

Kapunakea Preserve West Maui, Hawai‘i

**DRAFT Long-Range Management Plan
Fiscal Years 2010–2015**



Submitted to the
Department of Land & Natural Resources
Natural Area Partnership Program

Submitted by
The Nature Conservancy – Hawai‘i Operating Unit
August 2008

CONTENTS

EXECUTIVE SUMMARY	2
<i>Table 1. Overview of Kapunakea Preserve Accomplishments by Programs</i>	3
RESOURCES SUMMARY.....	6
General Setting	6
Flora and Fauna	6
<i>Figure 1. Kapunakea Preserve natural communities.</i>	7
MANAGEMENT	8
Management Considerations	8
Management Units.....	8
<i>Figure 2. Kapunakea Preserve boundaries and management units.</i>	9
Management Programs	10
Program 1: Non-native Species Control	10
A. Ungulate Control.....	10
<i>Figure 3. Existing and proposed fences at Kapunakea Preserve and surrounding lands.</i>	12
B. Invasive Plant Control.....	12
<i>Table 2. Priority Weed Species for Management in Kapunakea Preserve</i>	14
C. Small Mammal Control.....	15
Program 2: Resource Monitoring	15
Program 3: Rare Species Protection and Research.....	16
Program 4: Community Outreach.....	18
Program 5: Watershed Partnerships.....	18
Program 6: Personnel, Equipment, and Facilities.....	19
BUDGET SUMMARY	21
BUDGET TABLE	22
ENVIRONMENTAL REVIEW COMPLIANCE	22
<i>Appendix 1. Natural communities of Kapunakea Preserve</i>	23
<i>Appendix 2. Rare native plants of Kapunakea Preserve</i>	24
<i>Appendix 3. Rare native land snails of Kapunakea Preserve</i>	26
<i>Appendix 4. References and related documents</i>	27

EXECUTIVE SUMMARY

Established in 1980, The Nature Conservancy of Hawai‘i is a local affiliate of The Nature Conservancy, a leading international, nonprofit organization that preserves the plants, animals and natural communities representing the diversity of life on Earth by protecting the lands and waters they need to survive. The Conservancy has established a statewide system of preserves in Hawai‘i totaling almost 32,000 acres. As a member of eight watershed partnerships, the Conservancy also works closely with public and private partners to help preserve nearly one million acres statewide. The Conservancy has also extended its work from the forests to the reefs and is engaged in marine conservation in the nearshore waters of the main Hawaiian Islands.

The State’s Natural Area Partnership Program (NAPP) is an innovative program that aids private landowners in the management of their native ecosystems. NAPP provides matching funds (\$2 state to \$1 private) for the management of qualified private lands that have been permanently dedicated to conservation. Kapunakea Preserve is one of two state-funded Nature Conservancy of Hawai‘i (TNCH) preserves on Maui. Kapunakea was approved for NAPP funding in 1992, and soon thereafter TNCH implemented the management programs described in our initial plan, *Kapunakea Preserve FY1992 – FY1997 Long-Range Management Plan* (LRMP). In 1995, an environmental assessment was completed (*Final Environmental Assessment for Kapunakea Preserve Natural Area Partnership, 1995*). Subsequently, in 1997, NAPP funding for a new 6-year period was reauthorized following a renewal procedure which included the preparation of an updated plan (*Kapunakea Preserve FY1998 - FY2003 Long-Range Management Plan*) and another environmental assessment (*Final Environmental Assessment for Kapunakea Preserve Natural Area Partnership, 1997*). This plan was followed by the *Kapunakea Preserve FY2004 –FY2009 Long Range Management Plan*.

Presently, TNCH is seeking reauthorization of NAPP funding for the next 6-year period for the programs described within this *Kapunakea Preserve FY2010 – FY2015 Long-Range Management Plan*. This plan continues the programs implemented under the previous plans and environmental assessments. Herein, we request **\$781,880** in matched state funds for the 6 years spanning FY2010 – 2015. This plan was prepared in compliance with the NAPP agreement between the state, TNCH, and Hawai‘i Administrative Rules Chapter 13-210.

We successfully implemented the resource management projects of the previous six-year long-range plan, as well as many others. See Table 1.

Table 1. Overview of Kapunakea Preserve Accomplishments by Programs
FY 2004 – FY 2008 (5 Years)

<i>Indicator</i>	<i>Measure of Success</i>
Ungulate Control	
1. Total animal catches	<ul style="list-style-type: none"> • 63 pigs removed from lower preserve
2. Total snares checked	<ul style="list-style-type: none"> • 607 snares checked semi-annually in 2005 increased to 859 snares checked semi-annually in 2008
3. Miles of fence maintained or replaced in Kapunakea	<ul style="list-style-type: none"> • 1.5 miles maintained routinely • All fences in Kapunakea inspected and reinforced where needed • Strategic fence at 4,200 ft. replaced in 2003 • 235 meters of apron has been added • New ingress areas were identified via eartagging and satellite telemetry
Invasive Plant, Invertebrate and Small Mammal Control	
1. Acres and total numbers of priority invasive plants treated or removed	<ul style="list-style-type: none"> • Thousands of <i>Tibouchina</i> plants have been removed • Hundreds of strawberry guava controlled • Florida blackberry and broomsedge controlled opportunistically
2. Number of discovered or reported incipient, invasive species eradicated (plant or mammal)	<ul style="list-style-type: none"> • 1 incipient <i>Panicum maximum</i> removed
Resource Monitoring	
1. Frequency of ungulate sign	<ul style="list-style-type: none"> • Transects are monitored annually • Transects stations above 3500' showed zero sign of ungulates
2. Acres surveyed for plant infestations	<ul style="list-style-type: none"> • Aerial surveys were conducted for <i>Tibouchina</i>, and along the Preserve's southern boundary for <i>Tibouchina</i>, <i>Psidium</i>, <i>Grevillia robusta</i> and <i>Juniperus bermudiana</i> • Weeds were monitored for and controlled at landing zones, campsites and upper trails • Priority weed maps have been updated annually
Rare Species Protection and Research	
1. Numbers of new rare taxa discovered and/or mapped	<ul style="list-style-type: none"> • Rare plant surveys were conducted annually (including both in-house and those conducted by Hawaii Biodiversity and Mapping Program and Plant Extinction Prevention Program (PEPP)) • Three new rare plants were documented for Kapunakea: <i>Cyrtandra filipes</i>, <i>Cyanea lobata</i>, and <i>Cyrtandra munroi</i> • New locations of eleven rare species were documented: <i>Alectryon macrococcus</i>, <i>Ranunculus mauiensis</i>, <i>Eurya sandwicensis</i>, <i>Ctenitis squamigera</i>, <i>Nothocestrum latifolium</i>, <i>Exocarpus gaudichaudii</i>, <i>Bobea sandwicensis</i>, <i>Alphitonia ponderosa</i>, <i>Exocarpos gaudichaudii</i>, <i>Colubrina oppositifolia</i>, and two <i>Auriculella</i> snails (species unknown)
2. Number of research projects supported in Kapunakea	<ul style="list-style-type: none"> • A 3-year study on avian dispersal patterns for pest tress <i>Juniperus bermudiana</i> and <i>Ficus</i> spp. in lower Kapuankea was completed • Access support was provided to PEPP for <i>Colubrina oppositifolia</i> scouting, and Maui Nui Botanical Gardens for <i>Colubrina oppositifolia</i> air layering trials • Access was granted to PEPP for independent rare plant surveys

Over the next six years TNCH will continue to seek outside assistance to carry out effective management at Kapunakea. During the past 2 years, the West Maui Mountains Watershed Partnership (WMMWP) helped to manage Kapunakea under contract to TNCH. WMMWP is mandated to conserve and protect 50,000 acres of important forest lands of West Maui, which include Kapunakea preserve. Under a sub-contract with WMMWP, we are able to deepen our effective removal of ungulates (our program's primary goal) through increased scouting and regular checks and maintenance of fences and snares. WMMWP considers continuation of Kapunakea's management programs (particularly ungulate removal) key to the viability of the West Maui Mountains. As such, TNC seeks to continue to subcontract with WMMWP to remove pigs and monitor for their presence, conduct an annual aerial weed survey, maintain infrastructure, and provide occasional access to researchers. In addition, TNCH, at its own expense, contracted a professional animal control company to conduct intensive ungulate removal in Kapunakea in FY 08. These contract hunters successfully removed 16 pigs at Kapunakea this past year and identified several potential ingress areas through the lower boundary fence. TNCH will continue to pursue opportunities for contract work as opportunities arise.

