Kaʻū Preserve

Hawaiʻi Island, Hawaiʻi

Long-Range Management Plan
Fiscal Years 2019-2024

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

Submitted by
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EXECUTIVE SUMMARY

The Nature Conservancy of Hawaiʻi (TNCH) is an affiliate of The Nature Conservancy (TNC), an international, private, non-profit conservation organization with a mission to conserve the lands and waters on which all life depends. Established in 1980, the Hawai`i program has helped protect over 200,000 acres of Hawaiʻi's forests and currently manages 15 preserves statewide and at Palmyra totaling over 40,000 acres.

In total, TNC owns or manages 12,800 acres across Hawaiʻi Island. Our primary conservation work for this project will occur at TNC's Kaʻū Preserve. Our forest conservation priorities are to: 1) protect Hawaiʻi's remaining native forests and ensure they are managed as functioning watersheds and habitat for native species; 2) address the threats that invasive species pose to their health, our economy and way of life; and 3) develop innovative technologies to make conservation work more efficient.

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. TNCH is seeking reauthorization of NAPP funding for the next six-year period for the programs described within this *Kaʻū Preserve FY2019–FY2024 Long-Range Management Plan*. This plan continues the programs implemented under the previous plans and environmental assessment. Herein, we request $785,282 over six years in matched state funds for the six years spanning FY2019–2024. Due to higher management costs resulting from a 67% increase in remote fenced management area, we request a 16% increase in NAPP funding over the FY2013–2018 Kaʻū LRMP. This plan was prepared in compliance with the NAPP agreement between the state, TNCH, and Hawaiʻi Administrative Rules Chapter 13-210.

The state Department of Land and Natural Resources (DLNR), which administers the NAPP, is kept apprised of our progress in the preserve through data reporting and an annual inspection. In addition, a six month semiannual report is sent to DLNR each February. These documents are available upon request to others who are interested.

The first section of this plan is a brief overview of the native natural resources that are protected at Kaʻū Preserve. In the second section are management considerations that have shaped our programs. Finally, each management program is discussed in turn. Program goals are followed by an explanation of the management method we have chosen. Annual objectives and costs for each program from FY2019–2024 are also listed.

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

Ka‘ū Preserve’s FY2012–2017 accomplishments include increasing the area protected by fences from 1,200 to 2,000 acres at Kaiholena and maintaining zero tolerance ungulates since January 2009. Over 270 acres have been cleared of habitat modifying weeds, and TNC’s work with neighboring landowners to target incipient threats such as Axis deer, Little Fire Ant, and Australian Tree Fern continues to reach far beyond the preserve boundaries. The recovery of rare plant species such as *Trematalobelia wimmeri* and listed endangered *Pritchardia lanigera* is demonstrated by the hundreds of flowering *lobelia* along fence line trails, and three dozen naturally occurring wild *loulu* seedlings observed beneath 9 founder palms.

Working with PEPP, *loulu* seeds were supplied to Volcano Rare Plant Facility, with 164 seedlings outplanted back at Kaiholena in 2016. 11 research projects were facilitated, including the successful introduction of strawberry guava bio-control to lower Hīlea in Kaiholena. TNC hired 5 Ka‘ū community youth through Kupu’s Extended Internship Program, continued a community hunting program, volunteer workdays, educational hikes, and supported conservation efforts through participation in community events. In FY2014–2015, four miles of severely rusted VOG-affected fence was replaced to ensure that the recovery of the understory continues.

Table 1. Overview of Ka‘ū Preserve Accomplishments by Program, FY 2012 - 2017 (5 years)

	Indicator	Measure of Success
Ungulate Control	Total pig catches	19 pigs
	Miles of fence installed and maintained	8 miles maintained annually
Invasive Plant Control	Acres of priority invasive plants treated or removed	270 acres
Resource Monitoring	Frequency of ungulate sign on ungulate transects	Reduction from 80 to 0 percent ungulate sign on transects
Rare Species Protection and Research	Number of species outplanted and recovered	164 endangered *loulu* outplanted, 3 reproducing *loulu* located
	Number of research projects supported in Ka‘ū	11
Outreach	Total volunteer hunts coordinated	13
	Numbers of visitors or public educated	4,548
	Total volunteer hours	3,206

In 2007, TNCH staff installed nine kilometers of ungulate transects both in the preserve and adjacent Ka‘ū State Forest Reserve. The initial data showed ground disturbance in 72% of the area surveyed, with 80% for stations in Kaiholena unit alone. After the 1,200-acre ungulate

fence was completed, successful eradication efforts resulted in zero ungulate sign within the fenced area since January 2009. To maintain these gains, routine fence checks are conducted on a bi-weekly basis and all breaches caused by tree fall repaired.

In 2016 an additional 2.5 miles of fence was built adjoining the pig-free lower Kaiholena unit. The 800-acre Makaʻālia fence unit was completed in January 2016, linking together a one-mile wide corridor of protected forest from 1,800 to 4,500 feet elevation adjacent to Kaʻū Forest Reserve's planned 12,000 acre fenced management area.

Construction of these ungulate fences stands as our most important project to date, having resulted in significant regeneration of the understory. Native seedlings and mosses have filled in former wallows and pig trails, and species usually observed growing epiphytically such as *Trematolobelia wimmeri* and *Lobelia hypoleuca* have carpeted open sections of trail along the fence.

The hunter access program resulted in 13 hunts, contributing to reduced ungulate pressure outside of the fence unit and providing a productive outreach opportunity between TNC staff and Kaʻū hunters.

Over the next six-year period, we will focus on the following programs and goals. Details are discussed in each program section:

1. **Ungulate control** – The Nature Conservancy's primary management activity in Kaʻū will be to maintain forest integrity, reduce erosion, and limit weed invasion by reducing ungulate levels through use of standard management tools. Pigs are the primary targets of our removal programs, while mouflon sheep, goats, and Axis deer will also be targeted if they occur in the preserve. Innovative technologies will be used to achieve these management goals using real-time gps tracking collars, cellular linked game cameras, and remotely operated traps. Ungulate monitoring transects will be read to measure the success of our techniques, and presence of pig sign will be documented during routine field operations.

2. **Invasive Plant Control** – The goal of this program is to control high priority invasive plants in the preserve, and prevent the introduction and spread of problem weeds to areas where they are not currently established. As part of our routine management program, the Conservancy will survey for and maintain maps of habitat-modifying weeds and initiate control at strategic locations. Priority weed control areas along the Kaʻū Forest Reserve's lower boundary will be identified and controlled in collaboration with the Three Mountain Alliance (TMA) watershed plan.

3. **Resource Monitoring** – Monitoring is imperative to providing data that can be used to guide management programs at Kaʻū Preserve. Our goal is to monitor changes in the

integrity of the ecosystems in and around the preserve and to determine whether critical threats to those ecosystems are increasing or decreasing. We will use these data to gauge the effectiveness of our conservation strategies. Aerial imagery will be collected by unmanned aerial vehicle (UAV) and analyzed to identify priority areas for control.

4. **Rare Species Protection and Research** – To date, seven rare plant species, five rare bird species, and the endangered Hawaiian hoary bat have been observed in Kaʻū Preserve. Additional rare species reported from adjacent lands and similar habitats are likely to be found in Kaʻū Preserve with future surveys. Our goal is to prevent the extirpation of rare species in the preserve and to encourage research, predator control, and captive propagation of rare plant and bird species. Protecting habitat essential to the majority of the preserve's native plants and animals will be our primary protection strategy. We will also assess threats to the rarest species and take measures to protect them, as needed. Staff will also search for rare plant populations during routine management activities, and rare species maps will be updated on a periodic basis.

5. **Community Outreach** – The main objective of our outreach program is to increase awareness of the Kaʻū Preserve, the Kaʻū watershed and native ecosystems, and to help people understand their importance, threats to them, and efforts to protect them. More specifically, we seek to encourage and facilitate active participation and community pride among the residents of the Kaʻū District in the effective conservation of this special resource. The key strategies for our public outreach include a variety of potential programs, including: environmental education, year-round and summer intern and youth employment, volunteer opportunities, guided trips, community meetings, and hiking and hunting programs.

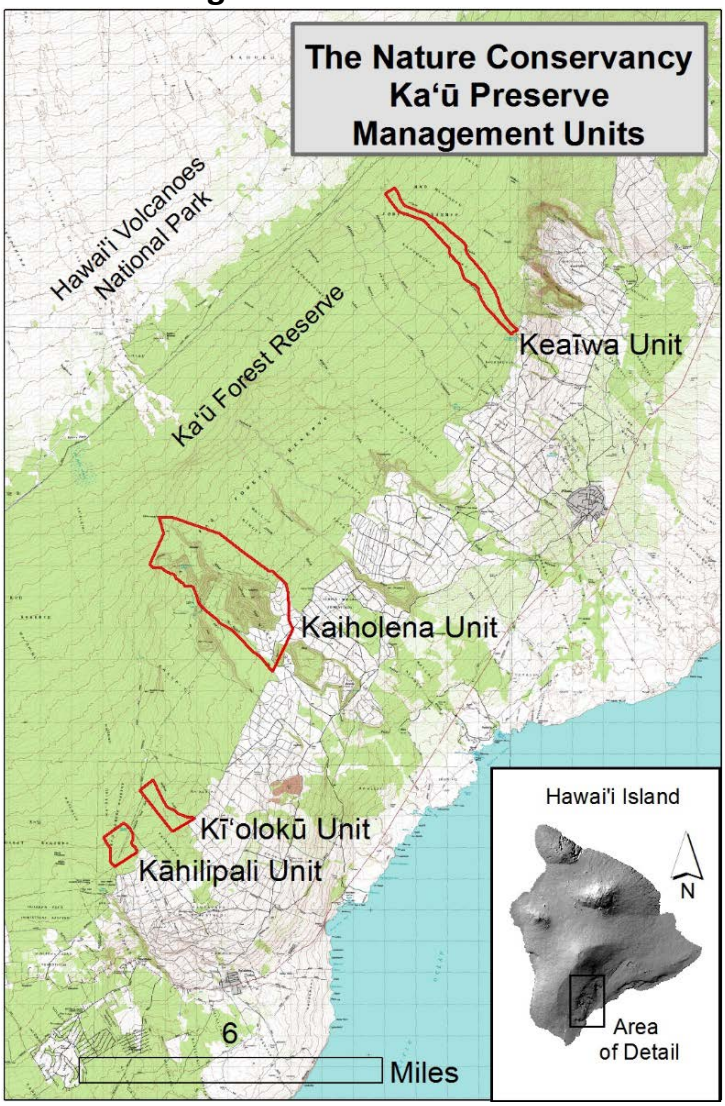
6. **Watershed Partnerships –** TNC is a member of, and our preserves are included within, the Three Mountain Alliance (TMA), an extension of the Olaʻa-Kīlauea Partnership. The members of this alliance (consisting of federal, state and private organizations) have coordinated information gathering, management planning, community outreach, and on-the-ground conservation action. Our goal is to facilitate further development of the TMA and help to implement initiatives that address the top watershed, forest, and biodiversity threats.

