

Three Mountain Alliance Management Plan December 31, 2007



Prepared by: Three Mountain Alliance (TMA)

Three Mountain Alliance Members:

Hawai‘i Department of Public Safety
Hawai‘i Department of Land and Natural Resources
Kamehameha Schools
National Park Service
The Nature Conservancy
U.S. Fish and Wildlife Service
U.S.D.A. Forest Service
U.S. Geological Survey
Natural Resources Conservation Service

TABLE OF CONTENTS

Table of Acronyms.....	3
Executive Summary	4
I. Introduction	6
II. Project Area Overview	7
A. BIOPHYSICAL RESOURCES	7
<i>Area, Location, Topography, Climate, Geology and Soil Types</i>	7
<i>Hydrology and Water Resources</i>	8
<i>Ecosystems and Species</i>	9
B. SOCIOCULTURAL RESOURCES	11
<i>Land Ownership, Land Use Zones and Land Management</i>	11
<i>Population and Local Communities</i>	12
<i>Historical and Cultural Resources</i>	13
<i>Recreational/Educational Opportunities</i>	14
<i>Infrastructure and Facilities</i>	15
III. Summary of Key Threats to TMA	16
A. Fire	16
B. Ungulates.....	16
C. Weeds	17
D. Additional Threats.....	17
IV. Overview of Existing Management in the TMA	22
<i>State</i>	23
<i>Federal</i>	23
<i>Private Owners/Non-Profit Organizations</i>	24
V. Management Program	26
A. Habitat Protection and Restoration	26
B. Watershed Protection	32
C. Compatible Economic Use.....	32
D. Compatible Recreation and Ecotourism	33
E. Education, Awareness and Public Outreach.....	35
F. Cultural and Historical Resource Protection	36
G. Research, Monitoring and Management Program Indicators	37
VI. Management Actions for Four Priority TMA Areas	39
A. ‘Ōla‘a Kīlauea Management Area	40
B. Kaū Kapāpala Management Area	44
C. South Kona Management Area	47
D. North Kona Management Area.....	51
VII. TMA Operations and Budget	56
VIII. References.....	58
IX. Appendices.....	66
A. TMA MOU	66
B. TMA Operating Guidelines.....	78

Table of Acronyms

BIGWIG	Big Island Wildfire Coordinating Group
BIISC	Big Island Invasive Species Committee
CWCS	Comprehensive Wildlife Conservation Strategy; State of Hawai‘i
DBEDT	Department of Business, Economic Development & Tourism; State of Hawai‘i
DLNR	Department of Land and Natural Resources; State of Hawai‘i
DOFAW	Division of Forestry and Wildlife; DLNR; State of Hawai‘i
DOH	Department of Health; State of Hawai‘i
DPS	Department of Public Safety; State of Hawai‘i
FR	Forest Reserve; State of Hawai‘i
GMA	Game Management Areas; State of Hawai‘i
HAVO	Hawai‘i Volcanoes National Park; NPS
KS	Kamehameha Schools
MOU	Memorandum of Understanding
NARS	Natural Area Reserve System; State of Hawai‘i
NPS	National Park Service
NRCS	Natural Resources Conservation Service
NWR	National Wildlife Refuge; USFWS
OHA	Office of Hawaiian Affairs; State of Hawai‘i
OKP	‘Ōla‘a Kīlauea Partnership
PIERC	Pacific Island Ecosystems Research Center; USGS
TMA	Three Mountain Alliance
TNC	The Nature Conservancy
USDA FS	United States Department of Agriculture, Forest Service
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey

Executive Summary

The Three Mountain Alliance (TMA) was formed when members of the ‘Ōla‘a Kīlauea Partnership (OKP), based on their 10 year success of partnering, decided to enlarge watershed protection and management to over one million acres across Mauna Loa, Kīlauea, and Hualālai as part of an expanded Partnership. OKP members have agreed there is a compelling need to collaborate on a wide variety of land management issues in forested watersheds across this TMA landscape. Coordinated management across this landscape is critical to sustain adequate quality and quantity of water and to provide important habitat for a wide diversity of native plants and animals, including endangered species. In addition, the health of these lands is strongly connected with the quality of life for people and local communities. Even in the absence of a formal partnership, private and public landowners in this region have recognized the value of collaboration to address shared management challenges such as invasive weeds, fire and feral cattle.

The OKP has been highly successful in addressing conservation challenges within a 30,000 acre area, centered on the ‘Ōla‘a Tract of Hawai‘i Volcanoes National Park. The OKP includes the State (Department of Land and Natural Resources, Department of Public Safety), National Park Service, U.S. Fish and Wildlife Service, U.S. Geological Survey Pacific Island Ecosystems Research Center, Kamehameha Schools, U.S.D.A Forest Service and The Nature Conservancy. For more than a decade, these partners have pooled staff expertise and funding to conserve native ecosystems and significantly reduce the threats of invasive ungulates and weeds on Federal, State and private lands.

The TMA will initially include the original eight State, Federal and private partners of the OKP, as well as the U.S.D.A Natural Resources Conservation Service. Other agencies and large, private landowners with a management interest in the landscape will be invited to join the TMA or, if they choose, to participate only in collaborative efforts addressing specific management challenges. A Memorandum of Understanding (MOU) outlines the following overall principles that serve as the foundation of the TMA:

- *The three mountains of Kīlauea, Mauna Loa and Hualālai are ancient, sacred to Hawaiians, and critically important to the life, health and well being of the native ecosystems and human communities that inhabit them.*
- *TMA members have a responsibility (kuleana) to care for these mountains, including native ecosystems and human communities that share this landscape.*
- *Management is needed to maintain healthy forested watersheds on the slopes of Kīlauea, Mauna Loa and Hualālai to sustain the future quality and quantity of fresh water.*
- *Other lands (e.g. younger lava flows, grasslands, crop land and coastal lands) within the TMA area also contribute to water quality and quantity.*
- *The health of the near shore ocean resources are intimately connected to the health of the uplands in the traditional ahupua‘a.*
- *Management of these lands would benefit Hawai‘i’s native flora and fauna.*
- *Many of the threats to the watershed, such as ungulates, fire, insects, diseases, and invasive non-native plants, occur across common land ownership boundaries.*

- *Effective management is best achieved through the coordinated actions of all major landowners in the TMA area irrespective of property lines.*

I. Introduction

The purpose of this plan is to:

1. Identify TMA management goals, objectives and operational protocols.
2. Identify and develop strategies to address the high priority management issues that affect multiple landowners and natural resources across the TMA landscape.

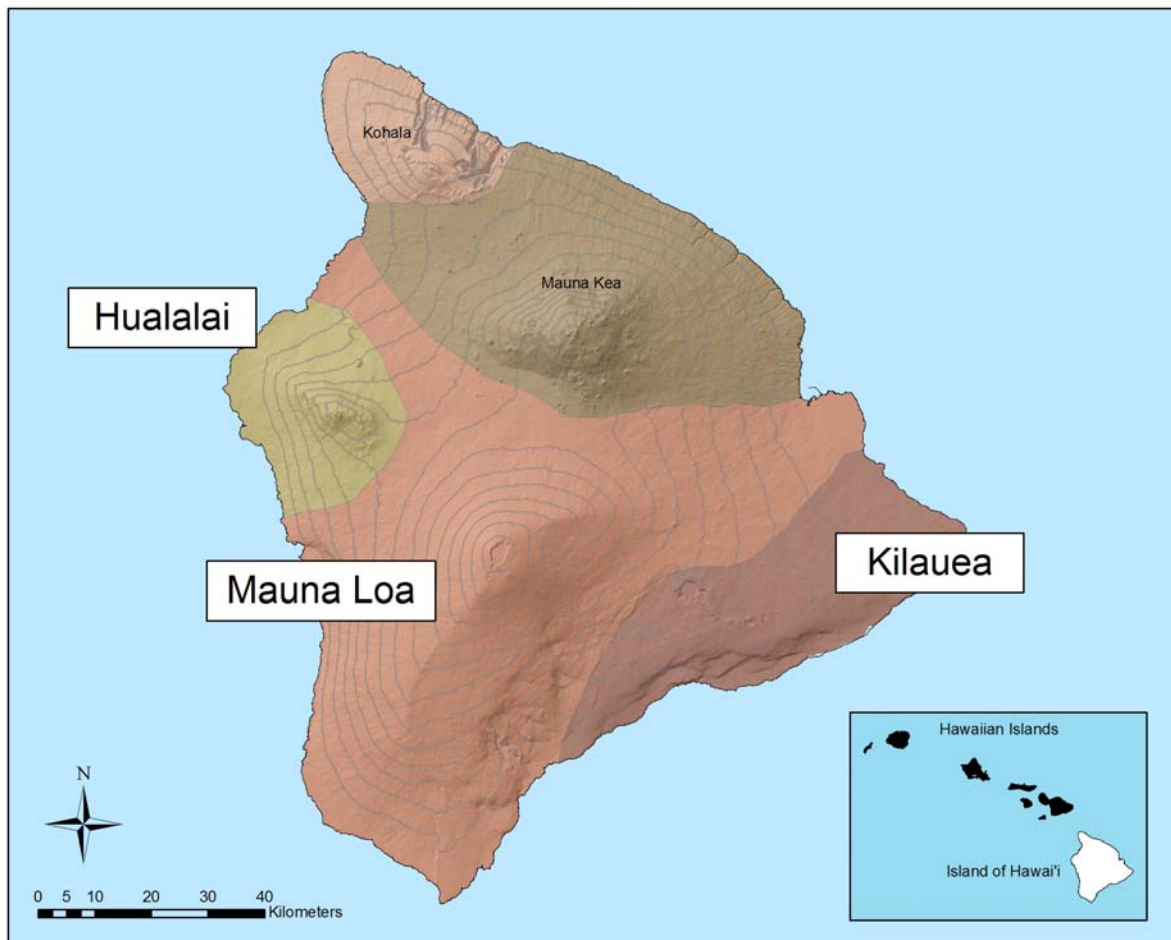
Individual TMA members have different management goals and priorities, numerous ongoing management and research activities as well as existing planning documents. This plan will not attempt to summarize individual TMA members' goals, projects and priorities, but will instead focus on jointly identified priorities and collaborative management and research efforts. TMA members will exchange relevant information needed to implement these joint management strategies and apply the results of scientific research to management actions. TMA members will also join in cooperative efforts to raise funds to implement these management strategies.

The TMA recognizes the difficulties of jointly managing such a large landscape. However, the TMA area has relatively few large landowners that are already working together on joint planning and management through the 'Ōla'a Kīlauea Partnership (OKP). In addition, many of the threats to the TMA area occur across the landscape and can best be addressed on a large-scale in a unified and coordinated manner. This plan summarizes the resources, threats and management needs for the broader TMA landscape, as well as subdivides the TMA into four smaller management areas ('Ōla'a Kīlauea, Kaū Kapāpala, South Kona and North Kona).

This plan will be updated every five years, and will also be supplemented annually by more detailed project plans that outline specific management, research activities and TMA funding and personnel needs. Specific projects proposed in this plan will complete required State and/or Federal compliance prior to implementation.

The TMA Operating Guidelines (Appendix B) address general operating procedures. The TMA operates by consensus of both land-owning and non-landowning members, and this plan reflects the consensus goals of TMA members.

II. Project Area Overview



A. Biophysical Resources

Area, Location, Topography, Climate, Geology and Soil Types

The Three Mountain Alliance (TMA) encompasses over one million acres (or 45%) of Hawai'i island's total 2,573,400 acres and consists of four priority management areas: 'Ōla'a Kīlauea, Ka'ū Kapāpala, South Kona, and North Kona. The area is home to three of the island's youngest volcanoes, Hualālai, Mauna Loa, and Kīlauea – all of which are active and characterize this area's landscape with extensive lava flows of varying ages influencing vegetation succession patterns. The presence of the three mountains also affects climate, as winds are driven around and upward by their presence. Warm trade winds bring moisture as rain or cloud drip on the windward side. At high elevations and on the Kona side, dry or even arid conditions predominate. Convection-driven onshore breezes on the leeward side create upslope showers most afternoons, resulting in a broad band of mesic forest. The peaks of Mauna Loa have permanent frost. Elevation ranges from coastal areas to 13,679 feet (Mauna Loa summit), resulting in a variety of different climates and vegetation communities from dryland to mesic

forests. High rainfall averages can run to over 270 inches of rain a year on the windward side. Soil orders found in the area consist mostly of lava, cinder, and rubble soil. These orders describe soils that consist of organic matter formed through decomposition, volcanic-ash based soils, and well-draining and fertile soils (State of Hawai‘i 2005; Juvik and Juvik 1998). The range in soil conditions reflects the geologic parent material. Pāhoehoe, ‘a‘ā, cinders, and weathered ash provide differing contributions of minerals and drainage characteristics. Accumulations of organic matter in the soil and ground litter are the most important factor in soil development on these relatively young substrates. Soil age and composition have considerable influence over plant community composition and hydrology.

Hydrology and Water Resources

The TMA is also characterized by major watersheds, which provide not only native habitats for native species, but also other ecosystem services such as water production and filtration, climate change mitigation benefits, flood control, and economic, social, and educational opportunities for the human communities found in the area (a 1999 University of Hawai‘i study valued such services provided by the Ko‘olau Mountains on O‘ahu at \$7.4-14 billion dollars).

A large amount of Hawai‘i island’s water budget is comprised of rainfall (over 8,000 million gallons per day or mgd) versus other sources such as direct runoff (2,000 mgd), groundwater recharge (5,000 mgd), and sustainable yield (a little over 2,000 mgd). Major aquifer recharge areas with sustainable groundwater high yields in the TMA can be found in Kīlauea (618 mgd), and Mauna Loa (1,201 mgd), with Hualālai falling between 21-56 mgd (Juvik and Juvik 1998). A majority of the water in Hawai‘i county is taken from ground water (versus surface water). There are several major water systems in the Kona, Ka‘ū, and Puna areas. These areas mostly rely on wells, springs, and roof catchments for their water supply (Hawai‘i County 2005).

Though the TMA has few perennial streams, there are several intermittent streams that can be found. Few surveys of these streams have been done; however, they could serve as important habitats for native species. The State of Hawai‘i Department of Land and Natural Resources Division of Aquatic Resources identifies the upper sections of several watersheds which fall under the TMA as headwater areas: Waiākea, Kea‘au, Hionamoa Gulch, Nīnole Gulch, Hīlea Gulch, Wai‘aha, Kealakekua, and Kohanaiki. A few of these watershed areas also have had native damselfly surveys conducted. Additionally, there are several U.S. Geological Survey stream gages located in areas such as Mauna Loa, Hualālai, and Ka‘ū that can provide water resource information for management purposes. The TMAs only major ditch system is located in the Ka‘ū District, which contains an extensive system of flumes formerly used to transport sugar cane. In addition, Ka‘ū contains several water impoundments (Parham 2006).

Upland forests provide essential groundwater recharge areas. It is probable that long-term degradation of forests through ungulate grazing and wildfire has caused a negative impact on hydrologic cycles in portions of the TMA, particularly North and South Kona. All groundwater sources in Kona ultimately depend upon recharge that primarily occurs in a band between the 1,500 and 5,500-foot elevations. In the lower part of this band, rainfall dominates from approximately the 1,500 to 3,000-foot elevation. Above the 3,000-foot elevation, fog that collects on trees and drips to the ground is a major contributor to the aquifer. Infiltration of rainwater, fog drip and dew are the primary fresh water inputs, while subsurface water flow and transmission to fresh water aquifers are the primary means of fresh water movement. Some of

the subsurface water captured in mauka areas finds its way down slope feeding springs and anchialine pools, and seeps in lava tubes. Groundwater entering the ocean contains dissolved nutrients that directly or indirectly support marine life including basic single celled organisms, limu, fishes and green sea turtles. Fresh water influx is required for the proper functioning of fishponds, which provided high protein food sources and were a vital part of Hawaiian culture (State of Hawaii 2003).

Flooding is considered a problem in parts of the North and South Kona Districts as well as in Kaū. Urban portions of the North Kona District have been experiencing increasing hazards from floodwater damages due to land use, steep slopes (approximately 15%), shallow soils, frequent high intensity rains, and the lack of well-defined drainage-ways. The South Kona area is geologically young so there are few well-defined drainage ways in the district. The soils of the area are extremely permeable and few streams show evidence of reaching the ocean. Overland and stream flows are rare and can only be detected when the rainfall intensity exceeds the rate of infiltration. The district is subject to sudden high intensity rainstorms that can strike anywhere and cause localized flooding. Flood prone areas have been identified by the Hawaii County General Plan (2005).

Ecosystems and Species

Approximately 85% of the total TMA land area is comprised of native ecosystems. The TMA contains some of the largest expanses of intact native forest remaining in the Hawaiian Islands (approximately 50% of the State's remaining native habitat). Due to the variations in elevation, climate, and vegetation, the TMA is home to thousands of native species as well as rare and threatened or endangered species (many of which are endemic to the island).

Major native ecosystems found in the TMA include alpine, subalpine, montane (dry, mesic and wet), and lowland (dry, mesic and wet). The Nature Conservancy of Hawai'i's Ecoregional Plan rates a majority of the TMA areas as in either good or very good condition with regard to their overall ecosystem viability ranking. The State of Hawai'i Division of Forestry and Wildlife (DOFAW) also identifies many State owned areas in the TMA as highest quality native vegetation or predominantly native vegetation according to their draft management guidelines. The Nature Conservancy of Hawai'i's Ecoregional Assessment (2006) summarizes major native ecosystems types and classifications as follows:

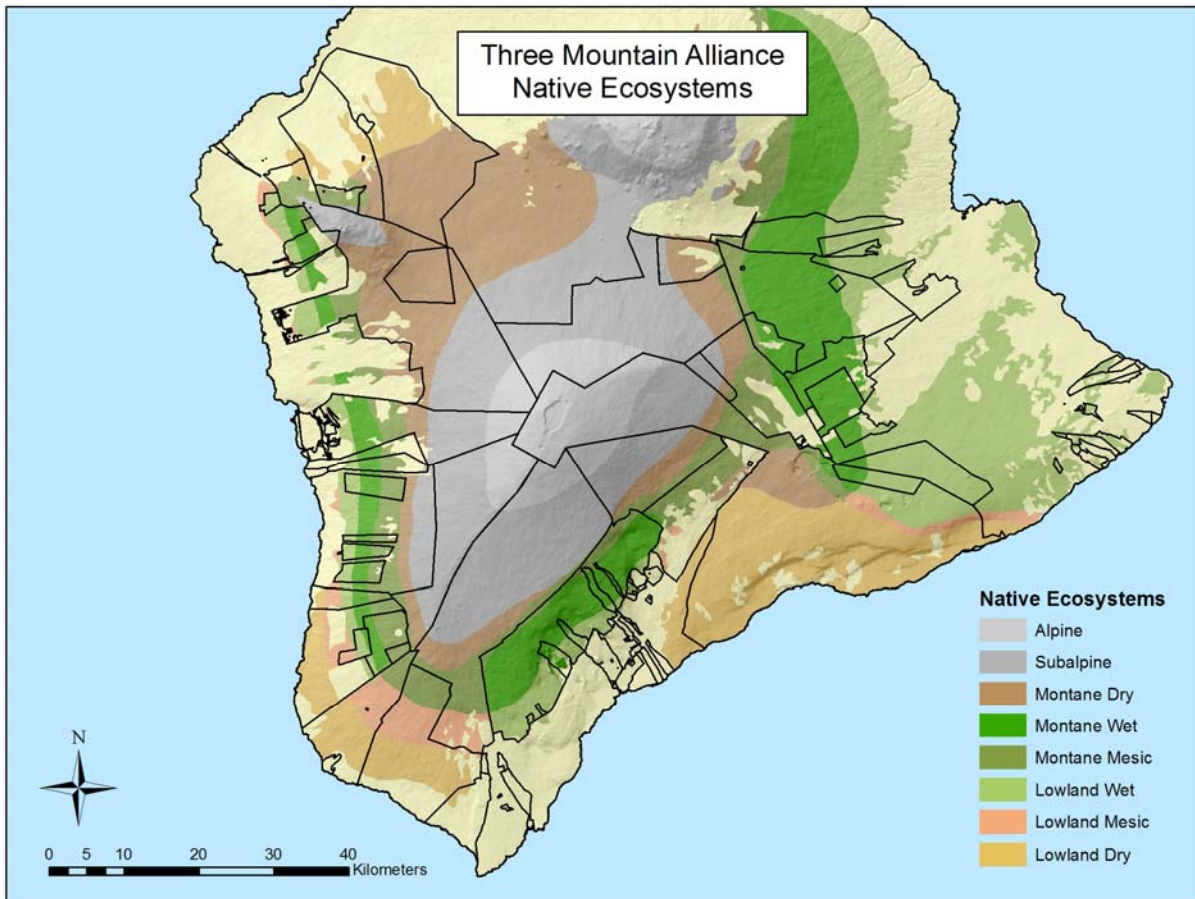
- **Alpine** (9% of TMA) - Summit regions of Mauna Loa above 3,000 m (9,000 ft) elevation. Natural communities include aeolian desert and a sparse shrubland of alpine adapted plants. Biological diversity is not high, but highly specialized plants and invertebrates occur here.
- **Subalpine** (24% of TMA) - Near-summit regions of Mauna Loa and Hualālai between 2,000 m (6,000 ft) and 3,000 m (9,000 ft) elevation. The subalpine system contains several natural communities including forest (e.g. Māmane-Naio (*Sophora chrysophylla* - *Myoporum sandwicense*) Subalpine Dry Forest), shrublands, and grasslands (e.g. *Deschampsia nubigena* Subalpine Dry Grassland). Biological diversity is not high, but specialized plants and invertebrates occur here, as well as bird species, such as the palila (*Loxioides bailleui*), adapted to foraging and nesting in subalpine habitats.
- **Montane Dry** (16% of TMA) - Natural communities between 1,000 and 2,000 m (3,000 - 6,000 ft) elevation, receiving less than 50 inches annual precipitation. This system is best

developed on the leeward side of the island in the North Kona area and in the Mauna Kea - Mauna Loa saddle. This system contains a number of natural communities including a variety of grasslands, shrublands, and forests. Biological diversity is moderate in this system, relative to lower elevation systems.