We plan to accomplish the following goals and objectives over the next six years:

Ungulate Control:

Goal: Remove all ungulates and prevent future invasion.

Activities:

- Complete two check cycles of snares throughout the lower, mid and upper elevations of the preserve.
- Complete one aerial and one ground scout to determine whether pigs are present in areas of the preserve not currently targeted for active animal control; in particular to determine if there is ingress or egress of pigs across Kapunakea's steep, natural barriers.
- Conduct monthly inspections and repairs of Kapunakea's fences, making repairs as necessary.
- Map and document breaches and record time between observed breach and repair.
- Establish 2-4 traps adjacent to lower boundary fence to reduce ungulate pressure.

Invasive Plant Control:

Goal: Remove habitat-modifying weeds from high-quality native habitats; prevent introduction or spread of problem weeds.

Activities:

- Continue treatment of top two habitat-modifying weeds (*Tibouchina* and Strawberry guava).
- Monitor weeds as needed according to management priorities.
- Respond to new weed threats and map efforts.
- Update and maintain priority weed maps semi-annually.

Small Mammal Control

Goal: Increase our understanding of threats posed by small mammals; reduce their negative impact where possible.

Activities:

- Continue to support studies into aerial application of rodenticides.
- Support other scientific research into effects of small mammals and their effective control.

Resource Monitoring

Goal: To track biological and physical resources of the preserve and evaluate changes in these resources over time, to identify new threats before they become established, and to promote research that guides management programs.

Activities:

- Reassess key vegetation monitoring plots. (2010 only)
- Monitor and maintain threat monitoring transects once per year.
- Provide logistical support to researchers.

Rare Species Protection and Research

Goal: Prevent the extinction of rare species in the preserve.

Activities:

- Continue to support PEPP in search and assessment of rare species populations to determine protection needs and to reduce threats.
- Maintain current maps of rare species populations.

Community Outreach

Goal: To educate, empower, and engage the community in the preservation of their natural and cultural heritage from summit to sea.

Activities:

- Present slide shows and talks as requested by community and school groups.
- Lead special hikes for targeted community members.

Watershed Partnerships

Goal: Assist the long-term effective management of the native ecosystems of West Maui by the West Maui Mountains Watershed Partnership.

Activities:

- Participate in partnership meetings to help set priorities for the WMMWP.
- Assist the WMMWP in accomplishing fundraising and management priorities.

RESOURCES SUMMARY

General Setting

Kapunakea Preserve was established in 1992 when Pioneer Mill Company, Ltd., a subsidiary of Amfac/JMB-Hawai'i Inc., granted The Nature Conservancy a perpetual conservation easement over 1,264 acres on West Maui. The preserve's upper elevations are recognized as among the highest quality native areas in the state. Kapunakea Preserve is adjacent to two other natural areas that are actively managed: Pu'u Kukui WMA (which is privately owned and part of the NAP program) and the Honokōwai section of the state West Maui Natural Area Reserve (NAR). In addition, the WMMWP is mandated to conserve and protect important forest lands of West Maui, which include Kapunakea Preserve, Pu'u Kukui and the West Maui NARs. These managed native forests and natural areas comprise more than 50,000 acres of contiguous, managed watershed.

Flora and Fauna

Kapunakea contains 11 native-dominated natural communities, ranging from lowland shrublands to montane forests and bogs, including the rare 'Ohi'a Mixed Montane Bog (Figure 1, Appendix 1). Four of the communities are not found in the nearby West Maui NAR, most notably Koa/'ohi'a (*Acacia koa*/*Metrosideros polymorpha*) Lowland Mesic Forest and Lama/'ohi'a (*Diospyros sandwicensis*/*Metrosideros polymorpha*) Lowland Mesic Forest. Figure 1 depicts the vegetation communities present in Kapunakea Preserve, established through GAP analysis.

Kapunakea protects at least 34 rare plants (Appendix 2). At least eight of Kapunakea's rare plants have not been seen in the NAR. Four native forest birds are found in Kapunakea: 'apapane, 'i'iwi, 'amakihi, and pueo. 'Ua'u have also been heard there. Populations of four species of rare Hawaiian tree snails have recently been documented at Kapunakea: *Partulina perdix*, *P. tappaniana*, *P. crocea*, and *Perdicella kuhnsi* (Appendix 3). These snails probably were once widespread and abundant on Maui, but in many areas their numbers have declined precipitously in this century due to habitat destruction, collection, and the depredation by introduced animals. A number of other snails also occur at Kapunakea, including tornatellinines and species of *Auriculella*, *Succinea*, and *Philonesia*.

