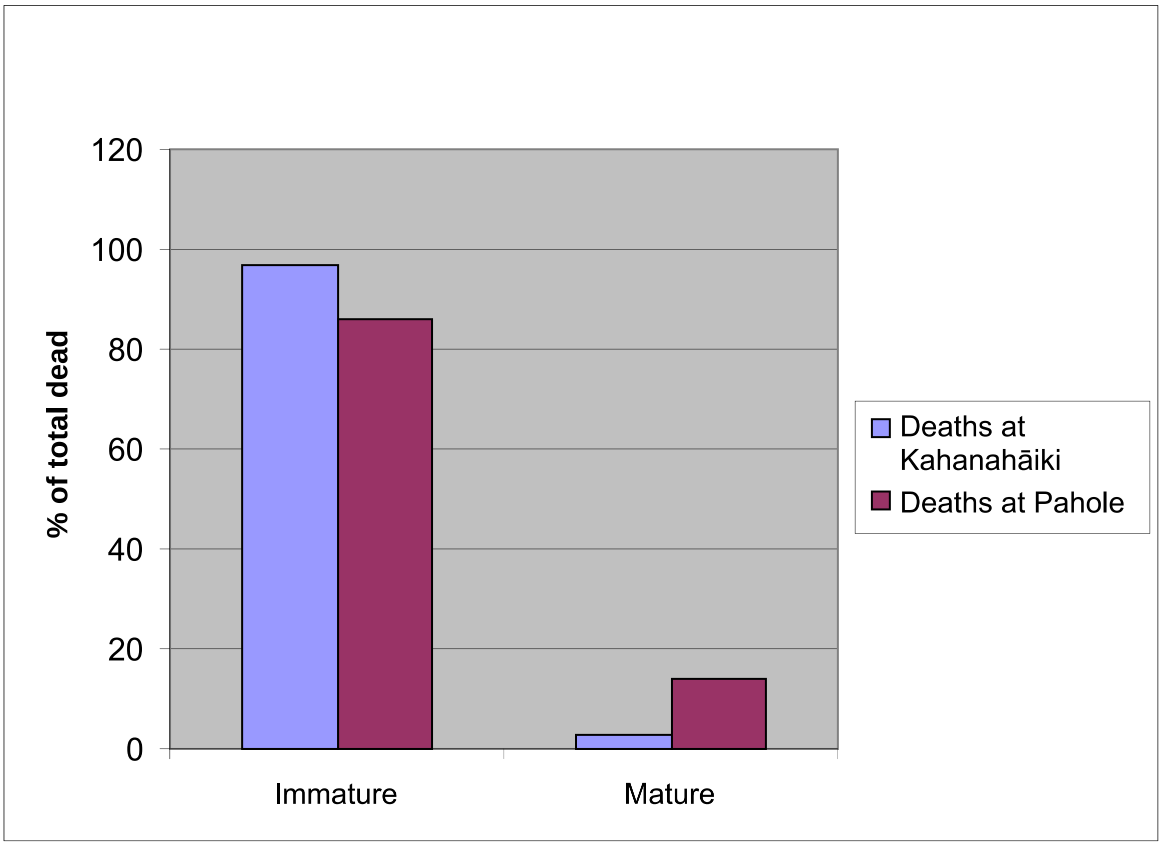


Figure 2.1.7c *Cyanea superba* mortality as a function of age class

In an effort to investigate if *C. superba* is truly a long lived perennial, NRS analyzed reintroduction data that spans a total of eight years. NRS was motivated to do this by inspecting the reintroduction data survivorship trends. Most outplantings that are four or more years old show survivorship rates of about 60%. NRS was interested in investigating where the mortality was occurring. Analysis showed that most of the mortality occurred before the plants became mature. Most plants mature at reintroduction sites in three to four years. Figure 2.1.7c shows that 97% of the mortality at Kahanahāiki and 86% at Pahole are with plants that have not yet reached maturity. (For the purpose of this analysis all plants that died of tree fall where removed). This may be due to a combination of factors such as site selection during planting (inappropriate micro-sites) and stock vigor (greenhouse propagated plants not suited for wild conditions). These results do seem encouraging as they suggest that once plants reach maturity they appear to have even higher survivorship. NRS will continue to track the fate of the growing number of mature plants and report on the survivorship rates of these plants as the population grows. In the next year, NRS will work to develop queries that will be able to use the number of days to maturity and senescence to further this investigation. In particular, NRS is interested to know if a majority of the plants die soon after planting or if it is the result of a particularly bad year or season.

Research Issues

Research on the impact of slugs on this taxon is ongoing. NRS plan to further explore the impact of slugs by doing experimental seed plots with *C. superba* in the spring of 2008. See discussion in the Research section, Chapter 5.2.

Surveys

No surveys were conducted in the last year and no new plants were found.

Taxon Threats

No new threats have been determined for this species.

Population Unit Level Discussion

Table 2.1.7e Population Unit Threat Control Summary

Action Area: In

TaxonName: Cyanea superba subsp. superba

PopulationUnitName	ManagementDesignation	Protected from Ungulates	Weeds Managed	Rats Controlled
Kahanahaiki	Manage for stability	Yes	Yes	Partial

Action Area: Out

TaxonName: Cyanea superba subsp. superba

PopulationUnitName	ManagementDesignation	Protected from Ungulates	Weeds Managed	Rats Controlled
Central and East Makaleha	Manage reintroduction for stability	No	No	No
Makaha	Manage reintroduction for storage	Yes	No	No
Pahole to Kapuna	Manage reintroduction for stability	Partial	Partial	No

Manage for Stability PUs

Kahanahāiki: Since 1998, 223 plants grown from Kahanahāiki stock were planted at six sites in Kahanahāiki gulch. Overall, survivorship is at 50% and there are now 111 plants, 19 mature and 92 immature plants. NRS controlled weeds in this area in the last year. This site will be augmented with stock grown from the unrepresented founders in the next two years and collections of mature fruit will continue this year for storage and propagation. Last year, NRS planned to collect stock from the only remaining progeny of MMR-A-2. Unfortunately, the peduncle rotted before the fruit matured. NRS will continue to monitor this individual and hope that fruit can be secured this year.

Pahole to Kapuna: Since 2001, 137 plants grown from Kahanahāiki stock have been planted at one site in Pahole gulch. Overall survivorship is 51% and there are now a total of 70 plants remaining; 36 mature plants and 34 immature plants. NRS controlled weeds in this area in the last year. This site will be augmented with stock grown from the unrepresented founders in the next two years and collections of mature fruit will continue this year for storage and propagation. This site does present challenges with weed control. NRS has worked successfully to remove habitat modifying weeds from the area to such as *Spathodea campanulata*, *Montanoa hibiscifolia* and *Kalanchoe pinnata*. Unfortunately, the understory is dominated by hard to manage species including; *Christella parasitica* and *Rubus rosifolius*. Presently, NRS do not have the resources to control these species. NRS believes that control of these weeds is not a priority until slugs can be controlled and there is a better chance of seedling survivorship on site. In addition, these understory weeds do not appear to be competing with the *C. superba* that are all much larger than the weedy understory. See the Chapter One for more information. Rats are also impacting fruits produced in this reintroduction site. NRS found significant damage to fruit when collecting this year and will consider baiting in future years.

There are two sites with reintroduced *C. superba* in Kapuna Gulch. There are currently 34 mature and six immature plants in these sites. NARS staff originally outplanted into these sites in 1997 and 1998. The original number of plants are unknown. NRS supplemented one site in 2001 with stock from more recent Kahanahāiki collections. Collections of mature fruit will be made this year for storage and propagation.

Mākaha: The ecosystem fence in this area was completed in August 2007. NRS will begin this reintroduction this winter. A site needs to be chosen and NRS will work with Joel Lau to determine the most appropriate area and begin site preparation. A candidate site has already been weeded of canopy trees.

Central and East Makaleha: No reintroductions will begin until the MU fence is built.

Other PUs

Honouliuli: As with other MIP and OIP taxa planted by TNC staff at Honouliuli, outplanting sites will continue to be maintained by remaining TNC staff with assistance by NRS when feasible. Stock planted in 2004 are now beginning to mature.

2.1.8 *Cyrtandra dentata*

Requirements for Stability:

- 4 Population Units (PUs)
- 50 reproducing individuals in each PU (short-lived perennial)
- Stable population structure
- Threats controlled
- Complete genetic representation of all PUs in storage

How many of the 4 MFS PUs have stable numbers of mature individuals?	How many of the 4 MFS PUs have had *in situ* recruitment?	How many of the 4 MFS PUs have full genetic storage?	How many of the 4 MFS PUs are protected from ungulates?	How many MFS PUs that need reintroductions have been initiated?
2/4	3/4	1/4	1/4	0/2

Taxon Level Discussion

There are four Manage for Stability (MFS) Population Units (PU) for this taxon because two PUs occur within the Makua Action Areas (AA). However, this taxon has stable numbers at both of these PUs. Conducting a general census of plants across these large PUs is quite time consuming, and NRS will monitor these more stable populations less frequently. The other two MFS PUs occur in the Koʻolaus, outside the AA. Numbers are not stable in any of the PUs outside the AA. This year NRS were able to meet storage goals for the Pāhole to Kapuna to West Makaleha PU and will now focus collection efforts in other PUs. The Kapuna fence construction should be finished by the end of the year and a sizeable population of this taxon within the Pāhole to Kapuna to West Makaleha PU will then be protected from ungulates. The State and NRS and NARS staff are actively working to eradicate pigs within the Pahole MU fence.

Two new plants were found by NRS this year in Central Makaleha. These plants fall outside any current PU designation and extend the range of this taxon further east. NRS plan to collect from these plants when visited again.

NRS are still working on a license agreement with landowner Kamehameha Schools that will allow NRS to build a fence that will encompass all the plants in the ʻŌpaeʻula PU. NRS will census all known plants before fence construction begins to ensure that all plants in the PU are included in the fence. In the Kawai Iki PU, two NRS spent three days re-monitoring the known sites and surveying new sites of *C. dentata*. They were overwhelmed with morphological variation and associated with this species. The species is difficult to identify if not reproducing, and freely hybridizes with other taxa in the genus.

Major Highlights/Issues Year 3

- NRS met storage goals for the Pāhole to Kapuna to West Makaleha PU.
- Two new individuals were found in Central Makaleha this year extending the range of this species in the Wai‘anae Mountains.
- NRS continue to work on a license agreement with KS for management at the Lower ‘Ōpaeula MU.
- Kapuna subunit III fence construction started.
- Two NRS spent three days surveying for *C. dentata* in the Kawai Iki PU.

Plans for Year 4

- Finish Kapuna subunit III and IV fences.
- Monitor ‘Ōpae‘ula PU before finalizing fence placement.
- Establish collections from the Kawai Iki and ‘Ōpae‘ula PUs.
- Work with Botanist Joel Lau to identify numbers of pure *C. dentata* in Kawai Iki
- Work with the NARS staff to eradicate all pigs from Pahole MU.
- Test seed storage at NCGRP for -150C (1N2) testing.

Table 2.1.8a Status Summary

Action Area: In

TaxonName: Cyrtandra dentata TaxonCode: CyrDen

Population Unit Name	Management Designation	Current Mature (Wild)	Current Immature (Wild)	Current Seedling (Wild)	Current Augmented Mature	Current Augmented Immature	Current Augmented Seedling	NRS Mature 2006	NRS Immature 2006	NRS Seedling 2006	Total Mature	Total Immature	Total Seedling	Population Trend Notes
Kahanahaiki	Manage for stability	156	57	27	0	0	0	156	57	27	**156**	**57**	**27**	No monitoring in the last year
Pahole to Kapuna to West Makaleha	Manage for stability	534	520	171	0	0	0	530	517	171	**534**	**520**	**171**	No monitoring in the last year, however no obvious decline in population while collections conducted
	Total for Taxon:	690	577	198	0	0	0	686	574	198	**690**	**577**	**198**	

Action Area: Out

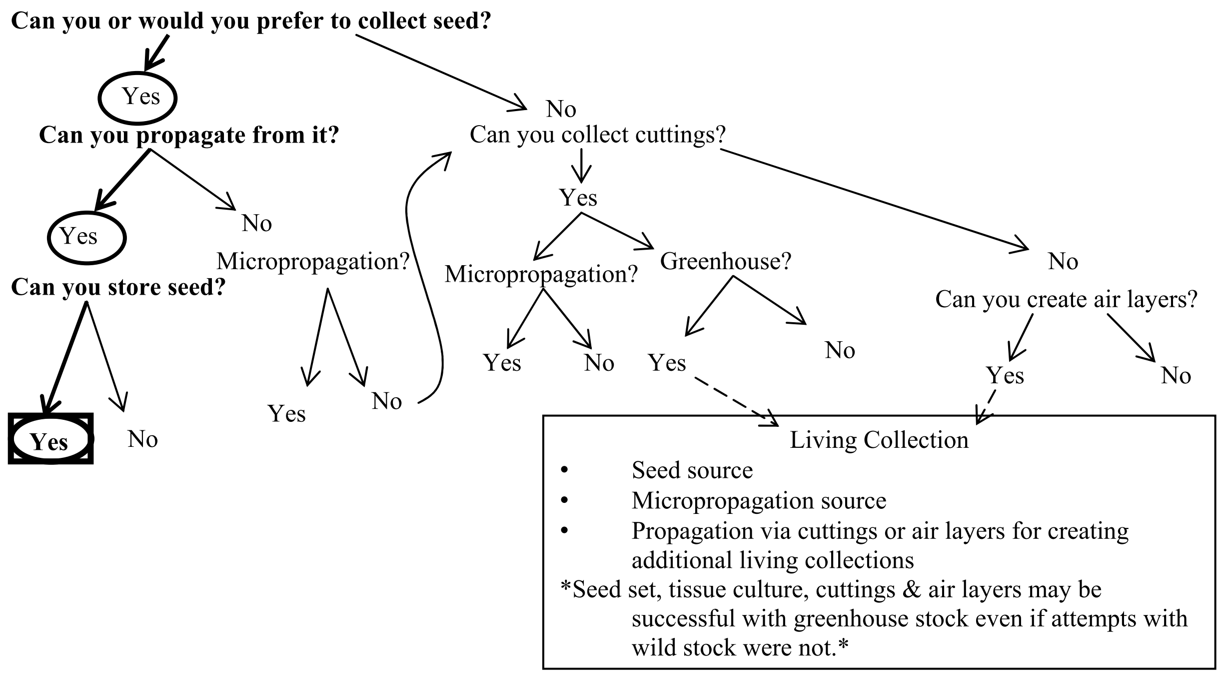
TaxonName: Cyrtandra dentata TaxonCode: CyrDen

Population Unit Name	Management Designation	Current Mature (Wild)	Current Immature (Wild)	Current Seedling (Wild)	Current Augmented Mature	Current Augmented Immature	Current Augmented Seedling	NRS Mature 2006	NRS Immature 2006	NRS Seedling 2006	Total Mature	Total Immature	Total Seedling	Population Trend Notes
Central Makaleha	Genetic Storage	3	0	0	0	0	0	3	0	0	**3**	**0**	**0**	Newly discovered in 2006
Kawaiiki (Koolaus)	Manage for stability	15	31	39	0	0	0	19	35	43	**15**	**31**	**39**	Monitoring highlighted difficulties in taxon identification
Opaeula (Koolaus)	Manage for stability	16	12	0	0	0	0	16	12	0	**16**	**12**	**0**	No monitoring in the last year
	Total for Taxon:	34	43	39	0	0	0	38	47	43	**34**	**43**	**39**	

Propagation and Genetic Storage

1) At this time, what is the preferred propagation technique?	2) At this time, what is the preferred genetic storage technique?	3) Has a successful storage method been determined?	4) Are additional steps required for obtaining enough seed?
Seed	Seed	Yes	No

Prioritizing Genetic Storage & Propagation Techniques



Collection: refer to OANRP 2006

Propagation: refer to OANRP 2006

Seed Storage Research: Viability trends indicate that this taxon may be short-lived in the storage seed bank (Fig.2.1.8a). Seeds stored very dry at -18C have not shown signs of aging after two years. All other temperatures and relative humidity combinations have aged after only two years of storage. Ongoing collaborative research with NCGRP suggests that a particular seed collection lost half of its viability after five years. Continued research should be able to determine exactly how often seed will need to be recollected within the next two years. Seeds of this species will be sent to NCGRP for -150C (lN2) testing.

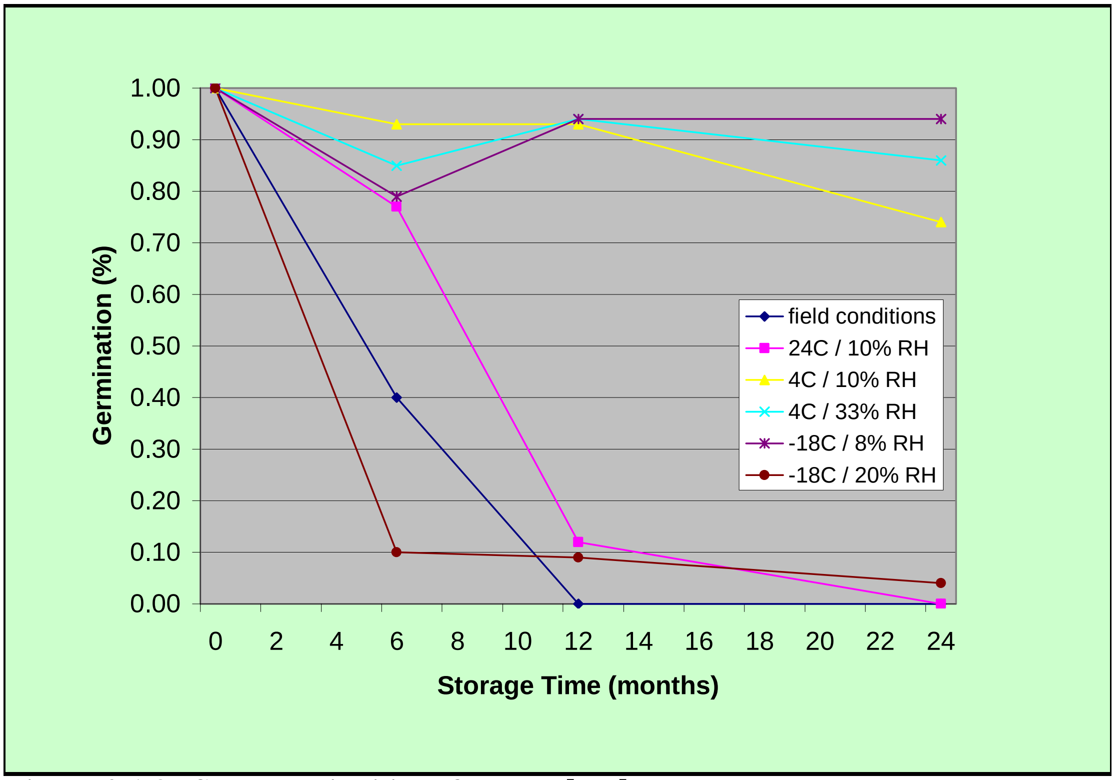


Figure 2.1.8a Storage Viability of *Cyrtandra dentata*

Genetic Storage: More opportunistic collections will be made from new individuals as seen this fruiting season.

Table 2.1.8b Genetic Storage Summary

	# of Potential Founders			Partial Storage Status			Storage Goals Met
Population Unit Name	Current Mature	Current Imm.	NumWild Dead	# Plants >= 10 in Seedbank	# Plants >=1 Microprop	# Plants >=1 Army Nursery	# Plants that Met Goal
Cyrtandra dentata							
Central Makaleha	3	0	0	0	0	0	0
Kahanahaiki	156	57	0	21	0	0	21
Kawaiiki (Koolaus)	15	31	0	0	0	0	0
Opaeula (Koolaus)	16	12	0	0	0	0	0
Pahole to Kapuna to West Makaleha	534	520	0	49	0	1	50
				Total # Plants w/ >=10 Seeds in Seedbank	**Total # Plants w/ >=1 Microprop**	**Total # Plants w/ >=1 Army Nursery**	**Total # Plants that Met Goal**
				70	0	1	71

Unique Species Observations
There have been no new observations for this taxon in the past year.

Outplanting Issues
This taxon has not been outplanted because wild populations are healthy and have good recruitment.

Research Issues
Research on slug impacts and control is underway (Chapter 5.2).

Surveys
Surveys and genetic storage collections were conducted by NRS in Kahanahāiki, Pahole to Kapuna to West Makaleha, and Kawai Iki PUs.

Taxon Threats
Pigs still remain a large threat to this taxon. Several pigs that are in the Pāhole fence are actively being snared out of the gulch. NRS have seen no direct damage to any individuals in Pāhole due to these pigs.

Population Unit Level Discussion

Table 2.1.8c Population Unit Threat Control Summary

Action Area: In

TaxonName: Cyrtandra dentata

PopulationUnitName	ManagementDesignation	Protected from Ungulates	Weeds Managed	Rats Controlled
Kahanahaiki	Manage for stability	Yes	Yes	Partial
Pahole to Kapuna to West Makaleha	Manage for stability	Partial	Partial	No

Action Area: Out

TaxonName: Cyrtandra dentata

PopulationUnitName	ManagementDesignation	Protected from Ungulates	Weeds Managed	Rats Controlled
Central Makaleha	Genetic Storage	No	No	No
Kawaiiki (Koolaus)	Manage for stability	No	No	No
Opaeula (Koolaus)	Manage for stability	No	No	No

Manage for Stability PUs

Kahanahāiki: Plants in this PU continue to thrive. The MU remains ungulate free. NRS collected from 12 more individuals this year for genetic storage and are nearly half way to reaching full genetic storage goals (Table 2.8b). NRS will continue to collect in the coming year.

Pāhole to Kapuna to West Makaleha: The plants in the Pahole gulch fenced portion of this PU continue to thrive and recruit vigorously. It is important to get pigs out of this exclosure as soon as possible. Some weed control conducted for other taxa in the last year also benefited *C. dentata*. Genetic storage collection goals were met, with the bulk of seeds coming from Kapuna and Keawapilau MUs where fences are not yet complete.

ʻŌpaeʻula: There is no new information for this PU.

Other PUs

Kawai Iki: As mentioned above, the presence of hybrids complicate determining pure *C. dentata* numbers. During surveys this year, one gulch had up to five species of *Cyrtandra* (within 100m) and there were many hybrid combinations of these five. Another gulch where plants were earlier confirmed as *C. dentata* by botanist Joel Lau, no longer had mature plants, making the individuals difficult to identify. However, one gulch to the west, *Cyrtandra* were counted as *C. dentata* as there did not seem to be any obvious signs of different looking species nearby. Collections of this species in this PU were held off during these surveys due to these complications. Further visits to these spots with J. Lau will be made to try to identify true forms of this species. This effort may involve tagging individual plants so that plants can be better tracked and pure *C. dentata* ‘zones’ can be more clearly defined within the hybrid swarms. The surveys did however help outline the range of *C. dentata* as every gulch west of the known populations was surveyed. The surveys also gave NRS a better idea about where fencing in this PU might be appropriate.

2.1.9 *Delissea subcordata*

Requirements for Stability:

- 4 Population Units (PUs)
- 100 reproducing individuals in each PU (short-lived perennial with population fluctuations and local declines, potentially an obligate out-crosser)
- Threats controlled
- Complete genetic representation of all PUs in storage
- Expedited Stabilization (10 years)

How many of the 4 MFS PUs have stable numbers of mature individuals?	How many of the 4 MFS PUs have had *in situ* recruitment?	How many of the 4 MFS PUs have full genetic storage?	How many of the 4 MFS PUs are protected from ungulates?	How many of the MFS PUs that need reintroductions have them all completed?
1/4	3/4	4/4	3/4	0/4

Taxon Level Discussion

There are four Manage for Stability (MFS) Population Units (PU) for this taxon because there are *Delissea subcordata* within both the Mākua and SBMR Action Areas (AA). Three of the MFS PUs are outside both AAs and one is in the Mākua AA. The Manuwai PU has recently been selected as the fourth MFS PU. All PUs are consistently monitored and some threats are controlled at all sites. Declining, this taxon seems to survive in fairly weedy forest dominated by *Schinus terebinthifolius* and *Psidium cattleianum*. The Huliwai and Ka‘awa PUs have been removed from the genetic storage management designation this year because no collections were historically made, and plants are believed to be extirpated from these PUs. NRS and NARS have been successful in establishing genetic storage collections of seeds from all PUs with *in situ* founders. This taxon does show occasional recruitment at wild and reintroduction sites, and collections will continue to be made as wild plants mature. Three MFS PUs have been augmented and survivorship is high. The largest threats to *D. subcordata* are pigs and goats. Slugs, rats, insects and weeds are also threats to this taxon. The Kapuna subunit III and IV fences currently under construction will include a historic *D. subcordata* site, as well as the remaining *in situ* plants in the Kahanahā‘iki to Keawapilau PU.

This year *D. subcordata* has been designated as a species “Expedited for Stabilization” by the US Fish and Wildlife Service. Conservation management requirements for this status are in alignment with current plans for this species. Four MFS PUs will be stabilized, three of which are to be outside of the AA. The significance of this new designation for this species is the expedited timeline for stability goals. Numerical stability will therefore need to be met in ten years at Kahanahā‘iki to Keawapilau within the AA, and at the following sites all outside of the AA:‘Ēkahanui, Kalua‘ā and Manuwai. This will only be accomplished by augmenting all PUs, as numbers of founders at each site are so low. Plants can mature in one year in the greenhouse, and this bodes well for reaching stability goals in the expedited time frame.

Major Highlights/Issues Year 3

- Fence construction of Kapuna subunit III and IV fences underway, protecting all *in situ* plants in this Kahanahāʻiki to Keawapilau PU.
- Large scale augmentation begun in the Kahanahāʻiki to Keawapilau PU.
- Reintroduction of Keālia stock established in Kaluakauila to be managed for Genetic Storage collection.
- Reintroduction of Palikea Gulch stock established in Kapuna to be managed for Genetic Storage.
- Storage goals met for seven of seven PUs from all mature founders; collected from remaining founders in South Mohiakea and Palikea Gulch.

Plans for Year 4

- Continue to supplement the Kahanahāʻiki to Keawapilau PU augmentation to balance founders from this PU.
- Continue to supplement the ʻĒkahanui PU augmentation to balance founders.
- Begin construction of ʻĒkahanui subunit II fence protecting large habitat around all *in situ* plants.
- Continue to balance founders at the Kaluaʻā reintroduction of South Mohiākea stock.
- Assist NARS to complete Kapuna subunit III and IV fences this year.

Table 2.1.9a Taxon Status Summary

Action Area: In

TaxonName: Delissea subcordata TaxonCode: DelSub

Population Unit Name	Management Designation	Current Mature (Wild)	Current Immature (Wild)	Current Seedling (Wild)	Current Augmented Mature	Current Augmented Immature	Current Augmented Seedling	NRS Mature 2006	NRS Immature 2006	NRS Seedling 2006	Total Mature	Total Immature	Total Seedling	Population Trend Notes
Kahanahaiki to Keawapilau	Manage for stability	5	0	0	17	111	0	22	0	0	**22**	**111**	**0**	117 plants reintroduced for augmentation this year
South Mohiakea	Genetic Storage	2	0	0	0	0	0	1	1	0	**2**	**0**	**0**	Reintroduction of stock to be managed in Kaluaa for genetic storage collections
	Total for Taxon:	7	0	0	17	111	0	23	1	0	**24**	**111**	**0**	

Action Area: Out

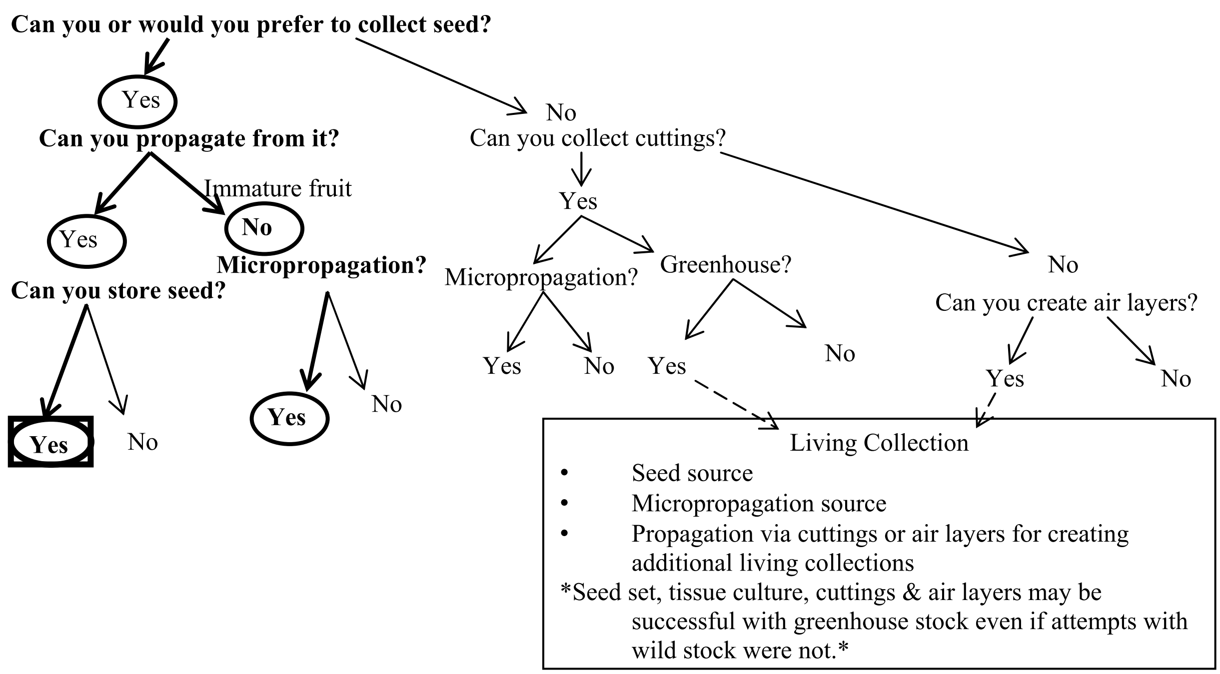
TaxonName: Delissea subcordata TaxonCode: DelSub

Population Unit Name	Management Designation	Current Mature (Wild)	Current Immature (Wild)	Current Seedling (Wild)	Current Augmented Mature	Current Augmented Immature	Current Augmented Seedling	NRS Mature 2006	NRS Immature 2006	NRS Seedling 2006	Total Mature	Total Immature	Total Seedling	Population Trend Notes
Ekahanui	Manage for stability	4	0	0	109	0	0	113	0	0	**113**	**0**	**0**	An additional 30 new plants were added to the augmentation this year
Kaluaa	Manage for stability	1	5	2	24	1	5	28	0	11	**25**	**6**	**7**	Several reintroduced mature individuals died this year; seedlings found in reintroduction
Kealia	Genetic Storage	2	0	0	5	34	0	2	0	0	**7**	**34**	**0**	NARS observations show no change in the last year
Manuwai	Manage reintroduction for stability	0	0	0	0	0	0	0	0	0	**0**	**0**	**0**	Reintroduction will begin when MU fences are complete
Palawai	Genetic Storage	4	0	1	0	0	0	5	0	0	**4**	**0**	**1**	Seedling found near mature individuals
Palikea Gulch	Genetic Storage	2	0	0	9	37	0	2	0	0	**11**	**37**	**0**	40 plants reintroduced in Kapuna
	Total for Taxon:	13	5	3	147	72	5	150	0	11	**160**	**77**	**8**	

Propagation & Genetic storage

1) At this time, what is the preferred propagation technique?	2) At this time, what is the preferred genetic storage technique?	3) Has a successful storage method been determined?	4) Are additional steps required for obtaining enough seed?
Seed	Seed	Yes	No

Prioritizing Genetic Storage & Propagation Techniques



Collection: refer to OANRP 2006

Propagation: refer to OANRP 2006

Seed Storage: Research is ongoing to test why this taxa can not be stored at -18C, while it has not shown a decrease in viability at 4C for over five years, and can be stored at -150C and -80C. Preliminary studies on lipid composition suggest that melting points of dominant lipids within the seeds of this taxon may be around -18C, causing continual phase changing at this temperature and consequential cell membrane damage. Until longevity at -80C and -150C is determined, seeds will remain stored at 4C.

Genetic Storage: New seed collections were made from one plant in the Palikea gulch PU and an additional founder in the South Mohiākea PU. NRS has reached genetic storage goals for this taxon.

Unique Species Observations
No new observations have been made in the last year.

Genetic Storage Summary Table 2.1.9b

	# of Potential Founders			Partial Storage Status			Storage Goals Met
Population Unit Name	Current Mature	Current Imm.	NumWild Dead	# Plants >= 10 in Seedbank	# Plants >=1 Microprop	# Plants >=1 Army Nursery	# Plants that Met Goal
Delissea subcordata							
Ekahanui	4	0	2	6	0	4	6
Kahanahaiki to Keawapilau	3	1	8	12	1	9	12
Kaluaa	1	5	0	1	0	1	1
Kealia	2	0	0	2	0	2	2
Palawai	4	0	2	6	1	2	6
Palikea Gulch	2	0	5	6	1	6	6
South Mohiakea	2	0	3	4	0	2	4
				Total # Plants w/ >=10 Seeds in Seedbank	**Total # Plants w/ >=1 Microprop**	**Total # Plants w/ >=1 Army Nursery**	**Total # Plants that Met Goal**
				37	3	26	37

Outplanting Issues

This year a new strategy for augmentation was used in the Kahanahāʻiki to Keawapilau PU. A target of 220 plants are to be planted at one site (so far 117 plants went out this year) with hopes that if frugivorous birds have a reliable, prolific food source, they may visit frequently and disperse seeds throughout the PU. This strategy has also been used in ʻĒkahanui by TNC and NRS continue to augment the PU there with this method. Recruitment in reintroductions has so far been seen in Kahanahāʻiki to Keaawapilau and Kaluaʻā.

NRS are also using reintroductions as genetic storage sources for Manage for Genetic Storage (MGS) PUs. As seed stock diminishes in the seed bank from extirpated plants in the MGS PUs, new collections will need to be made. NRS will establish reintroductions balancing all the founders from a PU at appropriate sites where current management is taking place. Seeds collected from these reintroductions can be used to meet genetic storage goals for these PUs, to use for experimental outplanting, and for seed storage testing. Table 2.1.9c illustrates where such PUs will be managed. No reintroduction will be established for Palawai stock given that there are still *in situ* plants, and seed stock is still fresh.

Palikea Gulch stock will be managed for stability in Manuwai Gulch. This stock was chosen to be used in the fourth MFS PU because there are no plans for management in Palikea Gulch. NRS will manage other taxa in the Manuwai MU fence, and it will be an appropriate site for Palikea Gulch stock.

Surveys

No surveys were conducted for this taxon in the past year. NRS will continue to look for new plants in the course of ongoing management. Exact locality information will be sought for extinct populations of newly proposed *Delissea* species in the Waiʻanae Mountains and surveys at these historic sites will be considered by NRS.

Table 2.1.9c Reintroductions managed for Genetic Storage or Stability

Population Unit Name	Management Designation	Site Selected for Management
South Mohiakea	Genetic Storage	Kaluaa (reintroduction managed for genetic storage)
Kealia	Genetic Storage	Kaluakauila (reintroduction managed for genetic storage)
Palikea Gulch	Manage for Stability	Manuwai (reintroduction managed for stability)

Research Issues

For more discussion on slug impacts see the Research Section Chapter 5.2.

This year NRS are asking Shelly James of Bishop Museum to conduct genetic research on the origin of a single plant that occurs 100 meters from the nearest reintroduced plants in Kahanahāʻiki. It is unclear if this single plant is an F_1 plant from the nearby reintroduction, transported to the site by a bird, or if it is a wild plant from the historic population. NRS will treat this individual plant as unique and significant pending results from genetic analysis.

Taxon Threats

No additional threats have been noted in the last year.

Population Unit Level Discussion

Table 2.1.9d Population Unit Threat Control Summary

Action Area: In

TaxonName: Delissea subcordata

PopulationUnitName	ManagementDesignation	Protected from Ungulates	Weeds Managed	Rats Controlled
Kahanahaiki to Keawapilau	Manage for stability	Partial	Partial	No
South Mohiakea	Genetic Storage	Yes	Yes	No

Action Area: Out

TaxonName: Delissea subcordata

PopulationUnitName	ManagementDesignation	Protected from Ungulates	Weeds Managed	Rats Controlled
Ekahanui	Manage for stability	Yes	Yes	Partial
Kaluaa	Manage for stability	Yes	Partial	No
Kealia	Genetic Storage	No	No	No
Manuwai	Manage reintroduction for stability	No	No	No
Palawai	Genetic Storage	Yes	Partial	No
Palikea Gulch	Genetic Storage	No	No	No

Manage for Stability PUs

‘Ēkahanui: There are currently four living wild mature plants at two sites. NRS and TNC staff built fences around these sites in 2004. Both sites are highly degraded and only minimal management is done to encourage the plants to mature and produce seed for storage and for reintroduction into higher quality managed habitat. A large augmentation exists in the 40 acre ‘Ēkahanui subunit I fence. The source stock for this site comes from six founders in ‘Ēkahanui. NRS continued to supplement this augmentation this year. Weed control is ongoing at this site. Seeds have been collected from wild and reintroduced plants in this PUfor storage. NRS will continue to monitor all plants in ‘Ēkahanui and continue collections as needed. NRS will emphasize searches for seedlings this year within the reintroduction as plants have been mature there for several years.

Construction of the ‘Ēkahanui subunit II fence will begin this year. This large exclosure will include all *insitu* plants, and protect a great deal of habitat for this taxon within the PU. NRS will consider another reintroduction in this exclosure of ‘Ēkahanui stock.

Kahanahā‘iki to Keawapilau: There are five *in situ* plants in this PU. All but one of these plants is fenced. The Kapuna subunit IV fence currently under construction will include this plant, as well as historical sites of this taxon in Kapuna Gulch. These five plants as well as three other extirpated plants from Kapuna Gulch serve as founders for the large-scale Pahole Gulch reintroduction. Established in February this year, the reintroduction currently has a 98% survivorship.

NRS will no longer continue to supplement reintroductions established elsewhere in this PU in the past, as they are no longer believed suitable to satisfy the stability requirements set for this taxon. However, remaining plants are still monitored, and a F1 plant reached maturity at this site.

Kalua‘ā: There is currently one mature, five immature plants, and two seedlings at an *in situ* site in this PU. All plants are within the Kalua‘ā fence exclosure. NRS target ecosystem altering weeds such as *Schinus terebinthifolius,* and *Passiflora suberosa* around these plants. NRS are propagating plants from seed of the mature individual to be outplanted nearby this year. As the plants mature, they will be added to the augmentation. TNC has also reintroduced 250 individuals in nearby gulches in the Kalua‘ā area of mixed stock from the Southern Wai‘anae Mountains. The wild Kalua‘ā plants are in a separate gulch from the TNC reintroductions and cross pollination is presumably unlikely.

Manuwai: This year, NRS have decided to manage the Palikea Gulch stock at a reintroduction in Manuwai. In order to satisfy stability goals, NRS chose a fourth MFS PU from a PU designated MGS. Palikea Gulch was chosen as it has the most founders currently represented in storage, and because there were no management plans other than fruit collection within Palikea Gulch itself. This reintroduction will be established when the MU fence is completed.

Other PUs

Pālāwai: Fences are being maintained around all plants at two sites in Pālāwai. Collections were secured from all six founders in this PU. These collections were made from five of the six plants from the wild and the remaining founder is represented with seeds collected from greenhouse plants grown from seed from the wild founder. A seedling was observed within one of the fences near a mature plant this year. Weeds are controlled at one site with native components. The other site is dominated by *S. terebinthifolius* weeds are controlled only two meters around the plants.

South Mohiākea: There are currently two mature plants in this PU. This year, one of these fruited for the first time and NRS were able to collect two fruits. Past collections have been made from this PU and are stored at the Army Seed bank. There are currently five founders for this PU. NRS controlled weeds within the small exclosure around these plants this year. Reintroduction of this stock has already begun in Kalua‘ā, where access is unlimited and active management is currently underway. This reintroduction will also be used to collect for genetic storage for this PU as stock numbers diminish in the seed bank. NRS will consider crossing this stock with the one mature and potentially more Kalua‘ā founders, but will keep sites of pure PU stock for now.

Palikea Gulch: Two mature plants are left in this PU at two separate sites. Neither site is protected by a fence and pigs are a noted threat at both. The fire this summer that burned through Lower Ka‘ala NAR burned within 500 meters of this PU. Mature seed has been collected for storage and germination by NARS and NRS from both sites in the past. There are currently 6 founders for this PU, one of which was collected from this year for the first time. Stock from this location is currently represented in a reintroduction in the West Makaleha exclosure, however this site has been deemed too wet, and rats were predating plants. NRS therefore reintroduced plants of this PU stock into Kapuna gulch as a living collection. Forty plants were planted this April, and currently 92% have survived. Seed stock from this reintroduction can be used for propagules for the Manuwai PU reintroduction. NRS may also use the Kapuna reintroduction seed to achieve genetic storage goals until this can be done so from Manuwai. This stock will also be used as a source for the forth MFS PU in Manuwai Gulch once the fence is built there.

Ke‘ālia: NRS have never visited this site as NARS Biologist is handling all collections from Ke‘ālia. Plants from two founders were reintroduced in nearby Kaluakauila where management for other taxa is currently underway. This reintroduction will be managed for future genetic storage collections. The *in situ* plants in this PU are currently on land in landholder transition, making management difficult. However, NRS will still pursue a fence around this PU to encourage more onsite recruitment.

2.1.10 *Dubautia herbstobatae*

Requirements for Stability

- 3 Population Units (PUs)
- 50 reproducing individuals in each PU (short-lived perennial)
- Stable population structure
- Threats controlled
- Complete genetic representation of all PUs in storage

How many of the 3 MFS PUs have stable numbers of mature individuals?	How many of the 3 MFS PUs have had *insitu* recruitment?	How many of the 3 MFS PUs have full genetic storage?	How many of the 3 MFS PUs are protected from ungulates?	How many MFS PUs that need reintroductions have been initiated?
2/3	2/3	0/3	3/3	0/1

Taxon Level Discussion

The ‘Ōhikilolo Mauka and Makai PU’s both have stable numbers of reproducing individuals, whereas the the Mākaha PU currently has 36 known reproducing individuals. However, with more surveys a stable population number may be reached. However, there are not the large numbers of individuals seen on ‘Ōhikilolo in Mākaha. NRS will assess the threats to this population to see if they can be mitigated to achieve population stability. Augmentation may also be considered pending survey data. The remaining PUs will be managed for genetic storage. The major challenge in working with this species is that all populations require rappelling making it difficult to get frequent and thorough monitoring data and collections. NRS has also struggled to collect viable seed from populations for storage and propagation trials. This year NRS was able to perform successful pollinations with greenhouse stock for the first time, resulting in the production of viable seed. NRS believe that with management at the two ‘Ōhikilolo PUs, stability is attainable. At the Mākaha PU additional survey and perhaps augmentation will be used to achieve stabilization.

Major Highlights/Issues Year 3

- Conducted cross-pollination with greenhouse plants that resulted in the production of viable seed.

Plans for Year 4

- In the coming years, NRS will continue to survey for new plants, particularly in the Mākaha PU, refine counts, determine management needs, including augmentation, and collect cuttings for propagation and seed collection.
- Investigate available habitat in the newly completed Mākaha fence for candidate reintroduction sites.
- NRS will continue to investigate remote sensing technologies and ways these methods could be applied to this taxa to achieve monitoring goals.

- NRS will attempt to use a spotting scope from strategic locations around PUs to search for additional plants and monitor existing sites.
- Continue pollination studies to determine if ambient pollination produces adequate seed for storage goals.

Figure 2.1.10a Flowering *Dubautia herbstobatae*

Figure 2.1.10b Detail of *Dubautia herbsobatae* flower

Figure 2.1.10c Rappel access to *Dubautia herbsobatae* PU

Figure 2.1.10d Detail of *Dubautia herbsobatae* fruit

Table 2.1.10a Taxon Status Summary

Action Area: In

TaxonName: Dubautia herbstobatae **TaxonCode: DubHer**

Population Unit Name	Management Designation	Current Mature (Wild)	Current Immature (Wild)	Current Seedling (Wild)	Current Augmented Mature	Current Augmented Immature	Current Augmented Seedling	NRS Mature 2006	NRS Immature 2006	NRS Seedling 2006	Total Mature	Total Immature	Total Seedling	Population Trend Notes
Keaau	Genetic Storage	70	0	0	0	0	0	70	0	0	**70**	**0**	**0**	No monitoring in the last year
Makaha/Ohikilolo	Genetic Storage	350	0	0	0	0	0	350	0	0	**350**	**0**	**0**	No monitoring in the last year
Ohikilolo Makai	Manage for stability	358	0	0	0	0	0	358	0	0	**358**	**0**	**0**	No monitoring in the last year
Ohikilolo Mauka	Manage for stability	382	6	0	0	0	0	382	6	0	**382**	**6**	**0**	No monitoring in the last year
	Total for Taxon:	1160	6	0	0	0	0	1160	6	0	**1160**	**6**	**0**	

Action Area: Out

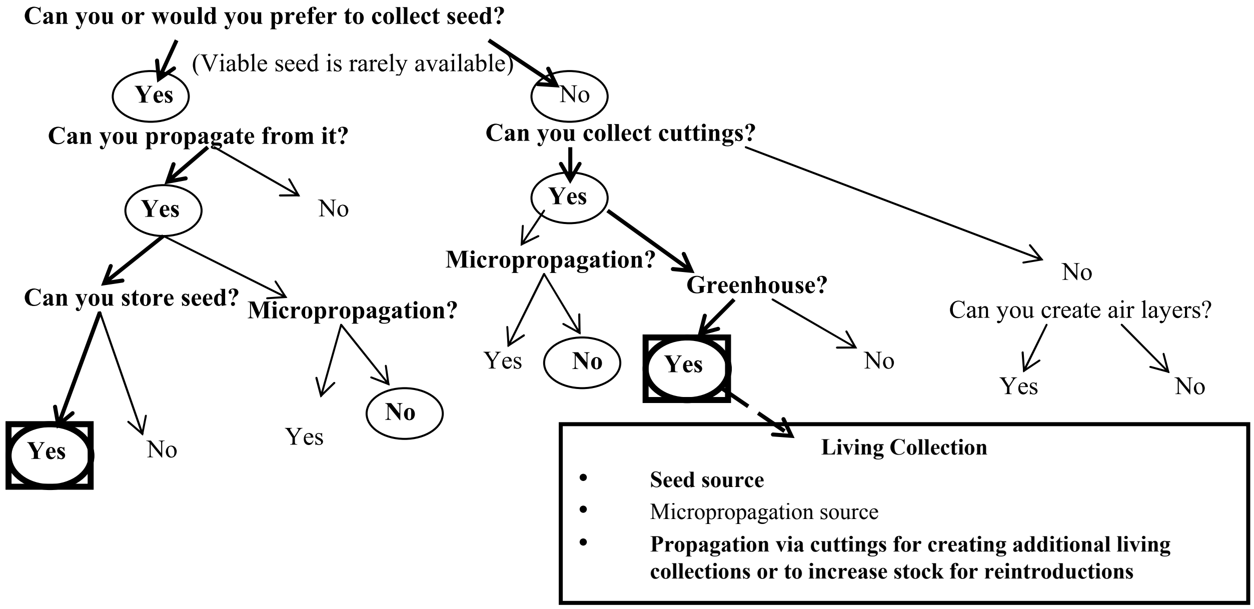
TaxonName: Dubautia herbstobatae **TaxonCode: DubHer**

Population Unit Name	Management Designation	Current Mature (Wild)	Current Immature (Wild)	Current Seedling (Wild)	Current Augmented Mature	Current Augmented Immature	Current Augmented Seedling	NRS Mature 2006	NRS Immature 2006	NRS Seedling 2006	Total Mature	Total Immature	Total Seedling	Population Trend Notes
Kamaileunu	Genetic Storage	0	0	0	0	0	0	0	0	0	**0**	**0**	**0**	No monitoring since 2001
Makaha	Manage for stability	36	1	0	0	0	0	36	1	0	**36**	**1**	**0**	No monitoring in the last year
Waianae Kai	Genetic Storage	10	4	0	0	0	0	10	4	0	**10**	**4**	**0**	No monitoring in the last year
	Total for Taxon:	46	5	0	0	0	0	46	5	0	**46**	**5**	**0**	

Propagation and Genetic Storage

At this time, what is the best preferred propagation technique?	At this time, what is the preferred genetic storage technique?	Has a successful storage method been determined?	Are additional steps required for obtaining enough seed?
Cuttings	Seed & Living Collection	Yes	No, new pollination protocol established

Prioritizing Genetic Storage & Propagation Techniques



Collection: Please refer to OANRP 2006 for current status.

Propagation: Please refer to OANRP 2006 for current status.

Seed Storage Research: Please refer to OANRP 2006 for current status.

Genetic Storage: In response to results from the pollination study (see Research Issues), cuttings from wild plants will be taken one PU at a time, isolated in the greenhouse, and used as seed source via intra-PU cross pollination. This will be the first attempt to collect enough seed from greenhouse stock for genetic storage purposes. The number of flowers produced remains limiting factor in collecting seed. Plants will be transplanted into larger pots and fertilized to promote flowering. Initial viability testing will be conducted to determine if enough viable seed is produced for genetic storage. If viability is low, then the number of seeds that need to be collected will be reciprocally large. Methods may need to be adjusted depending on next year's success.

Table 2.1.10b Genetic Storage Summary

	# of Potential Founders			Partial Storage Status			Storage Goals Met
Population Unit Name	Current Mature	Current Imm.	NumWild Dead	# Plants >= 10 in Seedbank	# Plants >=1 Microprop	# Plants >=1 Army Nursery	# Plants that Met Goal
Dubautia herbstobatae							
Kamaileunu	0	0	1	1	1	1	6
Keaau	70	0	0	0	0	0	12
Makaha	36	1	0	12	0	2	1
Makaha/Ohikilolo	350	0	0	1	0	0	2
Ohikilolo Makai	358	0	0	0	0	0	6
Ohikilolo Mauka	382	6	0	1	0	0	6
Waianae Kai	10	4	0	4	0	6	4
				Total # Plants w/ >=10 Seeds in Seedbank	**Total # Plants w/ >=1 Microprop**	**Total # Plants w/ >=1 Army Nursery**	**Total # Plants that Met Goal**
				19	1	9	37

Unique Species Observations
No unique observations by NRS in the past year.

Outplanting Issues
NRS are not proposing to do any reintroductions with this species in the next year. If NRS decide reintroductions are needed in the Mākaha PU, plans will developed in the next year.

Research Issues
Greenhouse Pollination Study**:** It is impractical to collect seed from wild plants as the areas are difficult to access and the plants are not large enough to produce enough fruit at one collection event to acquire enough seeds to meet genetic storage goals. As cuttings are easily established in the greenhouse, NRS planned to use cutting stock as seed source, yet none of the greenhouse plants had produced viable seed as of 2006. Pollination studies from last year clearly showed that no viable seed was produced from controlled selfing (OARNP 2006). To determine if this is due to self-incompatibility, crosses between plants must be conducted and produce viable seed. This summer, enough plants flowered to cross stock from four different founders. Viable seed was consequently produced, yet the number of viable seed per infructescence still remains low (Table 2.1.10c). This suggests that these plants may likely be self-incompatible to some degree. It has yet to be determined if there is any difference in seed set between intra-PU and inter-PU crosses. It has also yet to be determined whether or not plants in the greenhouse will receive enough crossing from ambient pollination or if hand-pollination is necessary to collect enough seed for storage goals within one flowering season. These questions will be addressed for the following flowering season.

Table 2.1.10c Summary of Germination of *Dubautia herbstobatae* in Pollination Study 2007

Female	Male	Cross Type	Percent Viable
MAK-A-1	MAK-A-1	Selfed	0.00
MAK-A-1	MAK-B-2	Inter-PU	4.00
MAK-B-1	MAK-A-1	Inter-PU	0.00
MAK-B-1	MAK-B-2	Intra-PU	2.00
MAK-B-1	WAI-A-3	Inter-PU	12.00
MAK-B-2	MAK-B-1	Intra-PU	0.00
MAK-B-2	MAK-B-2	Selfed	0.00
MAK-B-2	MAK-B-2	Selfed	0.00
WAI-A-3	MAK-B-1	Inter-PU	0.97

Surveys
No surveys were conducted for this taxon this year.

Taxon Threats
No new threats were identified this year.

Population Unit Level Discussion

Table 2.1.10d Population Unit Threat Control Summary

Action Area: In

TaxonName: Dubautia herbstobatae

PopulationUnitName	ManagementDesignation	Protected from Ungulates	Weeds Managed	Rats Controlled
Keaau	Genetic Storage	No	No	No
Makaha/Ohikilolo	Genetic Storage	Partial	No	No
Ohikilolo Makai	Manage for stability	Yes	No	No
Ohikilolo Mauka	Manage for stability	Yes	No	No

Action Area: Out

TaxonName: Dubautia herbstobatae

PopulationUnitName	ManagementDesignation	Protected from Ungulates	Weeds Managed	Rats Controlled
Kamaileunu	Genetic Storage	No	No	No
Makaha	Manage for stability	Yes	No	No
Waianae Kai	Genetic Storage	Yes	No	No

Manage for Stability PUs

‘Ōhikilolo Makai and ‘Ōhikilolo Mauka:
NRS do not monitor the majority of these PUs regularly because of their size and the need for rappelling to access populations. Rather, NRS monitor sites within the PUs when monitoring

more critically endangered sites of other taxa (*Hedyotis parvula*, *Sanicula mariversa* and *Viola chamissoniana*). If NRS see new threats or unexpected declines in these sites, then larger monitoring efforts would be initiated. Otherwise, NRS will strive to monitor a sample of sites within the PU every 3-5 years. NRS attempted a remote sensing trial this year within this PU. The goal was to use a high resolution camera mounted on a helicopter to capture images of the remote cliffs that this species inhabits. Unfortunately, due to a combination of factors the trial was unsuccessful. NRS will continue to pursue applying these methods in the next year. (See the Rare Plant Chapter Introduction). In theory, these images could then be geo-referenced. (With this method the picture is fitted to a map such that they mapped with GIS). If the image was of high enough quality individual plants and flowers could be seen on the image. NRS are hopeful that this technique will work as *D. herbstobatae* has a tendency to grow on exposed rock areas with sparse to little vegetation. This PU is fenced, and protected from ungulates. NRS will continue to maintain the fence on ‘Ōhikilolo ridge and keep the area goat free.

Mākaha:
NRS planned to access this PU in the last year and were unsuccessful. Access to this PU is challenging. The only way to access the site is via helicopter and the Landing Zone (LZ) is treacherous. Unfortunately, due to the narrow rocky substrate of the ridge crest where the LZ is located there is no way to improve the site. In the last year, NRS did not have a pilot that had adequate experience to attempt a landing at the site. In the next year, NRS will attempt a trip to the area. NRS will also consider alternative access methods to include setting a permanent system that can be accessed from the bottom of the cliff. NRS needs to resurvey and refine counts, determine the feasibility of threat control, consider augmentation possibilities and collect cuttings for nursery stock. This stock will then be used to produce seed for storage and propagation. In addition, NRS will attempt to use a spotting scope to remotely monitor this PU.

Other PUs

Kea‘au:
No action was taken in this PU by NRS in the past year. NRS will seek permission to visit this site in the next year as it has not been monitored since 2005. This PU is also under the greatest threat due to ungulate presence in the area and relative accessibility of plants. Therefore, NRS will collect cuttings to use as greenhouse stock to secure seed collections.

Kamaile‘unu:
No action was taken in this PU by NRS in the past year. NRS needs to re-visit the site to determine if there are individuals present as it has been many years since the area was monitored. This will require a substantial effort as the area is relatively large and remote. NRS will attempt this in the next year.

Wai‘anae Kai:
No action was taken in this PU by NRS in the past year. NRS will collect cuttings from this PU once seed collections are secured from Kea‘au.

2.1.11 *Flueggea neowawraea*

Requirements for Stability

- 4 Population Units (PU)
- 50 reproducing individuals in each PU (long-lived perennial, dioecious, low to no reproduction, all senescent, major pest problems)
- Stable population structure
- Threats controlled
- Complete genetic representation of all PUs in storage

How many of the 4 MFS PUs have stable numbers of mature individuals?	How many of the 4 MFS PUs have had *in situ* recruitment?	How many of the 4 MFS PUs have full genetic storage?	How many of the 4 MFS PUs are protected from ungulates?	How many MFS PUs that need reintroductions have been initiated?
0/4	0/4	0/4	0/4	1/4

Taxon Level Discussion

There are four Manage for Stability (MFS) PUs for this taxon because it is known from the Action Areas (AA) of both Mākua Military Reservation (MMR) and Schofield Barracks West Range (SBW). The Kahanahā'iki to Kapuna MFS PU and portions of the Mākaha MFS PU are within the MMR AA. The Central and East Makaleha and Manuwai MFS PUs are outside of both the MMR and SBW AAs. The known trees are all mature and no live juveniles or seedlings have ever been observed by NRS. This taxon is primarily dioecious and trees are usually alone, far from plants of the opposite sex. Only a few trees have been observed to produce viable seeds. Most trees are found in degraded unprotected habitat with high ungulate and weed threats. Trees are typically in poor health because of damage from the black twig borer (BTB) (*Xylosandrus compactus*) and its associated fungus (*Fusarium solani*). Stress from BTB damage may limit or prevent flowering by killing vascular tissue. Due to the overwhelming threat posed by the BTB, stabilizing this taxon will be challenging. Research on controlling the threat from the BTB is underway at outplanting sites (see Chapter 5). Currently, NRS is focusing on collecting cuttings and air layers from all the known trees and securing habitat with fences. Outplanting sites in Kahanahā'iki Gulch, at Leeward Community College (LCC) (Figure 2.1.11a) and Waimea Audubon Center (WAC) have done well and NRS will continue to establish clones of all known trees in botanical gardens and other *inter situ* sites. Some of the *inter situ* and nursery plants have flowered in the last year and NRS has been able to collect and store pollen, hand-pollinate greenhouse plants with the stored pollen and allowed the plants to cross naturally. Viable seed has been produced from these crosses and are being propagated for planting (Figure 2.1.11b). One of the plants in the greenhouse that has previously only been observed to produce male flowers was observed with an immature fruit in the last year. Unfortunately, the branch had already been bored by BTB and died before the fruit could mature. This confirms observations made by others in the past that a plant in cultivation can produce perfect flowers or both male and female flowers at the same time.

Major Highlights/Issues for Year 3

- Collections have been established and are being held in a living collection at the Pahole Mid Elevation Nursery from 21 of the 36 known trees.
- Cuttings taken from four unrepresented trees in the Pahole Natural Area Reserve have been collected and are being propagated by the State Horticulturist.
- Over the last year, pollen was collected from greenhouse plants. Some pollen was immediately applied to available female flowers. The rest was dried to 20% relative humidity and stored frozen. The frozen pollen was later applied to flowering female plants. Pollen has been held frozen for as long as six months and used to produce viable seed.
- Seed storage data shows that fresh mature seed can be stored dried and frozen for five years with no decrease in viability.
- Ethanol traps have been deployed around outplantings in the Kahanahāʻiki to Kapuna PU in an attempt to trap out the BTB in the immediate area (see Chapter 5 for more information).

Plans for Year 4

- Collect from the 11 unrepresented wild individuals. (LEH-A-1, LEH-A-3, LEH-B-1, LEH-D-1, LEH-E-2, LEH-G-1, LEH-I-1, LKN-C-1, LKN-C-3, MAK-A-2, MIK-A-1)
- Hand-pollinate plants in the greenhouse using fresh and frozen pollen. Crosses will be made to maximize founder pairs and utilize the oldest pollen first.
- Plants produced from seed collected from these greenhouse collections will be grown for planting into both the Mākaha and Kahanahāʻiki to Kapuna PUs in Year 5.
- Monitor the outplantings in Kahanahāʻiki to detect a relationship or correlation between the numbers of BTB found in the traps and BTB damage on the plants
- Continue to investigate the potential for using compounds like Verbenone® as repellents for BTB control around outplantings
- In Kahanahāʻiki Gulch, transplant the remaining juvenile plants from the Pteralyxia site to the new augmentation site in the gulch bottom

Figure 2.1.11a *F. neowawraea* at LCC

Figure 2.1.11b Seedlings from greenhouse plants

Table 2.1.11a Taxon Status Summary

Action Area: In

TaxonName: Flueggea neowawraea **TaxonCode: FluNeo**

Population Unit Name	Management Designation	Current Mature (Wild)	Current Immature (Wild)	Current Seedling (Wild)	Current Augmented Mature	Current Augmented Immature	Current Augmented Seedling	NRS Mature 2006	NRS Immature 2006	NRS Seedling 2006	Total Mature	Total Immature	Total Seedling	Population Trend Notes
Kahanahaiki to Kapuna	Manage for stability	7	0	0	0	72	0	8	59	0	7	72	0	One of the mature trees was mistakenly double counted until this year. Outplantings were supplemented.
Ohikilolo	Genetic Storage	1	0	0	0	0	0	1	0	0	1	0	0	Monitoring showed no change in the last year.
West Makaleha	Genetic Storage	6	0	0	0	0	0	6	0	0	6	0	0	Monitoring showed no change in the last year.
	Total for Taxon:	14	0	0	0	72	0	15	59	0	14	72	0	

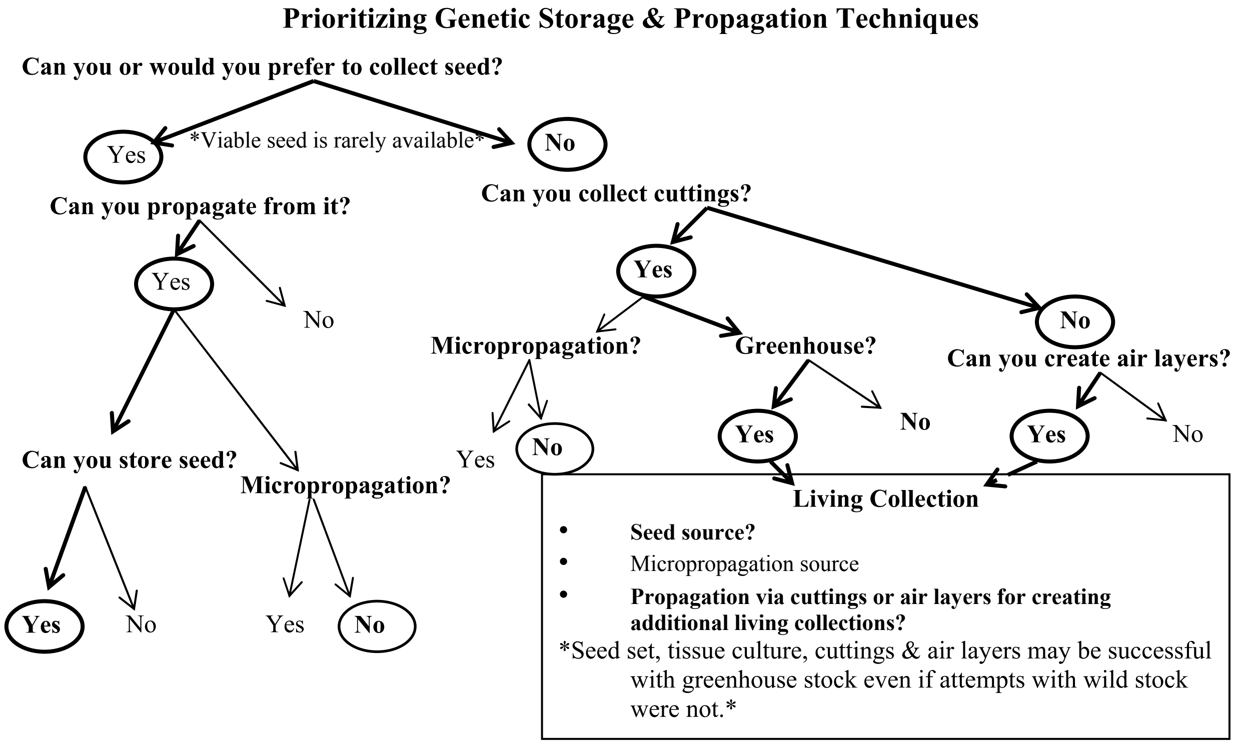
Action Area: Out

TaxonName: Flueggea neowawraea **TaxonCode: FluNeo**

Population Unit Name	Management Designation	Current Mature (Wild)	Current Immature (Wild)	Current Seedling (Wild)	Current Augmented Mature	Current Augmented Immature	Current Augmented Seedling	NRS Mature 2006	NRS Immature 2006	NRS Seedling 2006	Total Mature	Total Immature	Total Seedling	Population Trend Notes
Central and East Makaleha	Manage for stability	5	0	0	0	0	0	6	0	0	5	0	0	One of the known trees was observed to be dead.
Halona	Genetic Storage	2	0	0	0	0	0	2	0	0	2	0	0	No monitoring in the last year.
Kaluaa	No Management	0	0	0	0	0	0	0	0	0	0	0	0	
Kauhiuhi	Genetic Storage	1	0	0	0	0	0	1	0	0	1	0	0	Monitoring showed no change in the last year.
Makaha	Manage for stability	9	0	0	0	0	0	10	0	0	9	0	0	One mature tree was being double counted last year. Monitoring shows no change.
Manuwai	Manage reintroduction for stability	0	0	0	0	0	0	0	0	0	0	0	0	Reintroductions will begin once MU fences are complete
Mikilua	Genetic Storage	1	0	0	0	0	0	1	0	0	1	0	0	Monitoring showed no change in the last year.
Mohiakea	No Management	0	0	0	0	0	0	0	0	0	0	0	0	
Mt Kaala NAR	Genetic Storage	3	0	0	0	0	0	4	0	0	3	0	0	One of the known trees was observed to be dead.
Nanakuli, south branch	Genetic Storage	1	0	0	0	0	0	1	0	0	1	0	0	No monitoring in the last year.
Waianae Kai	No Management	0	0	0	0	0	0	0	0	0	0	0	0	
	Total for Taxon:	22	0	0	0	0	0	25	0	0	22	0	0	

Propagation & Genetic Storage

1) At this time, what is the preferred propagation technique?	2) At this time, what is the preferred genetic storage technique?	3) Has a successful storage method been determined?	4) Are additional steps required for obtaining enough seed?
Air layer / Cuttings	Living Collection / Seed	Yes	Yes – living collections



Collection: refer to OANRP 2006

Propagation: NRS continues to collect cutting material and install air layers from wild plants until all individuals are represented in the living collection in the Army Nursery.