- **Montane Mesic** (10% of TMA) - Natural communities between 1,000 and 2,000 m (3,000 - 6,000 ft) elevation, receiving between 50 and 75 inches annual precipitation. This system includes a variety of grasslands, shrublands, and forests and is best developed on the leeward side of the island in the Kona flank. Biological diversity is moderate in this system, relative to lower elevations, but this system is important habitat for forest birds, and specialized plants and animals historically occurred here, such as ‘alalā, the Hawaiian crow (*Corvus hawaiiensis*) and hō‘awa (*Pittosporum hosmeri*).
- **Montane Wet** (15% of TMA) - Natural communities between 1,000 and 2,000 m (3,000 - 6,000 ft) elevation, receiving greater than 75 inches annual precipitation. This system is best developed on the windward side of Hawai‘i. This system contains a variety of natural communities, including grasslands, shrublands, and forests. Biological diversity is moderate to high in this system, and specialized plants and animals occur here, such as predatory caterpillars and lobeliads. The montane wet system is important habitat for forest birds.
- **Lowland Wet** (10% of TMA) - Natural communities below 1,000 m (3,000 ft) elevation, receiving greater than 75 inches annual precipitation. This system is best developed on the windward side of Hawai‘i. There are a number of natural communities described within this system, including a variety of wet grasslands, shrublands, and forests. Biological diversity is high in this system, and specialized plants and animals occur here.
- **Lowland Mesic** (2% of TMA) - Natural communities below 1,000 m (ca 3,000 ft) elevation, receiving between 50 and 75 inches annual precipitation, or otherwise bearing prevailingly mesic substrate conditions (e.g. the Kona flank of Mauna Loa). There are a number of natural communities described within this system, including a variety of grasslands, shrublands, and forests. Biological diversity is high in this system, which is noted in particular for tree species diversity. A number of specialized plants and animals occur there, such as the Hawaiian bat, ‘ōpe‘ape‘a (*Lasiurus cinereus semotus*) and the native vine nuku‘i‘iwi (*Strongylodon ruber*). This system is of secondary importance for forest birds.
- **Lowland Dry** (14% of TMA) - Natural communities below 1,000 m (ca 3,000 ft) elevation, receiving less than 50 inches annual precipitation. This system is best developed on the leeward sides of the islands, for example, the Kona flank of Mauna Loa. There are a number of natural communities described within this system, including a variety of grasslands, shrublands, and forests. Biological diversity is low to moderate in this system, and specialized plants and animals occur here, such as pueo, the Hawaiian owl (*Asio flammeus sandwichensis*) and the rare Hawaiian tree cotton, hau hele ‘ula (*Kokia* spp.).

Due to the broad range of habitat types, many unique species can be found within the TMA. Lava flows from the active volcanoes isolate patches of forest called kīpuka, resulting in genetic divergence between isolated populations and speciation. Lava tubes in older flows host a diverse and unique cave invertebrate fauna. The TMA has some of the highest densities of native forest birds in the State due to the relative abundance of large tracts of intact, upper elevation native forests. Wet and mesic forests are home to a range of native forest birds including the endangered ‘akiapōlā‘au (*Hemignathus munroi*), Hawai‘i ‘ākepa (*Loxops coccineus coccineus*), and Hawai‘i Creeper (*Oreomystis mana*) as well as unique invertebrates such as happy-face spiders and carnivorous caterpillars. The TMA also provides abundant habitat for species such

as the ‘io (*Buteo solitarius* [Hawaiian hawk]), nēnē (*Branta sandvicensis* [Hawaiian goose]), and Hawai‘i’s only endemic land mammal, the ‘ōpe‘ape‘a. Seabirds such as the ‘ua‘u or dark-rumped petrel (*Pterodroma phaeopygia sandwichensis*) and the ‘akē‘akē or band-rumped storm petrel (*Oceanodroma castro*) nest on the upper slopes of Mauna Loa. The TMA has areas designated by the U.S. Fish and Wildlife Service as critical or recovery habitat for palila, Blackburn’s sphinx moth (*Manduca blackburni*), and 41 endangered plant species (State of Hawai‘i 2005).



B. Sociocultural Resources

Land Ownership, Land Use Zones and Land Management

The Three Mountain Alliance is comprised of the original eight members of the ‘Ōla‘a-Kīlauea Partnership (OKP): Kamehameha Schools (KS), The Nature Conservancy (TNC), State of Hawai‘i (Department of Public Safety (DPS), the Department of Land and Natural Resources (DLNR)- Division of Forestry and Wildlife (DOFAW)), U.S. Department of Agriculture (Forest Service-USDA FS), and the U.S. Department of Interior (National Park Service (NPS), Fish and Wildlife Service (USFWS), Geological Survey (USGS) in addition to the Natural Resources Conservation Service (NRCS). The government makes up the largest landowner (the State

followed by Federal), with Kamehameha Schools and other private landowners following (State 530,926 acres, Federal 373,631 acres, private 211,749 acres).

Out of the total TMA acreage, 490,358 acres or 44% of lands are designated as protected areas in some form (State 105,038 acres, Federal 373,631 acres, private 11,689). Additional designations are State Forest Reserves (which initially were set up for the protection of watersheds, but today have multiple mixed uses such as forest timber and products production, public hunting, hiking, and other uses) and partial areas on private lands managed for conservation (e.g. Keauhou Ranch owned by Kamehameha Schools). Other designations found within the TMA are State game management areas as well as a Federal designation for the State's only Experimental Tropical Forest. Though not an official partner in the TMA, the Pōhakuloa Training Area, owned by the U.S. Army, conducts environmental management of certain areas, is adjacent to the TMA, and has an Integrated Natural Resources Management plan developed.

A majority of the lands in the TMA are designated by the State Land Use Commission as Conservation District, with Agricultural District designation following second. Unlike the State designations, county zoning identifies several land use designations or patterns. Main county designations in the TMA include conservation and open space. Additionally, county policies recognize the need to keep watershed areas forested and in large landscapes by limiting the rezoning of lots and densities at certain elevations and requiring certain percentages of property above a certain elevation be kept in forest cover.

Ranching, agriculture, and forestry can be found in the TMA landscape. Agriculture and ranching include poultry, cattle, coffee, macadamia nuts, flowers, vegetables, fruits, forest products, and agro forestry. Other economic industries are tourism, real estate, and government services (Juvik and Juvik 1998; State of Hawai'i Department of Business, Economic Development and Tourism (DBEDT); Hawai'i County 2005).

Other initiatives supporting land management and planning for the TMA by providing resources or direction include the following: Hawai'i's Comprehensive Wildlife Conservation Strategy (CWCS) (State of Hawai'i 2005), State of Hawai'i Office of Planning's Ocean Resources Management Plan (2006), Mauka Kona Landowners Group, the Interim State Strategic Plan for Invasive Species Prevention, Control, Research, and Public Outreach, U.S. Fish and Wildlife Service plans, county plans, Hawai'i Tourism Strategic Plan, community development plans, Soil and Water Conservation District Management plans, Pacific Basin Information Node, Hawai'i Biodiversity and Mapping Program database, Hawai'i Gap Analysis Program, and the database of the Bishop Museum.

Population and Local Communities

A total of 158,000 residents reside on the island of Hawai'i. Most of the major communities such as Hilo, Kailua-Kona, Waimea, and Puna are not directly found within the TMA, but are adjacent to it. The North Kona district is the largest community in the TMA at close to 29,000 residents. Most of the other districts and subsequent communities in/adjacent to the TMA are relatively small (less than 10,000 in population) (State of Hawai'i 2005; Juvik and Juvik 1998; DBEDT State of Hawai'i). Areas of continued growth that may have TMA management implications are Kona, Ka'ū and Puna.

Tourism also adds to population numbers, with average daily visitor populations at about 22,000 (Hawai‘i Volcanoes National Park alone accounts for 1.2 million annual visitor days). Each year, 50,000 visitors to the island purchase tours to areas where they encounter at least some native habitats and species (State of Hawai‘i 2005).

Historical and Cultural Resources

Mauna Loa, Kīlauea, and Hualālai—the three mountains of the Three Mountain Alliance—dominate the Hawai‘i Island interior and together form the cultural core of traditional Hawaiian beliefs. These mountains and their landscapes helped structure the legends, sacred beliefs, and traditional customs that are integrated into all facets of Hawaiian life. This core belief system, manifest in the physical environment, is best described by author, historian, ethnographer, and Hawaiian practitioner Kepa Maly:

In Hawaiian culture, natural and cultural resources are one and the same. Native traditions describe the formation (literally the birth) of the Hawaiian Islands and the presence of life on and around them, in the context of genealogical accounts. All forms of the natural environment, from the skies and mountain peaks, to the watered valleys and lava plains, and to the shore line and ocean depths are believed to be embodiments of Hawaiian gods and deities (Maly 2002).

The physical landscape of the island provided the necessary resources for Hawaiians: off-shore and reef environments provided abundant marine fishery resources; inland agricultural zones used rich volcanic soils and ample rainfall to provide plentiful produce for island populations; and upland forested zones supplied materials used for canoes, house timbers, tools, and medicinal and ceremonial resources. These critical resources represent the essentials required to sustain island populations and were valued, protected, and preserved to ensure their sustainability. Belief systems reinforced the paramount relationship towards island resources and are described by Maly (2004c):

Hawaiians shared spiritual and familial relationships with the natural resources around them. Each aspect of nature from the stars in the heavens, to the winds, clouds, rains, growth of the forests and life therein, and everything on the land and in the ocean, was believed to be alive. Indeed, every form of nature was a body-form of some god or lesser deity...In the Hawaiian mind, care for each aspect of nature, the *kino lau* (myriad body-forms) of the elder life forms, was a way of life. This concept is still expressed by Hawaiian *kūpuna* (elders) through the present day, and passed on in many native families. Also, in this cultural context, anything which damages the native nature of the land, forests, ocean, and *kino lau* therein, damages the integrity of the whole. Thus caring for, and protecting the land and ocean resources, is a way of life. (Maly 2004c).

The shared customs of traditional Hawaiians helped create dynamic and complex political, religious, and societal constructs similar to chiefdoms throughout Polynesia. The complex arrangements grew from the first settlers to the islands, where traditions and cultural practices were passed down from generation to generation. Contemporary cultural practices continue this respect towards these paramount places of importance and continue to maintain their close connectedness to these *wahi kapu* (sacred lands).

Cultural and historical resources are distributed throughout the TMA including multiple site listings on both the Hawai‘i State and National Register of Historic Places. These sites denote levels of both state and national significance and range from pre-contact traditional Hawaiian sites to historic-era sites and structures. A sample of typical site types identified through archaeological investigations include: resource procurement sites, agriculture development, temporary residential sites, coastal and inland villages, ceremonial construction (*heiau*) and interment sites, trail networks, and boundary markers. Their preservation and protection affords interpretations of past events and preserves in them the shared cultural heritage of island residents.

Cultural resources within the TMA can be classified into four resource types: archaeological resources, historic structures, cultural landscapes, and ethnographic resources.

Archeological Resources exemplifying the Native Hawaiian adaptations are found throughout the TMA, from sea level to over 13,600 feet. These resources include a range of features and sites and represent the physical remains of both pre-historic and historic-era activities.

Historic Properties within the TMA include a full range of structures including buildings, monuments, trails, roads, fences, and structural ruins.

Cultural Landscapes are represented by modified settings that reveal the intricate ties between people and the land, areas defined by the interaction of natural and constructed landscapes.

Ethnographic Resources express cultural continuity demonstrated through both tangible and intangible cultural systems. Traditional resources are present within natural settings and encompass traditional beliefs and activities. Ethnographic resources support traditions and are represented by special locations in the natural world, natural materials, and structures with specific meanings and associations.

The immense area represented by the TMA encompasses traditional land divisions, *ahupua‘a*, that in turn contained developed environmental zones that supported island inhabitants and supplied them with the natural resources necessary for sustenance. Historic-era developments, including western-style ranching pursuits and plantation development, successfully used the same resources and resource zones, transforming expansive natural landscapes. A succession of cultural land use patterns created by different cultural interests created a cultural mosaic of material remains on the landscape.

Recreational/Educational Opportunities

The TMA includes public hunting areas on DOFAW lands and public as well as private hiking trails. Ainapo, Mauna Loa Observatory Road, and the Pu‘u O‘o Trails are some of the public hiking trails offered by the State’s Na Ala Hele Trail and Access Program, and a hiking trail system is being developed as part of the Pu‘u Wa‘awa‘a Management Plan. There are also preliminary plans to create a Mauna Loa Trail system on the upper slopes of Mauna Loa (TNC 2005) and plans for a coastal trail around large portions of the island (NPS 2007). These spectacular long-distance trail systems have the potential to become world-class attractions for residents and visitors. Additionally, some private landowners within the TMA also engage in eco-tourism and provide hikes and tours of native habitats and species. Landowners such as DOFAW as well as the NPS and TNC also have education and volunteer programs.

Infrastructure and Facilities

With the exception of the NPS (where extensive infrastructure for recreation, visitor services, conservation management, and roadways exist), there is very little infrastructure or facilities in many areas of the TMA. Infrastructure and facilities include major roadways such as Stainback Highway, Volcano Road, and Mamalahoa Highway, camping grounds, management cabins, and helicopter landing zones to transport crews and equipment for management projects and safety. Some facilities attached to public hiking trails include roadways and trail shelters. Public hunting trails, which are also found in the same areas as public hiking trails, may also have similar facilities.

TMA staff are based at Hawai'i Volcanoes National Park (HAVO) Resources Management Division in the same complex as other TMA members (NPS and USGS). TMA Kona staff are based at Pu'u Wa'awa'a. TNC has a field office in Na'alehu as well as a central office in Waimea. DOFAW office and baseyard are in Hilo. KS offices are in Keauhou Kona. The USFWS NWR and USDA FS offices are located in Hilo.

III. Summary of Key Threats to TMA (not in priority order)

A. Fire

Uncontrolled wildfires have become an increasingly serious threat to native ecosystems in the TMA area. Wildfires leave the landscape bare and vulnerable to erosion and non-native weed invasions. Invasive weeds, particularly fountain grass (*Pennisetum setaceum*) which is a fire-adapted weed that has evolved to rely on fire for regeneration, are quick to reclaim burned areas, further changing the natural fire dynamics. The presence of such species in Hawaiian ecosystems greatly increases the intensity, extent, and frequency of fire, especially during drier months or drought.

The principal human-caused ignition threats are catalytic converters and other hot surfaces of vehicles or heavy equipment. Careless disposal of cigarettes also presents a very real threat.

The principal natural ignition sources are lava flows and lightning. Thunderstorms are relatively infrequent, but they do occur with sufficient regularity to present a viable threat.

B. Ungulates

Hoofed animals, or ungulates, including pigs, goats, mouflon, sheep, and cattle are a major threat to the TMA area. Wild (feral) ungulates destroy native vegetation and prevent its regeneration through consumption, while accelerating the invasion of weed species through direct dispersal of seeds on their coats and in their droppings. In addition, pig wallows provide mosquito-breeding habitat that promotes the spread of avian malaria and pox – the two most deadly diseases for native forest birds, as well as human diseases. In some landscapes, feral ungulates have caused severe and extensive erosion, directly affecting both the forested uplands and the nearshore coral reefs. Cumulatively, ungulate impacts cause the decline of intact native ecosystems which can affect watershed functions and jeopardize the future existence of rare and endangered plants and animals (Katahira 1980; Cooray and Mueller-Dombois 1981; Diong 1982; Loope and Scowcroft 1985; Stone 1985; Stone et al. 1992).

Feral cattle are widely distributed across forested lands of the TMA, and they are extremely destructive to native forest. The TMA has identified several high priority areas requiring feral cattle control: Kaū Forest Reserve (FR), the Kahuku portion of HAVO, Kapāpala FR, South Kona FR, Honua‘ula FR, and the Kona Forest Unit of Hakalau Forest NWR.

Wide-ranging populations of pigs (*Sus scrofa*), sheep (*Ovis aries*), mouflon (*Ovis musimon*), and goats (*Capra hircus*) continue to pose significant management challenges for habitat and species management throughout the TMA area, contributing to losses of forest cover that adversely affects groundwater retention and stream quality, ultimately increasing marine sedimentation and decreasing coral reef viability.

Expanding populations of feral sheep-mouflon hybrids and mouflon at high elevations on Mauna Loa and on Hualālai threaten native vegetation and regeneration. They may also be directly affecting nesting resources for seabirds such as ‘ua‘u and ‘akē‘akē.

C. Weeds

The problem of non-native plant invasions in native habitats is a well-recognized management problem in Hawai‘i’s natural areas. Certain non-native plants displace native plants and are capable of converting native ecosystems to non-native dominated vegetation, often resulting in a less diverse forest which can then alter soil moisture, nutrient and fire regimes and reduce habitat for native species. Generally, the sustained pressure of ungulates is necessary for such ecosystem collapse, but a few non-native plants appear to be able to seriously degrade native ecosystems alone once dispersed into an area.

One of the major threats to native ecosystems and species in the TMA area is the uncontrolled spread of invasive non-native plants. These plants displace distinctive native flora, resulting in a loss of species diversity and eventually in more pronounced and permanent changes to ecosystem function such as alteration of primary productivity and nutrient cycling. Many invasive species completely replace native vegetation resulting in total loss of native habitats thereby negatively affecting native bird, arthropod and snail communities. Invasive plants such as fountain grass are fire-adapted and fire-prone which makes them a high threat to conservation of the remaining rare dry native habitats in Kona. Other non-native grasses in montane, mesic and wet forests inhibit seedling recruitment among native forest plants, so that mechanical removal is required for native reforestation. A partial list of invasive plant species that pose a significant threat to native plant communities in the TMA area and require aggressive management include miconia (*Miconia calvescens*), firetree (*Morella faya*), banana poka (*Passiflora tarminiana*), yellow Himalayan raspberry (*Rubus ellipticus*), and strawberry guava (*Psidium cattleianum*).