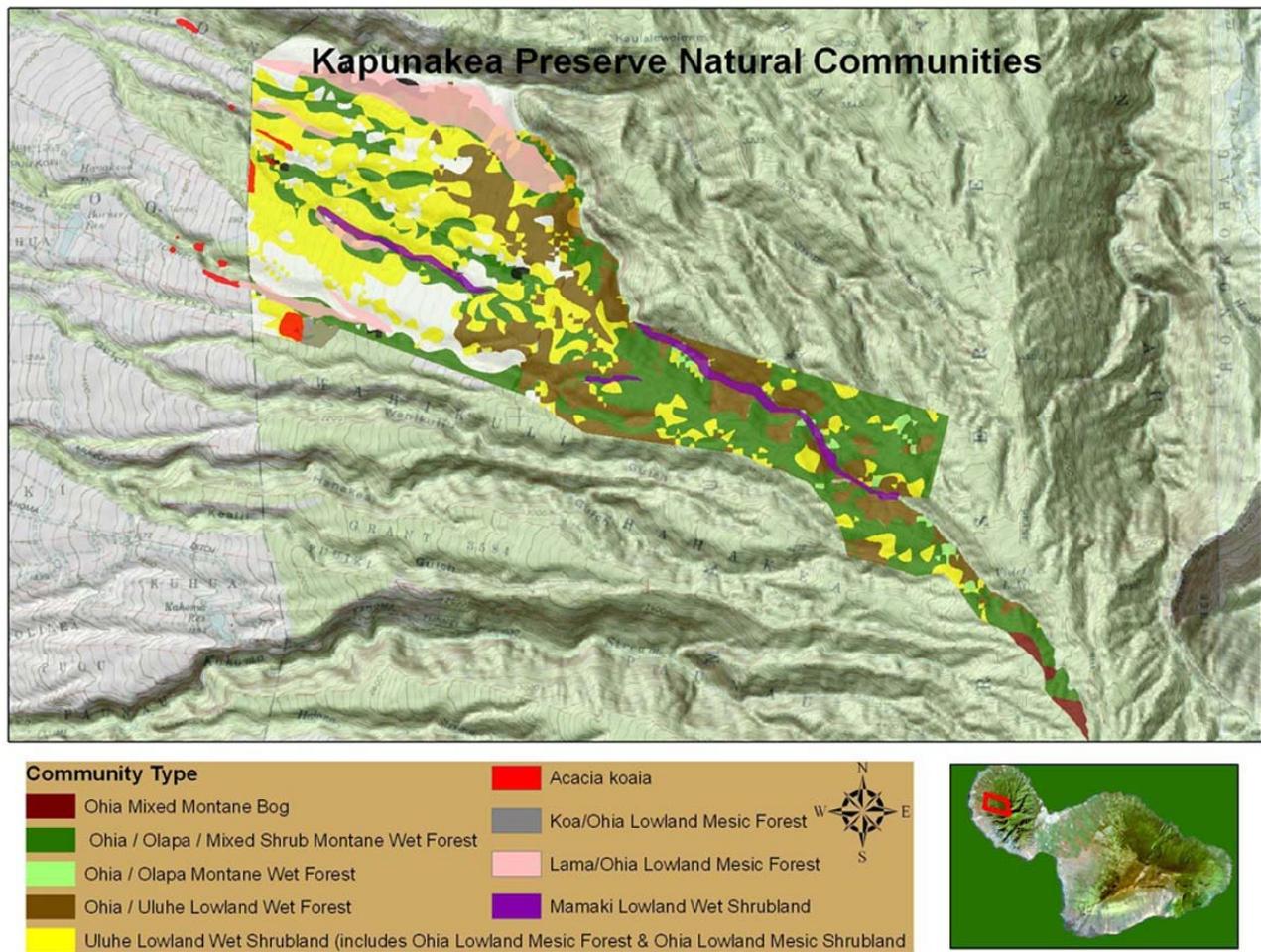


Figure 1. Kapunakea Preserve natural communities.

MANAGEMENT

Management Considerations

1. The primary strategy for protection of Kapunakea is to prevent the further introduction and/or spread of destructive alien species. Special care must be taken to avoid negative side effects of management activities. For example, trails and management activities are designed to prevent further weed and ungulate invasion. This strategy requires helicopter access to most parts of the preserve. Interpretive and educational uses are limited in scope. Guidelines are followed to minimize impacts such as trampling and weed dispersal.
2. The preserve is bounded on the west (lowland) side by private agricultural lands. Activities related to agricultural production (large, heavily-loaded trucks, agricultural burning, etc.) pose a risk to preserve users. As a result, public access is limited, and we carefully coordinate our management and interpretive activities with work in adjacent agricultural areas.
3. Kapunakea is remote and rugged. Given limited resources, the entire preserve cannot be managed equally. Management is concentrated at the most urgent threats (e.g. halting pig ingress), and in areas that contain special plants, animals, and native natural communities (e.g. the rare montane bog community).
4. Kapunakea Preserve is adjacent to two areas that are also managed to protect natural resources: Pu‘u Kukui WMA (privately owned) and the Honokōwai section of the state West Maui NAR. TNCH works closely with both Maui Land and Pineapple Co., managers of Pu‘u Kukui WMA, and with the State Division of Forestry and Wildlife, who are responsible for management of the NAR. Several agreements are used to coordinate management and sharing of staff, equipment, and expertise in order to maximize management efficiency.

Management Units

Kapunakea is managed as five units (Figure 2) defined by topographic boundaries, similarity of natural community types, and threats.

1. Unit 1 consists of the lowland (up to 3,000 feet elevation) portion of the preserve that is closest to Kapāloa Stream. It is primarily comprised of ‘Ohi‘a Lowland Wet Forest and Uluhe (*Dicranopteris linearis*) Lowland Wet Shrubland. Prior to our management efforts, this unit showed high levels of pig activity. Activity has been significantly reduced by control measures that must be maintained to keep activity low.
2. Unit 2 encompasses the remainder of the preserve’s lowland elevations. It contains five native communities, and non-native vegetation in the gulch bottoms. Because *Tibouchina* and strawberry guava are prevalent throughout the unit, we aim to prevent their spread into other units, rather than eliminate them from Unit 2. Pig activity, although high during the initial phases of ungulate control, has been reduced substantially.

3. Unit 3 comprises the majority of the preserve's mid-elevations (3,000 – 4,000 feet) and follows Kapāloa Stream along its northeast boundary. The four montane communities in Unit 3 are dominated by Uluhe or 'Ohi'a; Mamaki (*Pipturus albidus*) Lowland Wet Shrubland occurs along the streambed. The Uluhe- and 'Ohi'a-dominated communities are intact above 3,400 feet, with minimal weed problems. Our management focus in this unit is to eliminate ungulates and control weed invasions.
4. Unit 4 begins on the east side of Kapāloa Stream, and continues to the preserve's eastern boundary. The upper elevations in this unit must be reached by helicopter, due to the steep gulch walls. Management focuses on preventing new invasions.
5. Unit 5, encompassing the highest elevations of the preserve, is Kapunakea's most pristine unit. Initial survey data and more recent monitoring results have shown that this area contains only a few scattered alien plants (including *Tibouchina*). The management priority is to remove threats from this area before they damage the rare 'Ohi'a bogs. Access is by helicopter only. Travel is conducted from the upper elevations down to avoid transport of weeds that occur in lower elevations.

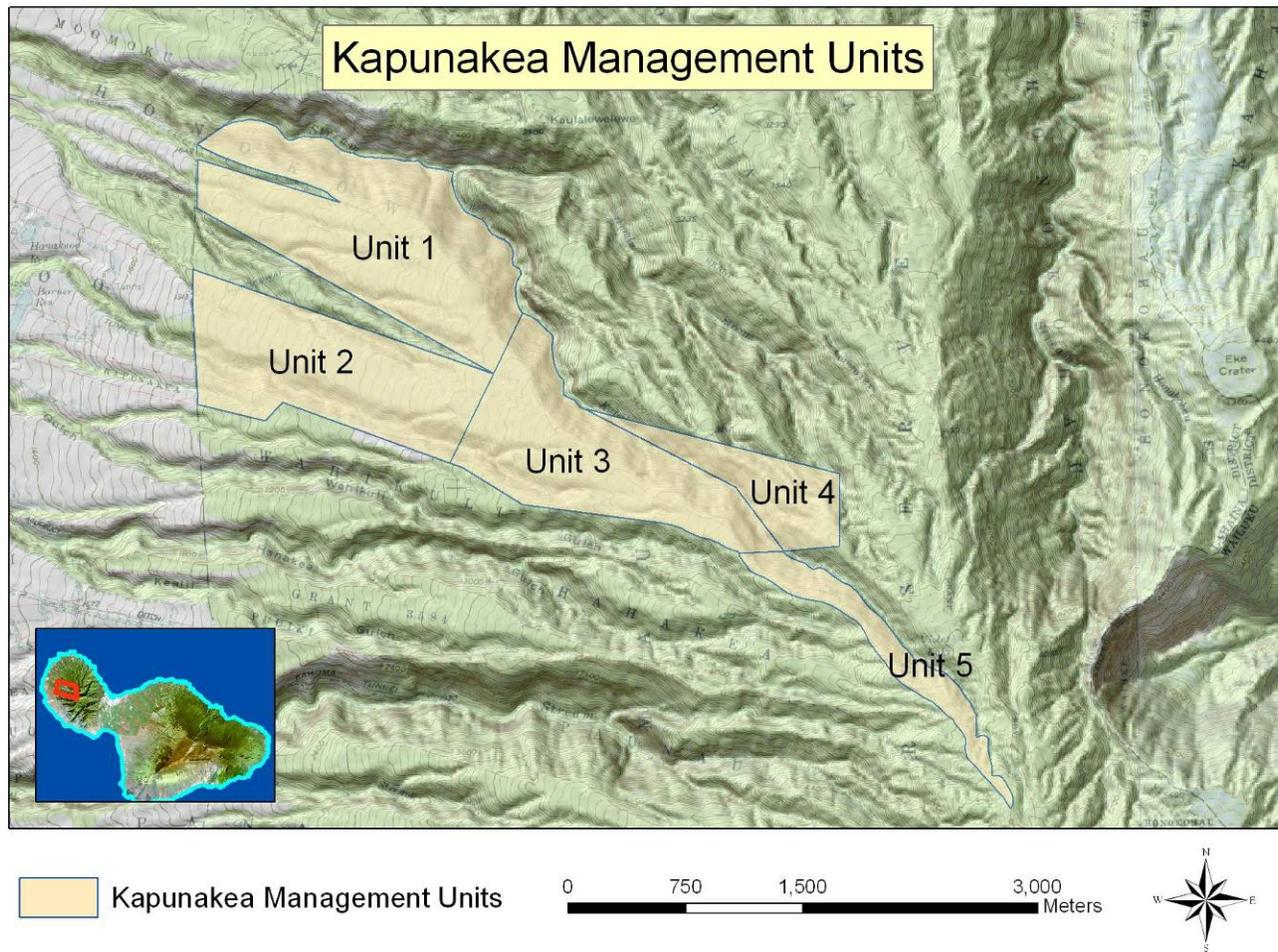


Figure 2. Kapunakea Preserve boundaries and management units.