RESOURCES SUMMARY

General Setting

Kaʻū Preserve (Figure 1) was established by TNCH in 2002 to protect biologically rich and intact forest. It was purchased by the Conservancy from a subsidiary of C. Brewer & Co. Ltd., who had owned the lands for over 100 years. It is contiguous to and within the external boundaries of the State's Kaʻū Forest Reserve on the southeast flank of Mauna Loa volcano, upslope from the coastal agricultural area between Waiʻōhinu and Pāhala in the Kaʻū District of Hawaiʻi Island. The 3,511-acre Preserve, which includes four separate units, is positioned within one of the largest areas of intact forest land in the State, totaling 61,500 acres.

Figure 1 - Kaʻū Preserve



Flora and Fauna

Native Natural Communities

There are four native-dominated natural communities in the Kaʻū Forest Reserve (Figure 2, Appendix 2), and all four are also represented in Kaʻū Preserve:

1. Koa/ʻŌhiʻa Montane Mesic Forest is present at the highest elevation portion of the Keaīwa unit,
2. Koa/ʻŌhiʻa Montane Wet Forest covers the middle portion of the Keaīwa unit,
3. ʻŌhiʻa Montane Wet Forest covers the lower portion of the Keaīwa unit and the upper portion of the Kaiholena unit, and
4. ʻŌhiʻa Lowland Wet Forest covers the lower portion of the Kaiholena unit and all of the Kāhilipali and Kīʻolokū units.

The very high quality of the wet and mesic forest communities in Kaʻū provides a rare opportunity to implement management before it is too late or too costly.

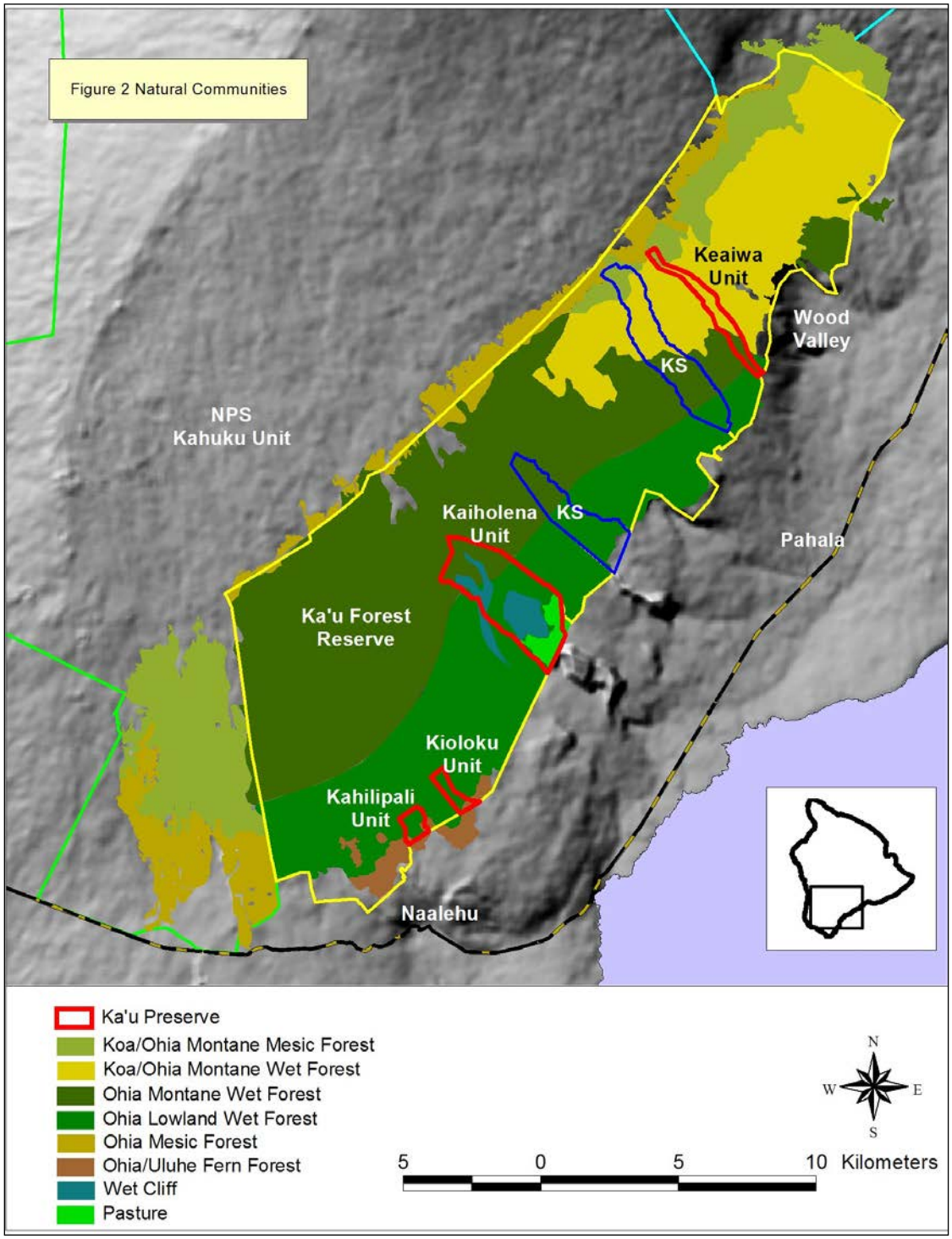
On Hawaiʻi Island, **Koa/ʻŌhiʻa Montane Mesic Forest** is the habitat of the endangered Hawaiian broadbean (*Vicia menziesii*) and a number of rare plant taxa, including members of the genera *Clermontia*, *Phyllostegia*, *Stenogyne*, and *Melicope*. This rare forest type is often important habitat for endangered forest birds. Protected examples of this community are in the Hakalau National Wildlife Refuge and Manukā Natural Area Reserve on Hawaiʻi, and the Kuia Natural Area Reserve on Kauaʻi.

Koa/ʻŌhiʻa Montane Wet Forest occurs on the islands of Kauaʻi, Maui, and Hawaiʻi and is not considered rare. This moderately imperiled forest type has a good representation of ʻōhiʻa and are often rich in native forest birds and invertebrates.

ʻŌhiʻa Montane Wet Forest is one of the most widespread wet forest communities in the Hawaiian Islands. This community type is moderately imperiled, and some occurrences are known to include rare plants, birds, and invertebrates. It is often important habitat for endangered forest birds. The steep slopes of the Kaiholena unit contain a subtype of this community called Wet Cliff, dominated by a mix of ferns and shrubby ʻōhiʻa.

In Kaʻū, the **ʻŌhiʻa Lowland Wet Forest** is floristically similar to the ʻŌhiʻa Montane Wet Forest immediately above it in elevation. This community type is moderately imperiled and provides habitat for rare native plants. It is typically not important habitat for endangered forest birds on Hawaiʻi Island due to the presence of mosquitoes associated with its lower elevation. The lower portions of the Kāhilipali and Kīʻolokū units contain a subtype of this community, ʻŌhiʻa/Uluhe (*Metrosideros/Dicranopteris*) Fern Forest, which is composed of a nearly continuous blanket of uluhe (*Dicranopteris linearis*) with emergent and widely spaced ʻōhiʻa trees.

Figure 2- Natural Communities of Ka'ū Preserve



Native Flora

From a statewide perspective, the southeast portion of Mauna Loa (eastern side of the Southwest Rift Zone), is surpassed only by East Maui in the number of different types of ecosystems present. Considering all of its nine ecosystems, this region is home to more extant, endemic species of flowering plants (178 species) than any other region of Hawaiʻi Island. In fact, its mesic and wet forest ecosystems alone support 153 endemic plant species. While Kaʻū Preserve does not contain the full diversity of species found within the region, the majority of the lands are very high quality. A list of native plants that occur in the Kaiholena unit is now being developed (see Appendix 7 for a draft listing of native plants).

Data for rare plants and animals in Kaʻū come from widely-spaced survey transects, very few of which actually fall within the preserve. Much of the rest of the land, within and outside the preserve, has not been surveyed but almost certainly harbors more rare elements.

Eight rare plant species have been observed in Kaʻū Preserve. Three species, *Cyanea tritomantha* (listed endangered), *Nothocestrum breviflorum* (listed endangered), and *Phyllostegia vestita* (species of concern) have been reported within the Kaiholena unit: *C. tritomantha*, last observed in Kaiholena in 1912 and *P. vestita*, last observed in Kaiholena in 1961, have never been reported within the nearby Kaʻū Forest Reserve. Five additional species have been observed in the Kaiholena unit by TNCH staff: *Trematolobelia wimmeri* (species of concern), *Lobelia hypoleuca* (restricted range), *Strongylodon ruber* (species of concern), *Pritchardia lanigera,* and *Pittosporum hawaiiense* (both listed endangered). The mesic and wet forests of the Kaʻū region are home to at least 22 known species of rare plants. Eleven of these are endangered, five are species of concern, and one has a restricted range.

Many of the plants that occur on Conservancy lands in Kaʻū are not listed in the State or Federal Register in any of the categories that may make them rare (Appendix 5); however, plants like *Charpentiera obovata* and *Touchardia latifolia* are rare on Hawaiʻi Island and/or rare from a population standpoint and will be treated as such with regards to rare species management for this proposal. Subpopulations of *Pritchardia lanigera* near Kaiholena were last observed in 1980 and were thought to be extirpated. However, three small subpopulations were located by TNCH staff working with local hunters and volunteers. This species was listed endangered in 2013, and has been regenerating naturally within the ungulate-free Kaiholena fence unit.

Native Terrestrial Fauna

Five endangered forest birds have been reported in the wet and mesic forests of Kaʻū: the ʻIo or Hawaiian Hawk, the Hawaiʻi ʻĀkepa, the Hawaiʻi Creeper or ʻAlawi, the Akiapōlāʻau, the Hawaiian Crow or ʻAlalā, along with the ʻIʻiwi, listed as threatened in 2017 (Appendix 3). ʻAlalā had been observed within the proposed fence area as recently as the mid-sixties in the valleys below Puʻu Makaʼālia, but by 1968 no crows were to be found in the area (Pers. Comm. Alfred

Galimba 9/17/2013). Efforts to reintroduce ‘Alalā into the Ka‘ū forest began in late 2016 with the release of over a dozen birds to date. Over the past 5 years TNCH has collaborated in targeted outreach within the Ka‘ū community in support of protecting habitat in the adjacent Forest Reserve, and through active management have constructed a fenced area providing a 1 mile-wide band of ungulate-free habitat ranging from 1,800’ to 4,500’ elevation for this critically endangered species.

Endangered Hawaiian hoary bats, ‘Ōpe‘ape‘a, have also been observed at the preserve, inhabiting the wet montane forests of Ka‘ū and likely roost, forage, and breed.