Seed Storage: This year, viability assays were conducted on seeds that have been stored for five years. No decline in viability is detected from seeds stored at 20% relative humidity at -18C. Additional seeds for testing may be useful to fine-tune RH protocols and eventually test if -80C better prolongs viability.

Genetic Storage: This year, one additional founder was secured in the living collection via air layering, and cutting collections secured five additional founders. An additional six founders were established in the greenhouse and 11 remain to be collected.

Figure 2.1.11c Fruit of *Flueggea neowawraea* produced from pollinations with stored pollen

Within the last year, greenhouse stock has reached maturity. Plants do not have a set flowering season in the greenhouse, contrary to the typically-observed late fall/early winter flowering season in the field. Plants have been observed to flower in cycles; after they mature, many have been observed to flower approximately once every four to five months. Pollen is collected and stored at 20% relative humidity and -18C until female flowers are available to pollinate. The donor decision is mostly opportunistic, when a female becomes receptive; the choice of donor is prioritized as follows:

1st – donor within the population site
2nd – donor from an old collection (to test storage longevity)
3rd – donor that has yet to be utilized (in storage has yet to produce seed for storage)
4th - donor that is novel for this particular female

There are currently no female-male combinations that NRS will not pursue, as there are only 36 known founders on O'ahu. Also, historically plants were relatively evenly-distributed throughout the Northern Waiʻanae Mountains and long distance pollen and fruit dispersal may have been more likely.

Fruit are collected once the fruit turn a dark purple and the pedicle turns red (Fig.2.1.11c). Empty seeds have been observed, and this may likely be due to low pollen load. Pollen grains are relatively large in comparison to other observed taxa in the MIP/OIP. Also, there is not a lot of pollen produced within each anther. When male flowers are collected, it is optimal to collect an opening flower prior to anther dehiscence. Once anthers dehisce, very little pollen can be collected. These initial crosses were intended to distribute as little pollen as possible to as many flowers as possible in order to estimate a minimum amount required. Since there was not a lot of pollen available, NRS wanted to maximize the amount of seed collected off an individual. It is possible that not enough pollen was placed on each stigma so that all six ovaries could have been fertilized. A minimum pollen load needs to be determined. A standard amount of pollen (slightly higher than the minimum) needs to be applied in order to more accurately track pollen viability through seed set for stored pollen collections. Pollinations will continue to generate seed for storage testing, genetic storage and reintroductions. Pollen is currently being stored or had been stored (and utilized) from eight founders. Pollen stored for six months has been used to produce viable seed. Seed was sown in September 2007 from one cross that utilized pollen that had been stored for one year. Seed has been collected from four founders and have been both propagated and stored. Different combinations of founders have produced seed to test and store (Table 2.1.11b, 2.1.11c.).

Table 2.1.11b Combinations of Founders with Germination Assays

Female	Male	Pollination Type	%Germ	Filled?
LEH-C-0002	x LEH-C-3	Hand	37.50	sink/float
LEH-C-0002	x LEH-C-3	Hand	0.00	float
LEH-C-0002	?	Ambient	100.00	sink/float
LEH-C-0002	x LEH-C-3	Hand	0.00	float
LEH-C-0002	x LEH-C-3	Hand	100.00	sink
LKN-C-0002	x NAN-A-1	Hand	50.00	sink/float
LKN-C-0002	x HAL-B-1	Ambient	54.91	sink/float
LKN-C-0002	x HAL-B-1	Ambient	18.18	sink/float
LKN-C-0002	x HAL-B-1	Ambient	32.35	sink/float
LKN-C-0002	x HAL-B-1	Ambient	100.00	sink/float
MAK-D-0003	x HAL-B-1	Hand	33.33	sink/float
MAK-D-0003	x NAN-A-1	Hand	11.11	sink/float
MMR-A-0001	x HAL-B-1	Ambient	16.67	sink/float
MMR-A-0001	x HAL-B-1	Hand	0.00	sink/float
MMR-A-0001	x MAK-D-1	Ambient	85.71	sink
MMR-A-0001	x MAK-D-1	Ambient	0.00	float

These germination tests were able to establish a quick method to determine seed set. Seeds that float did not germinate and were later opened and found empty. They are not viable. Therefore, only seeds that sink will be germinated and stored. From Table 2.1.11b, is it apparent that sinking seeds are highly viable and have high initial germination. For collections where seeds were not separated by sinker and floaters, “sink/float” appears in ‘Filled?’ Column.

Table 2.1.11c Combinations of Founders with Seeds Stored

Female	Male	Pollination Type	# Seeds Stored
LEH-C-0002	x LEH-C-3	Hand	468
LEH-C-0002	x LEH-C-3	Hand	82
LEH-C-0002	x LEH-C-3	Hand	53
LEH-C-0002	x HAL-B-1	Hand	14
LEH-C-0002	x MAK-D-1	Hand	57
LEH-C-0002	x LEH-C-3	Hand	13
LEH-C-0002	x MAK-D-2	Hand	6
MAK-D-0002	x MAK-D-3	Hand	6
MAK-D-0002	?		8
MMR-A-0001	x MAK-D-1	Ambient	33
MMR-A-0001	x MAK-D-1	Ambient	10
MMR-A-0001	x LEH-A-1	Hand	12

Table 2.1.11d Genetic Storage Summary

Population Unit Name	# of Potential Founders: Current Mature	Current Imm.	NumWild Dead	Partial Storage Status: # Plants >= 10 in Seedbank	# Plants >=1 Microprop	# Plants >=1 Army Nursery	Storage Goals Met: # Plants that Met Goal
Flueggea neowawraea							
Central and East Makaleha	5	0	1	1	0	2	1
Halona	2	0	0	0	0	2	0
Kahanahaiki to Kapuna	7	0	0	1	0	3	0
Kauhiuhi	1	0	0	0	0	1	1
Makaha	9	0	0	1	0	8	1
Mikilua	1	0	0	0	0	0	0
Mt. Kaala NAR	3	0	0	0	0	1	1
Nanakuli, south branch	1	0	0	0	0	1	0
Ohikilolo	1	0	1	0	0	1	1
West Makaleha	6	0	0	0	0	2	1
				Total # Plants w/ >=10 Seeds in Seedbank	**Total # Plants w/ >=1 Microprop**	**Total # Plants w/ >=1 Army Nursery**	**Total # Plants that Met Goal**
				3	0	21	6

Unique Species Observations

There were no additional observations in the last year. See OANRP 2006 for discussion.

Outplanting Issues

Since there is no natural recruitment in any of the PUs, augmentation will be needed to achieve stability. NRS has begun augmentation in three sites in the Kahanahāʻiki Gulch section of the Kahanahāʻiki to Kapuna PU. Plants grown from seed collected from the West Makaleha PU were planted into the three sites beginning in December 2003. Twenty-six plants were planted at the first site in December 2003 and as of January 2007 only five of these had died. The second augmentation site was established in February 2005 and there are currently 38 juvenile trees there. This site was cleared of canopy weeds and is located in the gulch bottom to maximize water availability. The plants at this second site have grown vigorously and far outperformed plants at the first site. Because most of the plants at the first site had not grown vigorously NRS transplanted seven to a new third site in January 2007. This third site is also in the gulch bottom and is more similar to the second site so NRS expect the transplanted plants to perform well. In addition, 17 plants grown from the same West Makaleha PU were also planted in the third site. The transplanted plants have all survived and will continue to be monitored. In the coming year, NRS will transplant more plants from the first site to the new third site in the gulch bottom. NRS are documenting the sex of all wild plants when in flower and will balance males and females in all augmentations.

Small collections are also established at LCC and WAC from plants grown from seed from the West Makaleha PU. These plants have flowered in the last year. Many of the fruit at LCC and at the Pahole Mid Elevation Nursery were taken by birds before they matured.

In the coming year NRS will begin to select and prepare outplanting sites in the Mākaha PU and will work with Natural Area Reserve System staff to develop an outplanting site in the Pahole Natural Area Reserve section of the Kahanahāʻiki to Kapuna PU. Plants grown from greenhouse collections will be ready for outplanting in the winter of 2008-2009.

Research Issues

See Chapter 5.1 for discussion on BTB research.

Surveys

Surveys targeting *F. neowawraea* were conducted in Mākaha in the last year, but no new trees were found. As NRS management expands into new areas, the expectation is that additional trees will be discovered.

Taxon Threats

No additional threats were noted in the last year. For a full discussion see OANRP 2006.

Population Unit Level Discussion

Table 2.1.11e Population Unit Threat Control Summary

Action Area: In

TaxonName: Flueggea neowawraea

PopulationUnitName	ManagementDesignation	Protected from Ungulates	Weeds Managed	Rats Controlled
Kahanahaiki to Kapuna	Manage for stability	Partial	Partial	No
Ohikilolo	Genetic Storage	Partial	No	No
West Makaleha	Genetic Storage	No	No	No

Action Area: Out

TaxonName: Flueggea neowawraea

PopulationUnitName	ManagementDesignation	Protected from Ungulates	Weeds Managed	Rats Controlled
Central and East Makaleha	Manage for stability	No	No	No
Halona	Genetic Storage	No	No	No
Kauhiuhi	Genetic Storage	No	No	No
Makaha	Manage for stability	Partial	Partial	No
Mikilua	Genetic Storage	Yes	No	No
Mt. Kaala NAR	Manage reintroduction for storage	No	No	No
Nanakuli, south branch	Genetic Storage	No	No	No

Manage for Stability PUs

Kahanahā‘iki to Kapuna: This PU has seven *in situ* trees known from Kahanahā‘iki, Pahole and Kapuna Gulches, and three outplanting sites in Kahanahā‘iki Gulch. The three outplantings are discussed in the ‘Outplanting Issues’ section above. BTB research with these trees is discussed in Chapter 5. The three *in situ* trees in Kahanahā‘iki have had cuttings or air layers established from them and are in a living collection at the Pahole Mid Elevation Nursery. In Pahole Gulch, there are three mature trees and one additional tree is known from Kapuna Gulch. The Pahole trees are within the larger Pahole fenced unit and the Kapuna tree will be inside the last sub-unit of the Kapuna fence when it is finished in the coming year. NRS collected cuttings from these four trees with State Horticulturist Doug Okamoto in the last year and material was brought to Lyon Arboretum for propagation. The eight mature trees reported in OANRP 2006 included a tree that was mistakenly counted twice. Data has been revised to show this.

Central and East Makaleha: Two trees are known from Central Makaleha. Cuttings from both trees have been successfully rooted and established at the Pahole Mid Elevation Nursery. Both trees are in moderate condition and are not fenced. Goat control has been conducted in this area, but there is no large-scale fence planned for Central Makaleha. NRS will consider PU scale fences if necessary. NRS has not monitored these trees in the last year.

In East Makaleha, NRS currently knows of three mature trees. NRS surveyed much of this area in the last year and confirmed a tree that was reported by past surveys to now be dead. One pf the three trees was observed with immature fruit in the last year, but the sex of the other two trees are not yet known. In the coming year, NRS will collect from the three unrepresented trees and will monitor the trees for flowers. Goat control was conducted in this PU, but no other management was conducted for *F. neowawraea* in the last year.

Mākaha: NRS know of nine *F. neowawraea* in Mākaha Valley. This is the largest PU. In the last year, NRS worked with the BWS Watershed Planner to install air layers on the unrepresented trees. Collections have now been secured from eight of the nine trees. In the coming year, NRS will collect from the unrepresented tree. Four of the trees in this PU are within the Mākaha fence that was completed this year and weed control in this area has begun. In the coming year, NRS will select an augmentation site and prepare it for outplanting in the winter of 2008-2009.

Manuwai: The fourth MFS PU will be established in Manuwai using stock grown from seeds produced from greenhouse and *inter situ* sites. Outplanting will begin once the MU fence is complete and reintroduction sites have been developed. There are no live trees known from Manuwai but a few have been reported in the past.

Other PUs

West Makaleha: This PU has six mature trees and it includes the only tree that has ever been observed to produce a large amount of viable fruit. Over 600 mature fruit were collected in December 2001. Plants grown from these collections have been reintroduced and planted, as discussed above in Kahanahā‘iki. This tree may prove to be the most productive wild individual on Oʻahu and NRS will continue to collect mature fruit. The two trees growing closest to this tree are male. NRS has secured stock from two of the six trees in this PU with cuttings and air layers and will collect from the remaining trees in the coming year. A fence will be built around this PU and weed control and augmentation will begin once this habitat is secured.

ʻŌhikilolo: There is one small fence around the last live tree in this PU. Cuttings have been established from this tree, and are being grown at the Pahole Mid Elevation Nursery. Fruit has also been collected from this tree, however none were viable. NRS has conducted weed control in this area and will continue this in the coming year.

Hālona: NRS worked with the Navy to collect cuttings from the two trees in this PU. Clones from both trees were rooted and are now being grown at the Pahole Mid Elevation Nursery. They will be managed as a living collection and will be cloned. No other management has occurred at this site.

Kauhiuhi: One female tree is known from this site and NRS worked with Navy staff to monitor the site and collect cuttings. The cuttings from this collection have become established and NRS will work to clone them in the coming year.. There is no management at this site. NRS will continue to work with the Navy to monitor this tree.

Mikilua: The single tree at this site is protected by a fence constructed by the Navy in 1998. This tree has been monitored and collected from by NRS in the past but cuttings have not been secured. This tree is in poor condition and NRS will work with the Navy again in the coming year to secure collections.

Mt. Kaʻala NAR: There are three living trees known in this PU. The trees are in one site that is just outside the Mt. Kaʻala NAR boundary in the Mokuleʻia Forest Reserve. One of these three trees has been observed producing viable seed in the past and NRS will continue to monitor this site to collect mature fruit. NRS has collected cuttings from two of the trees and there are now plants from one of them established at the Pahole Mid Elevation Nursery. A single tree at a different site in this PU was observed to be dead in the last year.

Nānākuli: NRS has monitored and collected cuttings from this tree in the past. It is a very healthy tree and cuttings are established at the Pahole Mid Elevation Nursery. No other management has occurred at this site.

2.1.12 Draft Stabilization Plan for *Gouania vitifolia*

Requirements for Stability

- 3 population units (PUs)
- 50 reproducing individuals (suspected dioecy)
- Stable population structure
- Threats controlled
- Genetic storage collections from PUs managed for stability
- Expedited Stabilization (ten years)


Figure 2.1.12a *Gouania vitifolia* at Kea‘au: Mature plant at left and flowers at right

Taxon Summary

Gouania vitifolia is a liana in the family Rhamnaceae. The vines have tendrils with which it climbs adjacent vegetation. *G. vitifolia* currently occurs only on Oahu and Hawaii Island but historically was collected on Maui. A photo of *G. vitifolia* is included in Figure 2.1.12a. It has been suggested that this taxon evolved from a separate ancestral colonizer than other Hawaiian *Gouania* species. This taxon has been characterized as being dioecious with a specialized breeding system called andromonoecy (Sakai et al, 1995). In addition, no fruit have been observed during long-term monitoring of the Wai‘anae Kai population. NRS have modified the stabilization goal for this taxon from the standard goal of 25 for long-lived perennials to 50 since this taxon is possibly dioecious. The Implementation Team should discuss this decision.

Table 2.1.12a Taxon Status Summary

Action Area: In

TaxonName: Gouania vitifolia | **TaxonCode: GouVit**

Population Unit Name	Management Designation	Current Mature (Wild)	Current Immature (Wild)	Current Seedling (Wild)	Current Augmented Mature	Current Augmented Immature	Current Augmented Seedling	NRS Mature 2006	NRS Immature 2006	NRS Seedling 2006	Total Mature	Total Immature	Total Seedling	Population Trend Notes
Keaau	Manage for stability	60	0	0	0	0	0	50	0	0	60	0	0	Population estimate reported by PEP
	Total for Taxon:	60	0	0	0	0	0	50	0	0	60	0	0	

Action Area: Out

TaxonName: Gouania vitifolia | **TaxonCode: GouVit**

Population Unit Name	Management Designation	Current Mature (Wild)	Current Immature (Wild)	Current Seedling (Wild)	Current Augmented Mature	Current Augmented Immature	Current Augmented Seedling	NRS Mature 2006	NRS Immature 2006	NRS Seedling 2006	Total Mature	Total Immature	Total Seedling	Population Trend Notes
Makaha	Manage reintroduction for stability	0	0	0	0	0	0	0	0	0	0	0	0	Reintroduction will begin when site is determined
Makaleha or Manuwai	Manage reintroduction for stability	0	0	0	0	0	0	0	0		0	0	0	NRS will revisit historic sites in the next year
Waianae Kai	Genetic Storage	2	0	0	0	0	0	2	0	0	2	0	0	Population estimate reported by PEP
	Total for Taxon:	2	0	0	0	0	0	2	0	0	2	0	0	

Discussion of Management Designation

There are only two extant sites known for *Gouania vitifolia* on O'ahu at Kea'au and Wai'anae Kai. PEP has been monitoring and collecting from both sites. The Kea'au PU has approximately 50 individuals. In contrast Wai'anae Kai only has two individuals. Mākaha has been chosen by NRS as a site to manage the Wai'anae Kai stock because of management challenges in Wai'anae Kai. The Forest Reserve in this vicinity is in the public hunting area and NRS understands that at the current time there is no support for large scale fencing in the area. The site is close to the trail and therefore prone to vandalism. The habitat in the area is degraded however there are native patches in the vicinity. There is a historic site in Makaleha reported form the early 1800s. NRS will investigate the collections and conduct field surveys to explore management options in Makaleha. NRS will also investigate Manuwai as an additional site that may be appropriate for *G. vitifolia*. Expedited stabilization goals for *G. vitifolia* outlined in the USFWS 2007 Biological Opinion are to have three *in situ* PUs, attain numerical stability at two PUs, and initiate reintroduction at one PUs outside the AA. Weed control, fire management, and monitoring must be ongoing and any cooperative agreements needed to conduct management must be in place.

Threats in the Action Area

At Kea'au *G. vitifolia* is in the low fire threat area as defined by the Mauka however, plants are surrounded by grass. The area is partially protected from fire by its topographic location on the north facing slope of Kea'au and its distance from the road. It is more than one km from Farrington Hwy and greater than one and a half kilometers from the road. There are grazed areas to the north at 'Ōhikilolo Ranch. There is also private land between the area and the road that limits private access. The southern ridge of Kea'au buffers the area to the south. When NRS visited the area with PEP in March 2006 there was no evidence that the area had burned in the past. This is remarkable in this area of the Wai'anae Mountains. However, it this does not mean that the area might not burn some time in the future. Goats are a threat to this PU, PEP reports that goats are often present. Arthropod and rodent impacts have not been documented. The area is predominantly non-native with invasive species including, *Leucaena leucocephala* and *Panicum maximum* (see Figure 2.1.12c)

Propagation, Seed Storage, and Reintroduction Information

Propagation and Genetic Storage

1) At this time, what is the best preferred propagation technique?	2)At this time, what is the preferred genetic storage technique?	3) Has a successful storage method been determined?	4) Are additional steps required for obtaining enough seed?
Seed	Seed	No; but all testing has been initiated	No

Figure 2.1.12b *Gouania vitifolia* at Kea‘au: Mature fruit at left and immature plant at right

Collection/Propagation: Plants are easily propagated from seed or cutting. Some plants in the field are very large and therefore there is adequate vegetative material for obtaining cuttings (Figure 2.12.a). Fruit should be collected after they have dried out and turned a tan color. There are typically three seeds per fruit (Figure 2.1.12b). Techniques to maximize germination time are currently being studied. Initial germination rates are low and slow, but storage tests with higher rates of germination suggest a possible dormancy mechanism for this taxon. Currently, it appears that seeds may have physical dormancy; and the seed coat is impermeable to water and scarification is necessary for germination. Also, seed set is variable, and seeds that float in water have all been observed to be empty.

Seed Storage Research: Forty founders have been collected from Kea‘au through the efforts of PEP. Seeds are being stored for all of them, and the majority of these 40 are also being propagated in Lyon Arboretum's Micropropagation Laboratory. Storage tests have been established from two separate collections made by the PEP Program; once in 2006 and 2007. One additional storage test has been set up with seed from a cultivated plant in a private collection. Preliminary results indicate higher germination after one year of storage when compared to initial germination. This may be reflective of fine-tuning germination protocols, or this taxon may also be subject to some kind of physiological or morphological dormancy. Preliminary storage protocols will be established in the following year.

Reintroduction. There have been no previous attempts at outplanting this species.

Management Notes

Fire Management :

Kea‘au: NRS has little experience with this PU and has relied on PEP for much of the information presented here. As fire is a threat to the PU, fire management plan need to be developed. Grass cover is prevalent in the PU. Fuels reduction around the PU should be considered, however this would be labor intensive. There is an old road that is used to access the site and this may be improved and perhaps maintained as a fire break. Additional breaks could also be constructed with machinery or hand tools. Finally, grazing occurs on adjacent lands and perhaps NRS could direct grazing in other boundary areas to manage fuels.

Waiʻanae Kai: The Waiʻanae Kai PU is in a more forested location and therefore is much less threatened by fire.
Mākaha: A site needs to be determined for the reintroduction in this PU. A forested site will be chosen that has a low fire threat.
Makaleha: As with Makaha the PU site has not been determined. NRS will consider the threat of fire when determining a site.

Ungulate Management:
Keaʻau: There are currently feral goats in the area. PEP reports that there is consistently goat sign in the vicinity of the plants and browse has been observed. However, goats do not appear to actively target *G. vitifolia* for forage and extensive damage has not been observed. NRS and PEP have only begun to consider options for fencing the area although it does appear to be feasible. In the next year NRS and PEP will develop a plan that can be taken to the state to seek support to construct a fence around the PU.
Waiʻanae Kai: This stock will be managed at Mākaha and ungulate impacts will be addressed at this site. The PU in Waiʻanae Kai is within the Public Hunting Area and close to a trail making a possible fence and perhaps the *G. vitifolia* susceptible to vandalism.
Mākaha: The current proposed site is within a fence and other sites that have been considered will be fenced in the future.
Makaleha: Once a site is determined a plan for fencing will be developed.

Weed control:
Keaʻau: There is currently thick cover of *P. maximum* at the Keaʻau site. This weed cover provides fuel for fire. It also likely interferes with recruitment. Currently there is a single immature *G. vitifolia* known from the area (see Figure 2.1.12b). NRS will begin to develop a weed control strategy for the area that will address both fire concerns as well as trying to improve habitat to encourage on site germination.
Waiʻanae Kai: This stock will be managed at Mākaha and weed impacts will be addressed at this site. The PU in Waiʻanae Kai will be monitored and weed control will be conducted to maintain the site as a Genetic Storage site.
Mākaha: Once a site is determined weed management will begin.
Makaleha: Once a site is determined weed management will begin.

Surveys: The highest priority for survey is in the Makaleha. The proposed Makaleha PU is based on a historical location that needs to be researched at bishop and then surveyed on the ground. The second priority area is Mākaha. In Mākaha an appropriate reintroduction site needs to be identified. The site should either be in the newly completed Subunit I fence or the area that will be enclosed by the Subunit III fence. There is also appropriate habitat in many areas of the Waiʻanae that could be surveyed as resources are available.

Mixing stocks: Keaʻau has a significant number of founders, in contrast Waiʻanae Kai has only two plants. With such low numbers a mixed reintroduction has been suggested. However, the two sites differ in many ways: 1) in elevation (400-800 feet for Keaʻau vs. about 1900 for Waiʻanae Kai); 2) associates (*Diospyros sandwicensis*, *Erythrina sandwichensis*, *L. leucocephala* for Keaʻau vs. *Hibiscus arnottianus*, *Pisonia sandwicensis*, *Aleurites moluccana, Pimenta dioica* for Waiʻanae Kai); 3) forest structure (open at Keaʻau and more forested at Waiʻanae Kai); 4) rainfall amounts (as predicted by elevation and associates listed above). Because of these differences in sites there many be local adaptations present in the populations that many be disrupted by mixing and result in plants that are not well adapted to either or any site. Therefore, perhaps mixing should be considered with caution. There are a couple of ways NRS would propose to work with this issue. First experimental mixes could be conducted in the greenhouse and the resulting progeny could be evaluated for vigor. The drawback to this is that it will take time to perform these trials. Secondly, NRS could mix in some sites and not others, then evaluate the results and adapt management appropriately. In addition to Mākaha, NRS may be able to reintroduce this stock into small fences planned for Wai‘anae Kai to protect other species.

Prefect or Unisexual flowers: Past monitoring suggests that the Wai‘anae Kai stock may be functionally unisexual (male type) and fruit have never been collected from the plants. In contrast, at Kea‘au , flowers appear to be perfect, although they have not been extensively investigated. NRS will continue to investigate these issues to clarify flower morphology and why Wai‘anae Kai has not produced any fruit. The results of this investigation will be important to determining whether or not to mix Kea‘au and Wai‘anae Kai stock.

Off Island Populations: There are extant populations on the Island of Hawai‘i. NRS will gather information on these sites. At this time it is unclear if NRS should get involved in management on other islands because of logistical constraints.

Figure 2.1.12c *Gouania vitifolia* habitat at Kea‘au: On the right, *Erythrina sandwicensis* moderate slope habitat. On the left, Mixed invasive gentle slope habitat.

Map removed,
available upon request

Figure 2.1.12d Current distribution of *Gouania vitifolia* in the Wai‘anae Kai Mountains, O‘ahu

Table 2.1.12b Priority Management Actions for *Gouania vitifolia* Army Stabilization PUs

Population Unit	Specific Management Actions	Timeline
Kea‘au	• Work with PEP to survey and monitor PU for additional individuals and potential area to fence. • Develop weed control plan. • Collect propagules for genetic storage.	MIP Year 4
	• Construct MU fence. • Conduct grass control and fuels modification. • Continue collections for genetic storage.	MIP Year 5
Wai‘anae Kai	• Investigate flowers to determine if perfect or unisexual. • Collect propagules for genetic storage. • Consider establishing stock in small fences that will be constructed for *Neraudia angulata.*	MIP Year 4
Mākaha	• Investigate sites for future reintroduction	MIP Year 4
Makaleha or Manuwai	• Investigate historical site and explore sites for possible reintroduction • Examine bishop collections to determine if they are similar to Wai‘anae Kai and Kea‘au	MIP Year 4

2.1.13 *Hedyotis degeneri* var. *degeneri*

Requirements for Stability:

- 3 Population Units (PUs)
- 50 reproducing individuals in each PU (short-lived perennial)
- Threats controlled
- Stable population structure
- Complete genetic representation of all PUs in storage

How many of the 3 MFS PUs have stable numbers of mature individuals?	How many of the 3 MFS PUs have had *in situ* recruitment?	How many of the 3 MFS PUs have full genetic storage?	How many of the 3 MFS PUs are protected from ungulates?	How many MFS PUs that need reintroductions have been initiated?
1/3	3/3	0/3	0/3	0/2

Taxon Level Discussion

Over the past several years, this taxon as a whole has not been given high management priority mainly due to the relatively high numbers of individuals in some of the PUs. However, continued population declines in three out of four PUs merit a greater effort by NRS to stabilize this species. Most of the known plants are found in the least degraded habitat for this species, the Kahanahāiki to Pahole PU. This MFS PU is inside the AA. The two other MFS PUs each contain several small degraded sites, and are outside the AA. Only plants in the Pahole area are protected from ungulates (however pigs are currently in the Pahole fence). None of the other sites are protected by a MU fence and weed control has not begun for most sites. Juvenile and seedling plants have been observed at most sites. Management has focused on seed collections for storage and some ungulate control. Propagation for augmentation of the Central Makaleha and West Branch of East Makaleha PU and the Ala‘ihe‘ihe, and Manuwai PU will begin once the habitat is secured with MU fences. Over the last year, NRS and NARS staff also controlled goat populations around the PUs in the Mokulē‘ia Forest Reserve and Mt. Ka‘ala NAR.

Major Highlights/Issues Year 3

- Seed collections for genetic storage and propagation were made from the Central Makaleha and West Branch of East Makaleha.
- Census monitoring of the Manuwai site rediscovered plants thought to be dead last year.
- A large fire in August 2007 burned the lower portions of Manuwai and Ala‘ihe‘ihe Gulches (see Appendix for fire report).
- A continued decline in the number of plants was observed in Kahanahāiki in the last year.
- The East branch of East Makaleha PU was monitored for the first time since 1999 and no plants were found.
- NRS walked a tentative fence route around the Kahanahāiki Subunit II portion of the Kahanahāiki to Pahole PU.

Plans for Year 4

- NRS will survey for new locations in Central Makaleha Gulch, in the West Branch of East Makaleha area, and in the East branch of East Makaleha Gulch.
- NRS genetic storage collection efforts will continue targeting underrepresented plants from all PUs.
- NRS, DOFAW, and NARS staff will continue hunting in the Mokulēʻia Forest Reserve and Mt. Kaʻala NAR to minimize goat impacts.
- NRS will construct a small subunit fence around the Kahanahāiki site in the next two years. Alternatively, NRS will plan a larger perimeter fence along the last unfenced portion of Mākua Valley pending ungulate movement and density research in Mākua.
- If needed, NRS will weed two meters around each plant upon collection to assist in recruitment and individual plant vigor.

Figure 2.1.13a *Hedyotis degeneri* mature dehisced fruits (top photo) and immature fruits nearing dehiscence (bottom photo)

Table 2.1.13a Taxon Status Summary

Action Area: In

TaxonName: Hedyotis degeneri var. degeneri **TaxonCode: HedDegDeg**

Population Unit Name	Management Designation	Current Mature (Wild)	Current Immature (Wild)	Current Seedling (Wild)	Current Augmented Mature	Current Augmented Immature	Current Augmented Seedling	NRS Mature 2006	NRS Immature 2006	NRS Seedling 2006	Total Mature	Total Immature	Total Seedling	Population Trend Notes
Kahanahaiki to Pahole	Manage for stability	243	9	8	0	0	0	492	16	16	**243**	**9**	**8**	The numbers reported last year were a mistake. The estimate for this year is the best available, although many more plants are likely in Pahole
	Total for Taxon:	243	9	8	0	0	0	492	16	16	**243**	**9**	**8**	

Action Area: Out

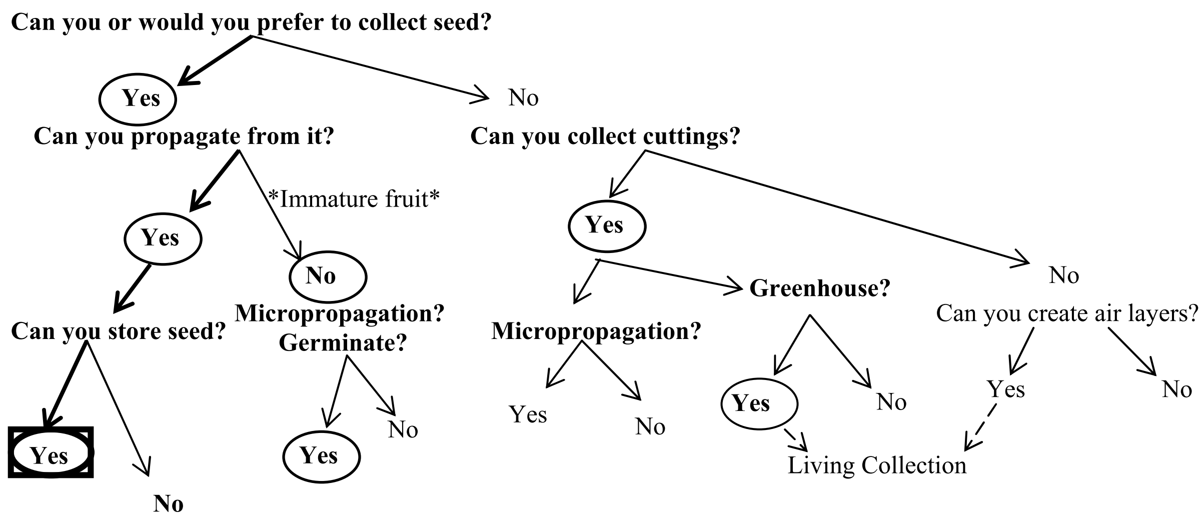
TaxonName: Hedyotis degeneri var. degeneri **TaxonCode: HedDegDeg**

Population Unit Name	Management Designation	Current Mature (Wild)	Current Immature (Wild)	Current Seedling (Wild)	Current Augmented Mature	Current Augmented Immature	Current Augmented Seedling	NRS Mature 2006	NRS Immature 2006	NRS Seedling 2006	Total Mature	Total Immature	Total Seedling	Population Trend Notes
Alaiheihe and Manuwai	Manage for stability	31	6	1	0	0	0	34	0	2	**31**	**6**	**1**	Monitoring in the last year rediscovered plants in part of this PU and another site not monitored since 1999 was found to have no plants
Central Makaleha and West Branch of East Makaleha	Manage for stability	25	10	17	0	0	0	33	3	7	**25**	**10**	**17**	A thorough census discovered less mature but more plants of smaller size classes
East branch of East Makaleha	Genetic Storage	0	0	0	0	0	0	10	0	0	**0**	**0**	**0**	The first monitoring of this site since 1999 found no plants
	Total for Taxon:	56	16	18	0	0	0	77	3	9	**56**	**16**	**18**	

Propagation and Genetic Storage

1) At this time, what is the best preferred propagation technique?	2) At this time, what is the preferred genetic storage technique?	3) Has a successful storage method been determined?	Are additional steps required for obtaining enough seed?
Seed	Seed	Yes	No

Prioritizing Genetic Storage & Propagation Techniques



Collection: refer to OANRP 2006

Propagation: refer to OANRP 2006

Seed Storage Research: refer to OANRP 2006. An additional collection was secured this year to complete all storage testing to determine best RH for storage as well as -80C storage potential.

Genetic Storage: Seeds from three additional founders from Makaleha and 22 founders from Pahole were collected this past year.

Table 2.1.13b Genetic Storage Summary

Population Unit Name	# of Potential Founders: Current Mature	# of Potential Founders: Current Imm.	# of Potential Founders: NumWild Dead	Partial Storage Status: # Plants >= 10 in Seedbank	Partial Storage Status: # Plants >=1 Microprop	Partial Storage Status: # Plants >=1 Army Nursery	Storage Goals Met: # Plants that Met Goal
Hedyotis degeneri var. degeneri							
Alaiheihe and Manuwai	31	6	0	7	0	0	5
Central Makaleha and West Branch of East Makaleha	25	10	16	21	0	0	18
East branch of East Makaleha	0	0	0	0	0	0	0
Kahanahaiki to Pahole	243	9	4	22	0	1	16
				Total # Plants w/ >=10 Seeds in Seedbank	**Total # Plants w/ >=1 Microprop**	**Total # Plants w/ >=1 Army Nursery**	**Total # Plants that Met Goal**
				50	0	1	39

Despite the problem of timing collections for mature, dehiscing fruit, NRS have made good progress at reaching storage goals for some PUs. Collection efforts will need to intensify in the coming year given the lack of a fence around three out of the four PUs and further habitat degradation by pigs in the Ala‘ihe‘ihe and Manuwai PU in particular. Living collections via cuttings may be needed to produce seed for storage in order to avoid losing more unrepresented individuals

Unique Species Observations

There have been no additional observations in the last year.

Outplanting Issues

NRS have not outplanted this species, nor have any other natural resource programs on O‘ahu. Reintroductions may be considered in the Central Makaleha and West Branch of East Makaleha PU once the MU fence is constructed. Experimental reintroductions may also be tried in the Kahanahāiki Subunit II fence once constructed. This effort will potentially preserve any local adaptations of this sub-population given its geographic separation from Pahole plants.

Research Issues

A continued decline of this taxon over the last six years is a concern for NRS. Habitat degradation is a likely factor for declines at some of the PUs. More frequent monitoring and detailed observations of microsites would assist NRS staff in documenting habitat changes and other factors contributing to the lack of adequate population replacement. Basic life history information (e.g. lifespan or age at first maturity) of this species is also needed

Surveys

No surveys for new populations were conducted for this species in the last year. Surveys are planned in the coming year.

Taxon Threats

No new threats have been observed to this taxon. Pigs were observed at the Ala'ihe'ihe and Manuwai PU further degrading the area. Fires did burn up to the 1,800 ft. elevation in the Ala'ihe'ihe Gulch in August 2007. While no individuals were directly threatened by fire, large fires irreversibly degrade surrounding habitat and increase the likelihood that future fires will burn even higher in elevation due to the spread of alien grasses. This taxon has been recorded from around 1,800-2,400 ft. in elevation, and known primarily from the windward side of the Wai'anae Mountains.

Table 2.1.13c Population Unit Threat Control Summary

Action Area: In

TaxonName: Hedyotis degeneri var. degeneri

PopulationUnitName	ManagementDesignation	Protected from Ungulates	Weeds Managed	Rats Controlled
Kahanahaiki to Pahole	Manage for stability	Partial	No	No

Action Area: Out

TaxonName: Hedyotis degeneri var. degeneri

PopulationUnitName	ManagementDesignation	Protected from Ungulates	Weeds Managed	Rats Controlled
Alaiheihe and Manuwai	Manage for stability	No	No	No
Central Makaleha and West Branch of East Makaleha	Manage for stability	No	No	No
East branch of East Makaleha	Genetic Storage	No	No	No

Manage for Stability PUs:

Kahanahāiki to Pahole: Weeds have not been observed to be a significant threat to the plants in Pahole. Although the Pahole portion is fenced, pigs have been in the fence for a number of months and about a dozen pigs have been removed so far by NRS and NARS staff from this fence unit.

Seed from 22 founders out of over 240 founders were collected from the Pahole portion of this PU in the last year (see also Table 2.1.12b Genetic Storage Summary). In the coming year, NRS will continue collecting for genetic storage. Monitoring efforts will focus on locating younger plants and constructing a better distribution map of the plants in Pahole. The habitat where this taxon lives in the Pahole portion is very intact and more plants are likely to be found.

NRS monitored the Kahanahāiki portion of this PU in June 2007 and found another decline in the numbers of living plants. Although there have been no more than ten plants observed at this site since 2002, this years observation of one mature and one immature plant is the fewest plants ever observed. Although this site is not protected by a fence, ungulates are not thought to have caused this decline as the habitat is still largely intact. NRS will continue to collect for genetic storage and monitor this site closely for further declines. Possible reasons for the decline of this sub-population include senescence, poor microsites for recruitment, and lack of adequate seed production for recruitment (some flowers of this taxon are only pistillate). Seeds collected from three plants have since died in storage, underscoring the need to maintain living collections to ensure adequate representation before more founders are lost from small sub-populations.

Ungulate control in the area hinges upon NRS decisions to construct the Kahanahāiki Subunit II fence in the next two years or construct a longer fence line along the rim of Mākua Valley. This longer, perimeter fence line would give NRS the opportunity to remove all pigs from Mākua Valley. In the coming year NRS will place GPS collars on pigs caught in Mākua Valley to track their movements hopefully provide better density estimates in order to make a more informed decision on the utility of constructing the last portion of the Mākua Valley rim fence.

Central Makaleha and West Branch of East Makaleha: This PU contains three separate sites. Plants are not protected from ungulates and NRS observed goats in this area again last year. NRS visited two of these sites to collect mature seed for storage and refined old population estimates for these sites in the last year. Fewer mature plants and more immature plants were observed last year than in the previous year (see Table 2.1.13a Taxon Status Summary). The third site was not visited. Seed collections from 21 plants are now storage including ten plants that are now dead (see also Table 2.1.12b Genetic Storage Summary). In the coming year, NRS will collect from the remaining mature plants for genetic storage and work with the DLNR to minimize goat impacts.

Ala‘ihe‘ihe and Manuwai: In the OANRP 2006 report, NRS reported a significant decline in this PU. However, another census of the Manuwai area in the last year rediscovered several plants. A small decline was noted this year, but not as significant as compared to other locations. This site is not protected from ungulates. Goats are known to be in this area, pigs were observed at one site and pig sign was observed throughout the area last year. Competition with weeds may also be a factor in the lack of population growth as *Clidemia hirta* is now a dominant component of the habitat. Seed collection for genetic storage has begun and will continue in the coming year. As mentioned previously, the lower reaches of Manuwai Gulch burned in the August 2007 fire (see Appendix Fire Reports).

There are three sites reported from the Ala‘ihe‘ihe section of this PU. One site that has not been monitored in recent years was searched in the last year and no plants were found. This has significantly reduced the number of known plants from this PU in the last year. NRS will continue to search for new locations in this PU.

Other PUs:

East Branch of East Makaleha: This area was searched last year for the first time since 1999 and no plants were observed. Goats are known to be in this area and a large MU fence is still proposed. NRS will conduct more surveys in this PU in the coming year. If no new plants are found, NRS may reconsider fencing this area for this taxon.

2.1.14 *Hedyotis parvula*

Requirements for Stability:
- 3 Population Units (PUs)
- 50 reproducing individuals in each PU (short-lived perennial)
- Stable population structure
- Threats controlled
- Complete genetic representation in storage of all PUs

How many of the 3 MFS PUs have stable numbers of mature individuals?	How many of the 3 MFS PUs have had *in situ* recruitment?	How many of the 3 MFS PUs have full genetic storage?	How many of the 3 MFS PUs are protected from ungulates?	How many MFS PUs that need reintroductions have been initiated?
2/3	2/2 (only 2 *in situ* PUs)	2/2 (only 2 *in situ* PUs)	2/3	0/1

Taxon Level Discussion
There are two MFS PUs with i*n situ* populations and one reintroduction planned for the third MFS PU. The ʻŌhikilolo PU is inside the AA. The Hālona PU and the reintroduction into Makaleha are both outside the AA. The reintroduction planned for the East Makaleha Management Unit fence will begin once construction is complete. Fence completion is tentatively scheduled for early 2009. Plants tend to grow on steep cliffs and feral ungulates are not considered a direct threat at this time. Fire threats have increased over the last several years. Fires in 2005 in Nānākuli and Lualualei came close to the Hālona PU. NRS conducted grass control around the PUs to reduce fire threat in the last year. NRS acquired significant collections of this taxon from the *in situ* populations in the last year and have met the genetic storage goals for this taxon.

Major Highlights/Issues Year 3
- Genetic storage goals have been met for both PUs with *in situ* populations.
- A thorough census of the historic location in East Makaleha found no plants.

Plans for Year 4
- Determine an outplanting location when the proposed East Makaleha fence is complete.
- Expand weed and fuel control at the Hālona PU.
- Focus monitoring on locating and tracking younger plants.
- Determine which stock should be used for the Makaleha outplanting.
- Assist DOFAW and NARS staff with goat control at the Halona and East Makaleha PUs.

Table 2.1.14a Taxon Status Summary

Action Area: In

TaxonName: Hedyotis parvula   TaxonCode: HedPar

Population Unit Name	Management Designation	Current Mature (Wild)	Current Immature (Wild)	Current Seedling (Wild)	Current Augmented Mature	Current Augmented Immature	Current Augmented Seedling	NRS Mature 2006	NRS Immature 2006	NRS Seedling 2006	Total Mature	Total Immature	Total Seedling	Population Trend Notes
Ohikilolo	Manage for stability	120	28	40	0	0	0	120	28	40	**120**	**28**	**40**	Monitoring showed no change
	Total for Taxon:	120	28	40	0	0	0	120	28	40	**120**	**28**	**40**	

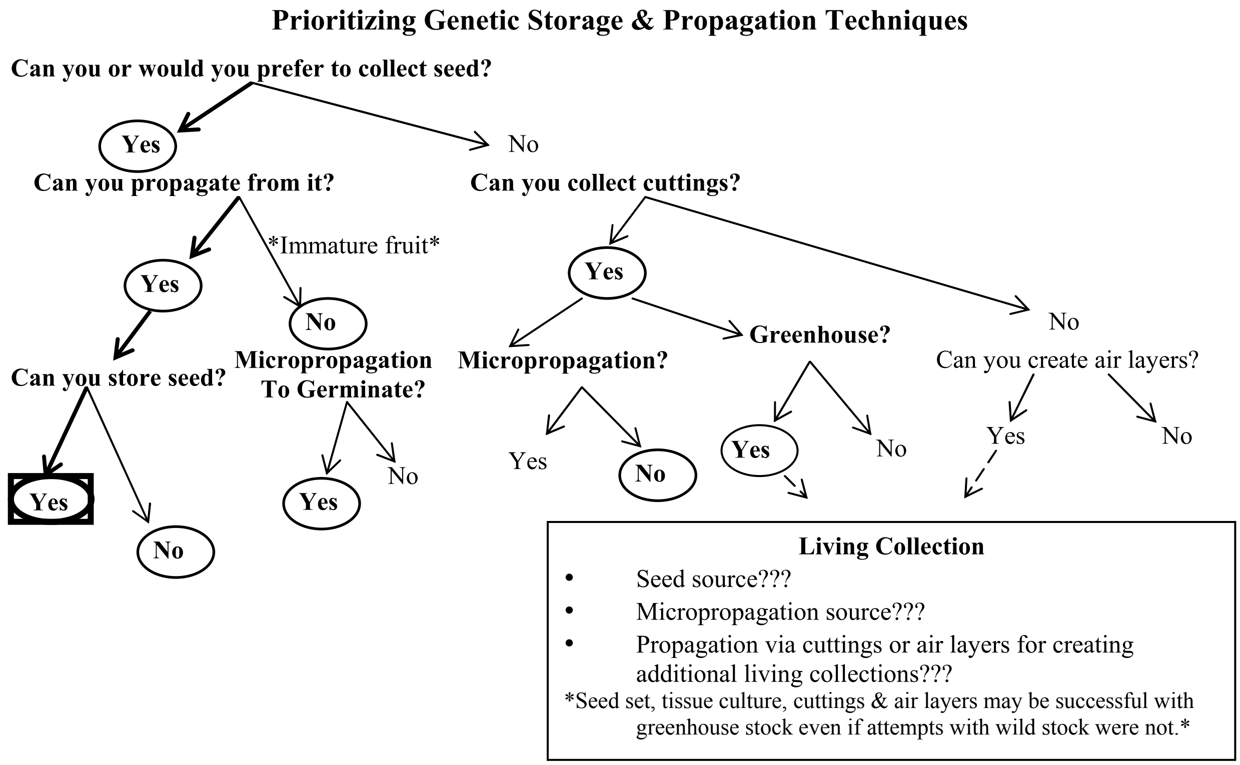
Action Area: Out

TaxonName: Hedyotis parvula   TaxonCode: HedPar

Population Unit Name	Management Designation	Current Mature (Wild)	Current Immature (Wild)	Current Seedling (Wild)	Current Augmented Mature	Current Augmented Immature	Current Augmented Seedling	NRS Mature 2006	NRS Immature 2006	NRS Seedling 2006	Total Mature	Total Immature	Total Seedling	Population Trend Notes
East Makaleha	Manage reintroduction for storage	0	0	0	0	0	0	0	0	0	**0**	**0**	**0**	A thorough census found no plants
Halona	Manage for stability	97	35	19	0	0	0	87	28	19	**97**	**35**	**19**	A thorough census found more plants in the last year
	Total for Taxon:	97	35	19	0	0	0	87	28	19	**97**	**35**	**19**	

Propagation and Genetic Storage

1) At this time, what is the preferred propagation technique?	2) At this time, what is the preferred genetic storage technique?	3) Has a successful storage method been determined?	4) Are additional steps required for obtaining enough seed?
Seed	Seed	Yes	No



Collection: refer to OANRP 2006

Propagation: refer to OANRP 2006

Seed Storage: refer to OANRP 2006. NRS was able to make collections for storage testing this year from the Hālona PU.

Genetic Storage: 16 additional founders were collected from the Hālona PU, and 11 from the ʻŌhikilolo PU. Several other plants from the ʻŌhikilolo PU were re-collected to meet storage goals.

Table 2.1.14b Genetic Storage Summary

	# of Potential Founders			Partial Storage Status			Storage Goals Met
Population Unit Name	Current Mature	Current Imm.	NumWild Dead	# Plants >= 10 in Seedbank	# Plants >=1 Microprop	# Plants >=1 Army Nursery	# Plants that Met Goal
Hedyotis parvula							
East Makaleha	0	0	0	0	0	0	0
Halona	97	35	0	70	0	2	62
Ohikilolo	120	28	5	108	0	0	102
				Total # Plants w/ >=10 Seeds in Seedbank	**Total # Plants w/ >=1 Microprop**	**Total # Plants w/ >=1 Army Nursery**	**Total # Plants that Met Goal**
				178	0	2	164

Excess seed in storage will be used for propagation of reintroduction stock.

Unique Species Observations

No new observations were made in the last year.

Outplanting Issues

No outplantings of this species have been done although plants of sufficient size for outplanting have been grown at the Army Nursery. Plants grow on very steep cliffs, so outplantings will likely need to take place on rappel. NRS are gaining technical expertise at outplanting on cliffs. For example, *Tetramolopium filiforme* was successfully outplanted on a cliff at Pu‘u Kumakali‘i. NRS will work to determine which stock should be used for outplanting in the coming year. No *Hedyotis degeneri* var. *degneri* are known from the East Makelaha area so possible hybridization with that taxon is not an issue at this time.

Research Issues

There are no research issues for this taxon at this time.

Taxon Threats

Goats can impact this taxon’s cliff habitat. Fortunately, no goat browse has been observed on this taxon. *Melinis minutiflora, Rubus argutus,* and *Erigeron karvinskianus* all threaten the habitat of *H. parvula* and NRS have initiated some control of these species at the ‘Ōhikilolo and Hālona PUs. A small herd of goats on State and Navy land in Lualualei threatens the Hālona PU and NRS will work with the landowners in the coming year to plan to eradicate these goats. A large fire, like the Nānākuli fire of 2005, would likely threaten the Hālona PU again. NRS began controlling grass at the Hālona PU in the last year to address the fire threat.

Population Unit Level Discussion

Table 2.1.14c Population Unit Threat Control Summary

Action Area: In

TaxonName: Hedyotis parvula

PopulationUnitName	ManagementDesignation	Protected from Ungulates	Weeds Managed	Rats Controlled
Ohikilolo	Manage for stability	Yes	Partial	No

Action Area: Out

TaxonName: Hedyotis parvula

PopulationUnitName	ManagementDesignation	Protected from Ungulates	Weeds Managed	Rats Controlled
East Makaleha	Manage reintroduction for storage	No	No	No
Halona	Manage for stability	Yes	Partial	No

Manage for Stability PUs

ʻŌhikilolo: The ʻŌhikilolo PU includes three *in situ* sites and has more than the number of mature individuals needed for stability. Goats were removed from ʻŌhikilolo and pigs do not threaten this PU. NRS monitoring at this PU over a number of years detected significant habitat improvements since goat removals. NRS continues to conduct grass control in the area and more recently began removing non-native trees on the cliff where the population is located. Genetic storage goals were met and exceeded for this PU as over a hundred founders are represented by large collections in the Seed Conservation Lab. Over representation of founders was intentional as excess seeds in storage will be used for propagation purposes. In the coming year, NRS will focus monitoring efforts on locating and tracking the smaller size classes at the two large populations and will search the third and smallest site for any additional plants. NRS will continue to test the seed collections for any decline in viability. Grass control will continue as will removal of alien trees such as *Schinus terebinthifolius* and *Grevillia robusta.*

Hālona: This PU includes two separate sites, one large population at the southern end of Hālona and one smaller population at the northern end of Hālona. Both sites are on State land above Lualualei Naval Magazine. The total population at this PU exceeds stabilization goals. The southern site with more plants will be fully managed with ungulate and weed control; while the northern site will just be monitored and collected from for seed storage. There are no observed ungulate threats directly in this PU. However, NRS will be working with the State and Navy in the coming year to prevent a larger herd from becoming established in the area and moving south to the PU.

The 2005 fire in Nānākuli and Lualualei came close to the southern site. Management of grass at the southern site has begun and NRS will expand this effort in the coming year. NRS will also develop a more comprehensive weed control plan this year as some noteworthy weeds

(*Ageratina riparia, Melinis minutiflora, Sphraeopteris cooperi, Morella faya*) impact the habitat in this PU. Other than landslides, this PU has no other known threats.

Central and East Makaleha: This proposed MU fence is slated for construction in year four of the MIP (2008-2009). State approval for this fence is still pending. In the last year, NRS spent a significant amount of time monitoring the historic site in this PU, and no plants were found. In the coming year, NRS will determine the best outplanting sites in anticipation of the fence completion.

2.1.15 *Hesperomannia arbuscula*

Requirements for Stability:
- 3 Population Units (PUs)
- 75 reproducing individuals in each PU (long-lived perennial but with low seed set, tendency for large declines or fluctuations in population size, and recent severe population declines)
- Stable population structure
- Threats controlled
- Complete genetic representation of all PUs in storage

How many of the 3 MFS PUs have stable numbers of mature individuals?	How many of the 3 MFS PUs have had *in situ* recruitment?	How many of the 3 MFS PUs have full genetic storage?	How many of the 3 MFS PUs are protected from ungulates?	How many MFS PUs that need reintroductions have been initiated?
0/3	3/3	0/3	3/3	0/3

Taxon-Level Discussion
This year has marked several highlights for *Hesperomannia arbuscula*. With the Army's new Mākua consultation and subsequent change in size and shape of the action area (AA), NRS anticipated that this species would no longer be considered a stabilization species (OANRP 2006). However, in the Mākua 2007 BO the USFWS determined that there would still be a potential fire threat to individuals located in Kapuna gulch of Pahole NAR, although the threat is considered low (USFWS 2007). During the consultation the last remaining individual in the Kapuna gulch population died. The BO however considers data points from the last 20 years. Thus while there are no extant individuals in the AA it is still considered a stabilization species. As mentioned previously (OANRP 2006), NRS worked closely with the Plant Extinction Prevention (PEP) program to ensure that the conservation of this species was continuous and those efforts continued this year. When the BO was finalized the Army Natural Resources and PEP programs determined that NRS would concentrate on the conservation of this species and the PEP would focus on other O'ahu PEP species.

With the Kapuna PU presumed extirpated with no *ex situ* representation NRS have decided to add Wai'anae Kai as a Manage for Stability population.

Additionally, this year saw the completion of the Mākaha management unit fence, which means that all three remaining populations of this species are now protected from ungulates (Mākaha, Wai'anae Kai, and Pālāwai).

This year considerable effort was made to cross pollinate this species both *in* and *ex situ*. Viable seed has been observed in the past, however, with the steep and rapid decline of wild individuals and extremely reduced numbers of flowering individuals within each remaining population there may be only one or two individuals per population that flower each year. Recently, viable seed was collected much less frequently, with no viable seed collected in 2006 and high fruit abortion observed. Therefore, with the current low numbers of individuals in each population, it appears necessary to cross pollinate these plants by hand.

Major Highlights/Issues Year 3

- This species still within the Mākua AA
- Pollination of wild plants resulted in numerous viable seed
- Mākaha PU is now fenced
- Nineteen propagules in the greenhouse, representing 17 wild individuals and all three of the remaining extant populations
- Wai‘anae Kai PU designated as Manage for Stability
- Kapuna PU presumed extirpated with no *ex situ* representation

Plans for Year 4

- Continue pollination of wild and greenhouse plants
- Continue air layer attempts of greenhouse plants
- Continue surveys for additional populations (SBMR, Wai‘anae Kai, Mākaha, Honouliuli)

Table 2.1.15a Taxon Status Summary

Action Area: In

TaxonName: Hesperomannia arbuscula **TaxonCode: HesArbu**

Population Unit Name	Management Designation	Current Mature (Wild)	Current Immature (Wild)	Current Seedling (Wild)	Current Augmented Mature	Current Augmented Immature	Current Augmented Seedling	NRS Mature 2006	NRS Immature 2006	NRS Seedling 2006	Total Mature	Total Immature	Total Seedling	Population Trend Notes
Kapuna	Genetic Storage	0	0	0	0	0	0	1	0	0	**0**	**0**	**0**	This single plant died in the last year
	Total for Taxon:	0	0	0	0	0	0	1	0	0	**0**	**0**	**0**	

Action Area: Out

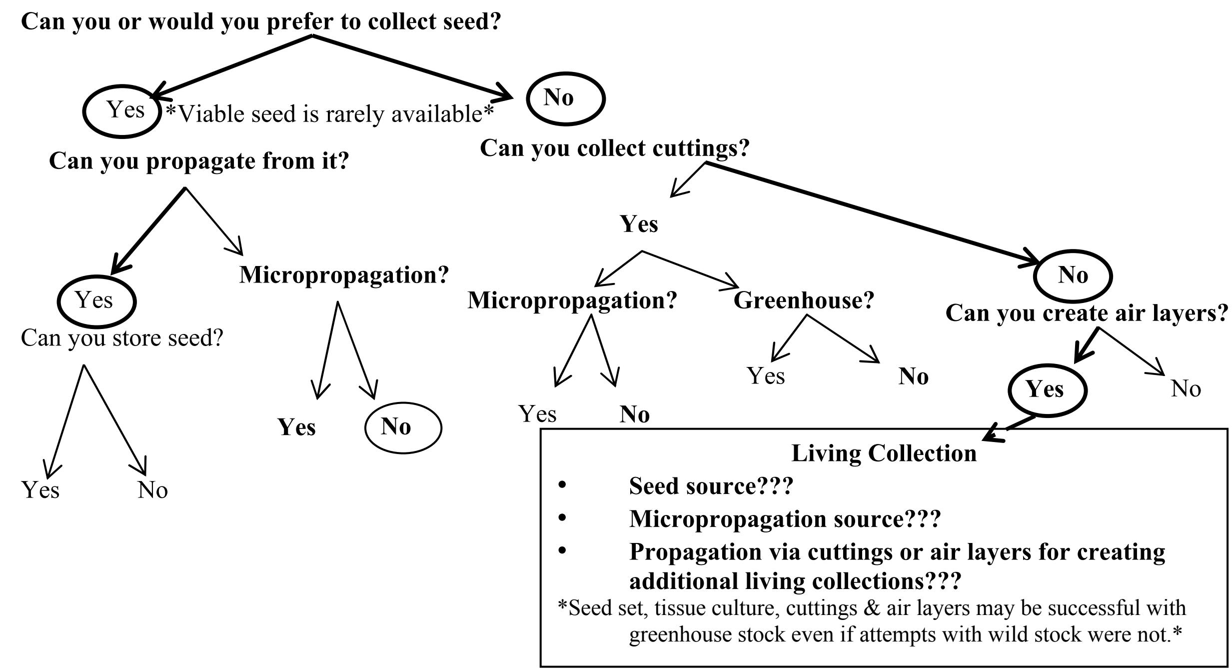
TaxonName: Hesperomannia arbuscula **TaxonCode: HesArbu**

Population Unit Name	Management Designation	Current Mature (Wild)	Current Immature (Wild)	Current Seedling (Wild)	Current Augmented Mature	Current Augmented Immature	Current Augmented Seedling	NRS Mature 2006	NRS Immature 2006	NRS Seedling 2006	Total Mature	Total Immature	Total Seedling	Population Trend Notes
Makaha	Manage for stability	4	8	0	0	0	0	5	8	1	**4**	**8**	**0**	One mature plant and one seedling died in the last year
North Palawai	Manage for stability	3	0	0	0	0	0	3	0	1	**3**	**0**	**0**	One seedling died in the last year
Waianae Kai	Manage for stability	2	1	0	0	0	0	2	1	0	**2**	**1**	**0**	No changes in this population since last year
	Total for Taxon:	9	9	0	0	0	0	10	9	2	**9**	**9**	**0**	

Propagation and Genetic Storage

1) At this time, what is the preferred propagation technique?	2) At this time, what is the preferred genetic storage technique?	3) Has a successful storage method been determined?	4) Are additional steps required for obtaining enough seed?
Seed (if available) & air layers	Living collection	No	Yes; living collection & cross pollination

Prioritizing Genetic Storage & Propagation Techniques



Collection: As mentioned above, there has been a high level of fruit abortion observed in the previous years, and it was proposed that a lack of outcrossing between individuals, due to decreasing number of individuals and potentially the number of receptive flowers at any given time, could be the reason. After observing floral morphology, timing of anther dehiscence and stigma receptivity on greenhouse stock this past February, NRS decided to hand pollinate receptive flowers with pollen from any other available individual (Fig. 2.1.15a). As flowers within a head emerge, anthers dehisce along the elongating style. Two to three days later the stigmas split into two and appear receptive. This is exemplary of a morphology intended to promote outcrossing. Eleven hand pollinations were made as plants were visited 21 times from February through August 2007. NRS and PEP Program staff visited individuals within the Mākaha, Waiʻanae Kai, and Pālāwai PUs for pollen collection, pollinations, and fruit collection (Table 2.1.15b). Pollen was collected for short-term storage for this year's pollinations. Pollen was stored undried at 4C. Pollen age served as an indicator for germination success. Pollen over one month old produced very few achenes that germinated. The last pollen collection was used for long-term viability testing to be used for next year's pollinations. The pollen type in the Asteraceae family is trinucleate, as opposed to binucleate. Trinucleate pollen grains are less likely to withstand desiccation and are typically short-lived (Brewbaker 1967). Pollen may be difficult to store and proper handling may be important to extend viability throughout the entire flowering season.

