Waikamoi Preserve East Maui Irrigation (EMI) Addition

East Maui, Hawai‘i

Long-Range Management Plan

Fiscal Years 2015–2020

Photo John DeMello

Submitted to the
Hawai‘i Department of Land and Natural Resources

By

The Nature Conservancy
Protecting nature. Preserving life.™

The Nature Conservancy, Maui Program
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EXECUTIVE SUMMARY

The Nature Conservancy of Hawai‘i is an affiliate of The Nature Conservancy (TNC), an international private, non-profit organization based in Arlington, Virginia. The mission of The Nature Conservancy is to preserve the plants, animals, and natural communities that represent the diversity of life on Earth by protecting the lands and waters all species need to survive. Since 1980, the Conservancy has been conserving and protecting Hawai‘i’s native forests, and more recently, its coastal waters and coral reefs. We have had significant success over the years — we now manage 10 nature preserves statewide totaling 40,000 acres and have helped to develop partnerships that now protect over 2.2 million acres of native forests and watersheds. TNC’s Maui program has remained on the frontlines of tropical forest conservation, helping to pioneer the watershed and invasive species partnerships now developed on all the major islands.

TNC is finalizing a conservation easement over 3,721 acres of East Maui Irrigation Co. Ltd. (EMI) lands adjacent to the 5,230 acre Waikamoi Preserve. The land is some of the highest quality and weed-free native forest in the state. In addition, much of the area has been designated as critical habitat by the U.S. Fish & Wildlife Service to protect *Geranium multiflorum* and eight other rare plant species. Ungulate and weed management, as well as species recovery in the EMI addition, have long been a management priority for TNC.

The first section of this plan is a brief overview of the native natural resources that are protected in the EMI addition adjacent to Waikamoi Preserve (hereafter referred to as the “EMI addition”). The second section discusses each management program in turn. Program goals are followed by an explanation of the management method we have chosen.

Activities covered under this long-range plan will focus on: western boundary fence construction; establishing helicopter landing zones and foot trails; ungulate scouting, monitoring and control; and invasive plant mapping and control.

Benefits as a result of this project:

- Potential recovery of listed endangered plant and animal species through the protection of intact native montane forest systems
- Climate change adaptation by maintaining ecosystem resilience
- Leveraging funds and conservation actions
- Conservation awareness and engagement to the local community
- Protection of 3,721 acres of Priority 1 Watershed areas, as identified in the state’s Rain Follows the Forest Initiative.
- Improved groundwater recharge ability through protection and enhancement of native canopy and ground cover
- Reduced damage to watershed forest vegetation and soil disturbance as a result of pig and other ungulate damage
- Improved watershed protection and function specific to the Upper Kula water system drainage area and Waikamoi/EMI reservoirs
- Documentation of conservation successes

RESOURCE SUMMARY

General Setting

The East Maui Irrigation conservation easement includes 3,721 acres, and is located mauka (upslope) of the towns of Makawao and Haʻikū on the island of Maui. The property lies at between 3,700 and 7,800 feet elevation and is marked by rugged terrain. Much of the property is remote and difficult to access unless by helicopter. The climate is cool and wet with an average rainfall that ranges from 118 to 270 inches per year.

The EMI addition is at the center of the 100,000-acre East Maui Watershed Partnership (EMWP) area, which is managed by six major landowners. It is bordered by the State of Hawai'i Koʻolau Forest Reserve, the Hanawī Natural Area Reserve, Haleakalā National Park, and lies immediately below TNC's Waikamoi Preserve, with which it shares a long seven mile boundary (Figure 1).

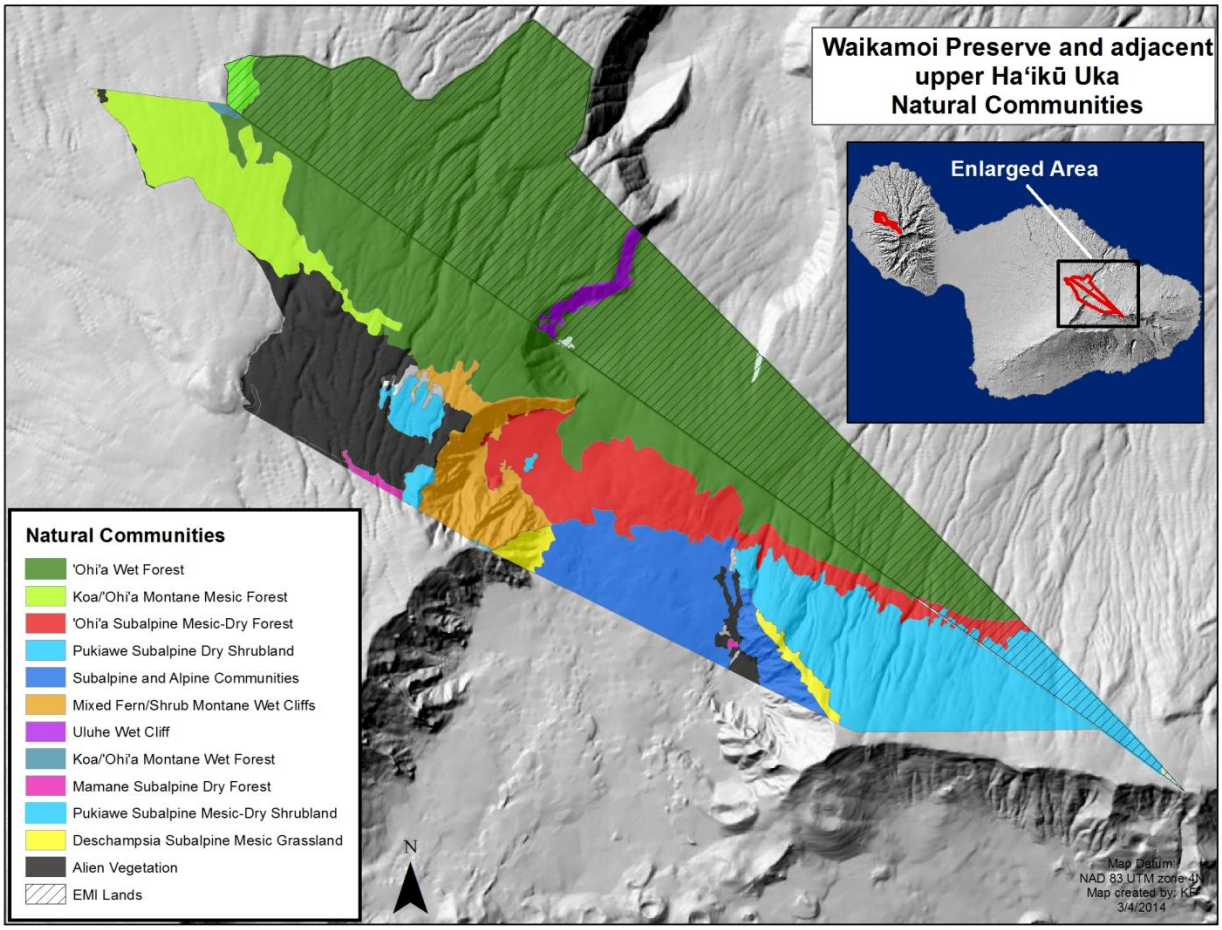


Figure 1. EMI addition and Waikamoi boundaries and natural communities

The EMI addition encompasses significant unmanaged portions of the upper East Maui Watershed Area. This project not only benefits 1,000 new unmanaged acres but also the entire 12,000 acre upper East Maui watershed area. The western flank of this 12,000 acre area is unfenced (Figure 2)

and urgently needs to be closed to prevent continued ungulate ingress. The property has been one of The Nature Conservancy's highest conservation priorities in Hawai'i for at least two decades. The continued and expanded management of this parcel is essential to effective management of the Waikamoi Preserve, EMI addition, and the entire EMWP managed area.