Management Programs

Although the following management programs are described separately, they form an integrated management approach. For each program listed in the following section, we have indicated a major goal and described the management methods chosen. Also included are highlights of past and current achievements, along with key management issues. Finally, objectives and costs for FY2010–FY2015 are listed. Staff time and effort, along with equipment expenses, are included separately within the ‘Personnel, Equipment, and Facilities’ program section.

Program 1: Non-native Species Control

A. Ungulate Control

Program Goal

Remove all ungulates and prevent future invasion.

Program Description

The elimination of ungulates in Kapunakea Preserve and on adjacent partnership lands continues to be our highest priority. Ungulate damage has been substantially reduced since 1995, especially in upper elevation areas. However, it is known that pigs continue to find their way into the preserve from adjacent lands. During 2008, 16 remaining animals were removed from Kapunakea by contract hunters at TNCH’s expense. However, if ungulates reappear in the preserve (and this is very likely based on past history and reliance on strategic fencing), their control will again become our highest priority. We will continue scouting and removal efforts as needed. Some resources may be shifted to weed control should we deem ungulate levels low enough to justify this shift.

The ungulate control program utilizes a combination of fencing, hunting (primarily contract hunting), and snaring to bring pig populations down to zero as rapidly as possible and prevent them from re-establishing. The fence along the lower boundary of the preserve was replaced in several phases between FY1993 and FY1995. This lower boundary fence replaced an aging Forest Reserve boundary fence in existence for many decades. This fence is key to preventing ungulate ingress into the Preserve; as such it is likely that ongoing maintenance and possible additions to this lower boundary fence will be necessary during the next six years. A short strategic fence initially constructed in FY1993 at 4,200 feet was replaced in 2003 to prevent pigs from moving into the bog areas. The WMMWP fencing crew recently completed a boundary fence on adjacent lands. We expect this approximately half-mile fence at Hähäkea to further prevent pig ingress into Kapunakea from neighboring lands. In the coming years we may need to continue constructing short strategic fences at possible points of pig ingress. In the near future, we may need to add fencing along the boundary separating Unit 3 above from Units 1 and 2 below. If ungulates continue to persist in lower elevation areas, this fence would be instrumental in keeping ungulates out of more pristine, higher elevation areas. Figure 3 depicts current and proposed fences in Kapunakea Preserve and on adjacent lands. We propose to make this decision in 2010 or 2011 after we have evaluated the effectiveness of recent improvements to the lower boundary fence.

Snaring is still the most effective and feasible technique for controlling pigs in areas too remote, rugged, and/or fragile for frequent hunting, and where hunting cannot remove low-density pig

populations from sensitive sites. Until an effective alternative can be found, snares will continue to be placed in pig-damaged areas. Additionally, if warranted by high levels of pig activity, we will snare other areas of the preserve (and other strategic areas). All snares are checked semi-annually, and groups of snares are conspicuously marked in the field.

In the past few years, axis deer (*Axis axis*) have greatly expanded their range on Maui to include West Maui areas near Ukumehame, Kapalua, and Kahakuloa. Control efforts for axis deer may be needed in the near future to protect the preserve.

Following standards implemented in 1993 (Dunn 1992), we have established a system of transects that extend the entire length of the preserve. (These are referred to throughout this document as resource/threat monitoring transects.) This system replaced a network of 500-meter-long ungulate and weed monitoring transects. We will gather data on animal activity and weed presence along the resource/threat monitoring transects once every year. We will also continue to record incidental observations of small mammal (cat, dog, mongoose) sign, and begin control as necessary.

As part of our routine management program, we will continue to: 1) survey for axis deer and goats on West Maui during routine helicopter operations; 2) assist the WMMWP and neighboring land managers with ungulate control efforts; and 3) participate as members of the Maui Invasive Species Committee (MISC).

Activities

Years 1-6 (FY2010-15)

- Complete two check cycles of snares throughout the lower, mid and upper elevations of the preserve.
- Implement contract hunting in key areas if needed.
- Complete one aerial and one ground scout to determine whether pigs are present in areas of the preserve not currently targeted for active animal control; in particular to determine if there is ingress or egress of pigs across Kapunakea's steep, natural barriers.
- Conduct monthly inspections and repairs of Kapunakea's fences, making repairs as necessary.
- Map and document breaches and record time between observed breach and repair.
- In 2010 – 2011, determine need for a ¾ mile strategic fence at 3,000 ft. elevation and construct if needed (Unit 3 lower boundary).
- Establish and maintain 2-4 traps adjacent to lower boundary fence to reduce ungulate pressure.

Kapunakea Preserve & Adjacent Fence Locations

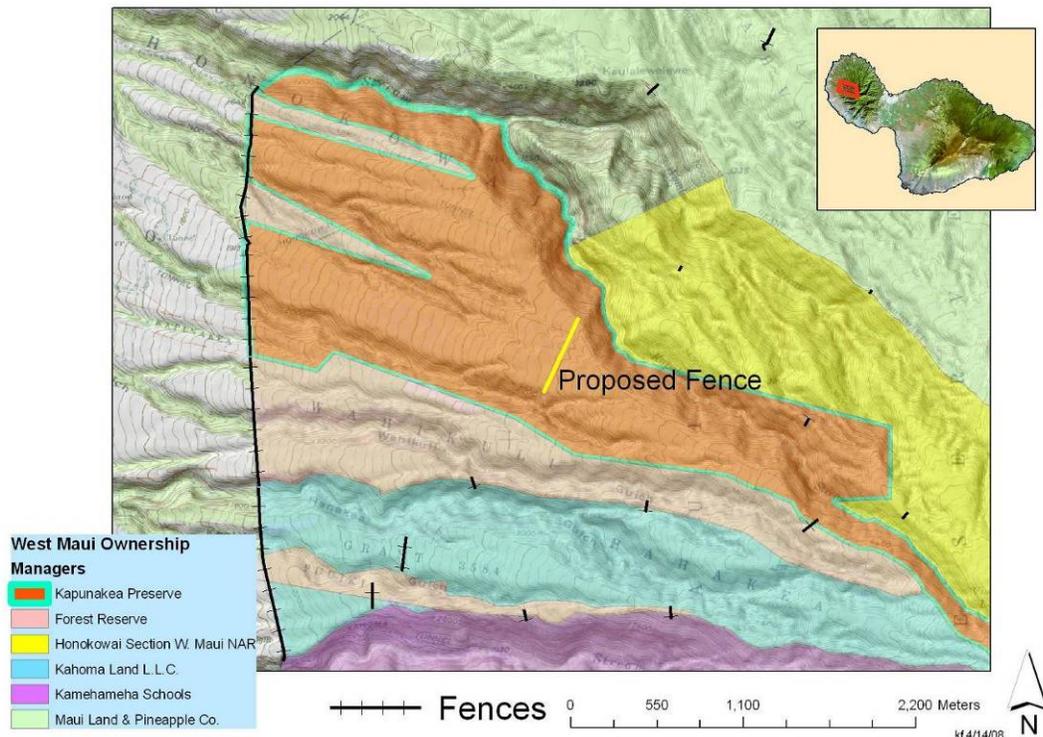


Figure 3. Existing and proposed fences at Kapunakea Preserve and surrounding lands.