In 2008, USFWS designated 245 acres of critical habitat in two separate areas of Ka‘ū Forest Reserve for a species of Picture Wing Fly (*Drosophila heteroneura*), which is unknown in TNCH’s Ka‘ū Preserve. The intact natural communities of Ka‘ū no doubt include hundreds of native invertebrates, the majority of which are endemic to the archipelago, and several of which are likely endemic to the Ka‘ū region.

MANAGEMENT

Management Considerations

1. Our primary management focus is to prevent degradation of the native forest by reducing feral ungulate damage, limiting the spread of non-native, habitat-modifying plants, and preventing the introduction of other invasive species. We are also committed to improving community outreach and to continue providing access as required by law for people who want to use the preserve in ways that will not degrade its natural resources.

2. The preserve is divided into four separate units spanning a distance of 12 miles (Figure 3). Each unit shares three boundaries with the State's Kaʻū Forest Reserve, and one boundary with a private landowner who purchased the properties from Kaʻū Agribusiness, a subsidiary of C. Brewer. As a result of sharing the southern (lowland) boundary with private agricultural lands, public access via unimproved roads is somewhat limited, and we carefully coordinate our management and interpretive activities with work in these adjacent agricultural areas.

3. Although the threat of fire is somewhat diminished due to the high level of precipitation on the preserve (approximately 60-120 inches annually), the proximity of the units to paved roads increases the possibility that a fire could start either accidentally or intentionally and affect the Preserve, particularly after a period of drought. Our participation with the Three Mountain Alliance includes working on a fire initiative with the other Alliance members.

4. The acquisition of Kahuku Ranch by the National Park Service (NPS) creates a mosaic of Kaʻū lands, with four principal landowners, all sharing a mandate for conservation and management of Hawaiʻi's natural resources: The Nature Conservancy, NPS, the State Department of Land and Natural Resources, and Kamehameha Schools. This provides the foundation for collaborative management at the watershed level as an effective way to address shared management challenges and opportunities.

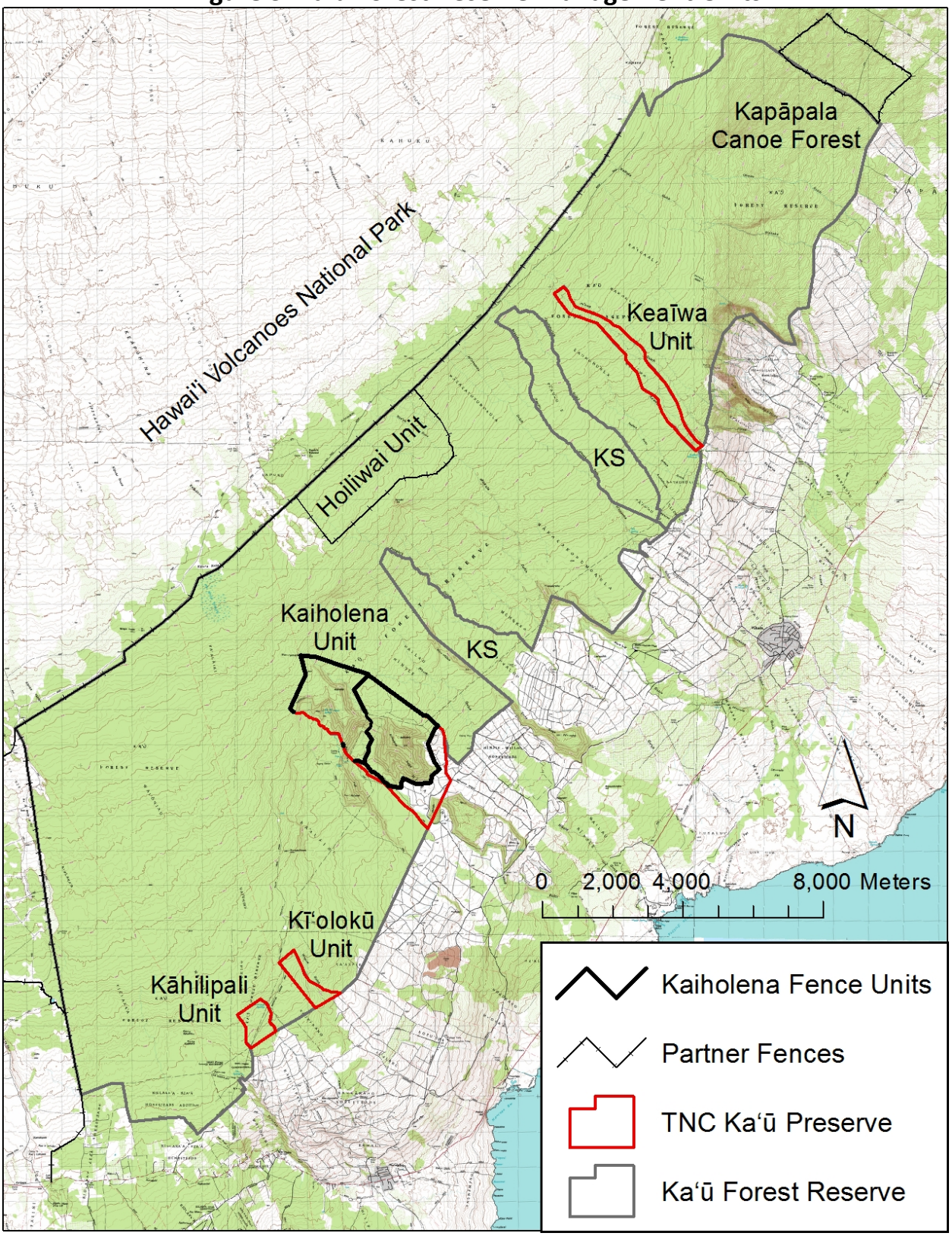
5. There is potential to provide additional public access to the Forest Reserve and the preserve at several points along their lower boundaries, as most access roads are not open to the public at this time. Roads that are currently used by the public to access Kaʻū watershed lands include: Hāʻao Springs Road, Mountain House Road and Lorenzo Road. Access into the upper areas of the preserve is limited by difficult terrain and a lack of roads and trails, so helicopter access is necessary.

6. There is a high level of interest regarding forest management in Kaʻū from various groups of people living near the preserve. This provides a rationale for coordinated

community outreach and functional partnerships that promote compatible uses of the forest (e.g., environmental education, recreation, native gathering, hunting, rare species conservation).

7. As provided by law, appropriate access to the preserve for traditional practice will help to mitigate the perception of decreased access. Three gates are available for preserve access on the Kaiholena side and 7 fence step-overs have been installed where needed; the locations were determined in consultation with the community.

Figure 3. Kaʻū Forest Reserve Management Units



Management Areas/Units

Kaʻū Preserve is divided into four separate units: Kāhilipali, Kīʻolokū, Kaiholena, and Keaīwa (Figure 3).

1. The Kāhilipali unit is the smallest (169 acres) and westernmost unit, accessed via the 4WD Mountain House Road. The elevation ranges from approximately 2,400 to 2,640 ft. The annual precipitation is 2,000 mm (79 in). A portion of this unit is zoned Agriculture and the rest is zoned for Conservation (subzone: Resource). Most of the unit contains ʻŌhiʻa Lowland Wet Forest, however the forest in the lower portion of the unit grades into the community subtype ʻŌhiʻa /Uluhe Fern Forest. Portuguese Springs is located in the upper northeast corner, at the head of Alapaʻi Gulch, which runs along the northeast boundary of the unit. A population of Himalayan ginger (*Hedychium gardnerianum*) is found near the Springs, where ongoing TNC and volunteer control efforts have cleared and maintained 30 acres. A maintained pipeline diagonally traverses the middle of the unit providing a corridor for non-native invasive plants such as guinea grass (*Panicum maximum*), sourbush (*Pluchea carolinensis*) and bamboo orchid (*Arundina graminifolia*), and more serious weeds such as strawberry guava (*Psidium cattleianum*), Koster's curse (*Clidemia hirta*), and Christmas berry (*Schinus terebinthifolius*). Glorybush (*Tibouchina urvilleana*) occurs along the Mountain House Road.

2. The Kīʻolokū unit is the next largest (211 acres) and is located approximately one mile north of the Kāhilipali unit. The elevation ranges from approximately 2,400 to 2,700 ft. The annual precipitation is 2,000 mm (79 in). The lower portion is accessed via ranch roads, while the upper elevation is accessed via the 4WD Mountain House Road. Waiaele Gulch runs along a portion of the northeast boundary of the unit. The forest, like the Kāhilipali unit, is mainly ʻŌhiʻa Lowland Wet Forest, with some areas of ʻŌhiʻa/Uluhe Fern Forest. Glorybush (*Tibouchina urvilleana*) occurs along the Mountain House Road, and weeds such as strawberry guava (*Psidium cattleianum*) and Koster's curse (*Clidemia hirta*) are present in the forest. An incipient population of Himalayan ginger has been cleared and maintained in 24 acres at Kīʻolokū. This unit is zoned for Agriculture.

3. The Kaiholena unit is the largest (approximately 2,620 acres) and is centrally located four miles from the Kīʻolokū unit and six miles from the Keaīwa unit. A puʻu (hill or mount), Kaiholena, rises sharply from its base elevation of 2,000 ft to a height of 3,723 ft and is geologically much older than the surrounding, more gently rolling Mauna Loa flows. Just northwest of the Puʻu Kaiholena, Puʻu Makaʼālia rises to a height of 4,240 ft. and is flanked on three sides by sheer cliffs. At its crest are sphagnum bogs where pollen cores dating back 22,000 years have been documented, and ongoing geological research dates the hill formation as the oldest found on Mauna Loa, at greater than 150,000 years before present. Hīlea Gulch runs between these two puʻu. Old Plantation Springs,

a portion of whose water rights are held by the previous owner, is nestled in the southern folds of Puʻu Makaʼālia at approximately 3,500 ft. The annual precipitation is 2,000 mm (79 in) except for a wetter area on the south side of Puʻu Kaiholena which has 3,000 mm (118 in) annual precipitation. A portion of this unit is zoned Agriculture and the rest is zoned for Conservation (subzones: Protective and Resource).

Directly south of Puʻu Makaʼālia lies Puʻu One (3,220 ft elevation), on State land just outside of the Kaiholena unit boundary. Historically this puʻu was considered with the others as all one place. The western side of Puʻu One is accessed via a 4WD road that leads to a gauging station on one branch of Hīlea Gulch.

The forest in the lower portion of the Kaiholena unit is ʻŌhiʻa Lowland Wet Forest, becoming ʻŌhiʻa Montane Wet Forest at approximately 3,200 ft elevation. Five rare plants have been reported in this unit. Very few weeds have established in Kaiholena. Those present and still controllable include Japanese anemone (*Anemone hupehensis*), palm grass (*Setaria palmifolia*), and strawberry guava (*Psidium cattleianum*). A large population of Koster's Curse (*Clidemia hirta*) is found in the Lower Hīlea area, and Himalayan ginger (*Hedychium gardnerianum*) is infrequently spotted during routine field operations. *Tibouchina herbacea* is present along the Puʻu One access road, and continues to spread into the surrounding forest. There are 315 acres of former cane land at the base of the Puʻu Kaiholena which have been converted to pasture and are now leased by a local rancher for cattle grazing. The incipient population of silk oak (*Grevillea robusta*) has been eradicated from the pasture. 260 acres of priority weed species have been cleared at Kaiholena since 2006.