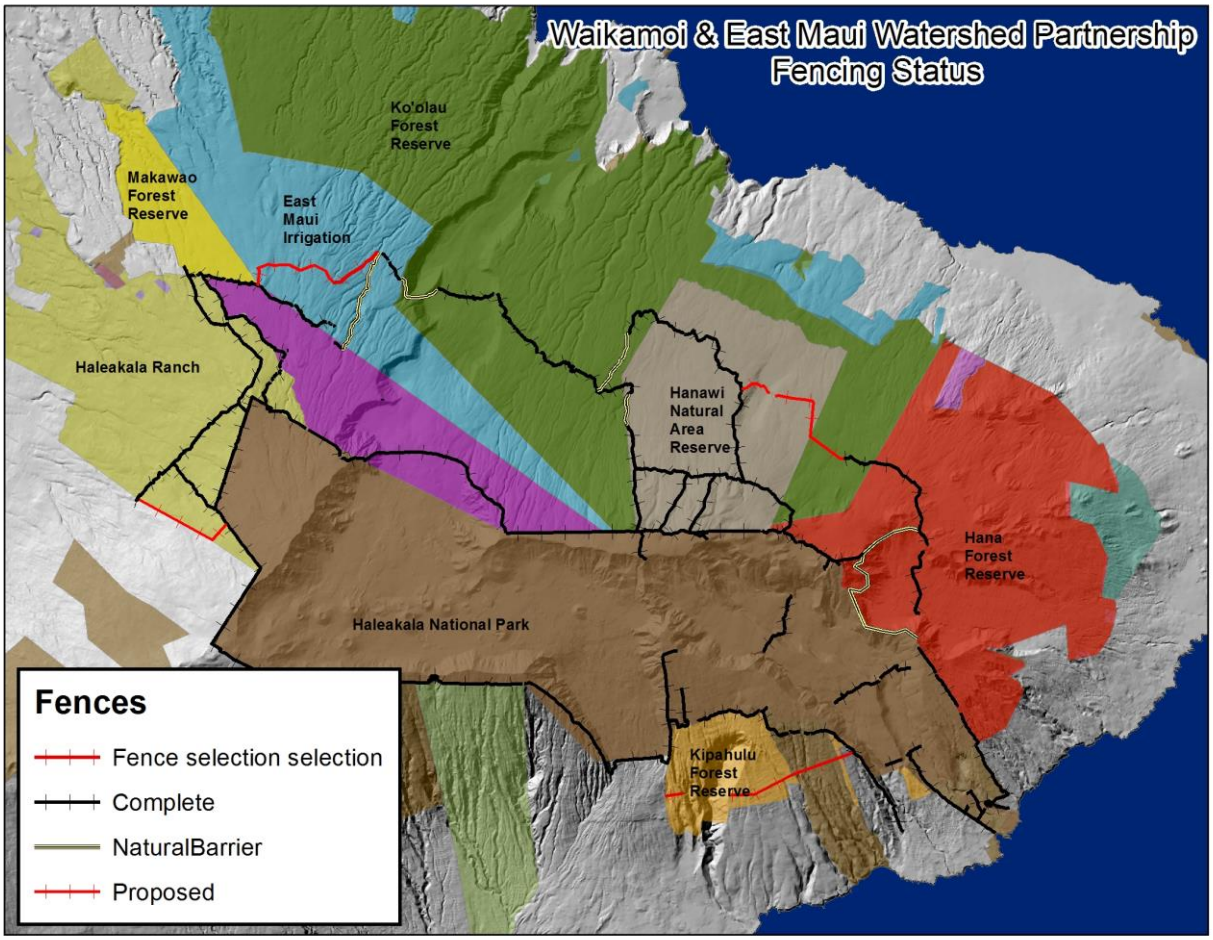


Figure 2. Waikamoi, EMI addition and East Maui Watershed existing and proposed fences

These managed areas, together with other state and private lands on the northeast slopes of Mt. Haleakalā, represent one of the largest intact native rain forests in the state, comprising more than 100,000 acres. The EMI addition also provides essential water resources for the island of Maui, together with Waikamoi Preserve serving as the headwaters for the majority of the major streams that contribute to the East Maui Watershed's surface water collection. The entire East Maui Watershed is the largest single source of harvested surface water in the state with an average harvested flow of 60 billion gallons per year. The EMI addition is also the primary watershed for the upper Kula water supply, which will continue to be degraded without immediate management (Figure 3).

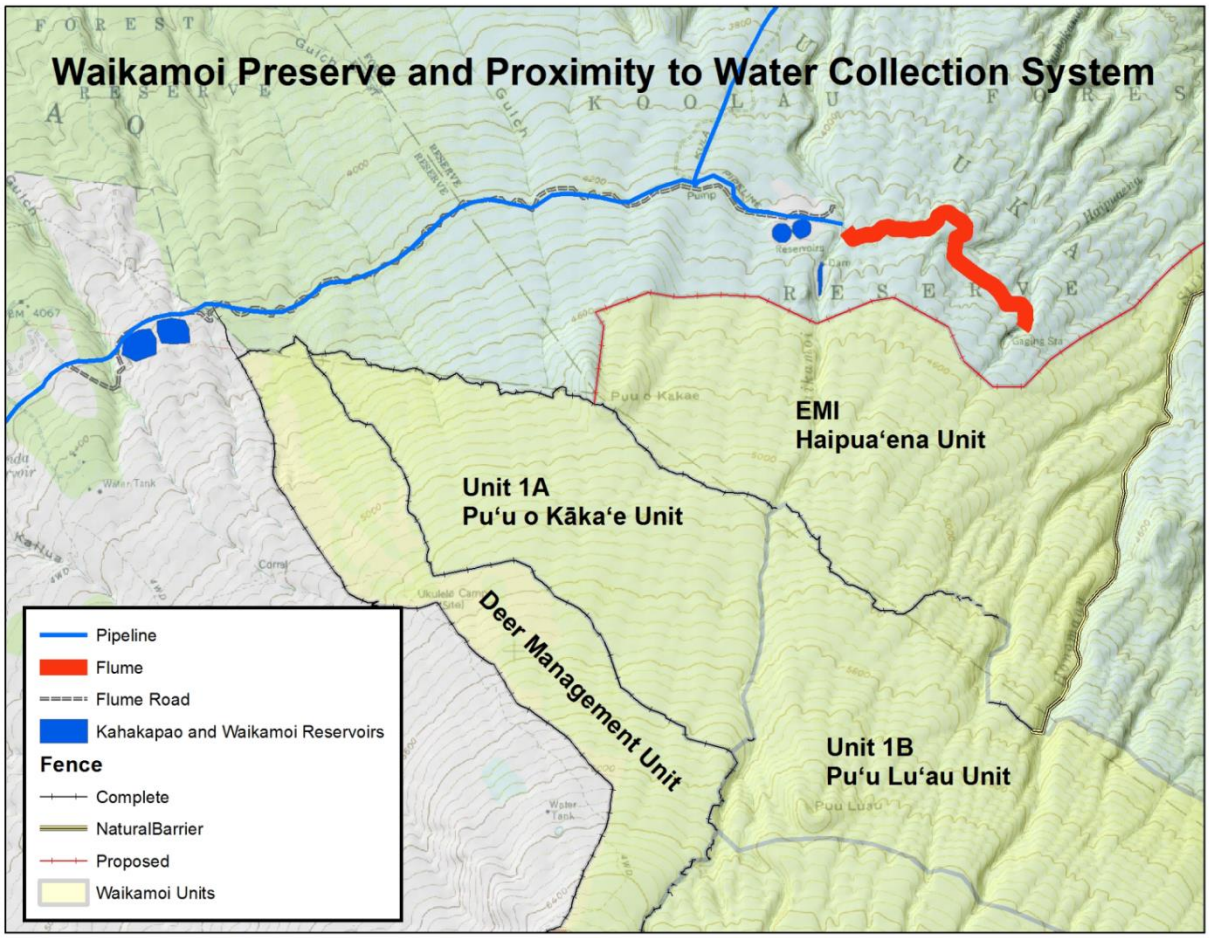


Figure 3. Proximing of Waikamoi Preserve and the Waikamoi Preserve EMI Addition to the upcountry water collection system.

Flora and Fauna

The entire 100,000 acre East Maui watershed, which includes the EMI addition at its center, is rich in biodiversity and supports hundreds of native plant species, including 74 rare species, many of which are endemic to Maui. The entire watershed contains at least nine plant communities and 13 rare or endangered native bird species. A significant portion of these species have been found or are likely to be found within the EMI addition.

The EMI addition is predominantly characterized by ‘ōhi’a montane wet forest habitat with a small portion of dry, subalpine pūkiawe shrubland (Figure 1). The dominant tree is ‘ōhi’a, and the area has an intact understory comprised of dozens of species of native ferns and shrubs. Small portions of the property are pocketed by non-native weeds, including reeds, sedges, and grasses (pampas grass), invasive blackberries, Himalayan ginger, and Tibouchina.

The EMI addition is primary habitat for the endemic ‘ākohekohe and kiwikiu (Figure 4), which are among the rarest birds in the United States. Additionally, the EMI addition contains 20 threatened or endangered plant and animal species, 18 species of concern, and 4 candidate species. Much of the area has been designated as critical habitat by the U.S. Fish & Wildlife Service to protect *Geranium*

multiflorum and eight other rare plant species. See Tables 1 and 2. Over the past six years, 2,500 acres of the EMI addition has received some TNC and EMWP management primarily to reduce ungulates. TNC management activities since the early 1990s in the far eastern area of the EMI addition area and Waikamoi Preserve have dramatically reduced the formerly heavy impact of goats and pigs resulting in a three-fold increase in shrub cover and a 50% reduction in alien grass cover, recently documented in a vegetation change study conducted by Hughes et al[1] (Figure 5).