This program represents an estimated 70% of the overall effort and budget in this long range management plan.

B. Invasive Plant Control

Program Goal

Remove habitat-modifying weeds from high-quality native habitats; prevent introduction or spread of problem weeds.

Program Description

The most important aspects of our weed control program are to control established weeds in intact native communities, and to prevent the introduction of new species of alien plants. (Elimination of ungulates is believed to be one of the most effective means of controlling the introduction and spread of habitat-modifying weeds.) In some cases, when weeds are considered a direct threat to rare plant populations occurring in alien-dominant habitat, localized control actions may be taken.

We will continue to enforce strict procedures to remove weed seeds from equipment and clothing before people enter the preserve. Helicopter flights will originate from areas free of aggressive weeds, and all equipment and clothing will be inspected and cleaned. Of the alien plants already established in the preserve, many are shade intolerant and pose no major problem if the native forest canopy and

ground cover remain intact. There are other alien plants, however, that displace native vegetation over large areas; these habitat-modifying plants are considered 'Priority Weeds' for management (Table 2). Based upon 10 years of experience with the dynamics of our weed populations, we revised our list of priority weeds in FY2003. Due to limitations in staff resources needed to combat all of the priority weeds, this list will be revised to reflect only the species that are most pressing in terms of direct threats.

We will continue to control weeds manually (by pulling or cutting), chemically (using herbicide), or with a combination of manual and chemical control methods. Herbicide use is limited, and in full compliance with the State of Hawai'i Department of Agriculture (HDOA) Pesticide Enforcement Division. (Weed control staff are also certified through HDOA's Pesticide Enforcement Division.) All herbicide use is in accordance with the product label and recorded in detail for reference and efficacy monitoring.

Target Species:

Tibouchina herbacea is rapidly expanding its range over West Maui. It has become widely established in the lower half of the preserve over the last 15 years. People, pigs, and wind seem to be the primary vectors of this habitat-modifying weed. Due to our diligence at scouting for and treating *Tibouchina* above 3,200 feet, we have minimized its establishment at higher elevations, despite our expectation that the infestations would explode beyond our control. We will continue to track the Department of Agriculture's success in identifying safe biocontrol agents for *Tibouchina* and, upon their demonstrated effectiveness, we will seek in-house approval to release them on TNC preserves. Dr. Tracy Johnson (Research Entomologist), who coordinates the biocontrol program at the Forest Service's quarantine facility in Volcano, has informed us that one potentially promising candidate has been identified, a beetle (*Syphrea uberabensis*) that consumes the roots and leaves of *Tibouchina herbacea*. Presently, a petition for release should be filed with HDOA in 2008, with possible release at a Maui site for 2009 or 2010. TNC will be involved in post-release monitoring once this occurs.

In the past 15 years, we have halted the spread of strawberry guava (*Psidium cattleianum*) in lower Unit 3 by treating thousands of trees with herbicide, and pulling thousands of seedlings. As feral pigs are a primary source for spreading strawberry guava, and we have significantly reduced pig numbers, the spread has slowed considerably. We continue to scout for this pest tree in critical areas above 3,200 feet, where the spread is very limited. A potential biocontrol agent, a guava leaf gall (*Tetracoccus* spp.) will be petitioned for release on Hawaii Island this year, with hopes of introduction to Maui in 2010. If released, TNC will assist with post-release monitoring.

Florida blackberry (*Rubus argutus*) is widespread and continues to spread (primarily via birds), although our prior treatment of trailside plants has prevented it from gaining density along those routes. Blackberry continues to dominate habitat along steep gulches, especially pig-disturbed terraces, where chemical control is impractical.

A tall thatch grass, *Andropogon virginicus* (Broomsedge), has recently presented Kapunakea with new challenges. Besides being a habitat-modifying plant, this grass also poses a serious wildfire threat as a medium fuel during drought periods. Mechanical and chemical control efforts have worked to limit the dominance of this weed along trails, camps, and especially landing zones.

We have had success at containing and shrinking populations of Hilo grass (*Paspalum conjugatum*) along strategic trails; future efforts will focus on maintaining that status for this shade-tolerant grass.

We routinely control specific priority weeds along trails, campsites, and landing zones above 3,200 feet elevation, limiting current infestations in otherwise intact forest or shrubland. This also serves to minimize spread of priority weeds to new places during other preserve activities.

As part of our routine management program, we will continue to: 1) monitor for and control new weeds at landing zones, campsites, and upper trails; 2) train staff in the proper handling and application of herbicides; 3) participate as a member of the Maui Invasive Species Committee; 4) update aerial survey and range maps for *Tibouchina* and guava; and 5) cooperate with DOCARE in marijuana control as needed. In the future, it is likely that we will be employing new passive technologies like remote sensing or high resolution aerial photography for weed mapping.

Table 2. Priority Weed Species for Management in Kapunakea Preserve

Rank	Scientific Name	Common Name
1	<i>Tibouchina herbacea</i>	Tibouchina
2	<i>Rubus argutus</i>	Blackberry
3	<i>Psidium cattleianum</i>	Strawberry guava (waiawi)
4	<i>Paspalum conjugatum</i>	Hilo grass
5	<i>Rubus rosifolius</i>	Thimbleberry
6	<i>Andropogon virginicus</i>	Broomsedge
7	<i>Passiflora suberosa</i>	Passiflora
8	<i>Melinis minutiflora</i>	Molasses grass
Other Important Pest Species:		
-	<i>Ficus</i> spp.	Banyan
-	<i>Buddleia asiatica</i>	Butterfly bush
-	<i>Juniperus bermudiana</i>	Juniper
-	<i>Grevillea robusta</i>	Silk oak
-	<i>Setaria gracilis</i>	Yellow foxtail
-	<i>Holcus lanatus</i>	Velvet grass
-	<i>Axonopus fissifolius</i>	Carpet grass
-	<i>Juncus planifolius</i>	Bog rush
-	<i>Psidium guajava</i>	Guava
-	<i>Hedychium coronarium</i>	White ginger

Activities

Years 1-6 (FY2010-15)

- Continue treatment of top habitat-modifying weeds above 3200' (especially *Tibouchina* and Strawberry guava).
- Monitor weeds as needed according to management priorities.

- Respond to new weed threats and map efforts.
- Update and maintain priority weed maps semi-annually.
- Carryout localized weed control in landing zones, camps, key microhabitats and trails.
- Follow strict protocols prevent inadvertent introduction and spread of priority weeds.

This program represents an estimated 15% of the overall effort and budget in this long range management plan.

C. Small Mammal Control

Program Goal

Increase our understanding of threats posed by small mammals; reduce their negative impact where possible.

Program Description

While it is recognized that mongoose and feral cats could pose a threat to native passerines and nesting seabirds, depredation of native land snails by rats is the most pressing impact from small mammals at Kapunakea. Prior research and management attempts during the last 12 years have shown intensive rat control to exceed realistic budgets in terms of staff and logistics. In addition the long-term impact from maintaining intensive rat trapping can cause significant damage to native plant communities. However, TNCH supports a long-term program aiming at protecting larger landscapes from small mammal depredation and has contributed toward trials that may result in the aerial application of rodenticide.

Activities

Years 1-6 (FY2010-15)

- Continue to support studies into aerial application of rodenticides.
- Support other scientific research into effects of small mammals and their effective control.

This program represents an estimated 1% of the overall effort and budget in this long range management plan.

Program 2: Resource Monitoring

Program Goal

To track biological and physical resources of the preserve and evaluate changes in these resources over time, to identify new threats before they become established, and to promote research that guides management programs.

Program Description

Resource monitoring differs from threat monitoring in that its purpose is to document and quantify natural resources (vegetation, birds, and invertebrates) and track them over time, identifying trends.