4. The Keaīwa unit is the second largest (511 acres) and easternmost unit. Keaīwa Reservoir (on State land) lies at the base of the unit at approximately 3,000 ft elevation. From there the unit stretches mauka. A 6 km-long strip of land, the Keaīwa unit is only 570 m wide at its widest point. Its northern boundary (5,700 ft) is approximately 1 km from the Kahuku unit of Hawaiʻi Volcanoes National Park. The annual precipitation in the lower portion of the unit is 3,000 mm (118 in), in the middle portion is 2,000 mm (79 in), and in the upper portion is 1,500 mm (59 in). Piʻikea and Kāʻalaʻala Gulches meander in and out of the Keaīwa unit. The uppermost portion of the unit (above 5,300 ft) contains Koa/ʻŌhiʻa Montane Mesic Forest (50 acres), while much of the rest of the unit consists of Koa/ʻŌhiʻa Montane Wet Forest, except for lower third of the site (below 4,000 ft) which is ʻŌhiʻa Montane Wet Forest and the bottom 50 acres (below 3,400 ft) which are ʻŌhiʻa Lowland Wet Forest. The endangered forest bird, Hawaiʻi ʻĀkepa, has been reported in this unit, observed between 4,000 and 5,000 ft elevation in 1995. Several highly invasive plants occur near the Keaīwa Reservoir, including Himalayan ginger (Hedychium *gardnerianum*), night-blooming jasmine (*Cestrum nocturnum*), Japanese anemone (*Anemone hupehensis*), and strawberry guava (*Psidium cattleianum*). In partnership with Ed Olson Trust II, TNCH has treated 6.5 acres for Himalayan ginger

along a flume trail north of the reservoir. The nearby village of Wood Valley (2 km away) is heavily infested with plume poppy (*Bocconia frutescens*), and the community there continues to work at containing a population of coqui frogs. This unit is zoned for Conservation (subzone: Protective).

Management Programs

Program 1: Ungulate Control

Program Goal: To reduce ungulate (cattle, pigs, sheep, goats, and axis deer) damage from 2,000 fenced acres of the Kaiholena Unit and in the Kāhilipali, Kīʻolokū, and Keaīwa Units.

<u>This program represents an estimated 40% of the overall effort and budget in this long range management plan.</u>

Survey transects completed in 2007 showed pig activity and extremely high levels of ground disturbance by pigs in all 123 stations of the Kaiholena Unit. Additional surveys conducted in the Keaīwa Unit and parts of the Kaʻū Forest Reserve showed extensive, severe ground disturbance by pig activity. Diminished diversity of groundcover and understory species had been observed over large areas. In some severely impacted parts of the forest, common groundcover and understory plants were persisting only epiphytically upon trees and tree ferns. Weed surveys conducted in the Kaiholena Unit showed a direct correlation between presence of weed species and pig activity. High levels of ground disturbance, coupled with reduced groundcover, led to an increase in water runoff, sheet erosion, and stream bank collapse. There was also a very high likelihood of wild cattle, mouflon sheep, and feral goats in the vicinity.

Of the four Kaʻū Preserve units, the largest expanse of intact, high-quality native lowland wet forest and most significant biological resources (rare plants and high native diversity) occur in the roughly 2,600-acre Kaiholena Unit. Therefore, Kaiholena was chosen for the first fencing effort in the Kaʻū Preserve. The initial phase of fence construction was completed in 2007, enclosing 1,200 acres. The final cost of this fence totaled $397,866 and was subcontracted out to Sunshine Fencing. Funding for fence construction was secured through the USDA Natural Resources Conservation Service's Wildlife Habitat Incentives Program (NRCS WHIP), which provided 75% of the cost. The rest of the cost was covered by TNC and a portion matched with NAPP funds. Over a period of two years, 33 pigs were removed from the Kaiholena unit during 44 hunts, conducted by volunteer hunters, contracted experts, and TNC staff. The last pig was removed by TNC staff in January of 2009.

The second phase of fence construction in the Kaiholena Unit is adjacent to the first unit, located just upslope on puʻu Makaʼālia. The new fence unit was completed in January 2016, expanding the total ungulate-free area in the Preserve to 2,000 acres. Staff and volunteer hunting and trapping efforts have removed 12 pigs, with 7 or fewer thought to remain in the unit. The final cost of this fence totaled $388,886 and was contracted to Big Country Fencing. Funding came from USFWS Partners Program, providing $276,000, with the remaining funds covered by TNC and a portion matched with NAPP funds.

Large areas of the Kaʻū Preserve units remain unprotected, however. Relying on public hunting, aerial shooting, staff hunts, and other means to reduce feral animal populations instead of fenced enclosures is not a feasible alternative because as long as areas remain unfenced, feral animals will continue to enter them from adjacent lands. Animal removal would have to continue indefinitely, would be expensive and unpopular, and make the goal of natural resource protection and rare plant reintroduction impossible. The best long-term solution is therefore to build additional fenced areas, and remove all feral ungulates as quickly as possible.

However, constructing fences that enclose all four Kaʻū Preserve units is not cost-effective or feasible at the present time. The Kāhilipali and Kīʻolokū units are isolated, small (169 and 211 acres, respectively), and somewhat degraded by invasive plants. Therefore fencing these units would not result in a significant enough contribution to resource protection from ungulates to justify the expenditure of funds that fencing would require. The Keaīwa unit (511 acres) is a "spaghetti" parcel with elongated dimensions: 6 km long by 500 m wide. Significant biological resources are present, with the upper 1/3 of the parcel above 4,500 feet elevation included in DOFAW's planned fence management units.

Working with our partners to implement large scale fencing in the upper Kaʻū State Forest will remain the operational focus for the duration of the six-year plan, and no new fences are proposed within the TNC preserve at this time.

In the unfenced units, as well as the unfenced portions of the Kaiholena unit, our objective is to reduce ungulate damage by enhancing hunter access (by installing signs, check-in stations, etc.) and encouraging public hunting in these areas through outreach. A back-country camp consisting of two modular cabins is in the upper reaches of the Kaiholena unit. This enables staff to have a dry place to camp overnight while conducting surveys, monitoring, and checking the fence. These OEQC approved structures are also available for hunters to use. Permanent ungulate activity monitoring transects have been installed in these units and will be monitored periodically for detection of changes in ungulate activity level.

The 2011 multiagency response effort to illegally-introduced Axis deer to a pasture below Nāʻālehu prompted the adoption of a several new strategies in the effort to locate and dispatch the population while it was still small. Our team worked closely with Big Island Invasive Species Committee (BIISC) field staff to survey large areas of undeveloped land, using innovative technologies including Forward Looking InfraRed scopes (FLiR) to identify ungulate species at great distances and improved monitoring techniques using trail camera arrays to monitor up to a thousand acres for animal movements over time. These new tools, and others developed out of the necessity to keep feral animals out of fenced units after clearing the area of ungulates, allow the removal work to progress more quickly, provide greater detail on population and movements, and help managers determine where to best direct limited staff resources.

In 2016 TNCH partnered with BIISC's Invasive Vertebrate crew to install a grid of 24 game cameras spaced at 250m intervals in an effort to gather population data for all traversable areas of the fence unit, excluding terrain over 70% slope. This camera grid augments 6 cameras installed at one-way gates and at points on the ungulate transect following the ridgeline at Palimuku, a natural barrier thought to prevent pig ingress. The 250-meter spacing was determined using USGS home range data collected from gps-collared pigs in the upper Kaʻū Forest within the National Park's Kahuku unit. The intent was to identify individual pigs by their markings so that the known population could be accounted for as removal efforts commenced.

In a four-week period the 24 game cameras captured 366 pig-triggered photos showing that one boar, two to three sows, and an estimated 10 to 14 piglets remained in the unit. Based on the data gathered from these cameras, the ungulate transect and aerial monitoring, we determined the best location to install a remotely activated, large capacity corral trap. Beginning in May, an automatic feeder was installed on site to spread dry corn on a daily interval. In an effort to familiarize pigs to the new food source, corn was poured into freshly split hapuʻu logs, and macadamia nuts, dried fish, fish heads, and fish emulsion was placed in the corral trap and along trails in the vicinity. The automatic feeder continued to operate into 2017, however, only one pig has been photographed entering the trap.

In June 2016, an aerial FLiR survey conducted by BIISC's Invasive Vertebrate crew failed to detect sign of ungulates on the cliff faces of Palimuku and Makaʻālia, providing further indication that the natural barrier can be relied on to prevent ingress. This aerial survey was paid for by TNC, providing flight time towards the team's Axis deer survey efforts in Kaʻū and South Kona, and testing the use of FLiR technology as a survey tool in inaccessible areas of the Makaʻālia unit.

Over the past 5 years, TNC has experimented with remotely monitored fencing that alerts Preserve managers to breaches when they happen. This system's design originates in New Zealand, where an electric line installed above ungulate fences is used to monitor downed branches and trees that fall onto the fence, grounding the electric current and alerting managers to a potential fence breach. At Kona Hema Preserve, we installed a remote fence breach detection system along the lower elevation boundary of the preserve's Honomalino unit where the pig population outside the fence is most abundant. When a tree falls on the fence it shorts the hot lead to hand-fabricated grounding bars, which changes an energizer's volt meter reading. We are assessing the effectiveness of a new Australian-made "smart energizer" that will send an alert via smart phone in response to breaches caused by trees falling on the fence, or posts jumping loose from earthquakes.

Manukā NAR shares a two-mile boundary fence with TNC's Kona Hema Preserve that is checked monthly for breaches and signs of ungulate ingress. This fence aligns with a corridor of suitable pig habitat, allowing TNC staff or subcontractors to manage pig traps in the NAR while carrying out routine Preserve field duties. Proposed management of traps will involve baiting,

monitoring, and dispatching caught pigs in 11 traps at Manukā NAR on a weekly schedule. Meat from the captured animals will go to local families in the south Kona and Kaʻū communities when possible, and catch data (# caught, sex, approximate weight, etc.) will be provided to NARS staff and compiled in the Kaʻū NAPP database. This project will begin in FY2019, continuing into FY20-FY21, if needed, as determined by NARs staff.

Ungulate Control Program Activities

Years 1-6 (FY2019 – FY2024)

- Monitor and maintain 8 miles of preserve fences on a monthly schedule
- Continue hunter access program at Kaiholena
- Monitor ungulate transects annually in all four Preserve units and Kaʻū Forest Reserve
- Use game cameras to monitor for ingress at Palimuku ridge and in Kaiholena fence units
- Assist with ungulate removal in upper Kaʻū Forest Reserve fence management units

Years 1-3 (FY2019 – FY2021)

- Bait and check 11 pig traps at Manukā NAR on a weekly schedule

Years 3-6 (FY2021 – FY2024)

- Facilitate implementation of large-scale ungulate fencing in upper Kaʻū forest

Program 2: Invasive Plant Control

Program Goal: To control high priority invasive plants in the preserve, and prevent the introduction and spread of problem weeds to core areas of native habitat where they are not currently established.