Pollinations were documented to record the age of the pollen, pollen source, timing of pollination with respect to stigma receptivity, number of filled achenes within a head, number viable, and seedling mortality. Percent of filled achenes appeared higher when timing was optimal as opposed to pollinations that were conducted as the flower had begun to die. No unfilled achene, whether collected from a hand pollination or ambient pollination, has germinated. Filled achene germination is high and ongoing. Filled seeds will serve as an indicator of embryo presence and unfilled achenes will not be sown.

Figure 2.1.15a *Hesperomannia arbuscula* pollinations
Clockwise from top left: receptive flower; pollinating; tagged immature fruit.

Table 2.1.15b Germination Results from Hand-Pollinations Mar-Jun 2007

Pollination #	Cross (♀ x ♂)	Pollen Age (days)	% Filled	Timing of Pollination	%Germ	# Seedlings
1	PAL-A-2 x MAK-A-16 (GH)	5	0.00%	Optimal	0.00%	0
2	WAI-A-13 x MAK-A-16	28	53.33%	Optimal	75.00%	14
3	WAI-A-13 x PAL-A-2 (or self)	~7	10.34%	Late	100.00%	2
4	WAI-A-13 x MAK-A-16	~90-100	3.03%	?	0.00%	0
5*	PAL-A-2 x WAI-A-13	~30-40	15.38%	Little Late	75.00%	5
6*	PAL-A-2 x WAI-A-13	~30-40	6.12%	Little Late	66.67%	2
7*	PAL-A-2 x MAK-A-16	68	16.33%	Optimal	0.00%	0
8*	PAL-A-2 x PAL-A-9	13	3.77%	Late		0
9	PAL-A-9 x PAL-A-2	13	NA		NA	
10*	PAL-A-9 x PAL-A-2	22	61.67%	Optimal	83.78%	31
11	PAL-A-9 x ?		32.81%	?	100.00%	18
TOTALS	*** assay ongoing**		20.80%		**55.61%**	**72**

Propagation: Filled seeds have a high percent germination and seedlings are easily transferred from germination media to pots of moss/Perlite mix and grown in the controlled-environment chambers. One achene from this year's germination assays produced two separate seedlings (Fig.2.1.15b). Both were slightly smaller than typical seedlings of this taxon, but are thriving. There are currently 72 seedlings growing in the Controlled Environment Chamber (Percival Scientific, Inc.) (Fig.2.1.15.c).

Figure 2.1.15b *Hesperomania arbuscula* twins

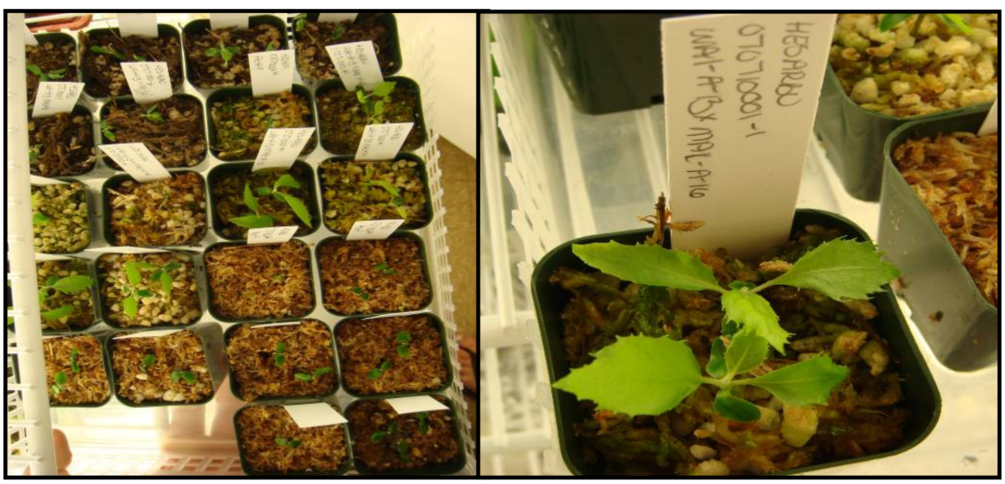


Figure 2.1.15c *Hesperomania arbuscula* seedlings

Seed Storage Research: No seeds are available yet for storage testing.

Genetic Storage: NRS will continue to establish a living collection for genetic storage and hopefully seed and air layer source. This year one air layer was collected off greenhouse stock.

Table 2.1.15c Genetic Storage Summary

Population Unit Name	# of Potential Founders: Current Mature	Current Imm.	NumWild Dead	Partial Storage Status: # Plants >= 10 in Seedbank	# Plants >=1 Microprop	# Plants >=1 Army Nursery	Storage Goals Met: # Plants that Met Goal
Hesperomannia arbuscula							
Kapuna	0	0	0	0	0	0	0
Makaha	4	8	0	0	0	1	0
North Palawai	3	0	14	0	2	8	3
Waianae Kai	2	1	8	0	1	1	1
				Total # Plants w/ >=10 Seeds in Seedbank	**Total # Plants w/ >=1 Microprop**	**Total # Plants w/ >=1 Army Nursery**	**Total # Plants that Met Goal**
				0	3	10	4

Unique Species Observations

In previous years NRS reported that flowers of the Wai‘anae Kai population had been picked, presumably by people. This year NRS observed obvious rodent predation on greenhouse and some wild plants. NRS believe some rat predation may be responsible for some flower losses this year and in the past. However, in past years larger woody stems have been cracked when flowers were missing, suggesting that there may have been more than rats targeting the flowers of this species. This year rat traps were placed at the bases of flowering individuals to help protect flowers and developing fruiting heads.

Outplanting Issues

Until NRS are able to propagate a larger number of individuals, no outplanting can be done with this species. When there are sufficient propagules to facilitate an outplanting NRS may choose to do a trial reintroduction at any of the three fenced wild sites or within the Kapuna one-acre fence. The Kapuna 1-acre fence currently contains NARS outplantings of *Cyanea superba* and *Delissea subcordata* and is approximately 500 meters from the wild *H. arbuscula* site within Kapuna gulch. This area appeals to NRS because it could be monitored frequently, watered, and treated for pests more easily than the natural sites. However, the canopy is slightly more open and the understory is more weedy than is found at the remaining natural sites.

Research Issues

As mentioned, this year pollination of wild individuals provided viable seed from Wai‘anae Kai and North Pālāwai PUs. NRS will continue to study the pollination of wild and greenhouse individuals in order to get more viable seed. This species may also benefit from the development of species specific pollen storage protocols as pollen may be the only genetic material we can salvage from some individuals if no viable seed is produced.

It has been suggested that *H. arborescens*, the more common Ko‘olau congener, be used as a surrogate for studies and as a base for emergency grafting to save some wild individuals. NRS has grown individuals of this species in the past and will continue to try to establish greenhouse individuals for this purpose.

Surveys
No surveys specific for this taxon in the past year.

Taxon Threats
This species appears to be fragile and trees within fenced areas have died after extensive monitoring and weeding, although, weeds continue to threaten this species in all known PUs. Rat predation of flowering heads and developing fruiting heads is suspected in all PUs. NRS have begun placing rat traps around flowering/fruiting trees during the reproductive season.

Population Unit Level Discussion

Table 2.1.15d Population Unit Threat Control Summary

Action Area: In

TaxonName: Hesperomannia arbuscula

PopulationUnitName	ManagementDesignation	Protected from Ungulates	Weeds Managed	Rats Controlled
Kapuna	Genetic Storage	No	Yes	No

Action Area: Out

TaxonName: Hesperomannia arbuscula

PopulationUnitName	ManagementDesignation	Protected from Ungulates	Weeds Managed	Rats Controlled
Makaha	Manage for stability	Yes	No	Partial
North Palawai	Manage for stability	Yes	Partial	Partial
Waianae Kai	Manage for stability	Yes	No	Partial

Manage for Stability PUs

Mākaha: This PU was fenced this year as part of the approximately 100 acre Makaha MU. This is the largest PU with four mature individuals and eight immature individuals. Two individuals flowered this year and cross pollination attempts were made however no mature fruiting heads were collected. The fruiting heads either fell off, did not mature, or disappeared (possibly due to rat predation). Three airlayers were attempted on three individuals in December 2006. Two of the three had good root development and were collected. One of these individuals died in propagation and one remains in the nursery. If this propagule survives it will be the first nursery representative and the only *ex situ* representation of this PU, as all micropropagation representatives from this PU are now gone.

North Pālāwai: Although this PU was fenced in 2003, the number of individuals continued to decline each year. Currently there are two mature individuals within the fence and one mature individual on a steep cliff approximately 20 meters outside the fence. A small immature individual, approximately six inches tall was observed to look water stressed at the end of June 2007. On subsequent visits for pollination/fruit collection NRS monitored and watered this individual. Initial watering and mulching with moss appeared to help, however on following visits the individual looked poor again. NRS discussed rescuing this individual if it looked like it would not survive in the wild. However, with the rotation of different people visiting the site each week, the decision to remove the plant may have come too late. The plant was taken into propagation several weeks after the initial observation of water stress however, the individual did not survive.

This area contains the most intact habitat for this species with a mostly native canopy and few weeds to control. This PU is also the best represented in *ex situ* propagation; there are nine seedlings from one fruit collection in 2005; five individuals that were rescued seedlings, and two plants represented via collected air layers. The Palikea MU, which is just two major ridges south of Pālāwai and will be fenced in the next year. This MU also contains appropriate intact habitat

NRS have been treating *Ehrharta stipoides* along the ridge leading to this PU. This grass is incipient in the area and NRS feel it is beneficial to prevent it from becoming well established in the area. See Chapter 1 Ecosystem Management for a more detailed discussion.

Wai‘anae Kai: This population continues to have two mature and one immature individuals *in situ*, one wild individual is represented in the nursery and one in the micropropagation lab. The NARS horticulturalist has air layered the nursery individual in an attempt to increase the propagules from this PU, however, this plant is in poor condition and may not survive. NRS assisted the PEP program in the pollination of one individual from this PU this year. This year one of the hand pollinated flowering heads produced 100% viable seeds.

Other PUs

Kapuna: NRS noticed a decline in vigor of this plant in the beginning of 2007 and consulted the NARS Horticulturalist and NARS Specialist as to what actions to take. NRS accompanied the NARS Horticulturalist to administer a liquid fertilizer to the plant. However, the plant died over the following weeks and no material was healthy enough to salvage. This population was never represented *ex situ* as there was only one individual for the last several years and this individual had not flowered for the past four years. NRS will continue to monitor this site periodically for any additional individuals that may come up. This site will be fenced within the proposed Kapuna subunit IV fence and receives weed control.

2.1.16 *Hibiscus brackenridgei* subsp. *mokuleianus*

Requirements for Stability

- 4 Population Units (PU)
- 50 reproducing individuals in each PU (short-lived perennial)
- Stable population structure
- Threats controlled
- Complete genetic representation of all PUs in storage
- Expedited Stabilization (10 yrs)

How many of the 4 MFS PUs have stable numbers of mature individuals?	How many of the 4 MFS PUs have had *in situ* recruitment?	How many of the 4 MFS PUs have full genetic storage?	How many of the 4 MFS PUs are protected from ungulates?	How many MFS PUs that need reintroductions have been initiated?
0/4	3/3 (only 3 *in situ* PUs)	0/3 (only 3 *in situ* PUs)	0/4	1/4

Taxon Level Discussion

Due to the high fire threat posed to *Hibiscus brackenridgei* subsp. *mokuleianus* at MMR, there are four MFS PUs. Three of the four MFS PUs will be established by introducing plants from *in situ* sites to currently unoccupied sites. Two of the four MFS PUs (Mākua and Kea‘au) are within the MMR AA. The Kea‘au population was added as the fourth MFS PU last year and will be established by outplanting stock grown from the Mākua PU once the MU management in that area has begun. The three other MFS PUs were selected to encompass the morphological diversity present in this species and include the Mākua PU on MMR, the Kaimuhole to Palikea Gulch PU on land owned by Dole Foods Co., and the Hā‘ili to Kawaiū PU on land owned by the State of Hawai‘i. Recruitment has been observed in every PU and juvenile plants have been observed surviving into maturity in several PUs.

Most of the *in situ* populations are found scattered across severely degraded habitat and the landowners where the largest PUs are have not yet agreed to *in situ* management such as fencing and outplanting. Because of this, NRS will need to rely on reintroduction of stock into more manageable areas to achieve stability. For the Hā‘ili to Kawaiū PU, NRS has begun outplanting at Dillingham Military Reservation (DMR). For managing the Kaimuhole to Palikea Gulch PU, NRS will pursue fencing a site in Ka‘awa Gulch on State land. The Mākua PU will be augmented and the stock will also be used to establish the new Kea‘au PU. Genetic storage collections from all PUs are kept as a living collection of plants at the Army nurseries and in several *inter situ* sites. In addition, collection for seed storage from a reintroduction in the Mākua PU has begun. The threats to this taxon include fire, weeds such as *Panicum maximum* and *Leucaena leucocephala* that both alter habitat and greatly increase fuel loads and ungulates. NRS has worked extensively with weed management and fuels modification in the Mākua PU and is prepared to utilize tools developed there is other PUs.

Expedited Stabilization for this species requires there be four PUs with 50 reproducing individuals in ten years. Three of these PUs must be outside the AA and a reintroduction outside the AA must be initiated. In addition, weed control and fire management must be ongoing and monitoring plans and cooperative agreements to allow access to all PUs must be in place. The requirements for Expedited Stabilization do not match the management proposed and discussed at the 2006 MIT meeting because only two of the four MFS PUs are outside the AA. This will need to be addressed in the coming year. At this time the landowners where the *in situ* PUs are have not agreed to any management proposed by NRS so it may be difficult to identify another site to conduct management outside of the AA.

The August 2007 Kaukonahua fire burned into the Kaimuhole and Palikea Gulch, Kaumoku nui and Kihakapu PUs. NRS estimate that 97% of the plants known from these three PUs were burned. This is obviously the most significant impact to this species ever witnessed. NRS did their best to support the fire fighting and damage assessment efforts in many ways. These included hiring two helicopters to drop water in known *H. brackenridgei* PUs, providing maps and resource location information to DOFAW and Honolulu Fire Department, communication support and providing resource impact data after aerial and ground surveys of all known rare plant populations. Discussions of impacts to each PU are discussed in the sections below and in the Kaukonahua Fire Report, Appendix II.

Major Highlights/Issues Year 3

- The population estimates for the three PUs affected by the Kaukonahua Fire have been revised to reflect the damage observed during surveys of all the sites after the fire. It is not likely that many of the plants observed to be standing will survive so they have been counted as dead. It is likely that the seeds in or on the ground have survived at these sites and NRS will continue to monitor all locations.
- Although many new seedlings were observed in the Mākua PU, the number of mature plants continues to decline.
- The reintroduction of stock from the Hāʻili to Kawaiū PU was expanded at DMR.
- Expedited Stabilization in ten years

Plans for Year 4

- Augment the Mākua PU with stock grown from cuttings in the winter of 2007-2008
- Pursue an entry permit from Castle and Cooke to monitor sites in the burned PUs for new plants and continue to collect for the living collection
- Continue expansion of the DMR reintroduction of stock from the Hāʻili to Kawaiū PU
- Collect from any new founders at any of the PUs
- Pursue a MU including an exclosure for managing the Kaimuhole and Palikea PU
- Continue expansion of the living collection of the Mākua PU at MMR Range Control
- Scope the Keaʻau MU for suitable planting sites

Table 2.1.16a Taxon Status Summary

Action Area: In

TaxonName: Hibiscus brackenridgei subsp. mokuleianus TaxonCode: HibBraMok

Population Unit Name	Management Designation	Current Mature (Wild)	Current Immature (Wild)	Current Seedling (Wild)	Current Augmented Mature	Current Augmented Immature	Current Augmented Seedling	NRS Mature 2006	NRS Immature 2006	NRS Seedling 2006	Total Mature	Total Immature	Total Seedling	Population Trend Notes
Keaau	Manage reintroduction for storage	0	0	0	0	0	0	0	0	0	**0**	**0**	**0**	Reintroduction will begin once management begins
Makua	Manage for stability	10	4	18	0	0	0	16	4	0	**10**	**4**	**18**	A few more mature plants died and a thorough census found many seedlings at the known site
	Total for Taxon:	10	4	18	0	0	0	16	4	0	**10**	**4**	**18**	

Action Area: Out

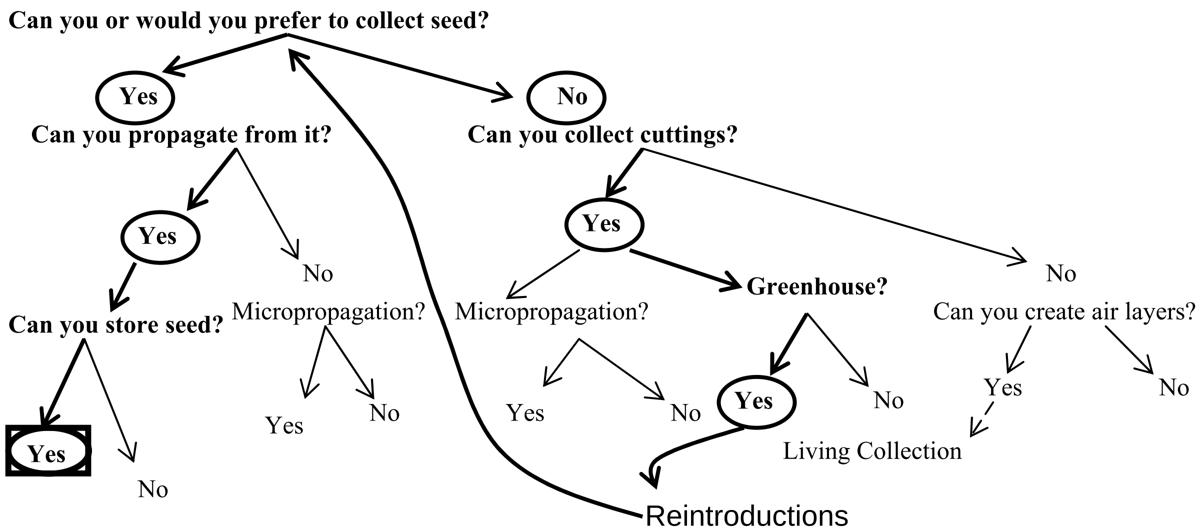
TaxonName: Hibiscus brackenridgei subsp. mokuleianus TaxonCode: HibBraMok

Population Unit Name	Management Designation	Current Mature (Wild)	Current Immature (Wild)	Current Seedling (Wild)	Current Augmented Mature	Current Augmented Immature	Current Augmented Seedling	NRS Mature 2006	NRS Immature 2006	NRS Seedling 2006	Total Mature	Total Immature	Total Seedling	Population Trend Notes
Haili to Kawaiu	Manage for stability	8	4	9	26	2	0	5	6	0	**34**	**6**	**9**	A thorough census of this PU found more plants at the wild site and more were added to the outplanting
Kaimuhole and Palikea Gulch	Manage for stability	1	8	0	0	0	0	7	230	8	**1**	**8**	**0**	No living plants were found at any known sites, but a new small group of plants was discovered alive
Kaumoku Nui	Genetic Storage	0	0	0	0	0	0	14	0	0	**0**	**0**	**0**	The fire burned all known plants
Kihakapu	Genetic Storage	1	0	0	0	0	0	6	316	57	**1**	**0**	**0**	The fire burned and killed all but one mature plant
	Total for Taxon:	10	12	9	26	2	0	32	552	65	**36**	**14**	**9**	

Propagation and Genetic Storage

1) At this time, what is the preferred propagation technique?	2) At this time, what is the preferred genetic storage technique?	3) Has a successful storage method been determined?	4) Are additional steps required for obtaining enough seed?
Cuttings	Seed	Yes	Insecticide treatments may help boast viability

Prioritizing Genetic Storage & Propagation Techniques



Collection: Collections made this year from the Mākua Range Control occurred earlier in the year as compared to previous years. Plants were not treated with insecticide, fertilizer, and pruning as they had been the previous year. Collections this year had the highest percentage of viable seed. It is possible that the seed borer might have been at a lower density earlier on in the fruiting season. NRS will not treat plants next year and schedule to collect as early as possible. If seeds are not as viable as this year, then plans for insecticide and fertilizer treatments will be revisited.

Propagation: refer to OANRP 2006

Seed Storage Research: No aging detected after four years of storage.

Genetic Storage: Seeds from ten additional Mākua founders outplanted at Mākua Range Control are now stored in the seed bank.

Table 2.1.16b Genetic Storage Summary

	# of Potential Founders			Partial Storage Status			Storage Goals Met
Population Unit Name	Current Mature	Current Imm.	NumWild Dead	# Plants >= 10 in Seedbank	# Plants >=1 Microprop	# Plants >=1 Army Nursery	# Plants that Met Goal
Hibiscus brackenridgei subsp. mokuleianus							
Haili to Kawaiu	8	4	3	0	0	7	3
Kaimuhole and Palikea Gulch	1	8	0	1	0	11	11
Kaumoku Nui	0	0	7	0	0	0	0
Kihakapu	1	0	0	2	0	10	9
Makua	10	4	15	20	0	17	20
				Total # Plants w/ >=10 Seeds in Seedbank	**Total # Plants w/ >=1 Microprop**	**Total # Plants w/ >=1 Army Nursery**	**Total # Plants that Met Goal**
				23	0	45	43

Unique Species Observations

There is no additional information to report.

Outplanting Issues

There are outplantings planned for all MFS PUs. NRS has planted into *inter situ* sites to hold living collections in accessible areas and plantings have also been done in remote wild sites in order to establish new populations. Both of these types of plantings will be needed to hold and introduce this species into managed areas for stabilization.

Inter situ sites have been used to hold stock from wild sites to provide propagules for production and seed storage. Stock from the Mākua PU is being held at the Ka‘ala Learning Center, Mākua Range Control and Koko Crater Botanical Garden. As discussed in the Genetic Storage section, NRS will continue to balance the Mākua Range Control site to plant clones of those that die and maintain all founders. The other sites will be augmented if stock is available. Stock from the Kaumoku nui PU is being held at Kaiser High School, the NRS baseyard in Wahiawa, Waialua High School and Waimea Audubon Center. These plants were removed from the cattle trails outside of the fence at the *in situ* site in 2002. In the coming year, NRS will consider collecting from the juvenile plants distributed to these sites to increase the number of founders represented in the living collection at the NRS baseyard since PU was burned this year. Stock from the other PUs is being kept as part of the nursery inventory.

Stock from the Mākua PU was planted into remote sites in the Kaluakauila MU in December of 2002. This is the only remote reintroduction location with Mākua stock. NRS first selected a site at the lower end of the MU in good dry forest habitat. This area burned in 2003 and 2006, when all but two of the remaining plants were killed, and the site was abandoned. Previously healthy and robust plants where killed. The plants had been vigorous and flowered even though NRS had not done any management on the site. Since then NRS conducted experimental outplantings in more forested portions of the MU where they are more protected from fire. The fourth MFS

PU in Kea‘au will be established with stock from the *inter situ* collections at Mākua Range Control and NRS will benefit from the lessons learned in these other plantings.

NRS began outplanting at Dillingham Military Reservation in November 2005 in an effort to establish a MFS population with stock from the Hā‘ili to Kaiwaiu PU. Cuttings have been collected as they became available on the wild founders and propagated for planting. There have been 31 juveniles planted at this site and all but three have survived and most have matured this last year. Plantings are being planned for the Kaimuhole to Palikea and Kea‘au PUs and in the next year NRS will begin to explore these areas and determine suitable sites for planting. NRS will continue to monitor past planting efforts to guide these new plantings.

Table 2.1.16c Founders Represented in Outplantings

TaxonName: Hibiscus brackenridgei subsp. mokuleianus **TaxonCode: HibBraMok**

Total Num Plants based upon Plants that have been numbered

PopulationUnitName	Management Designation	Number of Founders	Number of Founders Represented
Haili to Kawaiu	Manage for stability	15	9
Kaimuhole and Palikea Gulch	Manage for stability	9	1
Kaumoku Nui	Genetic Storage	7	6
Keaau	Manage reintroduction for storage	0	0
Kihakapu	Genetic Storage	1	0
Makua	Manage for stability	29	22
	Total for Taxon:	**61**	**38**

Number of Founders = Number of Mature, Immature, and Dead founder plants.
Number of Founders Represented = Number of founder plants represented in reintroductions.

Research Issues
There are no additional research issues to report.

Surveys
There have been no additional surveys in the last year.

Taxon Threats
A previously noted threat was fully realized this year when a fire burned through all of the gulches with *H. brakenridgei* from Schofield to Makaleha. This area has long been noted as having the potential for a large landscape-size fire and NRS will note this in future management strategies for those PUs. There is no change in the general status of threats to the taxa.

Population Unit Level Discussion

Table 2.1.16d Population Unit Threat Control Summary

Action Area: In

TaxonName: Hibiscus brackenridgei subsp. mokuleianus

PopulationUnitName	ManagementDesignation	Protected from Ungulates	Weeds Managed	Rats Controlled
Makua	Manage for stability	No	Yes	No

Action Area: Out

TaxonName: Hibiscus brackenridgei subsp. mokuleianus

PopulationUnitName	ManagementDesignation	Protected from Ungulates	Weeds Managed	Rats Controlled
Haili to Kawaiu	Manage for stability	No	Partial	No
Kaimuhole and Palikea Gulch	Manage for stability	No	No	No
Kaumoku Nui	Genetic Storage	Partial	No	No
Kihakapu	Genetic Storage	No	No	No

Manage for Stability PUs

Mākua: This site has been monitored closely since being discovered in November 2000. Initially, not all of the plants that were later found were known. New plants were discovered as management activities increased at the site and NRS became familiar with the distribution. From November 2000 through 2004, it appeared that numbers where steadily rising and that stability may be achieved through germination from the existing seed bank. However, since then the mature plants have been dying and are not being replaced by maturing juvenile plants. The individual counts are down again from last year, however many seedlings were observed this year. In past years NRS decided to not augment this site in order to maximize the diversity of the plants at the site by allowing for recruitment from the wild seed bank. New seedlings in areas not occupied by plants were discovered. The numbers of plants continue to decline and new seedlings are only found under existing plants. NRS will augment this site in the next year with stock grown from cuttings collected from the *inter situ* site. No additional cuttings were collected from additional plants in the *in situ* site this year. The Mākua Range Control *inter situ* collection will continue to be balanced so that there are at least three of each Mākua PU founder represented.

There have been 35 mature and juvenile plants tagged in the Mākua PU since 2001. There are 14 plants alive today and ten are mature. Since tagging started in 2001, 21 plants have died. Of these 21, six died before they were observed as mature and the rest were observed mature at least once before they died. Of the ten mature plants alive today, six were mature when they were discovered. Two were first observed in 2001, six in 2002, one in 2004 and one in 2006. Of the four immature plants alive today, two were first observed in 2002 and one each in 2004 and 2006. The majority of new plants were discovered in 2002 and the number of new mature and immature plants being tagged has declined significantly in the last few years. The 18 seedlings found in the last year is the largest number of that size class ever observed at this site. They were marked and NRS will continue to monitor and search for these smaller plants to track their survivorship in the coming year. Weed and fuel control by NRS is ongoing and is discussed in the Lower ʻŌhikilolo MU section of Chapter 1.

Table 2.1.16e Mākua PU Population Structure

Monitoring Date	Nov 2000	Mar 2001	Jan 2002	June 2003	March 2004	Aug 2005	July 2006	May 2007
Mature/Juvenile/Seedling	4/2/2	4/2/3	8/5/2	13/6/2	18/8/11	18/8/11	16/4/0	9/5/18

Hāʻili to Kawaiū: There are two *in situ* sites and one outplanting site in this PU and NRS has monitored all three of these sites in the last year. The two *in situ* sites will be used as propagule sources for the DMR outplanting where all the threats will be managed. Both *in situ* sites are not protected from ungulates and are dominated by *Panicum maximum* and *Leucaena leucocephala*. A few more immature plants had matured and nine seedlings were observed during monitoring at one of the *in situ* sites in January 2007. Cuttings were taken from two new founders and will be added to the DMR outplanting. The previous monitoring of this site was conducted in June 2006 when many plants have no leaves and the seedlings may have been there but were missed. Seedlings were also observed at this site in May 2005. The other *in situ* site was also monitored in January 2007 and one of the plants that was immature last year had matured. There are five founders known at this site and all have been collected from. Plants grown from these five founders are represented at the DMR outplanting. NRS will continue to collect from any new founders as they become available. Monitoring will focus on locating and tracking smaller plants.

The DMR outplanting was established in November 2005 with 21 plants and supplemented with an additional ten plants in December 2006. The site was last monitored in July 2007 and three plants had died. Most of the remaining plants were healthy and are growing well at the site. NRS will continue to supplement this site with stock from both *in situ* sites in the next year.

Kaimuhole and Palikea Gulch: This PU contains many sites in two gulches and was burned in the August 2007 Kaukonahua fire. Most of the *H. brakenridgei* in this PU were killed in the fire, but a few plants did survive. For a complete discussion of the fire see the Kaukonahua Fire Report attached as Appendix II. NRS has kept a small living collection of plants grown from cuttings taken from 11 founders from this PU. In OANRP 2006 and at the 2006 MIT meeting, NRS discussed how the landowner, Castle and Cooke had not agreed to any of the management proposed by NRS for the *in situ* sites. While a Management Unit around the *in situ* sites would be preferred, because it was not approved, NRS proposed establishing a MU to manage outplanted stock from this PU in the Mokuleia Forest Reserve in Kaʻawa Gulch. At the 2006 MIT meeting both Kaʻawa and another site in lower Manuwai Gulch also in the Mokuleia Forest Reserve were discussed. The Kaukonahua fire burned into both of these proposed areas and NRS has not visited them since the fire. In the coming year, NRS will survey both Kaʻawa and Manuwai Gulch and develop proposals and plans for managing the outplanted stock. A large fence unit and fuel and weed control projects would have to be in place at either site before stock could be outplanted. Until then, NRS will continue to monitor the *in situ* sites in this PU, collect from any new founders remaining in any of the partially burned sites and maintain the living collection.

Keaʻau: In OANRP 2006 and at the MIT meeting, NRS identified Keaʻau as the fourth MFS PU. There are no *in situ* plants known from this site and the PU will be established by outplanting stock grown from the Mākua PU. Keaʻau is inside the MMR AA and would require a large fence and fuel and weed control before outplanting could begin. Until then, NRS will continue to maintain the living collection of the Mākua stock to be used as the source for this PU. In the coming year, NRS will pursue permission from the landowner and visit the area to develop management proposals.

Other PUs

Kaumoku Nui: This PU is on Castle and Cooke land and was burned in the Kaukonahua fire. When it was monitored in July 2007, eight large mature plants were observed. Many of the plants had mature fruit and no additional threats were observed. A fence was built in this area many years ago, but the only live plants occurred on and above the cliff above and outside the fence. Cattle can walk all around this area but had not been in the area lately and the grass was especially thick. In July 2007, at least three trunks of old dead *H. brakenridgei* trees were observed amongst the living plants. These were some of the older mature plants that were alive as part of the 14 plants observed in 2006. Unfortunately, the Kaukonahua fire burned through this site and all the plants observed in July 2007 were killed. NRS has collected from many founders in this site and will work in the coming year to ensure that none are lost in cultivation. The site will be monitored for any new plants and collections from new founders will be made as they become available. This PU is to be managed for Genetic Storage, and no other *in situ* management is proposed.

Kihakapu: This PU is on Castle and Cooke land and was burned in the Kaukonahua fire. This PU contains ten sites in both Kihakapu and Puulu Gulch. All ten sites in the two gulches were burned but one site in Kihakapu Gulch was not completely burned and one live and two partially alive plants were observed. NRS has kept a living collection of plants grown from cuttings taken from ten founders from this PU. In the coming year, NRS will continue to monitor these sites for new plants and collect from any plants remaining in any of the partially burned sites. This PU is to be managed for Genetic Storage, and no other *in situ* management is proposed.

2.1.17 *Melanthera tenuifolia*

Requirements for Stability

- 3 Population Units (PUs)
- 50 genetically unique individuals in each PU (short-lived perennial with tendency to reproduce vegetatively)*
- Stable population structure
- Threats controlled
- Complete genetic representation of all PUs in storage

* It is difficult to distinguish genetic individuals, since vegetative reproduction creates identical adjacent plants. Genetic studies suggest that plant material separated by >2 m is genetically distinct.

How many of the 3 MFS PUs have stable numbers of mature individuals?	How many of the 3 MFS PUs have had *in situ* recruitment?	How many of the 3 MFS PUs have full genetic storage?	How many of the 3 MFS PUs are protected from ungulates?	How many MFS PUs that need reintroductions have been initiated?
3/3	3/3	0/3	2/3	N/A

Taxon Level Discussion

The three largest populations in the best habitat are designated as Managed for Stability (MFS). One PU is in the Action Area (AA) and the other two are located off-site. These three PUs already have stable numbers of individuals, but all threats are not controlled and genetic storage research is still ongoing. Ungulates have been controlled at the ʻŌhikilolo and Mt. Kaʻala NAR PUs and in August 2007 NRS completed a fence in Mākaha that protects a portion of the PU from ungulates. The population estimates for this taxon are being revised and are not yet reliable in determining trends. Many of the estimates are based on observations made many years ago and these sites are still being re-located and monitored more closely by NRS on. A challenge in working with this species is that many populations require rappelling to access thus making it difficult to get frequent and accurate monitoring data and collections. NRS has also struggled to collect viable seed from populations for storage and propagation trials. An additional challenge is with monitoring this species. It grows in large sprawling patches with long runners that root when in contact with the ground. Vegetative reproduction is likely an important component of regeneration; however NRS also see seedlings in the field. Estimating the numbers of individuals in these large sprawling patches is difficult. Fortunately, this taxon occurs in many locations and large populations have remained robust over time.

Major Highlights/Issues Year 3

- Completed the fence in Mākaha effectively protecting a portion of the Kamaileʻunu and Waiʻanae Kai PU.
- Isolated potential dormancy-breaking mechanism in seeds

Plans for Year 4

- NRS will investigate need to revisit PUs in high fire threat areas to collect additional material for living collections.

- NRS will continue studies to investigate dormancy-breaking mechanisms in order to determine the storage potential of seeds for genetic storage goals

Figure 2.1.17a Flowering *Melanthera tenuifolia*

Table 2.1.17a Taxon Status Summary

Action Area: In

TaxonName: Melanthera tenuifolia **TaxonCode: MelTen**

Population Unit Name	Management Designation	Current Mature (Wild)	Current Immature (Wild)	Current Seedling (Wild)	Current Augmented Mature	Current Augmented Immature	Current Augmented Seedling	NRS Mature 2006	NRS Immature 2006	NRS Seedling 2006	Total Mature	Total Immature	Total Seedling	Population Trend Notes
Kahanahaiki	Genetic Storage	54	23	4	0	0	0	54	23	4	**54**	**23**	**4**	No monitoring in the last year
Kaluakauila	Genetic Storage	64	20	40	0	0	0	64	20	40	**64**	**20**	**40**	No monitoring in the last year
Keawaula	Genetic Storage	45	15	0	0	0	0	45	15	0	**45**	**15**	**0**	NRS did post fire moniotoring and found no change in stautus
Ohikilolo	Manage for stability	1242	1	0	0	0	0	1242	1	0	**1242**	**1**	**0**	No monitoring in the last year
	Total for Taxon:	1405	59	44	0	0	0	1405	59	44	**1405**	**59**	**44**	

Action Area: Out

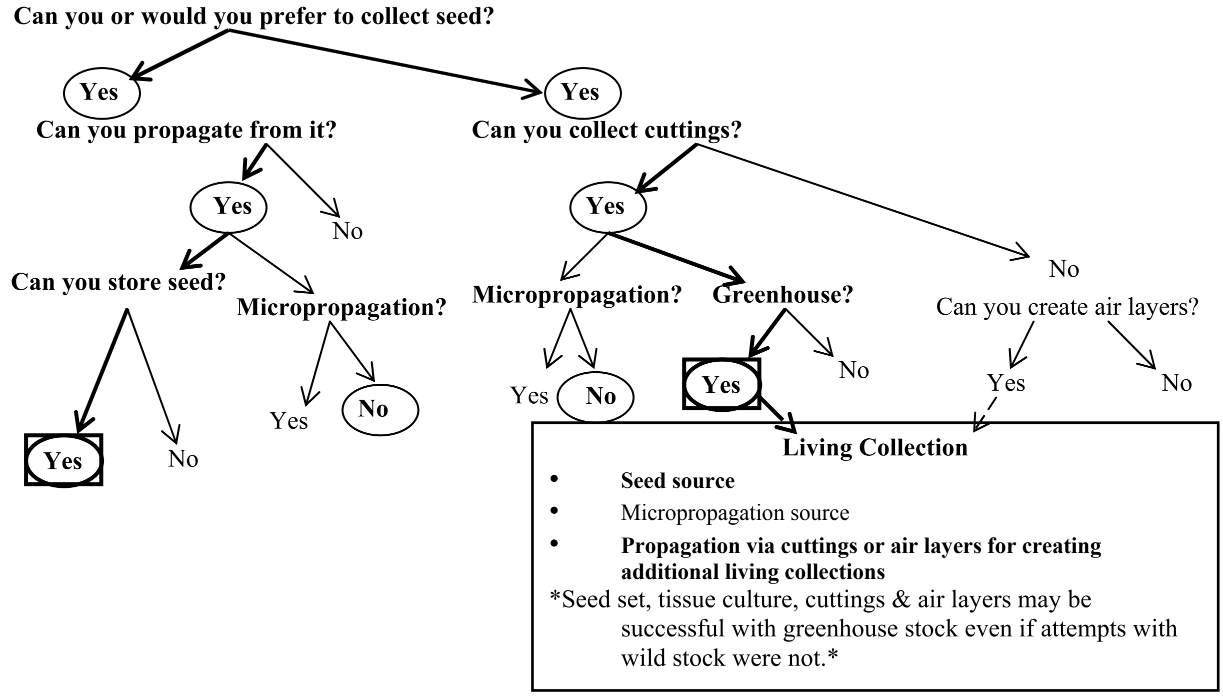
TaxonName: Melanthera tenuifolia **TaxonCode: MelTen**

Population Unit Name	Management Designation	Current Mature (Wild)	Current Immature (Wild)	Current Seedling (Wild)	Current Augmented Mature	Current Augmented Immature	Current Augmented Seedling	NRS Mature 2006	NRS Immature 2006	NRS Seedling 2006	Total Mature	Total Immature	Total Seedling	Population Trend Notes
Kamaileunu and Waianae Kai	Manage for stability	881	269	297	0	0	0	880	269	297	**881**	**269**	**297**	Changes caused by small fluctuations in portions of the PU
Mt. Kaala NAR	Manage for stability	300	0	0	0	0	0	300	0	0	**300**	**0**	**0**	No monitoring in the last year
	Total for Taxon:	1181	269	297	0	0	0	1180	269	297	**1181**	**269**	**297**	

Propagation and Genetic Storage

1) At this time, what is the preferred propagation technique?	2) At this time, what is the preferred genetic storage technique?	3) Has a successful storage method been determined?	4) Are additional steps required for obtaining enough seed?
Cuttings	Living Collection & Seed	Yes	Yes, living collections

Prioritizing Genetic Storage & Propagation Techniques



Collection: refer to OARNP 2006

Propagation: refer to OARNP 2006.

Seed Storage: Germination and storage studies are ongoing. Seeds appear to have some type of physiological or morphophysiological dormancy. Seeds may take years to overcome dormancy when stored at conditions used to maximize longevity (cold and dry). Temperature is critical for overcoming dormancy. Freshly-collected seeds sown at average temperatures for their natural environment and then moved to low temperatures after six months germinate more than seeds exposed to any other treatment. These other treatments include low temperature exposure followed by average temperature exposure, high temperature exposure followed by average, and continual exposure to low, average, and high temperatures (Fig. 2.17.b). For every temperature regime, seeds were exposed to an average daily temperature in light and an average nightly temperature in dark. The length of light was determined based on the average natural sunrise and sunset times for each month of the experiment.

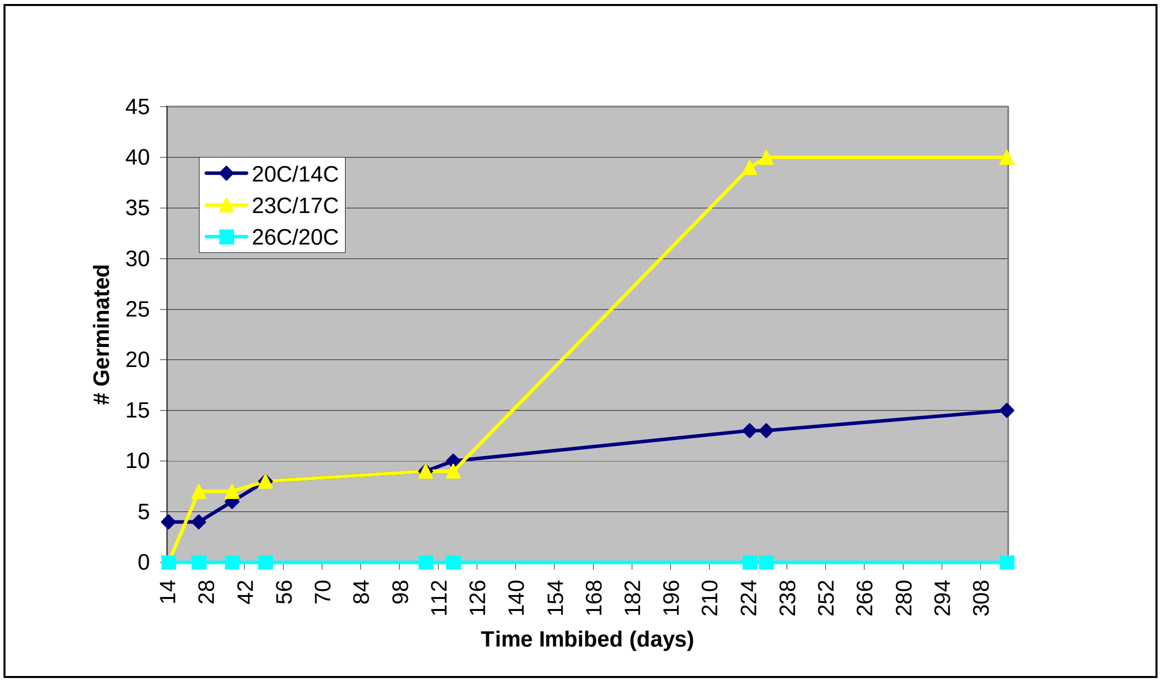


Figure 2.1.17b Germination at various temperature cycles of fresh seed of *Melanthera tenuifolia*

Seeds that have been stored for five years have also been tested this year. For both of the stored collections, fresh germination was low (5% and 12%). After five years, seeds had an average germination of 37.3%. For the one collection, seeds were stored dry at both 24C and -18C. Seeds stored at 24C germinated more than seed stored at -18C (χ^2 = 10.702, P-Value = 0.001). This supports the dormancy hypotheses, as seeds that are aging faster (by remaining at 24C) would be more likely to have come out of dormancy earlier than seeds stored at -18C (Fig. 2.1.17c).

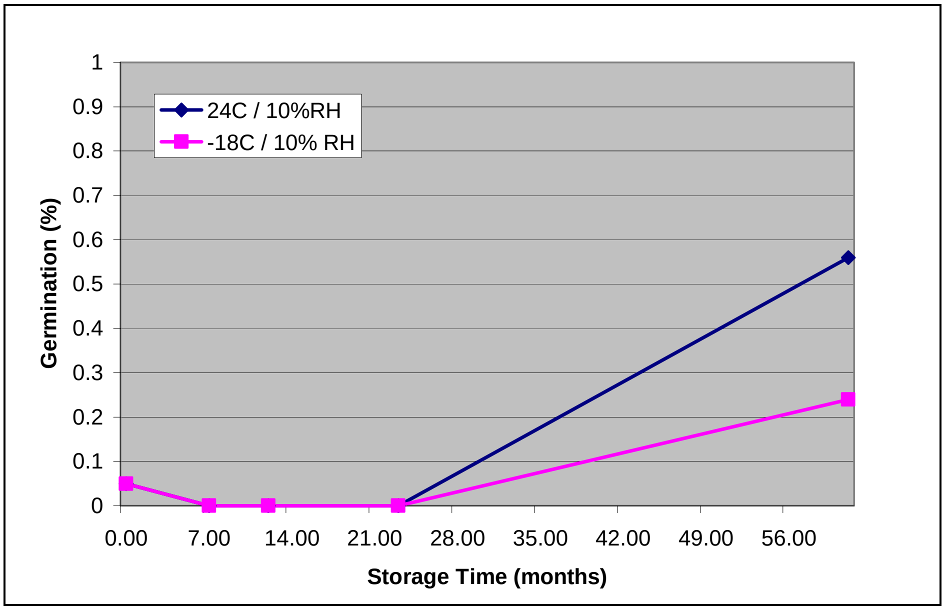


Figure 2.1.17c Percent germination over time stored in *Melanthera tenuifolia*

Genetic Storage: Preliminary results from ongoing germination and storage trials suggest that seeds of this taxon have good storage potential. If this holds true, seed collections from clonal stock in the Army Nursery will be made to meet genetic storage goals. Plants from the most fire-threatened PUs will be collected from first, and plants will be isolated and allowed to self or cross with stock in their PU.

In the next year NRS will revisit high fire threat PUs (Kahanahāiki, Kaluakauila and ʻŌhikilolo Makai portion of the ʻŌhikilolo PU) to collect more cutting for living collections as presently there is not adequate stock from these PUs. NRS will work to secure 35 individuals with two representatives from each plant in living collection.

Table 2.1.17b Genetic Storage Summary

Population Unit Name	# of Potential Founders: Current Mature	Current Imm.	NumWild Dead	Partial Storage Status: # Plants >= 10 in Seedbank	# Plants >=1 Microprop	# Plants >=1 Army Nursery	Storage Goals Met: # Plants that Met Goal
Melanthera tenuifolia							
Kahanahaiki	54	23	4	11	0	35	10
Kaluakauila	64	20	0	8	0	10	2
Kamaileunu and Waianae Kai	881	269	0	0	0	0	0
Keawaula	45	15	0	0	0	0	0
Mt. Kaala NAR	300	0	0	0	0	0	0
Ohikilolo	1242	1	11	16	0	18	14
				Total # Plants w/ >=10 Seeds in Seedbank	**Total # Plants w/ >=1 Microprop**	**Total # Plants w/ >=1 Army Nursery**	**Total # Plants that Met Goal**
				35	0	63	26

Outplanting Issues
NRS have not attempted to reintroduce this taxon into a wild site and do not expect that augmentations will be necessary to achieve stability at any of the three selected populations.

Research Issues
NRS plan to work with a graduate student at the University of Hawaii to continue seed propagation studies designed to determine the best germination method. Once established, the storage potential can be tested.

Taxon Threats
Other than fire, no additional threats have been noted in the last year.

Population Unit Level Discussion

Table 2.1.17c Population Unit Threat Control Summary

Action Area: In

TaxonName: Melanthera tenuifolia

PopulationUnitName	ManagementDesignation	Protected from Ungulates	Weeds Managed	Rats Controlled
Kahanahaiki	Genetic Storage	No	No	No
Kaluakauila	Genetic Storage	Yes	Partial	No
Keawaula	Genetic Storage	No	No	No
Ohikilolo	Manage for stability	Yes	No	No

Action Area: Out

TaxonName: Melanthera tenuifolia

PopulationUnitName	ManagementDesignation	Protected from Ungulates	Weeds Managed	Rats Controlled
Kamaileunu and Waianae Kai	Manage for stability	No	No	No
Mt. Kaala NAR	Manage for stability	Partial	No	No

Manage for Stability PUs

‘Ōhikilolo: NRS do not monitor the majority of this PU regularly because of its size and the need for rappelling to access populations. NRS monitor sites within the PU when monitoring more critically endangered sites of other taxa (*H. parvula*, *S. mariversa* and *V. chamissoniana*). If NRS saw new threats or unexpected declines in these sites then larger monitoring efforts would be initiated. NRS will strive to monitor a sample of sites within the PU every 3-5 years. Although most plants occur along tall cliff faces in the middle of ‘Ōhikilolo Ridge, the ‘Ōhikilolo Makai site is part of the same PU. It is at 400 ft. in elevation and less than 300 meters from the ocean. This site faces distinct challenges from fire, small population and habitat size and has extremely harsh conditions relative to the rest of the PU. NRS have committed significant resources to the *in situ* protection of this site and to creating an *ex situ* living collection. In the next year, NRS will revisit the site for monitoring and collect cuttings as needed to establish new founders.

Kamaile‘unu and Wai‘anae Kai: One population site with about 63 individuals was protected from ungulates this year with the completion of fencing in August 2007. In addition, the construction of fencing around a *S. mariversa* in the Pu’u Kawiwi vicinity also protected additional individuals.

Mt. Ka‘ala NAR: The Kaukonahua fire of August 2007 burned extensive areas below this population (Appendix II). This event may have driven ungulates into this PU. NRS will monitor the area in the next year and respond if ungulate control is necessary.

Other PUs

Kahanahāiki: There have been no additional actions in the last year. NRS will visit this PU in the next year monitor and collect to add founders to the living collection.

Kaluakauila: There have been no additional actions in the last year. NRS will visit this PU in the next year monitor and collect to add founders to the living collection.

Keawaʻula: NRS monitored this PU in September 2004 and estimated that there were more than 45 mature plants. This PU was burned in the July 2006 Keawaʻula fire (OANRP 2006). In the coming year, NRS will monitor this PU and collect for genetic storage as it is at perhaps the highest risk of extirpation due to fire as compared to other PUs. This PU is now in the AA as it has been redefined due to a re-evaluation of the fuels and fire risk.

2.1.18 *Neraudia angulata*

Requirements for Stability

- 4 Population Units (PUs)
- 100 reproducing individuals in each Manage for Stability PU (short-lived perennial, mostly dioecious, prone to large declines or fluctuations in population size)
- Stable population structure
- Threats controlled
- Complete genetic representation of all PUs in storage
- Expedited Stabilization (10 years)

How many of the 4 MFS PUs have stable numbers of mature individuals?	How many of the 4 MFS PUs have had *in situ* recruitment?	How many of the 4 MFS PUs have full genetic storage?	How many of the 4 MFS PUs are protected from ungulates?	How many MFS PUs that need reintroductions have been initiated?
0/4	2/4	0/4	2/4	2/3

Taxon Level Discussion

There are four PUs designated 'MFS' that represent the full geographic and morphological scope of this taxon. Known locations of the two *Neraudia* varieties show significant morphological differences. See the MIP Stabilization Plan for a more detailed discussion of morphological distinctions between the two varieties, locations of varieties and intermediate plants, and results from genetic analyses. Briefly, most PUs contain plants that trend toward var. *angulata* or an intermediate form. For example, the Mākua and Wai'anae Kai Makai sites have plants that are considered var. *angulata*. The Wai'anae Kai Mauka site has intermediate plants. The PUs with var. *dentata* plants are the most imperiled. The PUs with the var. *dentata* are Punapōhaku, Manuwai, and Kapuna. These var. *dentata* sites have low numbers of plants and the heavily degraded habitat continues to be severely impacted by ungulates. Stock from these three sites will be represented in two reintroductions in the much less degraded Kaluakauila MU.

Both the Wai'anae and the Mākua PUs have a relatively large total number of plants (see table below), but also contain many small sites that require genetic storage. Collections have focused on establishing cuttings from the smallest PUs for living collections in the nursery. In the last year, NRS continued collecting from the Kapuna, Wai'anae Kai Mauka, and Mākaha PUs. These collections will produce seed stock for genetic storage as well as storage research. *Neraudia* has been outplanted with initial high survivorship at two sites (Mākua and Kaluakauila) and natural recruitment from reintroductions occurred at Mākua in two instances. Ungulate and weed control is ongoing at some sites. Fire remains a significant threat for both large and small PUs.

This species is slated for Expedited Stabilization (see the Executive Summary for more details. The expedited stabilization goals for *Neraudia* are:

- Manage 4 *in situ* PUs.
- Attain numerical stability at 3 PUs outside the Action Area.
- Initiate reintroduction in one PU outside of the Action Area.

- Fence construction at the Wai‘anae Kai and Manuwai PUs.
- Weed control, additional fire management, and plant monitoring must be ongoing.
- Any cooperative agreements needed to conduct management must be completed.

Major Highlights/Issues Year 3

- Another F_1 mature plant was observed at one augmentation site in the Mākua PU.
- Collections have been established (but not completed) from all PUs in the last year for a living collection in the greenhouse.
- The sole Punapōhaku plant thought to be functionally male produced fruit this past year (hence the plant is polygamodioecious).
- A new reintroduction site at the Lower Kaluakauila patch was established using Manuwai stock.
- One additional wild plant was found at a new location in the Mākaha PU (Kamaili Gulch).
- Seed was produced and germinated from crosses using pollen stored for one year.
- Manuwai Gulch burned in the August 2007 Kaukonohua fire.

Plans for Year 4

- Continue collecting from wild populations in order to meet expedited stabilization goals.
- Continue monitoring wild and outplanted plants to guide reintroduction plans and gather further information about life histories, reproductive strategies, and habitat requirements.
- Continue to supplement the Kaluakauila PU with var. *dentata* stock from Punapōhaku Manuwai, and Kapuna PUs at two separate sites.
- Continue to augment the Mākua PU with stock established from cuttings to help meet stabilization goals.
- Pursue the ungulate control plans proposed to the State for the Wai‘anae Kai Mauka PU.
- Continue pursuing discussions with the State for fencing at the Manuwai MFS PU in order to manage a reintroduction for stability site in Manuwai or decide on another MFS PU elsewhere.
- Re-start fire pre-suppression work at Kaluakauila.

Table 2.1.18a Taxon Status Summary

Action Area: In

TaxonName: Neraudia angulata **TaxonCode: NerAng**

Population Unit Name	Management Designation	Current Mature (Wild)	Current Immature (Wild)	Current Seedling (Wild)	Current Augmented Mature	Current Augmented Immature	Current Augmented Seedling	NRS Mature 2006	NRS Immature 2006	NRS Seedling 2006	Total Mature	Total Immature	Total Seedling	Population Trend Notes
Kapuna	Genetic Storage	2	0	0	0	0	0	2	0	0	**2**	**0**	**0**	Monitoring showed no change in the last year.
Makua	Manage for stability	33	5	6	4	0	0	44	6	0	**37**	**5**	**6**	Monitoring showed seedlings replacing dead mature plants.
Punapohaku	Genetic Storage	1	0	0	0	0	0	1	0	0	**1**	**0**	**0**	Monitoring showed no change in the last year.
	Total for Taxon:	36	5	6	4	0	0	47	6	0	**40**	**5**	**6**	

Action Area: Out

TaxonName: Neraudia angulata **TaxonCode: NerAng**

Population Unit Name	Management Designation	Current Mature (Wild)	Current Immature (Wild)	Current Seedling (Wild)	Current Augmented Mature	Current Augmented Immature	Current Augmented Seedling	NRS Mature 2006	NRS Immature 2006	NRS Seedling 2006	Total Mature	Total Immature	Total Seedling	Population Trend Notes
Halona	Genetic Storage	30	4	0	0	0	0	30	4	0	**30**	**4**	**0**	No monitoring in the last year (last obs. 2005).
Leeward Puu Kaua	Genetic Storage	9	0	0	0	0	0	4	0	0	**9**	**0**	**0**	No monitoring in the last year (last obs. 2005).
Makaha	Genetic Storage	10	0	0	0	0	0	16	1	0	**10**	**0**	**0**	3 new plants found, 9 matures died, population declined somewhat from 2005, and significantly declined since 1999 when 80 plants observed with numerous seedlings.
Manuwai	Manage for stability	0	0	0	0	0	0	0	0	0	**0**	**0**	**0**	Monitoring did not detect any new plants.
Waianae Kai Makai	Genetic Storage	46	35	25	0	0	0	46	35	25	**46**	**35**	**25**	Possible decline in matures, non-thorough bino monitoring detected less plants this year.
Waianae Kai Mauka	Manage for stability	57	29	54	0	0	0	57	28	54	**57**	**29**	**54**	Possible decline in matures, more thorough census needed to detect all individuals.
	Total for Taxon:	152	68	79	0	0	0	153	68	79	**152**	**68**	**79**	

Table 2.1.18a Taxon Status Summary

Action Area: Reintro

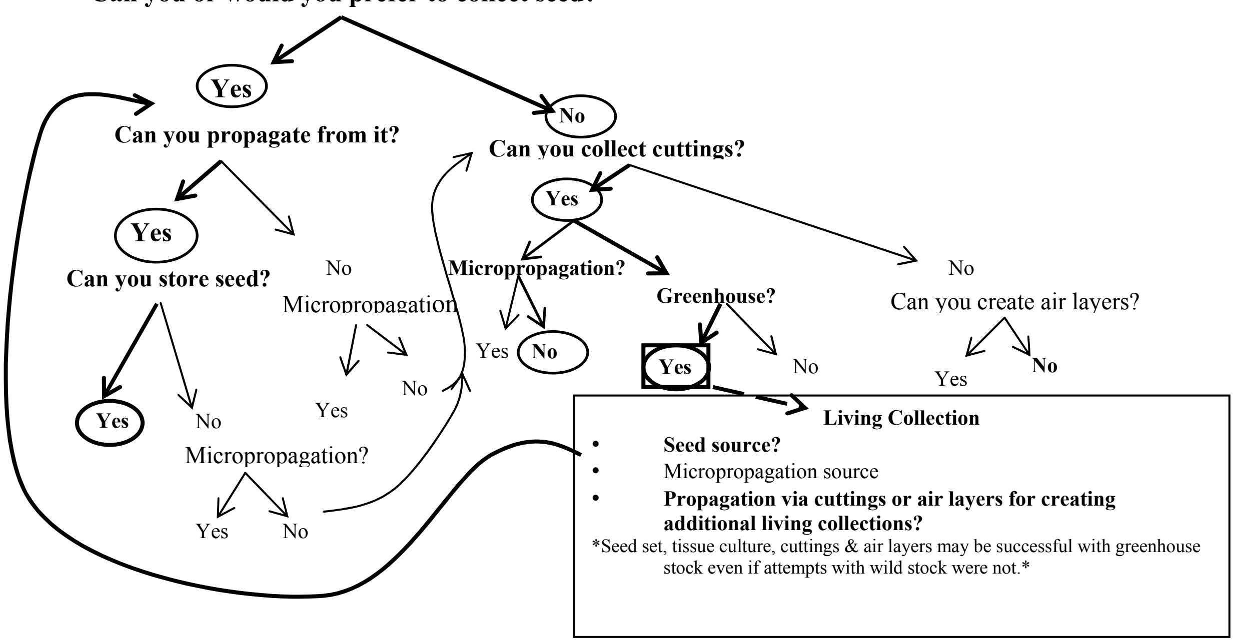
TaxonName: Neraudia angulata TaxonCode: NerAng

Population Unit Name	Management Designation	Current Mature (Wild)	Current Immature (Wild)	Current Seedling (Wild)	Current Augmented Mature	Current Augmented Immature	Current Augmented Seedling	NRS Mature 2006	NRS Immature 2006	NRS Seedling 2006	Total Mature	Total Immature	Total Seedling	Population Trend Notes
Kaluakauila	Manage reintroduction for stability	0	0	0	44	9	0	27	0	0	**44**	**9**	**0**	Additional plants were reintroduced into the Upper fence and new population reintroduced into Lower Fence.
	Total for Taxon:	0	0	0	44	9	0	27	0	0	**44**	**9**	**0**	

Propagation & Genetic Storage

1) At this time, what is the preferred propagation technique?	2) At this time, what is the preferred genetic storage technique?	3) Has a successful storage method been determined?	4) Are additional steps required for obtaining enough seed?
Cuttings	Living Collections & Seed	Yes	Yes, living collections, possibly including cross pollinations

Prioritizing Genetic Storage & Propagation Techniques



Collection: refer to OANRP 2006.

Propagation: refer to OANRP 2006.

Seed Storage Research: Recent storage tests support the hypothesis that seeds of this taxon possess a significant physiological or morphophysiological dormancy. Results from viability tests after two years of dry storage at 24C, 4C, and -18C show that seeds have the highest germination at the highest temperature (24C), and the lowest germination at the coldest temperature, -18C. This trend is typically displayed in dormant seeds, as seeds at higher temperature will age faster and come out of dormancy before seeds aging slower at lower temperatures. Future viability tests need to show a slow reversal of this phenomenon to support this hypothesis, where seeds stored at higher temperatures will slowly begin to die and decrease in germination.

Genetic Storage: Based on the above results, NRS will continue to use seed storage as a genetic storage option in addition to living collections. An additional founder was collected from the Kapuna PU and has been established in the living collection in the greenhouse. Stored and fresh pollen from the Punapōhaku male will be used to pollinate this stock to secure seeds in storage as has already been done for the stock of the other Kapuna female. NRS has continued viability testing of stored pollen this year by hand pollinating Kapuna stock with Punapōhaku pollen that had been stored dry at -18C for one year. Seed set was not high but seeds were produced and are currently being propagated (seeds take at least six months to germinate). The seed that developed last year from Kapuna flowers pollinated by fresh using fresh Punapōhaku pollen has germinated and the plants are growing in the greenhouse. Leaves are dentate (see Figure.2.1.18a). Plants in Kapuna and Punapōhaku remain the only known var. *dentata* individuals.

Left: leaf dentation. Right: Progeny compared to Manuwai stock.
Figure 2.1.18a Progeny of Kapuna x Punapōhaku (Manuwai stock is var. *anulata*)

Table 2.1.18b Genetic Storage Summary

Population Unit Name	# of Potential Founders: Current Mature	Current Imm.	NumWild Dead	Partial Storage Status: # Plants >= 10 in Seedbank	# Plants >=1 Microprop	# Plants >=1 Army Nursery	Storage Goals Met: # Plants that Met Goal
Neraudia angulata							
Halona	30	4	0	0	0	12	6
Kapuna	2	0	0	1	0	2	1
Leeward Puu Kaua	9	0	0	0	0	1	0
Makaha	10	0	7	2	0	6	1
Makua	33	5	50	0	0	27	2
Manuwai	0	0	4	0	0	2	1
Punapohaku	1	0	0	0	0	1	0
Waianae Kai Makai	46	35	0	0	0	0	0
Waianae Kai Mauka	57	29	1	0	0	4	3
				Total # Plants w/ >=10 Seeds in Seedbank	**Total # Plants w/ >=1 Microprop**	**Total # Plants w/ >=1 Army Nursery**	**Total # Plants that Met Goal**
				3	0	55	14

Unique Species Observations

Based on observations in the field and in the nursery over the past several years, individuals of this species asynchronously produce either male or female flowers throughout their lifespan, but infrequently produce perfect flowers (and be monecious) particularly as the plant ages and is able to produce more flowers over longer intervals. Another endangered Hawaiian Urticacea species, *Urera kaalae* similarly produces only male or female flowers at first maturity, but as it ages, produces both male and female inflorescences but asynchronously.