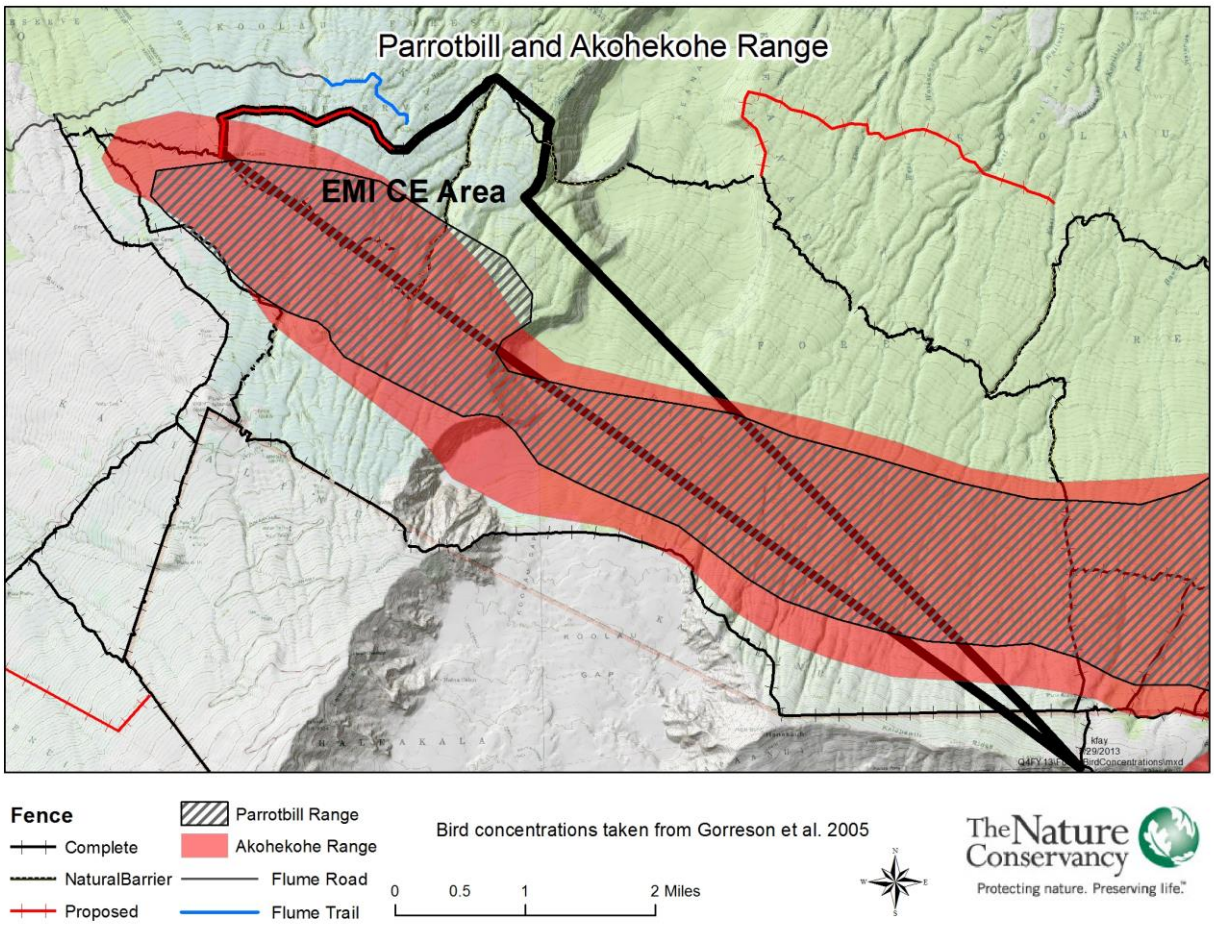


Figure 4. Endangered forest bird concentrations in relation to EMI addition area.

[1] Hughes, et al. 2014. Subalpine vegetation change 14 years after feral animal removal on Windward East Maui, Hawai'i. Pacific Science 68:1.

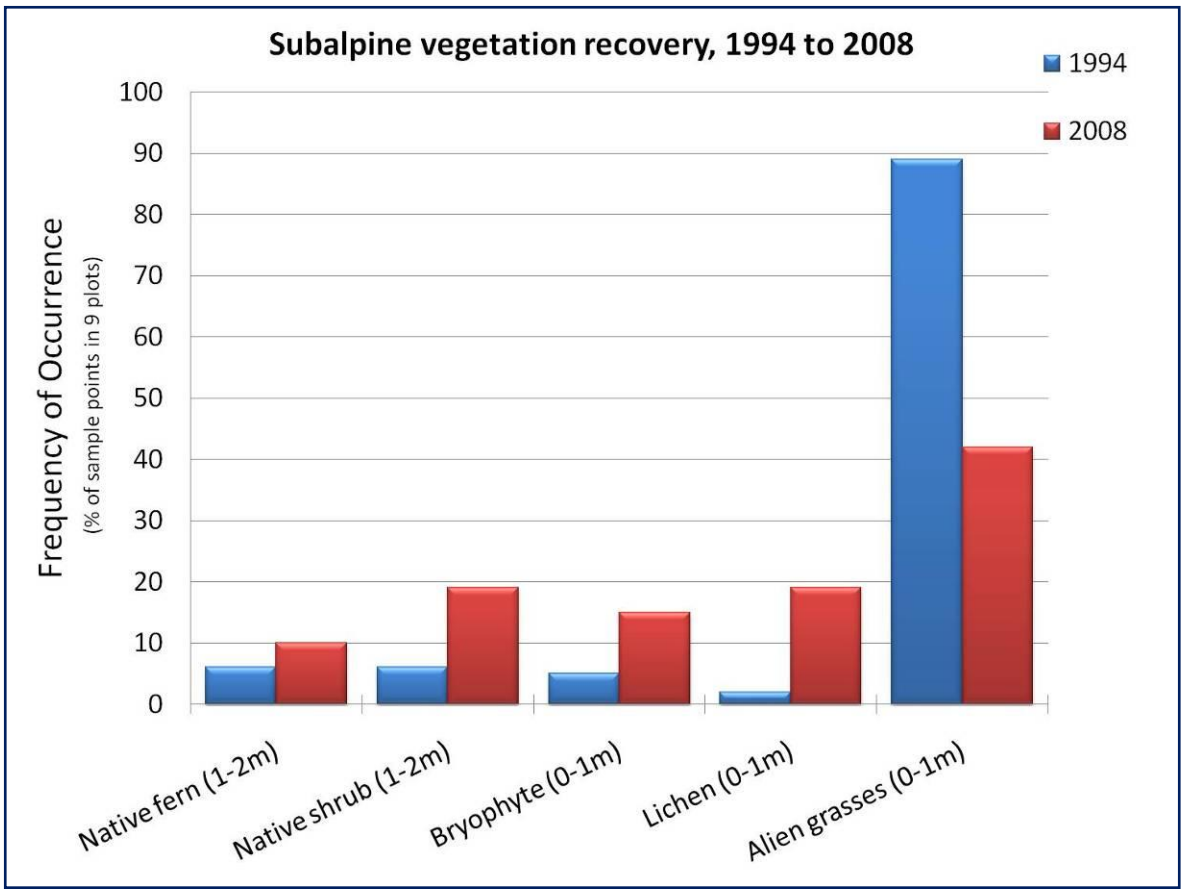


Figure 5. Recovery of native subalpine shrubland habitat documented in the eastern EMI addition and Waikamoi Preserve in 2008.

However, 1,000 acres of the western end of the property has received no management and is impacted by feral pigs and increasing invasive weed species, such as pampas grass, Himalayan ginger, blackberry, and strawberry guava. This unmanaged portion of the property contains some of last remaining unprotected habitat for kiwikiu, ʻākohekohe and many rare plant species (Figure 4).

Table 1. Rare plants associated with the EMI Addition area.[2]

Species Name	Hawaiian/ Common Name	Federal Listing
Anoectochilus sandwicensis	Hono hono orchid, jewel orchid	SOC
Asplenium fragile var. insulare		E
Asplenium haleakalense		SOC
Calamagrostis expansa		C
Clermontia oblongifolia subsp. Mauiensis	ʻŌhā; ʻŌhā Wai	E
Clermontia tuberculata	ʻŌhā; ʻŌhā Wai	SOC
Cyanea copelandii subsp. Haleakalaensis	Hāhā	E
Cyanea glabra	ʻŌhā, Hāhā, ʻŌhā Wai	E
Cyanea hamatiflora subsp. Hamatiflora	Hāhā	E
Cyanea horrida	Holokea, Hāhā nui	E
Cyanea kunthiana	ʻŌhā, Hāhā, ʻŌhā Wai	E
Cyanea mceldowneyi	ʻŌhā, Hāhā, ʻŌhā Wai	E
Cystopteris douglasii		SOC
Diplazium molokaiense		E
Dryopteris tetrapinnata		SOC
Dubautia reticulate	Naʻenaʻe	SOC
Fragaria chiloensis var. sandwicensis	ʻŌhelo papa	SOC
Geranium multiflorum	Nohoʻanu	E
Hillebrandia sandwicensis	Waimakanui, ʻakaʻakaʻawa	SOC
Joinvillea ascendens subsp. Ascendens	ʻOhe	C
Liparis hawaiensis	ʻAwapuhiakanaloa	SOC
Melicope balloui	Alani	E
Melicope haleakalae	Alani	SOC
Melicope sp. nov. 2	Alani	SOC
Phyllostegia ambigua		SOC
Phyllostegia bracteata		E
Phyllostegia macrophylla		SOC
Pritchardia arecina	Loulu	SOC
Ranunculus mauiensis	Makou	C
Rubus macraei	ʻĀkala	SOC
Sanicula sandwicensis		SOC
Schiedea diffusa subsp. diffusa		SOC
Sicyos cucumerinus	ʻAnunu; Kupala	SOC
Wikstroemia villosa	ʻĀkia	E

[2] Listing and abbreviations according to USFWS Species List January 5, 2010. E=Endangered; C=Candidate; T= threatened; SOC=Species of Concern

Table 2. Rare animals associated with the EMI Addition area[3]

Species Name	Hawaiian/ Common Name	Federal Listing
Branta (Nesochen) sandwicensis	Nēnē	E
Lasiurus cinereus semotus	ʻŌpeʻapeʻa Hawaiian Hoary Bat	E
Loxops coccineus ochraceus	Maui ʻĀkepa; ʻAkepeu`ie	E
Pseudonestor xanthophrys	Maui Parrotbill	E
Pterodroma phaeopygia sandwichensis	Hawaiian Dark-Rumped Petrel, ʻUaʻu	E
Puffinus auricularis newelii	Newell's shearwater, ʻAʻo	T
Palmeria dolei	Crested Honeycreeper, ʻĀkohekohe	E
Megalagrion nesiotes	Damselfly, pinao ʻula	C

ʻĀkohekohe. Photo by Jack Jeffrey.

Kiwikiu. Photo by Maui Forest Bird Recovery Project

Geranium multiflorum (Nohoanu). The Property has been designated critical habitat for this species. Photo by Forest and Kim Starr.