This program represents an estimated 30% of the overall effort and budget in this long range management plan.

Habitat-modifying weeds are non-native plants that have demonstrated the ability to suppress regeneration of and/or displace native vegetation. Many weeds become established when an area is disturbed by ungulates, which may also carry and spread seeds. Elimination of ungulates, therefore, may be one of the most effective means of controlling the introduction and spread of many habitat-modifying weeds in the preserve. To complement these efforts, our invasive plant control program focuses on removing habitat-modifying weeds that are already established in the preserve.

The presence of several serious invasive plant species both on and in the vicinity of the preserve has been identified (Table 2). In 2006–2012 we completed a systematic, preserve-wide inventory, survey and mapping effort to identify the location and extent of weed infestations. In the past 5 years high-resolution aerial imagery was collected for thousands of acres along the

lower edge of KFR and around Kaiholena Unit, helping to narrow down the extent of an incipient patch of Australian tree ferns above Pāhala and in isolated occurrences along the forest edge. Priority weed maps and a species- and unit-specific management plan continues to guide control efforts, and future management efforts will be prioritized according to feasibility of control, proximity to sensitive core areas of the preserve, and along corridors leading into the preserve.

Table 2. Known Pest Plants of Kaʻū Preserve

Common Name	Scientific Name
Australian tree fern	*Sphaeopteris cooperi*
Christmas berry	*Schinus terebinthifolius*
Common guava	*Psidium guajava*
Glorybush	*Tibouchina urvilleana*
Himalayan ginger	*Hedychium gardnerianum*
Japanese anemone	*Anemone hupehensis*
Night-blooming jasmine	*Cestrum nocturnum*
Palm grass	*Setaria palmifolia*
Silk oak	*Grevillea robusta*
Strawberry guava	*Psidium cattleianum*

Results of the weed survey showed a large infestation of strawberry guava and *Clidemia* in the Lower Hīlea subunit of the Kaiholena unit. This infestation continues to be the priority weed control area of the Preserve, and 175 acres above the core area were cleared of habitat-modifying weeds in the past five years (Figure 4).

Work in Year 1 will involve continuing to attack the infestation from the upper edge (using herbicide) working towards the core, a 25-acre area where *tectococcus* bio-control has been established. A large infestation of *Tibouchina urvilleana* is located in the Kīʻolokū unit. Aerial surveys have been conducted and were followed up with ground surveys. The extent of the infestation is greater than we first anticipated and the discovery of Himalayan ginger at Kīʻolokū and in neighboring Kāhilipali unit prompted immediate control of the priority species. Ginger control will continue to be the priority management goal in this area, with 54 acres controlled since 2006.

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 Hawaiʻi 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.

Staff and visitors will follow strict procedures to prevent the inadvertent introduction of invasive plants while working or hiking in the preserve. Our invasive species prevention protocol calls for inspecting all clothing and equipment for seeds before entering the preserve. We will remain vigilant in our search for incipient populations of invasive plants. Species such as fireweed (*Senecio madagascariensis*), Himalayan raspberry (*Rubus ellipticus*), cat's claw (*Caesalpinia decapetala*), and plume poppy (*Bocconia frutescens*) are found nearby but do not occur on the preserve. *Miconia calvescens,* which has extensively invaded Hilo and Puna up to 3,500 ft elevation, has not been reported in Kaʻū.

Other invasive pests and pathogens (e.g., coqui frogs, gall wasps, koa wilt) will be diligently surveyed for so that they can be detected as early as possible and responded to rapidly before they are able to gain a foothold. Rats will be controlled on a site-specific basis, as needed for the protection of rare plants, as described in Program 4.

In 2016 samples taken from a dead Ōhiʻa at Kaiholena confirmed the presence of Rapid ʻŌhiʻa Death on the Preserve. Aerial sketch mapping and UAV surveys suggest that the disease is located in all of the Preserve's units, and in the surrounding Kaʻū Forest. Preserve staff follow strict bio-sanitization protocols to prevent its introduction to uninfected areas, and visitors must undergo vehicle inspection and decontamination using 70% alcohol on blades, boots, and tires with a vehicle wash station provided at the Kaiholena unit. All tools and boots will be decontaminated once more before moving to a new forest site. Chain saws are not moved between Preserves, and must be thoroughly cleaned using high pressure air and brushed down with 70% alcohol when moving between lower and upper elevation sites.

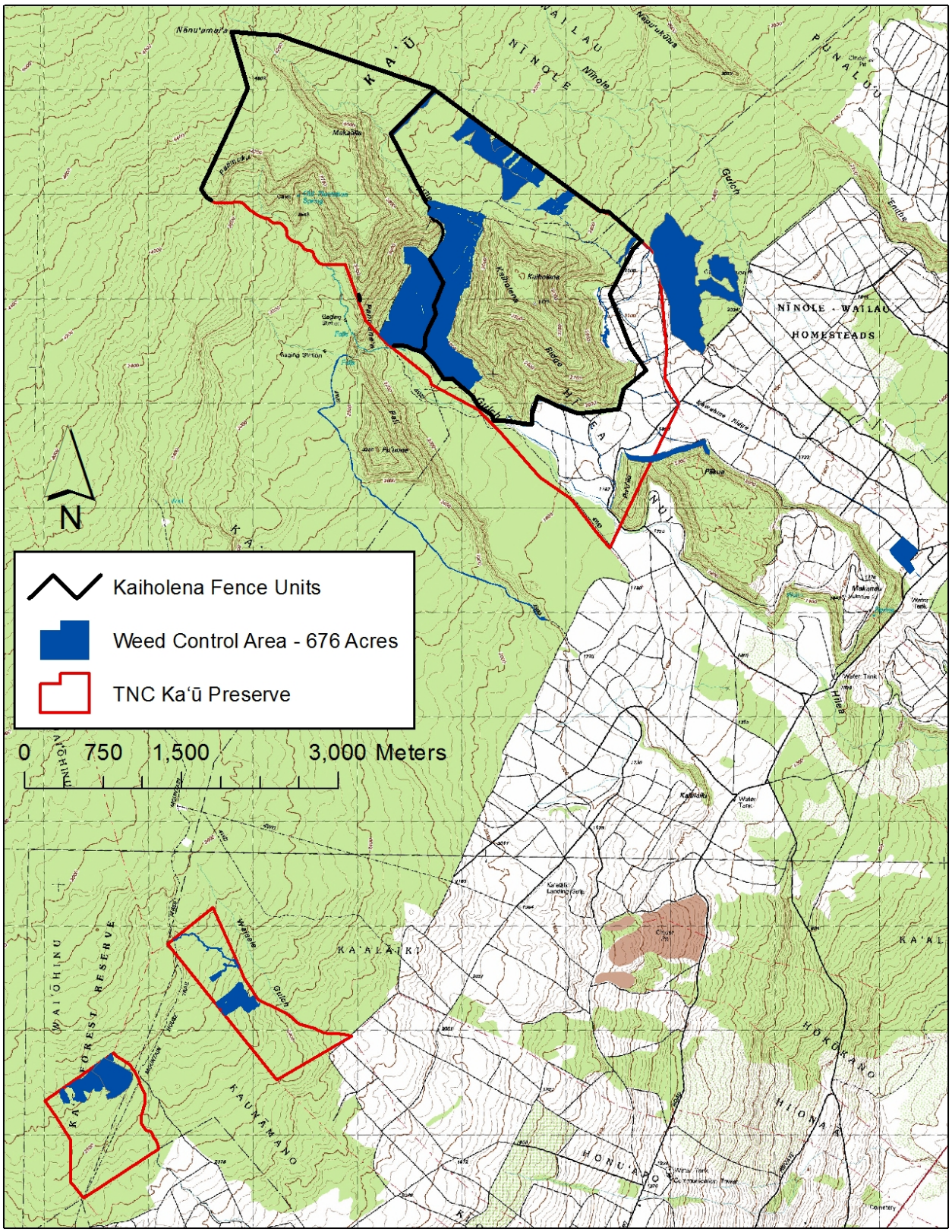


Figure 4. Invasive plant control in Ka'ū Preserve, FY2007-FY2017

Invasive Plant Control Program Activities

Year 1-6 (FY2019 - FY2024)

- Maintain priority weed maps
- Monitor effectiveness of treatments
- Continue adaptive management of weeds and adjust strategies as needed based on monitoring results
- Continue to participate as a member of BIISC
- Continue strict inspection and cleaning procedures to prevent introduction of weed species not currently in the preserve

Year 1 (FY2019)

- Work with TMA and BIISC to prioritize the most serious invasive weeds and geographic areas

Program 3: Resource Monitoring

Program Goal: To monitor changes in the integrity of the ecosystems in and around the preserve; to determine whether critical threats to those ecosystems are increasing or decreasing; and ultimately to gauge the effectiveness of our conservation strategies.

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

As an organization, The Nature Conservancy is trying to develop a more consistent and rigorous approach to evaluating the success or failure of our conservation actions. We have established a preliminary framework for assessing the effectiveness of our conservation actions based on the level of critical threats and on several key characteristics of the native ecosystems most greatly affected by them.

At Ka‘ū Preserve and vicinity, we continue to monitor critical threats as above by tracking changes in ungulate activity and the extent of habitat-modifying weeds. In particular, we propose to measure the indicators in Table 3.

Ungulate activity levels will be measured periodically on transects as discussed previously. The number, location, and sampling scheme for these transects will remain consistent with the past eleven years of data collection, with an additional 1,900-meter transect installed in 2016 along the natural barrier at Palimuku in the Maka’ālia fence unit. Innovative approaches to real-time ungulate monitoring and removal will be implemented as a best management practice. Data collected on these transects provide an index of ungulate activity and should indicate the level of success of ungulate removal efforts. In addition, field staff will also create activity maps from

field observations showing the presence of ungulate sign whenever it is detected. This information will direct our ungulate removal efforts where they are needed most.

High priority invasive plant species will be mapped opportunistically during all field operations and systematically when needed. Treated populations will be monitored to determine effectiveness of treatments.

Ecosystem extent, adjacent land use patterns, and canopy condition will be assessed through analysis of aerial imagery and/or maps produced. Much of this data has been collected by way of an aerial mapping contract for the preserve and along the lower forest edge. The quality of this imagery allows resource managers to see between gaps in the canopy to a resolution of 2 cm, potentially revealing weed populations in areas where field survey would prove to be too costly or too dangerous to attempt.

Vegetation understory and diversity will continue to be assessed using ground-based methods and through contracting of field botanists. Twenty-two understory monitoring plots were installed in the Maka'ālia fence unit in 2017, coinciding with pig removal efforts in that unit. Specific sampling schemes, frequency of monitoring, and data collection methods will be determined as management questions arise in the later years of this management plan.