Both the Kapuna and Punapōhaku plants were observed this past year with immature fruit confirming the potential for an individual plant to have both male and female flowers (and be monecious). This is the first instance of fruiting at the Punapōhaku site since monitoring began in 2005 as all previous observations noted only male flowers. It remains unclear whether this is a common occurrence given the low number of extant plants and the difficulty of regularly monitoring wild populations. Plants at the Army Nursery also produced both male and female flowers in succession. By recording the sex of all monitored plants over time, NRS hopes to clarify this relationship between plant age and degree of dioeciousness.

Outplanting Issues

NRS will continue to monitor all PUs to determine if larger populations are necessary to increase chances of pollination between functionally dioecious plants. Stock may come from seeds to overcome the problem of clones remaining functionally male or female. Reintroduced populations will hopefully have more outcrossing opportunities if more equal ratios of male and female plants are present and plants are planted in close proximity.

Outplantings at Mākua in 2005 were browsed by rats and it appears that this was an isolated incident. More recently, outplantings at the upper Kaluakauila patch were damaged by black twig borer (BTB) beetles. The current drought likely weakened the plants making them more susceptible to predation and disease. Survivorship at Kaluakauila in both the upper and lower patches is still 88% with 77 % plants of moderate to healthy vigor. This is the first instance that BTB damage was observed for this species. However other Hawaiian Urticaceae species (e.g. *Pipturus albidus*) regularly face BTB attacks and so the damage to *Neraudia* is not that surprising. See Chapter 5.1 BTB for an update on NRS research.

Research Issues

NRS will continue to monitor the reproductive biology of this taxon in order to determine the appropriate number of plants for stable, naturally recruiting reintroduction sites. As mentioned previously, black twig borer control efforts remain at the research stage (see Chapter 5.1 BTB for more details).

Surveys

NRS staff found one additional individual at Mākaha Valley in the course of three surveys in Mākaha this past year. More surveys in the Mākaha and Keawaʻula areas will be planned in the coming year as time permits. NRS will also continue to survey around known populations for additional plants during regular monitoring.

Table 2.1.18c Founders Represented in Outplantings

TaxonName: Neraudia angulata **TaxonCode: NerAng**

Total Num Plants based upon Plants that have been numbered

PopulationUnitName	Management Designation	Number of Founders	Number of Founders Represented
Halona	Genetic Storage	34	0
Kaluakauila	Manage reintroduction for stability	0	0
Kapuna	Genetic Storage	2	1
Leeward Puu Kaua	Genetic Storage	9	0
Makaha	Genetic Storage	17	0
Makua	Manage for stability	88	3
Manuwai	Manage for stability	4	2
Punapohaku	Genetic Storage	1	0
Waianae Kai Makai	Genetic Storage	81	0
Waianae Kai Mauka	Manage for stability	87	0
	Total for Taxon:	**323**	**6**

Number of Founders = Number of Mature, Immature, and Dead founder plants.
Number of Founders Represented = Number of founder plants represented in reintroductions.

As mentioned previously, Manuwai and Kapuna stock are represented at the Kaluakauila reintroduction. 45% of the founders from PUs designated as genetic storage will not be represented in outplantings. At the Mākua MFS PU a larger number of founders was previously represented in outplantings. These plants have since senesced given the short life span of this species and only three founders are currently represented. Another larger outplanting at Mākua is planned for the coming year to again represent a much larger percentage of the 88 founders. At the Wai‘anae Kai Mauka MFS PU, *in situ* management as opposed to reintroductions will be the focus once the area is fenced.

Taxon Threats

As mentioned in the outplanting issues section above, black twig borer damage can significantly affect this species, particularly in drought years.

Fire remains a major threat to all of the PUs. The Mākua and Kaluakauila PUs were again threatened by nearby fires this past summer and the Manuwai gulch area burned in the large Kaukonahua fire (see Appendix for fire reports).

Population Unit Level Discussion

Manage for Stability PUs

Mākua: Since March 2005, two strategic fences protected the area with the largest amount of plants from pigs. NRS continues to monitor and collect from the wild sites and inspect the fence.

As mentioned previously, on site recruitment was again observed this year at the augmentation site presumably from an outplanted individual. Given the relatively short lifespan of outplants, establishing larger outplanted populations and multiple plantings will likely be necessary to obtain recruitment. Additionally, planting younger (but still hardy enough) plants may also be required to ensure the longest reproductive period possible at outplanting sites.

Table 2.1.18d Population Unit Threat Control Summary

Action Area: In

TaxonName: Neraudia angulata

PopulationUnitName	ManagementDesignation	Protected from Ungulates	Weeds Managed	Rats Controlled
Kapuna	Genetic Storage	Yes	No	No
Makua	Manage for stability	Yes	Partial	No
Punapohaku	Genetic Storage	No	No	No

Action Area: Out

TaxonName: Neraudia angulata

PopulationUnitName	ManagementDesignation	Protected from Ungulates	Weeds Managed	Rats Controlled
Halona	Genetic Storage	No	No	No
Leeward Puu Kaua	Genetic Storage	No	No	No
Makaha	Genetic Storage	Partial	No	No
Manuwai	Manage for stability	No	No	No
Waianae Kai Makai	Genetic Storage	Partial	Partial	No
Waianae Kai Mauka	Manage for stability	Partial	No	No

Action Area: Reintro

TaxonName: Neraudia angulata

PopulationUnitName	ManagementDesignation	Protected from Ungulates	Weeds Managed	Rats Controlled
Kaluakauila	Manage reintroduction for stability	Yes	Yes	Yes

Kaluakauila: The Kaluakauila MU currently contains two reintroduction sites. The Upper Kaluakauila patch was founded with stock from the Kapuna PU and was supplemented again this past year using Kapuna stock. The goal for this site is 105 plants with equal founder and gender representation. 38 plants are currently at the Upper Kaluakauila patch (see Table 2.1.18e). Stock from the other Kapuna plant as well as the Punapōhaku individual remains to be planted at the upper patch.

Since the first outplantings in 2003, survivorship of outplants has been high at Kaluakauila (88% as of August 2007). 53 mature plants currently remain on site out of a total of 61 individuals planted. Plants have been observed with mature fruit, but no recruitment has been noted. NRS will continue to observe plants to determine the sex of individual plants and how often viable seed is produced.

This past year a new reintroduction site was established in the Lower Kaluakauila patch using 17 plants propagated from Manuwai population stock. 14 plants remain from this initial planting effort, of which seven plants are females and five plants are males (two plants could not be sexed as they were not reproductive).This is an important reintroduction as the Manuwai plants have all died in the wild. This reintroduction at the lower patch will eventually contain 100 plants. Rugged terrain between the first site and the new second site effectively separates these two reintroductions. Reproductive isolation between the two sites is intended to keep the Manuwai var. *dentata* stock separate as it is morphologically distinct.

Table 2.1.18e Reintroduction Plan for Kaluakauila PU

Site	Founding PU	# of founders in each PU	Target # of plants from each founder	Target # of outplants	Existing # of plants from founders	Type of stock used for outplantings
Upper Kaluakauila	Kapuna Punapōhaku	2 1	35,35 35	105	38,0 0	Cuttings Cuttings
Lower Kaluakauila	Manuwai	4	25	100	14,0,0,0	Cuttings

Waiʻanae Kai Mauka: Collections and monitoring continued at this population this past year. Collections are largely complete. NRS will continue to monitor and collect from unrepresented individuals in the coming year and a more thorough census is needed at this PU. A fence will be built pending approval of a proposal submitted to the State in 2004. Goat control in the area is planned for the coming year.

Manuwai: In just three years the number of plants at this site went from 11 mature individuals and one juvenile to zero because of ungulates. 12 plants were first found in March 2003 during surveys of the Mokulēʻia Forest Reserve. No plants were found as of August 2007. Fortunately, propagules were collected during a monitoring visit and are being grown at the Army Nursery. These Manuwai plants were cloned and planted into the Lower Kaluakauila site (see Kaluakauila PU discussion above). NRS will continue to monitor for regeneration at the extirpated Manuwai wild site in the coming year.

A portion of Manuwai Gulch burned in the August 2007 Kaukonahua fire (See Appendix for fire reports). Despite the recent fire, proposals for large and small fences are still planned for this area. But given the extirpation of all plants at the Manuwai site, NRS question whether this PU should remain a MFS PU given the reluctance of State officials to agree to fencing in this area. For the coming year, NRS will continue planting Manuwai stock at Kaluakauila (as well as keep it in living collections). NRS will also continue pursuing fencing at Manuwai for the eventual reintroduction of this taxon to the area. Unless more plants are found at Manuwai, this will be the second site where this taxon will be managed as a reintroduced population.

Other PUs

Punapōhaku : Discovered in 2005, this site has only one plant (var. *dentata)*. Stock has been secured from this plant and will be used in the Kaluakauila reintroduction as discussed above. No other management is planned for this site other than weeding around the plant and regular monitoring.

Kapuna: Discovered in 2000, this site currently has two plants, both var. *dentata*.. The site was severely degraded and dominated by weeds when first found. Both founders will be used to supplement the Kaluakauila reintroduction. The goal is to represent this PU in a reintroduction site that is equally mixed with the Punapōhaku PU (see Kaluakauila PU discussion above).

Mākaha: Plants at the larger population were monitored this past year, but no collections were made. Three surveys were done in the adjacent Kamaili Gulch and one individual was found and collected from. Unfortunately the collection did not survive in the greenhouse and the wild plant has since died. Additional surveys done in the course of other work may locate other individuals.

Leeward Pu‘u Kaua: NRS did not visit this PU in the past year. The only population of feral goats in the southern leeward Wai‘anae Mountains occurs threatens these plants and NRS will be working with the Navy and State agencies to control this growing goat population in the coming year. NRS will continue to maintain the living collection, monitor the second remaining historical site in the PU, and hopefully complete collections from this site to meet genetic storage goals. Unfortunately, the plants at this site are very difficult to reach and complete collection may not be possible.

Hālona: NRS did not visit this PU in the past year. NRS hope to visit the three sites in Halona area in the coming year in order to make progress on meeting genetic storage goals.

Wai‘anae Kai Makai: This PU was monitored this past year and no major changes in population size or distribution was noted. Fencing plans to exclude pigs and goats were submitted to the DLNR and NRS is awaiting approval. A few large *Casuarina glauca* and *Grevillea robusta* trees were removed from this area two years ago. NRS will continue to monitor these sites, control a few large invasive trees and work with DLNR to fence this gulch. Genetic storage collections will begin in the next year in order to establish a small living collection. Accessibility is difficult at this PU as nearly all the plants are on a nearly vertical cliff. This population is largely secure from ungulates with a relatively intact cliff habitat. It provides an important reference site when planning reintroductions outside of the Action Area. This large, population is not designated MFS because the same area is already a MFS designated PU for *Nototrichium humile*.

2.1.19 *Nototrichium humile*

Requirements for Stability

- 4 Population Units (PUs)
- 25 reproducing individuals in each PU (long-lived perennial)
- Stable population structure
- Threats controlled
- Complete genetic representation in storage of all PUs

How many of the 4 MFS PUs have stable numbers of mature individuals?	How many of the 4 MFS PUs have had *in situ* recruitment?	How many of the 4 MFS PUs have full genetic storage?	How many of the 4 MFS PUs are protected from ungulates?	How many of the MFS PUs that need reintroductions have been initiated?
4/4	1/4	0/4	1/4	N/A

Taxon Level Discussion

There are a total of 13 *Nototrichium humile* PUs known. Four PUs are designated as ‘Manage for Stability’ because this taxon is highly threatened by fire from Army training in Mākua. Two MFS populations are off-site and two are within the Action Area (AA). Each of these four PUs has stable population numbers of mature plants, but ungulates remain a threat in three of the four PUs. At this time genetic storage is done by establishing collections from cuttings of wild plants. Most of these collections are currently kept in the greenhouse, however a more long-term *inter-situ* or *ex-situ* site must be determined. NRS will continue to pursue a relationship with OHA to determine suitable *inter-situ* sites at the Waimea Audubon Center.

Major Highlights/Issues Year 3

- Conducted a post-fire assessment of the Keawaʻula PU. The July, 2006 fire came within 20 meters of the population but the plants were not impacted.
- A large fire burned a portion of the Kaimuhole and Palikea Gulch PU in August 2007. After an initial survey it appears that the fire burned a small patch of *N. humile* in the lower portion of Palikea, but did not affect the plants in the other areas.
- Collections were made from the Kahanahāʻiki PU.

Plans for Year 4

- Conduct a thorough census of the population structure in the four MFS PUs.
- Continue to establish plants from small and fire threatened PUs in living collections at WBG and other similar sites. These will be used to observe flowering and fruit production in order to guide future collection and storage plans.
- Resubmit the ungulate control plans to the State for the Waiʻanae Kai PU.
- NRS will strive to visit the remaining small PUs that have not been monitored recently and take cuttings to establish a living collection.
- Determine feasibility of seed collection and storage using living collections.

Table 2.1.19a Taxon Status Summary

Action Area: In

TaxonName: Nototrichium humile **TaxonCode: NotHum**

Population Unit Name	Management Designation	Current Mature (Wild)	Current Immature (Wild)	Current Seedling (Wild)	Current Augmented Mature	Current Augmented Immature	Current Augmented Seedling	NRS Mature 2006	NRS Immature 2006	NRS Seedling 2006	Total Mature	Total Immature	Total Seedling	Population Trend Notes
Kahanahaiki	Genetic Storage	67	10	0	0	0	0	70	4	0	**67**	**10**	**0**	A thorough census found a change in population structure with more immat and less mat
Kaluakauila	Manage for stability	198	35	0	0	0	0	198	35	0	**198**	**35**	**0**	No monitoring in the last year.
Keaau	Genetic Storage	21	31	0	0	0	0	21	31	0	**21**	**31**	**0**	No monitoring in the last year.
Keawaula	Genetic Storage	138	5	0	0	0	0	138	5	0	**138**	**5**	**0**	No monitoring in the last year.
Makua (East rim)	Genetic Storage	0	0	0	0	0	0	0	0	0	**0**	**0**	**0**	No monitoring in the last year.
Makua (south side)	Manage for stability	56	1	0	16	0	0	72	1	0	**72**	**1**	**0**	Monotoring shows no change in the last year
Punapohaku	Genetic Storage	302	14	7	0	0	0	302	14	7	**302**	**14**	**7**	No monitoring in the last year.
	Total for Taxon:	782	96	7	16	0	0	801	90	7	**798**	**96**	**7**	

Action Area: Out

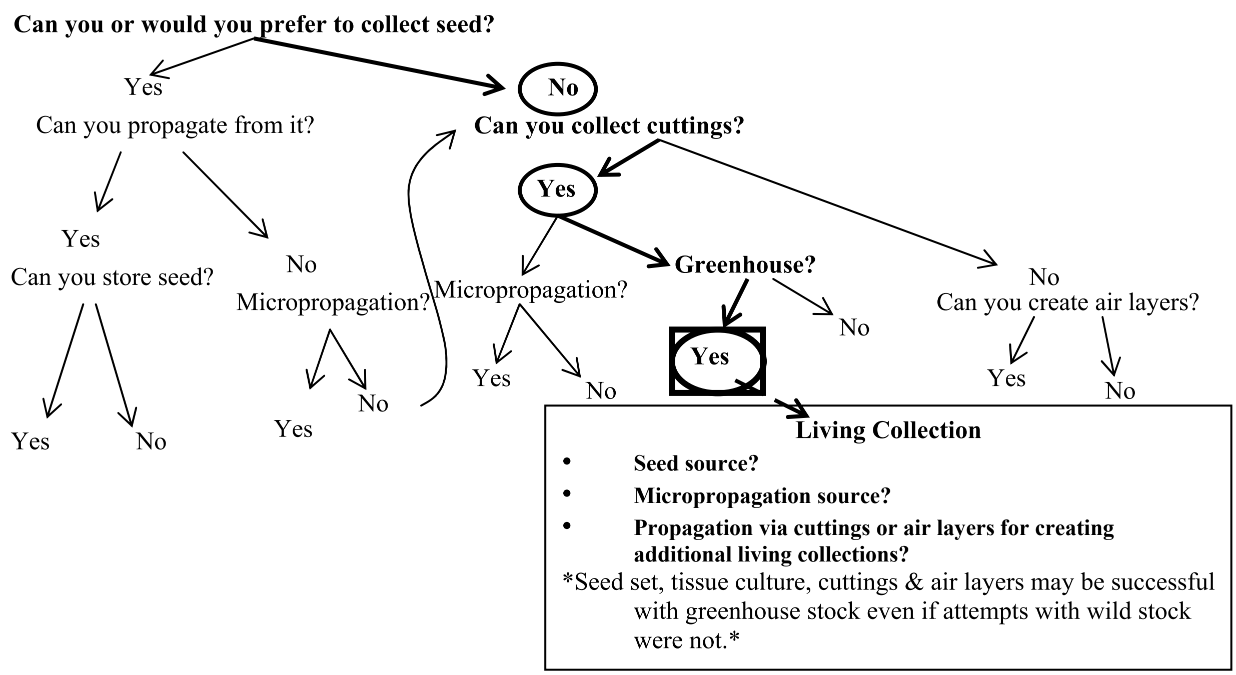
TaxonName: Nototrichium humile **TaxonCode: NotHum**

Population Unit Name	Management Designation	Current Mature (Wild)	Current Immature (Wild)	Current Seedling (Wild)	Current Augmented Mature	Current Augmented Immature	Current Augmented Seedling	NRS Mature 2006	NRS Immature 2006	NRS Seedling 2006	Total Mature	Total Immature	Total Seedling	Population Trend Notes
Kaimuhole and Palikea Gulch (Kihakapu)	Manage for stability	51	4	0	0	0	0	58	7	0	**51**	**4**	**0**	Monitoring showed one site impacted by August 2007 fire
Keawapilau	Genetic Storage	5	0	0	0	0	0	5	0	0	**5**	**0**	**0**	No monitoring in the last year.
Kolekole (east side)	Genetic Storage	12	0	0	0	0	0	12	0	0	**12**	**0**	**0**	No monitoring in the last year.
Makaha	Genetic Storage	15	3	0	0	0	0	16	3	0	**15**	**3**	**0**	No monitoring in the last year.
Nanakuli	Genetic Storage	5	0	0	0	0	0	5	0	0	**5**	**0**	**0**	No monitoring in the last year.
Puu Kaua (Leeward side)	Genetic Storage	2	0	0	0	0	0	12	0	0	**2**	**0**	**0**	A thourough census showed a decline in numbers plants
Waianae Kai	Manage for stability	224	5	0	0	0	0	224	5	0	**224**	**5**	**0**	No monitoring in the last year.
	Total for Taxon:	314	12	0	0	0	0	332	15	0	**314**	**12**	**0**	

Propagation and Genetic Storage

1) At this time, what is the preferred propagation technique?	2) At this time, what is the preferred genetic storage technique?	3) Has a successful storage method been determined?	4) Are additional steps required for obtaining enough seed?
Cuttings	Living Collection	No	Yes, further pollination studies needed

Prioritizing Genetic Storage & Propagation Techniques



Collection: NRS will use living collections in the next year to investigate the dynamics of fruiting and collection possibilities.

Propagation: This taxon is propagated via cuttings. NRS have had an 80% success rate in propagating cuttings of this taxon.

Seed Storage Research: A collection in Pahole was made by the NAR Specialist in 2002 and stored refrigerated (4C, 15-35% RH) for five years until sown this year by NAR Horticulturist. Germination was high (20:25 seeds). This observation supports the hypothesis that seeds of this taxon will likely have good storage potential. The main obstacle faced by NRS is determining whether or not infructescences contain seed.

Genetic Storage: More cuttings were made from the fire threatened “C-Ridge” in the Kahanahā‘iki PU to increase living collection representation. The living collection for this stock is in the Army Nursery and Waimea Audubon Center. Stock in the nursery from all represented founders in this PU is currently being prepared for breeding system studies. All founders will be represented by at least two plants, one of which will be transplanted into large three to five gallon pots and brought to the baseyard. The study is scheduled to begin within the next six months.

Table 2.1.19b Genetic Storage Summary

Population Unit Name	# of Potential Founders: Current Mature	Current Imm.	NumWild Dead	Partial Storage Status: # Plants >= 10 in Seedbank	# Plants >=1 Microprop	# Plants >=1 Army Nursery	Storage Goals Met: # Plants that Met Goal
Nototrichium humile							
Kahanahaiki	67	10	1	5	0	13	5
Kaimuhole and Palikea Gulch (Kihakapu)	51	4	0	0	0	13	12
Kaluakauila	198	35	0	5	0	0	4
Keaau	21	31	0	0	0	0	0
Keawapilau	5	0	0	0	0	5	4
Keawaula	138	5	0	0	0	9	0
Kolekole (east side)	12	0	0	0	0	9	0
Makaha	15	3	0	0	0	0	0
Makua (East rim)	0	0	0	0	0	0	0
Makua (south side)	56	1	0	0	0	0	0
Nanakuli	5	0	0	0	0	0	0
Punapohaku	302	14	1	0	0	11	1
Puu Kaua (Leeward side)	2	0	0	0	0	0	0
Waianae Kai	224	5	0	0	0	5	4
				Total # Plants w/ >=10 Seeds in Seedbank	**Total # Plants w/ >=1 Microprop**	**Total # Plants w/ >=1 Army Nursery**	**Total # Plants that Met Goal**
				10	0	65	30

Unique Species Observations

There have been no new observations made in the last year.

Outplanting Issues

There have been no new outplanting issues in the last year. NRS has only conducted two outplanting with this species, one in Lower Mākua, and another at the Waimea Audubon Center. NRS visited the Mākua site last year and the plants are extremely vigorous. Should outplanting ever be needed, it appears it will be successful with this species.

Research Issues

This year NRS will use the living collections to research the breeding system of this taxon in order to determine more effective seed collection methods. The lack of on site recruitment in protected PUs remains problematic. More study is needed on pollination limitations, seed fate and seed viability. NRS hopes to have significant replacement levels of mature plants in the near future.

Surveys
There were no surveys conducted for this taxon in the last year.

Taxon Threats
Drought this year continues to stress smaller plants.

Population Unit Level Discussion

Table 2.1.19c Population Unit Threat Control Summary

Action Area: In

TaxonName: Nototrichium humile

PopulationUnitName	ManagementDesignation	Protected from Ungulates	Weeds Managed	Rats Controlled
Kahanahaiki	Genetic Storage	Partial	No	No
Kaluakauila	Manage for stability	Yes	Partial	Partial
Keaau	Genetic Storage	No	No	No
Keawaula	Genetic Storage	No	No	No
Makua (south side)	Manage for stability	Partial	Partial	No
Pahole Gulch	N/A	Yes	No	No
Punapohaku	Genetic Storage	No	No	No

Action Area: Out

TaxonName: Nototrichium humile

PopulationUnitName	ManagementDesignation	Protected from Ungulates	Weeds Managed	Rats Controlled
Kaimuhole and Palikea Gulch (Kihakapu)	Manage for stability	No	No	No
Kealia	Genetic Storage	No	No	No
Keawapilau	Genetic Storage	No	No	No
Kolekole (east side)	Genetic Storage	Partial	No	No
Makaha	Genetic Storage	No	No	No
Nanakuli	Genetic Storage	No	No	No
Puu Kaua (Leeward side)	Genetic Storage	No	No	No
Waianae Kai	Manage for stability	No	No	No

Manage for Stability PUs

Kaimuhole and Palikea Gulch: A fire in August, 2007 threatened this PU. After an initial survey it appears that the fire did not burn the Kaimuhole population, but did burn a small patch of ten plants in the lower portion of Palikea Gulch. Fortunately, it did not reach the large core population in the upper section of Palikea Gulch.

Kaluakauila: There was no additional monitoring of this PU in the last year. The population estimate is likely still too low and NRS will strive to amend this in the coming year. Because this PU is so large, it has not yet been a priority to establish a living collection of this stock. All known threats with the exception of fire are currently controlled in this PU.

Mākua (South Side): A comprehensive monitoring of all the gulches encompassed by this PU has never been conducted and the population estimate may be too low. Three strategic fences have been built to restrict pigs by blocking the openings to very deep and steep gulches. These fences protect at least 50 individuals. At one site, 16 of the 18 plants that were outplanted in 2003 to augment the site remain and are growing vigorously.

Wai‘anae Kai: There has been no revision of the population estimates for this PU after the largest site was monitored in 2005. There are likely many more small groups of plants in this PU that have not been observed. Collections have been secured from plants in this PU in the greenhouse. NRS has proposed to the State to build strategic fences in this PU and this is pending approval.

Other PUs

Kea‘au: No additional actions have been taken for this PU in the last year. Collection from this PU is scheduled for this coming year.

Keawa‘ula: NRS first visited this site in September 2004 and observed 138 mature and five immature trees. The forest patch around this population is almost completely surrounded by *Panicum maximum* and is shrinking with each successive fire. A fire in July, 2006, again surrounded the forest patch. On a subsequent visit, NRS did not observe any further reduction in habitat for this taxon (Figure 2.1.19.a) NRS have some genetic representation from this population. Fuel loading of *P. maximum* is the biggest threat to this site.

Mākua (East Rim): No additional actions have been taken for this PU in the last year. NRS plans to visit this PU in the coming year and make collections.

Kahanahā‘iki: NRS currently have 28 representatives from the unmanaged portion of this PU planted at Waimea Audubon Center. This year, NRS collected from an additional ten unrepresented plants from this site.

Punapōhaku: No additional actions have been taken for this PU in the last year. NRS have a small number of representatives from this population.

Figure 2.1.19a Keawaula PU after July 2006 burn showing the core area of *Nototrichium humile* in the middle of the patch surrounded by the black line and the area that burned surrounding the patch in white.

Keawapilau: NRS have established a living collection from all five plants at this site. No monitoring has been done in the last year.

Kolekole (East Side): No additional actions have been taken for this PU in the last year. NRS has collected cuttings from plants found within a small fenced portion of the PU.

Mākaha: No significant monitoring of this PU was done in the last year. A strategic fencing project is currently being planned to protect a site for other taxa. NRS is still trying to assess the most effective method of capturing the core area of this site.

Nānākuli: No additional actions have been taken for this PU in the last year. Collection from this PU is scheduled for this coming year.

Pu'u Kaua (Leeward side): NRS surveyed this PU in the past year and found a decline in population numbers from 12 plants to two.

2.1.20 *Phyllostegia kaalaensis*

Requirements for Stability

- 4 Population Units (PUs)
- 50 genetically unique, reproducing individuals in each PU (short-lived perennial, seems to be primarily a vegetative reproducing taxon)
- Stable population structure
- Threats controlled
- Complete genetic representation of all PUs in storage
- Expedited stabilization (10 years).

How many of the 4 MFS PUs have stable numbers of mature individuals?	How many of the 4 MFS PUs have had *insitu* recruitment?	How many of the 4 MFS PUs have full genetic storage?	How many of the 4 MFS PUs are protected from ungulates?	How many of the MFS PUs that need reintroductions have been initiated?
0/4	0/4	0/4	1/4	3/4

Taxon Level Discussion

There are currently no known wild populations of this species. NRS and the Lyon Micropropagation Lab are maintaining the remaining stock from Palikea Gulch, Wai‘anae Kai, Keawapilau and Pahole PUs as stock plants and living collections. NRS is currently focusing on conserving the *ex situ* stocks and trying to ensure that the stock is represented in as many plant propagation facilities as possible. The plants do not easily produce seeds in the greenhouse and cuttings are used to maintain the stock and produce propagules for reintroduction. There are two reintroduction sites within the Keawapilau to Kapuna PU, the first of which was not successful. The second is a new reintro site in the Kapuna Gulch. Further reintroductions occurred within the Pahole Gulch. Powdery mildew and predation by mice impacted the outplantings in both Kapuna and Pahole. A new reintroduction site in the Mākaha PU was initiated this year. Unfortunately the plants did not thrive in the new site and most if not all have now declined. NRS are looking into possible microsite differences and greenhouse stock age to explain the low success rate of the reintroductions.

This year the USFWS designated *Phyllostegia kaalaensis* as an “expedited stabilization species” (Introduction for further details) in which the species should be stabilized in ten years. These goals require that NRS manage three stable PUs with 50 genetically unique reproducing individuals. Two of the PUs are required to be out of the action area. NRS aim to achieve this goal with stable numbers in the Manuwai and Mākaha PUs. The goal of expedited stabilization in 10 years may be challenging given the low success rate of reintroducing this taxon. NRS hopes that by examining microsite differences and by getting a better idea of the size class needed for reintroduction survival, expedited stabilization can be attained.

Major Highlights/Issues Year 3

- A new reintroduction was made into the Mākaha PU.
- A new reintroduction was made into the Keawapilau to Kapuna PU.
- The Pahole reintroduction site was augmented with 56 more plants.

- A HOBO ® station was deployed at the Pahole reintroduction site.
- This taxon is expedited for stabilization in 10 years.

Plans for Year 4

- NRS plan to work with the NARS Horticulturist to obtain additional seed collections from greenhouse stock plants.
- Additional surveys of historical locations will be conducted.
- NRS will study microsite differences by deploying weather stations with data loggers in order to improve the outplanting success rate for this species.
- NRS will conduct more reintroductions in both the Mākaha, Keawapilau to Kapuna and Pahole PUs.

Figure 2.1.20a Outplanted *Phyllostegia kaalaensis* in Kapuna Gulch. Note the powdery mildew, insect damage, and browsed canes.

Table 2.1.20a Taxon Status Summary

Action Area: In

TaxonName: Phyllostegia kaalaensis — TaxonCode: PhyKaa

Population Unit Name	Management Designation	Current Mature (Wild)	Current Immature (Wild)	Current Seedling (Wild)	Current Augmented Mature	Current Augmented Immature	Current Augmented Seedling	NRS Mature 2006	NRS Immature 2006	NRS Seedling 2006	Total Mature	Total Immature	Total Seedling	Population Trend Notes
Keawapilau	Manage for stability	0	0	0	17	0	0	0	0	0	**17**	**0**	**0**	17 of the 25 plants reintroduced this year remain at this site
Pahole	Manage for stability	0	0	0	0	30	0	0	2	0	**0**	**30**	**0**	56 new plants outplanted at this site with some decline
Palikea Gulch	Genetic Storage	0	0	0	0	0	0	0	0	0	**0**	**0**	**0**	No plants were observed when this site was monitored in the last year
	Total for Taxon:	0	0	0	17	30	0	0	2	0	**17**	**30**	**0**	

Action Area: Out

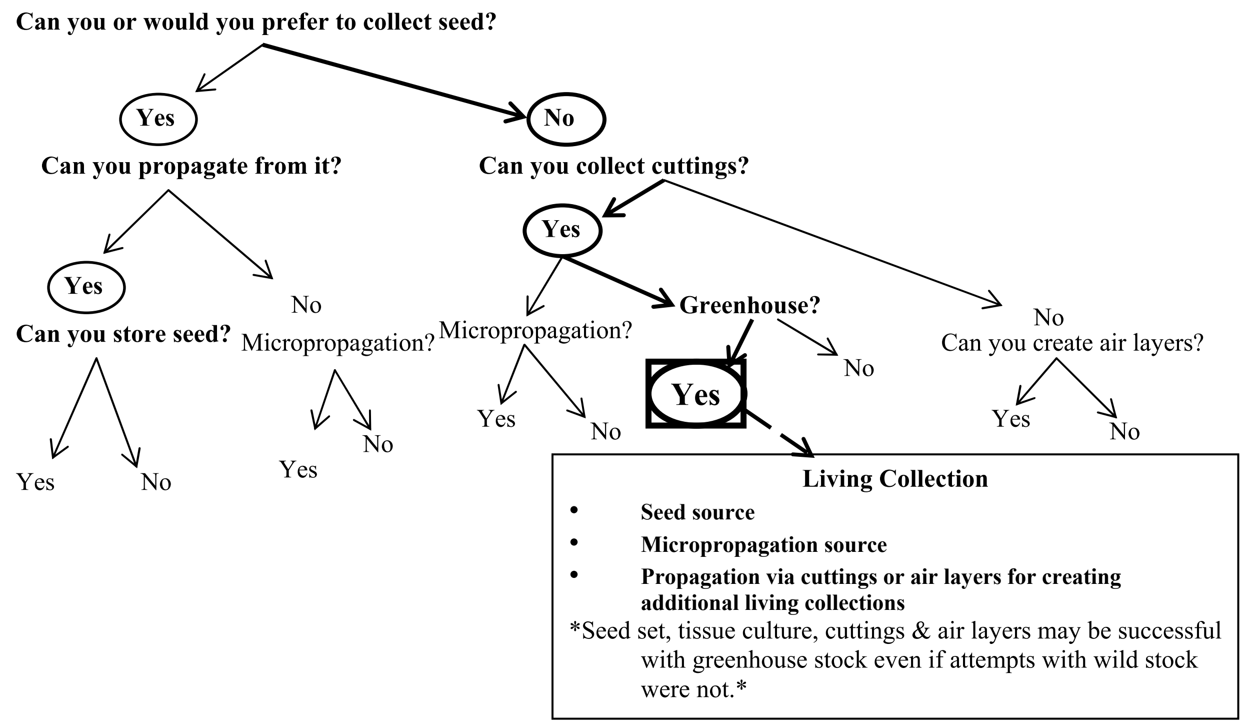
TaxonName: Phyllostegia kaalaensis — TaxonCode: PhyKaa

Population Unit Name	Management Designation	Current Mature (Wild)	Current Immature (Wild)	Current Seedling (Wild)	Current Augmented Mature	Current Augmented Immature	Current Augmented Seedling	NRS Mature 2006	NRS Immature 2006	NRS Seedling 2006	Total Mature	Total Immature	Total Seedling	Population Trend Notes
Makaha	Manage reintroduction for stability	0	0	0	4	20	0	0	0	0	**4**	**20**	**0**	83 plants introduced this year with significant decline
Manuwai	Manage reintroduction for stability	0	0	0	0	0	0	0	0	0	**0**	**0**	**0**	Reintroductions will begin when the MU fence is complete
Waianae Kai	Genetic Storage	0	0	0	0	0	0	0	0	0	**0**	**0**	**0**	No monitoring in the last year
	Total for Taxon:	0	0	0	4	20	0	0	0	0	**4**	**20**	**0**	

Propagation and Genetic Storage

1) At this time, what is the preferred propagation technique?	**2) At this time, what is the preferred genetic storage technique?**	**3) Has a successful storage method been determined?**	**4) Are additional steps required for obtaining enough seed?**
Cuttings	Living Collection	No	Yes, further pollination studies needed

Prioritizing Genetic Storage & Propagation Techniques



Collection: refer to OANRP 2006

Propagation: refer to OANRP 2006

Seed Storage: Low seed set remains the major issue for this taxon. A low number of seeds have been available for collection, and of the seeds that are collected many are empty (no embryo). NRS will continue to work with the NARS Horticulturist next year to obtain a larger collection for more tests.

Genetic Storage: All founders are represented in tissue culture. NRS will maintain living and tissue culture collections. Fruit from nursery stock will continue to be collected for viability testing.

Table 2.1.20b Status of Genetic Storage

Population Unit Name	# of Potential Founders: Current Mature	Current Imm.	NumWild Dead	Partial Storage Status: # Plants >= 10 in Seedbank	# Plants >=1 Microprop	# Plants >=1 Army Nursery	Storage Goals Met: # Plants that Met Goal
Phyllostegia kaalaensis							
Keawapilau	0	0	1	1	1	1	1
Pahole	0	0	4	0	2	2	2
Palikea Gulch	0	0	5	0	2	3	2
Waianae Kai	0	0	4	1	2	2	2
				Total # Plants w/ >=10 Seeds in Seedbank	**Total # Plants w/ >=1 Microprop**	**Total # Plants w/ >=1 Army Nursery**	**Total # Plants that Met Goal**
				2	7	8	7

Unique Species Observations
There have been no new observations in the last year.

Outplanting Issues
Four plantings of this taxon have been conducted in the last four years. They have had the lowest survivorship for any taxa planted by NRS. Two sites are located in the Keawapilau to Kapuna PU and one in the Pahole PU. The fourth site is in the Mākaha PU. Details of the outplantings are described in the PU section.

Other reintroductions will be conducted to test a variety of planting site characteristics, plant status pre-planting, variations in planting densities and variations of stocks. This year NRS got better idea of the size class needed for reintroduction. It seems that when the plants send out long canes there is a lot of active growth, which is better for outplanting. In the coming year, depending on the availability of healthy stock, NRS will reintroduce plants that are young, growing vigorously, and kept in shallower pots to prevent root rot (Doug Okamoto, NARS Horticulturist, pers. comm.). More intensive monitoring of these sites will also be done to refine site selection criteria and outplanting strategies.

Reintroductions will occur once again in the coming year in Mākaha, Keawapilau to Kapuna, and Pahole PUs. Stock for these reintroductions will come only from their respective PUs with the exception of the Mākaha reintroduction, in which stock will come from the Wai‘anae Kai. In the future, a Kapuna reintroduction will include a mix of stock from various PUs.

Currently, only three MFS PUs are designated. The fourth MFS PU will be designated once outplanting techniques are refined and proven to be successful at establishing stable, reintroduced populations. NRS is considering Manuwai for the fourth MFS PU with reintroduced Palikea Gulch stock.

Research Issues
Outplanting techniques, as stated above, require further research. When stock is available, research is also needed for seed storage techniques. Slug research continues and is described in detail in Chapter 5.2.

Surveys
No additional surveys were conducted this year.

Taxon Threats
In addition to threats mentioned in previous reports (see OANRP 2005) *P. kaalaensis* is prone to seasonal infestations of white fly and powdery mildew both in reintroductions and *ex situ*. It is unclear if these pathogens have a significant long-term effect on individual plant survival. Healthy plants kept in the greenhouse do not produce much seed and NRS will be investigating this in the coming year. Two of the reintroduction sites in the Pahole to Keawapilau PU were impacted by mice this year. NRS noticed significant browse by mice on the actively growing canes of the *P. kaalaensis.* Bait stations and snap traps were deployed in Pahole Gulch in an effort to curtail mouse impacts on the *P. kaalaensis.*

Population Unit Level Discussion

No wild populations are extant. NRS will not report on these PUs next year unless their status changes and will instead discuss the three reintroductions planned to capture all available stock. NRS will periodically monitor the extirpated sites for regeneration.

Table 2.1.20c Population Unit Threat Control Summary

Action Area: In

TaxonName: Phyllostegia kaalaensis

PopulationUnitName	ManagementDesignation	Protected from Ungulates	Weeds Managed	Rats Controlled
Keawapilau to Pahole	Manage for stability	Yes	Partial	No
Palikea Gulch	Genetic Storage	No	No	No

Action Area: Out

TaxonName: Phyllostegia kaalaensis

PopulationUnitName	ManagementDesignation	Protected from Ungulates	Weeds Managed	Rats Controlled
Makaha	Manage reintroduction for stability	No	No	No
Manuwai	Manage reintroduction for stability	No	No	No
Waianae Kai	Genetic Storage	No	No	No

Manage for Stability PUs

Pahole to Keawapilau:

Pahole: The Pahole reintroduction was established in November 2004. In November of 2006, there were only two plants left of the original 47 planted. In January of 2007, 56 additional plants were outplanted at this site. The outplantings experimented with different microsites. This year a HOBO weather station was installed in the Pahole Gulch. This device will allow NRS to determine if there are any measurable microsite differences. NRS will continue to examine microsites in an effort to determine optimal growing conditions for *P. kaalaensis.* The reintros were impacted by a host of threats including: mice, slugs and powdery mildew. Bait stations and snaps were deployed this year to lessen the impact by mice. Currently 30 plants remain at this site.

Two adult *Veronicella cubensis* (the Cuban slug) were found at the Pahole Gulch 4 reintroduction site. NRS believe that they may have been introduced during this years outplanting however without a thorough survey, it is not yet known if they are found in Pahole Gulch or the surrounding areas. NRS will continue to visit the site once a month for the next four months to ensure the area remains clean. If the slugs are encountered again measures must be taken to remove them from the area.

Keawapilau and Kapuna: In the past year NRS worked with the NARS Specialist to determine an appropriate outplanting site. A site where the wild plant recently occurred was chosen and stock from the Pahole site was mixed with the Keawapilau stock to establish an outplanting in the Kapuna Gulch. A temporary plastic fence was constructed around the outplanting area to exclude ungulates until the larger Kapuna fence is completed. The fence material is easily breached and NRS questions its effectiveness for future ungulate exclusion. This year in February, 25 plants were outplanted, and currently 17 remain at this site. The plants were impacted by powdery mildew and browsing by mice (see Fig. 2.1.20a). Weed control is conducted there regularly for other taxa.

Other PUs

Mākaha: Wai‘anae Kai stock was used to establish this introduction. Eighty three plants were outplanted into the Makai Gulch in Mākaha . The 100-acre exclosure was not completed at the time of the outplanting. NRS had planned for an earlier finish date, and therefore had plants ready for outplanting. NRS constructed a small temporary plastic fence to serve as a barrier in an effort to exclude ungulates from the outplanting site. NRS frequented the site and on multiple visits observed pig sign within the temporary exclosure. The site is located near a gulch bottom on a talus slope. Breaches in the fence were most often caused by falling rocks that blew through the weak plastic material. Fortunately no significant damage was caused by the ungulate infiltration.

The *P. kaalaensis* outplanting did poorly after initial signs of success. A number of plants flowered and possibly seeded and were growing at moderate levels. In a period of three months all plants quickly declined. Water stress was not the predominant factor as soil moisture appeared adequate. Plants died gradually, losing their largest leaves first and finally leaves at the meristems. Possible causes of death include slug predation, powdery mildew, insect predation, and transplant shock as nutrients in potting soil was depleted. During the most recent formal observation in July, 24 plants remained and most were poor in health. The large scale Mākaha MU fence was completed in September 2007. This opens up many possible outplanting sites within this MU. NRS will select and prepare another site for outplanting and the Wai‘anae Kai stock will be maintained in the Greenhouse and Micropropagation Lab.

Manuwai Reintroduction: Palikea Gulch stock will be used to establish this reintroduction when the Manuwai Gulch is be fenced in year seven of the MIP. Until this time, stock from Palikea Gulch will be maintained in the greenhouse, Micropropagation Lab, and at a future ‘Ēkahanui reintroduction.

‘Ēkahanui: This site will be used to plant stock from Palikea Gulch in the coming year. This will give NRS valuable experience outplanting this taxon and may serve as a back-up storage site for this stock. Palikea Gulch stock was chosen as this is the closest PU to ‘Ēkahanui.

Palikea Gulch: NRS monitored this site in August of 2006 and no plants were found. Collections were made from these plants in March of 2003 and are now being kept at the Army Nursery. Stock will be cloned and established in test tubes at the Lyon Micropropagation Lab in the next year.

Wai‘anae Kai: There is stock from this PU at the Lyon Micropropagation Lab and the Army Nursery. It will be used in the coming year as a reintroduction in Mākaha.

2.1.21 *Plantago princeps* var. *princeps*

Requirements for Stability
- 4 Population Units (PUs)
- 50 reproducing individuals in each PU (short-lived perennial)
- Stable population structure
- Threats controlled
- Complete genetic representation of all PUs in storage

How many of the 4 MFS PUs have stable numbers of mature individuals?	How many of the 4 MFS PUs have had *in situ* recruitment?	How many of the 4 MFS PUs have full genetic storage?	How many of the 4 MFS PUs are protected from ungulates?	How many MFS PUs that need reintroductions have been initiated?
0/4	4/4	0/4	2/4	0/4

Taxon Level Discussion

This year NRS worked closely with PhD candidate Stephanie Dunbar of the University of Hawaiʻi Botany Department to collect genetic samples from all presumed *Plantago princeps* var. *princeps* populations on Oʻahu, in both the Koʻolau and Waiʻanae Mountains. Her analyses, utilizing both nuclear and chloroplast DNA sequences, showed that the Waiʻanae range populations are genetically distinct from the Koʻolau populations (S. Dunbar pers. comm. 2007). In response to this new genetic information and the fact that the potential threat from military training to this taxon is in the Waiʻanae range, NRS decided to focus management on the Waiʻanae populations. Since this taxon is found in the AAs for both Mākua (MMR) and Schofield Barracks West Range (SBWR), four PUs were chosen as 'Manage for Stability': ʻŌhikilolo (within the Mākua AA), Kalena (within the SBMR AA), ʻĒkahanui (within TNCH's Honoʻuliʻuli Preserve), and Hālona (on State land in Nānākuli). Two populations will be managed for "Genetic Storage Collections": Pālāwai (within Honoʻuliʻuli Preserve) and Pahole (within Pahole NAR).

Another major highlight of this year was the first outplanting of this taxon. The outplanting was conducted within the Kaluaʻā-Waiʻeli management unit (MU) in TNCH's Honoʻuliʻuli Preserve. This site was chosen after NRS determined that augmentations should not be done with plants infected with the downy mildew reported previously (OANRP 2006). Over the coming year NRS plan to conduct a second reintroduction of this taxon within the ʻĒkahanui MU. The outplanting site will be sufficiently far from wild plants to avoid possible transfer of mildew spores.

Major Highlights/Issues Year 3
- NRS worked with researcher Stephanie Dunbar to collect and genetically analyze material from all presumed *Plantago princeps* var. *princeps* populations on Oʻahu.

- Genetic research indicates that *P. princeps* var. *princeps* is restricted to the Wai‘anae Mountain Range and that the Ko‘olau populations represent a form more closely related to *P. laxiflora* on Maui.
- NRS conducted the first outplanting of this species in Wai‘eli within TNCH’s Honouliuli Preserve.
- The South Branch of North Pālāwai site was rediscovered
- NRS observed downy mildew on wild individuals in Pahole

Plans for Year 4

- NRS will continue to refine propagation techniques and try to prevent and treat infestations of downy mildew in greenhouse plants
- NRS plans to propagate this year for a second reintroduction of this taxa near Pu‘u Kaua within the ‘Ēkahanui MU
- NRS plans to continue efforts to secure genetic storage collections from all populations of this taxon
- NRS will determine if fencing is necessary at the recently rediscovered south branch of north Pālāwai population

Figure 2.1.21a A healthy outplanted individual from the Wai‘eli reintroduction

Table 2.1.21a Taxon Status Summary

Action Area: In

TaxonName: Plantago princeps var. princeps **TaxonCode: PlaPriPri**

Population Unit Name	Management Designation	Current Mature (Wild)	Current Immature (Wild)	Current Seedling (Wild)	Current Augmented Mature	Current Augmented Immature	Current Augmented Seedling	NRS Mature 2006	NRS Immature 2006	NRS Seedling 2006	Total Mature	Total Immature	Total Seedling	Population Trend Notes
North Mohiakea	Manage for stability	10	16	2	0	0	0	10	2	11	**10**	**16**	**2**	More immature individuals observed in the last year
Ohikilolo	Manage for stability	12	14	0	0	0	0	12	14	0	**12**	**14**	**0**	No changes observed this year
Pahole	Genetic Storage	2	6	6	0	0	0	2	10	4	**2**	**6**	**6**	Small changes were observed in the last year
	Total for Taxon:	24	36	8	0	0	0	24	26	15	**24**	**36**	**8**	

Action Area: Out

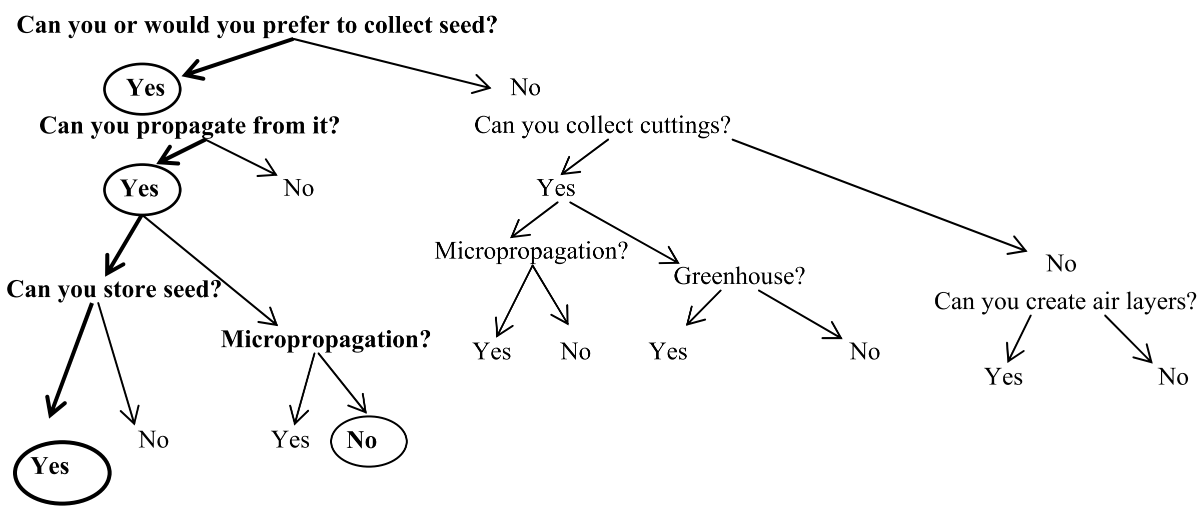
TaxonName: Plantago princeps var. princeps **TaxonCode: PlaPriPri**

Population Unit Name	Management Designation	Current Mature (Wild)	Current Immature (Wild)	Current Seedling (Wild)	Current Augmented Mature	Current Augmented Immature	Current Augmented Seedling	NRS Mature 2006	NRS Immature 2006	NRS Seedling 2006	Total Mature	Total Immature	Total Seedling	Population Trend Notes
Ekahanui	Manage for stability	29	39	7	0	0	0	34	50	36	**29**	**39**	**7**	Population decline observed over this past year
Halona	Manage for stability	10	17	11	0	0	0	10	17	1	**10**	**17**	**11**	Additional seedlings observed this year, not all sites visited
North Palawai	Genetic Storage	2	5	0	0	0	0	1	0	1	**2**	**5**	**0**	Second population rediscovered this year
Waieli	Manage reintroduction for storage	0	0	0	9	7	0	0	0	0	**9**	**7**	**0**	New reintroduction conducted this year
	Total for Taxon:	41	61	18	9	7	0	45	67	38	**50**	**68**	**18**	

Propagation and Genetic Storage

1) At this time, what is the preferred propagation technique?	2) At this time, what is the preferred genetic storage technique?	3) Has a successful storage method been determined?	4) Are additional steps required for obtaining enough seed?
Seed	Seed	No	No

Prioritizing Genetic Storage & Propagation Techniques



Collection: refer to OANRP 2006

Propagation: refer to OANRP 2006

Seed Storage: Seeds germinated for reintroductions after 15 months of storage show no decrease in viability.

Genetic Storage: NRS has continued and will continue to make collections from all the PUs to meet goals. Fifteen new founders were collected from this past year.

Figure 2.1.21b Mature fruit of *Plantago princeps* var. *princeps*

Table 2.1.21b Genetic Storage Summary

Population Unit Name	# of Potential Founders: Current Mature	Current Imm.	NumWild Dead	Partial Storage Status: # Plants >= 10 in Seedbank	# Plants >=1 Microprop	# Plants >=1 Army Nursery	Storage Goals Met: # Plants that Met Goal
Plantago princeps var. princeps							
Ekahanui	29	39	12	41	0	5	37
Halona	10	17	0	4	0	0	4
North Mohiakea	10	16	11	13	0	3	12
North Palawai	2	5	0	0	0	0	0
Ohikilolo	12	14	12	14	0	0	9
Pahole	2	6	0	1	1	0	1
				Total # Plants w/ >=10 Seeds in Seedbank	**Total # Plants w/ >=1 Microprop**	**Total # Plants w/ >=1 Army Nursery**	**Total # Plants that Met Goal**
				73	1	8	63

Unique Species Observations
The downy mildew that was reported by NRS last year on greenhouse plants (NRS 2006) was observed on wild individuals in Pahole. Some individuals appeared severely infected while others showed no signs of infection.

Outplanting Issues
The first reintroduction of this taxon, conducted this year at Wai‘eli MU, has been moderately successful. A total of thirty individuals, representing genetic stock from ‘Ēkahanui and North Mohiākea, were outplanted in March 2007. Currently, 1/3 of the plants are healthy, 1/3 are moderately healthy, and 1/3 have died.

NRS anticipate the need for reintroductions at each of the four Manage for Stability PUs in order to reach stability goals. NRS will continue to monitor the trial Wai‘eli reintroduction and will conduct another trial outplanting at ‘Ēkahanui PU in the coming year. The ‘Ēkahanui outplanting will be a chance for NRS to test different microsites. Following the ‘Ēkahanui trial outplanting and progress made on the greenhouse infestations of downy mildew NRS plan to augment the ‘Ōhikilolo and Hālona PUs.

Research Issues
As mentioned, genetic analyses by PhD Candidate Stephanie Dunbar (U.H. Botany Department) provided valuable insight on the evolution of this genus in Hawai‘i over the last year. In addition to showing that *P. princeps* var. *princeps* is restricted to the Wai‘anae Mountains, chloroplast sequences (trnL and ndhF) show that generally the Wai‘anae populations are indistinguishable from each other. However, two separate subgroups were discernible from the other populations with this sequence. The first group was the two sites in North Pālāwai and the second group was ‘Ōhikilolo and Hālona PUs (Stephanie Dunbar pers. comm. 2007). It is interesting that the

ʻŌhikilolo and Hālona PUs grouped together when they are closer geographically to the Pahole and North Pālāwai PUs respectively than to each other.

Surveys
No additional surveys were conducted in the last year for this taxon. NRS previously reported that surveys might be needed for a plant observed in Nāpepeiaoʻōlelo Gulch in Honouliuli Preserve. However, TNC and NRS believe that Pālāwai Gulch may have been mistakenly called Nāpepeiaoʻōlelo. NRS will discuss with Botanist, Joel Lau and may survey in this area.

Taxon Threats
No additional threats were noted in the last year however, rats, weeds, fire, pigs, fungal pathogens, landslides, and slugs threaten *P. princeps* var. *princeps*.

Population Unit Level Discussion

Table 2.1.21c Population Unit Threat Control Summary

Action Area: In

TaxonName: Plantago princeps var. princeps

PopulationUnitName	ManagementDesignation	Protected from Ungulates	Weeds Managed	Rats Controlled
North Mohiakea	Manage for stability	Partial	No	No
Ohikilolo	Manage for stability	Yes	No	No
Pahole	Genetic Storage	Yes	No	No

Action Area: Out

TaxonName: Plantago princeps var. princeps

PopulationUnitName	ManagementDesignation	Protected from Ungulates	Weeds Managed	Rats Controlled
Ekahanui	Manage for stability	Yes	Partial	Yes
Halona	Manage for stability	Partial	No	No
North Palawai	Genetic Storage	No	No	No
Waieli	Manage reintroduction for storage	Yes	Yes	Yes

Manage for Stability PUs

ʻŌhikilolo: No significant change was observed at this population over the last year. NRS have genetic storage collections representing 14 individuals, nine of which have more than 50 seeds in storage (Table 2.1.21b). NRS have been controlling ungulate threats to this population for the last 12 years. Rats are not being controlled at this site as no threat from rats have been observed at this site. Once propagation and reintroduction techniques are refined this PU will be augmented. NRS will continue to monitor and collect for genetic storage from this PU in the coming year.

'Ēkahanui: This PU is comprised of three smaller subpopulations along a 150 meter cliff in South 'Ēkahanui Gulch. Currently, almost all individuals in the three groups of plants are protected from ungulates by fencing, cliffs, and steep terrain. All the plants will be protected once the l70 acre 'Ēkahanui subunit II fence is completed in the next year. Rat damage has been observed in this PU and rat control is ongoing at these sites, although, no predation has been documented since May 2004. NRS have observed a decline in the numbers of individuals for this PU over the last year. However, new individuals were observed along the cliff face in some spots. NRS have met genetic storage collection goals for 37 individuals from this population (Table 2.1.21b).

Rat control efforts at this site benefit *Achatinella mustelina,* and other rare species in addition to *P. princeps* (for rat control data in 'Ēkahanui see Chapter 3.1). This year NRS conducted grass control in the southern most population. Grass control remains the priority along with reducing the alien canopy of *S. terebinthifolious* on the cliff.

North Mohiākea: NRS monitored this PU in the last year and made additional genetic storage collections. NRS now have storage collections representing 12 wild individuals. The North Mohiākea PU is located within Schofield Barracks West Range and was designated a MFS PU because it is within the SBMR AA. The *P. princeps* plants at this site are restricted to a steep cliff. Although pigs are present at the site, they only affect the plants at the bottom of the cliff. The weed threats are significant at this site. The most abundant ecosystem-altering weeds present at this PU are *R. argutus* and *Erigeron karvinskianus*. Access to this population requires a helicopter and access is limited because of its proximity to the live fire range. In the coming year, NRS will continue to monitor the site and will collect mature seeds from unrepresented plants. There is unsurveyed habitat for this species in this area. NRS will conduct surveys before augmentations are planned for this site.

Hālona: The plants at this site occur along a vertical cliff face in the back of Lualualei Valley on State Land. This area has not been completely surveyed and more plants may be found with additional surveys on adjacent cliffs. This year NRS re-visited a portion of this site, however a complete observation of this population was not made. The area where the plants are located is inaccessible to pigs, but there are goats nearby. The goats are known from gulches to the north of Hālona, and do not currently pose a threat to the plants. NRS have met with the Navy and DOFAW to discuss goat control in the area.

NRS have only surveyed portions of the available habitat for this species at this site. More surveys are needed before making plans to augment in the area. NRS currently have four individuals represented in genetic storage (Table 2.1.21b).

Other PUs

Pahole: NRS monitored this PU over the last year and observed a few new seedlings and some mortality of immature individuals. This site is within the Mākua AA. The plants occur along a steep cliff face that is dominated by native vegetation. The vegetation band where these plants occur is narrow, however there are adjacent areas that have not been surveyed. NRS will collect from all wild individuals to meet genetic storage goals.

North Pālāwai and South Branch of North Pālāwai: Last year NRS reported that the South Branch of North Pālāwai population was extirpated due to predation by rats. This year NRS revisited this site and found five individuals. This site is threatened by pigs, dominated by weedy species, and is not within any proposed management unit fences. NRS will likely need to fence these plants in order to secure genetic storage collections. NRS collected from one mature plant in the last year. However, the fruit appeared to be aborted. NRS will try to collect mature seed from all mature plants in the coming year.

Wai'eli reintroduction: This PU will be managed for genetic storage collections and as a trial reintroduction site. NRS will make genetic storage collections from these plants if unable to collect from the wild sites these founders represent.

***Plantago* sp. Ko'olau Taxon:**
NRS were able to visit two of these sites in the last year in order to help with the genetic identification of this taxon. Although NRS will no longer be working with these populations, we report on them here for the benefit of those interested. They will not be discussed in future reports.

Table 2.1.21d Ko'olau *Plantago sp.* Status

Population Unit Name	Management Designation	Current Mature (Wild)	Current Immature (Wild)	Current Seedling (Wild)	Current Augmented Mature	Current Augmented Immature	Current Augmented Seedling	NRS Mature 2006	NRS Immature 2006	NRS Seedling 2006	Total Mature	Total Immature	Total Seedling
Konahuanui	No Management	100	10	0	0	0	0	40	5	0	100	10	0
Nuuanu	No Management	4	8	0	0	0	0	1	0	0	4	8	0
Waiawa (Koolaus)	No Management	16	17	50	0	0	0	16	17	50	16	17	50

Nu'uanu: NRS were able to visit this site this year and observed 12 individuals. This site is on State Forest Reserve land below the Pau'oa flats trail and above the Nu'uanu reservoir. The site is somewhat steep and is threatened by weeds such as *E. karvinskianus*. There are several gulches in the area that appear to have similar vegetation and topography. Surveys of these gulches will likely result in new populations being discovered. However, with the Army's focus shifting to the Wai'anae populations, surveys for this taxon will not be a priority for NRS.

Kōnāhuanui: NRS visited this site this year with, Botanist Joel Lau, and counted over 100 individuals. There is also habitat on adjacent slopes may contain more individuals. These plants occur on steep, exposed, and erosion-prone rocky substrate.

Waiawa: NRS did not visit this PU in the past year. These individuals will be protected within the Army's proposed Wai'awa MU.

2.1.22 *Pritchardia kaalae*

Requirements for Stability

- 3 Population Units (PU)
- 25 reproducing individuals in each PU (long-lived perennial)
- Stable population structure
- Threats controlled
- Complete genetic representation of all PUs in storage

How many of the 3 MFS PUs have stable numbers of mature individuals?	How many of the 3 MFS PUs have had *in situ* recruitment?	How many of the 3 MFS PUs have full genetic storage?	How many of the 3 MFS PUs are protected from ungulates?	How many MFS PUs that need reintroductions have been initiated?
2/3	1/2 (only two *in situ* PUs)	0/2 (only 2 *in situ* PUs)	1/3	2/3

Taxon Level Discussion

There are three Manage for Stability (MFS) PUs for *Pritchardia kaalae.* They are located across the historic *Pritchardia kaalae* habitat belt stretching from ʻŌhikilolo ridge on Mākua Military Reservation (MMR) to the Kalena to Kaʻala ridge between Schofield Barracks West Range (SBW) and Waiʻanae Kai. The ʻŌhikilolo and Makaleha to Manuwai PUs have *in situ* populations with more than 25 mature plants, however very few juveniles or seedlings have been observed in any sites that have not had consistent rat control. The East ʻŌhikilolo and West Makaleha PU lies in between the two *in situ* PUs and has no known trees. This area has appropriate habitat and the PU will be established by outplanting stock collected from both *in situ* PUs. Most trees in all PUs produce flowers but rats are thought to consume most or all of the fruit before it can germinate and goats and pigs are known to browse the seedlings. *Pritchardia kaalae* is easy to grow from seed and outplantings have been successful. Management of all three MFS PUs will require large scale ungulate fences, weed control and rat control. Another major challenge for *P. kaalae* management is that outplanted and naturally recruiting young plants may not mature for decades. These plants will need a long-term commitment of ungulate and rat control to create stable and sustaining populations. A fence protects the ʻŌhikilolo PU and a portion of the East ʻŌhikilolo and West Makaleha PU. Fences are planned for West Makaleha, East Makaleha and Manuwai and and this will stabilize the habitat needed for these PUs. Genetic storage collections have not yet begun because research on the optimal storage techniques is ongoing. Preliminary results from research by the National Center for Genetic Resources Preservation (NCGRP) have identified an optimum storage protocol and collections for genetic storage will begin in the next year.

Major Highlights/Issues Year 3

- Rat control continues to be successful in allowing the development of mature fruit and the establishment of seedlings within the ʻŌhikilolo and Makaleha to Manuwai PUs.

- The outplantings that augment the ‘Ōhikilolo PU were supplemented with new plants and a new census of the small plants at the *in situ* sites with rat control found 640 immature plants.
- After three years of rat control, NRS began collection and propagation of mature seeds from seven founders from the Makaleha to Manuwai PU.

Plans for Year 4

- Continue to collect from unrepresented founders from the ‘Ōhikilolo and Makaleha to Manuwai PUs for propagation and genetic storage.
- Continue to outplant into the ‘Ōhikilolo and East ‘Ōhikilolo to West Makaleha PUs.
- Consider constructing small fences around *in situ* sites with seedlings in East Makaleha.
- Survey the Makaleha to Manuwai PU.
- Monitor the Waiʽanae Kai PU and assess the need for rat control in order to collect for genetic storage.