Invasive plants present an extremely difficult challenge. Because the seeds of some invasive plants persist for years in the soil bank, eradication can be exceedingly difficult after the plant is established, and control requires an ongoing effort to prevent further spread. However, control operations are expensive. Members of the partnership have been working on weed control individually, but the most threatening weeds easily cross land ownership and management boundaries.

D. Additional Threats

Additional non-native animals

Smaller animals also have the potential to become serious pests in the watershed. Feral cats, rats, mongoose, dogs, house mice, and certain non-native birds are known to consume or compete with native species. In addition, like ungulates, small mammals can affect water quality by serving as vectors of water-borne diseases.

On Hawai‘i Island today, feral cats range from relatively high densities near sea level where abandoned pets are frequently fed by well-meaning animal-lovers, to sparse isolated populations in remote rain forests and even alpine areas. Cats kill songbirds, which nest, feed, and roost in trees, as well as native sea birds and other species that nest on the ground or in burrows, such as

endangered 'ua'u and endangered nēnē. Long-lived native species are particularly vulnerable because their reproductive rates are low and parental investment in raising young is high.

Rats have been recorded as being particularly destructive to many rare species. At all elevations, rats prey on native bird eggs, nestlings, and native land snails. Rats are also known to eat the fruits of native *loulou* palms and lobelias and strip the bark of some native plants. Black rats (*Rattus rattus*) and Polynesian rats (*Rattus exulans*) are the dominant species throughout most of Hawai'i's forests. Rats are also known to carry human disease such as Leptospirosis.

All vegetation types in Hawai'i have been invaded by non-native forest birds, including: Japanese White-eye (*Zosterops japonicus*), Hwamei (*Garrulax canorus*), and Northern Cardinal (*Cardinalis cardinalis*). These species, and many others, compete with native forest birds for food and other resources, provide vectors for avian diseases, and are vectors for the spread of non-native plants such as *Clidemia* and strawberry guava.

Impacts of non-native invertebrates include direct consumption of rare plants, interference with plant reproduction, predation and parasitism of native animals, transmission of disease, alterations to soil formation processes, and hybridization with native forms. Many non-native invertebrates occur within the TMA area, but little is known about their specific populations and distribution. Yellowjackets (*Vespula pensylvanica*) and other predatory wasps are known to affect invertebrate communities in Hawai'i Volcanoes National Park as well as affect food availability for bird species. Yellowjackets and several ant species, particularly Argentine ants (*Linepithema humile*), are voracious predators and consume many species of native caterpillars. Additionally, parasitoid wasps kill native caterpillars by laying their eggs on, or inside of, them. By limiting caterpillar abundance as a food source, these exotic insects may indirectly influence native bird populations. Other non-native invertebrates also threaten native species of plants and animals; the erythrina gall wasp (*Quadrastichus erythrinae*) threatens native and ornamental *Erythrina* species; introduced ants such as the little fire ant *Wasmannia auropunctata*; Argentine ant *Linepithema humile*; and big-headed ant (*Pheidole megacephala*) impact native arthropods, as well as nestlings of native birds. Diverse State and Federal agencies are working to prevent the introduction and establishment of the stinging red imported fire ant (*Solenopsis invicta*).

Slugs (*Milax gagates*, *Limax maximus*, *Veronicella* spp.) consume fruit from native plants and prey on seedlings and mature plants. The two-spotted leafhopper (*Sophonia rufofascia*) is a major concern for the *uluhe* fern, which is particularly sensitive to leafhopper feeding. Another invertebrate, the black twig borer, burrows into branches and propagates a pathogenic fungus that kills its host. Mosquitoes (*Aedes albopictus* and *Culex quinquefasciatus*) transmit deadly diseases to native birds, and can also be vectors for human diseases as well. Non-native, cannibal snails (ie. Rosy wolf snail *Euglandina rosea*) have decimated the native Hawaiian snail fauna. Both Jackson's chameleons (*Chamaeleo jacksonii*) and coqui frogs (*Eleutherodactylus coqui*) threaten native invertebrates, such as insects, spiders, and small snails. Predatory flatworms (*Geoplana* sp.), and the introduced omnivorous snail (*Oxychilus alliarius*) represent a threat to native land snails.

Numerous non-native aquatic species threaten to cause ecological and economic harm to TMA freshwater streams and their users. Invasive non-native fish, mollusks, crustaceans, and arthropods already exist within streams and ditches in the TMA watersheds. Invasive aquatic species could also cause economic impacts to agricultural users of water, resulting from crop

damage, infrastructure damage, or contamination. Introductions of aquaculture and aquarium species into streams occur via flooding, effluents discharged back into the streams, intentional introduction, and by overland travel. Invasive fish used in aquaculture prey on native fish, crustaceans, and arthropods, thereby altering the entire structure of the stream ecosystem. In addition, disease and pathogens associated with cage-reared species could potentially spread through streams and ditches. Fish used in the aquarium industry directly compete with native stream fauna for food and other resources. Anchialine pond fauna are threatened by non-native fish and shrimp that are intentionally released into these ponds.

Current State regulations require more review and approvals for control of invasive non-native species than for introduction of the non-native species into the State, causing delays and reducing effectiveness of response and control actions as more species are introduced with limited control methods available to address them.

Introduced Diseases and Pathogens

Leptospirosis and Cryptosporidiosis are potentially fatal illnesses caused by water-borne microorganisms. People are typically exposed by eating food or drinking water contaminated with feces of infected animals, including ungulates, rodents, cats, dogs, humans, and even frogs. A few people become ill each year from wading in ponds or drinking water from affected springs and streams. The Department of Health (DOH) does not currently conduct any regular monitoring of stream pathogens in the TMA. Leptospirosis is a bacterial illness, while Cryptosporidiosis is a diarrheal illness caused by a microscopic intestinal parasite. According to DOH statistics, the windward side of the Island of Hawai'i historically reports the largest number of cases of these illnesses across the State.

Toxoplasmosis is a potentially fatal disease to humans caused by a protozoan organism (*Toxoplasma gondii*). Cats are the definitive host of the organism that has killed native Hawaiian birds such as the critically endangered 'alalā and the endangered nēnē. Because the protozoan can complete an important part of its life cycle in seawater, this disease also poses a threat to marine mammals such as the endangered Hawaiian monk seal (*Monachus schauinslandi*) and the spinner dolphin (*Stenella longirostris*) (Danner et al. 2007). In addition to threatening wildlife, toxoplasmosis is zoonotic and poses a significant health risk to pregnant women.

Avian pox and avian malaria are mosquito-transmitted diseases that affect native Hawaiian birds. In the extreme isolation of the Hawaiian Islands, birds evolved in the absence of these diseases and lost their natural immunity. Avian pox is caused by a virus (*Avipoxvirus*) and avian malaria by a single-celled parasite (*Plasmodium relictum*). For some bird species infection with these diseases is almost always fatal.

In early 2005, a fungal disease was found in 'ōhi'a trees (*Metrosideros polymorpha*) on O'ahu. The disease, named 'ōhi'a rust (*Puccinia psidii*), has since spread to all the main Hawaiian Islands, where it affects other Myrtaceae taxa. In severe infections, growing tips wither and die back.

Koa wilt is a serious, often fatal disease of the native tree koa (*Acacia koa*). Trees affected with the disease rapidly lose their canopies and may die within a few months. Young trees less than 15 years old seem to be affected more often than old trees, and the disease is more often seen on trees planted below 2,500 feet elevation than on trees growing in the forest at higher elevations.

Both koa and koaia (*Acacia koaia*) are susceptible to koa wilt. Koa wilt has been observed on the islands of Hawai‘i, Maui, O‘ahu, and Kaua‘i.

Human Disturbance

Human activities can also negatively impact the watershed. People access the watershed for hiking, hunting and other activities. Land managers access forested areas for land management activities. These seemingly benign practices can also have a negative impact on the watershed if not conducted in a responsible manner. Humans can damage vegetation directly through trampling and over-collection and by providing the ignition source for fire. Human beings can also increase the likelihood of plant pest introductions; in fact, human traffic has been implicated as a major culprit in the spread of such major pests as *Clidemia*. Fence-lines constructed without care to prevent introductions and spread of non-native species, or unmaintained fencelines, become avenues for the spread of weeds.

Urban development and road construction have large potential to negatively affect the water quality and quantity of the watershed. Urbanization can cause a decrease in soil permeability and infiltration rates, thereby reducing groundwater recharge and increasing runoff and flooding. It also often involves the removal of vegetation cover, disturbance and soil compaction, leading to increases in sedimentation. Construction enhances the transport system for sediments, increasing the damage from existing and additional sedimentation. The potential for these threats in some areas of the TMA is low, since these areas are currently zoned as Conservation District. But zoning designations and laws could always be changed for both public and private lands and could significantly increase the probability of these threats. The Kona Flank of Mauna Loa is the only region in the state where intact native forest is zoned for agriculture. As such, portions of this forest have been and continue to be ranched, logged, subdivided, and developed.

Motorized vehicle recreation can also be a significant source of damage in the watershed, causing erosion and facilitating the colonization of weeds by exposing bare soil or causing fire. Some sanctioned motorcross racing occurs in the watershed area, but increased motorcross ATV popularity has led to trespassing onto other areas. Fences and other barriers have proved to be ineffective against these transgressions.

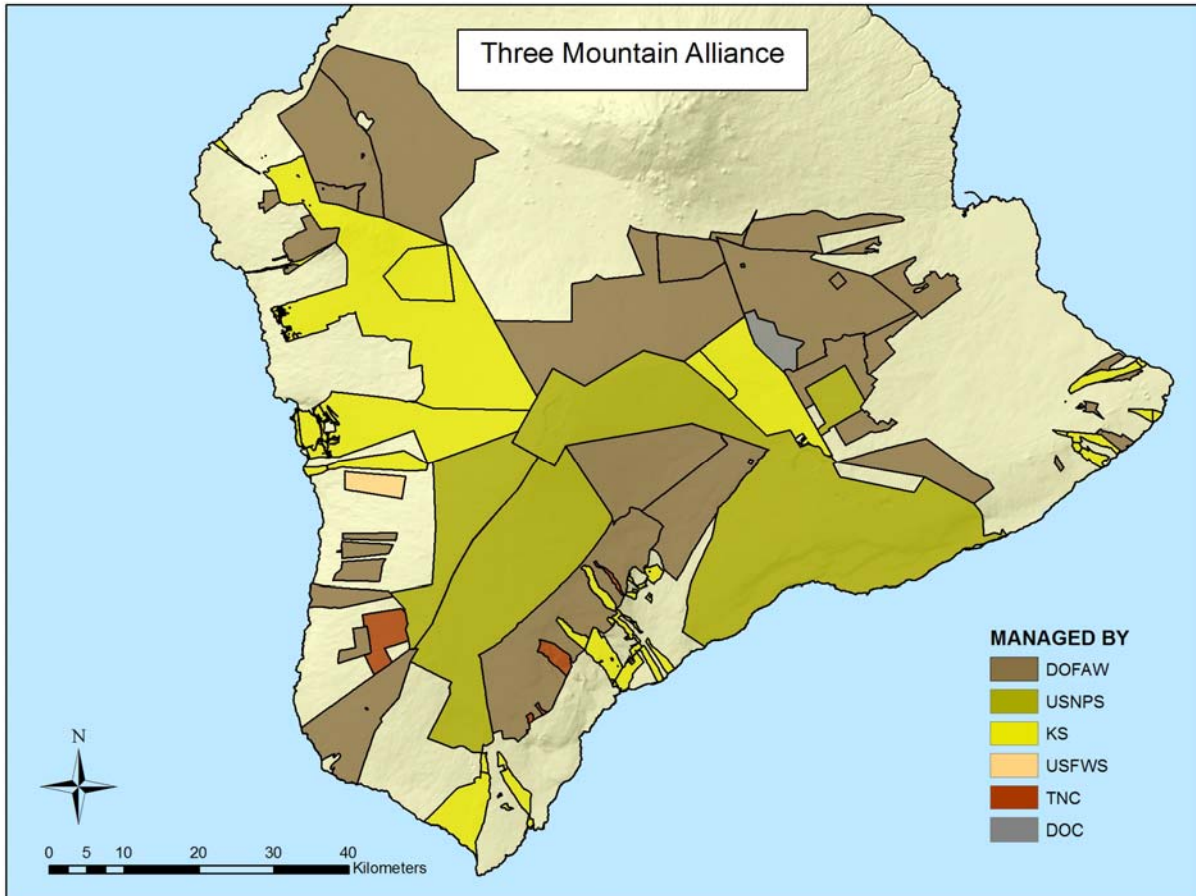
Within the watershed area, individuals and various *hula halau* collect some native plants, including: palapalai (*Microlepia strigosa*), ‘ōhi‘a, maile (*Alyxia stellata*) and other species. This practice however, has not been catalogued or documented in a comprehensive manner. Subsistence-based collection also occurs in the watershed on small scales, but the prevalence of this practice is also unknown and data mostly anecdotal. Illicit cultivation of contraband such as marijuana has historically been a concern. Though evidence has not been collected, it is likely that this activity persists today in some areas of the watershed. This illegal activity has led to the introduction of weeds and caused fires in the TMA.

Climate Change

Climate change has the potential to affect the TMA watershed hydrology through altering rainfall patterns and elevating cloud banks as well as changing forest structure and presence. Changing climate would affect the abundance and seasonality of precipitation, thereby affecting agricultural water users over a broad geographic area. Watershed functions would be compromised from the drying of the air, vegetation and soil, resulting from an elevation of the cloud bank. Rare ecosystems and species may be affected by relatively rapid changes in

precipitation, temperature, and humidity that result from a rapid and drastic change in regional or local climate patterns. Climate change would also impact the local culture and lifestyle. Populations of culturally-used plants, such as maile, may decline. Even the modern paniolo lifestyle that is characteristic of the region would be affected by a decline in rangeland quality resulting from a drying climate. Recreational opportunities might also be adversely affected.

IV. Overview of Existing Management in the TMA



The TMA area includes numerous Federal, State and private lands managed in part for long-term conservation. The TMA includes both land-owning and non-landowning members. Landowning members have various land-use designations, management policies and/or programs and plans for their lands. Non-landowning members provide expertise in land management and research that improves land management. Depending on land use purposes, land management can range from a variety of activities from agriculture to conservation. For protected areas, the main land management activities are for the preservation of resources (e.g. biological, cultural, historical, etc.) and include feral ungulate removal and control, invasive species removal and control, monitoring and surveying of resources, and research. Many protected areas also have management plans which guide land management.

State

Department of Land and Natural Resources, Division of Forestry and Wildlife (DOFAW) manages FRs, NARs, GMAs and Wildlife Sanctuaries. DOFAW has Draft Management Guidelines to help define DOFAW management priorities and apply a consistent philosophy for decisions and actions made by DOFAW (<http://www.dofaw.net>). The Draft Management Guidelines address three program areas with different resource demands or user groups: Outdoor Recreation, Forest Products, and Game Management (State of Hawaii 2003a). Additional unencumbered state lands are planned to be added to DOFAW management in the future, either under FR or NARS (e.g. Kamilo, Tract 22). In addition, the Office of Hawaiian Affairs (OHA) has purchased Wao Kele 'O Puna and DOFAW will provide management assistance to OHA.

- Forest Reserves (FR) were established to protect forested watersheds. They are also used for the production of timber and forest products, public hunting, and recreation. The TMA contains numerous Forest Reserves including Kaū FR, Kapapala FR, Mauna Loa FR, South Kona FR and Honua'ula FR, and the Pu'u Wa'awa'a FR (designation pending).
- The NARS was established to preserve and protect representative samples of Hawaiian biological ecosystems and geological formations. The TMA contains five NARS areas (60,609 acres). These areas include Pu'u Maka'ala NAR (12,106 acres), Waiākea 1942 Lava Flow NAR (644 acres), Kahauale'a NAR (16,726 acres), Manukā NAR (25,550 acres) and Kīpāhoehoe NAR (5,583 acres). Management Plans and Cultural Resource Overviews have been completed for the following NARS: Kahauale'a NAR (1992), Kīpāhoehoe NAR (2002), Manukā NAR (1992 and draft pending in 2007), and Pu'u Maka'ala (1989).
- Wildlife Sanctuaries were established to protect native and indigenous wildlife. The TMA includes the Pu'u Wa'awa'a Forest Bird Sanctuary (3,806 acres), and the Kīpuka 'Āinahou Nēnē Sanctuary (11,157 acres).
- GMAs are DOFAW lands designated for mammal and bird hunting. The TMA includes the Kapapala Cooperative GMA (29,614 acres) as well as the Pu'u Anuhulu GMA (69,278 acres).

Department of Public Safety, Corrections Division operates Kūlani Correctional Facility (7,400 acres) and has an interest in participating in the active preservation of natural habitat in the area and providing meaningful training and employment for its inmates. Kūlani lands have been managed for natural resource protection with the assistance of the OKP. Kūlani staff and inmates have assisted in fencing and other land management projects at Kūlani and on adjacent TMA lands.

Federal

U.S. Fish and Wildlife Service (USFWS) works with others to conserve, protect, and enhance fish, wildlife, and plants and their habitats for the continuing benefit of the American people. Two divisions of USFWS are involved in TMA (Ecological Services and Refuges). The Ecological Services Division (Conservation Partnerships) seeks to implement large-scale conservation efforts for the benefit of native ecosystems by working cooperatively with private landowners, conservation organizations, community groups, and other government agencies. The Refuge Division manages the Kona Forest Unit of Hakalau Forest NWR (5,341 acres) which

is included in the TMA. The primary purpose for establishing the Kona Forest Unit was to protect, conserve, and manage a portion of the native forest in South Kona for listed threatened or endangered species including forest birds, ‘io, and ‘alalā. Plans for the refuge include fencing, ungulate removal, weed control, and habitat restoration.

National Park Service (NPS) manages Hawai‘i Volcanoes National Park (323,431 acres) and is charged with the responsibility to conserve the scenery and the natural and historic objects and wildlife and to provide for the enjoyment of the same by the public. NPS management includes fencing and ungulate control, habitat restoration, eradication of priority non-native plants, propagation and outplanting of native plant species, monitoring and predator control for endangered birds, education and cultural resource protection. The NPS Inventory and Monitoring Program recently completed numerous marine and terrestrial inventories and monitoring protocols (for various species and habitats including fishes, fisheries, marine benthos, freshwater animals, selected birds, bat, terrestrial invertebrates, vegetation, land use changes, invasive species, and water quality). NPS will be revising its General Management Plan as well as completing an Environmental Impact Statement on their ungulate control program.

USGS Pacific Island Ecosystems Research Center (PIERC) works with other agencies and organizations to provide scientific understanding and technologies needed to support and implement sound management and conservation of biological resources on TMA and adjacent lands. USGS supports research on a wide variety of topics, including: invasive species impacts, endangered species biology, ecological restoration, population biology, avian disease dynamics, fire ecology and management.

USDA Forest Service, Institute of Pacific Islands Forestry (IPIF), conducts research and technology transfer on matters of the management, preservation, and restoration, of natural ecosystems and landscapes. Three focus areas are restoration of ecosystem processes, invasive species and forest management services. The Forest Service seeks to actively assist cooperators in land management and improvement of forest health on Federal, State and private lands. Pu‘u Wa‘awa‘a (State lands) was recently designated as a unit of the Hawai‘i Experimental Tropical Forest under a cooperative agreement with the US Forest Service. Pu‘u Wa‘awa‘a will provide a land base for conducting relevant natural resource related research (e.g. forest management, wildlife, fire, soil ecology, invasive species, global change etc).