The spread of a fungus believed to be the cause of Rapid ʻōhi'a Death into Kaʻū and South Kona forests demands strict bio-sanitization protocols be followed to prevent further harm inadvertently during field activities. Proprietary boots, raingear, and hand tools are restricted to each preserve, and all visitors and staff conduct vehicle and footwear decontamination procedures upon entering the preserves. Infected trees have been confirmed at the lower elevation of Kaʻū preserve. TNC will monitor the condition of the forest through the use of ultra-high resolution drone imagery, documenting changes in forest cover over time. This imagery will be shared with USFS and Three Mountain Alliance to provide vegetation cover data for these remote and infrequently surveyed forest sites.

In addition, we will continue to work with the Division of Forestry and Wildlife (DOFAW) to monitor forest birds according to the agency's statewide schedule. The last Kaʻū bird census was in FY07. The bird data are maintained and analyzed by the USGS Biological Resources Division. Conservancy staff and cooperators will also document incidental observations of rare birds observed while in the preserve.

Table 3. Planned Monitoring Framework for Ka‘ū Preserve and Vicinity

Threat Factors	Indicators
Ungulate activity	Frequency of ungulate sign
Extent of habitat-modifying weeds	Extent of specific weed species
Key Vegetation Attributes	
Extent of ecosystem or natural community	Acres of ecosystem or natural community
Adjacent land use	Percentage of ecosystem boundary adjacent to lands managed for threat reduction or biodiversity conservation
Vegetation canopy condition	Percentage of native canopy cover
Vegetation understory condition	Percentage of native vegetation cover in understory Percentage of native vegetation cover in ground layer
Diversity of indicator plant species	Percentage and frequency of native, indicator plant species in understory and ground layer

Resource Monitoring Program Activities

Year 1 (FY2019)

- Continue ungulate monitoring transects in all four management units
- Continue weed mapping and identification of highest priority weeds
- Monitor efficacy of weed treatments through photo-points and post-control inspection surveys
- Report findings of MUM plots established in Kaiholena unit

Years 2-6 (FY2020 - FY2024)

- Continue ungulate and weed monitoring
- Continue weed mapping and identification of highest priority weeds
- Analyze threat data and adjust management actions as needed
- Monitor MUM plots in Kaiholena unit
- Collect high-resolution aerial imagery to track the spread of ROD
- Facilitate Forest Bird Surveys, following DOFAW's schedule

Program 4: Rare Species Protection and Enhancement

Program Goal: To prevent the extirpation of rare species in the preserve, and to encourage research, predator control, and captive propagation of rare plant and bird species.

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

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 (Appendices 2-7). Additional rare species reported from adjacent lands and similar habitats are likely to be found in Kaʻū Preserve with future surveys.

Protecting ecosystems essential to the majority of the preserve's native plants and animals will be our primary management strategy. Our ungulate and weed control programs are integral to the protection of these ecosystems and rare species. In addition, we will supplement our understanding of the types and ranges of rare plants and animals with surveys to locate other rare species and assess their status, and to document all incidental observations of rare plants, birds, bats, and invertebrates while in the preserve. We will encourage research and provide logistical support to partners interested in specific rare species research and protection efforts.

Rare species protocols will be implemented, with permits secured and seeds delivered to Volcano Rare Plant Nursery (either by TNC, NPS, or by the State for future outplanting in the same general area). TNC will seek private funds to support the Rare Plant Nursery to offset their expenses in maintaining and propagating any collected seeds.

Fencing will continue to be installed as needed to protect populations of rare plants from ungulates. Rat control will be conducted around known population of endangered plant species.

In FY2019 and FY2020 predator control will target rats around groves of *Pittosporum spp* and *Pritchardia lanigera* found at Kaiholena. 5-dozen Goodnature A24 rat traps will be deployed within the Makaʻālia fence unit where concentrations of *hōʻawa* are located, and where reproductive *loulu* are found. The traps will be multi-purpose and will be used towards: (A) knocking down the rat population in small scale areas through high density trap deployment. This can be repeated systematically in adjacent plots to accumulate a larger area, simulating a toxicant drop, (B) A second phase would test the maintenance of population suppression with low density trap deployment following the knock-down described in A above, over larger areas, (C) A third application would be to deploy traps around clusters of epiphytic *Astelia* post-flowering to see if rat control can allow fruit maturity and dispersal. Currently, after 9 years of pig removal, *Astelia* is still not spreading beneath epiphytic clusters within Kaiholena unit. (D) A forth application is to deploy traps during critical periods to reduce rat populations around rare plants and out-plantings to elevate successful fruit production and seedling survival.

Subsequent to this project, the traps will be deployed around endangered plant species located within the Kona Hema and Kaʻū Preserves. Species targeted for future applications include

PEPP-planted *Cyanea stictophylla, Cyanea marksii, Fluggea neowawrae*a located in ungulate-free fence units at Kona Hema.

Rare Species Program Activities

Years 1-6 (FY2019 – FY2024)

- Protect and monitor rare plant populations
- Continue implementing rare species protocols
- Rare plant enhancement plans may include small exclosure fences of less than 10 acres around endangered species (see Ungulate Program for fence specifications)

Years 1-2 (FY2019 – FY2024)

- Conduct rare plant surveys in upper Kaʻū forest
- Implement predator control program targeting stands of endangered *hōʻawa* and *loulu* at Kaiholena unit

Program 5: Community Outreach

Program Goal: To build Kaʻū community understanding and support for the preservation of Kaʻū's native forests, and enlist volunteer assistance for preserve management.

This program represents an estimated 10% of the overall effort and budget in this long range management plan.

The main objective of our outreach program is to build upon the foundation built with the local community and to continue to increase awareness of Kaʻū Preserve, the Kaʻū watershed and native ecosystems, their importance, threats, and efforts to protect them. More specifically, we seek to encourage and facilitate active participation and community pride among the residents of the Kaʻū District in the effective conservation of this special resource. The key strategies for our public outreach work include a wide variety of programs, including: partnering with organizations on environmental education, employing summer interns, hosting volunteer days, guiding walks in the preserve, attending community meetings, participating in local events, and working with hunting programs.

The focus audience will continue to be the children of Kaʻū (elementary and high school), the adults of the community, and community leaders. Discussions with teachers at Pāhala and Nāʻālehu schools have occurred and strategies to implement on-site educational programs have been developed. An interpretive nature trail in the Kaiholena unit continues to be a powerful tool for showing people healthy native forest. Field activities will combine a mix of conservation projects and educational opportunities. Conservation projects will include trail construction and

maintenance, invasive plant control, fencing, and biological monitoring. Educational activities will address a wide variety of land management, cultural history, and natural history topics.

Community Outreach Program Activities

Year 1-6 (FY2019 – FY2024)

- Continue community outreach and volunteer program
- Continue University of Hawai`i at Hilo and Hilo Community College service workdays
- Continue to work closely with partners in communicating conservation goals to the Kaʻū community
- Facilitate community outreach objectives in line with broader upper Kaʻū forest management plan
- Expand the environmental education program to other Conservancy parcels and to other landowners in the region

Program 6: Watershed Partnerships

Program Goal: To assist the long-term effective management of the native ecosystems of the Kaʻū region by participating in the Three Mountain Alliance, a coordinated partnership of landowners and other partners.

This program represents an estimated 10% of the overall effort and budget in this long range management plan.

The Three Mountain Alliance comprises four landowners who are responsible for managing nearly 250,000 acres of contiguous lands in the Kaʻū region — the National Park Service, the State of Hawaiʻi, The Nature Conservancy, and Kamehameha Schools. These landowners and additional partners (e.g., U.S. Geological Survey, U.S. Forest Service, U.S. Fish and Wildlife Service) have committed to the need for a coordinated approach to information gathering, management planning, and community outreach. By participating in a watershed partnership, the Conservancy is reducing the threats to Kaʻū Preserve while leveraging funding by having partners.

Because the Conservancy has worked in the Kaʻū forest for almost 15 years, we are able to provide our partners and the community with a unique perspective on the current condition of the forest, the range and habits of invasive ungulates, and technical support in selecting a location and design for fences. We have longstanding relationships with community members and will be able to find consensus among a wide range of stakeholders. Our Geographic Information Systems (GIS) staff has the capacity to provide high-quality maps and our

communication team can prepare for public hearings where community members will have the opportunity to share and discuss their concerns.

The Nature Conservancy's goal is to collaborate with our state and federal partners through science input, planning, and community outreach to support a fencing project in the Kaʻū forest. If successful, this project will catalyze conservation throughout the entire forest, but the key will be implementing a plan that will be welcomed by stakeholders in the community.

In 2012 DOFAW completed the Kaʻū Forest Reserve Management Plan, calling for 12,000 acres of new fenced management units in the upper Kaʻū forest. The uppermost 1/3 of TNC's Keaīwa unit is included in this management area, and the 2016 Maka'ālia fence unit adds a mile to the southwestern boundary of the planned management area. The Conservancy is working with the National Park Service, Three Mountain Alliance, Kamehameha Schools, USFWS, and DOFAW to ensure the work called for in the plan is executable and well-received by the community. Our long-term goals for the project include the following:

- Implement a forest fence plan that protects core native bird habitat;
- Implement a community outreach plan to ensure support for the project;
- Work with partners to ensure funding is appropriated and the second phase of fence construction is initiated in core habitat;
- Complete an ungulate control strategy that will increase public access to Kaʻū Forest Reserve; and
- Work with partners to gain support for long-term zero tolerance ungulate control

TMA has joined the Big Island Wildfire Coordinating Group (BIGWIG) and continues to encourage other landowners to participate. This is a good venue for communication because fire response agencies are all represented, including DOFAW and the County of Hawaiʻi.

In 2013, TNC installed a firecam at Puʻu o Keokeo on the upper slopes of Mauna Loa. This site is within HVNP and lies approximately 2.5 miles above the Kona Hema Preserve boundary. The camera can detect smoke from wildfires as soon as they start and help direct firefighters to the scene. It scans the western slopes of Mauna Loa between the Kaʻu Forest Reserve and Kipahoehoe NAR. Images of the area are displayed on a video monitor in the preserve office at Honomalino and can be accessed on a cell phone. The camera can also be panned and zoomed to obtain greater detail. TNC operates and maintains the camera equipment on a regular basis, and provides an internet uplink allowing partners at HVNP to monitor the system remotely.