Accurately quantifying changes in natural resources provides land managers with the information needed to determine the efficacy of past management programs and to plan future research and management actions in Kapunakea. We have established a network of monitoring plots to quantify and better understand Kapunakea's baseline vegetation.

We completed a monitoring report for Kapunakea, *Long-Term Biological Threat and Resource Monitoring, Kapunakea Preserve, West Maui*, in 1995. It consists of four parts: vegetation monitoring, rare plant monitoring, pest plant monitoring and feral ungulate monitoring. Our monitoring transects include: 1) 10,000 meters of permanent belt transects for monitoring the distribution, frequency, and relative abundance of feral ungulates and alien plant species, and 2) 41 permanent, 250 square meter plots for obtaining in-depth quantitative data on forest vegetation. In FY2010, we plan to contract with a qualified botanist to complete one vegetation reassessment and survey and compare results with those completed in 1995. The need for additional resource monitoring will be decided once we have the results of this contract.

Bird surveys were conducted during various years along the same transects by observers trained in the U.S. Fish and Wildlife Service's Hawai'i Forest Bird Survey methodology. The purpose of these surveys is to document the relative abundance of all bird species in the forest. In the future, we will conduct bird surveys only during the state's routine bird surveys (every 5 years).

Activities

Year 1 (FY2010)

- Monitor and maintain threat monitoring transects once per year.
- Provide logistical support to researchers.
- Complete one vegetation reassessment and survey and compare results with those completed in 1995.

Year 2-6 (FY2011-15)

- Monitor and maintain threat monitoring transects once per year.
- Provide logistical support to researchers.

This program represents an estimated 3% of the overall effort and budget in this long range management plan.

Program 3: Rare Species Protection and Research

Program Goal

Prevent the extinction of rare species in the preserve.

Program Description

The preserve is home to at least 34 species of rare plants, including 9 that are listed as endangered (Appendix 2). TNCH uses data from the U.S. Fish and Wildlife Service, the agency responsible for administering the federal Endangered Species Act, to identify rare and endangered species and those that are listed as "candidate" or "special concern" species. In addition, data compiled by the Hawaii Biodiversity and Mapping Program (HBMP, formally the Hawai'i Natural Heritage Program) is

assessed to further identify rare species in Hawaii (Appendix 2). Four native forest birds are found in Kapunakea: ‘apapane, ‘i‘iwi, ‘amakihi, and pueo. ‘Ua‘u have also been heard there. Populations of four species of rare Hawaiian tree snails have recently been documented at Kapunakea: *Partulina perdis*, *P. tappaniana*, *P. crocea*, and *Perdicella kuhnsi* (Appendix 3). These snails probably were once widespread and abundant on Maui, but in many areas their numbers have declined precipitously in this century due to habitat destruction, collection, and the depredations of introduced animals. A number of other snails also occur at Kapunakea, including tornatellinines and species of *Auriculella*, *Succinea*, and *Philonesia*.

Our primary management goal is to protect habitat essential to the majority of the preserve’s native plants and animals. This protection will be achieved, in large part, by continuing to eliminate pigs and control weeds. However, we will continue to assess other threats to the preserve’s rarest species and to implement control measures for these threats as appropriate.

Formal surveys were conducted annually at Kapunakea by botanists from the HBMP. Their reports and accompanying maps are kept in Maui Field Office files. These surveys have yielded some significant results. For example, more than three-fourths of the endangered mahoe tree population (*Alectryon macrococcus* var. *macrococcus*) known on West Maui are concentrated in Kapunakea Preserve. The Plant Extinction Prevention Program (PEPP), administered through the Pacific Cooperative Studies Unit (PCSU) and coordinated by DOFAW, is actively visiting known locations of rare plants and finding more as mapping and vigor data is being taken. PEPP is focused on target species at Kapunakea, with the intent to collect seed for future propagation of rare plants. Accurate mapping and vigor of these populations is a byproduct of the PEPP work.

Maui field staff also routinely monitor various rare plants. This method has provided us with finding seed production for the preserve’s rarest plant, *Colubrina oppositifolia*. One senescent tree of this species was found in 1993 and another found at a separate location in 2007. This species is in serious decline due to the infestation of Black Twig Borer (*Xylosandrus compactus*). A seedling propagated in 2003 and outplanted at Kapunakea has been relocated to Maui Nui Botanical Gardens, where it is thriving and potential source for air layers, cuttings, or other forms of propagation. Seeds were also sent to Lyon arboretum for storage to use in tissue culture. When there is enough healthy stock to select from, plants may be relocated to Kapunakea in the future.

Activities

Years 1-6 (FY2010-15)

- Continue to support PEPP in search and assessment of rare species populations to determine protection needs and to reduce threats.
- Maintain current maps of rare species populations.

This program represents an estimated 1% of the overall effort and budget in this long range management plan.

Program 4: Community Outreach

Program Goal

To educate, empower, and engage the community in the preservation of their natural and cultural heritage from summit to sea.

Program Description

Sustaining biologically significant native ecosystems throughout the state requires an educated, empowered and mobilized public and private constituency. Our main goal is to increase conservation and advocacy for these areas through an understanding of the importance of, threats to, and protection efforts towards watersheds on Maui.

Currently, there is limited on-site public outreach at Kapunakea Preserve. TNC no longer provides scheduled monthly access to Kapunakea Preserve and other interpretive hikes. However, individuals may accompany staff and assist on field projects if they have experience in remote forestry work that requires camping. Also, the WMMWP provides the public information about forest protection efforts on West Maui and will provide the outreach infrastructure to safely lead selected groups into the preserve.

Activities

Years 1-6 (FY2010-15)

- Present slide shows and talks as requested by community and school groups.
- Lead special hikes for targeted community members.

This program represents an estimated 1% of the overall effort and budget in this long range management plan.

Program 5: Watershed Partnerships

Program Goal

Assist the long-term effective management of the native ecosystems of West Maui by the West Maui Mountains Watershed Partnership.

Program Description

The WMMWP provides protection for about 50,000 acres on West Maui administered by a coordinator and field crew (first hired in 2000). Activities include fencing, ungulate removal, and resource monitoring programs for all of West Maui's native forests. TNC's Maui Field Office has actively participated in partnership activities from the beginning in 1998. As a partner, we helped set management priorities, fundraise and administer projects. Initially, we supervised and trained WMMWP crews in ungulate and weed removal, monitoring techniques, fence building, and a wide array of safety procedures including rappelling, helicopter travel, and wilderness survival. The Maui Field Office will continue to provide the WMMWP with advice and training, and we will participate in

management activities on partnership lands as needed. We will also continue to contract with the WMMWP for ungulate and weed removal and monitoring.

Activities

Years 1-6 (FY2010-15)

- Participate in partnership meetings to help set priorities for the WMMWP.
- Assist the WMMWP in accomplishing fundraising and management priorities.

This program represents an estimated 5% of the overall effort and budget in this long range management plan.

Program 6: Personnel, Equipment, and Facilities

Program Goal

Maintain staff and facilities required to implement the goals of The Nature Conservancy on Maui in a safe, productive environment.

Program Description

Under a sub-contract with WMMWP, we are able to deepen our effective removal of ungulates (our program's primary goal) through increased scouting and regular check and maintenance of fences and snares. WMMWP considers continuation of Kapunakea's management programs (particularly ungulate removal) key to the viability of the West Maui Mountains. As such, TNC seeks to continue to subcontract with WMMWP to remove pigs and monitor for their presence, conduct an annual aerial weed survey, maintain infrastructure, and provide occasional access to researchers.