USDA Natural Resources Conservation Service (NRCS) (originally called the Soil Conservation Service) provides leadership to help America’s private land owners and managers conserve their soil, water, and other natural resources. NRCS employees provide technical and financial assistance to land-users, communities, and units of State and local government for planning and implementing conservation activities.

Private Owners/Non-Profit Organizations

Kamehameha Schools (KS) is a charitable, landed trust that seeks to create educational opportunities in perpetuity to improve the capability and well-being of people of Hawaiian ancestry. KS owns over 295,000 acres on Hawai‘i island, with the Land Assets Division managing approximately 285,000 acres. The Land Assets Division mission is to enrich Kamehameha Schools’ land legacy through the integration of sound asset management, place-

based educational experiences, and stewardship of lands, natural resources, and wahi kūpuna. KS seeks to mālama i ka ‘āina: practice ethical, prudent and culturally appropriate stewardship of lands and resources. KS lands are managed to derive an overall balance of economic, educational, cultural, environmental and community returns as well as protect and enhance native ecosystems and the wahi kūpuna they contain. KS lands in the TMA include ahupua‘a in Ka‘ū and West Hawai‘i.

The Nature Conservancy’s (TNC) mission is to preserve the plants, animals, and natural communities that represent the diversity of life on Earth by protecting the lands and waters they need to survive. TNC owns and manages the Ka‘ū Preserve (3,491 acres) and the Kona Hema Preserve (8,061 acres). TNC has established a Hawai‘i Island Program to implement strategies for high-priority conservation areas of the island and pursue cooperative conservation of these areas’ partners.

V. Management Program

The overall management goal of the Three Mountain Alliance is to sustain the multiple ecosystem benefits provided by the three mountains of Kilauea, Mauna Loa, and Hualālai by responsibly managing its watershed areas, native habitats and species, historical, cultural, and socio-economic resources for all who benefit from the continued health of the three mountains. Management programs have been developed to support these overall goals and include the following: habitat protection and restoration, watershed protection, compatible economic use, compatible recreation and ecotourism, education, awareness and public outreach, cultural resource protection and research, monitoring and management program indicators. Each program identifies an objective, priority (where applicable), and proposed actions.

A. Habitat Protection and Restoration

Management Objective: Protect, manage, and restore habitats in sufficient quantity and quality to maintain ecosystem structure and function and allow native species to thrive.

The TMA seeks to protect and recover native ecosystems to the point that they are self-sustaining, native-dominated communities with secure populations of native plant and animal species (e.g. invertebrates, forest birds, bat, aquatic, etc.). Long-term goals include perpetuation of natural evolutionary and ecological processes (e.g. speciation, colonization, succession), and maintenance of biological and genetic diversity. Healthy native ecosystems will be more resilient to threats such as climate change and will be more capable of recovery after disturbance. Management work will generally focus on a larger, ecosystem level scale rather than intensive management of individual species. This ecosystem management approach is more cost effective and has potential for positive results on a large number of native species, both common and rare. Portions of the project area will be prioritized for management based on the quality of the native ecosystem because the probability of success is higher and costs are lower when the most intact and diverse resources are managed first. This approach is based on HAVO Special Ecological Areas (Tunison and Stone 1992, NPS 1996).

The TMA will focus resources and joint management efforts on significant areas of native-dominated forest, particularly above 1,000 m (3,000-ft) elevation. The biological integrity of the forest in these areas with respect to intactness and fragmentation is good to excellent. Ecological processes, driven largely by interactions between native invertebrates and plants, appear largely intact, but are affected by the loss of lower elevation species and ecosystems. The four priority management areas contain the best and most extensive remaining native forest in the TMA area as determined by the Hawaiian High Islands Ecoregional Assessment (TNC 2006) and other planning documents (State of Hawai'i 2005, USFWS recovery plans).

Although the TMA will focus most joint efforts on upper elevation, forested areas, the TMA area does include other important areas (e.g. coastal, degraded forests that require restoration, agricultural lands, lava flows, lowland dry and wet forests). These areas provide habitat for

certain rare native species and are important buffers and links between mauka lands and ocean resources. The TMA will develop demonstration projects in these other areas.

The habitat protection and restoration program will include two types of management actions: 1) removing or reducing impacts from major threats including fire, feral ungulates, weeds; and 2) conservation of biodiversity through native habitat and species restoration.

Overall Management Priority: Reduce the impacts of urgent threats to native ecosystems and species by jointly managing threats across the four management areas.

Fire

Certain TMA areas such as HAVO are well-prepared for the threat of fire with detailed fire plans, ongoing fire pre-suppression management and designated fire management staff. Other TMA areas, particularly private lands, need assistance with preventing and managing the threat of fire. All TMA areas could benefit from increased coordination across land ownership boundaries with fire management. DOFAW is responsible for fire protection within DOFAW lands and is also required to cooperate with fire control agencies of the County and Federal Government in developing plans, programs and mutual aid agreements for assistance for prevention and control of fires on forest, pasture, and brush lands on other lands. USFWS has funded fuelbreak projects in North Kona through Wildland Urban Interface and other programs. On the island of Hawai'i, DOFAW currently has mutual aid agreements with the Hawai'i County Fire Department, NPS and the United States Army Support Command, Hawai'i. These fire response agencies as well as USFWS are represented in the Big Island Wildfire Coordinating Group (BIGWIG) that works together to plan and coordinate fire response.

Fire Priority: Reduce wildfire occurrence and minimize wildfire impacts. Proposed Actions:

- Identify and prioritize TMA areas that need fire prevention measures and pre-suppression planning. Prevention and pre-suppression planning will reduce fire hazard as well as ensure TMA members are prepared to detect and respond quickly and effectively to fire.
- Implement fire prevention measures and pre-suppression planning. This includes mapping of fuels/fire history, fuels reduction projects, fire potential monitoring (e.g. fire weather data), creating/maintaining firebreaks, and community awareness and education.
- Assist willing private landowners with development of fire plans, communication with fire response agencies and maps showing infrastructure (e.g. access roads, gates, water sources, important resources etc).
- Expand TMA member firefighting capacity through greater interagency cooperation (e.g., sharing equipment, training, and fighting capacity).
- Develop fire projects that address other threats (e.g. fountain grass reduction).
- Encourage TMA members and private landowners to participate in BIGWIG regarding concerns about fire response.
- Assist post-fire restoration - TMA can play an important role in ecosystem restoration following fire (e.g. technical expertise) and assist with developing fire recovery and restoration plans as well as with implementation.

Ungulates

The TMA has multiple goals for managing the threat of feral ungulates across the landscape. Certain portions of the landscape are already, or will be designated primarily for the highest

levels of protection from ungulates. These protected areas will require costly fencing and systematic ungulate control to eliminate all ungulates from within the fenced management units as well as ongoing fence maintenance, removal of ingress feral animals and fence replacement. The TMA would like to reduce ungulate damage in other high priority native forest areas that are unfenced to allow for the maintenance of native forest cover and species diversity. DOFAW has recently released a report that provides a comprehensive review and recommendations on ungulate control methods in conservation areas (State of Hawaii 2007a). The TMA will generally be following ungulate control recommendations as outlined in that report. In addition, TMA members are also committed to providing enhanced hunting opportunities for the public in designated game management areas. These multiple ungulate management goals will need to be balanced across the TMA landscape.

The TMA will also be planning different management strategies for the different types of ungulates. The removal of feral cattle across the landscape is currently the highest priority ungulate management project for the TMA, and there is widespread agreement on eliminating feral cattle from TMA member lands. The management of other ungulates, particularly feral pigs, goats and mouflon sheep, is much more controversial, and will require additional landscape-level planning and environmental compliance prior to implementing a management strategy.

Ungulate Priority: Eliminate and/or reduce feral ungulate damage in high priority native ecosystems and watersheds while providing for increased hunting opportunities in designated areas. Proposed Actions:

- Participate in the Game Management Area (GMA) planning process for island of Hawai'i in order to establish GMAs in appropriate areas. This process will also include review and revision of DOFAW's draft management guidelines for DOFAW lands to better reflect habitat conservation and game animal hunting needs.
- Feral Cattle – Work cooperatively on feral cattle control in Kaū FR, Kapapala FR, Kahuku, South Kona FR, Honua'ula FR, and other designated areas. Initiate discussions with major private landowners to facilitate cooperative feral cattle removal.
- Increase the total acreage of forest and watershed protected areas from degradation by nonnative ungulates by fencing and controlling ungulates. Link fenced protected areas when possible to reduce the cost of fencing and provide larger habitat areas. Priority areas include Kaiholena (TNC), Kahuku (NPS), Pu'u Maka'ala NAR, North Kona Habitat Restoration Project (KS), Kona NWR (FWS), Manukā and Kīpāhoehoe NARs, and Pu'u Wa'awa'a conservation units.
- Maintain existing and future fenced, ungulate-free management units, remove ingress animals and replace fencing as necessary.
- Increase knowledge of ungulate threats by supporting research across boundaries (e.g range expansion, impacts, population dynamics and control methods for mouflon sheep).

Weeds

The most intact portions of the TMA currently have a limited degree of non-native plant invasion thus reducing the degree and costs of management necessary. A concerted joint effort surveying, mapping and controlling these weeds before they have a chance to become more firmly established in native habitat is critical and will reduce the cost of control programs in the future.

The TMA seeks to jointly and strategically address the threat of invasive plants across land ownership and management boundaries at a landscape scale for greater effectiveness. A regional effort in mapping, planning and control will greatly increase the success of weed control across the TMA area and provide greater protection for the most intact native ecosystems and watersheds.

The TMA will work closely with Big Island Invasive Species Council (BIISC) whose focus is prevention, early detection of and rapid response to weeds which are incipient to the island. Complementing this work, TMA will focus on preventing the establishment of, or eradicating, priority invasive plants in pristine areas or areas with recovery potential.

TMA representatives individually and collectively have a wealth of expertise related to weed research, management, and control. Some members have particular strengths in weed mapping, database management, cost/benefit analysis and weed risk assessment. Landowning partners all have ongoing weed programs that can provide critical information on distribution, effective control techniques, and invasiveness of particular weed species. Sharing and centralization of weed distribution and control information will help identify data gaps, provide a more comprehensive view of the status of a particular species or habitat, and allow management decisions to be made using the most up-to-date, accurate information.

Weed Priority: Protect high quality native Hawaiian ecosystems and endangered species from habitat altering, non-native invasive plants, through coordinated, regional planning and control efforts. Proposed Actions:

- Hire a TMA Weed Management Specialist to develop a long term invasive plant control plan for the TMA to reduce the threat of invasive plants to the integrity of native ecosystems and endangered species.
- The Specialist will develop a target list of threatening weed species, consolidate existing distributional data from different sources, conduct surveys, create weed distribution maps, and prioritize weeds and areas for control.
- Initiate strategic control work on the highest priority incipient species on TMA lands with new field staff and existing weed control personnel. Direct control of invasive plants will be by proven mechanical and chemical methods or use of approved biocontrol agents where available. Monitor and map control efforts in order to evaluate the success of control.
- Support increased biocontrol research efforts for high priority weed species.

Additional Threats

Additional Threat Priority: Eliminate and/or reduce additional threats to native ecosystems.

Proposed Actions:

- Expand control of mammalian predators (e.g., feral cats, rats, mongoose) in waterbird (including nēnē), seabird, and forest bird habitats to benefit survival of these species as well as to reduce native seed predation using currently existing methods (live traps, poison-bait stations). Widespread control is not possible so control efforts will be focused in the highest priority areas (e.g. bird nesting sites, rare plant locations, etc).
- Support the development and implementation of new, more effective techniques for widespread control of mammalian predators by developing demonstration projects on TMA lands. New techniques will include aerial broadcast of rodenticides (once

Environmental Protection Agency approval received and environmental compliance is completed), establishment of predator-free areas using predator-proof fencing and development of new trapping and poison bait technology.

- Expand control efforts for non-native invertebrates that threaten native invertebrates in high priority areas. Limit spread of certain species (e.g. ants) into new areas through implementation of sanitation protocols.
- Develop a prevention and interdiction strategy for new incipient species and/or introduced diseases that reduces opportunities for introduction of potentially invasive or disruptive species and prepares managers to swiftly react to new introductions.
- Institute long-term monitoring and rapid response to new invasions, introduced disease etc.
- Identify where human disturbance threatens native ecosystems. Minimize the effects of destructive human activities by encouraging human activities in appropriate areas.
- Take climate change into account when planning management actions. Monitor changes due to climate change. Protect and manage large landscapes so ecosystems and species are more resilient to climate change.
- Support the enforcement of existing laws and rules to prevent unregulated and illegal land uses such as ATV and illegal camping/trespass/illegal logging.
- Comply with the goals of the Hawai'i Aquatic Invasive Species Management Plan (State of Hawaii 2003) to minimize harmful ecologic and economic impacts of invasive aquatic species, through the prevention and management of their introduction, expansion, and dispersal into, within, and from the TMA area.

The threat management actions described above targeted towards the highest quality native ecosystems will be the most critical management activities on TMA lands. The protection and recovery of rare and endangered plants and animals will also require additional efforts including habitat protection and species restoration projects.

Native Habitat Protection and Restoration

Native Habitat Protection and Restoration Priority: Protect and restore large areas of native habitat to conserve biodiversity and provide larger, more ecologically functional habitats and wildlife corridors. Proposed Actions:

- Strengthen existing and create new partnerships and cooperative efforts by encouraging additional landowner participation and involvement in TMA.
- Support the protection of remaining intact native forest areas from development through a combination of acquisition, conservation easements, or cooperative agreements with landowners.
- Restore degraded lands with native vegetation by removing or reducing threats, enhancing natural regeneration, planting and broadcast seeding. Important areas with ongoing or proposed restoration projects include Keauhou Ranch (KS), Pu'u Wa'awa'a and Honua'ula FR.
- Increase acreage of public land protected as well as funding for management (e.g. encourage the transfer of high quality unencumbered state land to FR or NAR management).

Species Restoration

As broad-scale management actions are incrementally completed, the TMA will spend more time and effort on monitoring and implementing specific recovery actions for rare and endangered species. The TMA will identify problems affecting native species stability as well as inventory current status of certain native species populations. Once critical problems are identified, the TMA will determine possible management options and how to implement them. Management actions will help reduce or alleviate problems and monitoring and evaluation will help us determine if we have reached our management objectives and/or how management should be changed. The USFWS has prepared recovery plans for numerous threatened and endangered species on Hawai‘i, including the Nēnē, Hawaiian Forest Birds, Blackburn’s sphinx moth, alalā, Hawaiian Hoary Bat and for threatened and endangered plants. These plans outline recovery goals for these species, major threats and proposed recovery actions.

Species Restoration Priority: Manage native species and ecosystems to protect and recover rare species. Proposed Actions:

- Rare plants – This project will include distribution mapping and searching for additional individuals and populations; monitoring to determine threats; protection of isolated occurrences of rare and endangered species that do not occur in areas appropriate for large-scale protection or restoration; collection of representative genetic material; propagation and outplanting in protected areas for species that appear to be inadequately reproducing in the wild or for those in need of restoring genetic representation. TMA staff and members will work with the Plant Extinction Prevention Program and Volcano Rare Plant Facility to coordinate efforts.
- Forest bird management – TMA members will be implementing management that will enhance native forest bird populations including managing feral ungulates (to enhance forest protection as well as reduce mosquito populations thereby reducing avian disease), reforestation, weed control, and predator control.
- Forest Bird Surveys - The abundance and distribution of native birds will be monitored annually in some areas (Kūlani, Kīlauea, Keauhou and USFWS Kona Forest Unit). More frequent surveys are needed in other areas (e.g. Ka‘ū and Upper Waiakea FR). TMA members will collaborate to prioritize surveys, share staff and resources to implement surveys and analyze survey data to produce summary reports (See for example Gorresen et al. 2005). Survey results will be used to demonstrate the effectiveness of ongoing management programs and to alert managers of any major population changes. Endangered forest birds will require more intensive demographic surveys to determine population trends. The TMA will encourage additional studies to determine the status and trends of the three species of endangered forest birds (‘akiapōlā‘au, Hawai‘i ‘ākepa, and Hawai‘i creeper).
- ‘Alalā - release of captive birds is proposed in approximately five years (2012), and the top priority sites are all within the TMA. TMA members will participate in selection of release sites, release planning, site preparation and implementation of release.
- Native invertebrates will benefit from the protection and enhancement of native plant communities as many are plant host specific. TMA members will also protect lava tube and cave habitats that support many species of rare subterranean invertebrates.
- Increase basic biological surveys in less well-known areas to find new populations of rare species and potentially lead to the discovery of new species in the area.

B. Watershed Protection

Management Objective: Maintain and/or restore native forest cover to provide important watershed protection benefits as well as benefits to native ecosystems and species.

Many watershed protection priorities and actions overlap with habitat protection and restoration priorities and actions described above. Mauka lands are important water catchment areas. They capture and transport water to the basal aquifer, where it is accessible for domestic, agricultural and industrial use. Land management practices that facilitate this process should be encouraged.

Flooding and sedimentation problems in makai communities are often attributed to land management practices in mauka areas, though the severity of the problems is exacerbated by or lies at the root of poor planning and limited capacity of low elevation floodways. Collaboration and access to additional funding are needed to address this problem.

The TMA will focus efforts on maintaining and re-establishing native forest cover in mauka areas to improve the capacity of the ground to absorb heavy rainfall. Maintaining a structurally-complex vegetative cover will promote infiltration and groundwater recharge and minimize erosion and flooding.

Proposed Actions:

- Manage threats such as ungulates, fire and weeds as described above to minimize disturbances to robust forested watershed.
- Protect, enhance, and manage high yield watershed areas to maintain water quantity and quality. Encourage forest cover to reduce the severity of flooding.
- Work closely with other private landowners and regulators to promote incentives for best-management practices and implement deterrents for inappropriate land-use practices.
- Support appropriate water development to meet the needs of future demand as well as appropriate water management policies.
- Monitor and document changes in forest composition and health. Conduct a monitoring program in conjunction with management projects to document short- and long-term changes in watershed quality. Revise management strategy, as appropriate, based on monitoring results.
- Develop programs to monitor long-term impacts to water quality and watershed health, in cooperation with other Watershed Partnerships.

C. Compatible Economic Use

Management Objective: Encourage economic uses of lands that are compatible with habitat and watershed protection goals.

Mauka lands provide a variety of ecosystem services that are critical to the economy and quality of life on Hawai'i Island. Certain economic uses of land such as ranching, sustainable forestry and agriculture can be done in a manner that provides significant environmental benefits such as climate regulation, flood control, and groundwater recharge. These land-uses can also enhance biodiversity as a co-benefit. Ecotourism can generate income for landowners and provide

environmental benefits such as public awareness. Development can also be done in a manner that is more consistent with land conservation objectives. Conservation objectives on private lands can best be accomplished by encouraging economic investment and financial return sufficient to stabilize ownership, fund proactive resource management and sustain critical ecosystem services.

Some TMA members are working closely with the Natural Capital Project, a joint project of TNC, World Wildlife Fund and Stanford University. The goal of this project is to “make conservation economically attractive and commonplace.” This project has ongoing research to identify and quantify ecosystem services as well as encourage private landowners to implement compatible economic development projects. The TMA will provide leadership in developing compatible economic uses by developing demonstration projects on TMA lands and supporting this type of alternative land management.