[3] Listing and abbreviations according to USFWS Species List January 5, 2010. E=Endangered; C=Candidate; T= threatened; SOC=Species of Concern

MANAGEMENT

Management Considerations

The Waikamoi EMI addition lies just below Waikamoi Preserve and above the State Koʻolau Forest Reserve (Figure 6). The eastern portion of the EMI addition has been managed by TNC for ungulates since the early 1990's, while some portions of the lower Honomanū and Koʻolau Gap have more recently been managed by the EMWP. Although management to date has been partially effective, significantly more work is needed, particularly in the western 1,000 acre area which is currently unmanaged. TNC will now be able to manage the entire 3,721 acre area for both ungulates and weeds promoting recovery of native plant and animal species.

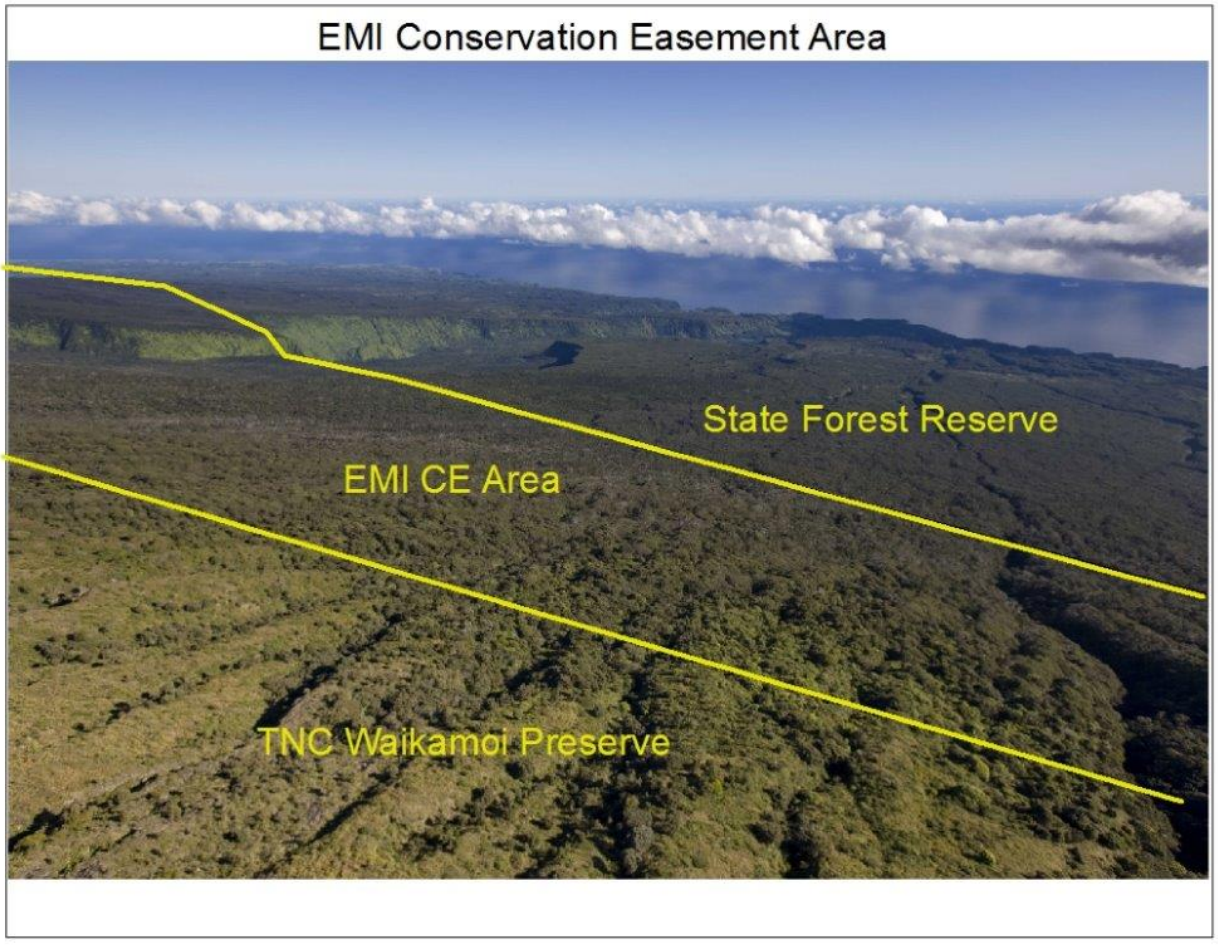


Figure 6. The Waikamoi EMI addition lies just below Waikamoi Preserve and above the State Koʻolau Forest Reserve.

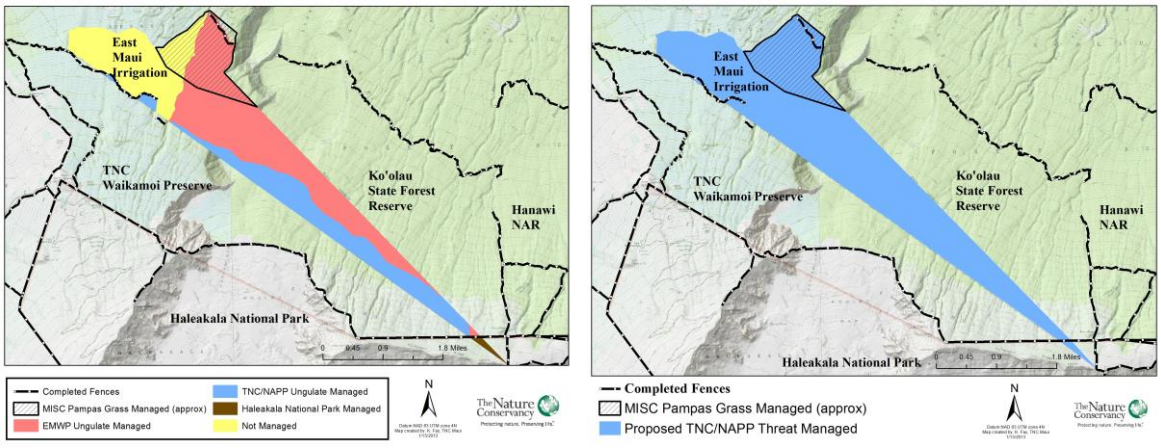
TNC partners routinely with the Maui Invasive Species Committee (MISC) and the Maui Forest Bird Recovery Project (MFBRP). MISC is currently controlling highly invasive pampas grass in the lower Honomanū section of the EMI parcel and will continue to do so. The MFBRP is currently banding kiwikiu and `ākohekohe in Waikamoi with plans to continue research and banding efforts to support the potential Nākula NAR release of kiwikiu, in addition to increasing our understanding of the current range and population of Maui's endangered forest birds. The EMI addition area contains high

quality kiwikiu and ʻākohekohe habitat that will continue to be further degraded without immediate management. It is also severely impacted by ungulates and increasing invasive weed species like Himalayan ginger and strawberry guava.

The EMI addition is very remote and rugged. Most of the area is primarily accessible via helicopter or extensive hiking. There are no roads that transit the area whatsoever. The most accessible area is the far western area which can only be accessed through private EMI lands and roads (i.e., the Waikamoi flume access road). The only structure on the entire 3,721 acre parcel is one approved temporary 8'x8' remote shelter maintained by TNC, "Camp 6". Nine landing zones (LZs) exist throughout the parcel and are maintained by TNC, EMWP, and/or MISC.

The property is owned by East Maui Irrigation Co., Limited (EMI), a subsidiary of Alexander & Baldwin. A&B is a multi-market transportation and real estate company. It is among the largest private landholders in Hawai'i. A&B/EMI has been an active participant in the EMWP since its formation in 1991. TNC expects to continue to nurture and develop this partnership into the future, and more so now that TNC holds a CE over this 3,721 acre parcel.

The East Maui Watershed Partnership (EMWP) has co-managed approximately 2,500 acres of the 3,721 acre project area cooperatively with The Nature Conservancy (TNC) since 2005. To date, the more eastern lands have been managed by the Nature Conservancy, while those in the lower Honomanū and Koʻolau gap area are managed by the EMWP (Figure 7). TNC will take the lead on the management of the additional 1,000 acres of the parcel, which are currently unmanaged, while the EMWP will continue to manage portions of the Honomanū and Koʻolau Gap sections. This management arrangement will either continue into the future or TNC will subcontract management to EMWP or another entity. The ultimate goal will be to manage the 3,721 acre area in the most cost-effective way possible under TNC leadership working collaboratively with EMWP.



Current Future

Figure 7. Current and proposed future management lead by agency and area

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 and key management issues. Finally, key objectives to achieve the goal are listed by year for FY2015–FY2020.

Program 1: Non-Native Species Control

A. Fencing, Ungulate Control & Monitoring

Program Goal**:** To protect large native-dominated areas and watershed within and adjacent to the EMI addition area by removing all ungulates and preventing future invasion.

Program Description: Ungulate damage to vegetation and the forest floor is the greatest threat to the critical East Maui watershed headwaters and Upper Kula water system drainage area, and is therefore the focus of the Waikamoi EMI addition resource management program. The primary strategy for protection of the EMI addition is to reduce damage to native vegetation and soils by ensuring that ungulates do not enter fenced areas. Feral pigs in particular eat native vegetation, facilitate non-native plant invasion, and hasten soil erosion. Invasive weeds compete for habitat and other resources with native species and spread easily with ungulate disturbance. Fences are the primary method for controlling the movements of feral pigs and keeping pigs from entering native forest systems.

Full ungulate control will require extensive hunting and trapping to bring pig populations down to zero as rapidly as possible, and to prevent new populations from becoming established in the preserve. Pigs in particular reproduce at very high rates. Scientific research tells us that seventy percent of the population must be removed annually to maintain lower pig numbers. Snares will continue to be used until an equally effective alternative can be found.