Table 2.1.22a Taxon Status Summary

Action Area: In

TaxonName: Pritchardia kaalae   TaxonCode: PriKaa

Population Unit Name	Management Designation	Current Mature (Wild)	Current Immature (Wild)	Current Seedling (Wild)	Current Augmented Mature	Current Augmented Immature	Current Augmented Seedling	NRS Mature 2006	NRS Immature 2006	NRS Seedling 2006	Total Mature	Total Immature	Total Seedling	Population Trend Notes
Ohikilolo	Manage for stability	75	685	19	0	321	0	75	287	407	**75**	**1006**	**19**	Almost 700 plants counted as seedlings last year have been included as immature plants and additional plants were added to the existing reintroductions
Ohikilolo East and West Makaleha	Manage reintroduction for stability	0	0	0	0	75	0	0	72	0	**0**	**75**	**0**	Additonal plants were added to the existing reintroduction
	Total for Taxon:	75	685	19	0	396	0	75	359	407	**75**	**1081**	**19**	

Action Area: Out

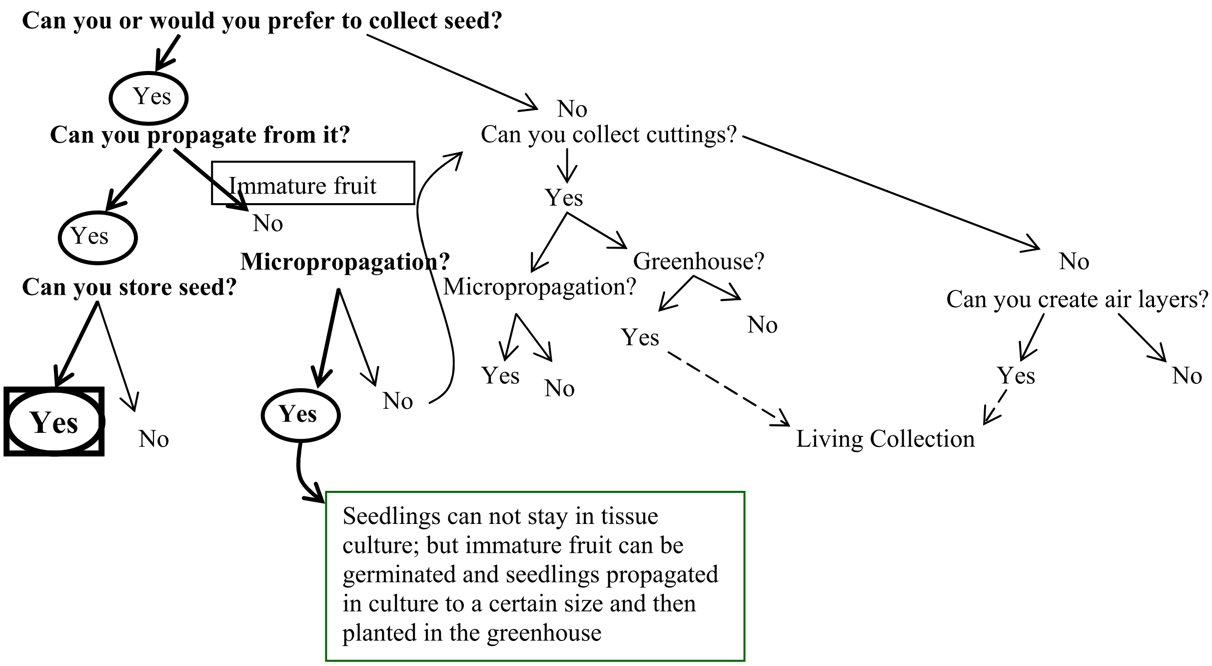
TaxonName: Pritchardia kaalae   TaxonCode: PriKaa

Population Unit Name	Management Designation	Current Mature (Wild)	Current Immature (Wild)	Current Seedling (Wild)	Current Augmented Mature	Current Augmented Immature	Current Augmented Seedling	NRS Mature 2006	NRS Immature 2006	NRS Seedling 2006	Total Mature	Total Immature	Total Seedling	Population Trend Notes
Makaha	Genetic Storage	4	0	0	0	0	0	4	0	0	**4**	**0**	**0**	No monitoring in the last year
Makaleha to Manuwai	Manage for stability	68	3	0	0	0	0	54	3	0	**68**	**3**	**0**	A more thorough census found more trees in the last year
Waianae Kai	Genetic Storage	4	5	0	0	0	0	4	5	0	**4**	**5**	**0**	No monitoring in the last year
	Total for Taxon:	76	8	0	0	0	0	62	8	0	**76**	**8**	**0**	

Propagation and Genetic Storage

1) At this time, what is the best preferred propagation technique?	2) At this time, what is the preferred genetic storage technique?	3) Has a successful storage method been determined?	4) Are additional steps required for obtaining enough seed?
Seed	Seed	Yes	No

Prioritizing Genetic Storage & Propagation Techniques



Collection: refer to OARNP 2006

Propagation: refer to OANRP 2006

Seed Storage: The NCGRP continues to conduct extensive seed storage research on the genus, *Pritchardia*. Researchers have determined that perceived dessication-sensitivity and potentially recalcitrant or intermediate storage behavior is not supported. Because seeds are so large and dense (in comparison to other MIP and OIP species), seeds need an exceptionally long time to dry. Standard drying procedures are for one month. Standards for *P. kaalae* are for at least three months, with continued monitoring of RH from month two through four. Seeds store well dry, but may contain certain lipids that would inhibit survival at -18C (see 2.00 Seed Storage). No aging has been detected at 4C, and NCGRP is currently conducting longevity trials at -80C. If -80C storage extends longevity more than 4C storage, NRS will store collections at this temperature.

Genetic Storage: NRS will follow NCGRP recommendations for seed storage protocols for this taxon and start to collect seeds for genetic storage. NRS is initiating a formal agreement with NCGRP for them to store these collections at -80C until NRS acquires their own facility.

NRS will also continue to collect from individuals that need to be represented at the reintroductions.

Table 2.1.22b Genetic Storage Summary

Population Unit Name	# of Potential Founders: Current Mature	Current Imm.	NumWild Dead	Partial Storage Status: # Plants >= 10 in Seedbank	# Plants >=1 Microprop	# Plants >=1 Army Nursery	Storage Goals Met: # Plants that Met Goal
Pritchardia kaalae							
Makaha	4	0	0	0	0	0	0
Makaleha to Manuwai	68	3	0	0	1	3	2
Ohikilolo	75	685	0	4	16	28	28
Waianae Kai	4	5	0	0	3	0	2
				Total # Plants w/ >=10 Seeds in Seedbank	**Total # Plants w/ >=1 Microprop**	**Total # Plants w/ >=1 Army Nursery**	**Total # Plants that Met Goal**
				4	20	31	32

Outplanting Issues

NRS has been growing and outplanting *Pritchardia kaalae* onto ʻŌhikilolo Ridge at MMR since 1999. Overall, outplanted individuals have high survivorship (347/403); however, they are not expected to mature for many years. *Pritchardia kaalae* seeds collected by National Tropical Botanical Garden Botanist Steve Perlman from ʻŌhikilolo in the early 1990s were grown and planted into an irrigated section of the Hawaiʻian collection at the Waimea Audubon Center (WAC). NRS and David Orr from WAC estimate the mature trees in this collection took at least seven years after planting to become mature.

The ʻŌhikilolo PU will be augmented with stock collected from the *in situ* sites on ʻŌhikilolo. The ʻŌhikilolo East and West Makaleha PU has no *in situ* sites and will be established by outplanting a mix of stock collected from both the ʻŌhikilolo and Makaleha to Manuwai PUs. The Makaleha to Manuwai PU will be augmented with stock collected from the *in situ* once the MU fences in East Makaleha and Manuwai are built and ungulates removed.

Taxon Threats

This taxon is threatened by rats that eat all or most of the fruit before the seeds can mature. If seedlings are produced, they would likely be browsed or disturbed in areas where pigs and goats are present. There are additional threats from weeds in some areas where species that produce thick ground cover such as (*Erigeron karvinskianus* and *Melinus minutiflora*) may hinder seedling survivorship. Besides large scale fences, rat control is the first necessary step towards stability for this taxon. NRS has been able to reliably control rats within small areas with bait stations and snap traps. The ʻŌhikilolo PU has been baited for over ten years and NRS has begun control in a few Makaleha sites. In the long-term, large-scale rat control is necessary to provide continued protection of these sites.

Population Unit Level Discussion

Table 2.1.22c Population Unit Threat Control Summary

Action Area: In

TaxonName: Pritchardia kaalae

PopulationUnitName	ManagementDesignation	Protected from Ungulates	Weeds Managed	Rats Controlled
Ohikilolo	Manage for stability	Yes	Partial	Partial
Ohikilolo East and West Makaleha	Manage reintroduction for stability	Yes	No	No

Action Area: Out

TaxonName: Pritchardia kaalae

PopulationUnitName	ManagementDesignation	Protected from Ungulates	Weeds Managed	Rats Controlled
Makaha	Genetic Storage	No	No	No
Makaleha to Manuwai	Manage for stability	No	No	Partial
Waianae Kai	Genetic Storage	No	No	No

Manage for Stability PUs:

‘Ōhikilolo: There is one main cluster of 60 mature trees and 15 other outlying patches and solitary mature trees on ‘Ōhikilolo Ridge. There are also three medium sized immature plants near these mature trees. Several hundred immature plants between one and seven years old are now also growing under the main cluster of mature trees where rat control has been ongoing for ten years. In addition to these *in situ* sites, there are three large outplanting sites in this PU. All goats have been removed from Mākua Valley. Once goats were excluded from the main cluster of trees and rat control was ongoing for about five years, many seedlings became established within the patch. NRS revised the population estimates in the last year to show that many of the plants that have been included as seedlings in past years are now several years old and have been moved into the juvenile size class. The number of smaller plants observed increased from 400 to 685. In addition, there are still seedlings in the PU that are estimated to be less than a year old. Until monitoring protocols are established to follow a subset of each size class, it may be difficult to determine the dynamics of the population structure in this extremely demographically fractured PU. All the sites in this PU are protected from goats by the ‘Ōhikilolo ridge crest fence, constructed in 1998. Pigs have not been observed as a threat. NRS has conducted weed control in the habitat around the managed *P. kaalae* sites. Stock from 44 of the 75 mature *in situ* founders has been outplanted and collections from the unrepresented trees will continue. NRS administers rat bait and deploys snap traps around three *in situ* sites. Baiting in the largest grid began in 1997 at the Prikaa-A patch (Table 2.1.22d). NRS re-stock 44 snap traps and 15 bait stations quarterly. This year the amount of bait taken increased compared to the last year, but not compared to the last five years.

Table 2.1.22d Prikaa-A Patch Baiting Data from 1997-2007

Year	# of Bait Stations	Amount of Bait Available	Amount of Bait Taken	% Bait Taken	# of Rats Snapped	# of Snap Traps	# of Site Visits
1997	7	141	134	95%	2		1
1997-1998	7	200	125	63%	0		3
1998-1999	7	224	166	74%	3		4
1999-2000	7	252	249	99%	0		4
2000-2001	7	280	280	100%	2		3
2001-2002	7	672	577	86%	5	12	5
2002-2003	15	960	591	62%	9	12	4
2003-2004	15	960	874	91%	9	12	4
2004-2005	15	720	661	92%	7	12	3
2005-2006	15	1136	677	60%	11	18	4
2006-2007	15	672	550	82%	12	18	3

Makaleha to Manuwai: NRS has been monitoring more regions of this PU in the last year and has revised the population estimates. NRS expect numbers may continue to increase as new areas are monitored. The original counts were based on Joel Lau's estimates of trees observed, many from afar, between 1991 and 2001. NRS has been able to visit many of the locations and revise the data. There are still substantial numbers of inaccessible plants on the cliffs of Kaumoku Nui and Kaumoku Iki, which have not been included in this total. NRS plans to manage all of the threats in the portion of this PU that is within the East Branch of East Makaleha. Weed control will begin once the fence is built. NRS has been controlling rats around at least 40-50 trees in order to collect mature fruit. NRS administers rat bait twice a quarter to protect the fruit of *P. kaalae* at these sites. Eighteen bait stations and 27 snap traps are currently deployed in three grids around three groups of accessible trees (Table 2.1.22e). NRS has been working with DOFAW and NARS to survey and control goat populations in this area in the last year. There is still a large group of goats in the area and NRS will continue to conduct goat control until the fences are complete. Collections of mature seed have begun and they will be used for propagation for the East ʻŌhikilolo and West Makaleha PU reintroductions. In the coming year, NRS will continue to bait for rats, collect for propagation and survey to revise population estimates.

Table 2.1.22e Rat data for Makaleha *Pritchardia kaalae*

Upper Patch	#of bait stations	Amount of Bait Available	Amount of Bait Taken	% of Bait Taken	# of Rats Trapped	# of Snap Traps	# of Site Visits
2004-2005	6	544	225	41%	15	11	6
2005-2006	6	672	490	73%	11	11	6
2006-2007	6	560	421	75%	3	11	5
Lower Patch	**#of bait stations**	**Amount of Bait Available**	**Amount of Bait Taken**	**% of Bait Taken**	**# of Rats Trapped**	**# of Snap Traps**	**# of Site Visits**
2004	8	128	89	70%	3	8	2
2004-2005	8	478	478	100%	26	8	6
2005-2006	8	736	515	70%	10	8	6
2006-2007	8	384	328	85%	8	8	3
TT Patch	**#of bait stations**	**Amount of Bait Available**	**Amount of Bait Taken**	**% of Bait Taken**	**# of Rats Trapped**	**# of Snap Traps**	**# of Site Visits**
2005	4	64	21	33%	3	8	1
2005-2006	4	256	193	75%	8	8	4
2006-2007	4	278	244	88%	2	8	4

‘Ōhikilolo East to West Makaleha: This PU has no known *in situ* sites and is located in between the known *in situ* sites to the north and south. Stock collected from trees in the *in situ* PUs will be used to establish reintroductions in this PU. Outplanting into the first site which is in West Makaleha in the Mokuleia Forest Reserve began in 2002. This site has high survivorship (41/46) and there is ongoing management of weeds and rats for this and other taxa. The second reintroduction site was established along the eastern portion of ‘Ōhikilolo ridge in 2002. The site is within the ‘Ōhikilolo ridge fence, and is protected from goats. However, the reintroduction is on one of the few ridges which connects smoothly to the valley floor, and was not protected from pigs. Plantings were initially successful, but some were later decimated by pigs. A fence was constructed around this site and it has been supplemented with additional plantings in February 2006 and January 2007. The primary weed threats are *Schinus terebinthifolius* and *Melinus minutiflora* and control is ongoing.

Other PUs:

Mākaha: Four mature plants are known from very remote inaccessible sites in Mākaha and NRS will further scope the area to determine if plants can be reached in the coming year. They are tall and spindly and surrounded by weeds. Goats are known from the area, and NRS assumes that rats are present as well. Collections made from this PU would be incorporated into reintroductions and living collections.

Wai‘anae Kai: A small patch of trees are known from just outside the Action Area for Schofield Barracks West Range on the Wai‘anae side of the dividing ridge. NRS has not monitored this site in the last year but will assess the need to restart rat control in order to collect mature fruit for genetic storage and to establish a living collection of all available founders at Leeward Community College.

2.1.23 *Sanicula mariversa*

Requirements for Stability

- 3 Population Units (PUs)
- 100 reproducing individuals in each PU (short-lived perennial with infrequent, inconsistent flowering)
- Stable population structure
- Threats controlled
- Complete genetic representation in storage of all PUs
- Expedited Stabilization (10 yrs)

How many of the 3 MFS PUs have stable numbers of mature individuals?	How many of the 3 MFS PUs have had *in situ* recruitment?	How many of the 3 MFS PUs have full genetic storage?	How many of the 3 MFS PUs are protected from ungulates?	How many MFS PUs that need reintroductions have been initiated?
0/3	3/3	0/3	2/3	0/3

Taxon Level Discussion

In the most recent Biological Opinion (BO) the USFWS determined that this species should be considered for expedited stabilization prior to the use of some additional weaponry at Mākua Military Reservation (MMR). The requirements for expedited stabilization are that each of the three manage for stability (MFS) populations be at numerical stability within the next 10 years and that one of those three be outside the new AA (see Executive Summary). The current MFS populations are: ʻŌhikilolo (inside the MMR AA), Keaʻau (inside the MMR AA), and Kamaileʻunu (outside the AA); Puʻu Kawiwi (outside the AA) will be managed for genetic storage collection.

This year NRS attempted to conduct a thorough monitoring of all individuals at each of the four known populations. Additional highlights from this year include the fencing of the Puʻu Kawiwi PU in Makaha and the observation of mature individuals at this site. This year NRS revisited this site and observed more individuals than in previous years and were able to represent this population in seed storage.

In the coming year NRS plan to continue long-term monitoring of individuals begun this year and will initiate greenhouse or *in situ* monitoring of laboratory-germinated seed in order to further understand the growth dynamics of this species. NRS also plan to construct the Kamaileʻunu and Keaʻau fences to protect these populations from goats.

Major Highlights/Issues for Year 3

- NRS conducted thorough monitoring of all individuals at each population
- NRS observed mature individuals at Puʻu Kawiwi
- The Puʻu Kawiwi population was fenced this year.
- FWS determined that this species requires expedited stabilization within 10 years (USFWS 2007)

- Installed data loggers to measure temperature at both ʻŌhikilolo, Keaʻau, and Kamaileʻunu PUs.

Plans for Year 4

- NRS will fence the Kamaileʻunu site in the coming year
- Deploy data loggers at the Puʻu Kawiwi
- Collect seed for dormancy and germination studies
- Conduct buried seed studies *in situ* to determine soil seed bank potential
- NRS will conduct greenhouse or *in situ* studies to provide more information on the growth rate, seasonality, and development of individuals when seedlings become available.
- Continue long-term monitoring of individuals in each PU

Figure 2.1.23a Recently monitored *Sanicula mariversa* in Keaʻau

Table 2.1.23a Taxon Status Summary

Action Area: In

TaxonName: Sanicula mariversa **TaxonCode: SanMar**

Population Unit Name	Management Designation	Current Mature (Wild)	Current Immature (Wild)	Current Seedling (Wild)	Current Augmented Mature	Current Augmented Immature	Current Augmented Seedling	NRS Mature 2006	NRS Immature 2006	NRS Seedling 2006	Total Mature	Total Immature	Total Seedling	Population Trend Notes
Keaau	Manage for stability	11	359	5	0	0	0	14	114	0	**11**	**359**	**5**	Due to thorough monitoring more individuals were observed this year
Ohikilolo	Manage for stability	3	112	0	0	0	0	0	52	0	**3**	**112**	**0**	Due to thorough monitoring more individuals were observed this year
	Total for Taxon:	14	471	5	0	0	0	14	166	0	**14**	**471**	**5**	

Action Area: Out

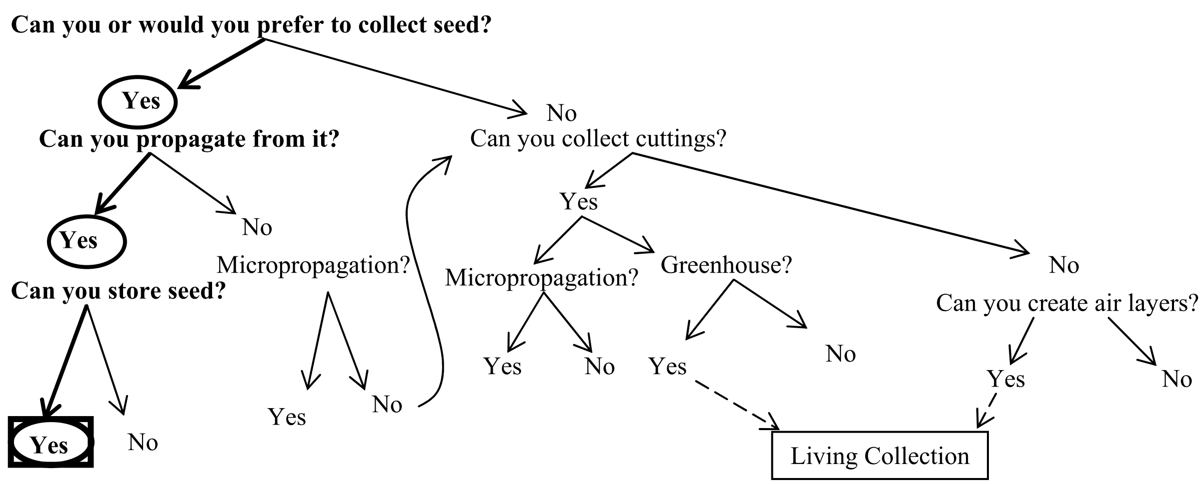
TaxonName: Sanicula mariversa **TaxonCode: SanMar**

Population Unit Name	Management Designation	Current Mature (Wild)	Current Immature (Wild)	Current Seedling (Wild)	Current Augmented Mature	Current Augmented Immature	Current Augmented Seedling	NRS Mature 2006	NRS Immature 2006	NRS Seedling 2006	Total Mature	Total Immature	Total Seedling	Population Trend Notes
Kamaileunu	Manage for stability	5	188	13	0	0	0	4	36	0	**5**	**188**	**13**	Due to thorough monitoring more individuals were observed this year
Puu Kawiwi	Genetic Storage	1	21	1	0	0	0	0	4	0	**1**	**21**	**1**	Due to thorough monitoring more individuals were observed this year
	Total for Taxon:	6	209	14	0	0	0	4	40	0	**6**	**209**	**14**	

Propagation and Genetic Storage

1) At this time, what is the preferred propagation technique?	2) At this time, what is the preferred genetic storage technique?	3) Has a successful storage method been determined?	4) Are additional steps required for obtaining enough seed?
Seed	Seed	Yes	No

Prioritizing Genetic Storage & Propagation Techniques



Collection: refer to OANRP 2006.

Propagation: Higher fresh germination was observed from collections made from Kea'au this year than was expected based on average fresh germination from previous years. Seeds started to germinate eight months after sowing and finished germinating ten months after sowing.

In conjunction with ongoing population viability assessment research (see Research Issues), NRS will propagate all seedlings produced from initial viability assays. These assays will be initiated next year following collection. Plants will be grown out to maturity and growth rate will be measured. This data will be applied to the *in situ* growth measurements to aid in the determination of size classes and to determine what, if any, growth variables could serve as indicators of when a plant will likely reach maturity.

Seed Storage Research: Both fresh and stored seeds exhibit high variability in germination. Sources for variability may be in seed viability (filled vs. unfilled), germination requirements, and laboratory methods. If seeds actually have highly variable seed set, germination tests may be reflective of this, regardless of germination or storage treatment. If there are specific germination requirements or ranges of temperatures that seeds must be exposed to in order to stimulate germination, assays up to now may have been only accounting for random germination throughout collections. In addition, germination substrates and temperatures have been highly irregular and inconsistent. Eliminating these laboratory variables will better address other sources of variation. Based on delayed fresh germination (sometimes up to eight months), the fact that germination of stored seed has been the highest after five years of storage, and that dormancy has been established in other species of *Sanicula*, dormancy is a reasonable explanation for low germination. NRS will continue to study dormancy in the laboratory, collect temperature data *in situ*, and conduct buried seed trials *in situ* to determine how long seeds last in the soil.

Genetic Storage: NRS continued to make collections from the Pu‘u Kawiwi, ‘Ōhikilolo, and Kea‘au PUs.

Table 2.1.23b Genetic Storage Summary

	# of Potential Founders			Partial Storage Status			Storage Goals Met
Population Unit Name	Current Mature	Current Imm.	NumWild Dead	# Plants >= 10 in Seedbank	# Plants >=1 Microprop	# Plants >=1 Army Nursery	# Plants that Met Goal
Sanicula mariversa							
Kamaileunu	5	188	41	46	0	0	39
Keaau	11	359	29	53	0	0	40
Ohikilolo	3	112	73	48	0	0	15
Puu Kawiwi	1	21	1	1	0	0	1
				Total # Plants w/ >=10 Seeds in Seedbank	**Total # Plants w/ >=1 Microprop**	**Total # Plants w/ >=1 Army Nursery**	**Total # Plants that Met Goal**
				148	0	0	95

Unique Species Observations

This species appears to be monocarpic. In addition, vegetative immature plants may not emerge every year.

Outplanting Issues

NRS conducted two small reintroductions of this species on ‘Ōhikilolo. In 2001, 30 plants were outplanted, 18 were vegetative in 2002 and 19 were vegetative in 2003. However, no plants have been observed over the last four growing seasons. A seed sowing trial was conducted in 1999 but only one plant was observed the next year. This year seeds were germinated and NRS will study the growth rate of these individuals either in the greenhouse or *in situ*.

Research and Monitoring Issues

As mentioned in previous reports (OANRP 2005b, 2006), this species has been challenging to monitor over time. The deciduous growth cycle of this species and dynamic fluctuations from year to year in the number of above ground individuals make it difficult to follow individual plants over consecutive years. The portion of the plant that lies dormant in the summer may be several inches below the soil surface and may be fairly undetectable. In addition, *S. mariversa* is monocarpic; plants have not been observed to flower more than once, and tap roots of mature individuals appear to rot after flowering stalks are dried. Additionally, not all immature individuals emerge each year. It is assumed that seedlings take several years to reach maturity.

This year NRS marked every individual in each population in order to monitor them over time to collect demographic data that will lead to development of a minimum viable population size. Every individual observed was tagged, mapped, and measurements of the number of leaves (and/or number of cotyledons), height of longest petiole, and radius of largest leaf were taken. Additionally, every reproductive individual was measured for height of inflorescence and number of fruit. This will help in projecting needs for reintroductions, genetic storage collections, and more accurately determine stability goals. It will be several years before NRS are able to determine what measurements are relevant to being able to determine when an individual is likely to mature or what the survivorship is as these individuals move through stage classes. However, as early as next monitoring NRS will be able to determine if the current method for marking individual plants is effective. Phenology data was collected to determine the number of immature fruit each individual produced this year (avg. 211.4 fruit, n=10).

Figure 2.1.23b is a box plot of the length of the longest leaf by population. While Figure 2.1.23c is a box plot of the number of leaves and the radius of the largest leaf by population. Figures 2.1.23d-f also show the three main data sets by population. All of these graphs show that each of the data sets are pretty similar across each population. The line graphs are first look at how well the data may fit a normal distribution and in subsequent years NRS will be able to track a subset of the individuals in each size class. At this time it is difficult to know where to divide the large immature size class into sub-classes of small, medium, and large or which data set is most informative. Although, this years data show that the length of the longest petiole for each individual is not a normal distribution and may be dependant on abiotic microsite differences such as light levels.

Figures 2.1.23d-f are regression plots to show how well each of the three main data points are able to predict any of the other values. Where: S is measured in the units of the response variable and represents the standard distance data values fall from the regression line. (For a given study, the better the equation predicts the response, the lower S is); R^2 (R-Sq) describes the amount of variation in the observed response values that is explained by the predictor(s). R^2 always increases with additional predictors; and Adjusted R^2 is a modified R^2 that has been adjusted for the number of terms in the model. If you include unnecessary terms, R^2 can be artificially high. Unlike R^2, adjusted R^2 may get smaller when you add terms to the model. Use adjusted R^2 to compare models with different numbers of predictors (Minitab 2007). If a regression model shows that any two data sets are highly correlated (perhaps >85%) then NRS may not need to collect both sets of data in the field, as one measurement may accurately predict the other.

Figure 2.1.23b Length of longest petiole by population

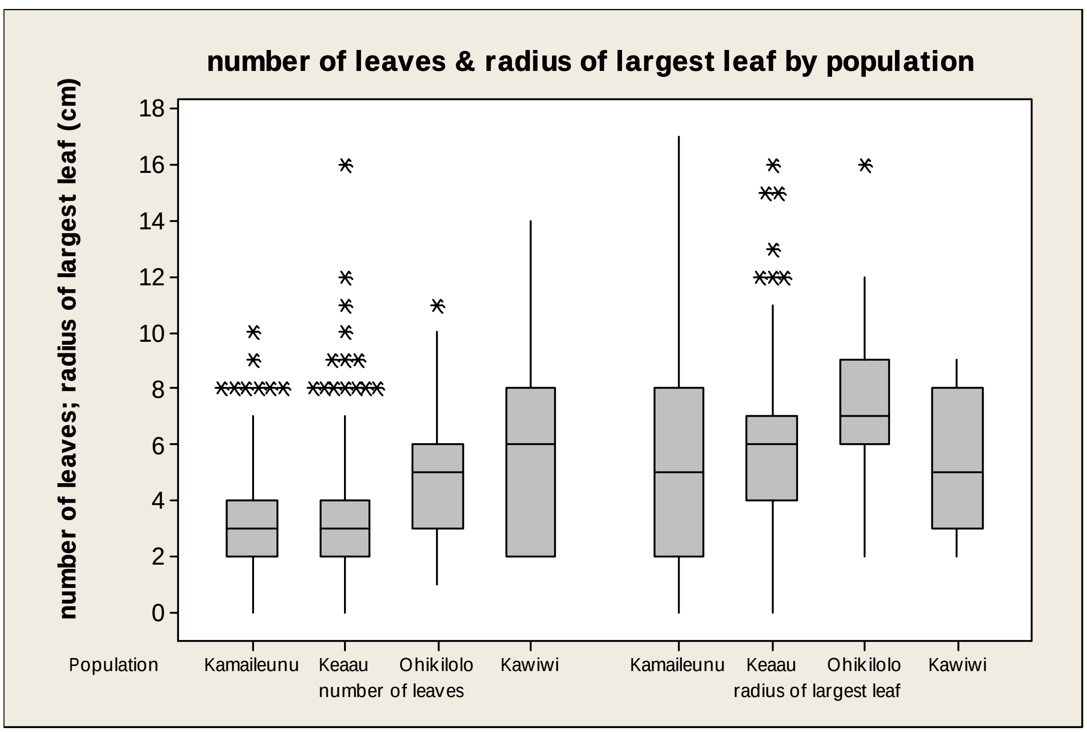


Figure 2.1.23c Number of leaves & radius of largest leaf by population

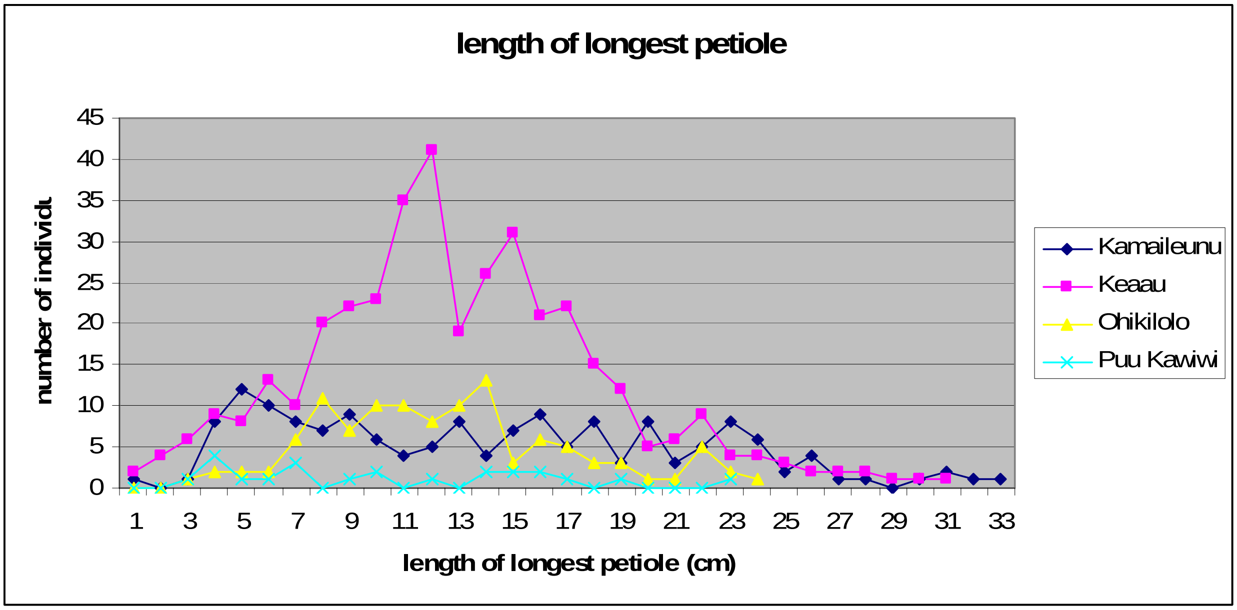


Figure 2.1.23d Counts of the length of longest petiole for each individual by population

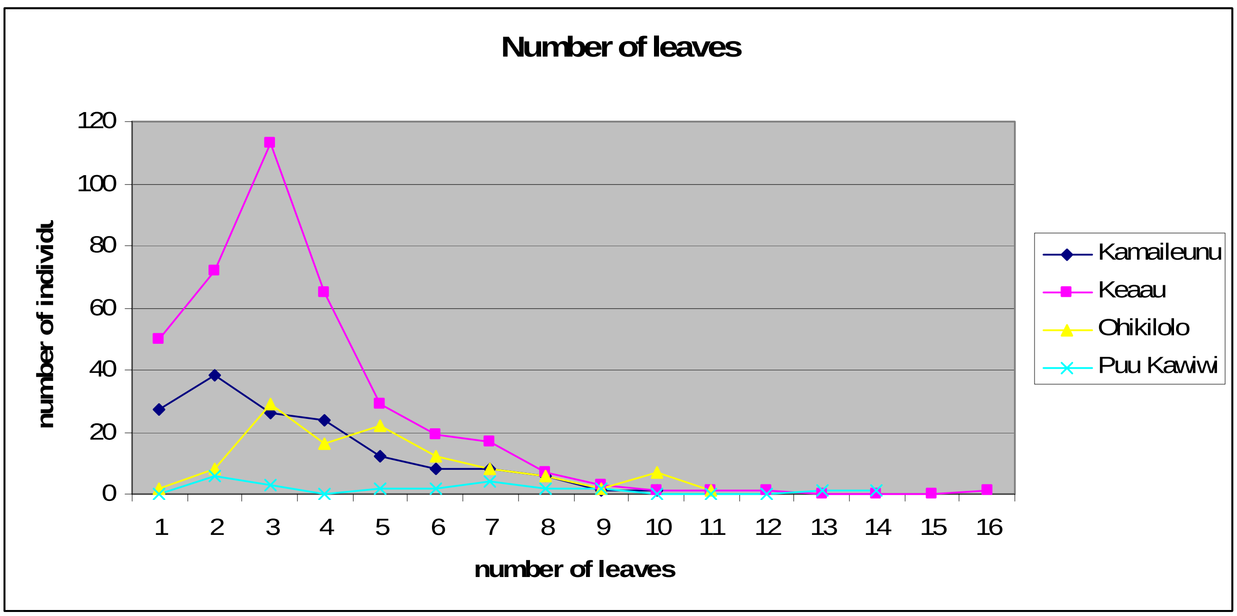


Figure 2.1.23e Counts of number of leaves for each individual by population

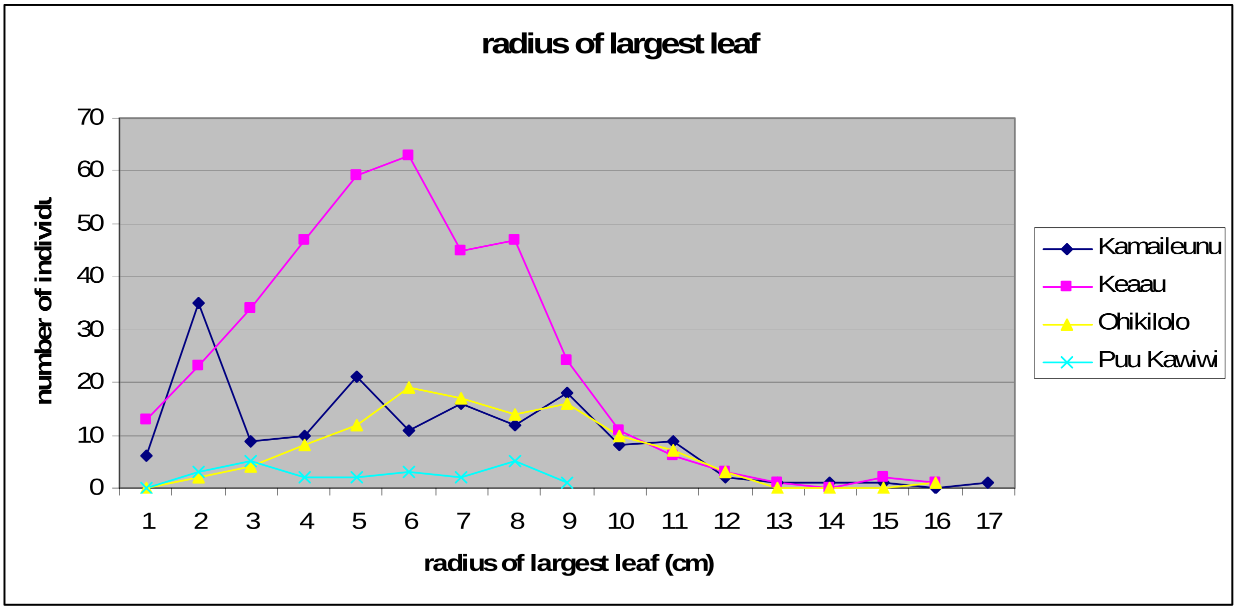


Figure 2.1.23f Counts of radius of largest leaf for each individual by population

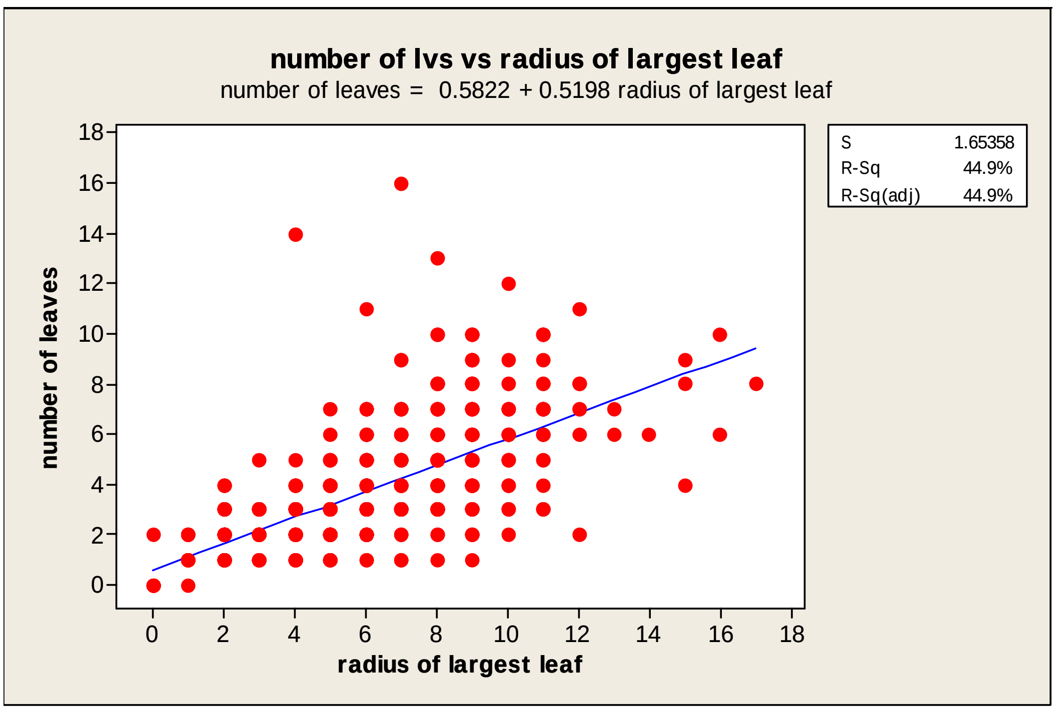


Figure 2.1.23g Regression analysis of number of leaves versus the radius of the largest leaf

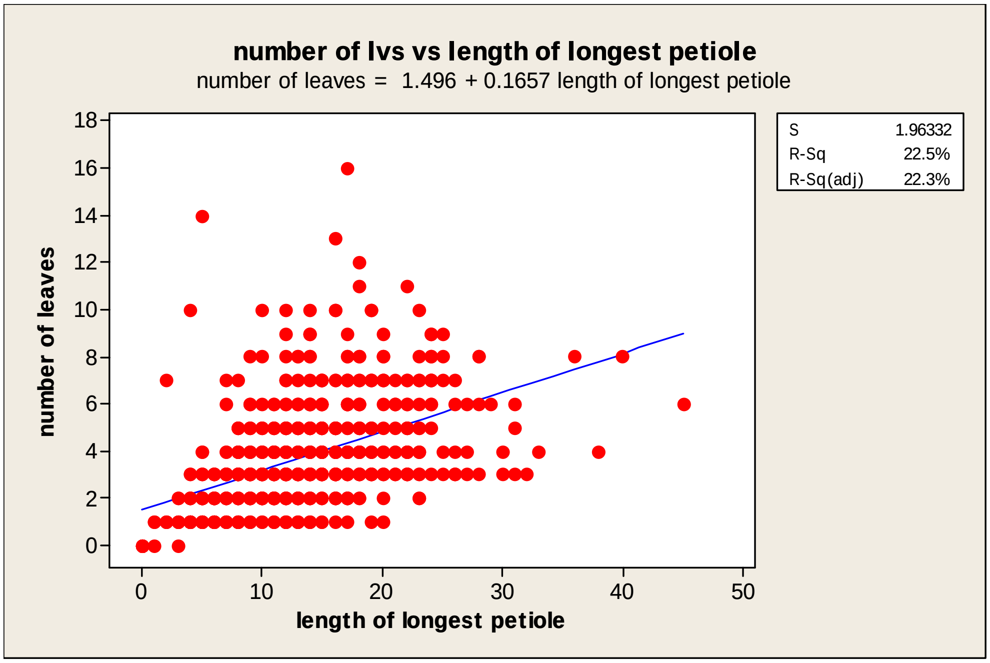


Figure 2.1.23h Regression analysis of the number of leaves versus the length of the longest petiole

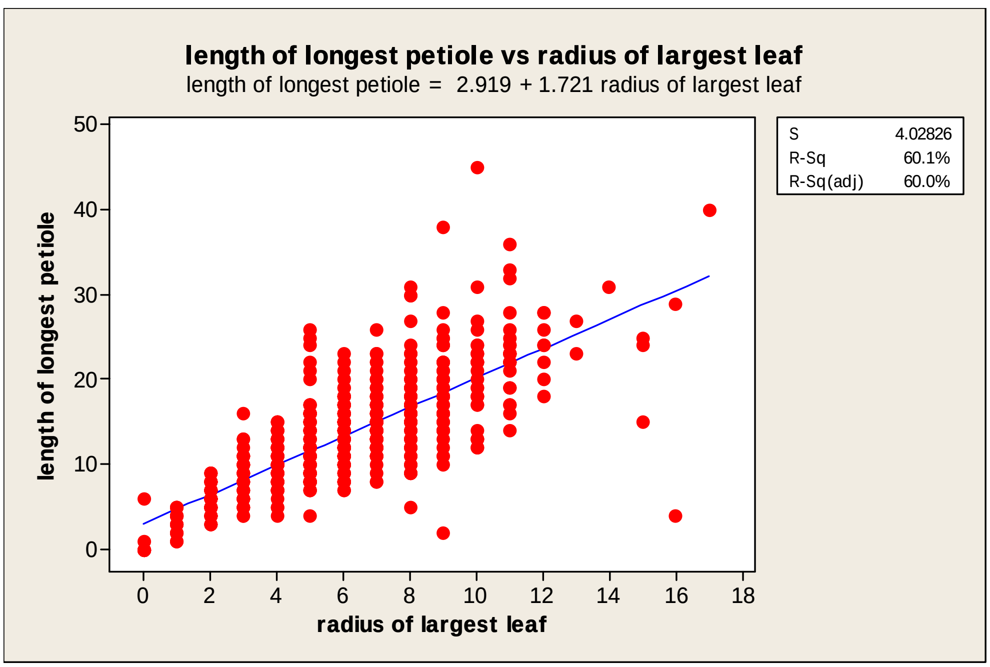


Figure 2.1.23i Regression analysis of length of longest petiole versus radius of largest leaf

The regression analysis depicted in figure 2.1.23d shows the number of leaves and the radius of the largest leaf are 44.9% correlated (R^2=44.9, P=<0.05). Figure 2.1.23e shows the number of leaves and the length of the longest petiole are only 22.5% correlated (R^2=22.5, P=<0.05). The final regression analysis (Figure 2.1.23f) shows the length of the longest petiole and the radius of the largest leaf are 60.1% correlated (R^2= 60.1, P=<0.05). This was the highest level of correlation among the three data sets. However, the R^2 value indicates one measurement will only predict the other with 60.1% accuracy. Next year NRS will continue to take these three measurements and re-evaluate when more data is available. Eventually, NRS would like to use this information to reassess stability targets for this species as the stability goal of 100 mature individuals may be unrealistic for this monocarpic species.

Surveys

No surveys were conducted for this taxon in the last year.

Taxon Threats

The most prominent threats to this taxon continue to be goats and weeds. It does not appear that goats are consuming this species but they can cause significant habitat degradation. Currently, two of the four PUs are protected from goats. NRS plan to have all four existing PUs fenced within the coming year.

Alien grasses such as *Melinus minutiflora, Setaria gracilis*, *Andropogon virginicus* and *Rhynchelytrum repens* will be controlled where necessary once ungulate fences have been constructed.

Population Unit Threat Control Summary

Table 2.1.23c Population Unit Level Discussion (*rats have not been observed to be a threat to this species)

Action Area: In

TaxonName: Sanicula mariversa

PopulationUnitName	ManagementDesignation	Protected from Ungulates	Weeds Managed	Rats Controlled *
Keaau	Manage for stability	No	No	No
Ohikilolo	Manage for stability	Yes	Yes	No

Action Area: Out

TaxonName: Sanicula mariversa

PopulationUnitName	ManagementDesignation	Protected from Ungulates	Weeds Managed	Rats Controlled
Kamaileunu	Manage for stability	No	No	No
Puu Kawiwi	Genetic Storage	Yes	No	No

Manage for Stability PUs

‘Ōhikilolo*:* There are two sites on ‘Ōhikilolo where *S. mariversa* has been observed. The mauka site was first monitored in 2001 when 12 individuals were observed. No individuals were seen in 2005 and the site was not monitored this past year. The makai site has been monitored regularly since the inception of the Army program in 1995. NRS conducted a seed sowing experiment in 1999 and trial outplanting of this species away from the wild plants in 2001. Plants from the outplanting emerged for two consecutive years however no plants have been observed at this site since 2003. None of the outplanted individuals reached maturity.

As mentioned, NRS conducted a thorough monitoring of the main makai population this year. More individuals were observed this year than any year previous. However, NRS do not believe the population had a sudden increase in numbers. Rather, thorough monitoring resulted in more individuals being observed.

Keaʻau: Significant seed collections have been made from this PU. This PU is also severely impacted by goats and erosion caused by goat populations. Even though goats appear to walk across the lower portion of this PU, NRS observed this population to be the largest of the known locations with 375 individuals. NRS plan to fence this population in the coming year. This site is largely covered in non-native grass habitat restoration with common native grass and shrub species will be considered.

Kamaileʻunu: NRS observed a total of 206 individuals at this PU this year. More individuals were observed due to a thorough monitoring. This area is severely impacted by goats. NRS have observed trampling and significant amounts of goat scat within the *Sanicula* population. However, there does not appear to be any goat browsing on *Sanicula* plants. NRS plan to construct this fence over the coming year. Once the ungulate fence is constructed, NRS will need to conduct weed control in this area.

Other PUs

Puʻu Kawiwi: This is the smallest known population and is designated to be managed for genetic storage. This PU requires a helicopter to access. Even though it is steep, goats are a threat to the area. NRS were able to fence this population in the last year. This year NRS observed a total of 23 individuals, the largest number recorded for this site over the last five years. This was also the first year NRS observed a flowering individual at this population. Fruit from this individual was collected and is being stored in the Army Seed Conservation Lab.

2.1.24 *Schiedea kaalae*

Requirements for Stability

- 4 Population Units (PUs)
- 50 reproducing individuals in each PU (short-lived perennial)
- Stable population structure
- Threats controlled
- Complete genetic representation of all PUs in storage

How many of the 4 MFS PUs have stable numbers of mature individuals?	How many of the 4 MFS PUs have had *in situ* recruitment?	How many of the 4 MFS PUs have full genetic storage?	How many of the 4 MFS PUs are protected from ungulates?	How many MFS PUs that need reintroductions have been initiated?
0/4	2/4	0/4	4/4	3/4

Taxon Level Discussion

There are many small PUs of this taxon across O‘ahu. NRS designated four MFS PUs because this taxon is in the Action Area (AA) for both the MMR and SBW training areas. Three MFS PUs are in the Wai‘anae Mountains and one is in the Ko‘olau Mountains. Two of the three Wai‘anae PUs are wild populations (‘Ēkahanui and Pahole) with Pahole lying inside the AA. The third Wai‘anae PU is a reintroduction site using mixed Wai‘anae founders in Central Kalua‘ā. The fourth PU is Ma‘akua Gulch in the Ko‘olau Mountains. NRS periodically monitors this PU with the O‘ahu PEP program.

NRS observed recruitment and vegetative reproduction in both the Wai‘anae and Ko‘olau Mountain Ranges amongst wild and reintroduced populations. Numerous seedlings were observed around several TNC outplantings in the Central and North Kalua‘ā area over the last few years (Figure 2.1.25a). NRS staff also observed that reintroduced plants in good microsites (e.g. Pu‘u Hāpapa) are growing more vigorously than in areas that are seasonally water limited. Based on observations at Ma‘akua Gulch, vegetative reproduction is more likely to occur in vigorously growing individuals.

Currently, NRS efforts are focused on establishing large reintroductions in the Wai‘anae PUs and researching slug control techniques (Chapter 5.2 Slugs). Until a slug control technique is developed, large reintroductions will hopefully overcome slug predation by producing a large seedbank.

The smaller non-MFS PUs will be managed for genetic storage.

Major Highlights/Issues for Year 3

- The first phase of slug control research was completed (Chapter 5.2 Slugs),
- Vegetative reproduction and seedlings continue to be observed at some TNC reintroduction sites in Kalua‘a (Figure 2.1.25a), but most Wai‘anae PUs do not show any recruitment.
- Smaller, non-MFS PUs continue to decline in numbers (e.g. both the Mohiākea and Kaipapa‘u wild individuals were lost due to rockfall).
- A ten acre pig exclosure was completed in Makaua Gulch in the Ko‘olau Mountains protecting *S. kaalae* habitat for that PU.

Plans for Year 4

- Continue balancing founders at reintroduction and/or augmentation sites.
- Continue slug control research (see Chapter 5.2). A label change is being pursued to use Sluggo® in the field and more research is needed to determine application rates and intervals in order to increase seedling survivorship.
- Continue genetic storage collections.
- Complete the larger ‘Ēkahanui fence for more outplanting sites.
- Continue monitoring reintroduction sites and plant performances at different microsites.


Figure 2.1.24a Seedlings at North Kalua‘a on left and vegetative reproduction at Pu‘u Hāpapa on right

Table 2.1.24a Taxon Status Summary

Action Area: In

TaxonName: Schiedea kaalae | **TaxonCode: SchKaa**

Population Unit Name	Management Designation	Current Mature (Wild)	Current Immature (Wild)	Current Seedling (Wild)	Current Augmented Mature	Current Augmented Immature	Current Augmented Seedling	NRS Mature 2006	NRS Immature 2006	NRS Seedling 2006	Total Mature	Total Immature	Total Seedling	Population Trend Notes
Mohiakea	Genetic Storage	0	0	0	0	0	0	1	0	0	0	0	0	Plant died in the last year.
Pahole	Manage for stability	2	0	0	39	9	0	19	3	0	41	9	0	NARS reports no change to the wild site other than augmentation by NRS.
	Total for Taxon:	2	0	0	39	9	0	20	3	0	41	9	0	

Action Area: Out

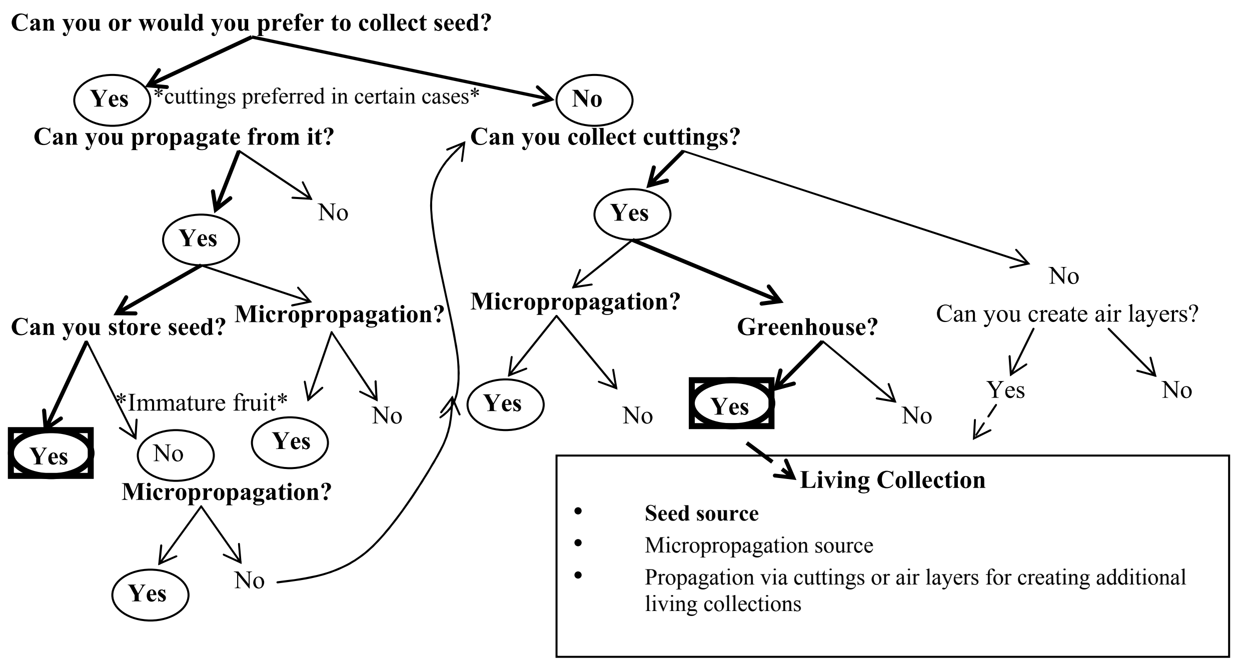
TaxonName: Schiedea kaalae | **TaxonCode: SchKaa**

Population Unit Name	Management Designation	Current Mature (Wild)	Current Immature (Wild)	Current Seedling (Wild)	Current Augmented Mature	Current Augmented Immature	Current Augmented Seedling	NRS Mature 2006	NRS Immature 2006	NRS Seedling 2006	Total Mature	Total Immature	Total Seedling	Population Trend Notes
Huliwai	Genetic Storage	0	0	0	0	0	0	0	0	0	0	0	0	No monitoring in the last year.
Kahana	Genetic Storage	7	0	0	3	0	0	5	2	0	10	0	0	PEP reports no change, more plants are likely exant in area.
Kaipapau	Genetic Storage	0	0	0	0	0	0	0	0	0	0	0	0	No monitoring in the last year.
Maakua (Koolaus)	Manage for stability	16	0	0	0	0	0	16	0	0	16	0	0	No monitoring the last year.
Makaua (Koolaus)	Genetic Storage	1	0	0	8	0	0	1	1	0	9	0	0	PEP reported no change at the wild site, 7 individuals outplanted at the new fence area upgulch.
North Palawai	Genetic Storage	1	0	0	0	0	0	1	0	0	1	0	0	Monitoring found no change.
South Ekahanui	Manage for stability	13	0	0	56	0	0	70	0	0	69	0	0	No change to the wild plants and more plants augmented to the larger fenced area.
	Total for Taxon:	38	0	0	67	0	0	93	3	0	105	0	0	

Propagation and Genetic Storage

1) At this time, what is the preferred propagation technique?	**2)** At this time, what is the preferred genetic storage technique?	**3)** Has a successful storage method been determined?	**4)** Are additional steps required for obtaining enough seed?
Cuttings for maintaining wild clones; *in situ* and reintro-produced seed for outplanting.	Seed storage and living collections to produce seed.	Yes	Yes, it is more practical to keep the Ko‘olau PUs as living collections in the greenhouse given the remote locations of some of the Ko‘olau PUs

Prioritizing Genetic Storage & Propagation Techniques



Collection: Seeds may be able to germinate in the mature capsules if they are moist. For example, they may retain moisture from dew or rain. When collections contain some seeds with radicles already emerging, germination is likely underway for many of the seeds from that collection. Seeds that have already started the germination process, even prior to radicle emergence, have lost the ability to withstand desiccation. These seeds, therefore, can not be stored. NRS will maintain viability testing and continually look for germinating seeds in a collection to secure desiccation-tolerant seeds for genetic storage.

Propagation: refer to OANRP 2006.

Seed Storage Research: No aging has been detected for dry storage at 4C or -18C after five years.

Genetic Storage: Seed collections continue for plants in more easily accessible PUs. Clonal stock is being secured in the greenhouse for eventual seed collection. Seeds from living collections will be used for storage testing, outplanting, and genetic storage.

Table 2.1.24b Genetic Storage Summary

	# of Potential Founders			Partial Storage Status			Storage Goals Met
Population Unit Name	Current Mature	Current Imm.	NumWild Dead	# Plants >= 10 in Seedbank	# Plants >=1 Microprop	# Plants >=1 Army Nursery	# Plants that Met Goal
Schiedea kaalae							
Huliwai	0	0	1	1	0	1	1
Kahana	7	0	0	0	5	0	4
Kaipapau	0	0	2	0	2	0	1
Kaluaa and Waieli	0	0	1	1	1	1	1
Maakua (Koolaus)	16	0	0	0	4	0	3
Makaua (Koolaus)	1	0	0	0	2	0	0
Mohiakea	0	0	1	0	0	1	0
North Palawai	1	0	0	1	0	1	1
Pahole	2	0	0	2	1	2	2
South Ekahanui	13	0	3	12	3	12	13
				Total # Plants w/ >=10 Seeds in Seedbank	**Total # Plants w/ >=1 Microprop**	**Total # Plants w/ >=1 Army Nursery**	**Total # Plants that Met Goal**
				17	18	18	26

Outplanting Issues

In addition to ungulate fencing and ecosystem scale weed control, outplanting has been the primary focus of field work with this species. Plants are easily grown to outplanting size in about a year from seeds or cuttings. Currently, five reintroduction/augmentation sites are monitored and maintained by NRS in three MUs. The goal is to maximize the amount of genetic exchange between all the remaining founders by planting an equal number of plants from each founder.

At, one experimental reintroduction site at Pahole (PAH-E) begun in 2006 only eight plants out of 29 plants planted have survived (28% survivorship). This compares with roughly a 60% survival rate over a two year period for NRS outplanting sites in ‘Ēkahanui and Kalua‘a. NRS assisted NARS staff in planting into a rock wall with netting along the stream bottom and at other sites in the ground. Water stress over the past year likely contributed to the steep decline in survivorship compared to other reintroductions in the Pahole NAR. The newest reintroductions in the Pahole NAR have survivorship rates above 90% (planted in the ground). The rock wall reintroduction effort highlights the value of experimenting with different microsites to determine the requirements for survival and recruitment overtime. Wild *S. kaalae* have been observed growing out of rock walls and waterfalls in the both the Wai‘anae and Ko‘olau Mountain Ranges. These types of experimental outplantings are particularly informative for species such as *S. kaalae* that have only a few remaining relict populations and whose precise habitat requirements are unclear.

In 2006 TNC established three additional reintroduction sites in North Pualii, North Kaluaʻā and Puʻu Hāpapa. These other TNC sites will be monitored by NRS staff in conjunction with other management work to learn about plant performance and recruitment rates at these different microsites.

Table 2.1.24c Founders Represented in Outplantings

TaxonName: Schiedea kaalae **TaxonCode: SchKaa**

Total Num Plants based upon Plants that have been numbered

PopulationUnitName	Management Designation	Number of Founders	Number of Founders Represented
Huliwai	Genetic Storage	1	1
Kahana	Genetic Storage	7	0
Kaipapau	Genetic Storage	2	0
Kaluaa and Waieli	Manage for stability	1	1
Maakua (Koolaus)	Manage for stability	16	0
Makaua (Koolaus)	Genetic Storage	1	0
Mohiakea	Genetic Storage	1	1
North Palawai	Genetic Storage	1	1
Pahole	Manage for stability	2	2
South Ekahanui	Manage for stability	16	19
	Total for Taxon:	**48**	**25**

Number of Founders = Number of Mature, Immature, and Dead founder plants.
Number of Founders Represented = Number of founder plants represented in reintroductions.

As the above table highlights, a little more than half of the founders are already represented in outplantings. Twenty-three founders not represented in outplantings are from the Koʻolau Mountains in the Kahana and Maʻakua PUs. The recently completed ten acre Makaua fence will serve as an outplanting site for the Kahana and Makaua PUs.

Research Issues
Slugs pose the most significant threat to this species in fenced areas. The NRS Research Specialist is researching control techniques (Chapter 5.2 Slugs).

Surveys
NRS will continue to encourage and assist PEP staff with more surveys in the Koʻolau PUs to locate additional plants, particularly in the Kahana PU.

Taxon Threats
As mentioned previously, slugs are the primary threat to this fleshy leaved, basal rosette species. Pigs are also considered a significant threat as this plant species prefers gulch bottom and lower slope habitats which are frequently disturbed by pigs. Most PUs are however, protected by fences. Rat damage was observed on individuals in the Pahole reintroduction in 2005. This seems to have been a one time event and has not been observed since. Rockfall also continues to threaten individual plants as this species prefers talus slopes along gulch bottom areas. Prolonged drought also threatens this species given its relatively high transpiration rates from large, wide leaves.

Population Unit Level Discussion

Table 2.1.24d Population Unit Threat Control Summary

Action Area: In

TaxonName: Schiedea kaalae

PopulationUnitName	ManagementDesignation	Protected from Ungulates	Weeds Managed	Rats Controlled
Mohiakea	Genetic Storage	Yes	Yes	Partial
Pahole	Manage for stability	Yes	Partial	Partial

Action Area: Out

TaxonName: Schiedea kaalae

PopulationUnitName	ManagementDesignation	Protected from Ungulates	Weeds Managed	Rats Controlled
Huliwai	Genetic Storage	No	No	No
Kahana	Genetic Storage	Partial	No	No
Kaipapau	Genetic Storage	No	No	No
Maakua (Koolaus)	Manage for stability	Yes	No	No
Makaua (Koolaus)	Genetic Storage	Yes	Partial	No
North Palawai	Genetic Storage	Yes	No	No
South Ekahanui	Manage for stability	Yes	Yes	Partial

Action Area: Reintro

TaxonName: Schiedea kaalae

PopulationUnitName	ManagementDesignation	Protected from Ungulates	Weeds Managed	Rats Controlled
Kaluaa and Waieli	Manage for stability	Partial	Yes	Yes

Manage for Stability PUs

Pahole: The NARS Specialist and NRS continue to monitor the two remaining wild plants. Propagule collection and nursery cultivation of clones (via cuttings) are ongoing. An augmentation was first established by NARS in Pahole Gulch in 2005. Two new reintroductions were planted by NRS in the current reporting period at Kapuna Gulch and Pahole Gulch. A total of three reintroduction sites now exist and all three sites are considered to be augmentations given their relative proximity to the remaining wild plants.

South ʻĒkahanui: There are still 13 mature wild plants in ʻĒkahanui however no juveniles or seedlings have survived at these sites. A few of the wild plants continue to reproduce vegetatively. All plants are within ungulate fences and NRS and TNC have been monitoring, collecting seeds and controlling weeds around these plants for many years. The augmentations in this site have been established using stock from many different founders. A 150 acre fence will be completed in ‘Ēkahanui by Spring 2008 and will provide more outplanting sites in the coming year.