Proposed Actions:

- The TMA will encourage the participation of additional private landowners, either through membership in the TMA and/or through the development of collaborative projects. The TMA will also collaborate with other existing landowner groups such as the Kona Mauka Land Group Forum to develop and implement compatible economic uses of important lands.
- Landowners considering diversification or a transition from ranching should be encouraged to pursue alternative sources of income such as sustainable forestry. TMA members will demonstrate the viability of sustainable koa forestry by developing demonstration projects and public education programs. TNC and KS have sustainable forestry management and research projects ongoing that can provide other land managers with the tools needed for sustainable forestry (e.g. thinning trials, evaluating the effects of invasive grasses on koa regeneration and growth, sustainable forestry certification).
- Grazing can benefit strategic areas by reducing fire risk and reducing weeds that threaten forested areas. High quality pasture with abundant trees can provide more environmental benefits than other more intensive land uses. TMA will develop grazing demonstration projects to control weeds and reduce fire risks. TMA is also interested in planning demonstration projects that combine sustainable forestry and grazing projects.
- Growing vegetation sequesters atmospheric carbon, thereby mitigating the adverse effects of carbon dioxide on global warming. The TMA will encourage policies, regulations and funding strategies that maintain and restore forest cover. The TMA will also encourage new, collaborative approaches to selling carbon credits.
- Support the policies, laws, and funding programs that provide incentives (e.g. compensation) to mauka landowners for land management practices that provide ecosystem services through direct payments and incentives.
- Support the development of alternative funding sources that promote forest conservation. This may include State and Federal landowner assistance programs, conservation easements, transfer of development rights, forest banking and related initiatives.

D. Compatible Recreation and Ecotourism

Management Objective: Increase compatible public recreation and ecotourism opportunities to provide residents and visitors an enjoyable way to experience the outdoors as well as increase public awareness and support for conservation of TMA's unique natural and cultural resources.

The TMA supports increased recreational and ecotourism uses of certain TMA lands where compatible with other watershed protection values. Public access for activities such as hiking, backpacking, hunting, camping, horseback riding, and bird-watching should be increased on certain public lands and onto private lands, where deemed compatible by the landowner. Ecotourism can provide economic benefits to landowners and also provide income to support conservation and watershed protection objectives.

The TMA will work closely with the Na Ala Hele state trail and access program to develop and maintain recreational use access for designated public lands. Na Ala Hele, administered by DLNR's Division of Forestry and Wildlife, was established in 1988, in response to public concern about the increasing loss of public access to trails and the threat to historic trails from development pressure.

Pu'u Wa'awa'a currently has hiking trails open to the public in the mauka regions, and the Kīholo-Huehue trail is part of the Na Ala Hele Trail and Access System. The Ala Kahakai National Historic Trail also passes through the makai reaches of Ka'upulehu, Pu'u Wa'awa'a and Pu'u Anahulu. There are numerous additional trails in the TMA area (See State of Hawaii Na Ala Hele website: www.hawaiitrails.org).

Some TMA members are working on the development of a Mauna Loa Trail system, and a feasibility study for this trail has been completed (TNC 2005). Modeled after highly successful long-distance trails systems in New Zealand, Europe and the United States, the proposed system would encircle Mauna Loa volcano at the mid-elevation ranges (4,000 to 7,000 feet) and exceed 350 miles in length. It would be the first long-distance trail system of its kind in the Hawaiian Islands. The Mauna Loa Trail System would provide for a wide diversity of activities and experiences, such as hiking, backpacking, camping, horseback riding, birding and hunting.

Proposed Actions:

- Increase public access for hiking and other recreational activities on public lands.
- Mauna Loa Trail – Determine TMA role in project. Determine appropriate next steps as recommended in the feasibility study and develop implementation plan.
- Continue to expand the Pu'u Wa'awa'a Trail system as staffing and resources become available.
- Maintain existing trails in TMA area.
- Support public hunting on appropriate TMA lands, where compatible with watershed protection values.
- Permit public access to and over private property only with explicit permission of private property owner or representative to promote enhanced recreational and ecotourism opportunities.
- Assess impact of eco-tourism activities on native wildlife and associated habitats.
- Both public and private lands in mauka Kona are virtually inaccessible to the general public for hiking, ecotourism and related recreation, in part because of concerns about

landowner liability. Action is needed to amend the Hawai'i Recreational Use Statute to address the liability issue.

E. Education, Awareness and Public Outreach

Management Objective: Environmental education is needed to increase public understanding of threats to the native watershed, as well as increase support for management projects to protect the watershed.

The TMA seeks to expand outreach and education to improve understanding of our natural resources among residents, visitors, and decision-makers as well as encourage the appropriate use of natural, watershed, cultural, and historical areas for educational projects.

The TMA is planning on supporting a full-time Environmental Education and Outreach Specialist position to coordinate education, awareness and public outreach throughout the TMA area. This program will provide students and their teachers with hands-on field opportunities to educate them about Hawai'i's natural resources. The Education Specialist will also coordinate teacher workshops, community outreach, and volunteer projects on native Hawaiian ecosystems and watershed issues. Over the long term, attitudes within the community regarding the environment will change and public knowledge, interest and awareness of the issues facing the TMA area will increase.

Proposed Actions:

- Educate decision-makers concerning the importance of supporting laws, policies, and funding to protect native habitats and species as well as watershed areas for the benefit of the people of Hawai'i Island.
- Put on standards-based (*Hawai'i State Content and Performance Standards*) teacher workshops on watershed protection and environmental stewardship. All workshops will be field-based and involve experts from the appropriate fields. This project will directly reach over 48 educators from local public and private schools annually.
- Implement a field based environmental education program for secondary grade levels during spring and summer breaks. This project will directly reach over 48 students annually.
- Collaborate with TMA members' educational programs and staff (e.g. DOFAW, NPS, TNC and BIISC) to increase joint educational and outreach efforts in order to reach a larger audience.
- Implement objectives for outreach and education outlined in the Pu'u Wa'awa'a Management plan and in the Hawai'i Experimental Tropical Forest cooperative agreement.
- Work with the 'Āina Ulu Program (KS) to develop appropriate educational projects on KS lands. The mission of 'Āina Ulu is to bridge land and natural resource management with education. This program seeks to carry out ethical, prudent, and culturally appropriate stewardship of lands and natural resources while extending educational opportunities to more lifelong learners of Hawaiian ancestry.
- Develop public service announcements (PSAs) on watershed issues focused on the TMA area to play on a popular local radio station. Each PSA will broaden the public's knowledge and increase public support for watershed management and protection. This project will also result in approximately 48 new PSAs (approximately four per month).

- Initiate a volunteer program focused on stewardship of the TMA area. Increased use of volunteers in projects such as weed control and reforestation will increase knowledge and support for TMA programs. The Environmental Education Specialist will also be available to lead volunteer groups (approximately 12/year).
- Provide internship opportunities for local students (e.g. University of Hawai‘i Forest Team, UH-Hawaiian Internship Program and Youth Conservation Corps).
- Expand education and work training opportunities for Kūlani inmates (native plant horticulture program, etc).
- Participate in public outreach including County Fair, Earth day and other community events (approximately 6/year).
- Provide updated information on TMA plans and projects on the Hawai‘i Association of Watershed Partnerships (HAWP) website as well as participate in professional conferences such as the HAWP Symposium and Hawai‘i Conservation Conference.

F. Cultural and Historical Resource Protection

Management Objective: Ensure that culturally significant areas and practices within the TMA are identified, protected, and enhanced.

Many culturally and historically significant sites are found on both private and public lands in the TMA. The TMA will work to identify these sites and ensure they are protected from disturbance. Very few archaeological investigations have been completed in many portions of the TMA. Land managers require such knowledge to effectively manage these resources and to mitigate potential impacts to cultural and archaeological resources while implementing other management objectives. Where these sites occur on lands accessible to the public, the cultural significance of these sites should be effectively interpreted. In addition, the historic and cultural patterns of land use and the “living” cultural significance of mauka lands should be recognized and fully considered in regional planning.

The TMA does not intend protection to mean the exclusion or extinguishing of traditional and customary cultural practices. Rather, the TMA intends to support and encourage these practices as described below.

“Traditional and customary cultural practices are done in a manner consistent with cultural subsistence, where each form of native life is treasured and protected. *Kūpuna* express this thought in the words, “*Ho‘ohana aku, a ho‘ōla aku!*” (Use it, and let it live!) (Maly 2004c).”

Proposed Actions:

- Survey, document, and protect culturally significant areas within the TMA, in collaboration with cultural resource specialists.
- Conduct comprehensive cultural and archaeological surveys in proposed project areas to determine the location and condition of historical sites.
- Develop access to less sensitive sites for educational purposes as well as for traditional cultural practices.

- Encourage the development of appropriate protocols for sustainable traditional and cultural gathering in selected portions of the TMA. Ensure the long-term availability and sustainability of resources for traditional resource gatherers, working with *kupuna* and others.

G. Research, Monitoring and Management Program Indicators

Management Objective: Direct the research and monitoring program towards the assessment of the success of management actions to provide direction for future actions.

The TMA will determine ecosystem parameters that can serve as targets for management in different areas, and will need to evaluate the current status of TMA ecosystems relative to these parameters. The TMA will also monitor the response of native and non-native species to management and use the results of monitoring to further refine management and research strategies. Criteria for evaluating the success of management will include ecosystem structure (e.g. expected population structure of dominant and co-dominant plant species, vegetation layers dominated by native species, and a high diversity of woody and non-woody native plant species), self-sustaining populations of common and rare native plant and bird species, and non-native species absent from the project area or at population levels that are not affecting native species. Successful response of the ecosystem to management will be indicated by stable and increasing populations of rare and endangered species as well as maintenance of the more common plant and animal species that comprise the ecosystem matrix. As research and monitoring help us gain an understanding of what constitutes a healthy native ecosystem, we will further refine our management activities.

Proposed Actions:

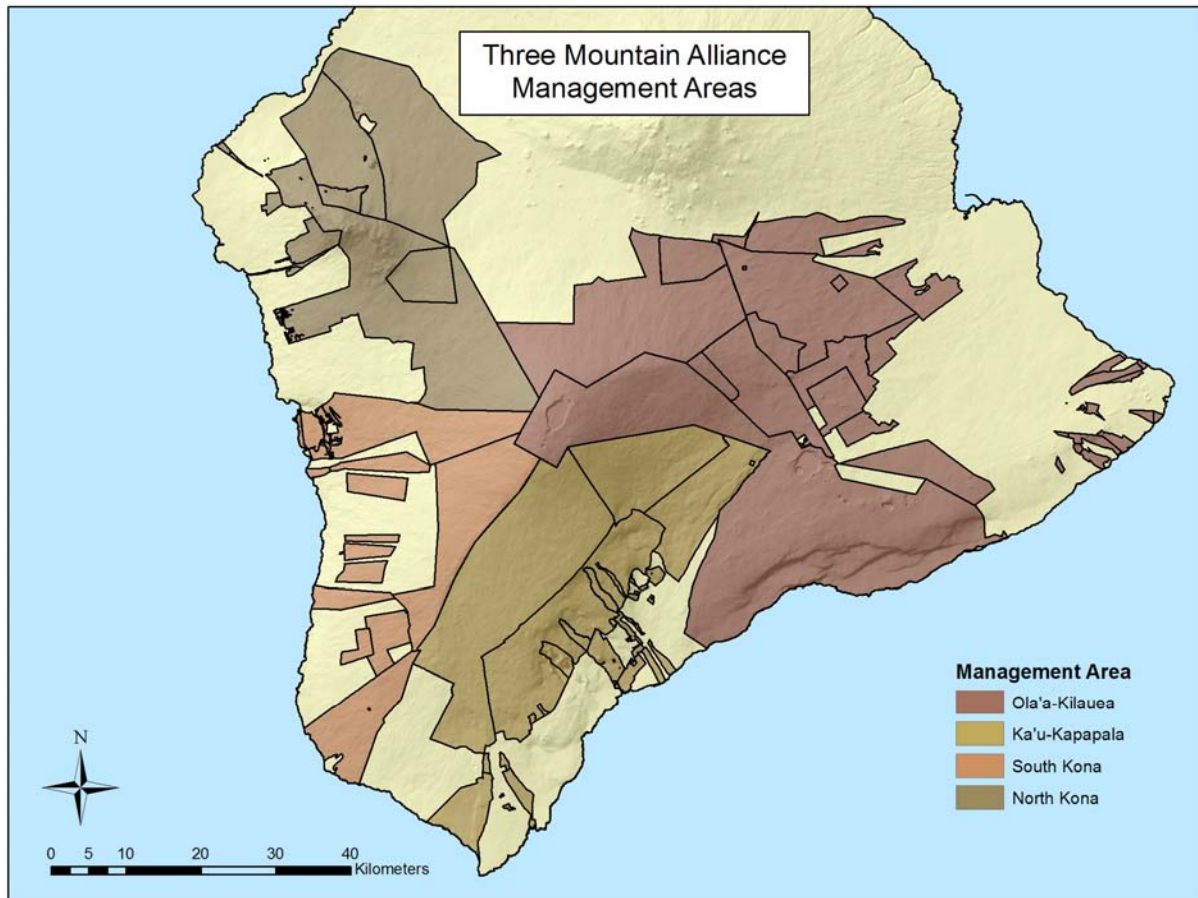
- Develop and implement new monitoring programs for TMA projects to guide conservation management and recovery programs.
- Continue ongoing monitoring programs (e.g. forest bird surveys, weed monitoring).
- Improve analysis and dissemination of existing research and monitoring data to TMA members regarding native species populations, habitat conditions and weed distribution.
- Develop management program indicators for each of the six main programs (habitat protection and restoration, watershed protection, compatible economic use, compatible recreation and ecotourism, education, awareness and public outreach and cultural resource protection) as well as for each of the four management areas. These indicators will show whether progress is being made.
- Support the use of new monitoring tools in the TMA area that can be more efficient on a large-landscape scale such as remote sensing technologies <http://cao.stanford.edu>.
- Develop lists of high priority research needs supporting management programs as well as potential research sites.
- Support relevant research initiatives such as the Ecohydrology Project. This project will examine how vegetation composition affects water balance processes in Hawaiian forests. It will be especially important to determine the degree to which native forest ecosystems might benefit the preservation of surface and groundwater reserves relative to non-native species.

http://www.botany.hawaii.edu/UH_EPSCoR_Ecology/Ecohydrology/EPSCoR_Ecohydrology_Project.htm.

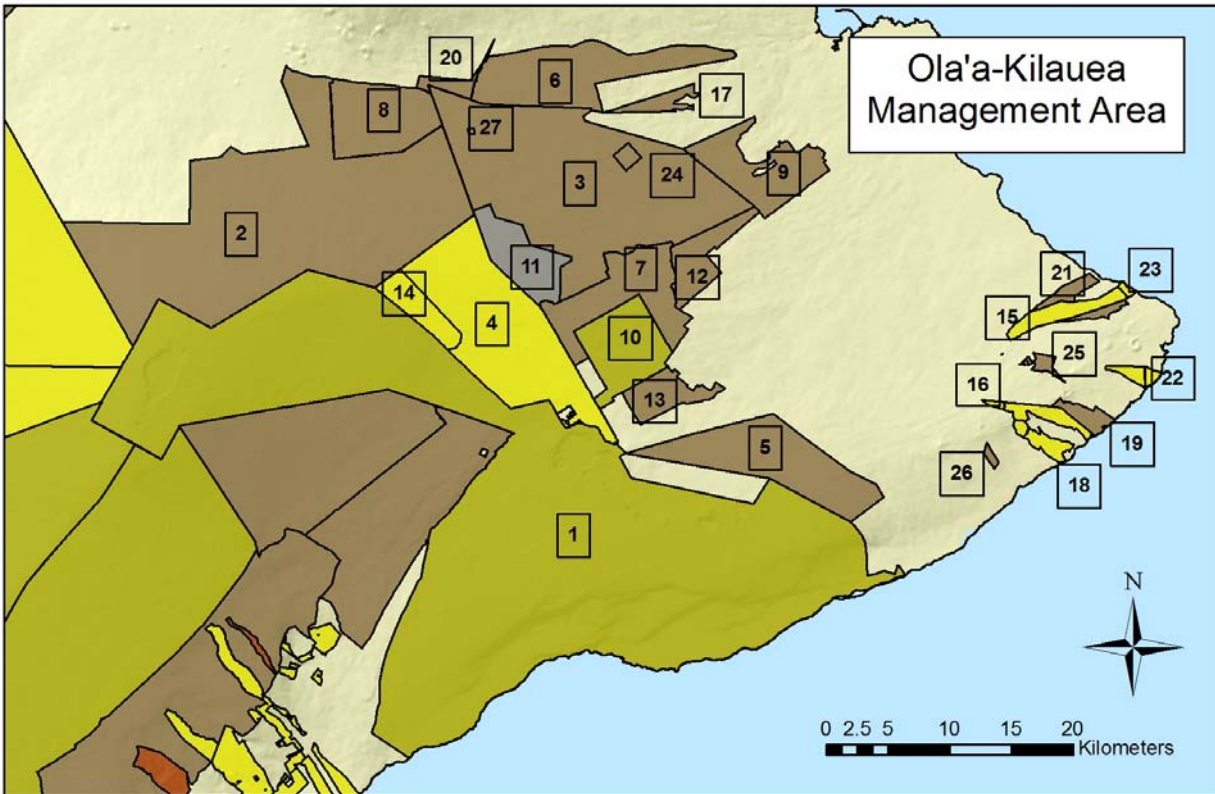
- Implement the research planned for the Hawai'i Experimental Tropical Forest at Pu'u Wa'awa'a. Expand relevant research results to other TMA areas.

VI. Management Actions for Four Priority TMA Areas

The previous section outlined the overarching management programs, goals, priorities, and actions focused on the entire TMA area. Given the large landscape under the TMA, for management purposes, it has been divided into four main priority TMA areas based on political, ecological, topographical, and land ownership characteristics. Specific priority projects which support the overarching management programs have been outlined under each of the four priority areas. Since there are no distinct boundaries between these areas, many management issues and actions will overlap across management areas. A detailed project statement for each listed priority project will be developed.



A. 'Ōla'a Kīlauea Management Area



ID	NAME	MANAGED BY	HECTARES	ACRES
1	HAWAII VOLCANOES NATIONAL PARK	USNPS	84,432	208,634
2	MAUNA LOA FOREST RESERVE	DOFAW	31,899	78,823
3	UPPER WAIAKEA FOREST RESERVE	DOFAW	21,495	53,115
4	KAMEHAMEHA SCHOOLS - KEAUHOU	KS	13,152	32,499
5	KAHAUALEA NATURAL AREA RESERVE	DOFAW	6,825	16,865
6	HĪLO RESTRICTED WATERSHED	DOFAW	6,563	16,217
7	PUU MAKAALA NATURAL AREA RESERVE	DOFAW	4,885	12,071
8	KĪPUKA AINAHOU NENE SANCTUARY	DOFAW	4,495	11,106
9	WAIAKEA FOREST RESERVE	DOFAW	3,981	9,836
10	HAWAII VOLCANOES NATIONAL PARK	USNPS	3,918	9,682
11	KULANI PRISON	DOC	2,915	7,203
12	OLAA FOREST RESERVE	DOFAW	2,061	5,093
13	OLAA FOREST RESERVE (MT. VIEW SEC.)	DOFAW	1,748	4,320
14	KEAHOU COOPERATIVE NENE SANCTUARY	KS	1,579	3,901
15	KAMEHAMEHA SCHOOLS - PUNA (KAHUAWAI)	KS	1,239	3,061
16	KAMEHAMEHA SCHOOLS - PUNA (KAUAEA)	KS	791	1,956
17	HĪLO FOREST RESERVE (KUKUAU SEC.)	DOFAW	706	1,744
18	KAMEHAMEHA SCHOOLS - PUNA (KAUELEAU)	KS	623	1,538
19	MALAMA KĪ FOREST RESERVE	DOFAW	611	1,509
20	PUU OO ADDITION	DOFAW	564	1,394
21	NANAWALE FOREST RESERVE	DOFAW	488	1,207
22	KAMEHAMEHA SCHOOLS - PUNA (PU'ALA'A)	KS	412	1,018
23	NANAWALE FOREST RESERVE (HALEPUAA SEC.)	DOFAW	283	698
24	WAIAKEA 1942 LAVA FLOW NATURAL AREA RESERVE	DOFAW	261	644
25	NANAWALE FOREST RESERVE	DOFAW	260	642
26	KEAUOHANA FOREST RESERVE	DOFAW	111	274
27	UPPER WAIAKEA BOG SANCTUARY	DOFAW	20	50

Background

The ‘Ōla‘a Kīlauea Management Area includes lands on Mauna Loa and Kīlauea jointly managed by the ‘Ōla‘a Kīlauea Partnership (OKP) (Hawai‘i Volcanoes National Park, Kūlani Correctional Facility, Pu‘u Maka‘ala Natural Area Reserve, Kīlauea Forest and Keauhou Ranch) as well as additional DOFAW and KS lands not previously included in the OKP (e.g. Upper Waiākea and Mauna Loa Forest Reserves, Waiākea 1942 Lava Flow NAR, Kīpuka ‘Āinahou Nēnē Sanctuary, Kahauale‘a NAR, etc). Most management to date has occurred in the OKP area, and the background of work in the OKP is discussed below. TMA members will work together to continue ongoing work in the OKP as well as expand joint planning and management work to the entire ‘Ōla‘a Kīlauea Management area in the future.