Ungulate numbers in adjacent Waikamoi Preserve are at all-time low levels. We will expand TNC's zero tolerance ungulate control strategy into the EMI addition. We have an excellent in-house dog team for removing pigs in accessible units where snaring is not appropriate. The dog program, along with more systematic scouting and adaptive management, has enabled us to bring ungulate numbers in the preserve to near zero. Dogs have also proven useful for detecting weaknesses in fence integrity. Effort is also being made to refine and improve our dog handling and training protocols.

Currently pigs remain in the EMI addition in fairly high numbers at multiple "hotspot" areas (Figure 8).

Figure 8. Recent pig damage in endangered forest bird habitat of unmanaged portion of EMI Parcel.

Our first step will be to construct a three-mile mile boundary fence along the western edge of the parcel in order to begin controlling ungulates. This area represents the western flank of the East Maui Watershed and urgently needs to be closed. The three-mile boundary fence is proposed to be constructed in three phases. Phase 1 will be the completion of .75 miles on the eastern end to Honomanū; Phase 2 will include a 1 mile section that crosses Haipuaʻena stream; and Phase 3 will cross Waikamoi stream and tie into our existing fencing of Waikamoi Preserve to the west (Figure 9). A contractor has been selected and initial construction of the Phase 1 fenceline has begun and Phase 1 is expected to be complete by May 2014.

In order to monitor the effectiveness of our ungulate control strategies and assess the threat level of ungulates, we established three 500m transects to measure ungulate activity[4]. We conducted an initial baseline monitoring and will continue to monitor the transects semi-annually for signs of ungulate activity in contiguous 5m X 10m plots along 500m-long transects (Figure 10). This monitoring method is used to gauge the effectiveness of our control strategies and techniques.

[4] "Ungulate activity" is determined by monitoring belt transects for presence or absence of ungulate signs (e.g., tracks, scat, wallows, evidence of browsing). For example, if ungulate sign(s) are present in 10 out of 100 transect stations, the activity level is said to be 10%.

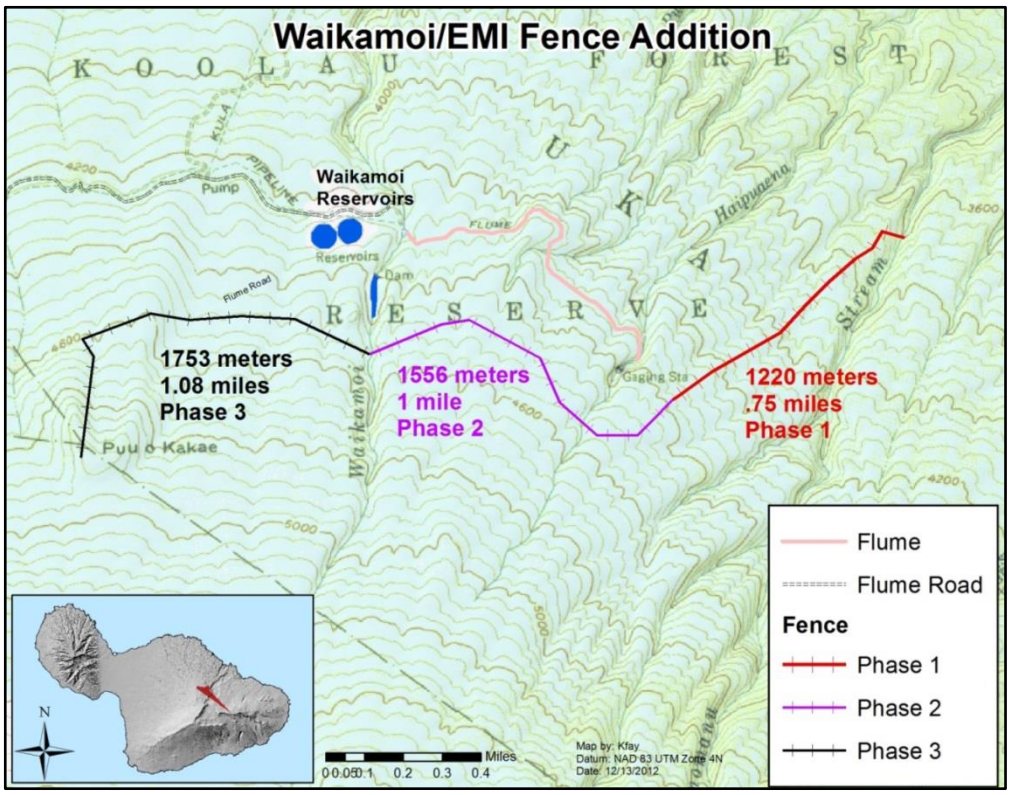


Figure 9. Waikamoi EMI addition western boundary fence and construction phases

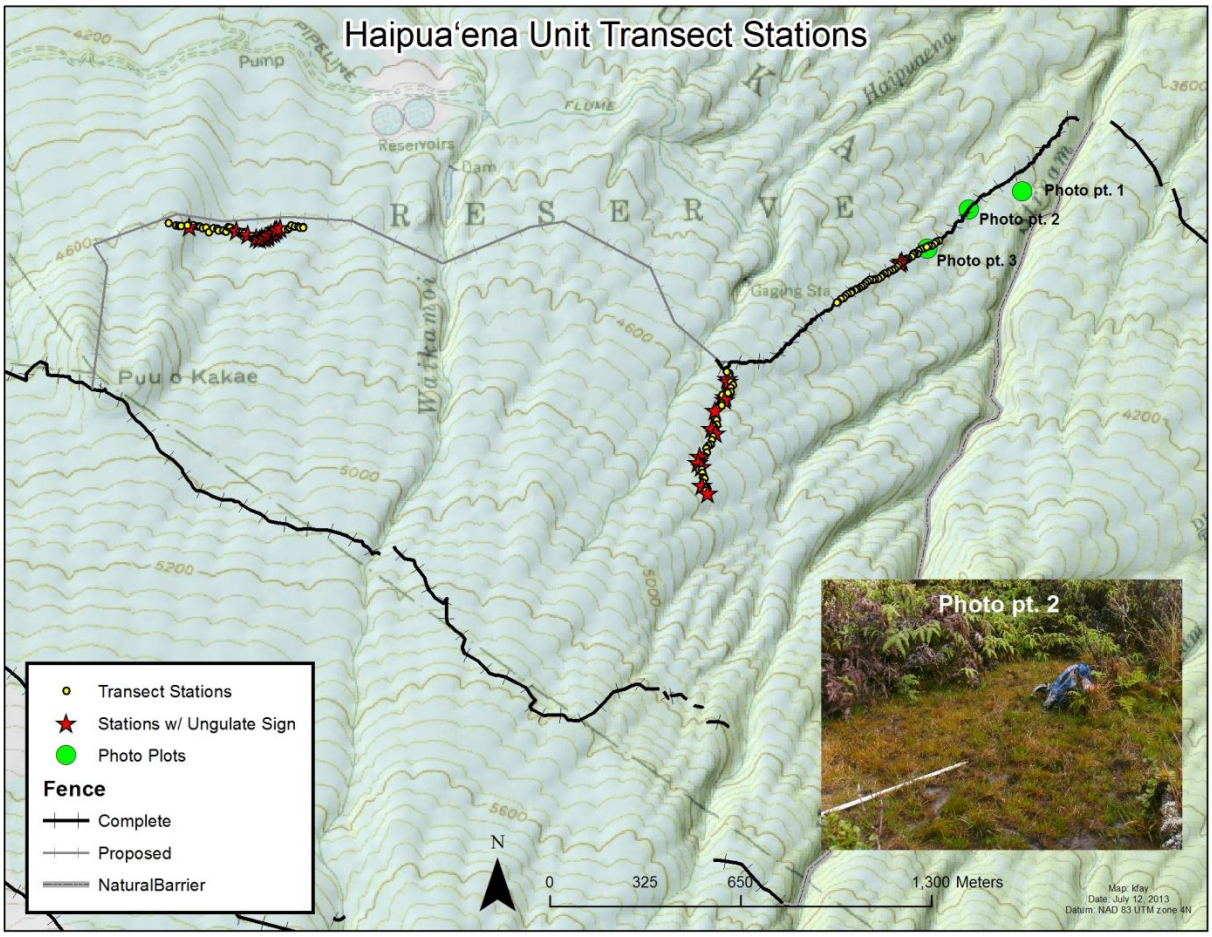


Figure 10. Three monitoring transects were installed and will be monitored semiannually.

The current regime of fencing, hunting, and snaring for ungulate removal has a proven track record. Snaring remains an essential tool in an integrated program for ungulate removal. Once built, fences will be checked and maintained on a regular schedule, and will be repaired and replaced incrementally as needed. Over the next six years, we will explore new strategies and techniques so that our ungulate control program continues to be as effective, efficient and humane as possible. Notice of any significant changes to the management program will be included in progress reporting.

Activities

Year 1 (FY2015):

- Complete final scouting, surveying and fence alignment for western boundary fence.
- Complete .75 miles of western boundary fence.
- Complete initial ungulate hot-spot map of western 1,000 acres via FLIR and ground scouts.
- Complete installation of monitoring transects.

Years 1–6 (FY2015–2020):

- Inspect western boundary fence quarterly and make repairs immediately. Inspect fences immediately following storms or other natural or suspected events (e.g., vandalism). Identify new fencing needs and add strategic fences as needed.
- Initiate and maintain zero tolerance ungulate control. Implement staff hunting with dogs, community hunt program, and/or contract hunting to initially bring high pig numbers down. Install snares throughout parcel in areas identified as hotspot or pig transit routes.
- Scout for ungulates routinely and track animal catches. Update pig activity and scout maps annually.
- Semiannually monitor three 500 meter transects to track ungulate activity.
- Improve dog program effectiveness, including training, handling, and hunting techniques. Share dog program knowledge with partners as feasible.
- Test innovative and new monitoring technologies, including Forward Looking Infrared (FLIR) and remote game cameras.