Central Kalua‘ā: There are no longer any wild plants in this PU. This PU currently consists of three TNC outplanting sites located in the Central Kalua‘ā fence and one NRS reintroduction site. TNC maintains three sites that consist of plant stock from ‘Ēkahanui, Kalua‘ā, and Pālāwai. NRS manages another site, higher in the gulch, which contains genetic stock from ‘Ēkahanui, Mohiākea, Pālāwai, North Kalua‘ā and Huliwai. In the coming year, NRS will continue to assist TNC in monitoring the plants, collecting mature seed, maintaining the fences, and conducting weed control. NRS also plan to continue supplementing the site with more plants to balance the founders and replace any losses.

Ma‘akua: NRS did not visit this site last year and will work with PEP in the coming year to ensure that collections are established as a living collection. Waterfalls protect this PU from ungulates.

Other PUs

Huliwai: There are no wild plants left in this PU. NRS will continue to hold this stock as a living collection and collect seeds for use in reintroduction and storage.

Kahana: PEP has been monitoring this population in the last year. Cuttings have been collected and are being grown at Lyon Arboretum. These will be used as a propagule source in the future and serve as a living collection of these plants. More potential founders are likely to be found at this site.

Kaipapa‘u: The two mature plants known from this PU have died. The last remaining plants were taken out by a landslide. Both plants are represented at Lyon and will serve as a living collection in the nursery and a propagule source. Much of the upper reach of this stream has not been surveyed due to inaccessibility and additional plants are likely to be found along those upper reaches.

Maka‘ua: PEP has been monitoring this PU over the last year. One mature and one immature plant were observed here in the past. The immature plant died in the last year. Cuttings have been collected from both plants and are growing successfully at Lyon Arboretum. They will serve as a living collection.

Mohiākea: The only known wild plant from this PU recently died due to rockfall. Seeds were collected and individuals grown from these collections were outplanted in Kalua‘ā. NRS will collect mature seed for storage and supplement the existing site in Kalua‘ā utilizing seeds or cuttings from the Mohiākea stock outplanted in Kalua‘ā.

North Pālāwai: There is one mature plant in Pālāwai; it continues to seed prolifically as in past years. This plant is at least ten years old. A PU fence protects it from ungulates and small scale weeding is occasionally conducted. NRS will continue to work with TNC to monitor this site and collect mature seed for storage and propagation for outplanting as needed.

North Kalua‘ā: This population has not been observed since 2000, when a single mature plant was observed and collected. This stock is both in genetic storage and being grown for reintroduction into the Central Kalua‘ā outplanting site. NRS occasionally monitors the known historic locations for this PU in the course of other management work.

Figure 2.1.24b Healthy outplants at Pu‘u Hāpapa

2.1.25 *Schiedea nuttallii*

Requirements for Stability

- 3 Population Units (PUs)
- 50 reproducing individuals in each PU (short-lived perennial)
- Stable population structure
- Threats controlled
- Complete genetic representation of all PUs in storage
- Expedited Stabilization (5 years)

How many of the 3 MFS PUs have stable numbers of mature individuals?	How many of the 3 MFS PUs have had *in situ* recruitment?	How many of the 3 MFS PUs have full genetic storage?	How many of the 3 MFS PUs are protected from ungulates?	How many MFS PUs that need reintroductions have been initiated?
1/3	2/3	0/2 (only 2 *in situ* PUs)	2/3	0/3

Taxon Level Discussion

Schiedea nuttallii is extremely rare and appears to be in severe decline. There are three *insitu* population sites known, all of which fall in the Kahanahāʻiki to Pahole PU. One of these sites consists of a single plant. The Kahanahāʻiki to Pahole PU has reached the goal set for number of reproducing individuals. The goal has been reached mostly due to reintroduction. Forty-two of the 61 mature plants in the PU are reintroduced plants. This year there was a significant decline in the wild population in Kahanahāʻiki. This site formerly had the most onsite recruitment. Drought is believed to be a significant cause of this abrupt decline. NRS have however been collecting clones and seed from this population since 1996 and therefore not all founder stock is lost. Numbers of plants in the two *in situ* sites in Pahole remain relatively constant, and two new individuals were found this year.

The last known plant at the Kapuna-Keawapilau Ridge PU died this year. NRS had representation from three of the four known plants from this site, however, two of these wild stock were lost in the greenhouse.

This year *Schiedea nuttallii* has been designated by the Fish and Wildlife service as a species "Expedited for Stabilization." Conservation measures required for this status include 3 MFS PUs, and that numerical stabilization be reached at one of the MFS PUs *outside* the Makua Action Area within five years. There are currently only two extant PUs and the Mākaha PU will be the third MFS PU. NRS will plan to reach the goal of 50 mature plants in the Mākaha PU in five years to satisfy this requirement. Considerable propagation and reintroduction efforts will have to take place in the next few years to establish such a population. While NRS feel it is important to get Kahanahāʻiki stock established in Mākaha as another MFS site, efforts to boost numbers at the extant populations are believed to be of greater overall significance to this species as a whole.

Major Highlights/Issues Year 3

- Kapuna fence construction has begun.
- Species identified as expedited for stabilization in five years by USFWS in the 2007 MMR Biological Opinion.
- The Mākaha fence is finished and a small number of plants were reintroduced this year.
- The only extant plant in the Kapuna to Keawapilau PU died this year.
- Two founders from the Kapuna to Keawapilau PU died in the greenhouse this year; stock from only one founder now exists.
- NRS continued to get genetic representation from wild plants in Kahanahā'iki and Pahole (with the help from NARS staff).
- There was a significant decline in wild plants found in Kahanahā'iki this year.
- A new reintroduction site was established in Pahole this year for Pahole stock.

Plans for Year 4

- Continue to reintroduce Kahanahā'iki stock into Mākaha.
- Spend time looking for recruitment at wild and reintroduced sites.
- Assist NARS with Kapuna subunit IV fence construction.
- Reassess reintroduction/augmentation plans for the Kapuna to Keawapilau PU.

Figure 2.1.25a *Schiedea nuttalii* individual *in situ.*

Table 2.1.25a Taxon Status Summary

Action Area: In

TaxonName: Schiedea nuttallii TaxonCode: SchNut

Population Unit Name	Management Designation	Current Mature (Wild)	Current Immature (Wild)	Current Seedling (Wild)	Current Augmented Mature	Current Augmented Immature	Current Augmented Seedling	NRS Mature 2006	NRS Immature 2006	NRS Seedling 2006	Total Mature	Total Immature	Total Seedling	Population Trend Notes
Kahanahaiki to Pahole	Manage for stability	19	3	4	42	4	0	80	8	3	**61**	**7**	**4**	Monitoring showed significant decline in wild population in Kahanahaiki
Kapuna-Keawapilau Ridge	Manage for stability	0	0	0	0	0	0	3	0	0	**0**	**0**	**0**	All of the known plants have died in the last year
	Total for Taxon:	19	3	4	42	4	0	83	8	3	**61**	**7**	**4**	

Action Area: Out

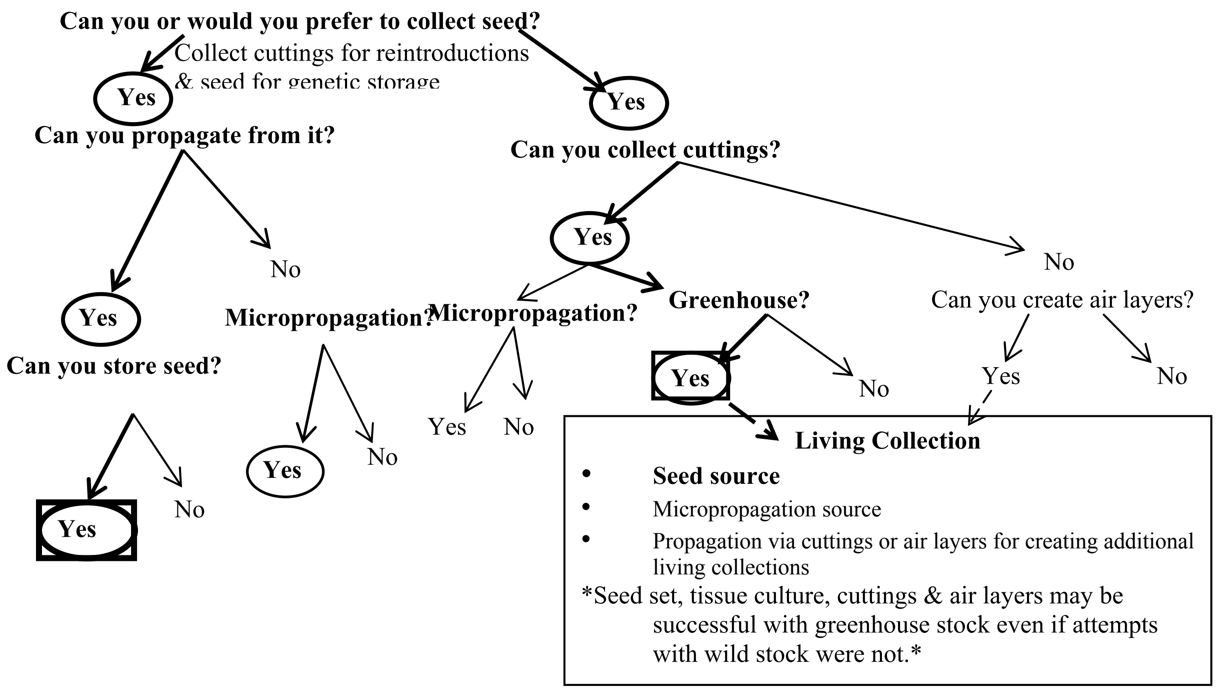
TaxonName: Schiedea nuttallii TaxonCode: SchNut

Population Unit Name	Management Designation	Current Mature (Wild)	Current Immature (Wild)	Current Seedling (Wild)	Current Augmented Mature	Current Augmented Immature	Current Augmented Seedling	NRS Mature 2006	NRS Immature 2006	NRS Seedling 2006	Total Mature	Total Immature	Total Seedling	Population Trend Notes
Makaha	Manage reintroduction for stability	0	0	0	7	0	0	0	0	0	**7**	**0**	**0**	7 plants outplanted into Makaha this year
	Total for Taxon:	0	0	0	7	0	0	0	0	0	**7**	**0**	**0**	

Propagation and Genetic Storage:

1) At this time, what is the preferred propagation technique?	2) At this time, what is the preferred genetic storage technique?	3) Has a successful storage method been determined?	4) Are additional steps required for obtaining enough seed?
Cuttings (preferred) and seed (when cuttings are not available or seed is already banked)	Seed	Yes	Yes, collect from living collections

Prioritizing Genetic Storage & Propagation Techniques



Collection: refer to OANRP 2006

Propagation: refer to OANRP 2006

Seed Storage Research: refer to OANRP 2006

Genetic Storage: NRS will continue to increase the living collection for this taxon for seed collection as well as propagate for reintroductions. Additional founders from Pahole were collected and propagated at Pahole Mid-elevation Nursery. Wild plants that had died and had been reintroduced were collected from to secure in the greenhouse for propagation stock and eventually to be used as a seed source. Aging has yet to be detected in stored seeds for four years at 4C and -18C at the Army Seed Conservation Lab. Therefore, NRS will not re-collect more often than every four years until storage data indicates otherwise.

Table 2.1.25b Genetic Storage Summary

Population Unit Name	# of Potential Founders: Current Mature	Current Imm.	NumWild Dead	Partial Storage Status: # Plants >= 10 in Seedbank	# Plants >=1 Microprop	# Plants >=1 Army Nursery	Storage Goals Met: # Plants that Met Goal
Schiedea nuttallii							
Kahanahaiki to Pahole	19	3	41	16	1	26	21
Kapuna-Keawapilau Ridge	0	0	4	0	0	1	0
				Total # Plants w/ >=10 Seeds in Seedbank	**Total # Plants w/ >=1 Microprop**	**Total # Plants w/ >=1 Army Nursery**	**Total # Plants that Met Goal**
				16	1	27	21

Unique Species Observations
No new observations were made during this reporting period.

Outplanting Issues
Reintroductions have been established at four sites in the Kahanahāʻiki to Pahole MU; two in Kahanahāʻiki and two in Pāhole. While NRS still monitor the remaining plants in the Kahanahāʻiki sites, reintroduction will no longer continue at these sites, as more appropriate site, historically known with *S. nuttallii* has been chosen instead. This site occurs on the Pahole side of the Pahole/Kahanahāʻiki fenceline and NRS have been balancing founders here for three years. NRS aim to have at least two representatives from each founder in this reintroduction of Kahanahāʻiki stock. Kahanahāʻiki stock will also be represented in the Mākaha reintroduction that began this year with 7 plants. This year, NRS established a site in Pahole of all Pahole stock, of which there are currently 15 founders. NRS still have not observed any recruitment on site at any reintroduction. However, NRS will make a concerted effort this winter to look for seedlings at all sites where mature individuals have contributed to the seedbank.

NRS had originally hoped to augment the Kapuna-Keawapilau Ridge PU using stock from the four known *insitu* founders in this PU. However, now that there is only stock from one of these founders, NRS need to reassess the reintroduction plan for this PU. NRS do not want to start a reintroduction with only one founder, therefore mixing with the next closest population, Pahole, seems appropriate. When the Kapuna subunit III and IV fences are finished, NRS will consider where to establish a reintroduction for this stock.

Schiedea nuttallii is a particularly fragile plant that is sometimes damaged during transport to outplanting sites. Plants have many opportunities to be broken as they are hand loaded into a transport device, flown by helicopter, landed on often times uneven ground, hand unloaded, and carried to individual planting sites. This year NRS will experiment to better stabilize these plants throughout this transition from nursery to reintroduction site by doing a more intensive packing of each plant individually.

Research Issues
No research was conducted this year on this taxon specifically. Ongoing research by NRS Research Specialist investigating slug control will benefit this species (Chapter 5.2).

Surveys
No surveys were conducted over the last year for this taxon.

Taxon Threats
A new observed threat to this and several other taxa this summer is mice (*Mus musculus*). Mice chewed off all the leaves of several plants at one of the Pahole reintroduction sites this year. NRS are investigating new types of specific mice controls as it is difficult to measure success of reducing the population with the current rat baiting grids and snap traps. If found effective, these types of tools, or the standard rat baiting grid and snap traps will be used at this site. This impact appears very seasonal with focused damage in the summer. Seasonal control will be investigated.

A small number of pigs are currently being snared out of Pāhole exclosure. No pig damage has been observed around any *S. nuttallii* populations. Other threats to this taxon remain the same (OANRP). NRS are researching possible control methods for slugs (Chapter 5.2).

Population Unit Level Discussion

Table 2.1.25c Population Unit Threat Control Summary

Action Area: In

TaxonName: Schiedea nuttallii

PopulationUnitName	ManagementDesignation	Protected from Ungulates	Weeds Managed	Rats Controlled
Kahanahaiki to Pahole	Manage for stability	Yes	Partial	No
Kapuna-Keawapilau Ridge	Manage for stability	No	Partial	No

Action Area: Out

TaxonName: Schiedea nuttallii

PopulationUnitName	ManagementDesignation	Protected from Ungulates	Weeds Managed	Rats Controlled
Makaha	Manage reintroduction for stability	Yes	Partial	No

Manage for Stability PUs

Kahanāhaiki to Pāhole: As mentioned above, numbers of wild plants dropped significantly in this PU at what was once the largest wild population site in Kahanahā'iki. NRS observed significant water stress in the seven remaining mature plants, and managed to take cuttings from these before they died. NRS are hopeful that seeds in the seed bank will germinate with appropriate conditions, and the population may recover. Stock from founders of this population will be continually propagated until safe numbers of individuals exist either in the greenhouse or in reintroductions. All plants in this PU are within a fenced exclosure and habitat quality at most sites is good. Because most sites are on fragile steep areas, weed control around sites is conducted as needed, and not regularly scheduled. It will be beneficial to try new reintroduction sites in the future, in order to find a site where threats are reduced and ultimately where this taxon will successfully regenerate. NRS will also continue to balance stock at current sites with the hopes of building up a seed bank large enough to overcome threats. This year NRS established a new reintroduction site in Pahole for Pahole stock. NRS continued to work this year with NARS staff to collect and store stock from Pahole founders. NRS also weeded around the larger wild Pahole population while monitoring and collecting from the population, and found one new mature and one immature plant while doing so.

It is essential that pigs are completely removed from the Pāhole fence. No plants have been threatened by the pigs currently in the fence, but there is a potential devastating threat, mostly to the reintroductions.

Kapuna-Keawapilau Ridge: Finishing the Kapuna subunit III and IV fences, will be important in facilitating appropriate habitat for future reintroduction sites for this population. See outplanting issues for more discussion about this PU.

Mākaha Reintroduction: An ecosystem-sized fence in Mākaha was completed this year. The exclosure contains appropriate *S. nuttallii* habitat for reintroductions, and NRS began the reintroduction there with seven mature plants. These plants were planted into a small temporary fence before the Mākaha subunit I fence was completed. Pigs dug up habitat outside this fence where more plants were slated for reintroduction. No plants inside the temporary fence were harmed. NRS will consider whether or not expanding the site into the pigged area is appropriate, or to choose a new site. All pigs should be removed from the Mākaha subunit I fence by the end of this year. NRS will continue to balance founders in the Māhaka reintroduction with Kahanahā‘iki stock this year.

2.1.26 *Schiedea obovata*

Requirements for Stability

- 3 Population Units (PUs)
- 100 reproducing individuals in each PU (short-lived perennial which is prone to large fluctuations)
- Stable population structure
- Threats controlled
- Complete genetic representation of all PUs in storage
- Expedited Stabilization (10 years)

How many of the 3 MFS PUs have stable numbers of mature individuals?	How many of the 3 MFS PUs have had *in situ* recruitment?	How many of the 3 MFS PUs have full genetic storage?	How many of the 3 MFS PUs are protected from ungulates?	How many MFS PUs that need reintroductions have been initiated?
1/3	2/2 (only 2 *in situ* PUs)	2/2 (only 2 *in situ* PUs)	2/3	0/3

Taxon Level Discussion

There are currently three *in situ Schiedea obovata* populations, all in the Keawapilau to West Makaleha Population Unit (PU). Prior to the disappearance of *S. obovata* from other known sites, seeds were collected and are being used to augment the Kahanahāʻiki to Pahole, and Keawapilau to West Makaleha PUs. Both of these PUs are to be Managed for Stability, (MFS) and are inside the Mākua Action Area (AA). The Mākaha PU is outside of the AA. A reintroduction established here will serve as the third MFS population. Genetic storage collection goals have been met for this species. NRS will continue to monitor and collect from new plants as they mature. No significant changes occurred within the wild populations this year. This year, NRS continued to balance founders at three reintroduction sites in the Kahanahāʻiki to Pahole PU, and at one site in the Keawapilau to West Makaleha PU. A new augmentation site was established in the Keawapilau to West Makaleha PU with 50 plants this year. The Mākaha subunit I fence is finished and a reintroduction will be established. Rats have still been an observed threat to this species. At one particular reintroduction site where continual rat damage has been observed, NRS plan to install bait stations and snaps prior to new outplantings, for as long as is felt necessary.

NRS have determined this year that plants can be cross pollinated in the nursery. Seed from these crosses were collected, and will be grown to outplant into the Mākaha PU in year 5. NRS are looking to see the differences in survivorship of progeny of these crosses to determine whether or not outbreeding depression will occur. See Research Issues below for more details on these pollination studies.

This year the US Fish and Wildlife service designated this taxon as a species to be “Expedited for Stabilization” in the 2007 Biological Opinion. This requires stabilization for *S. obovata* in one PU outside the action area within five years. NRS are also to initiate a reintroduction outside of the Mākua Action Area (AA). Therefore the Mākaha PU would serve as both a PU managed for stability and the reintroduction initiated for stability outside of the AA. As with some other species that fall under this designation, the only *in situ* PUs of *S. obovata* are within the AA, and NRS feel these PUs are higher priority populations for stability. However, seed source is readily available, and it is feasible that 100 plants can be propagated and outplanted in Mākaha. Although, in order for this PU to achieve a stable population structure, it will have to overcome threats and recruitment difficulties observed in other PUs.

Major Highlights/Issues Year 3

- Plants from different populations were successfully cross pollinated in the greenhouse.
- Mākaha fence construction is finished.
- Species Expedited for Stabilization in five years.
- A new augmentation site was established in Keawapilau with Keawapilau stock (from Dr. Steven Weller who has seed from the extirpated site)
- Kapuna subunit III and IV fence construction has begun.

Plans for Year 4

- Continue to balance founders at all reintroduction sites.
- Continue growing wild stock in the greenhouse to cross pollinate.
- Grow out progeny from cross pollinated plants to determine signs of outbreeding depression.
- Determine stock to be used in Mākaha

Table 2.1.26a Taxon Status Summary

Action Area: In

TaxonName: Schiedea obovata **TaxonCode: SchObo**

Population Unit Name	Management Designation	Current Mature (Wild)	Current Immature (Wild)	Current Seedling (Wild)	Current Augmented Mature	Current Augmented Immature	Current Augmented Seedling	NRS Mature 2006	NRS Immature 2006	NRS Seedling 2006	Total Mature	Total Immature	Total Seedling	Population Trend Notes
Kahanahaiki to Pahole	Manage for stability	0	0	0	177	119	7	103	134	56	**177**	**119**	**7**	
Keawapilau to West Makaleha	Manage for stability	43	16	11	20	48	0	55	30	11	**63**	**64**	**11**	
	Total for Taxon:	43	16	11	197	167	7	158	164	67	**240**	**183**	**18**	

Action Area: Out

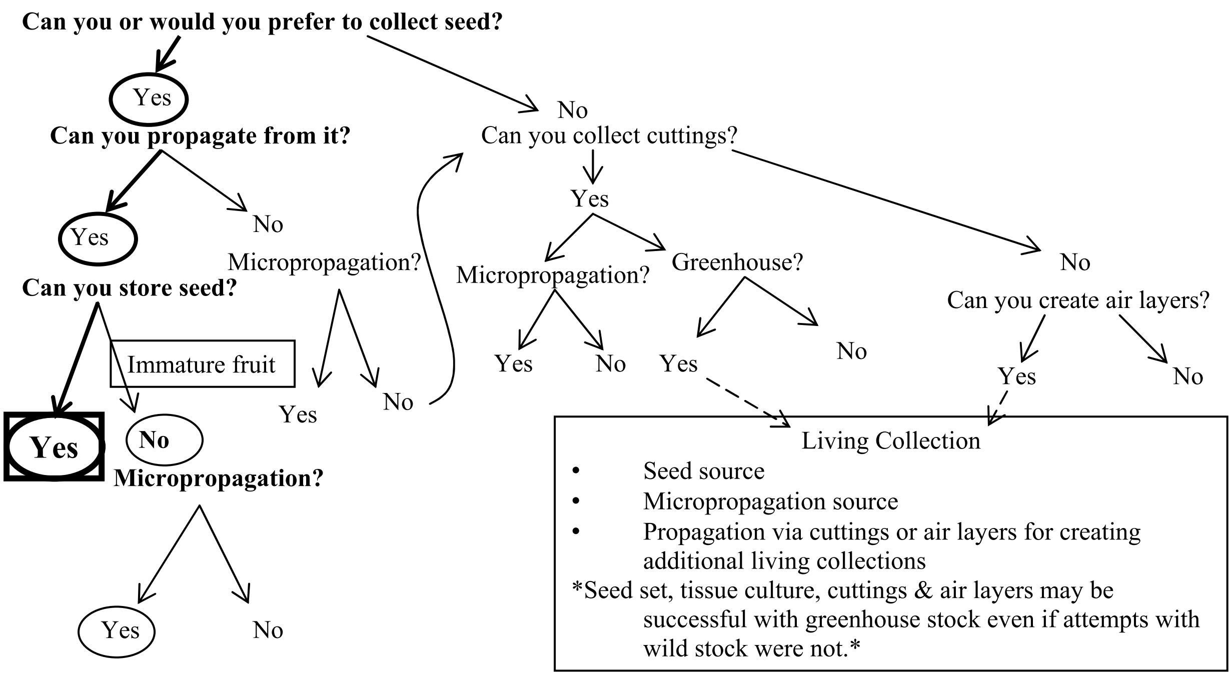
TaxonName: Schiedea obovata **TaxonCode: SchObo**

Population Unit Name	Management Designation	Current Mature (Wild)	Current Immature (Wild)	Current Seedling (Wild)	Current Augmented Mature	Current Augmented Immature	Current Augmented Seedling	NRS Mature 2006	NRS Immature 2006	NRS Seedling 2006	Total Mature	Total Immature	Total Seedling	Population Trend Notes
Makaha	Manage reintroduction for stability	0	0	0	0	0	0	0	0	0	**0**	**0**	**0**	
	Total for Taxon:	0	0	0	0	0	0	0	0	0	**0**	**0**	**0**	

Propagation and Genetic Storage

1) At this time, what is the preferred propagation technique?	2) At this time, what is the preferred genetic storage technique?	3) Has a successful storage method been determined?	4) Are additional steps required for obtaining enough seed?
Seed	Seed	Yes	No

Prioritizing Genetic Storage & Propagation Techniques



Collection: refer to OANRP 2006

Propagation: refer to OANRP 2006

Seed Storage Research: refer to OANRP 2006. No aging has been detected in seeds stored dry at -18C or -150C (lN2). Seeds have been tested for over ten years at -150C.

Genetic Storage: refer to OANRP 2006. Genetic storage goals have been met for this taxon. Once backup storage collections are established for this taxon at NCGRP, NRS will most frequently re-collect once every ten years.

Unique Species Observations

Within and among populations, there is wide variation in morphological traits such as leaf morphology and branch development. For example, leaf length among similarly-aged cohorts ranged from 2-8 cm. The widest variation in leaf length was observed in a single population (northwest Makaleha). NRS will hopefully be able to tell if leaf variation is environmental or genetic now that cross pollination can occur.

Table 2.1.26b Genetic Storage Summary

Population Unit Name	# of Potential Founders: Current Mature	Current Imm.	NumWild Dead	Partial Storage Status: # Plants >= 10 in Seedbank	# Plants >=1 Microprop	# Plants >=1 Army Nursery	Storage Goals Met: # Plants that Met Goal
Schiedea obovata							
Kahanahaiki to Pahole	0	0	5	5	1	5	5
Keawapilau to West Makaleha	43	16	9	60	1	12	60
				Total # Plants w/ >=10 Seeds in Seedbank	**Total # Plants w/ >=1 Microprop**	**Total # Plants w/ >=1 Army Nursery**	**Total # Plants that Met Goal**
				65	2	17	65

Outplanting Issues

Using seed collected by NRS and NARS from four wild sites: Kahanahā'iki, Pahole (2 sites), and West Makaleha, NRS have been propagating and outplanting *S. obovata* to augment those PUs. Stock has only been mixed in the Kahanahā'iki PU where plants from a site in West Makaleha were outplanted by a U.H. graduate student for a research project. Seedling recruitment has been observed at a few sites, but is significant at only one of the Pahole sites. Whether the absence of slugs or some other factor is responsible for the observed recruitment is still unknown. There were two outplanting events at this Pahole site, the first with 50 plants, and the second with nearly 70. It is also possible that planting lots of plants at a time is helpful in establishing a large seedbank. In order to try many sites for reintroduction, another Pahole reintroduction is spread out across the Kahanahā'iki/Pahole boundary across 4 sites further north than the other. No seedlings have been seen at any of these sites. However, no more than 30 plants were planted at any of these sites. If NRS do not have enough plants to drastically increase numbers at each site, it may be worth it to reintroduce in to only a couple of the sites to bulk up numbers there. In Kahanahā'iki, a new outplanting was established last year close to a reintroduction site where recruitment was observed. This site is also near the historical wild Kahanahā'iki plant. So far there is no recruitment at this reintroduction, and survivorship levels are at 50%. This is likely due to rat damage that was observed within the first two months of the first set of plants being planted.

This year an augmentation was established near the Keawapilau plants found last year, using stock from seed Dr. Weller had from an extirpated Keawapilau individual. NRS were able to collect seed from the wild population found last year, and plants from this seed will be included in this augmentation next year. Dr. Weller has also supplied NRS with stock from extirpated sites in Pahole. NRS are grateful for the relationship with Dr. Weller and will keep up-to-date on his seed stock levels to make sure there is enough seed available to reach stability goals. If not, NRS will utilize greenhouse plants to collect more seed.

Research Issues

Mixed-stock Outplanting Update:

NRS would like to determine what founders should be represented together in a reintroduction in Mākaha. Though not yet formally concluded, *S. obovata* is at least a facultative selfer, and probably has a very high selfing rate in the wild. With typically selfing species, outbreeding depression becomes a concern for mixed progeny may not be as fit as either parent for the habitat of the reintroduction. NRS decided to cross all available greenhouse stock. NRS attempted crossing plants in the greenhouse during the summer of 2006 with no success. Pollination methods were refined and plants were crossed in the greenhouse this past summer. Flowers were emasculated prior to anther dehiscence, pollinated with fresh pollen, and monitored. Fruit abortion, collection, and number of seeds per fruit were recorded. There were no significant differences between the fruit set or seed set between population site for maternal plants, pollen sources, or any combination. There is a slight trend indicating higher fruit set from plants when the pollen source is Population Reference Site LEH-B (NW corner West Makaleha), though this is not significant nor supported in seed set. Additional crosses from founders that were not yet crossed may be conducted next year. Germination has not yet begun. NRS proposes to start viability assays to measure offspring fitness from these collections.

Surveys

No new surveys were conducted for *S. obovata* this past year.

Taxon Threats

Ungulates, weeds, slugs, and possible rats all threaten the survival of *S. obovata*. There are fences completely protecting plants in two PUs. The completion of the Kapuna subunit III fence will protect the third. Weed control is conducted at all extant populations. Slug research is still underway, and rat control may be necessary at the Kahanahāʻiki reintroduction site.

Population Unit Level Discussion

Table 2.1.26c Population Unit Threat Control Summary

Action Area: In

TaxonName: Schiedea obovata

PopulationUnitName	ManagementDesignation	Protected from Ungulates	Weeds Managed	Rats Controlled
Kahanahaiki to Pahole	Manage for stability	Yes	Partial	No
Keawapilau to West Makaleha	Manage for stability	Partial	Partial	Partial

Action Area: Out

TaxonName: Schiedea obovata

PopulationUnitName	ManagementDesignation	Protected from Ungulates	Weeds Managed	Rats Controlled
Makaha	Manage reintroduction for stability	No	No	No

Manage for Stability PUs

Kahanahāʻiki to Pahole: This PU encompasses three former *in situ* sites of *S. obovata*; two in Pahole and one in Kahanahāʻiki. The wild populations in Kahanahāʻiki and Pahole were gone from the wild by 2001. Historic sites are checked for new seedlings, but none have been found. Reintroduced *S. obovata* in Kahanahāʻiki have performed poorly compared to those reintroduced to Pahole (see Outplanting Issues). Onsite germination has been seen at two reintroduction sites in Kahanahāʻiki, but numbers were very low. NRS continued outplanting near a reintroduction where germination was observed. This outplanting occurs across a larger area that is actively being restored with common outplantings and frequent weed control.

The most productive reintroduction site in Pahole is over 4 years old and is very successful. There are currently 98 mature individuals, 17 immatures, and 68 seedlings. Twenty-seven % of these mature individuals are F1 generation. Figure 2.1.26d shows F1 plants of all size classes between reintroduced individuals. NRS will continue to balance founders at this site this year, and as long as founders remain balanced, will let the population respond on its own. This population serves as a great opportunity to observe population dynamics for this taxon. Photo below shows a group of more than 30 F1 individuals of all age classes.

Figure 2.1.26a *Schiedea obovata* Pahole outplanting

Keawapilau to West Makaleha: This PU encompasses all three known extant populations of *S. obovata*; two in West Makaleha and a new site found in Keawapilau. A population extirpated in Keawapilau in 2000 is also included in this PU. Wild plants at one site in West Makaleha are numerous. No monitoring was done this year at this population, but will be done next year. NRS conduct weed control around all plants throughout this PU. This year, NRS continued to augment the smaller West Makaleha population in the Three Points fence nearby. This population has 68% survivorship.

Mākaha: Construction of the Mākaha Subunit I was completed this year and NRS will work with the IT to determine the best stock for this PU.

2.1.27 *Tetramolopium filiforme*

Requirements for Stability
- 4 Population Units (PUs)
- 50 reproducing individuals in each PU (short-lived perennial)
- Stable population structure
- Threats controlled
- Complete genetic representation of all PUs in storage

How many of the 4 MFS PUs have stable numbers of mature individuals?	How many of the 4 MFS PUs have had *in situ* recruitment?	How many of the 4 MFS PUs have full genetic storage?	How many of the 4 MFS PUs are protected from ungulates?	How many MFS PUs that need reintroductions have been initiated?
1/4	1/4	0/4	3/4	1/3

Taxon Level Discussion
Tetramolopium filiforme occurs in five sites in the northern Wai‘anae Mountains. All but one of the PUs are inside either the Mākua AA or Schofield AA. Since this taxon is found within two AAs there are four PUs that are designated to be managed for stability. The threats for this species are manageable and NRS believe that with reintroductions and increased management of additional habitat, stability is attainable.

Major Highlights/Issues Year 3
- Cuttings from all plants in the Kalena PU are established in the nursery. Kalena PU stock is being duplicated in the greenhouse so the goal of >3 plants per founder can be attained.
- The Pūhāwai outplanting was augmented with three additional plants this year.

Plans for Year 4
- Keep Kalena PU stock separate from other *T. filiforme* stocks at Pahole Nursery in order to secure seed for storage. Continue to subculture greenhouse plants in order to maintain plant vigor and genetic representation.
- Collect cuttings from Wai‘anae Kai PU stock to establish in the nursery as a seed source.
- Show Botanist, Joel Lau the nursery stock from the Kalena PU and the Pūhāwai PU to determine if there are any characteristics unique to one or the other.

Table 2.1.27a Taxon Status Summary

Action Area: In

TaxonName: Tetramolopium filiforme **TaxonCode: TetFil**

Population Unit Name	Management Designation	Current Mature (Wild)	Current Immature (Wild)	Current Seedling (Wild)	Current Augmented Mature	Current Augmented Immature	Current Augmented Seedling	NRS Mature 2006	NRS Immature 2006	NRS Seedling 2006	Total Mature	Total Immature	Total Seedling	Population Trend Notes
Kahanahaiki	Genetic Storage	45	0	0	0	0	0	45	0	0	**45**	**0**	**0**	Monitoring showed no change in the last year.
Kalena	Manage for stability	9	0	6	0	0	0	9	0	0	**9**	**0**	**6**	Monitoring showed no change in the last year.
Keaau	Genetic Storage	30	41	17	0	0	0	30	41	17	**30**	**41**	**17**	No monitoring in the last year
Makaha/Ohikilolo Ridge	Genetic Storage	300	0	0	0	0	0	300	0	0	**300**	**0**	**0**	No monitoring in the last year
Ohikilolo	Manage for stability	2442	552	1	0	0	0	2442	552	1	**2442**	**552**	**1**	Monitoring found no change in the last year
	Total for Taxon:	2826	593	24	0	0	0	2826	593	18	**2826**	**593**	**24**	

Action Area: Out

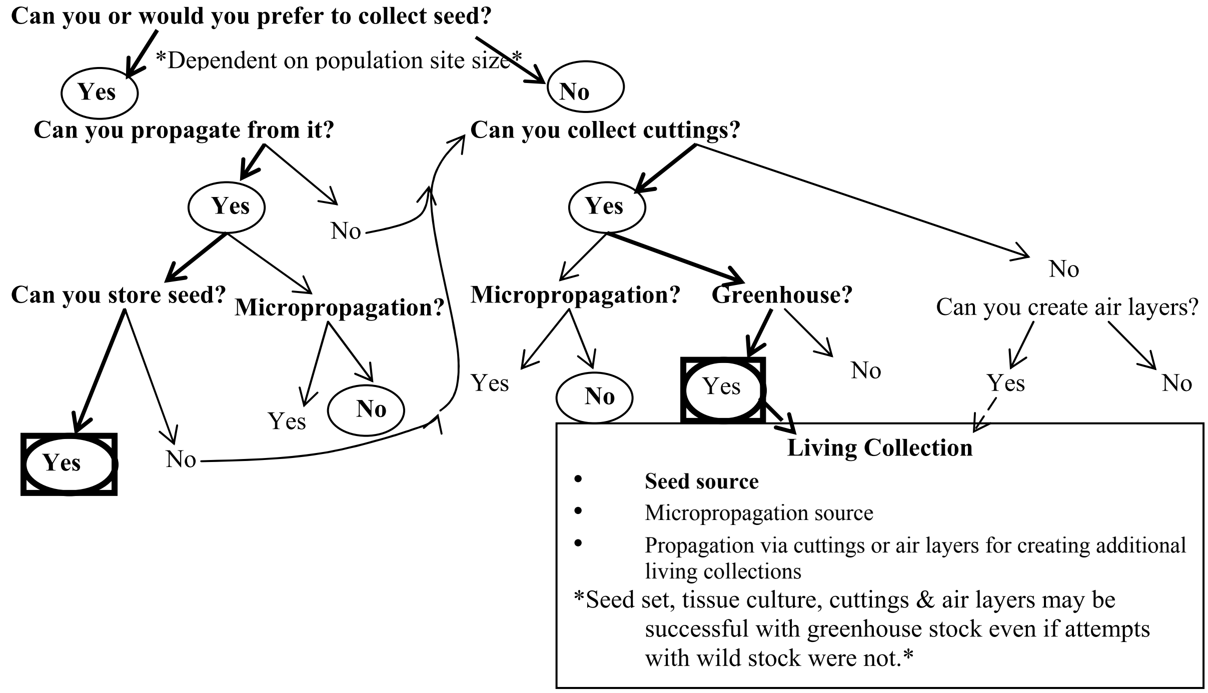
TaxonName: Tetramolopium filiforme **TaxonCode: TetFil**

Population Unit Name	Management Designation	Current Mature (Wild)	Current Immature (Wild)	Current Seedling (Wild)	Current Augmented Mature	Current Augmented Immature	Current Augmented Seedling	NRS Mature 2006	NRS Immature 2006	NRS Seedling 2006	Total Mature	Total Immature	Total Seedling	Population Trend Notes
Puhawai	Manage for stability	1	2	3	6	0	0	19	2	3	**7**	**2**	**3**	High mortality in reintroduced plants since last year. Three new outplants put out this winter. Wild population not monitored thoroughly this year.
Waianae Kai	Manage for stability	30	8	1	0	0	0	30	8	1	**30**	**8**	**1**	No monitoring in the last year
	Total for Taxon:	31	10	4	6	0	0	49	10	4	**37**	**10**	**4**	

Propagation & Genetic Storage

1) At this time, what is the preferred propagation technique?	**2)** At this time, what is the preferred genetic storage technique?	**3) Has a successful storage method been determined**?	**4)** Are additional steps required for obtaining enough seed?
Cutting and seed	Seed	Yes	Yes; living collections as seed source for smaller population sites

Prioritizing Genetic Storage & Propagation Techniques



Collection: refer to OANRP 2006

Propagation: refer to OANRP 2006

Seed Storage Research: Preliminary results from collaborative research with NCGRP has indicated that aging has been detected for this taxon at various temperatures. Collections may become half as viable as they were initially within a decade after collection (rough estimate). This would be the time to re-collect. Seeds may also be stored at lower temperatures and this might extend their longevity.

Genetic Storage: Seed collections from isolated cutting stock in the Army Nursery from the Kalena PU were attempted this year. The plants did flower but viable seed was not produced. Plants were consequently moved to Pahole Mid-elevation Nursery. Though this taxon has produced viable seed at the Army Nursery before, this summer may have been too hot or plants from this PU may have different environmental requirements for seed set. Since the Pahole Nursery is closer in elevation than the Army Nursery, NRS hopes this move may yield viable seed and plans to continue monitoring plants until genetic storage goals are met in the storage seedbank. Until so, this stock will remain in the nursery as a living collection.

Table 2.1.27b Genetic Storage Summary

	# of Potential Founders			Partial Storage Status			Storage Goals Met
Population Unit Name	Current Mature	Current Imm.	NumWild Dead	# Plants >= 10 in Seedbank	# Plants >=1 Microprop	# Plants >=1 Army Nursery	# Plants that Met Goal
Tetramolopium filiforme							
Kahanahaiki	45	0	37	99	0	0	60
Kalena	9	0	0	7	0	9	7
Keaau	30	41	0	17	0	0	2
Makaha/Ohikilolo Ridge	300	0	0	0	0	0	0
Ohikilolo	2442	552	1	111	0	0	42
Puhawai	1	2	9	4	0	3	4
Waianae Kai	30	8	0	1	0	0	0
				Total # Plants w/ >=10 Seeds in Seedbank	**Total # Plants w/ >=1 Microprop**	**Total # Plants w/ >=1 Army Nursery**	**Total # Plants that Met Goal**
				239	0	12	115

Unique Species Observations

There have been no new unique species observations in this reporting period.

Outplanting Issues

In the last year, NRS supplemented the Pūhāwai augmentation with three additional plants. These plants were added in order to balance founders based on initial survivorship recorded after last year's planting. Of the 28 plants outplanted in the 2005-2006 planting season, only three plants remain. This reintroduction represents the first attempt by NRS to plant onto a cliff. Planting spots with soils deep enough for digging a hole are very limited at the reintroduction site chosen near Pu'u Kūmakali'i. NRS will continue to reintroduce at this site but will choose planting locations similar to those where plants have performed the best. NRS expected that the initial attempts at reintroducing this taxon would be somewhat experimental in nature. The last few years have also been extremely dry perhaps further confounding the success of outplantings.

Figure 2.1.27a *Tetramolopium filiforme* from 4"pot and packaged for transport

Table 2.1.27c Founders Represented in Outplantings

TaxonName: Tetramolopium filiforme **TaxonCode: TetFil**

Total Num Plants based upon Plants that have been numbered

PopulationUnitName	Management Designation	Number of Founders	Number of Founders Represented
Kahanahaiki	Genetic Storage	82	0
Kalena	Manage for stability	9	0
Keaau	Genetic Storage	71	0
Makaha/Ohikilolo Ridge	Genetic Storage	300	0
Ohikilolo	Manage for stability	2995	0
Puhawai	Manage for stability	12	3
Waianae Kai	Manage for stability	38	0
	Total for Taxon:	**3507**	**3**

Number of Founders = Number of Mature, Immature, and Dead founder plants.
Number of Founders Represented = Number of founder plants represented in reintroductions.

Research Issues
There are no new research issues related to this taxon.

Surveys
NRS conducted surveys near the Kalena PU in adjacent habitat. NRS will continue to investigate undersurveyed habitat near small PUs for more individuals of this taxon.

Taxon Threats
Major threats to this taxon include feral goats and fire. No new threats were documented during this reporting period.

Population Unit Level Discussion

Manage for Stability PUs

‘Ōhikilolo: The ‘Ōhikilolo PU contains well over the 50 mature individuals required for stability. Estimates given to the MIP in 2000 were based on multiple observations from over fifteen sites on ‘Ōhikilolo Ridge. NRS compiled over fifty observations from ‘Ōhikilolo Ridge since 1997 and found that the summary numbers of plants estimated in each of these observations exceeds the estimate given in the MIP. NRS have been attempting to visit each of these sites in an effort to gauge any population fluctuations in this large PU. At this time, weeds are not considered a significant threat and ungulates no longer impact plants in this PU. Fire is only a high threat to the plants found in the lowest elevation site. Within the makai site, fire would likely not reach all of the plants as most are on very large steep cliffs that do not harbor much fuel. Most of the plants in this PU are found on the ridges further back in the valley and are not continuous with the large amount of fuel in the lower part of the valley. Otherwise, this PU has a stable number of mature individuals, the known threats are controlled, genetic storage techniques are known and collections are adequate. In the last year the “*Tetramolopium* peak” site within this PU was visited and a few additional collections were secured.

Table 2.1.27d Threat Control Summary

Action Area: In

TaxonName: Tetramolopium filiforme

PopulationUnitName	ManagementDesignation	Protected from Ungulates	Weeds Managed	Rats Controlled
Kahanahaiki	Genetic Storage	Yes	No	No
Kalena	Manage for stability	No	No	No
Keaau	Genetic Storage	No	No	No
Makaha/Ohikilolo Ridge	Genetic Storage	No	No	No
Ohikilolo	Manage for stability	Yes	Partial	No

Action Area: Out

TaxonName: Tetramolopium filiforme

PopulationUnitName	ManagementDesignation	Protected from Ungulates	Weeds Managed	Rats Controlled
Puhawai	Manage for stability	Partial	No	No
Waianae Kai	Manage for stability	No	No	No

Pūhāwai: At the wild site within this PU, the number of plants in all age classes has decreased over the last five years. In the last year, NRS did not complete a thorough monitoring on rappel, instead NRS only made observations using binoculars. NRS have observed the Pūhāwai site to be a much drier habitat than ʻŌhikilolo ridge. There appear to be no other obvious limiting factors to the Pūhāwai population. Ungulates are not known from this area and weeds have not been noted as a threat. The amount of appropriate habitat present at Pūhāwai is a key limiting factor to the continued existence of this population. Genetic storage collections from nursery stock of this PU have been very successful and will continue as necessary. NRS augmented this PU in 2006 and again this past year.

Waiʻanae Kai: *Tetramolopium filiforme* at this PU are located on cliffs that are very difficult to access. Because of their inaccessible nature, this area is not well surveyed. In the next year, NRS will attempt to collect from accessible plants and will survey new cliffs in the vicinity. Cuttings obtained will be maintained as clones in the nursery for *ex situ* storage and as seed stock plants.

Kalena: In the last year, NRS secured cuttings from all nine founder plants at this PU. The highest priority action for this PU is to address goat ingress from Waiʻanae Valley. NRS plan to work with the DOFAW in the next year to address the overwhelming goat population in the Waiʻanae Protected Watershed. In addition, NRS will collect seed from nursery clones for storage. The IT last year recommended that Joel Lau look at plants from the Kalena and Pūhāwai sites before any decisions were made about whether to mix the Kalena PU with the Pūhāwai PU. Some IT members supported mixing to avoid inbreeding depression and other IT members felt stock should be kept separate. NRS have not yet observed any traits unique to either site based on nursery observations. NRS do not plan to augment this PU until a decision is made about mixing populations.

Other PUs

Kahanahā ʻiki*:* The Kahanahāiki population of *T. filiforme* is located on a small cliff surrounded by *Diospyros sandwicensis* forest. This cliff is fairly devoid of vegetation, with only small, sparse shrubs present. Fire is the most significant threat to this site. NRS has seen the forest patch around this PU shrink after each fire burns the forest edge. Ungulate impacts are not an issue as all plants are located on a vertical cliff. This cliff is very sparsely vegetated, therefore the direct impacts of weeds on *T. filiforme* is minimal. *Panicum maximum* invasion, as it is linked to fire, is the most significant weed issue affecting the forest around this PU. NRS have conducted some control in years past. Genetic storage goals have been met for this PU.

Keaʻau: The first estimates for this site were based on the HBMP Botanist's observation from the ridge crest in 2002. In 2006, NRS monitored this site on rappel and collected seeds from 20 mature plants for genetic storage. NRS did not revisit the Keaʻau PU in the last year. This PU is within the Keaʻau Public Hunting Area and is not proposed to be fenced. Goats browse the habitat around the *T. filiforme* cliff region of Keaʻau but as of 2006 were not able to reach any *T. filiforme*. No substantial and direct threat from weeds was noted, but fire may be of concern in the future.

Mākaha /'Ōhikilolo Ridge: This PU was originally lumped with the ʻŌhikilolo PU due to the close proximity of the sites, but was later treated separately because of its location outside of the ʻŌhikilolo ridge fenceline. Monitoring and collecting from the site has not been a high priority because it is assumed to be genetically similar to the ʻŌhikilolo stock. No significant weed threats have been observed.

2.1.28 *Viola chamissoniana* subsp. *chamissoniana*

Requirements for Stability

- 4 Population Units (PUs)
- 50 reproducing individuals in each PU (short-lived perennial)
- Stable population structure
- Threats controlled
- Complete genetic representation of all PUs in storage

How many of the 4 MFS PUs have stable numbers of mature individuals?	How many of the 4 MFS PUs have had *in situ* recruitment?	How many of the 4 MFS PUs have full genetic storage?	How many of the 4 MFS PUs are protected from ungulates?	How many MFS PUs that need reintroductions have been initiated?
1/4	0/4	0/4	3/4	0/2

Taxon Level Discussion

Since this taxon is found inside the Action Areas (AA) of both MMR and SBW, there are four PUs that are designated MFS. A major challenge with this PU has been to collect seeds for storage and propagation. Most sites are accessed only by rope and the plants do not hold onto mature seed for long, instead seed is dehisced soon after maturity. To overcome this difficulty, NRS collected cuttings from wild plants and established a living collection in the nursery. This collection has been used to develop propagation, pollination and seed collection techniques. In the last year, NRS has made significant gains on this project and plan to begin large scale stock management for seed production in the next year. NRS will begin with stocks that have the lowest numbers of founders remaining as a priority.

Major Highlights/Issues Year 3

- NRS collaborated with researchers from the University of Hawaii and Ohio University to investigate physiology and phylogeny of Hawaiian violets.
- NRS completed the Mākaha Subunit I fence protecting the Mākaha PU
- NRS refined management and pollination of greenhouse stock and successfully collected seeds.
- Joel Lau discovered a new population in Central Makaleha

Plans for Year 4

- NRS plans to collect cuttings from PUs with low population numbers to be propagated for seed production.
- Search historical sites within Kamaileunu PU.
- Investigate areas in the Mākaha Subunit I for augmentation.
- Continue to investigate remote sensing options for developing monitoring techniques.
- NRS will search cliff areas around J. Lau's new site in Makaleha and collection if numbers are low.
- Investigate the relationship between the two subspecies of plants found at the Hālona PU.

Table 2.1.28a Taxon Status Summary

Action Area: In

TaxonName: Viola chamissoniana subsp. chamissoniana   TaxonCode: VioChaCha

Population Unit Name	Management Designation	Current Mature (Wild)	Current Immature (Wild)	Current Seedling (Wild)	Current Augmented Mature	Current Augmented Immature	Current Augmented Seedling	NRS Mature 2006	NRS Immature 2006	NRS Seedling 2006	Total Mature	Total Immature	Total Seedling	Population Trend Notes
Keaau	Genetic Storage	40	10	0	0	0	0	40	10	0	40	10	0	No monitoring in the last year
Makaha/Ohikilolo Ridge	Genetic Storage	7	0	0	0	0	0	7	0	0	7	0	0	No monitoring in the last year
Ohikilolo	Manage for stability	433	10	0	0	0	0	433	10	0	433	10	0	Some portions of MU monitored, no change
Puu Kumakalii	Manage for stability	44	0	0	0	0	0	44	0	0	44	0	0	Monitoring in the last year found no change
	Total for Taxon:	524	20	0	0	0	0	524	20	0	524	20	0	

Action Area: Out

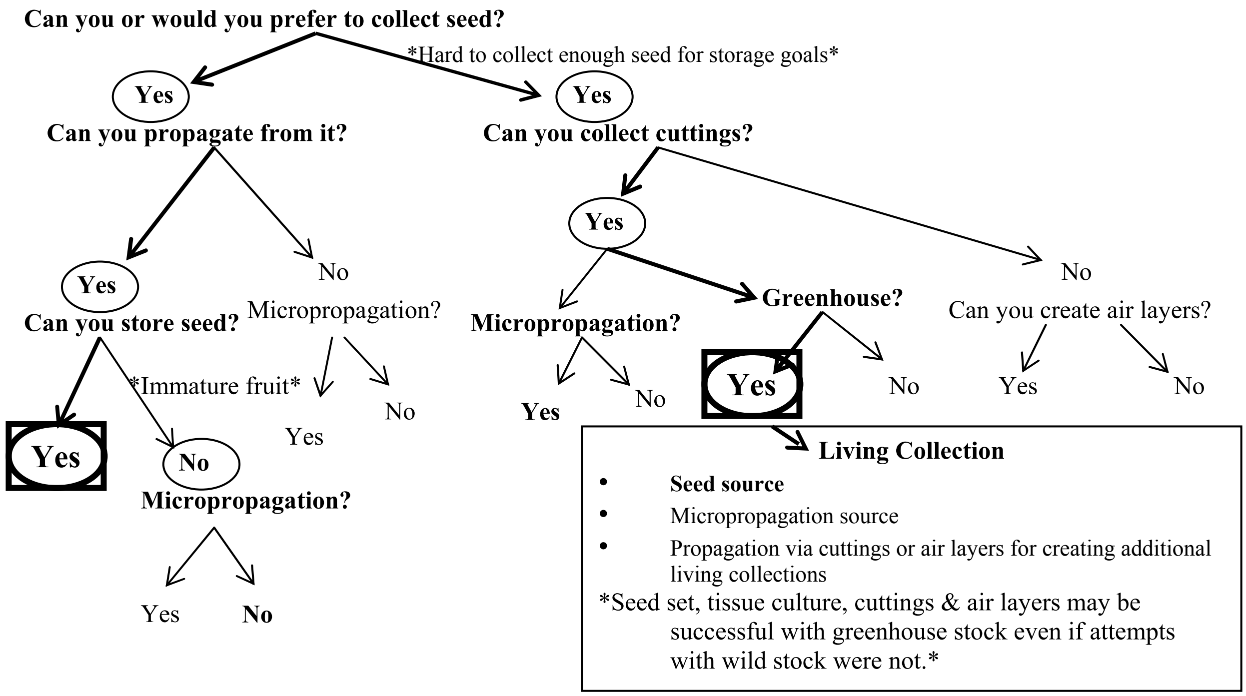
TaxonName: Viola chamissoniana subsp. chamissoniana   TaxonCode: VioChaCha

Population Unit Name	Management Designation	Current Mature (Wild)	Current Immature (Wild)	Current Seedling (Wild)	Current Augmented Mature	Current Augmented Immature	Current Augmented Seedling	NRS Mature 2006	NRS Immature 2006	NRS Seedling 2006	Total Mature	Total Immature	Total Seedling	Population Trend Notes
Halona	Manage for stability	41	3	0	0	0	0	41	3	0	41	3	0	No monitoring in the last year
Kamaileunu	Genetic Storage	35	0	0	0	0	0	35	0	0	35	0	0	No monitoring in the last year
Makaha	Manage for stability	17	2	0	0	0	0	24	0	2	17	2	0	Monitoring showed a decline in the last year
Makaleha	Genetic Storage	1	0	0	0	0	0	0	0	0	1	0	0	One new plant was discovered in the last year
Puu Hapapa	Genetic Storage	13	0	0	0	0	0	13	0	0	13	0	0	No monitoring in the last year
	Total for Taxon:	107	5	0	0	0	0	113	3	2	107	5	0	

Propagation and Genetic Storage

1) At this time, what is the preferred propagation technique?	2) At this time, what is the preferred genetic storage technique?	3) Has a successful storage method been determined?	4) Are additional steps required for obtaining enough seed?
Cuttings	Living collection for seed	Yes	Yes; living collection

Prioritizing Genetic Storage & Propagation Techniques



Collection: Viable seed is difficult to obtain from the wild plants. A high rate of fruit abortion has been observed for both wild and greenhouse plants. Also, fruit dehisce violently, dispersing many seeds immediately (Fig.2.1.28a). NRS conducted a pollination study in the greenhouse this year and determined that enough seed could be collected from plants for genetic storage goals. NRS will therefore place light-weight, breathable organza bags over immature fruit in the living collection as the primary method of seed collection.

Propagation: refer to OARNP 2006

Seed Storage: No aging has been detected in seeds stored at -18C and 20% RH. Results are for seeds that have been tested five years after storage.

Genetic Storage: Goals should be met for many of the founders represented in the greenhouse from Pu‘u Kūmakali‘i and Pu‘u Hāpapa PUs this year or next year from the pollination study. Additional cuttings will be collected from individuals in the smallest PUs first to add to the living collection to serve as a seed source.

Figure 2.1.28a Dehisced fruit with seeds (left). Flower of *Viola chamissoniana subsp. chamissoniana* (right).

Table 2.1.28b Genetic Storage Summary

Population Unit Name	# of Potential Founders: Current Mature	# of Potential Founders: Current Imm.	# of Potential Founders: NumWild Dead	Partial Storage Status: # Plants >= 10 in Seedbank	Partial Storage Status: # Plants >=1 Microprop	Partial Storage Status: # Plants >=1 Army Nursery	Storage Goals Met: # Plants that Met Goal
Viola chamissoniana subsp. chamissoniana							
Halona	41	3	0	3	0	2	1
Kamaileunu	35	0	0	0	0	0	0
Keaau	40	10	0	0	0	0	0
Makaha	17	2	0	0	0	0	0
Makaha/Ohikilolo Ridge	7	0	0	0	0	0	0
Ohikilolo	433	10	0	1	0	4	2
Puu Hapapa	13	0	0	4	0	9	5
Puu Kumakalii	44	0	0	10	0	19	11
				Total # Plants w/ >=10 Seeds in Seedbank	**Total # Plants w/ >=1 Microprop**	**Total # Plants w/ >=1 Army Nursery**	**Total # Plants that Met Goal**
				18	0	34	19

Unique Species Observations

No new observations have been made during this reporting period.

Outplanting Issues

NRS have yet to conduct an outplanting with this taxon. In the next year, NRS will begin to look at the Mākaha PU and determine if there is a suitable site.

Research Issues

Phylogeny Study: NRS accompanied researchers from the U.H. (Professor, Dr. Lawren Sack) and O.U. (Chris Havran, PhD candidate) to *Viola* sites this year. In this study researchers are investigating physiology and phylogeny of Hawaiian violets through the groups adaptive radiation in similar micro sites across their range in Hawaii. NRS will keep in contact with these researchers and report on their research results in next year's report.

Pollination Study: This year plants flowered abundantly and continuously from May through September 2007. Plants had been moved from the mist house at Pahole Mid-Elevation Nursery into a more open shade house at the beginning of the year. This may have stimulated flowering. Four treatments were applied: 1) Bagged flower buds for selfed flowers (pollinator-exclusion); 2) Bagged immature fruit for ambient pollination; 3) Pollen added to open flowers from opportunistic donors (including self); 4) Pollen added to emasculated flowers from opportunistic donors (including self). Fruit collection is still ongoing and formal conclusions will be available for 2008. However, ample seed was collected from the fruit in the study. Additional fruit were produced but not bagged for collection. If all fruit produced on the plants were bagged for collection to retrieve all seeds within the fruit, storage goals could be met within one greenhouse flowering season.

Surveys

No surveys specifically targeting this taxon were performed in the last year. NRS plan to survey sites from Ken Wood in 1999 and 2000 in the Kamaileunu PU. J. Lau discovered a new location for this taxom in East Makaleha. A single plant was seen by J. Lau. NRS will return to the area in the next year to search surrounding cliffs and potential habitat.

Taxon Threats

No new threats have been determined for this species.

Population Unit Level Discussion

Manage for Stability PUs

'Ōhikilolo: This large PU has well over the number of plants required for stability. NRS will attempt to determine the population structure in the coming year. As the PU is so large, NRS only monitors a portion of the PU each year. In the next year NRS plan to begin to develop a sampling strategy with Jim Jacobi (USGS Botanist) to better track population trends. A perimeter goat fence along 'Ōhikilolo ridge protects this PU from goats. Last year, NRS reported that goat sign was found near this MU. Fortunately, NRS was able to repair the fence and remove the goats that had gotten through the fence before any damage was observed. Weeds that threaten the *V. chamissoniana* PU include *Erigeron karvinskianus* and *Melinus minutiflora*. Most observations of this taxon are done with binoculars so most often juveniles and seedlings are not reported. However, when NRS is able to access these sites on rappel, the smaller size classes are found. NRS conducted a remote sensing trial this year at Ōhikilolo in hopes that the flowers of *V. chamissoniana* could be detectable. Unfortunately, the trial was not conducted along dry cliffs for a combination of reasons (see the Rare Plant Chapter Introduction).

Pu‘u Kūmakali‘i: This population is peculiar for the taxon, as many of the plants found here are not located on cliffs. Large portions of the plants at this PU are found on steep slopes just above cliffs. Two years ago, goats were observed in SBW. NRS have established snares in the area to control the goats and two individuals were removed. Since that time, NRS has not observed any sign of goats. *Melinus minutiflora* is present, but NRS have yet to implement grass control. NRS will control grass in the more accessible portions of this PU. A living collection has been established in the nursery to serve as a source for genetic storage trials as discussed above. NRS took C. Havran from the University of Ohio to this PU this year to collect leaves and make measurements. Currently he is analyzing his data and NRS hopes to receive results within the year.

Table 2.1.28c Population Unit Threat Control Summary

Action Area: In

TaxonName: Viola chamissoniana subsp. chamissoniana

PopulationUnitName	ManagementDesignation	Protected from Ungulates	Weeds Managed	Rats Controlled
Keaau	Genetic Storage	No	No	No
Makaha/Ohikilolo Ridge	Genetic Storage	No	No	No
Ohikilolo	Manage for stability	Yes	Partial	No
Puu Kumakalii	Manage for stability	Yes	No	No

Action Area: Out

TaxonName: Viola chamissoniana subsp. chamissoniana

PopulationUnitName	ManagementDesignation	Protected from Ungulates	Weeds Managed	Rats Controlled
Halona	Manage for stability	No	Partial	No
Kamaileunu	Genetic Storage	Partial	No	No
Makaha	Manage for stability	Partial	No	No
Puu Hapapa	Genetic Storage	Yes	No	No

Mākaha: NRS completed the Mākaha Subunit I fence in September 2007. This effectively protects the majority of the plants from ungulates. Now that the fence is complete, NRS will begin to scope out weed control projects in the area. NRS will also look for potential augmentation sites within MU. NRS will also investigate other sites in the PU that were reported by Ken Wood in 1999. NRS will collect across the PU to establish a living collection that can be used to product seed and cuttings for storage and augmentation.

Hālona: NRS did not monitor the PU this year, but believe with additional surveys more *V. chamissoniana* may be found. Goats have been observed recently in North Hālona. Currently there are no goat populations at the site, but the habitat is vulnerable to impacts. The same set of weeds which are present at other PUs are present at Hālona. However, these weeds are not abundant. NRS consider this site to have a low weed threat. In the coming year, NRS will further investigate the plants found at this site. Both subspecies are known from this site and some plants of the subsp. *tracheliifolia* may have been included in the population estimates above.

Other PUs

Mākaha/‘Ōhikilolo Ridge: This PU was created by subdividing the ‘Ōhikilolo PU with the fence that runs along ‘Ōhikilolo ridge. These plants will be monitored opportunistically in combination with other actions in the area. Monitoring and collecting from the site has not been a high priority because it is assumed to be genetically similar to the ‘Ōhikilolo PU. NRS do not plan to control goats or conduct weed control in this area.

Kamaile‘unu: There are two sites that comprise this PU. NRS has been unable to relocate one site that National Tropical Botanical Garden Staff found in 2000 near Pu‘u Kawīwī. The second site has not been visited by NRS since 1999. These areas will be a priority for monitoring in the next year. Depending on the number of plants found when NRS monitor the PU, the urgency of collection will be determined. If only a few plants are found the site will be high priority for collection to establish an *ex situ* collection. NRS will also consider using this stack to augment the Makaha PU.

Pu‘u Hāpapa: NRS has not monitored this population in the last year. Cuttings were taken in 2005 from plants and are being used in a living collection at the nursery to produce seed for research and storage. NRS will revisit this site in the next year and collect more cuttings if necessary for the nursery living collection. NRS will collect seed from this stock as a priority in the next year due to low population numbers.