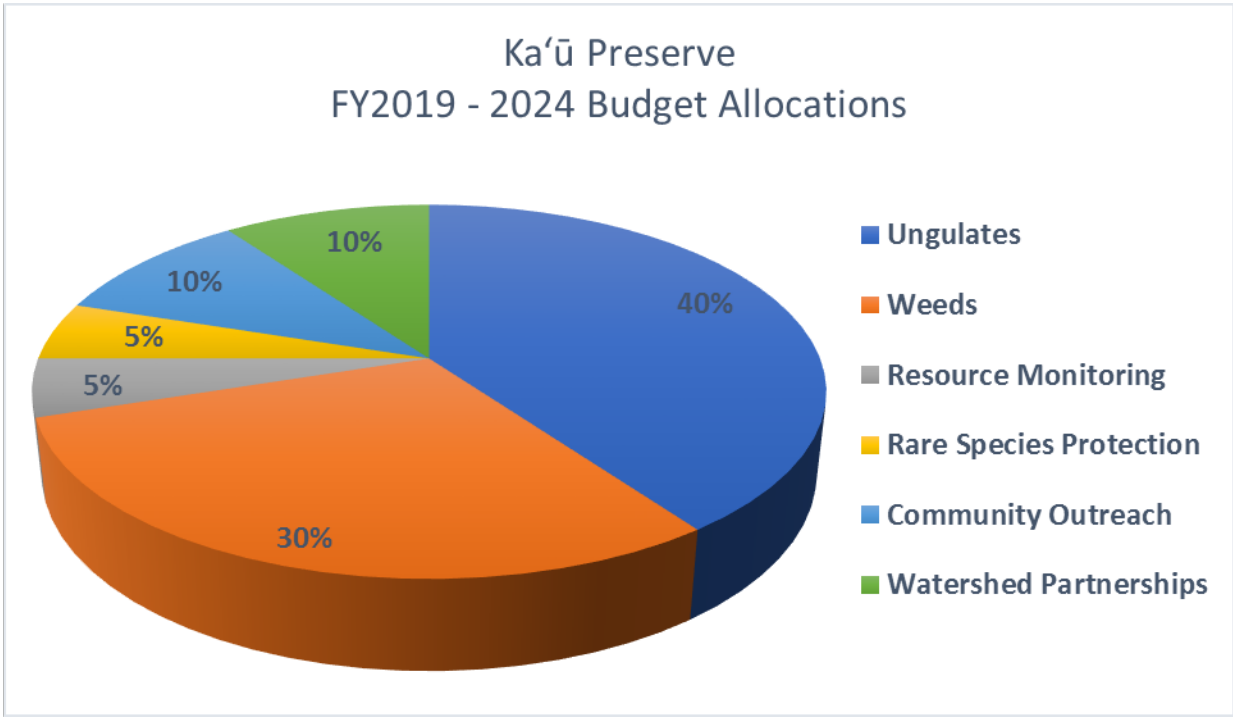
As mentioned in the Ungulate Control Program description above, TNC also intends to increase public access to allow for public hunting. In support of the overall regional management, there would also be increased access to Kaʻū for DOFAW management of the Kaʻū Forest Reserve (e.g., access along the roads to the base of Puʻu One (Kaiholena unit), and access through the Kīʻolokū and Kāhilipali units along the Mountain House Trail or other existing road networks).

Watershed Partnership Program Activities

Year 1-6 (FY2019 – FY2024)

- Support priority management activities developed by the Three Mountain Alliance
- Promote DOFAW's implementation of a forest access plan for greater public hunting access along lower boundary of Kaʻū Forest Reserve
- Continue to work with partners to achieve long term ungulate control

BUDGET SUMMARY



The table in the next section summarizes the six-year budget for the Ka'ū Preserve 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 one-third.

The Conservancy's Ka'ū operation maintains a full-time base staff of two. Other part-time, short-term, or year-to-year personnel, in addition to staff overtime, are covered in this budget and will be utilized as project needs warrant. Technical and annual planning support is primarily provided by the Honolulu office of the Conservancy. As budget and needs allow, these support staff members 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.

This budget includes project-related supplies, subcontract expenses to conduct fence checks/maintenance and weed/ungulate control, and other miscellaneous project-related costs including vehicle expenses both as equipment purchases and equipment leases. The Conservancy routinely provides trainings for staff to improve job performance, and in addition to these trainings, supervisory staff regularly attend meetings in Honolulu. Travel and training funds are included within this budget to cover airfare, board and lodging, and training expenses.

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. Although the Conservancy's overhead rate is currently 23.31% (the annual rate changes each year per negotiations with DOI), the NAPP program will currently pay only 10%, leaving the remainder as a portion of the Conservancy's one-third match.

Budgetary Constraints: This Kaʻū NAPP budget includes a 20% increase in funding since the last LRMP (FY2013–FY2018). This increase in staff labor and contract costs for years 1-3 of this LRMP (FY2019-FY2021) will support ungulate control efforts at Manukā NAR, continuation of which to be determined by NARS staff at the end of FY2019. Should TNC receive significant private funds in addition to NAPP funding, we hope to complete additional management activities. This will depend entirely on TNC's statewide priorities and its ability to raise additional funds. We will report on progress on all accomplishments in Kaʻū Preserve and on adjacent lands regardless of funding source.

BUDGET TABLE

	FY2019	FY2020	FY2021	FY2022	FY2023	FY2024	TOTAL
Labor & Benefits	150,566	153,145	157,861	135,785	142,574	149,703	889,634
Contractual	29,000	30,000	30,000	14,000	14,000	14,000	131,000
Communications	0	0	0	0	0	0	0
Travel	3,000	3,000	3,000	3,000	3,000	3,000	18,000
Supplies	9,000	10,000	10,000	10,000	10,000	10,000	59,000
Other	500	500	500	500	500	500	3,000
Subtotal	*192,066*	*196,645*	*201,361*	*163,285*	*170,074*	*177,203*	*1,100,634*
Overhead	19,207	19,665	20,136	16,329	17,007	17,720	110,063
TOTAL	211,273	216,310	221,497	179,614	187,081	194,923	1,210,697
	Year 1	**Year 2**	**Year 3**	**Year 4**	**Year 5**	**Year 6**	**Total**
Ka‘ū Budget	211,273	216,310	221,497	179,614	187,081	194,923	1,210,697
Private Match (1/3 of total)	70,424	72,103	73,832	59,871	62,360	64,974	403,566
TOTAL NAPP REQUEST (2/3)	**140,848**	**144,206**	**147,665**	**119,742**	**124,721**	**129,949**	**807,132**

Appendices

Appendix 1. Kaʻū Preserve accomplishments, FY2013-FY2017

Ungulate Control

- Kaiholena 1,200-acre fenced unit maintained pig-free for 9 years
- Maka'alia 800-acre new fenced unit implemented a grid of 24 game cameras spaced 300 meters apart to monitor the new Maka'alia fenced area for 4 weeks, establishing a baseline of ungulate populations. Installed 4 one-way trap gates located along the fence at intersections with animal trails, and a large capacity wirelessly operated corral trap was baited daily with dry corn at an area with highest observed pig activity, as detected by the camera grid. Ungulate transects were monitored for pig disturbance, and an aerial FLIR survey indicated no pig presence on the natural barrier at Palimuku. Currently, cameras continue to monitor the area, traps are employed, and as efforts continue to eliminate the final population of 6 juvenile pigs

Fence Work

- Executed contract with Big Country Fencing for construction of 2.85 mile, 800-acre Makaʻālia fence in the Kaiholena unit.
- Hogwire replacement along 4 miles of lower Kaiholena fence.
- Deer fence installed on 5.5 miles of fence.

Weed Control

- High priority weeds were located and removed from a total of 175 acres of Lower Hīlea, Kaiholena Unit, Ka'ū preserve through contracts and 67 through staff and volunteer efforts
- Himalayan ginger control work was monitored at Kīʻolokū and 23 acres controlled at Kāhilipali, and 5.5 acres controlled and monitored along a flume at Keaīwa
- Aerial imagery data was collected across Kaʻū Forest Reserve in a series of transects running southwest to northeast along elevation contours spaced 500 meters apart to isolate incipient populations of weeds

Rare species monitoring

- Makaʻālia plant survey conducted

- 3 additional mature *Pritchardia lanigera* were located, seeds collected, propagated by Volcano Rare Plant, and 164 seedlings replanted in the preserve with the assistance of PEPP
- Seeds from *Trematolobelia wimmeri* sourced at Kaiholena propagated and outplanted into a NPS fence unit in the upper Kaʻū forest

Outreach

- Reached 4,548 people with volunteer days, outreach, and other events, not including 2,000 people reached with the Rapid Ōhiʻa Death PSA, or the 2,000 people attending the Merrie Monarch Parade
- Utilized 3,206 hours of volunteer labor time for everything from infrastructure to fence repair
- TNC staff was the Master of Ceremonies (MC) at the 2016 ʻAlalā release VIP event & 2017 Ōhiʻa Love Fest
- Assisted with Ka'ū community outreach for DOFAW's Kaʻū Forest Reserve Management Plan

Infrastructure

- Built new helicopter landing zone
- Built new water tank
- Built herbicide shed
- Remote camp made more livable for work crews in our new Maka'ālia Unit by replacing tents with OEQC approved structures

Research assistance

- Frank Bonaccorso, USGS – documenting population trends, altitudinal and regional migrations by season, foraging and roosting habitat, and reproduction for the Hawaiian hoary bat
- Kerry Shaw, Cornell University – observe the interactions of two species of the Hawaiian cricket *Laupala* as part of an experiment on acoustic interactions
- Dennis LaPointe, USGS PIERC Kīlauea Field Station – studying "Distributional anomalies of native Hawaiian forest birds and avian disease in the Kaʻū Forest region of the Island of Hawai'i"
- Dr. Rosemary Gillespie, Essig Museum of Entomology – conducted field surveys towards "Research on Community Level Approach to Understanding Speciation in Hawaiian Arthropods"
- Frank Trusdell, USGS at Hawaiʻi Volcanoes National Park – collected gravity data from the vicinity of Makaʻālia towards research on the structure and age of the Nīnole Hills

- Tracy Johnson, USFS – Introduction of *Tectococcus* inoculated plants to Kīʻolokū research plots to reinvigorate colony as a biocontrol to combat strawberry guava
- Idelle Cooper, JMU, Damselfly variation across elevations
- Steve Hunter, University of Wisconsin – Phylogeny and historical biogeography of the Hawaiian lobeliads
- Jeff Stallman, UH, fungi in the family *Agaricaceae*
- Lucas Fortini, USGS, Ecohydrology trial site – exploring the differences in key soil characteristics that control runoff and groundwater recharge across managed and relatively intact native mesic and wet forest communities across the state of Hawai'i.
- Matthew Clark, UH – Moʻolelo o Kaʻū: "Hīlea i Kalo ʻEkaʻeka" (Stories of Kaʻū: "Hīlea of the dirty taro") – Internship paper prepared for TNC that researched historical names, places and stories in the ahupua'a of Hīlea. (The Kaiholena unit is located in Hīlea)

Partnerships

- Provided office space and logistical support towards community outreach effort for DOFAW's Kaʻū Forest Reserve Management Plan
- Collaborated with Hawaiʻi Ant Laboratory, BIISC and community members in treatment of ~15 acre Little Fire Ant infestation in Nāʻālehu
- Monitored effectiveness of Australian tree fern treatment in 115 acres of neighboring lands, controlling 9 mature and 50 immature individuals
- Continued to support BIADWG survey and control efforts in South Kona and Kaʻū through facilitating landowner access, field orientation for new BIISC Invasive Vertebrate staff, and serving as chair for BIADWG in FY2015–2016