B. Invasive Plant Control

Program Goal: To maintain existing large native-dominated core areas within the EMI addition area that are free of the highest priority habitat-modifying weeds, to contain already established populations of habitat-modifiers, and to prevent the introduction and spread of problem weeds to areas where they are not currently established.

Program Description: The most important aspects of our invasive plant control program are to minimize current disturbances to intact native communities, reduce infestation size of priority weeds with a focus on outliers, while first surveying for and controlling their outlying populations, and to prevent the introduction of additional invasive plant species. Ungulate removal significantly reduces the introduction and spread of invasive habitat-modifying weeds. We enforce strict procedures to remove weed seeds, mud, and debris from equipment and clothing before people enter the preserve. Helicopter flights originate from areas free of priority weeds, and all equipment and clothing is inspected and cleaned. See Appendix 1, Prevention Protocols.

We strive towards an Integrated Pest Management (IPM) approach to weed control — consisting of manual/mechanical methods, herbicides, and/or biological control. As biological controls are developed and approved for release on our top priority weeds, we will work cooperatively with agencies mandated to monitor these agents. Cultural control (minimizing soil disturbance and new pest plant introductions) is incorporated into routine field operations through gear sanitation protocols. Herbicide use is in full compliance with the State of Hawai‘i Department of Agriculture (HDOA) Pesticide Enforcement Division, used according to the product label, and recorded in detail for reference and efficacy monitoring. Staff coordinating weed control are certified with the HDOA Pesticide Enforcement Division through a Forestry Applicators’ exam and card. We may employ other techniques or tools for weed control as they are developed. Any new application methodology used regularly will be coordinated in full compliance with HDOA.

Control work is prioritized to target species. Our management efforts are guided by the *East Maui Conservation Site Weed Management Plan* (TNC 2009) as it applies to the habitat of the EMI addition

and the likelihood of listed weed targets getting established there. The highest priority is the containment and localized eradication of Himalayan ginger (*Hedychium gardnerianum*), primarily due to its established range, rate of spread, and aspects of habitat modification. Other priority weeds with established populations in some areas of the parcel include pampas grass (*Cortaderia jubata)*, *Tibouchina herbacea, Rubus* spp., *Andropogon virginicus,* and *Setaria palmifolia*. It is suspected that strawberry guava *(Psidium cattleianum)* and *Clidemia* may be found with additional surveys. *Miconia* has not yet been found on the parcel.

We have found that aerial and ground surveys provide the best measure of determining the extent of weeds and provide a visual estimate of ecosystem extent and quality. We will initially scout the entire area to map populations and outliers of priority habitat-modifying weeds, and will then devise specific strategies for each species.

Table 3. Priority weed species for management in the EMI Addition

Scientific Name	Common Name
TOP PRIORITY SPECIES	
Hedychium gardnerianum	Himalayan ginger
Ulex europaeus	Gorse
Pinus spp.	Mexican weeping pine, Monterey pine, etc.
Acacia melanoxylon	Blackwood acacia
Cortaderia jubata	Pampas grass
EARLY DETECTION/ RAPID RESPONSE PRIORITY SPECIES	
Psidium cattleianum	Strawberry guava
Cyathea cooperi	Australian tree fern
Angiopteris evecta	Mulesfoot fern
Clidemia hirta	Clidemia

Table 4. Weed species not yet established in the EMI Addition

Scientific Name	Common Name
Clidemia hirta	Clidemia
Cyathea cooperi	Australian tree fern
Miconia calvescens	Miconia
Paspalum conjugatum	Hilo grass
Delaria odorata	German ivy

In FY09, the Conservancy began contracting with Resource Mapping Hawai‘i, Inc. (RMH), to map our priority target weeds on East Maui utilizing high resolution aerial imagery. The project is still underway as of December 2013. Project goals are to obtain and analyze very high resolution multispectral imagery to produce detailed maps of the distribution and abundance of selected invasive plant species in the project area and guide follow-up control of mapped invasive weeds. Staff and volunteers will then follow-up to treat mapped invasive plant populations. While the project originally focused on Himalayan ginger, strawberry guava, and *Clidemia hirta*, RMH has struggled with the “signature” of different species and therefore may try to map other invasive weeds instead.

Staff from TNC also attend the Maui Invasive Species Committee's (MISC) miconia and pampas grass operations meetings, which focus exclusively on crew progress, improvements in methodology, and new detections. This enables TNC to be better informed on the status of such priority weed targets within or approaching native-dominant watershed, and may involve future cooperative projects between TNC–EMWP and MISC field crews.

Years 1–6 (FY2015–2020):

Activities

Year 1 (FY2015):

- Initiate priority weed mapping throughout entire EMI addition area.

Years 1–6 (FY2015–2020):

- Scout and map priority habitat-modifying weeds during all management activities throughout the area.
- Initiate weed control on select priority species, focusing on treatment of outliers.
- Sweep and control Himalayan ginger throughout the native-dominant areas, focusing on outliers; maintain control of the leading edge of ginger invasion from adjacent EMI lands and the Makawao Forest Reserve.
- Conduct routine weed monitoring and control of habitat-modifying weeds at landing zones, fences, and camp infrastructure.
- Prevent other incipient weed establishment by continuing strict inspection and cleaning procedures to prevent their introduction.
- Support the Maui Invasive Species Committee (MISC) in their work to contain serious habitat-modifying weeds.
- Collaborate with MISC on pampas grass control and Miconia surveys.
- Evaluate currently flown Resource Mapping high resolution imagery and ground scouts to refine priority weed locations.
- Utilize maps generated by Resource Mapping analyses to conduct rapid response removal of top target weeds, especially when identified as outliers.

C. Small Mammal, Invertebrate Pest, and Pathogen Prevention and Control

Program Goal: To prevent the introduction and spread of small mammals, non-native insects, mollusks, pathogens, and other pests deemed to be a significant threat, and reduce their negative impact where possible.

Program Description: Non-native insects and small mammal damage is evident throughout Maui's native ecosystems. For example, the non-native argentine ant (*Iridomyrmex humilis)* is currently the greatest threat to the survival of the Haleakalā silversword (*Argyroxiphium sandwicense* ssp. m*acrocephalum*); it decimates the native yellow faced bee (*Hylaeus volcanica)* that pollinates the plant. Rats, mice, cats, and mongoose pose a threat to many native birds including the endangered ground nesting nēnē. Prior research and management attempts 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, TNC 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. We also implement protocols for cleaning and monitoring to prevent the accidental introduction of new alien species.

Lack of resources precludes a full-scale predator control program. We will follow strict established protocols for cleaning and monitoring to prevent the accidental introduction of new alien species. We will also support partners on developments toward aerial application of rodenticides and consider other partner led predator control strategies should they become feasible.

Activities

Years 1–6 (FY2015–FY2020):

- Support viable control programs for small mammals or other pests by our partners.
- Map and respond immediately to control *Vespula* or ant nests when found in preserve. Map significant pest locations and sign as found through routine scouting.
- Support research on *Puccinia rust* or other forest pathogens.

Program 2: Resource Monitoring, Rare Species Protection, and Research

Program Goal: Conduct and support monitoring and research to track the status of biological and physical resources of the EMI addition, especially rare species, while encouraging and assisting with research that increases our understanding and management of the area's natural resources.

Program Description: The goal of our resource monitoring program is to track biological and physical resources of the preserve, evaluate changes in these resources over time, and improve efficacy of management responses. 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. Biological surveys have shown that the preserve protects numerous rare species, many of which are federally listed as endangered. Although protecting essential habitat is our main strategy to their protection, we also inventory the rarest species and take measures to protect them. 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 throughout the East Maui Watershed, 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. We work closely with PEPP and support their efforts to protect and restore rare and endangered species found in the preserve.

We also encourage and support independent research aimed at answering important resource and management questions. Key questions include: What is the status of forest birds in East Maui, and how can we promote their survival? How do we best control Himalayan ginger in remote areas? How is climate change affecting the biological resources of the preserve, and how can we adapt to climate change?

We may employ new passive monitoring technologies such as remote sensing, high resolution aerial photography for vegetation monitoring, and remote photo monitoring for fire, ungulates and/or ungulate traps. Other monitoring tools may be employed as they are developed and become available.

Staff will continue to identify, map (using GPS) and recover rare plant populations during routine management activities. When available, fruit will be collected and given to PEPP for propagation. We will continue to support and assist PEPP with outplanting and monitoring of rare plants, in addition to sharing GIS data on rare plant locations in East Maui.

We will continue to encourage independent research in Waikamoi and the EMI Addition area by offering necessary application materials to researchers online. Priority research is the Maui Forest Bird Recovery Project's continuing population studies and banding of the westernmost kiwikiu (Maui Parrotbill) populations found in Waikamoi Preserve. To date, 45 individuals have been identified a roughly two square kilometer area adjacent to the EMI CE. Although no Conservancy funding for research is provided to projects, we provide technical guidance and logistical support to approved research.

Activities

Years 1–6 (FY2015–FY2020):

- Collaborate with EMWP and MFBRP for landscape scale management and forest bird protection.
- Continue to support PEPP in search and assessment of rare species populations to determine protection needs and to reduce threats.
- Maintain and update current maps of rare species populations. Update database as necessary.
- Review and provide technical guidance to research proposals as necessary.
- Perform occasional in-house rare plant surveys in new areas when possible.

Program 3: Community Outreach

Program Goal**:** To build public understanding and support for the preservation of natural areas, and enlist volunteer assistance for preserve management.