TNCH's Maui field office staff split time and effort between two preserves; approximately 10% is charged to Kapunakea and 90% to Waikamoi.¹ The Director of Maui Programs oversees all work and is responsible for planning, budgeting, and reporting activities. The Program Coordinator is responsible for tracking expenses, paying bills, reporting on the budget to the Director, and various administrative duties associated with running an office. The Maui Natural Resource Manager is responsible for the management of fieldwork in the preserve; in addition, some planning tasks are also a component to this position. The Field Representative is responsible for planning, reporting, and assists with outreach activities. The Invasive Plant Specialist is responsible for weed management, rare and endangered species monitoring, and coordinating scientific research in our preserves. The Field Coordinator is responsible for supervision of the Field Technicians and any other field staff or volunteers doing ungulate control work. Field Technicians are responsible for all threat control; these individuals also assist with research and outreach activities. It should be noted that TNC's negotiated fringe benefit rate with the United States Agency for International Development, our guiding federal agency, is currently 38.5%.

In terms of contractual and TNC time and effort, roughly 70% of personnel time budgeted for Kapunakea is spent on ungulate control; 15% is spent on weed control activities. The remainder of the

¹ Director of Maui Programs, Natural Resource Manager, Program Coordinator, Field Representative, Invasive Plant Specialist, Field Coordinator, and four Field Technicians.
Kapunakea LRMP 2010-2015

personnel budget is divided among the following activities: monitoring (3%); rare species protection (1%); small mammal control (1%); community outreach (1%); watershed partnerships (5%), and planning and administration (5%).

The Nature Conservancy's Honolulu office provides administrative, technical and annual planning support. In particular, the Director of Conservation, the Science team, and other resource staff will help prepare annual plans and reports and develop and implement monitoring and research programs.

All full-time field staff are provided training in first aid, CPR, and fire suppression. Field staff participate in a variety of emergency and safety training programs offered by cooperating state and federal agencies (fire training, helicopter safety, hunter safety, rappelling, etc.). Other training needs, such as computer, communication, and other skill-building courses, are provided to staff on an individual, as needed basis.

Travel costs consist of airfare, ground transportation, board and lodging for TNCH staff traveling off-island, along with supervisory staff attending regular meetings at the Honolulu office. Because the NAP program requires an annual inspection, we have budgeted airfare for DOFAW staff to help cover expenses for this visit. Facilities costs include 10% of office and baseyard facilities incurred to support the Kapunakea Preserve program. Supplies include the cost of fuel, insurance, and maintenance for the vehicles, along with the cost of general supplies needed to perform overall management activities. Contractual fees consist of technical assistance provided by Hawai'i Biodiversity and Mapping Program (HBMP) and National Tropical Botanical Garden's botanists, ecologists, and science staff, who assist with resource monitoring and research, and data compilation.

This program represents an estimated 5% of the overall effort and budget in this long range management plan.

BUDGET SUMMARY

The following table summarizes the six-year budget for the Kapunakea NAPP Project. Through the NAPP program, the state pays two-thirds of the management costs outlined in this long-range plan and TNC funds (from private and other government sources) the remaining third.

Personnel:

This NAPP request will cover a portion of the costs of the Maui Island Program staff that will have responsibilities in implementing the management plan. Other part-time, short-term, or year-to-year personnel may be hired periodically as the budget allows and project needs warrant.

The Personnel line item includes: a combined effort of Maui's base staff equal to .54 FTE. This FTE percentage could increase substantially (up to ~ 2.5 FTE) in the event that the WMMWP is unable to continue contract work. In this event, Conservancy staff or another contractor will resume work.

The Nature Conservancy's currently negotiated fringe benefit rate will accrue on all salary/wage costs.

Technical and annual planning support is also provided by the Honolulu office of the Conservancy. In particular, the Conservation Programs Director, Conservation Programs Coordinator, Conservation Planner, Senior Scientist, and other island resource staff help prepare annual plans and reports, develop and implement monitoring and research programs, and establish interpretive and intern programs at the preserve. As budget and needs allow, these support staff members may charge a small portion of their time to this project.

Supplies and Equipment:

\$2,000 has been budgeted each year to cover various project related supplies and expenses. Funds will be allocated towards vehicles, equipment and materials based on availability and need.

Travel:

A travel budget of \$2,200 has been budgeted in the first year and a 3% inflation increase added each year thereafter to cover a portion of staff inter-island travel for workshops, training, staff meetings and one mainland trip for 4 staff to attend a workshop.

Subcontracts:

Three percent inflation rate added each year. Funds may also be allocated for LRMP renewal and professional/contractual costs based on availability and need. In the future, we may use a portion of contract funds to support remote sensing or high resolution aerial photography for weed mapping.

FY10

Stewardship Subcontract to WMMWP + Helicopter Travel - \$115,000

FY11

Stewardship Subcontract to WMMWP + Helicopter Travel - \$118,450

FY12

Stewardship Subcontract to WMMWP + Helicopter Travel - \$122,004

FY13

Stewardship Subcontract to WMMWP + Helicopter Travel - \$125,664
FY14

Stewardship Subcontract to WMMWP + Helicopter Travel - \$129,434
FY15

Stewardship Subcontract to WMMWP + Helicopter Travel - \$133,317

Baseyard:

\$3,000 has been budgeted in the first year and a 5% inflation increase each year thereafter to cover a portion of the baseyard, security, insurance and other miscellaneous project related expenses.

Overhead:

The allowable overhead rate of 10% on NAPP projects has been included on all costs.

BUDGET TABLE

Kapunakea NAPP							
	FY2010	FY2011	FY2012	FY2013	FY2014	FY2015	TOTAL
Labor and Fringe	42,090	43,563	45,087	46,666	48,299	49,989	275,694
Supplies/Equipment	2,000	2,000	2,000	2,000	2,000	2,000	12,000
Travel	2,200	2,266	2,334	2,404	2,476	2,550	14,230
Subcontracts	115,000	118,450	122,004	125,664	129,434	133,317	743,869
Baseyard	3,000	3,150	3,308	3,473	3,647	3,829	20,407
<i>Subtotal</i>	<i>164,290</i>	<i>169,429</i>	<i>174,733</i>	<i>180,207</i>	<i>185,856</i>	<i>191,685</i>	<i>1,066,200</i>
Overhead @ 10%	16,429	16,943	17,473	18,021	18,586	19,169	106,620
TOTAL	180,719	186,372	192,207	198,227	204,441	210,854	1,172,820
	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Total
Kapunakea Budget	180,719	186,372	192,207	198,227	204,441	210,854	1,172,820
Match (1/3 of total)	60,240	62,124	64,069	66,076	68,147	70,285	390,940
TOTAL NAPP REQUEST (2/3)	120,479	124,248	128,138	132,151	136,294	140,569	781,880

ENVIRONMENTAL REVIEW COMPLIANCE

Although all actions being proposed for reauthorization in this Long-Range Management Plan are substantially similar to, and relevant to, the actions previously considered in the *Final Environmental Assessment of Kapunakea* for which we received a "Finding of No Significant Impact" in 1997, we will be completing a new Environmental Assessment in order to comply with Conservation District Use Application requirements.