Kea‘au: J. Lau discovered this population in 2002. He noted that goats threaten the site. No significant weed threats were observed. This population is not a priority for management as it is located in such close proximity to the larger ‘Ōhikilolo populations. Monitoring and collecting from the site has not been a high priority because it is assumed to be genetically similar to the ‘Ōhikilolo PU.

East Makaleha: J. Lau discovered a single plant while working with NRS crews in East Makaleha. It is high priority to for NRS to visit the area with rappelling gear and explore cliff habitat to deter determine the number of individuals.

Chapter 2.1.0: RARE PLANT STABILIZATION PLAN STATUS

General Rare Plant Issues

This section outlines the status update sections prepared for OIP species. In general most of the information regarding the overarching plant management infrastructure, research, monitoring and strategies, is covered in the MIP Rare Plant Introduction. This section will cover any areas that are unique to OIP species.

Stabilization Strategy
This is the third year that NRS has used the stabilization strategy for designing rare plant management for these species. For details on this strategy please see OANRP 2006.

Example of Species Status Summary

The species status summary outlines PU work conducted for some of the 23 OIP plant taxa. NRS reported on 18 of these taxa for which there is significant information to report and management actions need to be evaluated. The six species that are not reported on are species that NRS has not yet begun to work extensively with and therefore do not have significant information to report. The format varies slightly for each taxon. Format follows the MIP, however only sections that have pertinent information are reported on. Deviations from the MIP format for these sections are discussed below.

Requirements for Stability: This section defines requirements for reaching stability for each taxon.

- 3 Population Units (PUs) are designated for all species. However, for species meeting the following criteria 4 PUs have been designated:
    - with presence in both Makua Action Area (AA) and Schofield AA (Example: *Plantago princeps*)
- Tier 1-3 is indicated (see OIP for reference, OANRP 2005a)

Taxon-Level Discussion: This section follows the format of MIP taxa, however there is one difference. The plan years are different in the bulleted lists. This year was “Urgent Action” year for OIP species and next year will be “Year 1” of the OIP

Propagation and Genetic Storage: In most cases this section has been condensed for the OIP species covered in comparison to MIP species. For most OIP taxa there is no follow chart or table in this section. As more information is collected in year one this section will expand.

2.2.1 *Abutilon sandwicense*

Requirements for Stability

- 4 Population Units (PUs)
- 50 reproducing individuals in each PU (short-lived perennial)
- Stable population structure
- Threats controlled
- Genetic storage collections from PUs managed for stability
- Tier 1 stabilization priority

Taxon Level Discussion

There are several hundred plants known from ten PUs across the Wai‘anae Mountains. Four Manage for Stability (MFS) PUs were selected because it occurs in both the Mākua Military Reservation (MMR) and Schofield Barracks West Range (SBW) Action Areas (AA). There are *in situ* plants known in three of the four MFS PUs and the Kaluakauila PU will be established by outplanting stock grown from the Kahanahā‘iki PU. The major threats to *Abutilon sandwicense* are goats, pigs, fire and weeds. The Kaluakauila PU is protected by a fence and other large fences are planned for Manuwai, Mākaha Mauka and Ekahanui. These fences will secure enough habitat for augmentations which may be needed in all PUs to meet stability goals. Collections of seed have been stored from the ‘Ēkahanui and Huliwai PU and clones from the Kahanahā‘iki plant are maintained as a living collection. NRS will begin a more extensive collection effort in the coming year.

Major Highlights/Issues in Urgent Actions

- The August 2007 Kaukonahua fire killed plants in the Alaiheihe to Puulu PU.
- Additional plants were added to the Kaluakauila PU reintroduction.

Plans for OIP Year 1

- Complete the Ekahanui MU fence
- Begin collections from small PUs with major threats inside the AAs.
- Begin augmentation of the ‘Ēkahanui and Huliwai PU.

Table 2.2.1a Taxon Status Summary

Action Area: In

TaxonName: Abutilon sandwicense **TaxonCode: AbuSan**

Population Unit Name	Management Designation	Current Mature (Wild)	Current Immature (Wild)	Current Seedling (Wild)	Current Augmented Mature	Current Augmented Immature	Current Augmented Seedling	NRS Mature 2006	NRS Immature 2006	NRS Seedling 2006	Total Mature	Total Immature	Total Seedling	Population Trend Notes
Alaiheihe to Puulu	Genetic Storage	14	5	1	0	0	0	22	10	0	14	5	1	Portions of this PU was burned in the Kaukonahua fire killing at least 12 plants
	Total for Taxon:	14	5	1	0	0	0	22	10	0	14	5	1	

Action Area: Out

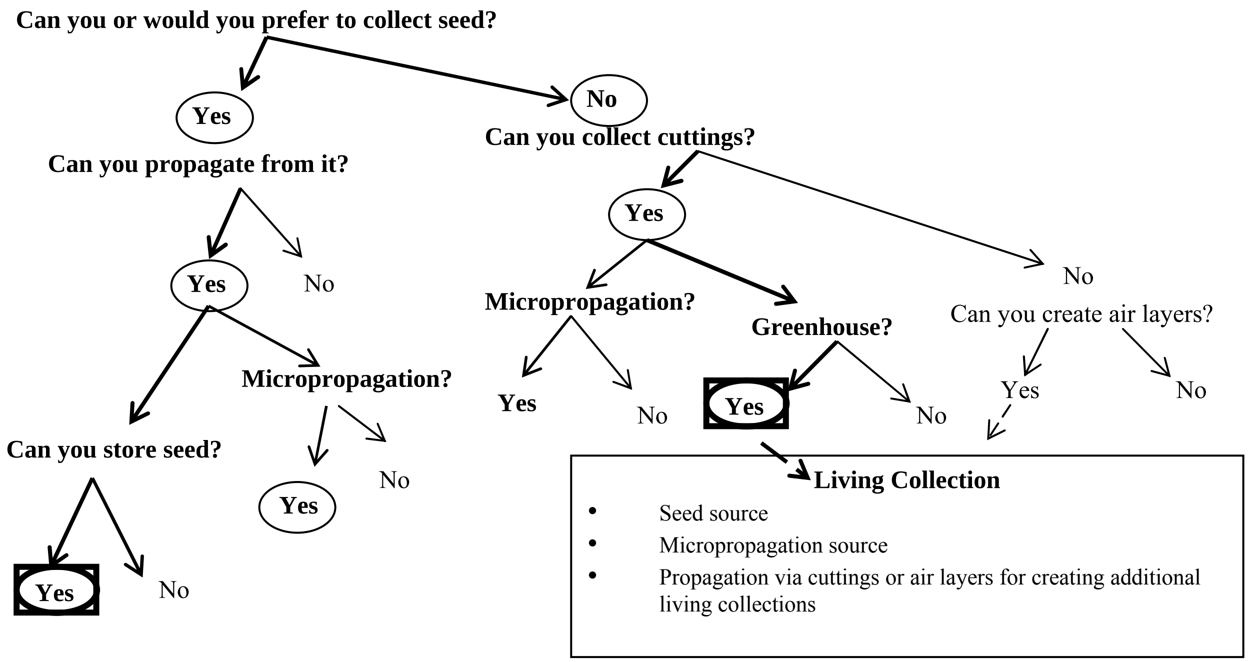
TaxonName: Abutilon sandwicense **TaxonCode: AbuSan**

Population Unit Name	Management Designation	Current Mature (Wild)	Current Immature (Wild)	Current Seedling (Wild)	Current Augmented Mature	Current Augmented Immature	Current Augmented Seedling	NRS Mature 2006	NRS Immature 2006	NRS Seedling 2006	Total Mature	Total Immature	Total Seedling	Population Trend Notes
East Makaleha	Genetic Storage	2	2	40	0	0	0	2	2	0	2	2	40	This PU has not been monitored since 1998 so no changes are known
Ekahanui and Huliwai	Manage for stability	18	38	0	0	0	0	16	31	0	18	38	0	More individuals found in known sites in Huliwai this year
Kaawa to Kaomoku Iki	Genetic Storage	1	18	1	0	0	0	1	18	1	1	18	1	This PU has not been monitored since 2003 so no changes are known
Kahanahaiki	Genetic Storage	0	0	0	0	0	0	0	0	0	0	0	0	The only known plant has been dead since 2003
Kaluakauila	Manage reintroduction for stability	0	0	0	0	23	0	0	22	0	0	23	0	Three reintroduced plants died and four new plants were added in the last year.
Keaau	Genetic Storage	1	0	10	0	0	0	1	0	0	1	0	10	Population not monitored since 2002 so no changes are known
Makaha Mauka	Manage for stability	5	58	4	0	0	0	40	100	0	5	58	4	A thorough census found a decline since the 2006 estimates
Manuwai	Manage for stability	6	59	1	0	0	0	7	59	0	6	59	1	Monitoring showed a small change in the last year
West Makaleha	Genetic Storage	0	2	0	0	0	0	0	2	0	0	2	0	No monitoring done in the last year
	Total for Taxon:	33	177	56	0	23	0	67	234	1	33	200	56	

Propagation and Genetic Storage

1) At this time, what is the preferred propagation technique?	**2)** At this time, what is the preferred genetic storage technique?	**3)** Has a successful storage method been determined?	**4)** Are additional steps required for obtaining enough seed?
Cuttings & Seed	Seed	Yes	No

Prioritizing Genetic Storage & Propagation Techniques



Collection: Fruit has been collected and cuttings have been taken. Fruit should be collected when capsules have turned tan and are no longer green.

Propagation: Cuttings have varied success; some collections root easily while others have been difficult to establish. Plants are easily propagated from seed. Seeds of this taxon have physical dormancy and need to be scarified to stimulate germination. Seed viability is variable. Seeds that float in water are typically empty and therefore discarded. This is necessary to get an accurate count of filled seeds that could potentially germinate.

Seed Storage Research: Seeds stored dry at -18C have shown no signs of aging after four years. Actually, seeds have higher germination after one, two, and four years of storage than freshly-germinated seeds. Seeds, therefore, may have some level of physiological or morphophysiological dormancy in addition to the physical dormancy. This phenomenon will continue to be studied. If germination continues to be higher after one year of storage, NRS will try to organize collection and reintroduction plans in order to allow seeds time in storage to maximize the number of seeds germinated and plants produced for reintroduction.

Genetic Storage: Seeds will be collected for genetic storage for plants in PUs where a high number of individuals are present. For plants in PUs with a low number of individuals, cuttings will be taken and clonal representation established in the nursery.

Outplanting Issues

NRS have been outplanting stock grown from the Kahanahāʻiki plant into two sites in Kaluakauila since 2005. Survivorship has been high (23/26) but the plants have not been observed flowering.

Surveys

NRS conducted surveys of the Alaiheihe to Puulu and Manuwai PU that were burned in the August 2007 Kaukonahua fire (see Kaukonahua Fire Report Appendix I). NRS will continue to monitor the burned areas that were known to have plants. In addition NRS will conduct surveys in PUs with low numbers of plants and major threats.

Threats

All known PUs are threatened by goats and pigs except Kaluakauila which is fenced. Fire is a threat to most PUs and the Kaukonahua fire burned into Alaiheihe to Puulu and Manuwai. Weeds threaten most PUs and control will begin once MU fences are complete.

Table 2.2.1b Threat Control Summary

Action Area: In

TaxonName: Abutilon sandwicense

PopulationUnitName	ManagementDesignation	Protected from Ungulates	Weeds Managed	Rats Controlled
Alaiheihe to Puulu	Genetic Storage	No	No	No

Action Area: Out

TaxonName: Abutilon sandwicense

PopulationUnitName	ManagementDesignation	Protected from Ungulates	Weeds Managed	Rats Controlled
East Makaleha	Genetic Storage	No	No	No
Ekahanui and Huliwai	Manage for stability	No	No	No
Kaawa to Kaomoku Iki	Genetic Storage	No	No	No
Kahanahaiki	Genetic Storage	No	No	No
Kaluakauila	Manage reintroduction for stability	Yes	Partial	Yes
Keaau	Genetic Storage	No	No	No
Makaha Mauka	Manage for stability	No	Partial	No
Manuwai	Manage for stability	No	No	No
West Makaleha	Genetic Storage	No	No	No

2.2.2 *Cyanea crispa*

Requirements for Stability

- 3 population units (PUs)
- 50 reproducing individuals (short-lived perennial)
- Stable population structure
- Threats controlled
- Genetic storage collections from PUs managed for stability
- Tier 2 stabilization priority

Major Highlights/Issues in Urgent Actions

- An outplanting within the newly constructed Helemano fence was established using stock from the Kawai Iki PU.
- Stock from NRS collections from the Makaua PU in1997 were transplanted from tissue culture at the Lyon Arboretum to the Pahole Mid-elevation Facility.
- Plant Extention Prevention (PEP) constructed a small scale fence protecting *Cyanea crispa* habitat was constructed in Makaua.

Plans for OIP Year 1

- Surveys for new plants in the three MFS PUs will be conducted by NRS.
- Continue to monitor and collect from additional founders in the Kawai Iki PU
- Monitor the outplanting in Helemano
- Work with PEP to begin collection of mature seed from the Kahana PU and augmenting the Kahana PU with stock from the nearby Makaua PU

Figure 2.2.2a Healthy wild *Cyanea crispa* in Kahana and reintroduced Helemano *Cyanea crispa* with possible slug predation

Table 2.2.2a Taxon Status Summary

Action Area: In

TaxonName: Cyanea crispa **TaxonCode: CyaCri**

Population Unit Name	Management Designation	Current Mature (Wild)	Current Immature (Wild)	Current Seedling (Wild)	Current Augmented Mature	Current Augmented Immature	Current Augmented Seedling	NRS Mature 2006	NRS Immature 2006	NRS Seedling 2006	Total Mature	Total Immature	Total Seedling	Population Trend Notes
Kawaiiki	Manage for stability	2	8	0	0	0	0	8	0	0	2	8	0	A thorough cencus showed a change in the population #s
	Total for Taxon:	2	8	0	0	0	0	8	0	0	2	8	0	

Action Area: Out

TaxonName: Cyanea crispa **TaxonCode: CyaCri**

Population Unit Name	Management Designation	Current Mature (Wild)	Current Immature (Wild)	Current Seedling (Wild)	Current Augmented Mature	Current Augmented Immature	Current Augmented Seedling	NRS Mature 2006	NRS Immature 2006	NRS Seedling 2006	Total Mature	Total Immature	Total Seedling	Population Trend Notes
Aihualama	N/A	0	0	0	0	0	0	1	0	0	0	0	0	No monitoring in the last year
Kahana and Makaua (Makaua portion)	N/A	0	0	0	0	0	0	25	0	0	0	0	0	No monitoring in the last year
Kahana portion of Kahana and Makaua	Manage for stability	6	0	0	0	0	0	30	0	0	6	0	0	No monitoring in the last year
Kaipapau	N/A	0	0	0	0	0	0	3	0	0	0	0	0	No monitoring in the last year
Kapakahi	N/A	0	0	0	0	0	0	1	0	0	0	0	0	No monitoring in the last year
Kawaipapa	N/A	0	0	0	0	0	0	1	0	0	0	0	0	No monitoring in the last year
Maakua	N/A	0	0	0	0	0	0	2	0	0	0	0	0	No monitoring in the last year
Maunawili	N/A	0	0	0	0	0	0	1	0	0	0	0	0	No monitoring in the last year
Pia	N/A	0	0	0	0	0	0	20	0	0	0	0	0	No monitoring in the last year
Pukele	N/A	0	0	0	0	0	0	6	0	0	0	0	0	No monitoring in the last year
Wailupe	Manage for stability	0	0	0	0	0	0	15	0	0	0	0	0	No monitoring in the last year
	Total for Taxon:	6	0	0	0	0	0	105	0	0	6	0	0	

Taxon Level Discussion
Cyanea crispa is known from 12 separate small PUs in mesic to wet habitat in both leeward and windward valleys in the Koʻolau Mountains. There are estimated to be 110 mature plants throughout its geographical range and the three MFS PUs were chosen to cover this entire range. NRS have not monitored many of the offsite PU for this species and therefore, the numbers in the table are compiled from a combination of NRS, HBMP and Oahu PEP data. The Kawai Iki PU occurs within the KLOA AA but all other PUs are offsite and out of the AA. There are approximately eight individuals in the Kawai Iki PU, however, some or all of these individuals may be clones created as a result of trampling by pigs or humans. This PU is considered an unusual outlying population because the habitat and location are not consistent with current and historical observations. Because this population is at the edge of the species range it is considered important to manage. NRS will manage the Kawai Iki, Kahana, and Wailupe PUs for stability. The remaining PUs contains one or a few individuals and the Army has determined that genetic storage collections are not a priority from the other PUs for this taxon.

Propagation and Genetic Storage

1) At this time, what is the preferred propagation technique?	2) At this time, what is the preferred genetic storage technique?	3) Has a successful storage method been determined?	4) Are additional steps required for obtaining enough seed?
Cuttings (suckers) & Seed	Living Collection & Seed	Yes	Yes, collect from ex situ stock

Collection: For individuals that are not reproductive, suckers will be collected and propagated *ex situ* to serve as seed source, then outplanting stock. For reproductive individuals, fruit will be collected.

Propagation: Plants are easily propagated from suckers and seeds. Plants propagated via tissue culture have been observed to have altered morphologies when removed from test tubes and grown in the greenhouse. NRS will grow out more plants to see if this was a rare or typical occurrence for this taxon, as it has not been observed before and may be isolated to that particular collection.

Seed Storage Research: As with other species of *Cyanea*, this taxon can not be stored at -18C. Once more seed becomes available, -80C and/or -150C trials will commence. Seeds do, however, have good storage potential, as seeds have been stored dry at 4C for five years with no decrease in viability.

Genetic Storage: No fruit has been observed since March 1998 from the PU. In order to meet storage goals for individuals in this PU, plants will be propagated *ex situ* via suckers to serve as seed source, or seed will be collected from plants at the Helemano reintroduction. Seeds will be collected *in situ* from all other reproductive individuals.

Outplanting Issues
In order to meet the genetic storage goals for the Kawai Iki PU, NRS will need to outplant. Five plants grown from the Kawai Iki PU were grown and outplanted within the newly constructed

Helemano fence in February, 2007. Three plants remained at the site when they were monitored in August 2007. The two plants that died were out in the open, whereas the ones surviving were under mixed ʻōhiʻa canopy. NRS planted them this way to see what conditions the plants were better suited for. Predation was also observed on the plants, due to slugs (See Fig. 2.2.1a). NRS plan to monitor this introduction in order to collect seeds for storage and eventual augmentation within the Kawai Iki MU. In the coming year, NRS will work with PEP to reintroduce a few plants grown from the Makaua PU into the small fence in either Kahana or Makaua.

All MFS PUs may eventually need augmentation because of the low numbers of individuals. Surveys should be done in nearby habitat both inside and outside the AA to find source material for augmentation. In the event that no new plants are discovered in the Kawai Iki PU, augmentation with stock from Kaipapaʻu or Maʻakua drainages on the windward side of the summit has been discussed. NRS will confer with the IT on this issue. NRS plan to construct the Kawai Iki MU fence in the next five years. Stock for augmenting the other MFS PUs will be determined once surveys are complete.

2.2.3 *Cyanea st.-johnii*

Requirements for Stability

- 3 population units (PUs)
- 50 reproducing individuals (short-lived perennial)
- Stable population structure
- Threats controlled
- Genetic storage collections for all occurrences
- Tier 3 stabilization priority

Taxon Level Discussion

This taxon is extremely rare and is impacted by a broad range of threats including weeds, rats, ungulates and possibly slugs. NRS are currently focusing management on the Helemano PU which is inside the AA. This PU was recently fenced and NRS successfully bagged and collected seed last year. These collections will be used for genetic storage and propagation for future augmentations. In addition, in the last year the Oʻahu PEP program has been monitoring and collecting mature seed from the other PUs. The population estimates displayed for these other PUs are based on monitoring reported in the August 2007 Oahu PEP report. In the next year, NRS will work to support PEP actions for these PUs by assisting in monitoring and collection. PEP identified a relatively large number of seedlings this year in the field at both the Waimano and Ahuimanu-Halawa Summit Ridge PUs. This is encouraging as it shows that despite the impacts of slugs and rats there is germination. Although fencing these PUs outside the AA has been identified as a low priority for the Army, NRS will work with PEP to fence one of the PUs in the next year.

Major Highlights/Issues in Urgent Actions

- Oʻahu PEP secured collections from individuals in PUs and revised population estimates
- NRS completed the Helemano fence
- NRS collected seed from the Helemano PU

Plans for OIP Year 1

- Work with PEP to secure landowner permission to fence the Waimano and Ahuimanu-Halawa Summit Ridge PUs
- Survey the Waiheʻe-Waimalu summit ridge PU for more plants and threats
- Continue to collect mature seed from the Helemano PU for storage
- Support PEP so that all PUs are monitored and collect mature seed

Table 2.2.3a Taxon Status Summary

Action Area: In

TaxonName: Cyanea st.-johnii **TaxonCode: CyaStj**

Population Unit Name	Management Designation	Current Mature (Wild)	Current Immature (Wild)	Current Seedling (Wild)	Current Augmented Mature	Current Augmented Immature	Current Augmented Seedling	NRS Mature 2006	NRS Immature 2006	NRS Seedling 2006	Total Mature	Total Immature	Total Seedling	Population Trend Notes
Helemano	Manage for stability	5	0	0	0	0	0	5	0	0	**5**	**0**	**0**	Monitoring found no change
	Total for Taxon:	5	0	0	0	0	0	5	0	0	**5**	**0**	**0**	

Action Area: Out

TaxonName: Cyanea st.-johnii **TaxonCode: CyaStj**

Population Unit Name	Management Designation	Current Mature (Wild)	Current Immature (Wild)	Current Seedling (Wild)	Current Augmented Mature	Current Augmented Immature	Current Augmented Seedling	NRS Mature 2006	NRS Immature 2006	NRS Seedling 2006	Total Mature	Total Immature	Total Seedling	Population Trend Notes
Ahuimanu-Halawa Summit Ridge	Manage for stability	14	0	20	0	0	0	12	0	0	**14**	**0**	**20**	Population estimates reported by PEP
Waiahole-Waiawa Summit Ridge	Manage for stability	6	0	1	0	0	0	9	1	0	**6**	**0**	**1**	Population estimates reported by PEP
Waihee-Waimalu summit ridge	Genetic Storage	10	0	0	0	0	0	10	0	0	**10**	**0**	**0**	Population estimates reported by PEP
Waimanalo-Wailupe Summit Ridge	Genetic Storage	11	0	0	0	0	0	12	1	0	**11**	**0**	**0**	Population estimates reported by PEP
Waimano	Genetic Storage	8	0	20	0	0	0	12	0	0	**8**	**0**	**20**	Population estimates reported by PEP
	Total for Taxon:	49	0	41	0	0	0	55	2	0	**49**	**0**	**41**	

Propagation and Genetic Storage

1) At this time, what is the preferred propagation technique?	2) At this time, what is the preferred genetic storage technique?	3) Has a successful storage method been determined?	4) Are additional steps required for obtaining enough seed?
Seed	Seed & Tissue Culture	Yes for genus, but not specific to species	No?

Collection: Mature fruit for this taxon has been difficult to collect. Immature seeds found in aborted fruit typically have lower germination than mature seeds and do not store well. Fruit appears to abort prior to maturation on many of the individuals. At this time, it is unclear as to why this phenomenon occurs.

Propagation: For fruit collected with immature seeds, tissue culture has been a necessary technique, yet this species remains one of the hardest species of *Cyanea* to propagate for the Harold L. Lyon Arboretum Micropropagation Lab. Seedlings grow very slowly and the controlled environment has been essential for their survival. Seeds germinated in Petri dishes then potted and kept in the controlled-environment chambers have had high mortality and displayed a lack of growth. Seedlings have yet to be removed from test tubes and propagated in the greenhouse.

Seed Storage Research: Not enough mature seed has been collected to use for testing.

Genetic Storage: PEP has made many collections from plants in Halawa, Waiawa, Hawaii Loa Ridge, and Waimano. Individuals are represented mostly in tissue culture and some in seed storage. Mature seed will continue to be stored, while immature seed will be propagated via tissue culture.

Outplanting Issues
Outplanting may be necessary at all of the MFS PUs once they are fenced. No outplanting of this species has been attempted to date. NRS will attempt to augment these species into the Helemano MU once enough propagules are available.

Population Unit Level Discussion
Plans for management of each PU are outlined below.

Manage for Stability PUs

Helemano
There is currently one site with five mature plants in the Helemano PU. This PU is the northernmost location in the Ko`olau Mountains and one of a few known from habitat other than the wind-sweep ridge crest. It is in a very intact native area and in order to limit impact to the area it is not monitored often. On the trips that NRS have taken to visit the site the focus has been on trying to secure stock for propagation and reintroduction. Cuttings have been taken on two occasions. Both were tried with traditional methods as well as tissue culture but none have rooted. Viable seed was successfully collected in November 2006 after fruits were bagged. Seeds from this collection are currently being propagated at the Lyon Arboretum Micropropagation Lab. This stock is being cultured at the Lyon Arboretum Micropropagation Lab until there is adequate stock to allow for

material to be moved to the nursery while keeping the remaining in the lab for storage. It will likely take a year or more before there are plants in the greenhouse. As this approaches, NRS will develop reintroduction plans. The upper Helemano drainage fence was finished during the summer of 2007. This fence excludes ungulates from the fragile area around the *C. st.-johnii*, protects numerous other endangered plant species, and secures additional habitat that may be used for reintroduction.

Ahuimanu-Halawa Summit Ridge
NRS will work with PEP to continue collections from this PU. This area is a high priority for fencing as there is often ungulate sign in the area around the plants and the terrain is such that fencing would be relatively easy. Because this PU is on Kamehameha Schools' (KS) property, it may be advantageous for PEP to pursue a fencing plan as they are a non-federal agency. NRS can provide technical assistance, labor and materials. NRS will work to develop plans with PEP over the next year.

Waiahole-Waiawa Summit Ridge
NRS will work with PEP to continue collections from this PU. It is designated as MFS and as with the Ahuimanu-Halawa Summit Ridge PU, NRS will work with PEP to develop a fence plan that PEP can be taken to KS. The fencing of this PU will be second priority to Ahuimanu-Halawa Summit Ridge PU.

Other PUs

Waimanalo-Wailupe Summit Ridge
NRS will work with PEP to continue collections from this PU. Steep terrain in the vicinity of the plants appears to protect the area from ungulates; therefore this population is not a high priority for fencing. This PU occurs on State land.

Waiheʻe-Waimalu Summit Ridge
NRS visited this site with Joel Lau in 2003, but it has not been monitored since. In the next year, NRS will work with PEP to seek permission from KS to do another survey of the area and develop management plans.

Waimano
This PU has the second highest number of seedlings as reported by PEP. It also overlaps with *Lobelia gaudichaudii* subsp. *koolauensis* PU and occurs on state land. Because of these factors, it is the highest priority area to fence and NRS will work to pursue a fence around the PU. NRS will work with PEP to scope the project and approach the DLNR with a proposal in the next year.

2.2.4 *Cyrtandra subumbellata*

Requirements for Stability

- 3 population units (PUs)
- 50 reproducing individuals (short-lived perennial)
- Stable population structure
- Threats controlled
- Genetic storage collections from accessible portions of PUs managed for stability
- Tier 3 stabilization priority

Taxon Level Discussion

NRS observed a new PU of this species in Uwao Valley on the windward side of the Koʻolau Mountains. Just two individuals were observed which may have been hybrid with sympatric species in the area. This PU is designated at ʻManage for genetic storageʼ. Therefore there are now four known PUs, three of which are designated as ʻManage for stabilityʼ: Kaukonahua, Kahana, and Punaluʻu.

This species is not well known and the habitat that this species seems to preferentially occupy, along the wet steep slopes of the windward side of the Koʻolau Mountains, is relatively under surveyed. Therefore, NRS believe there may be many more individuals than are currently known. The only leeward population for the species is in South Kaukonahua Gulch in SBE. A total of about 212 plants are known from the four PUs. The South Kaukonahua PU, which is the only one in the AA, contains two mature and one immature plants.

Three of the four currently known PUs were found since 2000. The South Kaukonahua Gulch PU was found in 1994 on a biological survey of SBE. The Punaluʻu plants were discovered in 1995. In contrast, one Kahana population (KNA-A) became known to botanists in the early 1900s when the Schofield-Waikane Trail was built through the *C. subumbellata* PU.

Major Highlights/Issues in Urgent Actions

- No monitoring of known populations in the last year
- One new PU found
- Observation of flower and fruit production in Army Nursery of seedling stock (Figure 2.2.4a)

Plans for OIP Year 1

- Monitor the South Kaukonahua and Punaluʻu PUs
- Survey areas in the windward Koʻolau Mountains
- Collect propagules for storage testing if observed

Table 2.2.4a Taxon status summary

Action Area: In

TaxonName: Cyrtandra subumbellata **TaxonCode: CyrSub**

Population Unit Name	Management Designation	Current Mature (Wild)	Current Immature (Wild)	Current Seedling (Wild)	Current Augmented Mature	Current Augmented Immature	Current Augmented Seedling	NRS Mature 2006	NRS Immature 2006	NRS Seedling 2006	Total Mature	Total Immature	Total Seedling	Population Trend Notes
Kaukonahua	Manage for stability	2	0	1	0	0	0	3	2	0	**2**	**0**	**1**	This PU was not visited in the last year
	Total for Taxon:	2	0	1	0	0	0	3	2	0	**2**	**0**	**1**	

Action Area: Out

TaxonName: Cyrtandra subumbellata **TaxonCode: CyrSub**

Population Unit Name	Management Designation	Current Mature (Wild)	Current Immature (Wild)	Current Seedling (Wild)	Current Augmented Mature	Current Augmented Immature	Current Augmented Seedling	NRS Mature 2006	NRS Immature 2006	NRS Seedling 2006	Total Mature	Total Immature	Total Seedling	Population Trend Notes
Kahana	Genetic Storage	8	7	0	0	0	0	8	7	0	**8**	**7**	**0**	This PU was not visited in the last year
Punaluu	Manage for stability	200	0	0	0	0	0	100	0	0	**200**	**0**	**0**	Clarification of data resulted in higher numbers; This PU was not visited in the last year
Uwao	Genetic Storage	2	0	0	0	0	0	2		0	**2**	**0**	**0**	new PU discovered this year
	Total for Taxon:	210	7	0	0	0	0	110	7	0	**210**	**7**	**0**	

Figure 2.2.4a Flowering *Cyrtandra subumbellata* in Greenhouse

Propagation and Genetic Storage

Plants can be propagated from seed. Seedling stock has flowered one year after being sown. Seeds from a 2006 collection were placed in one -18C storage treatment and will be first tested in 2008. Based on recent studies that indicate several species of *Cyrtandra* may age rather quickly in storage, this collection will be closely monitored to try and detect when seeds first start to age in storage. Future collections will be used for additional storage tests.

Unique Species Observations

Hybridization appears to easily occur between this species and other native members of this genus.

Outplanting Issues

It will be important to utilize what is considered pure stock when outplanting this species. Collections for genetic storage and/or future outplantings should be made from pure stock.

Research Issues

Seed storage potential specific for this species needs to be tested.

Surveys

More surveys need to be conducted in the future to determine the extent of the known PUs. Additionally, surveys in potential habitat may reveal more individuals. Priority habitat to be surveyed is the area around the Kaukonahua PU which currently has only three individuals (Figure 2.2.4b).

Figure 2.2.4b Priority potential survey habitat for *Cyrtandra subumbellata*

2.2.5 *Eugenia koolauensis*

Requirements for Stability

- 3 population units (PUs)
- 25 reproducing individuals (long-lived perennial)
- Stable population structure
- Threats controlled
- Genetic storage collections from all MFS PUs
- Tier 1 stabilization priority

Major Highlights/Issues in Urgent Actions

- All MFS populations have sharply declined in health and number of individuals.
- Air layer collections, fruit collections, cuttings, and seedling removals, were made at all three MFS populations in an attempt to secure genetic representation in the nursery. Air layers and cuttings have been largely unsuccessful so far, but most seedlings rescued from the sites have survived.
- A complete census was done for all individuals in the fence areas (including marking all seedlings).
- An experimental outplanting of tree ferns was done at all three fenced areas to help restore the understory to a more native composition and reduce weed density.

Plans for OIP Year 1

- Continue census of MFS PUs (including surrounding areas just outside the fences).
- Continue propagation research to determine best means of securing genetic representation.
- Collect genetic representation from other PUs in addition to further collections from MFS PU populations.
- Continue air layering mature trees.
- Selective weed control to prevent seedlings from being smothered by weeds.
- Possibly conduct fungicidal control on relatively healthy mature trees during their reproductive period to obtain seeds for propagation.
- Fund *Puccinia* rust research to determine best management practices for control work.

Table 2.2.5a Taxon Status Summary

Action Area: In

TaxonName: Eugenia koolauensis **TaxonCode: EugKoo**

Population Unit Name	Management Designation	Current Mature (Wild)	Current Immature (Wild)	Current Seedling (Wild)	Current Augmented Mature	Current Augmented Immature	Current Augmented Seedling	NRS Mature 2006	NRS Immature 2006	NRS Seedling 2006	Total Mature	Total Immature	Total Seedling	Population Trend Notes
Aimuu	Genetic Storage	5	3	6	0	0	0	5	3	0	5	3	6	
Kaunala	Manage for stability	36	45	89	0	0	0	36	43	89	36	45	89	
Pahipahialua	Manage for stability	37	42	171	0	0	0	37	42	171	37	42	171	
Western portion of Ohiaai and Oio	Manage for stability	17	14	40	0	0	0	17	14	40	17	14	40	
	Total for Taxon:	95	104	306	0	0	0	95	102	300	95	104	306	

Action Area: Out

TaxonName: Eugenia koolauensis **TaxonCode: EugKoo**

Population Unit Name	Management Designation	Current Mature (Wild)	Current Immature (Wild)	Current Seedling (Wild)	Current Augmented Mature	Current Augmented Immature	Current Augmented Seedling	NRS Mature 2006	NRS Immature 2006	NRS Seedling 2006	Total Mature	Total Immature	Total Seedling	Population Trend Notes
Hanaimoa	Genetic Storage	1	0	0	0	0	0	1	0	0	1	0	0	
Kaiwikoele and Kamananui	Genetic Storage	16	16	15	0	0	0	16	16	0	16	16	15	NRS did not visit in the last year
Kaleleiki	Genetic Storage	25	30	250	0	0	0	25	30	0	25	30	250	NRS did not visit in the last year
Palikea Gulch	Genetic Storage	0	0	0	0	0	0	3	0	2	0	0	0	may have burned
Papali	Genetic Storage	0	0	0	0	0	0	1	0	0	0	0	0	
	Total for Taxon:	42	46	265	0	0	0	46	46	2	42	46	265	

Taxon Level Discussion

Eugenia koolauensis is threatened by fire, pigs, human trampling, weed competition, and plant pathogens, specifically, the *Puccinia* rust (‘ōhi‘a rust). Threat abatement began at the three largest populations of this taxon two years ago: Pahipahi‘ālua, Kaunala and West ‘Ō‘io. These sites were chosen for their size, accessibility, and quality of surrounding habitat. They were fenced two years ago protecting them from pigs and trampling. These three sites continue to show the deadly impacts from the ‘ōhi‘a rust, first detected in 2006. Figure 2.2.5a displays the population estimates from monitoring pre-rust (NRS 2006 numbers). The 2006 numbers come from population estimates conducted mainly in the 2005 reporting year before the rust was detected. Therefore, the numbers show the full impact of the decline due to the rust. Of the remaining populations, most were not monitored in the past year, and ‘ōhi‘a rust impact is unknown. No weed control occurred at any of the populations largely because of concerns of further drying out the seedling microsites in a drought year. The steep decline of these populations as shown in the graphs below paints a bleak picture for this species. NRS staff fear that this species may go extinct in the wild within the next five years because of the rust. NRS will be funding research to determine the efficacy of fungicides on this rust species in the coming year. The rust acutely affects new growth including young leaves, flowers and fruits (Figure 2.2.5a). Thus, plants are unable to survive (much less reproduce) on just their older leaves and eventually senesce.

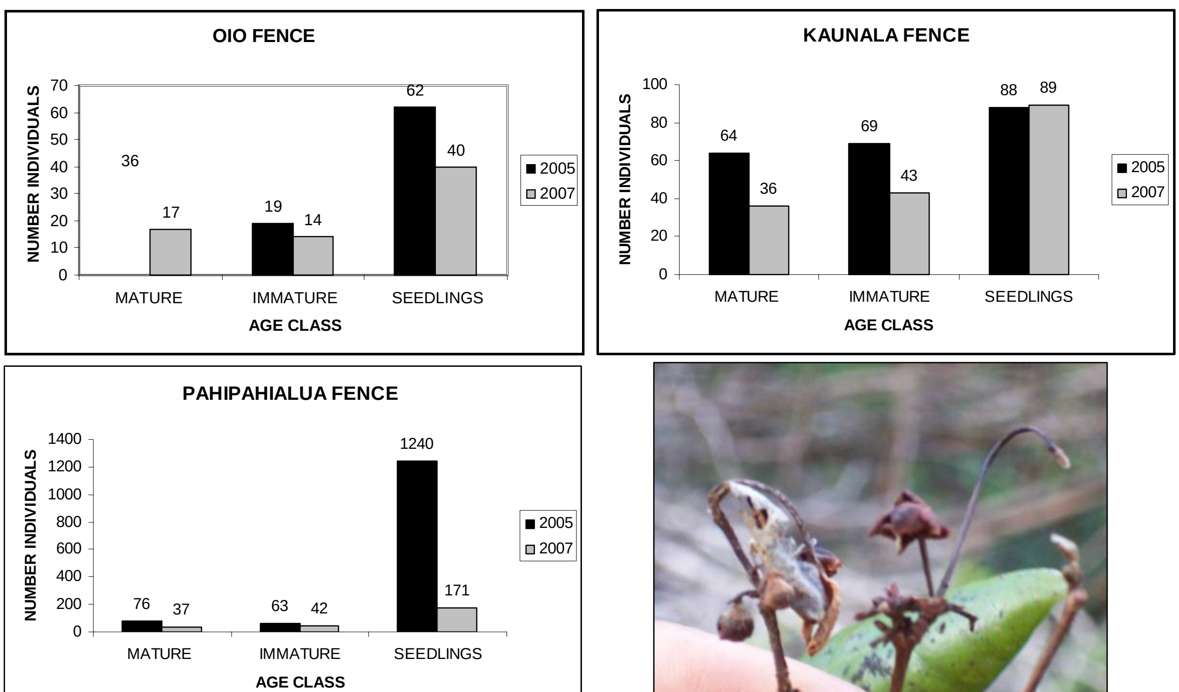


Figure 2.2.5a Graphs of population decline and photo of diseased reproductive growth

Most worrisome is the loss of roughly half of the mature trees at each MFS site given that the largest mature trees contributed the most seeds for population replacement. The high number of seedlings remaining after two years (with the notable exception of the Pahipahi‘ālua area) appears promising. However, after a review of our database it was likely that not all seedlings were counted in 2005.

In the course of building fences around the Kaunala and Pahipahiʻālua populations, NRS discovered additional mature and immature *E. koolauensis*. These new plants are not reflected in the Taxon Summary table above because exhaustive counts at the populations were not conducted. However, NRS feel that they significantly add to the number of mature plants known at each location, and will conduct thorough censuses in the next year.

Fire remains a significant threat to this species, particularly in this period of drought.

Propagation and Genetic Storage

Collection and Propagation: Cuttings have not been successful so far, and one air layer did produce roots but soon died in the greenhouse. Seedlings that have been removed from the field are growing in the Army Nursery where they can be more carefully monitored, maintained, and treated with fungicide. Seeds from eight individuals have been collected and sown this year. Germination is high. Seven individuals total are in the greenhouse, grown from either from collected seed or seedlings removed from the field.

Seed Storage Research: One small collection was made in 2001 from Pahipahiʻālua for storage testing. Results indicate that seeds may be desiccation-sensitive and not be able to store long-term. Five collections have been made by the State Horticulturist from a plant at Pahole Mid-Elevation Nursery this year, totaling 19 seeds. One collection of two seeds were sown, and then the remainder were used to indicate survival at various conditions for one year. All results are pending. Each of the four remaining collections received a different storage treatment to be tested after one year for survival. With such a low number of seeds collected, determining if seeds survive a treatment is all that can be determined at this time. Due to prior storage data that might suggest seeds are desiccation-sensitive, as well as seed size and no evidence of physical dormancy, it is unlikely that seeds will ever be a viable genetic storage option.

Genetic Storage: Currently, it is unlikely that seed will be utilized to meet genetic storage goals. Therefore, collected seed and air layers will be propagated in the nursery with the intent to outplant or create an *inter situ* site if a location becomes available. If next year's tests indicate seed survival at one of the storage treatments tested, the genetic storage strategy will need to be revised.

Unique Species Observations

The ʻōhiʻa rust was first observed in Hawaii in April 2005 and by August 2005 had spread throughout the State. In March 2006, NRS observed ʻōhiʻa rust damage on *E. koolauensis* at Pahipahiʻālua. The rust subsequently was found at Kaunala and West ʻŌʻio. The entire Kahuku Training Area contains significant stands of *Syzigium jambos* (rose apple), a primary carrier of the ʻōhiʻa rust. Other hosts are also abundant, including *Metrosideros polymorpha*, *Eucalyptus robusta*, and *Melaleuca quinqueveria*. Some of the trees at Pahipahiʻālua exhibit less rust damage. This is possibly due to less constant exposure as the rose apple stands are further away. Due to the widespread reach of the rust, and the impracticality of treating large numbers of trees in the wild, there is little NRS can do at this point to mitigate its affects. The loss of over a thousand seedlings at Pahipahiʻālua may be due to a combination of rust, drought and aggressive weed control in the past which dried the area out too quickly for the seedlings to survive.

Outplanting Issues
No outplantings are planned for this species. When successful propagation methods are developed, NRS will consider establishing ex situ collections at botanic gardens, such as Waimea and Hoʻomaluhia where plants can be more consistently monitored and treated for rust and other problems. Reintroduction goals may change if threats to the species increase.

Research Issues
The largest threat currently facing *E. koolauensis* is the ʻōhiʻa rust fungus. NRS is in the process of funding rust control research by Dr. Janice Uchida at UH Mānoa. Some of the work proposed by Dr. Uchida includes the following:

1) Greenhouse propagation of disease free *Eugenia koolauensis* and rose apple.
2) Experimentation to document the protective effect of different fungicides, including Heritage, an environmentally friendly fungicide on rose apple plants, a bioassay plant.
3) Experimentation to treat rare endangered severely diseased *E. koolauensis* in the forest.
4) Experimentation to confirm the efficacy of fungicides on *E. koolauensis* in greenhouse tests.
5) Experimentation to register effective fungicides in Hawai'i and to obtained related EPA data needed.
6) Experimentation to rush a special local needs permit for fungicide use on *E. koolauensis*.
7) Develop a clean disease free stock of *E. koolauensis* potted plants for future propagation.
8) Communication of results with other researchers, forest health professional, conservation environmentalist, ecologist, etc as results are obtained. This will be through community meetings and short research up-dates as data is gathered.
9) The ultimate goal is to provide chemical tools to protect the endangered species and cultivars in the native forests and those in propagation.

Complicating the rust problem is the lack of detailed knowledge about the life history of this species. More information is needed on its growth rate and light requirements. Propagation techniques also need to be refined. A number of the cuttings are still in the greenhouse, but have not rooted. This species is naturally very slow growing and more research is needed on methods to quicken rooting.

Surveys
During census monitoring around the three MFS populations, additional plants will likely be found in the immediate area outside the three fences.

2.2.6 *Gardenia mannii*

Requirements for Stability

- 3 population units (PUs)
- 25 reproducing individuals (long-lived perennial)
- Stable population structure
- Threats controlled
- Genetic storage collections from PUs managed for stability
- Tier 1 stabilization priority

Taxon Level Discussion

The following are three Manage for Stability (MFS) Population Units (PU) for this taxon: Hale‘au‘au, Helemano and ‘Ōpae‘ula, and Helemano and Poamoho. The Kalua‘a and Maunauna PU is designated for genetic storage collection. This and the Hale‘au‘au PUs are the only known location of plants in the Wai‘anae Mountain Range. Numbers listed in Taxon Summary Report reflect initial OIP numbers reported in 2005. More surveys need to be done in order to confirm other sites known by former TNC staff. Current numbers differ from 2005 numbers due to reorganization of plant populations within individual PUs. No status in PUs with any management designation changed in the last year. Plants occur across a wide range in the Koolaus, and the areas with the highest densities of plants have been selected as MFS PUs. NRS are focusing propagation efforts and management in the Wai‘anae Mountains because numbers of individuals are so low.

The proposed Lower Pe‘ahināi‘a exclosure has been expanded and will now protect approximately 19 individuals. The Hale‘au‘au plants are also fenced, and weeding took place around trees within the exclosure this year. Limited military access has made management for this PU difficult. Revisitation of population sites for this taxon in the Ko‘olaus is infrequent as small population sites are distributed across the Ko‘olaus in currently unmanaged areas. For some populations, estimates are from 1993. NRS will focus on monitoring populations that are in Manage for Stability PUs.

Major Highlights/Issues in Urgent Actions

- Successfully airlayered two of three plants in Hale‘au‘au this year; installed airlayer on the third.
- Airlayers installed on two Kalua‘a plants; monitoring shows airlayers should take.

Plans for OIP Year 1

- Revisit population sites in MFS PUs to ensure more accurate population numbers.
- Continue airlayering until all plants in Hale‘au‘au and Kalua‘a and Maunauna PUs are represented.

Table 2.2.6a Taxon Status Summary

Action Area: In

TaxonName: Cyanea crispa **TaxonCode: CyaCri**

Population Unit Name	Management Designation	Current Mature (Wild)	Current Immature (Wild)	Current Seedling (Wild)	Current Augmented Mature	Current Augmented Immature	Current Augmented Seedling	NRS Mature 2006	NRS Immature 2006	NRS Seedling 2006	Total Mature	Total Immature	Total Seedling	Population Trend Notes
Kawaiiki	Manage for stability	2	8	0	0	0	0	8	0	0	2	8	0	A thorough cencus showed a change in the population #s
	Total for Taxon:	2	8	0	0	0	0	8	0	0	2	8	0	

Action Area: Out

TaxonName: Cyanea crispa **TaxonCode: CyaCri**

Population Unit Name	Management Designation	Current Mature (Wild)	Current Immature (Wild)	Current Seedling (Wild)	Current Augmented Mature	Current Augmented Immature	Current Augmented Seedling	NRS Mature 2006	NRS Immature 2006	NRS Seedling 2006	Total Mature	Total Immature	Total Seedling	Population Trend Notes
Aihualama	N/A	0	0	0	0	0	0	1	0	0	0	0	0	No monitoring in the last year
Kahana and Makaua (Makaua portion)	N/A	0	0	0	0	0	0	25	0	0	0	0	0	No monitoring in the last year
Kahana portion of Kahana and Makaua	Manage for stability	6	0	0	0	0	0	30	0	0	6	0	0	No monitoring in the last year
Kaipapau	N/A	0	0	0	0	0	0	3	0	0	0	0	0	No monitoring in the last year
Kapakahi	N/A	0	0	0	0	0	0	1	0	0	0	0	0	No monitoring in the last year
Kawaipapa	N/A	0	0	0	0	0	0	1	0	0	0	0	0	No monitoring in the last year
Maakua	N/A	0	0	0	0	0	0	2	0	0	0	0	0	No monitoring in the last year
Maunawili	N/A	0	0	0	0	0	0	1	0	0	0	0	0	No monitoring in the last year
Pia	N/A	0	0	0	0	0	0	20	0	0	0	0	0	No monitoring in the last year
Pukele	N/A	0	0	0	0	0	0	6	0	0	0	0	0	No monitoring in the last year
Wailupe	Manage for stability	0	0	0	0	0	0	15	0	0	0	0	0	No monitoring in the last year
	Total for Taxon:	6	0	0	0	0	0	105	0	0	6	0	0	

Propagation and Genetic Storage
Individuals in Hale‘au‘au PU still show no sign of viable seed production. In the Ko‘olaus, fruits have been collected in the past from Lower Pe‘ahināi‘a. Seeds were viable plants were successfully propagated. NRS will monitor phenology and study pollination biology of MFS populations in the Wai‘anaes to better understand collection potential. NRS will make an effort at as many population sites as possible to observe morphology and timing this next flowering season to determine how likely pollination is occurring, either through outcrossing or selfing of flower. NRS will attempt to record pollinator visitation through timed observations throughout the day and evening. Seeds from collections will be utilized to determine viability and storage longevity. These tests will allow us to determine whether or not seed is useful genetic storage option for this PU.

NRS attempted to air layer plants from Hale‘au‘au this year in response to the lack of seed production. Three air layers were put on two plants in the Hale‘au‘au population in September, 2006. Healthy air layers were harvested with many roots in August of this year. An additional air layer was installed on a third plant this year with an innovative climbing device. Air layers have been installed on the two known plants in Kalua‘a. One of these was recently installed, and the other has root formation and will be ready for collection in a couple months. Air layers may be the best propagation technique for plants where viable seed cannot be collected, and these plants can be maintained as a living collection.

Research Issues
The main priority for research is seed storage of this species.

Surveys
No surveys were done specifically for *G. mannii* this year, however three new plants were found in the Ko‘olaus while surveying for other taxa.

2.2.7 *Huperzia nutans*

Requirements for Stability

- 3 Population Units (PU)
- 50 reproducing individuals (short-lived perennial)
- Stable population structure
- Threats controlled
- Genetic storage collections from all occurrences when propagation techniques become available
- Tier 2 stabilization priority

Taxon Level Discussion

There are four PUs with eight plants known from the Ko‘olau Mountains. Both the South Kaukonahua and portions of the Kahana and North Kaukonahua PU are in the Action Area (AA) for Schofield Barracks East Range (SBE). The Kawainui-Koloa Summit Ridge PU is in the Kawailoa Training Area (KLOA) AA. These three PUs are designated as Manage for Stability (MFS). To date, no more than two plants have been found at a single location and plants are often solitary. The gametophytes of *H. nutans* have not been studied and propagation techniques are not developed. All PUs will require augmentation to achieve the numbers of reproducing individuals required for stability. The major threat to the known sites is from pig damage and no PUs are fenced. Large fences are planned for Koloa and the North and South Kaukonahua MUs. These will protect many known *in situ* sites and secure outplanting sites. The habitat at all known PUs is primarily native and weeds are not considered a significant threat. Since so few individuals are known at this time, developing an *ex situ* conservation plan and surveys are the highest priority.

Major Highlights/Issues in Urgent Actions

- Cuttings of *Huperzia phyllantha* have begun to establish roots, new growing tips and strobili.
- Surveys at one of the sites in the Kahana and North Kaukonahua PU rediscovered a plant that was previously assumed to be dead.

Plans for OIP Year 1

- Collect cuttings and divisions of *H. phyllantha*
- Monitor known sites for mature fertile tips for spore collection
- Surveys in Kaipapa‘u and Kahana

Table 2.2.7a Taxon Status Summary

Action Area: In

TaxonName: Huperzia nutans   TaxonCode: HupNut

Population Unit Name	Management Designation	Current Mature (Wild)	Current Immature (Wild)	Current Seedling (Wild)	Current Augmented Mature	Current Augmented Immature	Current Augmented Seedling	NRS Mature 2006	NRS Immature 2006	NRS Seedling 2006	Total Mature	Total Immature	Total Seedling	Population Trend Notes
Kahana and North Kaukonahua	Manage for stability	4	0	0	0	0	0	4	0	0	**4**	**0**	**0**	One known plant was not observed during monitoring in the last year and is considered dead
Kawainui-Koloa Summit Ridge	Manage for stability	1	0	0	0	0	0	1	0	0	**1**	**0**	**0**	No monitoring in the last year
South Kaukonahua	Manage for stability	1	0	0	0	0	0	1	0	0	**1**	**0**	**0**	No monitoring in the last year
	Total for Taxon:	6	0	0	0	0	0	6	0	0	**6**	**0**	**0**	

Action Area: Out

TaxonName: Huperzia nutans   TaxonCode: HupNut

Population Unit Name	Management Designation	Current Mature (Wild)	Current Immature (Wild)	Current Seedling (Wild)	Current Augmented Mature	Current Augmented Immature	Current Augmented Seedling	NRS Mature 2006	NRS Immature 2006	NRS Seedling 2006	Total Mature	Total Immature	Total Seedling	Population Trend Notes
Kaipapau	Genetic Storage	2	0	0	0	0	0	2	0	0	**2**	**0**	**0**	No monitoring in the last year
	Total for Taxon:	2	0	0	0	0	0	2	0	0	**2**	**0**	**0**	

Propagation and Genetic Storage

In order to develop propagation protocols, NRS made collections of cuttings from *H. phyllantha* from the Poamoho Trail in February 2007. From the collected material, 13 smaller cuttings, two to three inches in length, were divided into three different propagation techniques. These techniques were determined based on correspondence with Chad Hubsy, a fern ecophysiologist at Florida International University. C. Husby also recommended the website of the Australian National Botanic Gardens (ANBG 2006). Five cuttings were propagated vertically with the cut end buried and the growing tip exposed. Five cuttings were propagated vertically with the growing tip buried and the cut end exposed. Three cuttings were laid across the media and both ends were covered with media. All three cuttings that were laid on their side produced roots, new vegetative growth, and are developing strobili. None of the cuttings that were placed upside down have produced new growth and appear to be dying. Three of the five upright cuttings have developed new vegetative growth, immature strobili, and roots. One additional cutting appears to have produced roots from the growing tip but appears t be slowly dying. The media used was a mix of perlite and vermiculite. Cuttings have remained on the Army Nursery mist bench, and growth was noticed as early as August 2007. These results are very encouraging. Therefore, NRS will continue to collect *H. phyllantha* in the coming year to continue to develop propagation techniques.

Figure 2.2.7a Developing roots on cutting material from *Huperzia phyllantha*

Research Issues

The main priority for research is developing propagation techniques. Due to the low number of extant individuals and the risk of removing material from the known plants, more testing should be done on the more common *H. phyllantha*. Vegetative-propagation techniques will continue to be tested at the Army Nursery. Strobili collections will also be made to experiment with spore germination at the Lyon Arboretum Micropropagation Laboratory.

2.2.8 *Labordia cyrtandrae*

Requirements for Stability

- 2 Population Units (PU)
- 100 reproducing individuals from East Makaleha to North Mohiakea & 50 reproducing individuals from the Manana area (long-lived perennial; dioecious; low seed set)
- Stable population structure
- Threats controlled
- Genetic storage collections from PUs managed for stability
- Tier 1 stabilization priority

Taxon-specific issues

There are two Manage for Stability (MFS) PUs for *Labordia cyrtandrae.* The plants from East Makaleha to North Mohiakea in the Waiʻanae Mountains are in one PU. These plants occur over a large area but are considered one PU. The other MFS PU is Manana Gulch in the Koʻolau Mountains where one mature plant is known. There are still large under-surveyed areas of appropriate habitat for this taxon in both ranges, but especially in the Koʻolau Mountains where only one site is known. Although some individuals may occasionally produce perfect flowers, more female plants than male plants have been observed. Juvenile and seedling plants are rarely seen in the wild, but two seedlings were observed in the last year. Natural Resource Staff (NRS) consider *Labordia cyrtandrae* to be functionally dioecious so NRS have developed an *ex situ* propagation plan to obtain collections from *in situ* plants via air layering and pollen storage. These e*x situ* collections and plants grown in *inter situ* sites will be used for seed production. Seeds grown from these plants will then be used to establish and supplement reintroductions. NRS has stored pollen collected from the Manana plant by the Oahu Plant Extinction Prevention (PEP) program which will be used to pollinate plants from the Waiʻanae PU in the greenhouse in the coming year.

Major Highlights/Issues in Urgent Actions

- Pollen was collected from wild and reintroduced plants by PEP and NRS. It was stored for the short-term for hand pollinations and long-term for viability testing.
- Hand pollination trial of greenhouse and reintroduced plants begun; immature fruit currently developing on plants
- Air layers were installed on 14 additional *in situ* founders
- An additional plant was discovered in East Makaleha

Plans for OIP Year 1

- Establish a living collection of clones in the greenhouse from each *in situ* founder
- Produce seed for storage testing, genetic storage and propagation for outplanting through natural and hand pollination from living collections and the three reintroductions on State land
- Survey around historic sites in the Koʻolau Mountains (Manana and Kaʻalaea)
- Survey around new areas at Mt. Kaʻala (Waiʻanae Kai and Makaleha)
- Identify new potential reintroduction sites inside the Kaʻala Management Unit (MU)

Table 2.2.8a Taxon Status Summary

Action Area: In

TaxonName: Labordia cyrtandrae TaxonCode: LabCyr

Population Unit Name	Management Designation	Current Mature (Wild)	Current Immature (Wild)	Current Seedling (Wild)	Current Augmented Mature	Current Augmented Immature	Current Augmented Seedling	NRS Mature 2006	NRS Immature 2006	NRS Seedling 2006	Total Mature	Total Immature	Total Seedling	Population Trend Notes
Makaleha to Mohiakea	Manage for stability	46	1	2	14	19	0	44	1	0	60	20	2	
	Total for Taxon:	46	1	2	14	19	0	44	1	0	60	20	2	

Action Area: Out

TaxonName: Labordia cyrtandrae TaxonCode: LabCyr

Population Unit Name	Management Designation	Current Mature (Wild)	Current Immature (Wild)	Current Seedling (Wild)	Current Augmented Mature	Current Augmented Immature	Current Augmented Seedling	NRS Mature 2006	NRS Immature 2006	NRS Seedling 2006	Total Mature	Total Immature	Total Seedling	Population Trend Notes
Manana	Manage for stability	1	0	0	0	0	0	1	1	0	1	0	0	
	Total for Taxon:	1	0	0	0	0	0	1	1	0	1	0	0	

Propagation and Genetic Storage

1) At this time, what is the preferred propagation technique?	2) At this time, what is the preferred genetic storage technique?	3) Has a successful storage method been determined?	4) Are additional steps required for obtaining enough seed?
Air layers	Living Collection	No	Yes – living collections

Collection: NRS has collected fruit, cuttings and air-layers from *in situ* plants. Cuttings have never been successful. Fruit collection has been difficult for several reasons. First, the fruit take several months to develop and it is difficult to determine maturity. Second, fruit appear to be bored by an insect and seed predation is commonly observed. Third, plants are dioecious, and many fruit have been observed intact (seed predation absent) with empty seeds (no embryos). This suggests that females may produce fruit regardless of fertilization. With pollen dispersal and range unknown, it is not clear how regularly female individuals are pollinated, regardless of male proximity. Viable seed is rarely observed.

Propagation: Viable mature and immature seed delivered to the Harold L. Lyon Micropropagation Lab has been germinated, propagated *in vitro*, grown in the greenhouse, and successfully outplanted. Mature seed has also been propagated without tissue culture techniques. Half of the air layers collected have been successfully established *ex situ*.

Seed Storage Research: Further studies are necessary. All seed produced this year from greenhouse and reintroduction pollinations will be used for extensive storage testing. Viability testing on two collections stored dry at 4C for four years yielded no survival. There was germination for one of these collections after two years. No initial viability tests were conducted on these collections, so the seed quality of these two collections remains uncertain.

Genetic Storage: NRS was successful this year at collecting pollen from individuals *in situ* and at outplantings for immediate hand-pollinations of reintroduction and *ex situ* stock. Any and all seeds produced by these pollinations will be used for long-term storage viability testing. Collections and pollinations were made throughout May and June 2007. Pollen was collected from one *in situ* plant and three separate reintroduced individuals (representing two founders), at one of the Ka'ala outplantings on State land (ALA-A). One plant at this site and one at another nearby outplanting on State land (ALA-B) were pollinated immediately with the collected pollen. Another individual at ALA-B was pollinated three weeks later. All three plants currently have immature fruit. The pollen was also used to pollinate five plants in the greenhouse. Pollen was one to seven weeks old. Fifty-two flowers were pollinated. Four months later, 26 immature fruit are developing on the plants. The remaining pollen was dried to 20% RH and stored at -18C to test viability during next year's flowering season.

There are 48 plants that NRS consider potential *in situ* founders. Of these 48, 21 are known female, five are male including the Manana plant and 22 are still unknown. NRS propose to establish a living collection grown from air layers of all 48 founders. Prioritization of air layer installation is as follows: 1) all males; 2) unknowns in underrepresented sites; 3) unknowns in represented sites; 4) collect from females not within an ungulate fence; 5) collect from females to accomplish even representation throughout sites. Since there are so few males, NRS anticipates that focusing efforts on unknowns may increase the number of known males. Including the flowering females already present in the greenhouse, this approach will hopefully create a living collection with sufficient flower production for hand pollination trials and enough seed for storage research. NRS has focused collections on the priorities discussed above and have installed air layers on 14 additional founders in the last year. Plants represented by clones in outplantings will be collected there.

Table 2.2.8b Genetic Storage Summary

	# of Potential Founders			Partial Storage Status			Storage Goals Met
Population Unit Name	Current Mature	Current Imm.	NumWild Dead	# Plants >= 10 in Seedbank	# Plants >=1 Microprop	# Plants >=1 Army Nursery	# Plants that Met Goal
Labordia cyrtandrae							
Makaleha to Mohiakea	46	1	1	0	3	5	3
Manana	1	0	0	0	0	0	0
				Total # Plants w/ >=10 Seeds in Seedbank	**Total # Plants w/ >=1 Microprop**	**Total # Plants w/ >=1 Army Nursery**	**Total # Plants that Met Goal**
				0	3	5	3

Outplanting Issues

Four outplanting sites have been established inside the Ka‘ala MU to augment the East Makaleha to North Mohiakea PU. Three are on State land and the other site is planted on Army land on Schofield Barracks West Range (SBW). The stock was grown from both seed and air layers collected from plants in the East Makaleha to North Mohiakea PU. No stock from the Makaleha section of this PU has been outplanted yet. Survivorship in all sites has been high (33/38) and plants grown from air-layers have begun to flower. NRS will continue to augment the site on SBW and will search for additional outplanting sites in the coming year. As discussed in the Propagation and Genetic Storage section above, the stock from hand-pollinated fruit in the reintroduction sites and the greenhouse will be used for propagation and storage testing. Once germinated, the plants will be used to supplement the SBW reintroduction.

Research Issues

Research on the black twig borer may help protect this species (Chapter 5.1). This threat and other insect predation may contribute to the little/ low recruitment.

Surveys

In the next year, NRS will work to survey appropriate habitat on Ka‘ala at the summits of Wai‘anae Kai and Mākaha Valleys. Surveys in historic Ko‘olau Mountain sites are needed to determine the full extent of those PUs.

Taxon Threats

Threats to *Labordia cyrtandrae* include pigs, goats, black twig borer, seed predation, and competition with non-native plant species such as *Rubus argutus*. The plants inside the Ka‘ala MU are protected from ungulates and the individuals in East Makaleha will be protected from ungulates within the East Makaleha MU. Those that fall outside these two MUs will be protected with strategic fencing or clones will be outplanted into the MUs. Weed control is conducted throughout the Ka‘ala MU and will continue. The plant at Manana does not need a fence at this time but will be protected in the Manana MU fence which will secure habitat for outplanting.