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, threats, and protection efforts at Waikamoi Preserve, the EMI addition, and the East Maui watershed. TNC carries out an outreach program because it is important for raising public awareness and garnering support for conservation programs and their funding. Being an accessible natural area, Waikamoi Preserve serves as an excellent staging area for our East Maui conservation partners who may not have a site to exemplify the aspects of natural area protection to their outreach clientele. We can directly translate the experience visitors have in Waikamoi Preserve to the adjacent EMI addition area. Therefore, we have no plans to conduct public hikes in the EMI addition. However, we

will likely have some limited hiking opportunities for funders, partners, donors, volunteers, and other supporters who support management of the EMI addition.

Along these lines, our major public outreach tool will be leading hikes in the Waikamoi Preserve, although we also cultivate one-on-one contacts, present slide shows, and lead hikes and volunteer work trips. The Conservancy-trained hike docents lead small custom hikes for community and school groups, donors, and community leaders. Haleakalā National Park brings visitors once weekly into Waikamoi on our most actively used trail, the Bird Loop trail. The Waikamoi Boardwalk trail is accessible only via hikes by TNC and our partners, and provides access to pristine native forest. Routine maintenance on the other trails also helps minimize impacts as well as enhancing interpretive value.

The primary audience of public access to Waikamoi Preserve is the local community and others who can increase our effectiveness in stewardship. We do not engage in any practice or use that is inconsistent with the long-term survival of vulnerable native species or ecosystems. All donations generated by these activities are used in support of our management.

Other outreach activities include participation at local community events, such as the East Maui Taro Festival, and the Maui Ag Fest. There is also consistent interaction with UH Maui College Natural Resources department through field trips or class presentations.

TNC Maui consistently hosts Americorps KUPU interns for periods ranging from 12 weeks to 1 year. Americorps interns assist TNC staff with the on the ground management activities necessary to meet our conservation goals.

Activities

Years 1–6 (FY2015–FY2020):

- Support outreach efforts of partners such as HALE, MISC, MFBRP, and EMWP by providing access and staff resources as available
- Utilize volunteers as available to further conservation goals and bring environmental awareness to the local community.
- Participate in one or two community events per year to encourage constituents to support our work, such as East Maui Taro Festival in Hāna.
- Coordinate and periodically train docents to accommodate special community hikes.

Program 4: Fire, Emergency, and Safety

Program Goal: Provide staff with training and equipment that will allow them to assist primary fire and rescue agencies during a fire or emergency on or adjacent to the preserve.

Program Description: All staff are trained in basic first aid and CPR. Other training may include advanced wilderness first aid, fire suppression and pre-suppression, helicopter safety, and hunter's education. Field staff are provided with first aid kits and required to use proper personal protective

equipment (PPE) when conducting field work. The TNC Maui fire plan enables an immediate multi-agency response to wildfires within and adjacent to Waikamoi Preserve including the EMI CE area.

Activities:

Years 1–6 (FY2015–FY2020):

- Provide emergency training opportunities for staff including but not limited to maintaining current First Aid and CPR certifications.
- Conduct annual first aid kit inventory and resupply.
- Maintain fire suppression training for key staff.
- Purchase equipment as needed to allow immediate response to fire threats.
- Respond to emergencies or fire threats.*
- Maintain and improve access roads in high risk areas of preserve.
- Maintain and improve fire cameras.

Program 5. Watershed and Invasive Species Partnerships

Program Goal: Support the East Maui Watershed Partnership and the Maui Invasive Species Committee (MISC) where cooperative management activities mutually benefit Waikamoi, EMI addition and adjacent lands.

Program Description: The EMWP provides protection for about 100,000 acres on East Maui and is administered by a coordinator and field crew. Activities include fencing, ungulate removal, invasive plant removal, and resource monitoring programs for all of East Maui's native forests. TNC Maui helped to form and has actively participated in Partnership activities from the beginning in 1991. As a partner, we helped set management priorities, fundraise and administer projects. Initially, we supervised and trained EMWP crews in ungulate and weed removal, monitoring techniques, fence building, and a wide array of safety procedures including rappelling, helicopter travel, and wilderness survival. We continue to work closely with EMWP, as they have been awarded a subcontract to conduct management some activities for Waikamoi Preserve. We meet regularly with EMWP staff and crew to discuss priorities, strategies, and management actions and techniques. The Program Director serves on the Executive Committee of the EMWP. TNC staff regularly provide guidance and support to EMWP, and we participate in management activities on partnership lands as needed.

Activities

Years 1–6 (FY2015–FY2020):

- Participate and provide leadership to the EMWP.
- Support EMWP and MISC in accomplishing fundraising and resource management priorities.
- Provide EMWP and MISC access to the EMI addition to accomplish outreach and volunteer activities on a mutually cooperative basis.

BUDGET SUMMARY

The table in the next section summarizes the six-year budget for the Waikamoi EMI Addition 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 one-third. The EMI Addition NAPP budget currently represents approximately 40% of the overall operation at the TNC Waikamoi EMI Addition. Continued management at our current level will be contingent upon TNC's ability to fundraise for the remaining 60% from other sources.

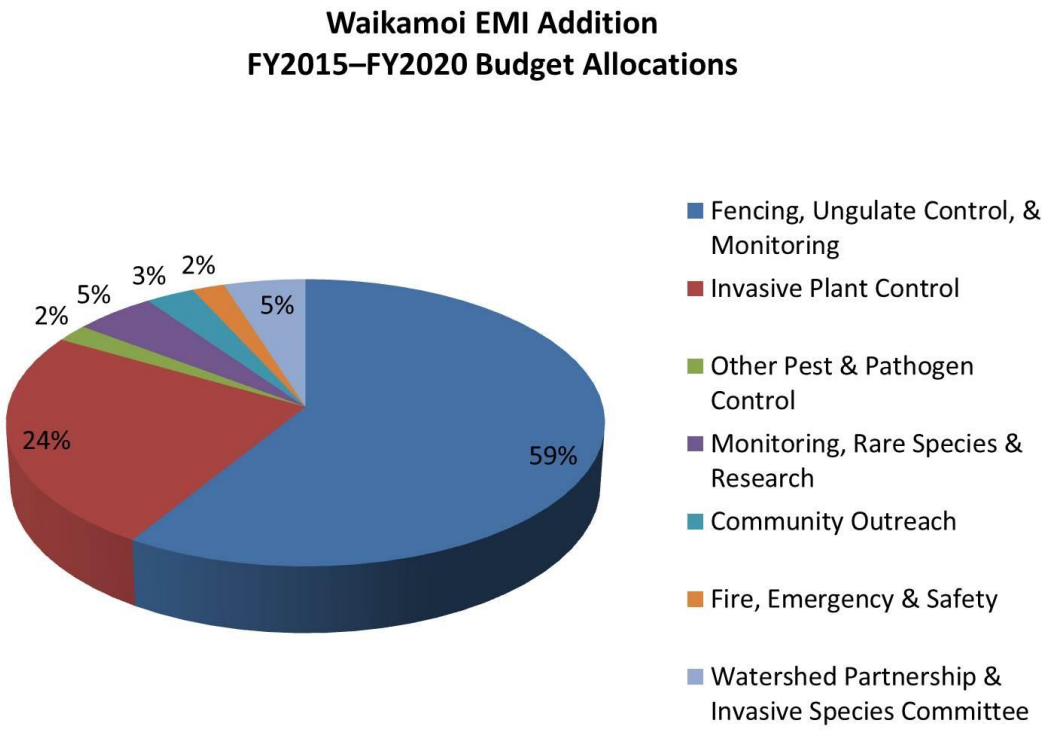


Figure 1. Waikamoi EMI Addition Approximate Budget/Effort by Program, FY15–FY20

The Conservancy's Maui operation maintains a full time base staff of seven. These staff also periodically work on Lāna'i and Molokai whose programs are supervised by the Maui Nui office. An estimated .75 FTE of Maui base personnel costs for managing the Waikamoi EMI Addition are funded by the Waikamoi EMI Addition NAPP budget. However, this number may fluctuate depending on the use of contractors vs. staff to complete deliverables. Technical and annual planning support is also included, and other island support staff may charge a small portion of their time to this project. The Nature Conservancy's annually negotiated fringe benefits rate will also accrue on all salary costs.

The NAPP portion of this budget does not include NAPP renewal costs such as an Environmental Assessment and other miscellaneous project-related costs such as vehicle expenses. NAPP funds will cover a portion of staff or subcontract/subaward expenses to conduct fence checks/maintenance and ungulate/weed removal and miscellaneous project-related field supplies. Note that the contractual

line item includes some helicopter time. The Conservancy routinely provides trainings for staff to improve job performance, and in addition to these trainings, supervisory staff regularly attend meetings in Honolulu.

An overhead rate is included (subject to slight change each year) to recognize the Conservancy's indirect costs for facilities, accounting, legal, and other administrative support. The NAPP program will pay only 10% of the Conservancy's overhead rate of 14.99% (FY14), leaving the remainder as a portion of the Conservancy's one-third match.