APPENDIX 1
NATURAL COMMUNITIES OF KAPUNAKEA PRESERVE

NATURAL COMMUNITY	HERITAGE RANK (a)
Lowland:	
Koa/‘Ohi‘a (Acacia/Metrosideros) Lowland Mesic Forest ^{^†}	G3
Lama/‘Ohi‘a (Diospyros/Metrosideros) Lowland Mesic Forest [^]	G3
Mamaki (Pipturus) Lowland Wet Shrubland	G3
‘Ohi‘a (Metrosideros) Lowland Mesic Forest ^{^†}	G3
‘Ohi‘a (Metrosideros) Lowland Mesic Shrubland	G3
‘Ohi‘a/Uluhe (Metrosideros/Dicranopteris) Lowland Wet Forest [^]	G3
Uluhe (Dicranopteris) Lowland Wet Shrubland	G3
Montane:	
‘Ohi‘a (Metrosideros) Mixed Montane Bog	G2
‘Ohi‘a (Metrosideros)/Mixed Shrub Montane Wet Forest	G3
‘Ohi‘a /‘Olapa (Metrosideros/Cheirodendron) Montane Wet Forest	G3
Aquatic Communities:	
Hawaiian Intermittent Stream	G4

(a) Heritage Rank:

- G2 = Imperiled globally (typically 6 to 20 current occurrences)
- G3 = Restricted range (typically 21 to 100 current occurrences)
- G4 = Apparently secure globally (>100 occurrences)

- [^] = Not known from West Maui NAR
- ^{*} = Not known from Puu Kukui WMA

APPENDIX 2
RARE NATIVE PLANTS OF KAPUNAKEA PRESERVE

SCIENTIFIC NAME	COMMON NAME	HERITAGE RANK (a)	FEDERAL STATUS (b)
<i>Acacia koaia</i> †	koai ‘a, koai ‘e, koa ‘oha	G2	SC
<i>Alectryon macrococcus</i> var. <i>macrococcus</i> [^]	‘ala‘alahua, mahoe	G1T1	LE
<i>Alphitonia ponderosa</i> ²	kauila, kauwila, oa	G2	
<i>Argyroxiphium caliginis</i>	‘eke silversword	G1	
<i>Bobea sandwicensis</i> ^{^†}	‘ahakea	G1	
<i>Bonamia menziesii</i> ^{^†}	-	G1	LE
<i>Calamagrostis expansa</i>	-	G1	C
<i>Chamaesyce arnottiana</i> var. <i>integrifolia</i> ²		G1	
<i>Chamaesyce olowaluana</i> ²	akoko	G2	SC
<i>Clermontia oblongifolia</i> sbsp. <i>Mauiensis</i> ²	‘oha	G3T1	LE
<i>Colubrina oppositifolia</i> ^{^†}	kauila	G1	LE
<i>Ctenitis squamigera</i>	pauoa	G1	LE
<i>Cyanea glabra</i> ²		G1	LE
<i>Cyanea lobata</i> subsp. <i>lobata</i> ¹		G1	LE
<i>Cyrtandra filipes</i> ¹		G1	C
<i>Cyrtandra munroi</i> ¹		G1	LE
<i>Eurya sandwicensis</i>	anini, wanini	G2	SC
<i>Exocarpos gaudichaudii</i> †	Heau	G1	SC
<i>Geranium hillebrandii</i> (formerly <i>humile</i>)	Nohoanu, hinahina	G1	C
<i>Hibiscus kokio</i> ssp. <i>kokio</i> †	koki ‘o ‘ula ‘ula	G2T1	SC
<i>Kadua</i> (formerly <i>Hedyotis</i>) <i>formosa</i> [^]	-	G1	SC
<i>Keysseria</i> (formerly <i>Lagenifera</i>) <i>maviensis</i>	howaiaulu	G2	
<i>Liparis hawaiiensis</i> ²	Jewel orchid	G3	
<i>Melicope orbicularis</i> *	alani	G3	
<i>Myrsine vaccinioides</i>	kolea	G1	C
<i>Neraudia melastomifolia</i> ^{^†}	ma ‘aloa, ma ‘aloa, ‘oloa	G2	SC
<i>Nothoestrum latifolium</i> ^{^*†}	‘aiea	G1	C
<i>Phyllostegia bracteata</i> *	-	G1	
<i>Phyllostegia stachyoides</i> *†	-	G1	C
<i>Platanthera holochila</i>	-	G1	LE
<i>Ranunculus mauiensis</i> ^{^†}	makou	G2	C
<i>Santalum freycinetianum</i>	‘iliahi, sandalwood	G3T3	

<i>var.freycinatianum</i>			
<i>Sicyos cucumerinus</i> †	‘anunu, kupala	G1	SC
<i>Strongylodon ruber</i> ²		G2	

Number of rare plants in Kapunakea 34
¹ = Newly discovered since last Long-range management plan
² = Known from Kapunakea, recently given rare plant status
^ = Not known from West Maui NAR 8
† = Not known from Pu‘u Kukui WMA 12
* = Known from preserve historically (pre-1975) 3

(a) Heritage Rank:

G1 = Species critically imperiled globally (typically 1 - 5 current occurrences)
G2 = Species imperiled globally (typically 6 - 20 current occurrences)
G3 = Species has restricted range (typically 21 - 100 current occurrences)
GH= Species possibly extinct
Q = Questionable taxonomic assignment
T1 = Subspecies or variety critically imperiled globally
T2 = Subspecies or variety imperiled globally
TH= Subspecies or variety possibly extinct

(b) Federal Status:

LE = Listed as endangered
SOC = Special concern
C = Candidate

APPENDIX 3
RARE NATIVE LAND SNAILS OF KAPUNAKEA PRESERVE

SCIENTIFIC NAME	HERITAGE RANK (a)
<i>Partulina crocea</i> †	GNR
<i>Partulina perdix</i>	G1
<i>Partulina tappaniana</i>	G1
<i>Perdicella kuhnsi</i>	G1

† = Not known from Pu‘u Kukui WMA

(a) Heritage Rank:

G1 = Species critically imperiled globally (typically 1 to 5 current occurrences)

GNR = Insufficient data available to assign definite rank

APPENDIX 4 REFERENCES AND RELATED DOCUMENTS

Hadfield, M.G. Undated. *Report on a Survey of Achatinelline Tree Snails in Kapunakea Preserve, Maui, September 10–12, 1993*. Unpublished report prepared for The Nature Conservancy.

Hawaii Biodiversity and Mapping Program. 2008. *Online Databook*. <http://hbmp.hawaii.edu/data.html>.

Hawai‘i Heritage Program. 1991. *Amfac/JMB West Maui Watershed Resource Information Notebooks (1&2)*. Unpublished.

Hughes, G.D. Undated. *Long-term Biological Threat and Resource Monitoring. Kapunakea Preserve, West Maui, Hawai‘i, 1993*. Unpublished.

Long-Term Biological Resource and Threat Monitoring of Kapunakea Preserve. Undated. Unpublished.

NatureServe. 2008. *Explorer: An online encyclopedia of life*. <http://www.natureserve.org/explorer/>.

The Nature Conservancy of Hawai‘i. 1991. *Kapunakea Preserve, West Maui, Hawai‘i. Long-Range Management Plan, Fiscal years 2004 - 2009*. Unpublished document prepared for the Department of Land and Natural Resources Natural Area Partnership Program.

The Nature Conservancy of Hawai‘i. *Semi-annual Progress Report, Kapunakea Preserve, West Maui, Hawai‘i*. Unpublished document prepared for the Department of Land and Natural Resources Natural Area Partnership Program and Amfac/JMB Hawai‘i, Inc. Prepared annually; reports for 1992 – 2008 are available.

The Nature Conservancy of Hawai‘i. *Operational Plan and Progress Report, Kapunakea Preserve, West Maui, Hawai‘i*. Unpublished document prepared for the Department of Land and Natural Resources Natural Area Partnership Program and Amfac/JMB Hawai‘i, Inc. Prepared annually; reports for 1992 – 2008 are available.

The Nature Conservancy of Hawai‘i. 1991. *Maui Project Wildfire Management Plan*. Unpublished.

The Nature Conservancy of Hawai‘i, Maui Project Office. 1995. *Final Environmental Assessment for Kapunakea Preserve Natural Area Partnership*.

The Nature Conservancy of Hawai‘i, Maui Project Office. 1997. *Final Environmental Assessment for Kapunakea Preserve Natural Area Partnership*.

The Nature Conservancy of Hawai‘i. *Semi-annual Progress Report, Kapunakea Preserve, West Maui, Hawai‘i*. Unpublished document prepared for the Department of Land and Natural Resources Natural Area Partnership Program and Amfac/JMB Hawai‘i, Inc. Prepared annually; reports for 1992 – 2008 are available.