The OKP was established in 1994, and OKP activities have been guided by the 1999 Final Environmental Assessment and Management Plan. Although this plan is out of date, the management goals and priorities for this core OKP area remain the same. Management goals include enhancing the long-term survival of native ecosystems and managing a large contiguous area across land ownership boundaries. Management and research are currently focused on reducing impacts from feral animals, non-native plants and non-native predators, restoring native habitat and endangered species, and providing work training and education to Kūlani inmates.

The OKP area is essential habitat for four species of endangered forest bird, and also supports the endangered ‘io, nēnē, Hawaiian bat, two species of seabird, numerous rare invertebrates and twenty-two rare and/or endangered plant species. The Partnership goal for this area is to implement projects to protect and restore ecosystems with high biological value. Most joint management work to date has been done in Kūlani, Kīlauea Forest, Keauhou Ranch and in portions of Pu‘u Maka‘ala Natural Area Reserve.

Fencing and subsequent feral ungulate control (pigs, sheep, mouflon sheep and goats) have been the focus of management efforts over the last ten years, and the OKP has made significant progress in achieving our goal of creating a large network of contiguous, fenced management units and reducing ungulate numbers in over 60,000 acres. The OKP has over 10,000 acres fenced and ungulate-free, and ungulate control work is underway in an additional 25,000 acres. The focus of management efforts has been intact, high elevation, native-forest areas (mesic and wet koa/‘ōhi‘a forest, wet ‘ōhi‘a/hapuu forest and mesic and dry ‘ōhi‘a forest). The fenced units are now being used as recovery areas for native ecosystems and rare and endangered species. These units are all linked to over 25,000 acres of existing fenced management units on national park lands and include some of the best quality native forest in Hawai‘i.

New additions to this management area are primarily managed by DOFAW. The TMA will assist DOFAW with cooperative watershed management planning and implementing an increased level of management in these areas. Management planning for these areas will include consideration of multiple interests such as conservation, hunting, recreation, timber management and cultural uses. These areas are critical watershed areas, are important buffers to existing fenced management units, and also contain very important native ecosystems and species.

Threats and Management Needs

Feral ungulates will continue to remain a threat because there are high numbers of animals outside fenced management units. Ongoing management (fence inspection, maintenance and replacement) will ensure that management units currently free of feral ungulates will remain that

way, and fenced areas with feral animals will continue to have the animals removed until they are at zero-levels. The high quality native forest in these areas will continue recovering from previous feral animal damage with ongoing management. New fencing and ungulate removal is planned for additional high quality forested portions of this management area (e.g. Pu'u Maka'ala NAR).

Invasive weed control is now the most critical management action needed to maintain the high quality of the forest within fenced management units as well as in other portions of this management area. There are 23 priority invasive plants that will be the focus of distribution mapping, control, and monitoring efforts. An overall control strategy and prioritization of species and areas for control will be developed using distribution mapping information. Staff will control plants using manual or mechanical means and/or herbicides. Target weed populations will be monitored to determine the effectiveness of control treatments and the possible need for follow-up control. Monitoring information will be used to monitor the distribution of all invasive weed species along transects to detect long-term change over time, assess overall health of the ecosystem, and help determine future management actions.

Portions of this management area contain degraded forest lands that are a high priority for restoration (e.g. Keauhou Ranch). These lands link high priority managed areas and provide important habitat for native species.

Priority Projects

- Maintain existing fenced, feral-animal free units, and monitor/control ingress animals in fenced management units (Boy's School, Pu'u Kipu, Kūlani Cone, Pu'u Lalaau, North Boundary, Lava Flow, Na Lua Mahoe, and Aku Units).
- Complete ongoing feral animal control projects in fenced management units (Keauhou Ranch, Kūlani South Boundary, and Wright Rd).
- Implement a strategic weed control plan for fenced management units in the OKP area.
- Assist Kamehameha Schools with reforestation work (Keauhou Ranch).
- Encourage conservation management and compatible economic uses of Kūlani lands (Dept. of Public Safety).
- Assist the Department of Public Safety (Kūlani Correctional Facility) and Kamehameha Schools (Keauhou and Kīlauea) with the development of a Habitat Conservation Plan and/or Safe Harbor Agreement.
- Implement new fencing projects and ungulate control (e.g. Pu'u Maka'ala NAR fencing in 2010 – 10 miles of fence to protect an additional 5,000 acres). Initiate ungulate control in 2012.
- Cooperative watershed management planning and implementing management for upper elevation sections of Hilo Watershed, Upper Waiākea Forest Reserves, Waiākea 1942 Lava Flow NAR, Mauna Loa Kīpuka Mosaic areas, Kīpuka 'Āinahou Nēnē Sanctuary (DOFAW) and high quality forested lands in the lower Puna region (Kahauale'a NAR, Nānāwale, Puna, Keauohana, Malama-Kī Forest Reserves and KS lands).
- Implement rare plant restoration projects in fenced, ungulate-free areas.
- Implement bird restoration projects. Continue and expand annual forest bird surveys to detect any changes in the status or population trends of native forest birds. Additional surveys for forest birds and seabirds ('ua'u, 'akē'akē) are needed in adjoining areas (Mauna Loa and Upper Waiākea FR).

- Implement non-native mammalian predator control to protect nēnē, nesting seabirds and forest birds.
- Add Tract 22 to the Kahaualea NAR.

The following plans were used to develop the priority projects:

Keauhou, Ka'ū Management Team. 2004. Ka Leo 'Āina Lono 'Ia, Attending to the Voice of the Land: Land and Natural Resources Plan for Keauhou, Ka'ū. Unpublished report.

Maly, K. and O. Maly. 2004b. He Mo'olelo 'Āina: A cultural study of the Pu'u Maka'ala Natural Area Reserve, Districts of Hilo and Puna, island of Hawai'i. Prepared by Kumu Pono Associates LLC for State of Hawai'i Department of Land and Natural Resources, Division of Forestry and Wildlife, Natural Area Reserves Program.

Maly, K. and O. Maly. 2005a. He Wahi Mo'olelo No Keauhou A Me Na Wahi Pano Ma Laila - A collection of traditions, historical accounts and kama'aina recollections of Keauhou and its storied places; with notes from adjoining lands in Ka'ū and Puna, island of Hawai'i. Prepared by Kumu Pono Associates LLC for Kamehameha Schools.

Maly, K. and O. Maly. 2005b. He Mo'olelo 'Āina: A cultural-historical study of the upper Waiākea-Humu'ula mountain lands: The proposed Kīpuka 'Āina Mauna Natural Area Reserve, District of Hilo, island of Hawai'i. Prepared by Kumu Pono Associates LLC for State of Hawai'i Department of Land and Natural Resources, Division of Forestry and Wildlife, Natural Area Reserves Program.

'Ōla'a-Kīlauea Management Group. 1999. 'Ōla'a-Kīlauea Management Area: Natural Resources Management Plan. Prepared by 'Ōla'a Kīlauea Partnership.

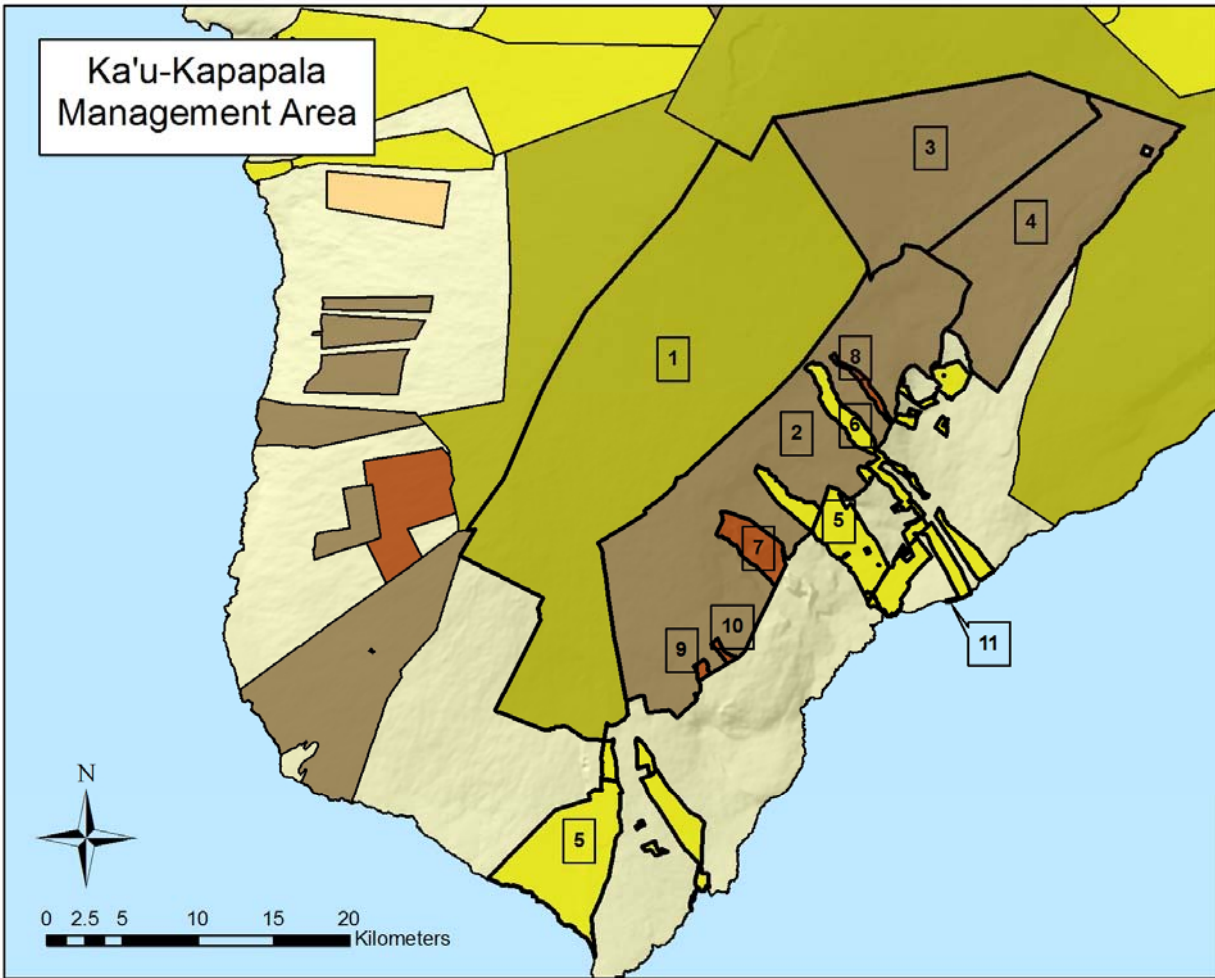
'Ōla'a-Kīlauea Management Group. 1999. Final Environmental Assessment for the 'Ōla'a-Kīlauea Management Area: Natural Resources Management Plan. Prepared for State of Hawai'i Department of Land and Natural Resources Division of Forestry and Wildlife Natural Area Reserves System as part of the 'Ōla'a-Kīlauea Partnership.

'Ōla'a-Kīlauea Management Group. 2003. Final Environmental Assessment for Fence Construction, Wright Road Unit, 'Ōla'a-Kīlauea Partnership. Prepared for State of Hawai'i Department of Land and Natural Resources Division of Forestry and Wildlife Natural Area Reserves System as part of the 'Ōla'a-Kīlauea Partnership.

'Ōla'a Kīlauea Management Group. November 2004. Final Environmental Assessment: Keauhou Ranch Upper Boundary Protective Fencing Project. Prepared by 'Ōla'a Kīlauea Partnership.

State of Hawai'i Department of Land and Natural Resources Division of Forestry and Wildlife Natural Area Reserves System. 1989a. Pu'u Maka'ala Natural Area Reserve Management Plan.

B. Kaū Kapāpala Management Area



ID	NAME	MANAGEDBY	HECTARES	ACRES
1	HAWAII VOLCANOES NATIONAL PARK - Kahuku Ka'u	USNPS	42,625	105,328
2	KAU FOREST RESERVE	DOFAW	24,895	61,518
3	KAPAPALA FOREST RESERVE	DOFAW	15,059	37,212
4	KAPAPALA COOPERATIVE GAME MANAGEMENT AREA	DOFAW	11,984	29,614
5	KAMEHAMEHA SCHOOLS - KA'U	KS	10,918	26,979
6	KAMEHAMEHA SCHOOLS - KA'U (FOREST UNITS)	KS	1,284	3,174
7	KAU PRESERVE Kaiholena Unit	TNC	1,043	2,578
8	KAU PRESERVE Keaiwa Unit	TNC	229	567
9	KAU PRESERVE Kahilipali Unit	TNC	85	209
10	KAU PRESERVE Kioloku Unit	TNC	82	202
11	KAMEHAME BEACH (NATURE CONSERVANCY)	TNC	13	32

Background

The Ka‘ū Kapāpala Management Area consists of four principal landowners, all sharing a mandate for conservation and management of Hawai‘i’s natural resources: the National Park Service, the State Department of Land and Natural Resources – Division of Forestry and Wildlife, The Nature Conservancy, and Kamehameha Schools. In 2003, the NPS purchase of the 116,000 acre Kahuku Ranch solidified the need for collaborative management of this area at the landscape level.

Ka‘ū Kapāpala contains some of the most diverse and least invaded forest on the island. Its high stature closed canopy forests support one of the highest known vegetation biomass profiles and some of the highest densities of forest birds in the State. Lower portions of the Ka‘ū FR are known to harbor a diverse native insect fauna. The Management Area provides an elevational and moisture gradient that would allow wildlife populations to move in response to changing climate or weather conditions.

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. This region is home to more extant, endemic species of flowering plants (178 species) than any other region of Hawai‘i Island. In fact, its mesic and wet forest ecosystems alone support 153 endemic plant species. The forests of the Ka‘ū region are home to at least 12 known species of rare plants. Six of these are endangered, two are candidates for listing as endangered, three are species of concern, and one has a restricted range. The very high quality of the wet and mesic forest communities in Ka‘ū Kapapala provides a rare opportunity to implement management before it is too late or costly.

The Ka‘ū Kapāpala Management Area contains eight native-dominated natural forest communities, including: 1) ‘Ōhi‘a Montane Dry Forest; 2) ‘Ōhi‘a Subalpine Forest; 3) Subalpine Dry Shrubland; 4) ‘Ōhi‘a Montane Mesic Forest; 5) Koa/‘Ōhi‘a Montane Mesic Forest; 6) Koa/‘Ōhi‘a Montane Wet Forest; 7) ‘Ōhi‘a Montane Wet; and 8) ‘Ōhi‘a Lowland Wet Forest.

Threats and Management Needs

During the last century, the forests of Ka‘ū were bordered almost completely by sugar cane fields to the southeast, which were burned every 18 months. This practice kept most weeds out of the forest, but the demise of sugar, and the resulting mosaic of adjacent landowners, opened up the old cane fields to new weed invasions, which threaten the native forests.

Although Ka‘ū’s sugar plantations were not irrigated, cane was transported to the mills by an extensive system of flumes. Water for the flumes came through a network of tunnels driven through the hills. Remains of these flumes are still evident across the district and the freshwater springs that feed them are the subject of increasing interest today. In 2006, a group of Ka‘ū landowners and lessees formed the Ka‘ū Agricultural Water Cooperative to “promote effective and compatible agriculture business uses of the lands located in the district of Ka‘ū” including Ka‘ū’s “cooperative water system...the existing tunnels and springs which the Cooperative is permitted to use and may be required to maintain under the terms and conditions of leases or other documents of conveyance.” The group’s articles of incorporation recognize seven separate water cooperatives, including: Ha‘ao Springs, Honu‘apo/Mountain House, Hilea/Makanau,

Alili/Moa'ula, Keaiwa, Kāpāpala, and Wood Valley. While the development of water resources in Ka'ū could have positive impacts on the district's economy by making diversified agriculture more feasible, it will also enable increased development of mauka lands adjacent to the forest, which could be detrimental to forest conservation and restoration. In order to address the lack of a coordinated watershed plan for this area, the TMA has identified the Ka'ū – Kapāpala area as a high priority for an increased level of watershed management and protection. The area has also been identified as important in the Hawai'i CWCS (State of Hawai'i 2005) as well as in USFWS recovery plans.

The TMA has also identified the Ka'ū Kapāpala Management Area as a high priority for feral cattle control. Cooperative work (HAVO and DOFAW) was initiated in the Ka'ū and Kahuku areas in 2006, and other TMA members with land in the Ka'ū area are also supportive of the project (e.g. TNC and KS). Funding was provided by the DOFAW Watershed Management grant program in 2007 and is being used for the radio-collaring of judas animals in the Ka'ū and Kapāpala Forest Reserves. This work will assist ground and aerial hunting and the elimination of feral cattle populations in the management area.

A principal focus of the TMA weed control effort will be the lower Ka'ū FR. Ka'ū FR is relatively weed-free, although there are priority invasive weeds just becoming established along the lower FR boundary. A concerted joint effort surveying, mapping and controlling these weeds before they have a chance to become more firmly established in native habitat is critical.