BUDGET TABLE

	FY 2015	2016	2017	2018	2019	2020	TOTAL
Labor and Fringe	59,000	59,000	59,000	59,000	59,000	59,000	**354,000**
Contractual	40,273	40,273	40,273	40,273	40,273	40,273	**241,638**
Communications	0	0	0	0	0	0	**0**
Travel	0	0	0	0	0	0	**0**
Supplies	3,000	3,000	3,000	3,000	3,000	3,000	**27,000**
Other	0	0	0	0	0	0	**0**
Subtotal	*102,273*	*102,273*	*102,273*	*102,273*	*102,273*	*102,273*	***613,638***
Overhead @ 10%	10,227	10,227	10,227	10,227	10,227	10,227	**61,362**
TOTAL	112,500	112,500	112,500	112,500	112,500	112,500	**675,000**
	Year 1	**Year 1**	**Year 1**	**Year 1**	**Year 1**	**Year 1**	**Total**
EMI Addition budget	112,500	112,500	112,500	112,500	112,500	112,500	**675,000**
Match (1/3 of total)	37,500	37,500	37,500	37,500	37,500	37,500	**225,000**
TOTAL NAPP REQUEST (2/3)	**75,000**	**75,000**	**75,000**	**75,000**	**75,000**	**75,000**	**450,000**

Appendices

Appendix 1. Gear Sanitation Protocols

Hawai'i's natural resources management crews work in a variety of habitats in the course of their conservation work. These different habitats likely have weed strata that reflect the climate, elevation, or relatively pristine nature of the sites.
As a result, managers should be keenly aware of the composition of those various weed strata, especially in terms of priority invasive plants.
While other people besides conservation workers may frequent these assorted places, and possibly transport weeds seeds in their gear, it is imperative that conservation workers hold a much higher standard that reflects their value to protect natural areas. Any complacency in this regard only will undermine the huge effort made to preserve native ecosystems.

FOOTWEAR: When working in areas where seeds of highly invasive plants are likely to be in the soil, footwear should be inspected and cleaned (on site when possible) prior to entering vehicles.
This can be done with water and a shoe brush, disposing of the debris in 1) a known contaminated site, 2) a site that will have continued monitoring, or 3) trash receptacles, all depending on the severity of the species.
While the extremely tiny seeds of plants like melastomes are one of the greatest concerns, they may need mud or fruit pulp to adhere to footwear.
Grass seeds, on the other hand, are notorious for sticking to even dry boots.
An often overlooked aspect of cleaning footwear is the collection of seeds (especially grasses) inside the tongue and laces of boots. This requires a thorough inspection of laced footwear and is the main reason that rubber boots are often suggested.
In all cases, the insides of footwear should be inspected and brushed as well.

RAINGEAR: The seams of most raingear make them susceptible to hiding tiny seeds within the flap. Even raingear that is dedicated to certain sites known to harbor highly invasive plants should be periodically washed. This can be done in a tub containing 5% bleach in water, with disposal going into a place routinely monitored for any seedlings.
For less severe species, a hose can be directed at the seams, or they can be dry brushed. Also make a point of cleaning any pockets. The guidelines for where any debris is disposed of can be similar to that of footwear.

PANTS: Cloth pants are more difficult to separate as gear than rainpants, and therefore should be viewed in the same context as other working gear. They could be easily overlooked when removing and cleaning other gear, and contaminated pants could even be inadvertently worn inside vehicles. At some sites, it is not always practical or modest to be removing pants upon return to the vehicle. Provisions should be made to anticipate removal of pants (also shirts, hats, and socks) contaminated with mud from an area with highly invasive plants, such as wearing shorts underneath.
Again, depending on the severity of the weed and potential for contamination, change of clothing should be waiting for workers upon return to the vehicle.

PACKS: One of the most overlooked aspects of sanitation procedures is the pack.
Some workers make special effort to hang their packs above ground, while many other set them down in contaminated mud or weed debris.

As in raingear, packs contain many seams or netting material that readily adhere seeds. All sections of the pack, including the inside, should be examined for hitchhiking seeds or mud. Disposal guidelines as listed above.

GLOVES: If gloves are worn in areas where tiny seeds of invasive plants could be in mud or debris, they should be separated and washed as recommended above. In some cases, gloves should be dedicated gear per specific weed.

TOOLS: Machetes, hip chains, flagging tape, radios, GPS, spray bottles, and other supplies and tools that accompany crews into invasive plant work sites are sometimes just as susceptible in carrying unwanted seeds as personal gear. An example is the machete scabbard, which has an interior that no one looks at (cleaning a used scabbard will reveal dirt that has been hidden for some time).
According to the site and severity of the weed, this gear should be designated for use on a specific plant, or at the least, routinely inspected and cleaned.
Extra precaution should be taken for any camping gear used at such sites.
Disposal areas for debris the same as listed above.

GEAR CONTAINMENT: Once work is completed at a site and personnel return to the vehicle, provisions should be made for storage of the potentially contaminated gear. Gear designated for use on a particular species should be stored as such, with clear writing indicating the use. Large poly tubs are practical storage for these items, and plastic trash bags may provide an additional layer to contain boots, packs, and muddy clothes. This procedure minimizes the potential to contaminate the work vehicle.

VEHICLES: Vehicle sanitation is a concern only if 1) it is driven into the infested site, or 2) if contaminated gear enters the vehicle.
Mud should be rinsed from the undersides of the vehicle by washing under the wheel wells and bumpers with high pressure. Once the vehicle cools, the differential, driveshaft, splash pan, and other components that may hold mud or debris, can be hosed. Vacuum or brush inside floors, pockets, and seats. Sweep and hose out the pickup bed.
The disposal area would be relative to the severity of the weed, but should be routinely monitored to see what seedlings sprout in the wash.

INSECTS ETC.: Also be aware when entering natural areas to avoid carrying roaches, ants, spiders, etc., in packs and supplies. Gear and food items should be inspected prior to going into natural areas.

COMMON SENSE: This task becomes much easier when personnel anticipate what challenges they will encounter when following sanitation procedures.
Each crew should have the same understanding of the priority weeds and their locations.
Knowing aspects of the target plant, such as seed size and likelihood to be in the soil or air, can help crews address the necessary precautions. As crews become confident in following these procedures, they can also be confident they are part of the solution and not the problem of vectoring priority weeds.

Appendix 2. Native Natural Communities Of Waikamoi Preserve and EMI Addition

NATURAL COMMUNITY NAME	GLOBAL RANK
Lowland	
Uluhe (*Dicranopteris linearis*) Lowland Wet Shrubland	G4
Montane	
ʻĀkala (*Rubus hawaiiensis*) Montane Wet Shrubland #	G3
Carex Montane Wet Grassland #	G3
Koa/ʻŌhiʻa (*Acacia koa*/*Metrosideros polymorpha*) Montane Wet Forest #	G3
Mixed Fern/Mixed Shrub Montane Wet Shrubland #	G3
ʻŌhiʻa /Hāpuʻu (*Metrosideros polymorpha*/*Cibotium* spp.) Montane Wet Forest	G3
ʻŌhiʻa (*Metrosideros polymorpha*)/Mixed Shrub Montane Wet Forest #	G3
ʻŌhiʻa /ʻŌlapa (*Metrosideros polymorpha*/*Cheirodendron* spp.) Montane Wet Forest	G3
ʻŌhiʻa /Uluhe (*Metrosideros polymorpha*/*Dicranopteris*) Montane Wet Forest #	G3
Subalpine	
Deschampsia nubigena Subalpine Mesic Grassland* #	G2
Māmane (*Sophora chrysophylla*) Subalpine Dry Forest*	G2
ʻŌhiʻa (*Metrosideros polymorpha*) Subalpine Mesic Forest #	G3
Pūkiawe (*Styphelia tameiameiae*) Mixed Subalpine Dry Shrubland	G3
Multizonal	
Pioneer Vegetation on Lava Flow	G3
Subterranean Communities	
Uncharacterized Montane Lava Tube*	GU
Uncharacterized Subalpine Lava Tube*	G1G2
Aquatic Communities	
Hawaiian Intermittent Stream	G4

* Rare natural community # Also known from Hanawʂ NAR

Key to Global Ranks as defined by Heritage Program:
G2 = Imperiled globally (typically 6-20 current occurrences).
G3 = Restricted range (typically 21-100 current occurrences).
G4 = Apparently secure globally (> 100 occurrences).
GU = Natural community rank uncertain (rank uncertain, provisionally considered rare).

Appendix 3. Native Birds of Waikamoi Preserve and EMI Addition area

SCIENTIFIC NAME	COMMON NAME	FEDERAL STATUS	AUDUBON STATUS*
Hemignathus lucidus affinus◊*	Maui nukupu‘u	Listed endangered; last seen 1996	
*Loxops coccineus ochraceus**	Maui ‘ākepa	Listed endangered; Last seen 1995[1]	
Melamprosops phaeosoma†*	po‘ouli	Listed endangered; Last seen 2004[2]	
Palmeria dolei	‘ākohekohe, crested honeycreeper	Endangered	
Pseudonestor xanthophrys	kiwikiu, Maui parrotbill	Endangered	
Pterodroma phaeopygia sandwichensis	‘ua‘u, Hawaiian petrel	Endangered	
Branta sandvicensis	nēnē, Hawaiian goose	Endangered	
Puffinus auricularis newelli[3]	‘a‘o, Newell’s shearwater	Threatened	
Paroreomyza montana	‘alauahio	--	
Vestiaria coccinea	‘i‘iwi	--	
Asio flammeus sandwichensis	pueo	--	
Himatione sanguinea	‘apapane	--	--
Hemignathus virens	‘amakihi	--	--

◊ Known in adjacent areas; thought to occur in Waikamoi

† Unconfirmed sighting; known from adjacent Hanawī NAR

1 Natural Diversity Database and Forest Bird Survey data

2 Gorreson et al., 2009

3 Possibly in Waikamoi Preserve (see Wood and Bily 2008)

* Audubon and the American Bird Conservancy analyzed the most recent scientific and citizen data nationwide to determine the species that are most in need of immediate conservation help (Watchlist 2007)

 Red–Species in this category are declining rapidly and/or have very small populations or limited ranges, and face major conservation threats. These typically are species of global conservation concern.

 Orange–this category includes species that are either declining or rare. These typically are species of national conservation concern.