Table 2.2.8c Population Unit Threat Control Summary

Action Area: In

TaxonName: Labordia cyrtandrae

PopulationUnitName	ManagementDesignation	Protected from Ungulates	Weeds Managed	Rats Controlled
Makaleha to Mohiakea	Manage for stability	Partial	Partial	No

Action Area: Out

TaxonName: Labordia cyrtandrae

PopulationUnitName	ManagementDesignation	Protected from Ungulates	Weeds Managed	Rats Controlled
Manana	Manage for stability	No	No	No

2.2.9 *Lobelia gaudichaudii* subsp. *koolauensis*

Requirements for Stability

- 3 Population Units (PU)
- 75 reproducing individuals (short-lived perennial; monocarpic; inconsistent flowering)
- Stable population structure
- Threats controlled
- Genetic storage collections from Pus managed for stability
- Tier 3 stabilization priority

Taxon Level Discussion

Lobelia gaudichaudii subsp. *koolauensis* has been reported from six sites in the Koʻolau Mountains on Oʻahu. There are three Manage for Stability (MFS) PUs that cover the full geographic range of this taxon. This taxon is monocarpic and only a small fraction of each population may flower in any given year. Monitoring data and stabilization targets will reflect this life-cycle. Most plants will be counted as immature and mature plants will be only counted as they flower and die. In addition, two of the PUs are known to have both *L. gaudichaudii* subsp. *gaudichaudii* and *L. gaudichaudii* subsp. *koolauensis*. The current population estimate for the Kīpapa PU includes immature *L. gaudichaudii* subsp. *gaudichaudii* in addition to *L. gaudichaudii* subsp. *koolauensis.* The Kawai Iki PU has both sub-species but only two mature plants of *L. gaudichaudii* subsp. *koolauensis* have ever been observed amongst the many *L. gaudichaudii* subsp. *gaudichaudii*. The major threat is from ungulates. Fences are planned for the three MFS PUs and weed control will begin once fences are complete. The Kaukonahua and Kīpapa PUs will need to be augmented once Management Unit (MU) fences are complete.

Major Highlights/Issues in Urgent Actions

- Population estimates and monitoring data has been for all known PUs

Plans for OIP Year 1

- Begin planning small PU fences around the Kaukonahua and Kīpapa PUs
- Monitor PUs for mature plants and collect seed for genetic storage

Figure 2.2.9a Mature plants at the Kawai Iki PU

Table 2.2.9a Taxon Status Summary

Action Area: In

TaxonName: Lobelia gaudichaudii subsp. koolauensis **TaxonCode: LobGauKoo**

Population Unit Name	Management Designation	Current Mature (Wild)	Current Immature (Wild)	Current Seedling (Wild)	Current Augmented Mature	Current Augmented Immature	Current Augmented Seedling	NRS Mature 2006	NRS Immature 2006	NRS Seedling 2006	Total Mature	Total Immature	Total Seedling	Population Trend Notes
Kaukonahua	Manage for stability	3	45	2	0	0	0	3	45	2	**3**	**45**	**2**	No observations in the last year
Kawaiiki	Genetic Storage	2	0	0	0	0	0	2	0	0	**2**	**0**	**0**	No observations in the last year
	Total for Taxon:	5	45	2	0	0	0	5	45	2	**5**	**45**	**2**	

Action Area: Out

TaxonName: Lobelia gaudichaudii subsp. koolauensis **TaxonCode: LobGauKoo**

Population Unit Name	Management Designation	Current Mature (Wild)	Current Immature (Wild)	Current Seedling (Wild)	Current Augmented Mature	Current Augmented Immature	Current Augmented Seedling	NRS Mature 2006	NRS Immature 2006	NRS Seedling 2006	Total Mature	Total Immature	Total Seedling	Population Trend Notes
Kipapa	Manage for stability	0	100	20	0	0	0	0	100	20	**0**	**100**	**20**	No observations in the last year
Waiawa portion of Waiawa to Waimano	Manage for stability	0	80	0	0	0	0	0	80	0	**0**	**80**	**0**	No observations in the last year
	Total for Taxon:	0	180	20	0	0	0	0	180	20	**0**	**180**	**20**	

Propagation and Genetic Storage

1) At this time, what is the preferred propagation technique?	2) At this time, what is the preferred genetic storage technique?	3) Has a successful storage method been determined?	4) Are additional steps required for obtaining enough seed?
Seed	Seed	Yes	No

This taxon has been successfully propagated from seed and seed is the preferred propagation technique. A 1999 collection from Waiawa has been used for storage testing. Seeds display similar storage traits as other lobelioids, as seeds do not survive -18C storage but remain viable at 4C. This is yet another species that would benefit from lipid analyses as well as starting storage treatments at -80C and/or -150C when more seed becomes available (see 2.00 Seed Storage Research). Germination rates at 4C were highly variable over the past five years and it is uncertain if there is any decrease in viability. This treatment will continue to be tested. Cuttings and airlayers are not considered to be viable options for propagation since most plants are single stemmed. Seeds are being stored from two founders from the Kawai Iki PU and four founders in the Kaukonahua PU.

Table 2.2.9b Genetic Storage Summary

	# of Potential Founders			Partial Storage Status			Storage Goals Met
Population Unit Name	Current Mature	Current Imm.	NumWild Dead	# Plants >= 10 in Seedbank	# Plants >=1 Microprop	# Plants >=1 Army Nursery	# Plants that Met Goal
Lobelia gaudichaudii subsp. koolauensis							
Kaukonahua	3	45	0	4	0	0	3
Kawaiiki	2	0	0	2	0	0	2
Kipapa	0	100	0	0	0	0	0
Waiawa portion of Waiawa to Waimano	0	80	0	0	0	0	0
				Total # Plants w/ >=10 Seeds in Seedbank	**Total # Plants w/ >=1 Microprop**	**Total # Plants w/ >=1 Army Nursery**	**Total # Plants that Met Goal**
				6	0	0	5

Research Issues

Outstanding research issues include studies of possible hybridization between the two subspecies, development of techniques to differentiate immature plants of the subspecies from each other and life history research for *L. gaudichaudii* subsp. *koolauensis*.

Table 2.2.9c Threat Control Summary

Action Area: In

TaxonName: Lobelia gaudichaudii subsp. koolauensis

PopulationUnitName	ManagementDesignation	Protected from Ungulates	Weeds Managed	Rats Controlled
Kaukonahua	Manage for stability	No	No	No
Kawaiiki	Genetic Storage	Yes	No	No

Action Area: Out

TaxonName: Lobelia gaudichaudii subsp. koolauensis

PopulationUnitName	ManagementDesignation	Protected from Ungulates	Weeds Managed	Rats Controlled
Kipapa	Manage for stability	No	No	No
Waiawa portion of Waiawa to Waimano	Manage for stability	No	No	No

2.2.10 *Melicope lydgatei*

Requirements for Stability

- 3 population units (PUs)
- 25 reproducing individuals (long-lived perennial)
- Stable population structure
- Threats controlled
- Genetic storage collections from all PUs
- Tier 2 stabilization priority

Taxon Level Discussion

There are two Manage for Stability (MFS) Population Units (PU) for this taxon: Kaiwikoʻele to Kawai Nui Ridge and Kawai Iki and ʻŌpaeʻula. All but three known plants occur in the Kawai Iki and ʻŌpaeʻula PU. Most of these plants have not been monitored in many years. NRS are currently securing permission from Kamehameha Schools in order to begin building a large scale fence the Lower Peahinaīʻa MU. Since finding 22 more individuals of this taxon two years ago, the proposed fence was expanded to include a total of 31 plants. Weed control in this exclosure will also be crucial given that weeds such as *C. hirta* and *P. cattleianum* are abundant.

Few surveys been conducted in the Kaiwikoʻele to Kawai Nui Ridge PU thus far. This year NRS will survey to locate more individuals. No fences are currently planned for this PU, however NRS are looking for means of storing and propagating material of this population until the populations can be secured by fencing. Two cuttings collected from wild plants in this PU were successfully grown in the Pahole Nursery. Fruit was collected from these plants and processed for germination, but have not yet germinated. Several seeds were also collected from two different plants last year for germination.

Major Highlights/Issues in Urgent Actions

- Fruit from greenhouse plant collected. Currently waiting for seed germination.
- Fruit germinated from *in situ* plant collected in Kaiwikoʻele to Kawai Nui Ridge PU.

Plans for OIP Year 1

- Conduct surveys in the Kaiwikoʻele to Kawai Nui Ridge PU.
- Continue propagation and genetic storage research on this taxon.
- Surveys to find one additional PU

Table 2.2.10a Taxon Status Summary

Action Area: In

TaxonName: Melicope lydgatei **TaxonCode: MelLyd**

Population Unit Name	Management Designation	Current Mature (Wild)	Current Immature (Wild)	Current Seedling (Wild)	Current Augmented Mature	Current Augmented Immature	Current Augmented Seedling	NRS Mature 2006	NRS Immature 2006	NRS Seedling 2006	Total Mature	Total Immature	Total Seedling	Population Trend Notes
Kaiwikoele-Kawainui Ridge	Manage for stability	3	0	0	0	0	0	3	0	0	3	0	0	Numbers of plants in 2006 inaccurate. No change in population this year.
Kawaiiki and Opaeula	Manage for stability	38	0	0	0	0	0	45	0	0	38	0	0	Population not monitored this year.
	Total for Taxon:	41	0	0	0	0	0	48	0	0	41	0	0	

Propagation and Genetic Storage

NRS has had difficulty germinating taxa in Rutaceae. Seeds likely have some type of dormancy, yet this is hard to determine as large amounts of seed are not possible to collect. *M. lydgatei* has a very thick seed coat, which suggests that it is water impermeable and may have physical dormancy. Often seeds that are scarified (as seeds coat is very thick) rot quickly, where seeds left untreated may take months to germinate or not germinate at all. Seeds may have some combination of morphological and physical dormancy, and scarification prior to complete embryo development may inhibit germination. NRS will continue to try to collect seeds, either *in situ* or *ex situ*, to determine germination protocols. NRS will focus collection efforts on more common species of *Melicope* on which to practice proposed germination techniques. Only after germination and dormancy is understood will storage testing commence. Seeds may also be intermediate in storage behavior, where seeds may not be tolerant of really dry or cold conditions. Several other agencies, including the Lyon Micropropagation Lab, the National Center for Genetic Resource Preservation and the Royal Botanical Garden, Kew, continually work on other species in this family and information will hopefully be available to guide NRS efforts.

Two propagation highlights occurred this year. First, one out of five seeds collected from two individuals in the Kawai Iki and ‘Ōpae‘ula PU in August 2006 germinated in May 2007. It took one month from radicle emergence to complete germination (radicle + cotyledons emergence). Second, two cuttings that have been established in the greenhouse have flowered year round, and a few seed have been collected. The seeds were sown in January of this year and have still not germinated. There is less fruit produced than the number of flowers observed on this nursery stock. These highlights support the practicality of attempting to gain a better understanding of dormancy issues for this taxon.

Surveys

No surveys were conducted specifically for this taxon this year. A trip was planned to the Kawailoa trail to collect from two individuals there, but the trip was canceled due to weather conditions. NRS will continue to pursue cuttings from this population, and keep vigilant for more plants.

2.2.11 *Phyllostegia hirsuta*

Requirements for Stability

- 3 Population Units (PUs)
- 75 reproducing individuals (short-lived perennial)
- Stable population structure
- Threats controlled
- Genetic storage collections from PUs managed for stability
- Tier 1 stabilization priority

Major Highlights/Issues in Urgent Actions

- New population North of Pu‘u Kalena
- New immature plant or a new growth from stolon at Pālāwai gulch site that was thought to be extripated
- Last remaining seedling at Huliwai population removed to ex-situ site
- Kalena Notch (SBW-B) population extripated

Plans for OIP Year 1

- Continue to monitor and collect stock for reintroduction from all PUs
- Install weather stations to monitor microsite conditions at wild populations to create a criteria for selecting reintroduction sites
- Control priority weeds at MFS PUs.
- Survey Hale‘au‘au to Pu‘u Kalena

Figure 2.2.11a *Phyllostegia hirsuta* inflorescence

Table 2.2.11a Taxon Status Summary

Action Area: In

TaxonName: Phyllostegia hirsuta **TaxonCode: PhyHir**

Population Unit Name	Management Designation	Current Mature (Wild)	Current Immature (Wild)	Current Seedling (Wild)	Current Augmented Mature	Current Augmented Immature	Current Augmented Seedling	NRS Mature 2006	NRS Immature 2006	NRS Seedling 2006	Total Mature	Total Immature	Total Seedling	Population Trend Notes
Central Waieli	Genetic Storage	8	5	3	0	0	0	8	5	3	**8**	**5**	**3**	formerly known as Waieli, one site observed and is healthy
Haleauau	Genetic Storage	0	3	0	0	0	0	0	3	0	**0**	**3**	**0**	formerly Mohiakea-Haleauau, two sites were moved out of this PU
Helemano and Opeaula	Genetic Storage	7	9	0	0	0	0	7	9	0	**7**	**9**	**0**	There were no observations in the last year
Kaipapau-Kawainui Summit Ridge	Genetic Storage	5	0	0	0	0	0	5	0	0	**5**	**0**	**0**	There were no observations in the last year
Kaukonahua	Genetic Storage	4	2	0	0	0	0	4	2	0	**4**	**2**	**0**	There were no observations in the last year
Kawai Iki	Genetic Storage	2	0	0	0	0	0	2	0	0	**2**	**0**	**0**	There were no observations in the last year
Mohiakea	Genetic Storage	50	0	0	0	0	0	50	0	0	**50**	**0**	**0**	Site was formerly in thePU Mohiakea- Haleauau. There were no observations in the last year
South Central Haleauau	Manage for stability	3	8	1	0	0	0	25	25	25	**3**	**8**	**1**	old site extirpated, new site found, formerly found in Mohiakea-Haleauau PU
South Helemano	Genetic Storage	1	0	0	0	0	0	1	0	0	**1**	**0**	**0**	There were no observations in the last year
	Total for Taxon:	80	27	4	0	0	0	102	44	28	**80**	**27**	**4**	

Table 2.2.11a Taxon Status Summary

Action Area: Out

TaxonName: Phyllostegia hirsuta **TaxonCode: PhyHir**

Population Unit Name	Management Designation	Current Mature (Wild)	Current Immature (Wild)	Current Seedling (Wild)	Current Augmented Mature	Current Augmented Immature	Current Augmented Seedling	NRS Mature 2006	NRS Immature 2006	NRS Seedling 2006	Total Mature	Total Immature	Total Seedling	Population Trend Notes
Ekahanui	Genetic Storage	0	0	0	0	0	0	0	0	0	**0**	**0**	**0**	Plants are dead
Huliwai	Genetic Storage	0	0	0	0	0	0	3	9	0	**0**	**0**	**0**	heavy decline, last seedling brought into greenhouse
Kaipapau Gulch	N/A	1	0	0	0	0	0	1	0	0	**1**	**0**	**0**	There were no observations in the last year
Kaluaa to South Waieli	Manage for stability	1	13	3	0	0	0	2	20	12	**1**	**13**	**3**	formerly known as just Kaluaa, one site extirpated, others declining
Kaluanui	N/A	5	0	0	0	0	0	5	0	0	**5**	**0**	**0**	There were no observations in the last year
Koloa	Manage for stability	0	0	0	0	0	0	0	0	0	**0**	**0**	**0**	future reintroduction site
Makaha-Waianae Kai Ridge	N/A	2	0	0	0	0	0	2	0	0	**2**	**0**	**0**	This is a population known only by Joel Lau
Palawai	Genetic Storage	0	1	0	0	0	0	0	0	0	**0**	**1**	**0**	regrowth or new plant at old site observed
	Total for Taxon:	9	14	3	0	0	0	13	29	12	**9**	**14**	**3**	

Taxon Level Discussion

On O‘ahu, this species is found in both the Wai‘anae and Ko‘olau Mountains. In the Wai‘anae Mountains it is found from Hale‘au‘au to ‘Ēkahanui, and in the Ko‘olau Mountains it ranges from Kaukonahua to Kawainui and is found in both windward and leeward locations. There is a great deal of undersurveyed *P. hirsuta* habitat in the Ko‘olau Mountains. Preferred habitat varies from wet forest in the Ko‘olau Mountains to mesic-wet talus slopes in the Wai‘anae Mountains. In the Wai‘anae Mountains this species has been known to occur in large groups. Many of these large population sites have not been seen recently by NRS and their status is unclear. Most Wai‘anae PUs contain very low numbers and NRS has clearly documented a steady decline. Weeds, ungulates, and landslides are the primary causes of this decline. Without immediate attention many PUs are likely to disappear. In the next year NRS will begin to collect cuttings from every known living individual in order to establish living collections and provide stock for reintroductions at the three MFS PUs (See Table 2.2.10a and Outplanting Issues). The Wai‘anae sites will be the first priority due to the decline in populations. As seed storage is currently not feasible (see Propagation and Genetic Storage), NRS will use the Lyon Micropropagation Lab and the Pahole Mid-elevation Nursery to maintain stock for storage and future outplanting.

Propagation and Genetic Storage

Plants are easily propagated from cuttings and seeds. Fresh seeds have high germination rates and seedlings grow vigorously. Seeds have been germinated at the Lyon Micropropagation Lab and plants can be subcultured and maintained *in vitro*. Storage viability for this taxon is unknown, but based on other species of *Phyllostegia*, it is likely that seeds will be able to be stored to meet genetic storage goals. A large collection of seed, hopefully from an increasing living collection, will need to be tested. If seeds can be stored, the living collection can serve as the seed source. Until seed storage is determined, tissue culture and a living collection will serve to meet genetic storage goals. Seeds were collected from the Wai‘eli population the previous report year. Stock from Kalua‘ā, Poamoho, ‘Ēkahanui and ‘Ōpae‘ula PUs are currently represented in the greenhouse. A new population was discovered at Pu‘u Kalena, but all the mature plants were vegetative at the time of discovery. One immature plant has emerged in Pālāwai at a site thought to be extirpated, and may be brought into the greenhouse at a later date.

Table 2.2.11b Genetic Storage Summary

Population Unit Name	# of Potential Founders: Current Mature	Current Imm.	NumWild Dead	Partial Storage Status: # Plants >= 10 in Seedbank	# Plants >=1 Microprop	# Plants >=1 Army Nursery	Storage Goals Met: # Plants that Met Goal
Phyllostegia hirsuta							
Central Waieli	8	5	0	1	1	1	1
Haleauau	0	3	0	0	1	0	1
Helemano and Opeaula	7	9	1	0	0	1	0
Huliwai	0	0	1	0	0	1	0
Kaipapau	1	0	0	0	0	0	0
Kaipapau-Kawainui Summit Ridge	5	0	0	0	0	0	0
Kaluaa to South Waieli	1	13	0	0	0	1	1
Kaluanui	5	0	0	0	0	0	0
Kaukonahua	4	2	0	0	0	0	0
Kawaiiki	2	0	0	0	0	0	0
Makaha-Waianae Kai Ridge	2	0	0	0	0	0	0
Mohiakea	50	0	0	0	0	0	0
North Ekahanui	0	0	0	0	0	0	0
Palawai	0	1	0	0	0	1	1
South Central Haleauau	3	8	0	0	0	0	0
South Helemano	1	0	0	0	0	0	0
				Total # Plants w/ >=10 Seeds in Seedbank	**Total # Plants w/ >=1 Microprop**	**Total # Plants w/ >=1 Army Nursery**	**Total # Plants that Met Goal**
				1	2	5	4

Unique Species Observations

In the Ko‘olau range this species is generally found as only single individuals or very small populations growing in wet forest. However, in the Wai‘anae Mountains population sizes are observed to be larger and growing on steep rocky slopes in mesic-wet forest.

Outplanting Issues

In the Ko‘olau Mountains *P. hirsuta* has a widely scattered distribution that makes it difficult to encompass 75 individuals within one MU. Therefore, all the populations within the AA (from Kawai Iki to Kaukonahua) and adjacent windward areas (Kaluanui and Kaipapa‘u) will be managed as a propagule source for a Koloa PU reintroduction. NRS will investigate the differences in micro-sites while monitoring and collecting from these PUs in order to determine if the Koloa reintroduction will be an appropriate site for all Ko‘olau PUs. As information is gathered NRS will have the IT review plans.

The Mohiākea and South Central Hale‘au‘au PUs will be reintroduced into a proposed fenced area within the Kalena-Ka‘ala Ridge MU. The Hale‘au‘au PU (and possibly Mākaha-Wai‘anae Kai ridge PU) will be reintroduced into the Ka‘ala MU. There are fenced sites on the slopes of Ka‘ala where this species should thrive. The PUs that occur South of Kolekole pass (Central Wai‘eli, Kalua‘ā to South Wai‘eli, Huliwai, and Pālāwai) with living stock will be incorporated into a reintroduction in the Kalua‘ā and Wai‘eli Subunit IIb MU. In the next year NRS will make collections from PUs for a trial outplanting next winter (Figure 2.2.10b).

Figure 2.2.11b *Phyllostegia hirsuta* PU Groupings for Reintroduction

It should be noted that TNCH has outplanted *P. hirsuta* three times at three sites in the Kalua’ā to South Wai‘eli PU over the last four years using about two dozen plants for each outplanting attempt. Two of the three outplantings are considered failures given the lack of any seedlings and the death of most outplants. The third outplanting is a year and a half old and its success or failure remains to be seen, however some individuals have survived to maturity and have fruited. Conditions at this site may be a bit wetter and cooler then previously used sites. This fairly short lived species seems to rely on high seed production and replacement as a primary reproductive strategy. Reasons for the outplanting failure may lie with improper micro-site conditions resulting in poor vigor or lack of sufficient number of plants outplanted and not enough plants surviving to maturity to produce a viable seed bank. However, limited monitoring of the outplantings occurred so any conclusions about success or failure may be premature. The problems TNCH faced with its outplantings underscore the difficulties faced by NRS in establishing stable populations for a species with naturally dynamic populations.

Research Issues
Seed storage potential for this species needs to be investigated; however, this will likely not be completed until reintroductions are established.

Surveys
In the last year some sites within the TNCH Honouliuli Preserve were revisited to update population numbers and monitor threats. An immature plant from a known site in the Pālāwai PU was discovered. The last individuals seen before this one was in 2002. A survey during October 2006 found the SBW-B population within the South Central Hale‘au‘au PU had been extirpated. However, a new population was discovered within this PU, just North of Pu‘u Kalena, on a survey of SBW in July 2007.

Population Unit Level Discussion

Manage for Stability PUs

South Central Hale‘au‘au: This PU contains the sites at Pu‘u Kalena and Kalena Notch that used to be in the Mohiākea – Hale‘au‘au PU, was divided up due to geographic isolation of the sites. The site at Kalena Notch (SBW-B) was visited and found extirpated, but a new site with 12 plants was found just North of Pu‘u Kalena. This PU lies within a proposed fenced area for the Kalena-Ka‘ala Ridge MU, but the start date for construction is undetermined due to the complexities of access to the range, UXO, etc.

Kalua‘ā to South Wai‘eli: This PU was formerly known just as Kalua‘ā but the name was changed because some of the sites fall in Wai‘eli. There are four sites within this PU. All sites were visited in the past two years and one appears to have been extirpated. At the three remaining sites plants are not vigorous and there has been a steady decline, likely the result of weed competition as well as land slides. The wild plants in Central Kalua‘ā (KAL-A) are fenced, the plants in Wai‘eli are not.

Koloa: NRS are still negotiating a Right of Entry/License Agreement with Hawaii Reserves Inc., the land manager of the Koloa parcel. After this agreement is in place, NRS will pursue a Koloa MU fence. This action is considered the highest management priority for this taxon in the Ko‘olau Mountains. Once the fence is complete NRS will develop a reintroduction plan for the site (see Outplanting Issues). In the meantime, NRS will work to fully survey the area and determine if there are any naturally occurring populations.

Other PUs

Hale‘au‘au: This PU, formerly known as Mohiākea-Hale‘au‘au, was made up of four sites: Hale‘au‘au, Pu‘u Kalena, Kalena Notch, and North Mohiākea. This PU now only consists of the population in central Hale‘au‘au. The site had three immature plants in August 2002, but has not been visited since. NRS will revisit the site and make collections for storage and reintroduction within the Ka‘ala MU(see outplanting issues section above).

Mohiākea: This PU, formerly included in the Mohiākea-Hale‘au‘au PU, now only consists of the population in North Mohiākea. The site has not been visited in a number of years and its current status is unknown, however it is a high priority area for NRS to resurvey.

Central Wai‘eli: There are two sites within this PU. NRS discovered one of these sites in the previous report year. One mature plant occurs at this site and seeds and cuttings were collected from this single healthy individual. There are now eight propagules in the greenhouse from this source. The second site has not been visited since May 2003. NRS will return in the next year to determine the extent of both sites and collect stock to reintroduce at the Kalua‘ā and Wai‘eli Subunit II B MU (see Outplanting Issues).

Kawai Iki: There is one site in this PU that was last visited in May of 1999. NRS will visit this site in the next year to monitor and collect stock for reintroduction at the Koloa PU (see Outplanting Issues).

Kaipapa‘u-Kawainui Summit Ridge: There are two sites within this PU, one of which NRS and Joel Lau discovered in February of 2006. Only the Joel Lau is familiar with the other site. NRS will work to collect from these sites in the next couple years for reintroduction in the Koloa PU.

Kaukonahua: There is one site in this PU that was last visited in February of 2001. NRS will visit this site in the next year to monitor and collect stock for reintroduction at the Koloa PU (see Outplanting Issues).

Helemano and Opaeula: There are four sites in this PU. These sites have been visited at various times over the past four years. NRS will work to collect from these sites in the next couple years for reintroduction into the Koloa PU. The site near the Lower Pe‘ahināi‘a trail (KLO-G) has a more narrow leaf than has been noted at other populations. This may be due to its location on the more exposed windward side. NRS will seek input from Joel Lau and the IT regarding the significance of this difference and whether or not it should influence outplanting plans for the Koloa PU (see Outplanting Issues).

South Helemano: There is one site in this PU that was last visited in March of 2003. NRS will visit this site in the next year to monitor and collect stock for reintroduction at the Koloa PU.

‘Ēkahanui: There are two sites within this PU. The North ‘Ēkahanui population died during the previous report year and another historic location in South ‘Ēkahanui was resurveyed this year and found to be extirpated as well. NRS will monitor the sites in the coming year and search for any regeneration.

Mākaha-Wai‘anae Kai Ridge: This is a population known only by Joel Lau. NRS will get directions regarding the location in the next year and visit the site while conducting other management in the area to determine status. As this PU has no management designation for NRS, if plants are found they will be reported to the BWS watershed planner and considered for inclusion into the reintroduction site in the Ka‘ala MU.

Huliwai: This PU contains one site that was last visited in June of 2007. This population has been declining over the past several years due to landslides, ungulate activity, and the small number of mature individuals. Only one small immature was observed during the June visit. After reviewing all threats and options, NRS decided to remove the plant from the wild and place it in the greenhouse, where it is currently thriving. NRS will propagate the Huliwai stock for reintroduction at the Kaluaʻā and Waiʻeli Subunit II B MU. NRS will also revisit this site in the spring of 2008 to monitor for additional seedlings.

Kaipapaʻu Gulch: This site has no management designation for NRS and is outside the area of NRS operations. NRS will not visit the site but will encourage other agencies to begin management of this site.

Kaluanui: This site has no management designation for NRS and is outside the area of NRS operations. NRS will not visit the site but will encourage other agencies to begin management of this site.

Pālāwai: This site was thought to be extirpated until NRS found an immature plant in early 2007. This plant may be a resprout from a stolon of one of the plants observed in 2002 as it is in the general area of the previous observed plants, though it is unclear. NRS will continue to monitor the site and collect for genetic storage when the plant has sufficient growth or has matured.

2.2.12 *Phyllostegia mollis*

Requirements for Stability

- 3 population units (PUs)
- 75 reproducing individuals (short-lived perennial, with tendency for large declines or fluctuations in population size)
- Stable population structure
- Threats controlled
- Genetic storage collection for full genetic representation
- Tier 1 stabilization priority

Major Highlights/Issues in Urgent Actions

- Puali‘i fence completed by TNC last fall will be used for reintroduction site.
- New individual found in Central Kalua‘a.
- All remaining individuals from the Mohiākea PU (Schofield Barracks West Range) died this past year of unknown causes.

Plans for OIP Year 1

- Continue balancing founders at existing reintroduction and/or augmentation sites and begin new reintroduction at Puali‘i.
- Continue genetic storage and propagation work for large outplantings.
- Complete the larger ‘Ēkahanui fence for more outplanting sites.
- Some survey work at old sites and adjacent areas for new founders as time permits.
- Weed control at some old sites to hopefully stimulate germination of new founders as time permits.

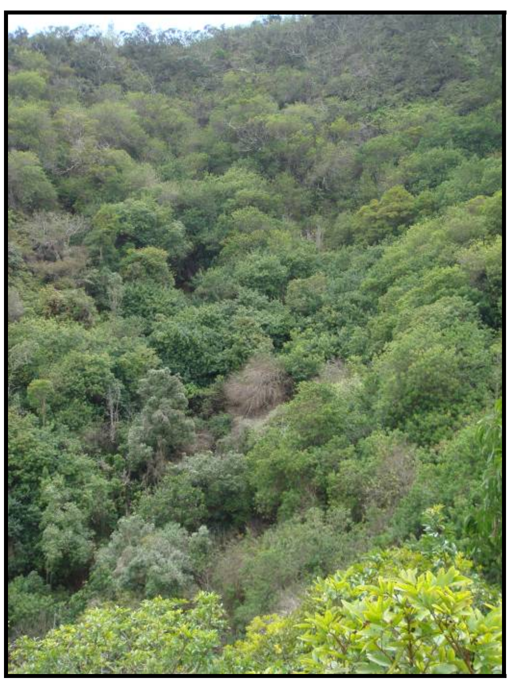


Figure 2.2.12a Central Kalua‘ā outplanting and wild site (Gulch 3)

Table 2.2.12a Taxon Status Summary

Action Area: In

TaxonName: Phyllostegia mollis — TaxonCode: PhyMol

Population Unit Name	Management Designation	Current Mature (Wild)	Current Immature (Wild)	Current Seedling (Wild)	Current Augmented Mature	Current Augmented Immature	Current Augmented Seedling	NRS Mature 2006	NRS Immature 2006	NRS Seedling 2006	Total Mature	Total Immature	Total Seedling	Population Trend Notes
Mohiakea	Genetic Storage	0	0	0	0	0	0	0	1	2	**0**	**0**	**0**	
	Total for Taxon:	0	0	0	0	0	0	0	1	2	**0**	**0**	**0**	

Action Area: Out

TaxonName: Phyllostegia mollis — TaxonCode: PhyMol

Population Unit Name	Management Designation	Current Mature (Wild)	Current Immature (Wild)	Current Seedling (Wild)	Current Augmented Mature	Current Augmented Immature	Current Augmented Seedling	NRS Mature 2006	NRS Immature 2006	NRS Seedling 2006	Total Mature	Total Immature	Total Seedling	Population Trend Notes
Ekahanui	Manage for stability	0	0	0	13	0	0	0	0	0	**13**	**0**	**0**	
Huliwai	Genetic Storage	0	0	0	0	0	0	0	0	0	**0**	**0**	**0**	
Kaluaa	Manage for stability	0	1	0	15	36	0	14	0	0	**15**	**37**	**0**	
Pualii	Manage for stability	0	0	0	0	0	0	0	0	0	**0**	**0**	**0**	
Waieli	Genetic Storage	1	0	0	0	0	0	1	0	0	**1**	**0**	**0**	
	Total for Taxon:	1	1	0	28	36	0	15	0	0	**29**	**37**	**0**	

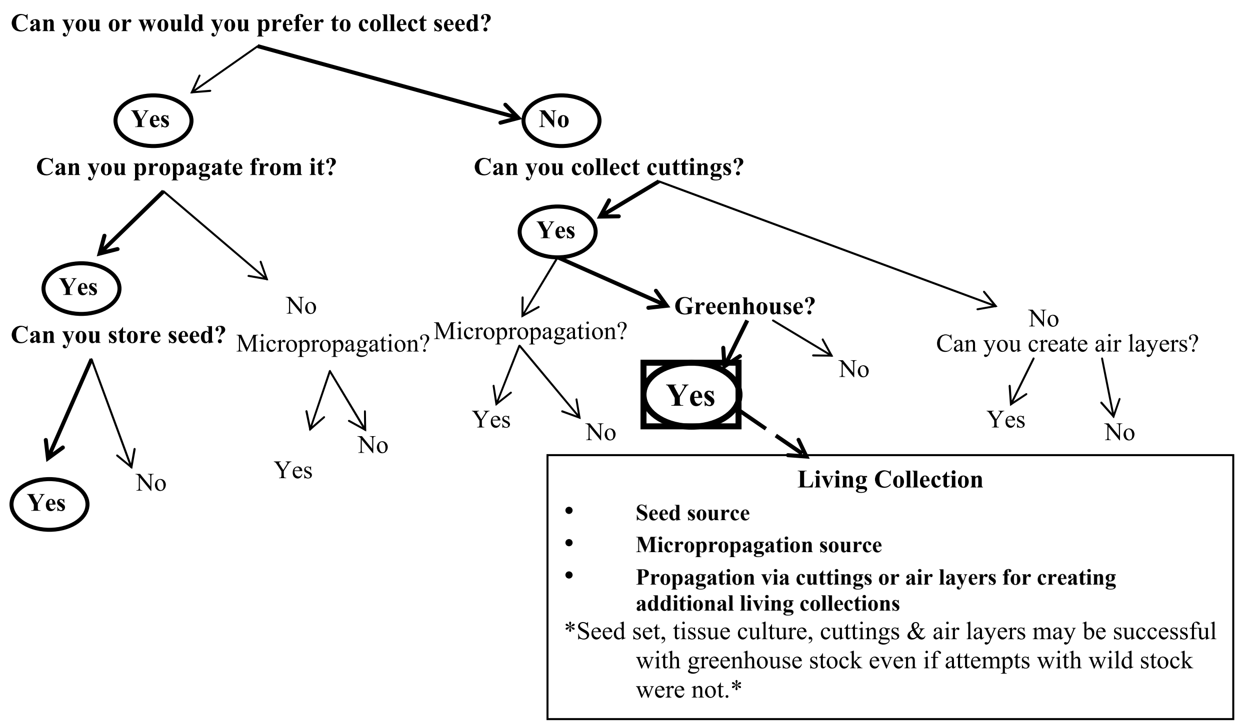
Taxon Level Discussion

The current status of this taxon is still very bleak. Plants are extirpated from all but two of the six known sites. The two remaining sites are at Schofield Barracks South Range (SBS) and a newly discovered location at Central Kalua‘a gulch in TNC’s Honouliuli Preserve. Augmentation must be used to achieve stabilization for this taxon. NRS will not report on PUs with no remaining individuals next year unless a change in status occurs.

Propagation and Genetic Storage

1) At this time, what is the preferred propagation technique?	2) At this time, what is the preferred genetic storage technique?	3) Has a successful storage method been determined?	4) Are additional steps required for obtaining enough seed?
Cuttings	Living Collection	No	Yes, further pollination studies needed

Prioritizing Genetic Storage & Propagation Techniques



Collection: Cuttings are the preferred collection method for tissue culture and greenhouse propagation. Seed production rates are often low even from older, mature plants.

Propagation: This species is easily propagated from tip cuttings as well as seeds. There are no special germination requirements. Germination from fresh seeds is high.

Seed Storage Research: Soil seed bank potential was tested in the lab with a dark, imbibed treatment. Seeds show no decrease in viability after one year in the dark, imbibed. No aging was detected in seeds stored dry at -18C after 19 months of storage.

Genetic Storage: Seven additional founders have been established in tissue culture this year. NRS will continue to maintain all stock as a living collection and in tissue culture. Any seeds produced in the greenhouse will be collected for seed storage testing or storage.

Table 2.2.12b Genetic Storage Summary

Population Unit Name	# of Potential Founders: Current Mature	Current Imm.	NumWild Dead	Partial Storage Status: # Plants >= 10 in Seedbank	# Plants >=1 Microprop	# Plants >=1 Army Nursery	Storage Goals Met: # Plants that Met Goal
Phyllostegia mollis							
Ekahanui	0	0	1	0	1	1	1
Huliwai	0	0	1	1	1	1	1
Kaluaa	0	1	0	0	0	0	0
Mohiakea	0	0	12	1	4	5	5
Pualii	0	0	1	0	0	1	1
Waieli	1	0	4	3	5	5	5
				Total # Plants w/ >=10 Seeds in Seedbank	**Total # Plants w/ >=1 Microprop**	**Total # Plants w/ >=1 Army Nursery**	**Total # Plants that Met Goal**
				5	11	13	13

With the exception of stock from Mohiākea PU, genetic storage goals have largely been met for this species. Cuttings from the immature plant at Kalua‘ā will likely be made this year.

Table 2.2.12c Founders Represented in Outplantings

TaxonName: Phyllostegia mollis **TaxonCode: PhyMol**

Total Num Plants based upon Plants that have been numbered

PopulationUnitName	Management Designation	Number of Founders	Number of Founders Represented
Ekahanui	Manage for stability	1	1
Huliwai	Genetic Storage	1	1
Kaluaa	Manage for stability	1	0
Mohiakea	Genetic Storage	12	3
Pualii	Manage for stability	1	0
Waieli	Genetic Storage	5	5
	Total for Taxon:	**21**	**10**

Number of Founders = Number of Mature, Immature, and Dead founder plants.
Number of Founders Represented = Number of founder plants represented in reintroductions.

Unique Species Observations

This species looks very similar to *Phyllostegia parviflora* var. *lydgatei*. *P. parviflora* and *P. mollis* once co-occurred in Pālāwai, Puali‘i and ‘Ēkahanui gulches and are difficult to differentiate. This has lead to some confusion with regard to existing collections both *in situ* and *ex situ*. In order to clarify this issue, Dr. Clifford Morden from U.H. at Mānoa conducted genetic analyses. The results were not completely conclusive but do indicate that the Pualii plant in question is likely a hybrid. NRS will treat the Puali‘i population as a hybrid between the two taxa and will be treated separately in future management. This stock will be reintroduced into the Puali‘i area and not mixed with any pure *P. mollis* stocks. *P. parviflora* var. *lydgatei* is extirpated from the wild. Three TNC reintroduced populations of *P. parviflora* var. *lydgatei* are doing fairly well in the Palikea, Kalua‘a and South Puali‘i fence areas with vegetative reproduction occurring at two of the three reintroduction sites. This small success of the TNC reintroductions offers hope that future Army reintroductions will also be successful.

Outplanting Issues

As with other Hawaiian mint species, *P. mollis* is a short-lived perennial species relying on vegetative and sexual reproduction for population replacement. A key factor for population growth over time is the individual plant’s microsite. This species appears to prefer loose granular soil in semi-disturbed sun gaps along the lower gulch bottom slopes. This type of habitat is now mostly degraded limiting overall potential for recruitment over time. Outplanting sites may require weed control at least one year prior to outplanting in order to stabilize the habitat by re-opening the canopy, removing subsequent weeds that will invade this semi-disturbed habitat, and allowing native colonizing species (e.g. *Pipturus albidus*) to stabilize the habitat. Large numbers of outplantings will also likely be needed at each site (e.g. 200 individuals) in order to obtain a stabilized target population of 75 plants given the dynamic nature of populations of this species. See also the Kalua‘ā MFS PU section below for further discussion on outplanting issues specific to those sites.

Discussion of Management Designations

The strategy for this taxon involves substantial reintroductions. The MFS augmentations and reintroductions will be conducted in three zones. Figure 2.2.12b below, shows the designated population reference codes to be planted into the three core management sites, Kalua‘ā, ‘Ēkahanui and Puali‘i. Each population reference code represents the location of the source material (e.g. KAL = Kalua‘ā).

Map removed,
available upon request

Figure 2.2.12b Outplanting Zones for *Phyllostegia mollis*

Research Issues
Outplanting techniques and site selection require some research as reintroduction survival rates over time are low for this taxon. Perhaps research in the area of drought and fungal susceptibility of this taxon would assist managers in understanding reasons for dramatic declines. Additional genetics would not be useful as all techniques will be limited by sample size. Slug control research will also benefit this species.

Surveys
No surveys have been conducted recently for this taxon. In the next year NRS will direct some staff time to survey for additional populations. Revisiting historical locations and searching adjacent sites will be the highest priority. The newly discovered plant in Central Kalua‘ā offers some hope that additional plants can still be found.

Manage for Stability PUs

Kaluaʻā

Kaluaʻā, Waieli, and Mohiākea stock is available for use in this MU. The newly discovered Kaluaʻā individual is not yet in propagation as it is still too small for cuttings to be taken. The Central Kaluaʻā MU fence continues to be maintained and provides secure habitat for management of this taxon. Two reintroductions have already been conducted into this fence. The KAL-B reintroduction was initiated in 2002 with 26 plants. All plants from this effort have since died. No recruitment was ever observed at the KAL-B site although a number of the outplants flowered and fruited. Plants were planted in possibly too much shade for them to thrive and produce a lot of seeds or new stolons before senescing. The KAL-C site was first established in February 2006 with 16 plants. 14 of those 16 plants died quickly in the space of two months in the summer of 2006. NRS suspect that powdery mildew and/or a virus caused the quick decline as rainfall was more than adequate and plants were healthy just prior to dying. More frequent monitoring will hopefully detect any future declines in time for a management response. In early 2007, 51 plants were added to the KAL-C site, at the same location of the 2006 outplanting, and at another location approximately 100m up gulch. As of July 2007 only two plants have died from this last reintroduction. Overall survivorship at the KAL-C site is 76% over the last two years. Based on stock availability, an additional site may be established within the adjacent Waieli exclosure. Weed control is on going at the Kaluaʻā reintroduction sites, see Chapter 1 for weed control details.

ʻĒkahanui

All the wild plants from this zone are extirpated. Stock from the ʻĒkahanui and Huliwai PUs were used for a reintroduction in the past year. This initial effort consisted of 13 individuals and more plants will supplement this site in the coming year.

Subunit I of the ʻĒkahanui MU contains some suitable habitat for this taxon. The NRS fencing crew expect to have Subunit II of this MU completed sometime by Spring 2008. This will increase the available habitat for *P. mollis* reintroductions in ʻĒkahanui significantly. One potential reintroduction site was weeded last year by TNC. Substantial reintroductions are planned for the coming year into this MU.

Pualiʻi

TNC completed a new exclosure in Pualiʻi gulch last fall and reintroduced a mixed outplanting of *P. mollis* and *P. parviflora var. lydgatei* last November in the upper reach of South Pualiʻi. The NRS reintroduction will be in North Pualiʻi at a site geographically distinct from the existing TNC reintroduction. Weed control at this planned reintroduction site is already ongoing by TNC and NRS staff.

Other PUs

Waieli

NRS continue to monitor the wild site in North Waiʻeli (SBS-A). One mature individual still exists at a degraded site dominated by *Schinus terebinthifolius* and *Toona ciliata*. This extant individual is represented *ex situ*. In recent years, there were additional mature plants nearby.

NRS will continue to monitor all sites where plants were previously found in Waieli in hopes of securing representation from additional founders. Plants have not been observed recently at the Central Waieli site (ELI-A).

Mohiākea

Range restrictions limit the access to this site. Unfortunately, all six remaining plants died at this site of unknown causes. This population had been declining over the past several years despite fencing. Limited range access made more frequent monitoring difficult. NRS will continue monitoring this site periodically for any new seedlings.

Figure 2.2.12c *Phyllostegia mollis* formerly at Mohiākea

2.2.13 *Pteris lidgatei*

Requirements for Stability

- 3 Population Units (PU)
- 50 reproducing individuals (short-lived perennial)
- Stable population structure
- Threats controlled
- Genetic storage collections from PUs managed for stability
- Tier 3 stabilization priority

Taxon Level Discussion

There are three Manage for Stability (MFS) PUs for *Pteris lidgatei*. Two of the MFS PUs are within the Action Area (AA) for Schofield Barracks East Range (SBE) and the other is inside the Kawailoa Training Area (KLOA) AA. There are currently no plants known from the North Kaukonahua PU, so the Helemano and Kawa‘iki PUs have been identified as two backup sites. Since there is little potential impact to *Pteris lidgatei* from Army actions it has been a low priority to schedule management in the last year. This species is threatened by pigs and weeds but most sites occur along steep stream banks and waterfalls and are not directly threatened by pigs. NRS has monitored all the O‘ahu PUs except the South Kaukonahua and Kaluanui PUs in the last two years. These PUs and the North Kaukonahua PU will be the priorities for monitoring and surveys in the coming year. Propagation methods have not yet been developed and NRS will search for appropriate material while monitoring PUs.

Major Highlights/Issues in Urgent Actions

- No NRS monitoring in the last year
- *Pteris lidgatei* was discovered on Moloka‘i by Steve Perlman and Hank Oppenheimer. Previously, it was known only from O‘ahu and West Maui.

Plans for OIP Year 1

- Monitor the known sites in the South Kaukonahua PU
- Survey for additional plants in the North Kaukonahua, Helemano and Kawai Nui PUs
- Collect mature sori for propagation trials

Table 2.2.13a Taxon Status Summary

Action Area: In

TaxonName: Pteris lidgatei **TaxonCode: PteLid**

Population Unit Name	Management Designation	Current Mature (Wild)	Current Immature (Wild)	Current Seedling (Wild)	Current Augmented Mature	Current Augmented Immature	Current Augmented Seedling	NRS Mature 2006	NRS Immature 2006	NRS Seedling 2006	Total Mature	Total Immature	Total Seedling	Population Trend Notes
Helemano	Manage for stability (backup site)	2	2	0	0	0	0	2	2	0	**2**	**2**	**0**	No observations in the last year
Kawaiiki	Manage for stability (backup site)	3	0	0	0	0	0	3	0	0	**3**	**0**	**0**	No observations in the last year
Kawainui	Manage for stability	0	1	0	0	0	0	0	1	0	**0**	**1**	**0**	No observations in the last year
North Kaukonahua	Manage for stability	0	0	0	0	0	0	0	0	0	**0**	**0**	**0**	No observations in the last year
South Kaukonahua	Manage for stability	6	0	0	0	0	0	6	0	0	**6**	**0**	**0**	No observations in the last year
	Total for Taxon:	11	3	0	0	0	0	11	3	0	**11**	**3**	**0**	

Action Area: Out

TaxonName: Pteris lidgatei **TaxonCode: PteLid**

Population Unit Name	Management Designation	Current Mature (Wild)	Current Immature (Wild)	Current Seedling (Wild)	Current Augmented Mature	Current Augmented Immature	Current Augmented Seedling	NRS Mature 2006	NRS Immature 2006	NRS Seedling 2006	Total Mature	Total Immature	Total Seedling	Population Trend Notes
Waimano	Genetic Storage	0	2	0	0	0	0	0	2	0	**0**	**2**	**0**	No observations in the last year
	Total for Taxon:	0	2	0	0	0	0	0	2	0	**0**	**2**	**0**	

Propagation and Genetic Storage
This species has not been successfully propagated. NRS plan to collect mature sori for propagation this year if any material is available.

Outplanting Issues
All three MFS PUs will require augmentation to achieve the numbers needed for stability. NRS will develop propagation techniques once mature sori are collected. Outplanting *P. lidgatei* into the waterfall and stream bank habitat where they are found may be challenging.

Research Issues
The biology of this species is not well known and research on the gametophyte and sporophyte generation is needed. Propagation methods are not developed.

Surveys
No surveys have been conducted in the last year. Additional surveys would be beneficial as habitat for this species is largely under surveyed. NRS will contact Maui PEP in the coming year to get an update on the Maui PUs and potential propagation techniques.

Figure 2.2.13a An immature frond of a plant in the Helemano PU

2.2.14 *Sanicula purpurea*

Requirements for Stability

- 3 Population Units (PU)
- 100 reproducing individuals (short-lived perennial; inconsistent flowering)
- Stable population structure
- Threats controlled
- Genetic storage collections from Pus managed for stability
- Tier 2 stabilization priority

Taxon Level Discussion

There are three Manage for Stability (MFS) PUs for *Sanicula purpurea.* Two are inside the Kawailoa Training Area (KLOA) Action Area (AA) and the third is inside the Schofield Barracks East Range (SBE) AA. These three MFS PUs contain all but four of the known plants on O‘ahu. There are several hundred plants known from West Maui. None of the O‘ahu PUs have more than 25 plants and the goal for each MFS PU is to have 100 reproducing plants. Augmentation will be necessary at all three MFS PUs to achieve stability. Few mature plants have been observed in the wild. Observations of inconsistent flowering indicate that this species may be difficult to monitor and determine population trends. Ongoing research with *Sanicula mariversa* may provide insight into how to adapt to these difficulties. NRS has grown plants from the Helemano-Punalu‘u Summit stock and outplanted four plants in 2000. One of these plants was observed flowering at the reintroduction site in May 2006 and seedling recruitment was observed in July 2006. Pigs and weeds especially *Axonopus fisifolius* are the major threats at all PUs.

Major Highlights/Issues in Urgent Actions

- A thorough monitoring of the Helemano-Punalu‘u Summit Ridge PU found more plants
- NRS began intense monitoring of *Sanicula mariversa* PUs which may help guide stabilization targets and strategies for this taxon as well

Plans for OIP Year 1

- Monitor and determine fenceline at the Kaukonahua-Punalu‘u Summit Ridge PU
- Collect mature seed from any PUs for propagation in the greenhouse for seed production

Table 2.2.14a Taxon Status Summary

Action Area: In

TaxonName: Sanicula purpurea   TaxonCode: SanPur

Population Unit Name	Management Designation	Current Mature (Wild)	Current Immature (Wild)	Current Seedling (Wild)	Current Augmented Mature	Current Augmented Immature	Current Augmented Seedling	NRS Mature 2006	NRS Immature 2006	NRS Seedling 2006	Total Mature	Total Immature	Total Seedling	Population Trend Notes
Helemano-Punaluu Summit Ridge	Manage for stability	2	10	12	0	0	0	0	10	0	**2**	**10**	**12**	Monitoring revised estimates in the last year
Kahana-Kaukonahua Summit Ridge	Manage for stability	0	21	0	0	0	0	0	21	0	**0**	**21**	**0**	No monitoring in the last year
Kaukonahua-Punaluu Summit Ridge	Manage for stability	0	21	0	0	0	0	0	21	0	**0**	**21**	**0**	Monitoring showed no change in the last year
	Total for Taxon:	2	52	12	0	0	0	0	52	0	**2**	**52**	**12**	

Propagation and Genetic Storage

Fruit collected from the Helemano-Punaluʻu Summit population were successfully propagated in the greenhouse and outplanted at the ʻŌpaeʻula Summit. *Sanicula purpurea* will likely mimic its congener *S. mariversa* in dormancy and germination behavior and storage potential. Seeds collected form this reintroduction last year took eight months to germinate. Bulk collections have been difficult to obtain from *S. purpurea* because of the sporadic and infrequent flowering patterns. Until sufficient bulk seed collections are obtained, NRS will store *S. purpurea* using techniques developed for *S. mariversa*.

Figure 2.2.14a A plant reintroduced in 2000 was observed flowering again in the last year

Outplanting Issues

NRS outplanted four individuals grown from the Helemano-Punalu’u Summit PU into a site at the **ʻ**Ōpaeʻula Summit in 2000 in order to work out reintroduction techniques for the taxon. Currently, all four of the reintroduced plants are still alive. One plant has reached reproductive maturity, and a new seedling was found near the mature plant. NRS did not have success outplanting *S. mariversa* and suspect this result was due to much drier conditions in the

Wai'anae Mountains. The success of the first reintroduction attempt with this taxon give NRS hope that *S. purpurea* may be easier to reintroduce and manage than its congener.

Research Issues

Due to a lack of knowledge about the biology of wild plants, research on both *S. mariversa* and *S. purpurea* should focus on determining seasonality. Propagules may be faster and better produced for storage testing in the greenhouse if a few plants can be maintained. In this way NRS avoid impacting wild PUs. To keep these plants healthy, NRS may need to mimic the saturated conditions at wild sites.

2.2.14 *Schiedea trinervis*

Requirements for Stability

- 1 Population Unit (PU) of at least 150 reproducing individuals throughout the range of the species
- Stable population structure
- Threats controlled
- Genetic storage collections from 50 plants across the range of the species
- Tier 1 stabilization priority

Taxon Level Discussion

There are several hundred *Schiedea trinervis* known from 28 sites in the wet forest habitat around Mt. Kaʻala and Puʻu Kalena. Most known sites are within the Schofield Barracks West Range (SBW) Action Area (AA). The majority of plants are also within the Mt. Kaʻala Management Unit (MU) and are inside a fence where weed control is ongoing. All other sites are not fenced and pigs are the major threat. Juvenile and seedling plants are found at most sites and the PU has more than the required number of reproducing plants. Additional fences are planned for the East Makaleha and Kalena-Kaʻala Ridge MUs and these will protect the plants in those areas. NRS will consider building small fences for any plants outside these MU fences if needed to collect for genetic storage. NRS will continue to work with State of Hawaiʻi Natural Area Reserve System and Forestry and Wildlife staff to exclude pigs from the Mt. Kaʻala MU and to begin control of the goats near plants along the ridge between Mt. Kaʻala and Puʻu Kalena. NRS are controlling *Psidium cattleianum* and *Hedychium gardernarium* across the Mt. Kaʻala MU, which are the most significant weed threats to this taxon. New sites were discovered in the last year and additional surveys would likely discover more plants. Genetic storage collections are ongoing and collections will continue prioritizing unprotected areas. NRS expect to meet the goal to have 50 seeds from 50 plants in storage in the coming year. Limited experimental reintroduction has been conducted with this taxon but no further planting is planned.

Major Highlights/Issues in Urgent Actions

- New plants were found at Puʻu Kalena and in East Makaleha
- Monitoring data was revised to display the best estimates of smaller size classes

Plans for OIP Year 1

- Collect mature seed for genetic storage from 15 additional founders. Priority will be given to plants in unprotected and outlying areas
- Survey for additional plants in East Makaleha

Table 2.2.15a Taxon Status Summary

Action Area: In

TaxonName: Schiedea trinervis **TaxonCode: SchTri**

Population Unit Name	Management Designation	Current Mature (Wild)	Current Immature (Wild)	Current Seedling (Wild)	Current Augmented Mature	Current Augmented Immature	Current Augmented Seedling	NRS Mature 2006	NRS Immature 2006	NRS Seedling 2006	Total Mature	Total Immature	Total Seedling	Population Trend Notes
Kalena to East Makaleha	Manage for stability	169	206	322	6	37	0	166	169	0	**175**	**243**	**322**	
	Total for Taxon:	169	206	322	6	37	0	166	169	0	**175**	**243**	**322**	

Propagation and Genetic Storage

Plants are easily propagated from seed. There is no detected decrease in viability after more than six years of dry storage at 4C or -18C. Fresh seeds may initially be slow to germinate due to dormancy but typically have high germination (>75%). Seedlings have also been established in tissue culture from seeds, and these seedlings have been propagated in the greenhouse. Based on ease of seed collection, storage, and propagation, seed is the preferred method of genetic storage.

Table 2.2.15b Genetic Storage Summary

	# of Potential Founders			Partial Storage Status			Storage Goals Met
Population Unit Name	Current Mature	Current Imm.	NumWild Dead	# Plants >= 10 in Seedbank	# Plants >=1 Microprop	# Plants >=1 Army Nursery	# Plants that Met Goal
Schiedea trinervis							
Kalena to East Makaleha	169	206	15	36	1	0	35
				Total # Plants w/ >=10 Seeds in Seedbank	**Total # Plants w/ >=1 Microprop**	**Total # Plants w/ >=1 Army Nursery**	**Total # Plants that Met Goal**
				36	1	0	35

Surveys

There were no surveys targeting *Schiedea trinervis* in the last year, but a few new sites were discovered. These sites were at the southern and northern end of the PU at Puʻu Kalena and Kaumoku nui Gulch, where fewer plants are known. NRS will continue to note new locations and surveys will be done in East Makaleha in the coming year.

2.2.16 *Stenogyne kanehoana*

Requirements for Stability

- 3 Population Units (PUs)
- 50 reproducing individuals (short-lived perennial)
- Stable population structure
- Threats controlled
- Genetic storage collections from all individuals
- Tier 1 stabilization priority

Major Highlights/Issues in Urgent Actions

- A new reintroduction was established at Pu‘u Hapapa for the Kalua‘ā stock.
- One Kalua‘ā stock plant in the nursery flowered.

Plans for OIP Year 1

- Carefully monitor nursery stock for flowering.
- Continue to reintroduce at established reintroduction sites.

Figure 2.2.16a Flowering *Stenogyne kanehoana* in the greenhouse

Table 2.2.16a Taxon Status Summary

Action Area: In

TaxonName: Stenogyne kanehoana **TaxonCode: SteKan**

Population Unit Name	Management Designation	Current Mature (Wild)	Current Immature (Wild)	Current Seedling (Wild)	Current Augmented Mature	Current Augmented Immature	Current Augmented Seedling	NRS Mature 2006	NRS Immature 2006	NRS Seedling 2006	Total Mature	Total Immature	Total Seedling	Population Trend Notes
Haleauau	Manage for stability	1	0	0	0	0	0	1	0	0	1	0	0	Monitoring showed no change in the last year.
	Total for Taxon:	1	0	0	0	0	0	1	0	0	1	0	0	

Action Area: Out

TaxonName: Stenogyne kanehoana **TaxonCode: SteKan**

Population Unit Name	Management Designation	Current Mature (Wild)	Current Immature (Wild)	Current Seedling (Wild)	Current Augmented Mature	Current Augmented Immature	Current Augmented Seedling	NRS Mature 2006	NRS Immature 2006	NRS Seedling 2006	Total Mature	Total Immature	Total Seedling	Population Trend Notes
Central Kaluaa (Gulch 2)	Manage reintroduction for stability	0	0	0	0	18	0	0	0	0	0	18	0	This reintroduction is new this year.
Central Kaluaa (South Fenceline)	Manage for stability	0	0	0	0	36	0	0	30	0	0	36	0	A few of plants from last year's reintroduction died and some new plantings were conducted.
	Total for Taxon:	0	0	0	0	54	0	0	30	0	0	54	0	

Taxon Level Discussion
This taxon is extremely rare. Until three years ago, it was extant at only one site. Significant threats include feral pigs, weeds (particularly *Clidemia hirta*) and possibly low genetic variation. Plants flower very infrequently. The stabilization for this taxon emphasizes seed collection in order to capture more genetic variation, habitat protection and augmentation.

Propagation and Genetic Storage

1) At this time, what is the preferred propagation technique?	2) At this time, what is the preferred genetic storage technique?	3) Has a successful storage method been determined?	4) Are additional steps required for obtaining enough seed?
Cuttings	Living Collection & Tissue Culture	No	Yes, collect from ex situ stock

Collection & Propagation: Cuttings are the preferred method of propagation.

Genetic Storage: Both wild populations are represented *ex situ* at Lyon Arboretum *in vitro* and in the Army Nursery. For almost the entire month of April 2007, one Kaluaʻā stock plant began to flower at the TNC nursery. This plant was transported to the Army Nursery for pollination observations. The plant produced fifteen flowers. NRS studied floral morphology and attempted hand-selfing nine flowers. Anthers emerged from the corolla tube and dehisced prior to elongation of the style and possible stigma receptivity. Pollen was collected and used throughout the month to add to stigmas on elongated styles. Excess pollen was dried and is stored at -18C. Pollen will be tested if plants continue to flower or pollen tube germination trials may be conducted to monitor viability. The taxon flowers so infrequently that NRS hoped to obtain as much information as possible on its reproductive biology. Initially, three fruit began to swell and develop. It seemed promising that some fruit could be collected. Then the flowering stem began to die and all the fruit aborted. The flowering stem was heavy and hung over the edge of its pot putting strain on the stem. In the future, NRS will construct a support for the stem to avoid this occurring again.

Unique Species Observations
Primarily, this taxon reproduces vegetatively. Very seldomly have plants been observed with flowers or fruit. The Haleʻauʻau population has yet to be observed reproducing sexually.

Research Issues
Reproductive biology studies were conducted as discussed above in the propagation and genetic storage section. NRS will research ways to stimulate flowering in the greenhouse so that seed collections can be secured and cross pollination can be done. It has been suggested that treating plants fertilizer containing fish emulsion should be tried to stimulate flowering.

Surveys
No surveys were conducted for this taxon during this reporting period.

Population Unit Level Discussion

Table 2.2.16b Threat Control Summary

Action Area: In

TaxonName: Stenogyne kanehoana

PopulationUnitName	ManagementDesignation	Protected from Ungulates	Weeds Managed	Rats Controlled
Haleauau	Manage for stability	Yes	Yes	No

Action Area: Out

TaxonName: Stenogyne kanehoana

PopulationUnitName	ManagementDesignation	Protected from Ungulates	Weeds Managed	Rats Controlled
Central Kaluaa (Gulch 2)	Manage reintroduction for stability	Yes	Yes	No
Central Kaluaa (South Fenceline)	Manage for stability	Yes	Yes	No

Manage for Stability PUs

Hale‘au‘au

This population was discovered in June 2004. A 30 x 20 meter fence was constructed to protect it from pigs. NRS conducted weed control at this site once in the last year. NRS are careful that weed control efforts have minimal impact on the *S. kanehoana*. NRS have observed that the *S. kanehoana* canes do best when supported by other vegetation. Therefore, NRS are very deliberate in their choice of weeds to remove. *Acacia koa* growing within the fence will likely provide some shade for the *S. kanehoana* in the near future. Access restrictions continue to limit the number of visits to this population. Clones of plants from this population have been reintroduced into Kalua‘ā and are represented in the nursery and micropropagation.

Central Kalua‘ā (South Fenceline)

The only wild plant in this population died in March 2005. NRS augmented this PU approximately 100 meters from the site of the original wild plant along the south Kalua‘ā fenceline with stock from both Kalua‘ā and Hale‘au‘au. Stock from this PU is represented in reintroductions, in the nursery and at the Lyon Micropropagation Lab. In the last year, a nursery plant of this stock flowered.

Two augmentations have been conducted over the last two years along the south Kalua‘ā fenceline. Reintroduction survivorship numbers are listed in Table 2.2.16d. Only three of the plants reintroduced in 2006 remained at last monitoring. So far all the 2007 plantings have survived and look healthy. The plants that look the healthiest are those that are buried in the uluhe fern. NRS will apply this planting approach to future outplantings. A number of the outplants are now reproducing vegetatively.

Table 2.2.16c Reintroduction Survivorship Summary

SteKan.KAL-B — **Kalua'a Reintro** — **DateLastMonitored: (Current/Accurate obs)** 2007-08-01

Year Planted	Num. Plants Planted	Number Dead	Number Remaining	%Remaining
2006	35	27	8	22.86%
2007	28	0	28	100.00%
Total for Site:	63	27	36	57.14%

SteKan.KAL-C — **Central Kaluaa (Gulch 2)** — **DateLastMonitored: (Current/Accurate obs)** 2007-08-29

Year Planted	Num. Plants Planted	Number Dead	Number Remaining	%Remaining
2007	23	6	17	73.91%
Total for Site:	23	6	17	73.91%

Central Kalua‘ā (Gulch 2)

The Gulch 2 planting was established based on determinations by NRS and the IT that there should be a site where pure Kalua‘ā stock is represented. This site was selected because of the intact uluhe (*Dicranopteris linearis*) fern cover presence. Planting operations involved clearing small openings in the uluhe. A total of 18 *S. kanehoana* were planted in March 2007. Many of these plants were damaged during transport. The drop zone selected was very sloped and the plant transport box flipped on its side. Although all the *S. kanehoana* are still alive, most of them have either poor or moderate vigor. The uluhe clearing may have contributed to this poor plant performance. This clearing caused the site to dry out and more uluhe along the perimeter of the clearings to die. For future reintroductions, care will be taken to minimize damage to uluhe during planting and make openings just large enough for the plants. The site may also be suffering because of the drought conditions that Hawai‘i is experiencing. Perhaps the uluhe and *S. kanehoana* will improve after winter rains.