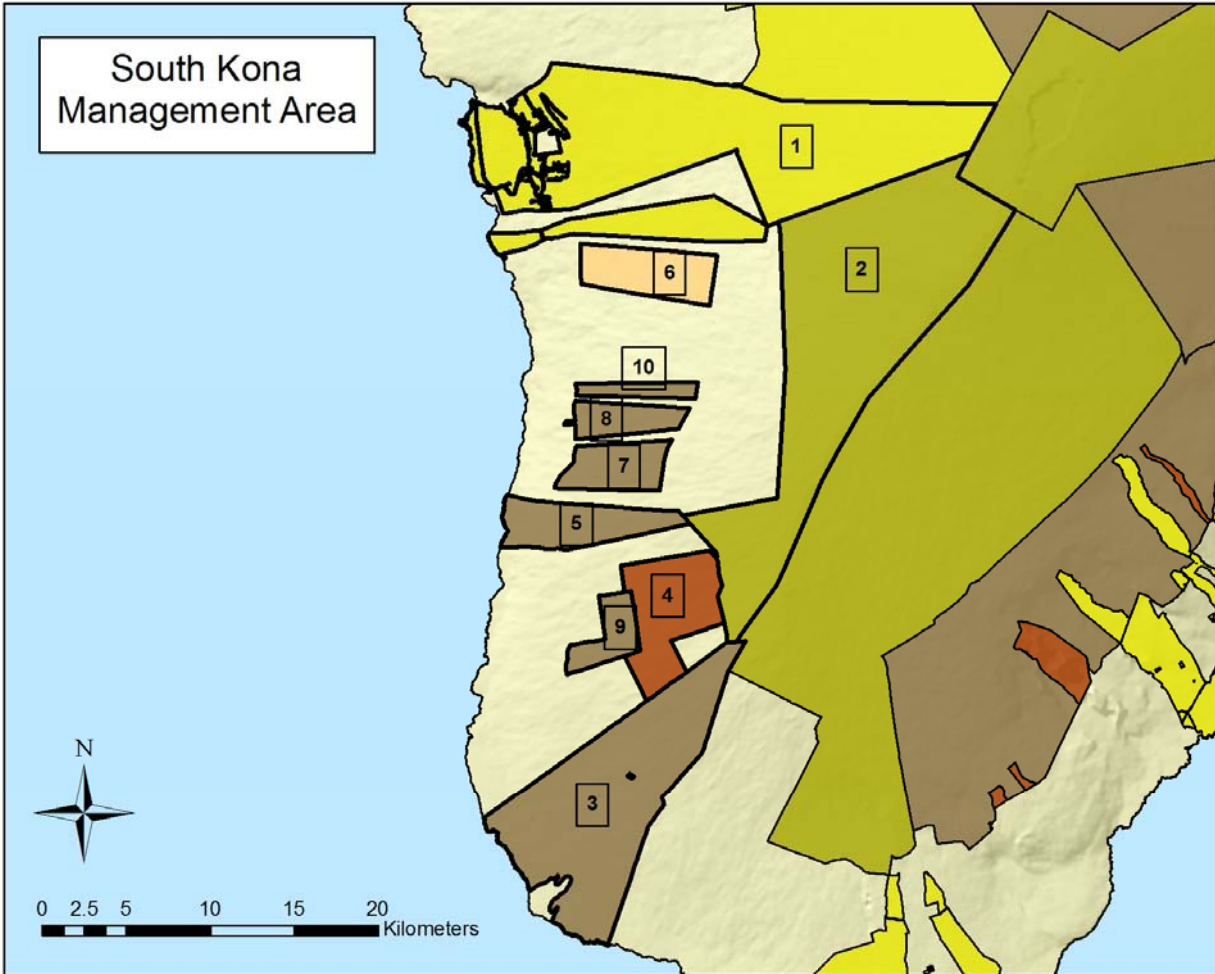
Priority Projects

- Develop a comprehensive watershed management plan which will discuss natural and cultural resources, threats and management activities (e.g. public access, fencing, feral animal control, public hunting, rare species protection, invasive species management, fire pre-suppression and suppression).
- Continue DOFAW's initial work to reduce feral cattle to remnant populations through aerial and ground hunting.
- Coordinate NPS, TNC, DOFAW, and KS Planning processes to include: DOFAW planning for a fenced management unit in the Ka'ū FR and development of a Game Management Plan for Hawai'i; and NPS general and ungulate management plans.
- Develop a multi-agency fencing strategy to address other ungulates and protect a core conservation area.
- Implement new fencing projects (e.g. Boundary between Kahuku and Ka'ū FR).
- Enhance hunter access to lower elevation Ka'ū FR to reduce ungulate densities. Develop Access Agreements (NPS and other landowners) for increased hunter access.
- Collaborate on a comprehensive weed mapping, monitoring and control plan for target weed species.
- Collaborate on the implementation of DLNR's experimental koa forest restoration project at Kapāpala.

The following plan was used to develop the priority projects:

The Nature Conservancy-Hawai'i. 2006a. Ka'ū Preserve, Hawai'i Island: Long Range Management Plan: Fiscal Years 2007-2012.

C. South Kona Management Area



ID	NAME	MANAGED BY	HECTARES	ACRES
1	KAMAHAMEHA SCHOOLS - SOUTH KONA	KS	19,972	49,352
2	HAWAII VOLCANOES NATIONAL PARK - Kahuku Kona	USNPS	18,095	44,714
3	MANUKA NATURAL AREA RESERVE	DOFAW	10,434	25,782
4	KONA HEMA PRESERVE (NATURE CONSERVANCY)	TNC	3,279	8,102
5	KIPAOEHOE NATURAL AREA RESERVE	DOFAW	2,311	5,711
6	HAKALAU FOREST NATIONAL WILDLIFE REFUGE S.KONA SEC	USFWS	2,164	5,348
7	SOUTH KONA FOREST RES. (OLELOMOANA OPIHIHALI SEC.)	DOFAW	1,573	3,886
8	SOUTH KONA FOREST RESERVE (KUKUIOPAE SEC.)	DOFAW	1,147	2,835
9	SOUTH KONA FOREST RESERVE (HONOMALINO SEC.)	DOFAW	1,093	2,700
10	SOUTH KONA FOREST RESERVE (KAOHE SEC.)	DOFAW	636	1,573

Background

The South Kona Management Area includes habitat ranging from intact forests to open degraded parkland and rangeland. The montane mesic forest dominated by koa (*Acacia koa*) and 'ōhi'a (*Metrosideros polymorpha*) found at the middle elevations along the Kona flank has been historically targeted for koa harvesting and is considered rare and imperiled.

Koa/'ōhi'a Montane Mesic Forest occupies a significant portion of the native-dominated landscape between 3,500 and 5,500 feet elevation and lies between subalpine dry shrublands above and 'ōhi'a-dominated wet and mesic forest below. The Koa/'ōhi'a Forest has tall-statured, closed to open canopied 'ōhi'a forest with frequent to occasional koa. The montane koa-bearing zone includes important upper elevation habitat for endangered forest birds, which also occupy the 'ōhi'a -dominated forests below.

Koa drops out of the forest below about 3,500 ft, and 'ōhi'a Montane Wet Forest, one of the most widespread wet forest communities in the Hawaiian Islands, prevails to about 3,000 ft. This community type is moderately imperiled. It is important habitat for forest birds, and also includes rare plants and invertebrates.

The natural communities within the Manukā and Kīpāhoehoe NARs provide habitat for a diverse range of native plants and animals, from rare birds to endemic shrimp. The coastal area of makai Manukā is culturally rich and traditionally important for access to marine resources.

Volcanic caves, including lava tube caves, are numerous in this management area. These caves may contain interesting geologic formations; rare or unusual plants and animals specialized for life in the cave ecosystem; cultural remains; and paleontological remains of recently extinct or prehistoric animals or plants. Caves may also play a role in the hydrologic cycle.

In the South Kona Management Area, federally endangered forest birds including 'io, 'ākepa, 'akiapōlā'au and Hawai'i creeper are found in core areas of the forest. The last known range of the endangered Hawaiian crow, or 'alalā, is also found in South Kona. Forests and lava tubes in the region provide habitat for native invertebrate fauna including rare insect species: two undescribed damsel bugs, stink bug, koa bug, kissing bug, lacewing, weevil, two moths and two candidate *Drosophila* species. Snails found recently in Kapu'a include *Pronesopupa* sp., *Elasmias fuscum*, and *Tornatellides/Tornatellaria* species. South Kona provides habitat for sixteen listed endangered plant species (e.g. mehamehame (*Flueggea neowawraea*), kauila (*Colubrina oppositifolia*), *Gouania vitifolia*, Halapepe (*Pleomele hawaiiensis*), haha (*Cyanea stictophylla* and *Cyanea marksii*), 'oha (*Cyanea hamatiflora* ssp. *Carlsonii* and *Clermontia lindseyana*), and loulou (*Pritchardia schattaueri*) as well as additional plant species considered rare.

Threats and Management Needs

Koa as a species is an important part of both the forest ecosystem and forestry industry of Kona. Thus koa is not only a conservation target that we would like to see thrive in the landscape but also provides an economic incentive for sustainability. For more than a century, cattle grazing and logging, together with invasive species, have degraded the condition of the native forest at a landscape scale. Yet, substantial tracts of relatively intact forest remain on TMA lands and adjacent private ranches. Additionally, the forested slopes of Kona continue to provide

important ecosystem services such as aquifer recharge, flood minimization, recreation, wood products and carbon sequestration.

Most of the forested, and formerly forested, lands on the Kona flank of Mauna Loa are privately owned and zoned for agricultural use. Therefore perhaps the best hope for the protection of South Kona's native forest lies in its management as a working landscape where a transition to forest restoration and sustainable harvest of forest products is an economically attractive alternative to detrimental historic land use practices or land development. The objective would be to maintain the economic viability of working lands, while enhancing their conservation value. The measures of success in this transition would include a significant expansion of forest cover, an increase in native plant and animal diversity, recovery of rare species, increased variety of habitat types, and sustainable economic benefits.

Wildfires are a serious threat, especially to the mesic forests that occur above the 1,524-meter (5,000-foot) elevation. South Kona is one of the most drought-prone regions in Hawai'i. The summer maximum rainfall condition that occurs along the Kona area is unique within the Hawaiian archipelago, as are the ecosystems supported by that climate (TNC 2006). Introduced kikuyu grass (*Pennisetum clandestinum*) and meadow ricegrass (*Ehrharta stipoides*) are a potential wildfire fuel hazard unless they are controlled and replaced with native understory species (including ferns, grasses, and shrubs). In areas from which cattle have been removed, grasses may increase the fire fuel load, especially in the mesic portions of this management area during the dry season.

Priority Projects

- Eradicate feral cattle in South Kona FR and Kona Forest NWR.
- Implement fencing and ungulate control at higher elevations where native forest communities are intact to protect forested watershed and protect and recover endangered species (Kona Forest NWR, Kīpāhoehoe and Manukā NARs, NPS Kahuku).
- Develop fire management and response plans and fuels reduction projects (Kona Forest NWR, Manukā and Kīpāhoehoe NARS).
- Develop control program for noxious nonnative plants (Kona Forest NWR, Manukā and Kīpāhoehoe NAR, Kona Hema and South Kona FR).
- Cooperatively control the increasing feral goat population in the lower elevations.
- Work cooperatively to protect areas from human impacts such as overuse, encroachment, illegal marijuana cultivation, ATVs and illegal koa/ōhi'a harvesting.
- Comprehensively address conservation management across the mauka lands in the South Kona Management Area including State (Kīpāhoehoe and Manukā NARs, South Kona FR), Federal (Kona Forest NWR and the South Kona portion of the Kahuku unit of Hawai'i Volcanoes National Park) and private lands (The Nature Conservancy, Kamehameha Schools) by developing a watershed management plan. The plan will discuss natural and cultural resources, threats and management activities (e.g. public access, fencing, feral animal control, public hunting, rare species protection, invasive species management). Cultural Assessments have been completed for the Manukā and Kīpāhoehoe NARS and may be needed for additional areas and proposed projects to complete regulatory compliance.
- Work with additional private landowners as potential partners of TMA.
- Support the acquisition of conservation easements on private lands and Forest Legacy and Legacy Lands acquisitions of private land.

- Promote sustainable koa forestry.
- Promote voluntary and incentive based programs for forest conservation.
- Restore degraded and unprofitable rangelands and degraded forest habitat through control of nonnative species and reforestation.
- Explore possible ecotourism activities.
- Identify/implement outreach initiatives that promote public/political awareness of watershed conservation needs.
- Increase public recreation opportunities (South Kona FR), and provide opportunities for public nature interpretation and education (Kona Forest NWR).
- Preserve and manage lava tube/cave resources for biological, cultural, and hydrologic resources (Kona Forest NWR, Manukā and Kīpāhoehoe NARs).
- Rehabilitate degraded forest habitat through volunteer reforestation programs (Kona Forest NWR).

The following plans were used to develop the priority projects:

Kona Mauka Landowner Group. 09/14/06. Mauka Land Vision, Draft Guidelines and Principles. Unpublished document prepared for the Kona Community Development Plan (under preparation).

Maly, K. and O. Maly. 2002. Kīpāhoehoe Ma Kapalilua- Kona Hema, Hawai‘i: A Cultural Study of Kīpāhoehoe and neighboring lands in Kapalilua, South Kona, island of Hawai‘i. Prepared by Kumu Pono Associates LLC for State of Hawai‘i Department of Land and Natural Resources, Division of Forestry and Wildlife, Natural Area Reserves Program.

Maly, K. and O. Maly. 2004b. He Mo‘olelo ‘Āina: A cultural study of the Pu‘u Maka‘ala Natural Area Reserve, Districts of Hilo and Puna, island of Hawai‘i. Prepared by Kumu Pono Associates LLC for State of Hawai‘i Department of Land and Natural Resources, Division of Forestry and Wildlife, Natural Area Reserves Program.

State of Hawai‘i Department of Land and Natural Resources Division of Forestry and Wildlife Natural Area Reserves System. 1989b. Kīpāhoehoe Natural Area Reserve Management Plan.

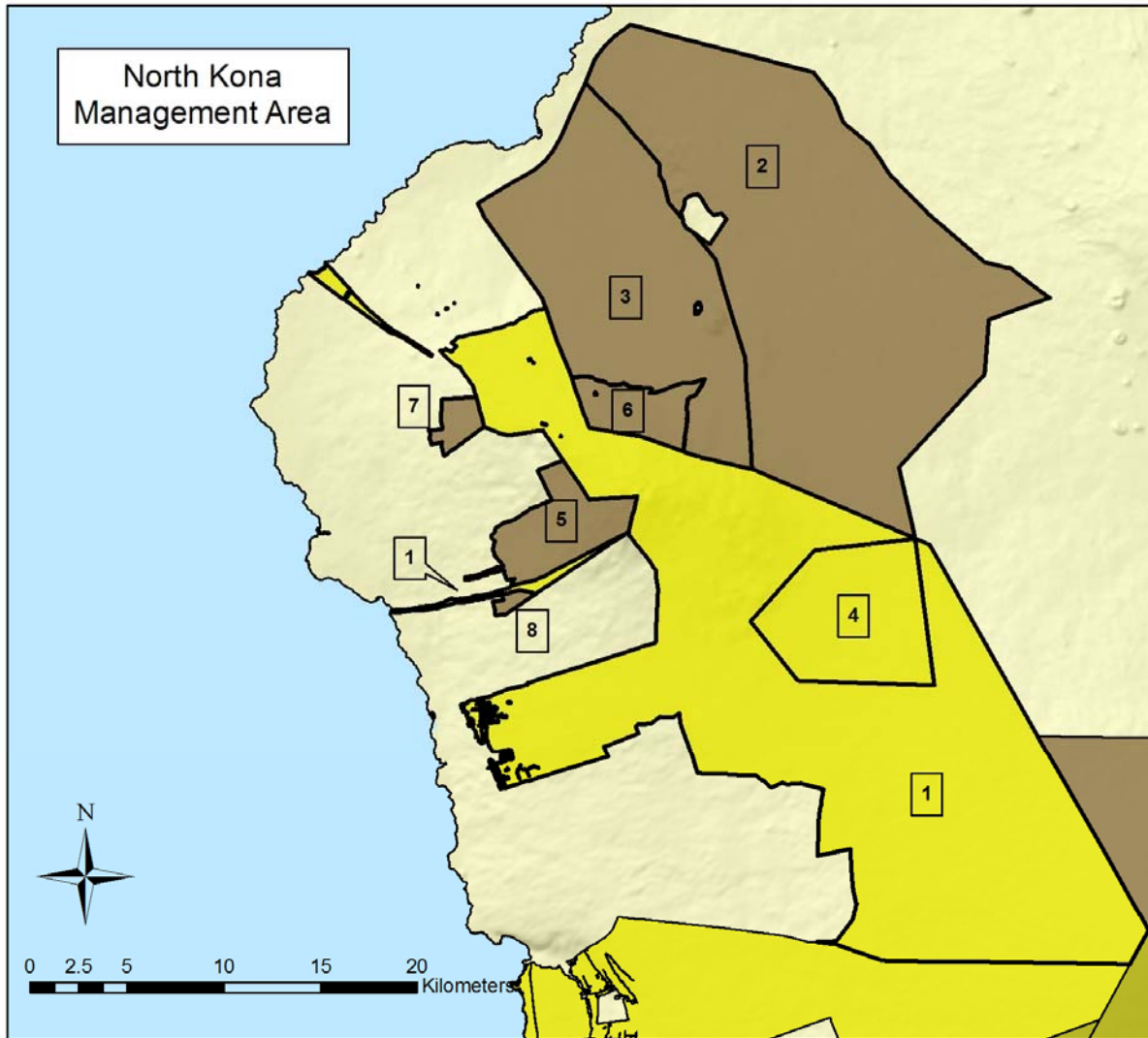
State of Hawai‘i Department of Land and Natural Resources Division of Forestry and Wildlife Natural Area Reserves System. 1992b. Manukā Natural Area Reserve Management Plan. Revised plan under preparation (2007).

The Nature Conservancy-Hawai‘i. 2004. Kona Hema Preserve Forest Stewardship Plan.

United States Department of the Interior Fish & Wildlife Service. 2007. Cultural Resource Investigation for Boundary and Cross Fences at Kona Forest of the Big Island NWRC.

United States Department of the Interior Fish & Wildlife Service. 2007. Draft Environmental Assessment for Fencing of the Kona Forest Unit of the Hakalau Forest National Wildlife Refuge Hawai‘i County, Hawai‘i.

D. North Kona Management Area



ID	NAME	MANAGEDBY	HECTARES	ACRES
1	KAMEHAMEHA SCHOOLS - NORTH KONA	KS	47,904	118,372
2	PUU ANAHULU AHUPUAA	DOFAW	27,631	68,277
3	PUUWAAWAA AHUPUAA	DOFAW	13,227	32,684
4	KEAUHOU II (HUALALAI) COOPERATIVE NENE SANCTUARY	KS	5,323	13,154
5	HONUULA FOREST RESERVE	DOFAW	2,442	6,034
6	PUU WAAWAA FOREST BIRD SANCTUARY	DOFAW	1,524	3,766
7	HONUULA FOREST RESERVE (MAKAULA-OOMA MAUKA SEC.)	DOFAW	515	1,272
8	WAIAHA SPRINGS RESTRICTED WATERSHED (N KONA FR)	DOFAW	146	361

Background

The North Kona Management Area consists of KS and State lands in the North Kona District of the island. Ka'ūpūlehu, Keauhou II, Hualālai summit area and Makalawena are owned and managed by KS. Pu'u Wa'awa'a and Anahulu (mauka of Queen Ka'ahumanu Highway) Honua'ula Forest Reserve, and Waiaha Restricted Watershed are owned and managed by DOFAW.

The ahupua'a (traditional land division) of Keauhou II is over 130,000 acres and extends across the broad, upland plateau stretching from the western summit of Mauna Loa to the summit of Hualālai. This area includes multiple habitat types and vegetation zones (alpine, sub-alpine zones, forested zones, and barren lava flows). The broad saddle between Hualālai and Mauna Loa harbors the largest area of mamane forest on Mauna Loa and also supports the largest and most important stands of sandalwood (or 'iliahi) remaining on the island. Several rare insects are known from this forest type. Some are obligate specialists on 'iliahi and may face extinction due to the loss of their host plants. This area is characterized by several vegetation types including montane dry and mesic forests and woodlands, subalpine forests, woodlands and shrublands, and grasslands. Major plant communities include 'ōhi'a dominated forest or woodland on 'a'ā lava or at upper elevations, mixed koa forest with native shrubs, sedges, and/or grasses, pūkiawe-'a'ali'i shrubland and grasslands. This region includes some of the most diverse and best-preserved native grassland areas left in Hawai'i.

The ahupua'a of Pu'u Wa'awa'a and Pu'u Anahulu are located on the northern flank of Hualālai volcano, extending from sea level to within a mile of the summit. The lands makai of Queen Ka'ahumanu Highway in Pu'u Wa'awa'a and Pu'u Anahulu (Kīholo Bay and proximity) are comprised of 4,300 acres of coastal lands designated as a State Park Reserve, pending the completion of a Master Plan. Pu'u Wa'awa'a ("many furrowed hill" in Hawaiian), an extinct volcanic vent, and the Pu'u Anahulu ridge are the oldest geologic formations on Hualālai (over 100,000 years old). This distinctive hill is over one mile in diameter and rises to 3,967 feet elevation. Due to its older age, high degree of soil development and complex topography, Pu'u Wa'awa'a cone has greater botanical diversity and supports a different plant community than the surrounding area. Dry and mesic forests in this region were once considered the most diverse forests in all the Hawaiian Islands (Rock 1913).