Appendix 2. Native Natural Communities Of Kaʻū Preserve

Natural Community (common and scientific names)	**Heritage Global Rank***
Koa/ʻŌhiʻa Montane Mesic Forest *Acacia koa/Metrosideros polymorpha* Montane Mesic Forest	G1
Koa/ʻŌhiʻa Montane Wet Forest *Acacia koa/Metrosideros polymorpha* Montane Wet Forest	G3
ʻŌhiʻa Montane Wet Forest *Metrosideros polymorpha* Montane Wet Forest	G3
ʻŌhiʻa Lowland Wet Forest *Metrosideros polymorpha* Lowland Wet Forest	G3

* Key to Heritage Global Ranks:

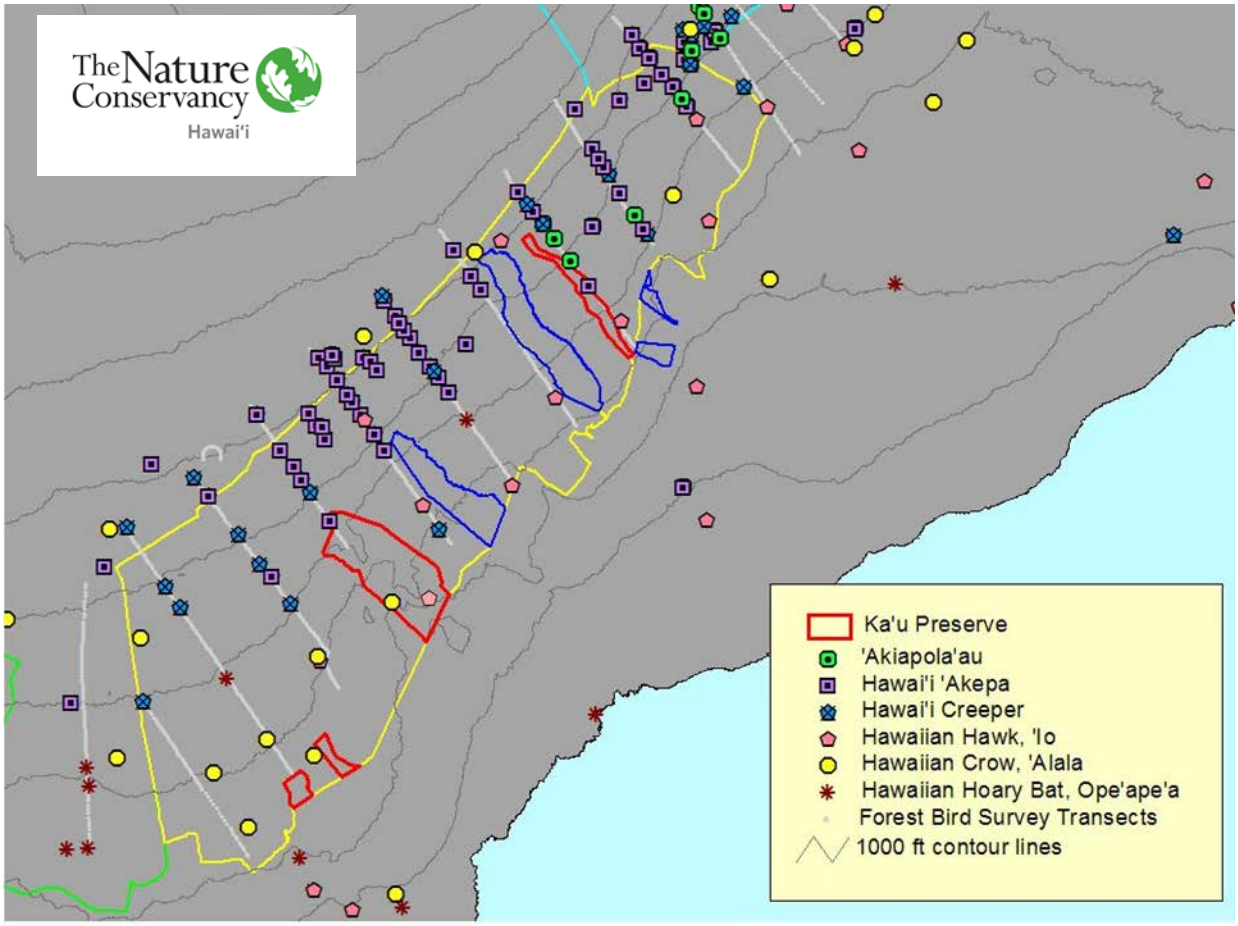
G1 = Critically imperiled globally (typically 1-5 current occurrences).

G3 = Moderately imperiled globally or restricted in range (typically 21-100 current occurrences).

Appendix 3. Rare Vertebrates in Kaʻū Preserve (6 Endangered, 1 Threatened)

Species	Federal Status*	Island Distribution
Buteo solitarius (Hawaiian Hawk, *ʻIo*)	LE	Hawaiʻi
Corvus hawaiiensis (Hawaiian Crow, *ʻAlalā*)	LE	Hawaiʻi
Drepanis coccinea (Scarlet Honeycreeper, *ʻI'iwi*)	T	Hawai'i, Maui, Kauaʻi, Oʻahu, Molokaʻi
Hemignathus munroi (ʻAkiapōlāʻau)	LE	Hawaiʻi
Lasiuris cinereus semotus (Hawaiian hoary bat, *ʻŌpeʻapeʻa*)	LE	Hawaiʻi, Maui, Oʻahu, Kauaʻi
Loxops coccineus coccineus (Hawaiʻi ʻĀkepa)	LE	Hawaiʻi
Oreomystis mana (Hawaiʻi Creeper, *ʻAlawī*)	LE	Hawaiʻi

Appendix 4. Map of Rare Animals in Ka'u Preserve Vicinity



Appendix 5. Rare Plants in Vicinity of Kaʻū Preserve (11 Endangered)

Species	Federal Status*	Critical Habitat
Asplenium peruvianum var *insulare*	LE	
Charpentiera obovata	-	
Clermontia lindseyana	LE	
Cyanea shipmanii	LE	
Cyanea stictophylla	LE	X
Cyanea tritomantha	LE	
Cyrtandra menziesii	SOC	
Eurya sandwicensis	SOC	
Lobelia hypoleuca	-	
Marattia douglasii	-	
Melicope zahlbruckneri	LE	X
Nothocestrum breviflorum	LE	
Phyllostegia floribunda	LE	
Phyllostegia velutina	LE	X
Phyllostegia vestita	SOC	
Pittosporum hawaiiense	LE	
Pritchardia lanigera	LE	
Ranunculus hawaiensis	C	
Strongylodon ruber	SOC	
Stenogyne scrophularioides	-	
Touchardia latifolia	-	
Trematolobelia wimmeri	SOC	

* Key to Federal Status:

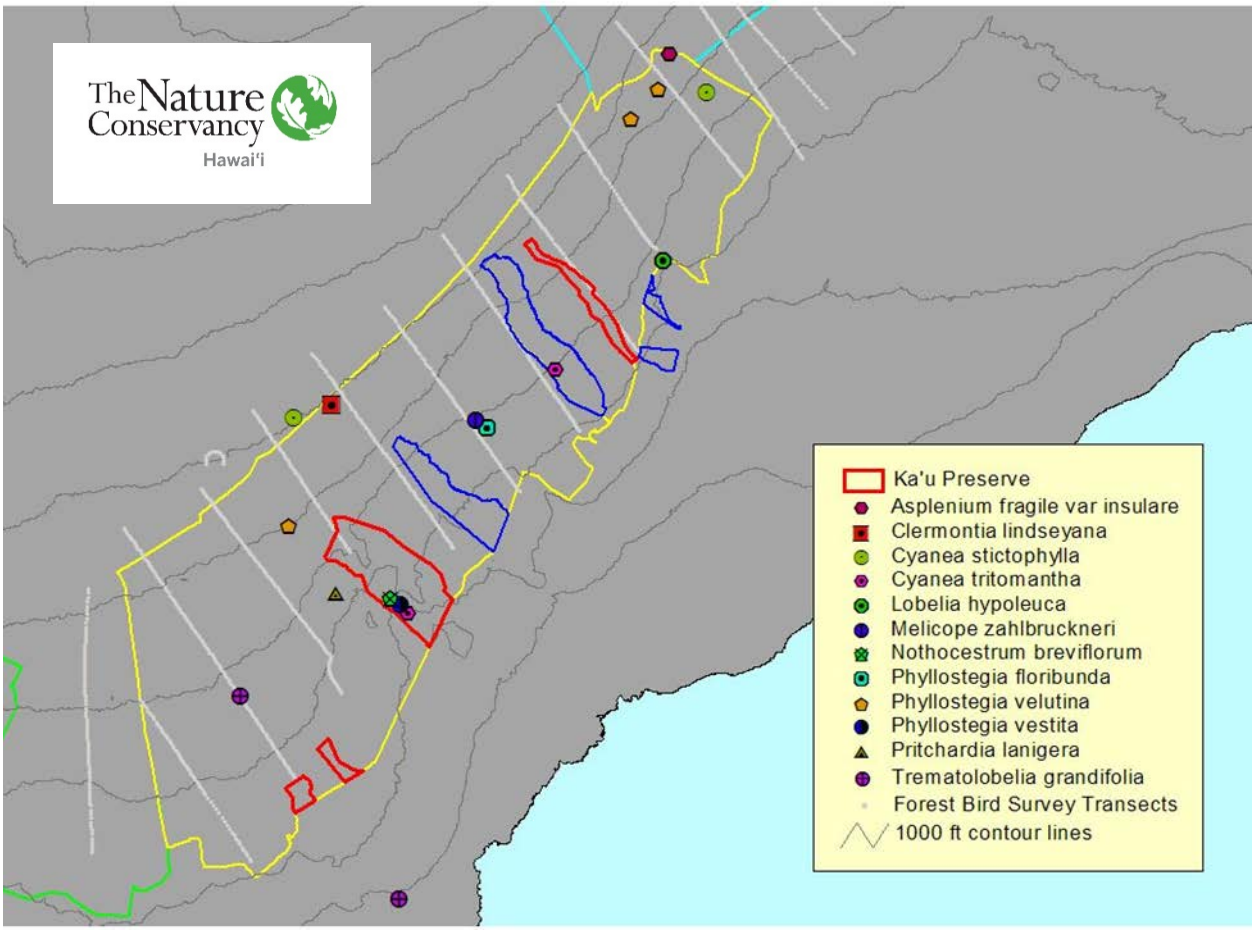
Listed Endangered (LE) = Taxa listed as endangered.

Candidate (C) = Taxa for which substantial information on biological vulnerability and threat(s) support proposals to list them as threatened or endangered.

Species of Concern (SOC) = Taxa for which available information meets the criteria for concern and the possibility to recommend as candidate.

Threatened (T) = Taxa likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range.

Appendix 6. Map of Rare Plants in Vicinity of Kaʻū Preserve



Appendix 7. Draft list of native plants, as compiled by Emmet Judziewicz, University of Wisconsin-Stevens Point

(See attachment)