A unique assemblage of natural communities and plant and animal species are still found within this area, many of which are rare or restricted in distribution. The USFWS recovery plans identify the Pu'u Wa'awa'a Forest Bird Sanctuary as essential habitat for certain endangered birds ('alalā, 'akepa, and Hawai'i creeper). Other birds in the area include nēnē, 'io, pueo, and more common native forest birds. Pu'u Wa'awa'a provides habitat for a diverse native arthropod community. Of critical concern is the survival of unique insects such as the endangered Blackburn Sphinx moth and the beetle *Plagithmysus simplicicollis* (*Cerambycidae*). Both species are extremely rare and are restricted to the endangered 'aiea tree (*Nothocestrum breviflorum*). An extensive network of lava tube caves in the region have important cultural, biological, geological, aesthetic, recreational and educational resources and values.

The Honua'ula FR has grown to 7,146 acres with recent 2006 parcel additions. These additions are former pasture lands with a good native component that will recover well once cattle are removed.

The North Kona Management Area also contains important coastal areas such as Makalawena. Resources in these areas include native coastal vegetation, anchialine ponds and wetlands, significant cultural and archaeological sites, and marine resources.

In 2002, the management responsibility over public lands in Pu‘u Wa‘awa‘a and Pu‘u Anahulu was transferred from the State Land Division to DOFAW (mauka lands) and the Division of State Parks (makai lands) for resource management purposes. DLNR and the Pu‘u Wa‘awa‘a Advisory Council jointly developed *The Management Plan for the ahupua‘a of Pu‘u Wa‘awa‘a and the Makai Lands of Pu‘u Anahulu (2003)*. A guiding principle of the Plan is to protect and enhance the rich and diverse natural, cultural, and recreational resources of the project area for the enjoyment of current and future generations. Management objectives include the restoration of native ecosystems, preservation of cultural resources, reforestation, hunting, public recreation, research, pasture management, environmental and cultural education, and eco-tourism activities. The design and implementation of Pu‘u Wa‘awa‘a’s management plan will emulate the concept and approach of ahupua‘a management, which was developed and practiced by ancient Hawaiians. The following Hawaiian phrase serves as the foundation of these efforts: “E malama i ka ‘aina, a malama ka aina ia ‘oe” (“Care for the land and the land will care for you”).

Threats and Management Needs

The most severe threats in this region are fire, weeds (particularly fountain grass) and ungulates. Management needs are focused on removing or reducing these threats.

Tropical dry forests are extremely rare worldwide and are one of the most endangered habitats in Hawai‘i. Their steady degradation due to threats such as land development, fire, grazing by feral ungulates and invasion by non-native flora is contributing to biodiversity loss in both the State of Hawai‘i and worldwide. Cabin et al. (2000) estimated that 90% of dryland forests in the Hawaiian Islands have been eliminated due to human presence, and that the remaining 10% are heavily degraded by non-native weeds and ungulate grazing. Pu‘u Wa‘awa‘a and Keauhou II provide a unique opportunity to protect and restore many species that are found only here or in other dry and dry-mesic forest areas of Hawai‘i.

Native forest communities in this area have been greatly altered during the past 100 years. Grazing by domestic and feral ungulates has severely impacted native vegetation. Subsequent invasion by non-native plant species has brought about some of the most notable changes. The profusion of fountain grass has caused a major increase in the area’s readily ignitable fuel load, making wildland fires the primary threat to the remnant native dryland forests. Roadside ignition is responsible for approximately 90% of all wildfires started at Pu‘u Wa‘awa‘a, however several recent starts have been attributed to lightning strikes. Such ignitions will continue if invasive vegetation is not controlled.

The general TMA fire management priorities and actions addressed in earlier sections of this plan are also applicable to the North Kona Management Area. This area also provides an opportunity to consider continued use of grazing as a means to control fire fuels build up. DOFAW will be developing and implementing a long-term grazing plan to support the diverse objectives of the Pu‘u Wa‘awa‘a management plan. Livestock grazing activities within Pu‘u Wa‘awa‘a will shift towards providing grazing as a management tool for fire control and natural resource conservation priorities. This grazing plan may provide a model for other areas with a

similar significant fire threat. Grazing that provides economic returns to landowners as well as ecosystem services of fire management could be a valuable management tool to apply across the broader TMA landscape.

The West Hawai'i Wildfire Management Organization is a 501(c)(3), non-profit organization whose mission is to mitigate wildfire impacts to communities and natural resources by facilitating planning among relevant agencies and organizations. Their focus is a 250,000 acre area in the North Kona area. This organization disseminates information, and develops and implements fuels management activities and research. The TMA would like to work closely with this organization and expand these types of efforts to additional areas.

With regard to weeds, fountain grass will be a focus of TMA weed efforts, particularly halting the spread of it into new areas. Other prominent weeds in the Pu'u Wa'awa'a and Pu'u Anahulu region include silk oak (*Grevillea robusta*), tree tobacco (*Nicotiana glauca*), fire weed (*Senecio madagascariensis*), lantana (*Lantana camara*), apple of sodom (*Solanum linneanum*), german ivy (*Delairia odorata*), pamakani (*Ageratina riparia*), banana poka (*Passiflora tarminiana*) and others. Proposed activities in the North Kona Management Area include distribution mapping of primary threat species and control efforts across land ownership boundaries by jointly seeking outside funding, acquiring equipment and hiring a field crew for the region.

There are plans for fencing and ungulate control in portions of this management area that will enhance the protection and restoration of the most important sections of remaining native ecosystems. At Pu'u Wa'awa'a, the best remaining native forest communities have been defined and prioritized for fencing and ungulate control. The Pu'u Wa'awa'a Forest Bird Sanctuary (3,806 acres) is the largest area proposed for protection, and the ungulate control fence was completed in October of 2005. The TMA is also planning on similar actions in the Keauhou II area on KS lands for over 13,000 acres of remaining mamane-naio forest. Protection and restoration of these areas through fencing and ungulate control provides benefits to rare native species, including plants, insects, and forest birds. Once these areas are fenced and protected, these areas can be used for the reintroduction of rare and endangered native plants and animals.

Dry forest restoration is also taking place on KS lands at Ka'ūpūlehu through the planting of dry forest trees and controlling rodents and goats within a 70 acre parcel. Forest communities featuring such species as kaūila, uhiuhi, 'iliahi, and lama are protected and enhanced by efforts of the Dry Forest Working Group, which is a loose affiliation of interested individuals and organizations dedicated to the conservation and restoration of dry forests and Ka 'Ahahui O Ka Nahelehele, a non-profit group interested in the preservation and perpetuation of the dry forest serves as an "umbrella" organization for landowners, agencies, and groups that wish to partner for the benefit of native dry forests. A makai section of the Ka'ūpūlehu ahupua'a is leased to a private organization and the mauka section includes a lease to the National Tropical Botanical Garden. The other lands are leased to Hualālai Ranch.

Technical assistance and funding for projects that have a common interest across land ownership boundaries include weed surveys and management, feral goat management, and establishment of multiple outplanting sites for the protection of rare and endangered species. The TMA partnership involvement envisioned includes the establishment of a regional field crew that would participate in weed prevention, management and control work as well as native

outplanting across North Kona to interrupt the existing fire cycle and re-establishment of native dry forest cover.

Priority Projects

- Assist with the ongoing implementation of the Management Plan for the *Ahupua'a* of Pu'u Wa'awa'a and the Makai Lands of Pu'u Anahulu (State of Hawai'i 2003b).
- Implementation of the North Kona Habitat Restoration Project – Fencing, ungulate control, fire management, reforestation and other management for 13,000 acres at Keauhou II (KS lands) (OKP Management Group 2007).
- Honua'ula FR fencing, feral cattle control and reforestation project (DOFAW) – Fence 1.5 miles to prevent cattle ingress from neighboring ranches. Implement USDA Forest Service reforestation grant for Honua'ula Tract II (reforest 1,200 acres). Increase management and public recreational access by constructing new access roads.
- Establish Education and Outreach program for North Kona.

The following plans were used to develop the priority projects:

Dougherty, D. and J. Moniz-Nakamura. 2006. A Cultural Resource Overview Report for the Proposed North Kona Fencing and Habitat Restoration Project, North Kona, Hawai'i. Prepared for 'Ōla'a Kīlauea Management Group, the Hawaiian Silversword Foundation, and the United States Department of the Interior, National Park Service, Hawai'i Volcanoes National Park.

'Ōla'a Kīlauea Management Group. 2007. Final Environmental Assessment: North Kona Protective Fencing Project: North Kona District, Island of Hawai'i. Prepared by 'Ōla'a Kīlauea Partnership.

State of Hawai'i Department of Land and Natural Resources Division of Forestry and Wildlife and Division of State Parks. 2003b. The Management Plan for the *Ahupua'a* of Pu'u Wa'awa'a and the Makai Lands of Pu'u Anahulu.

State of Hawai'i Department of Land and Natural Resources Division of Forestry and Wildlife. 2003c. Pu'u Wa'awa'a Biological Assessment: Pu'u Wa'awa'a, North Kona, Hawai'i. Prepared by Jon Giffin.

State of Hawai'i Department of Land and Natural Resources Division of Forestry and Wildlife. 2007b. Draft Environmental Assessment Honua'ula Forest Reserve Reforestation Project.

United States Department of the Interior National Park Service, Hawai'i Volcanoes National Park. 2007a. Archaeological Reconnaissance Survey Report for Proposed Hienaloli Road Corridor, Hienaloli 1 *Ahupua'a*, North Kona, Hawaii (TMK 3-7-5-013:013,022).

United States Department of the Interior National Park Service, Hawai'i Volcanoes National Park. 2007b. Archaeological Reconnaissance Survey Report for Proposed Koa Reforestation Site, Honuaua Forest Reserve, Tract 2, North Kona, Hawaii (TMK 3-7-4-001:003).

VII. TMA Operations and Budget

The TMA staff is hired through the Pacific Cooperative Studies Unit (PCSU) of the Research Corporation of the University of Hawai‘i. Staff is administratively based at Hawai‘i Volcanoes National Park Resources Management Division. TMA staff (regular, full-time) consists of a TMA Coordinator, Kūlani Inmate Crew Supervisor, Environmental Education Specialist, a Vegetation Management Specialist, and two Field Technicians. The TMA also supports a part-time Administrative Assistant who manages PCSU project accounting.

Project funding currently comes from TMA members (primarily U.S. Fish and Wildlife Service, DOFAW and KS) and outside grants. Other TMA members provide in-kind service to accomplish priority projects (e.g. inmate labor, sharing personnel and equipment). TMA project funding is primarily managed by PCSU and the Hawaiian Silversword Foundation, a 501(c)(3) organization. Most current on-the-ground projects are in the ‘Ōla‘a Kīlauea Management Area.

Proposed Actions:

- Continue support of core existing TMA staff (six personnel) to coordinate and implement ongoing projects in the TMA, maintain communication among partners, and raise funds.
- Consider increasing full-time staffing to include Coordinators/Operations Managers and Field Technicians (2) for each of the four Management Areas. These staff can be based with other TMA members with offices in appropriate locations (e.g. DOFAW Hilo baseyard, TNC Nā‘ālehu office, Pu‘u Wa‘awa‘a).
- Expand options for managing project funds to additional non-profit organizations with an interest in TMA management priorities and actions.
- Infrastructure development for existing and expanded TMA staff such as vehicles, equipment storage areas and office space.

Projected Five Year Core Operational Budget*:

Budget Item	FY2008	FY2009	FY2010	FY2011	FY2012	TOTAL
TMA Coordination	\$60,000	\$62,000	\$64,000	\$66,000	\$68,000	\$320,000
Habitat Protection and Restoration	\$200,000	\$215,000	\$225,000	\$235,000	\$250,000	\$1,125,000
Watershed Protection	\$10,000	\$20,000	\$30,000	\$40,000	\$50,000	\$150,000
Compatible Economic Use	Included in TMA Coordination and other Budget Items					
Compatible Recreation and Ecotourism	Included in TMA Coordination and other Budget Items					
Education, Awareness and Public Outreach	\$50,000	\$60,000	\$70,000	\$75,000	\$75,000	\$330,000
Cultural Resource Protection	\$25,000	\$28,000	\$30,000	\$32,000	\$35,000	\$150,000
Research, Monitoring and Management Program Indicators	\$10,000	\$15,000	\$20,000	\$25,000	\$30,000	\$100,000

TOTAL	\$355,000	\$400,000	\$439,000	\$473,000	\$508,000	2,175,000
-------	-----------	-----------	-----------	-----------	-----------	-----------

*This budget reflects “core” TMA costs. This includes TMA staff salary, benefits, vehicle and equipment costs and other projects coordinated and implemented primarily by TMA staff. TMA Coordination includes TMA Coordinator Salary/Benefits, travel and coordination costs. Habitat Protection and Restoration includes Salary/Benefits for four TMA staff (Kūlani Inmate Crew Supervisor, 2 Field Technicians, and Vegetation Specialist), vehicles and basic equipment costs. Watershed Protection includes vehicle and basic equipment costs. Education, Awareness and Public Outreach includes TMA Environmental Educator Salary/Benefits, vehicle, equipment and supplies. Cultural Resource Protection includes costs of cultural compliance surveys and documents associated with proposed project work. Research, Monitoring and Management Program Indicators costs are vehicle, equipment and supplies costs.

Management Area Project Costs

Management for each of the four TMA management areas will require budgets ranging in several million dollars for each area over the next five years (FY08-FY12). These are additional costs to implement specific proposed projects in each of the four management areas. Since budget needs for each of the four areas also encompass different agency and organization budgets, no specific operational budgets have been identified at this time. Instead, the TMA will develop more detailed operational and project plans and budgets that will supplement this management plan for management in each of the four areas.

VIII. References

- Cabin, R. J., S. Weller, D. Lorence, T. Flynn, A. Sakai, D. Sandquist, and L. Hadway. 2000. Effects of long-term ungulate exclusion and recent non-native species control on the preservation and restoration of a Hawaiian tropical dry forest. *Conservation Biology* 14:439-453.
- Cooray, R.G., and D. Mueller-Dombois. 1981. Feral pig activity. Pp. 309-317 in D. Mueller-Dombois, K.W. Bridges, and H.L. Carson (eds). *Island ecosystems - biological organization in selected Hawaiian communities*. Hutchinson Ross Publishing Company, Stroudsburg, PA.
- Danner, R.M., D.M Goltz, S.C. Hess and P.C. Banko. 2007. Evidence of feline immunodeficiency virus, feline leukemia virus, and *Toxoplasma gondii* in feral cats on Mauna Kea, Hawaii. *Journal of Wildlife Disease* 43(2).
- Diong, C.H. 1982. Population biology and management of the feral pig (*Sus scrofa* L.) in Kipahulu Valley, Maui. Ph.D. dissertation, University of Hawai'i, Honolulu. 408 pp.
- Dougherty, D. and J. Moniz-Nakamura. 2006. A Cultural Resource Overview Report for the Proposed North Kona Fencing and Habitat Restoration Project, North Kona, Hawai'i. Prepared for 'Ōla'a-Kīlauea Management Group, the Hawaiian Silversword Foundation, and the United States Department of the Interior, National Park Service, Hawai'i Volcanoes National Park.
- Gorresen, P.M., R.J. Camp, T.K. Pratt and B.L Woodworth. 2005. Status of forest birds in the central windward region of Hawai'i Island: population trends and power analyses: U.S. Geological Survey, Biological Resources Discipline, Open-File Report 2005-1441, 81 p. Available at: http://biology.usgs.gov/pierc/HFBIDPSite/Central_Windward_OFR_2005-1441.pdf.
- Hawai'i Cooperative Park Service Unit, Western Region Natural Resources and Research Division, National Park Service. December 1990. *Hawai'i Stream Assessment: A Preliminary Appraisal of Hawai'i's Stream Resources*. Written for Commission on Water Resource Management, State of Hawai'i. Honolulu, Hawai'i.
- Hawai'i County General Plan:
<http://www.Hawai'i-county.com/la/gp/2005/main.html> (last accessed February 2007).
- Hess, S., B. Kawakami, D. Okita, and K. Medeiros. 2006. A preliminary assessment of mouflon abundance at the Kahuku Unit of Hawai'i Volcanoes National Park. US Geological Survey Open File Report OF 2006-1193.
- Juvik, Sonia P and James. O Juvik, ed. 1998. *Atlas of Hawai'i*, 3rd Edition. University of Hawai'i Press, Honolulu, Hawai'i.

- Keauhou, Ka'ū Management Team. 2004. *Ka Leo 'Āina Lono 'Ia*, Attending to the Voice of the Land: Land and Natural Resources Plan for Keauhou, Ka'ū. Unpublished report.
- Katahira L. 1980. The Effects of Feral Pigs on a Montaine Rain Forest in Hawai'i Volcanoes National Park. Proceedings, 3rd Conference in Natural Sciences, Hawai'i Volcanoes National Park. Cooperative National Park Resources Studies Unit, Honolulu, HI, p.173-178.
- Kona Mauka Landowner Group. 09/14/06. Mauka Land Vision, Draft Guidelines and Principles. Unpublished document prepared for the Kona Community Development Plan (under preparation).
- Loope and Scowcroft. 1985. Vegetation response within exclosures in Hawai'i: a review. Pp. 377-402 in C.P. Stone and J.M. Scott (eds). Hawai'i's terrestrial ecosystems: preservation and management. University of Hawai'i Cooperative National Park Resources Studies Unit. University of Hawai'i Press, Honolulu.
- Maly, K. and O. Maly. 2005a. *He Wahi Mo'olelo No Keauhou A Me Na Wahi Pano Ma Laila* - A collection of traditions, historical accounts and kama'aina recollections of Keauhou and its storied places; with notes from adjoining lands in Ka'ū and Puna, island of Hawai'i. Prepared by Kumu Pono Associates LLC for Kamehameha Schools.
- Maly, K. and O. Maly. 2005b. *He Mo'olelo 'Āina*: A cultural-historical study of the upper Waiākea-Humu'ula mountain lands: The proposed Kīpuka 'Āina Mauna Natural Area Reserve, District of Hilo, island of Hawai'i. Prepared by Kumu Pono Associates LLC for State of Hawai'i Department of Land and Natural Resources, Division of Forestry and Wildlife, Natural Area Reserves Program.
- Maly, K. and O. Maly. 2004a. *He Mo'olelo 'Āina*: A cultural study of the Manukā Natural Area Reserve lands of Manukā, District of Kaū and Kaūlanamauna, District of Kona, Island of Hawai'i. Prepared by Kumu Pono Associates LLC for State of Hawai'i Department of Land and Natural Resources, Division of Forestry and Wildlife, Natural Area Reserves Program.
- Maly, K. and O. Maly. 2004b. *He Mo'olelo 'Āina*: A cultural study of the Pu'u Maka'ala Natural Area Reserve, Districts of Hilo and Puna, island of Hawai'i. Prepared by Kumu Pono Associates LLC for State of Hawai'i Department of Land and Natural Resources, Division of Forestry and Wildlife, Natural Area Reserves Program.
- Maly, K. and O. Maly. 2004c. *He Mo'olelo 'Āina*: A Cultural Study of the Pu'u O Umi Natural Area Reserve and Kohala-Hāmākua Mountain Lands, District of Kohala and Hāmakuā, Island of Hawai'i. Prepared by Kumu Pono Associates LLC for State of Hawai'i Department of Land and Natural Resources, Division of Forestry and Wildlife, Natural Area Reserves Program.
- Maly, K. and O. Maly. 2002. *Kīpāhoehoe Ma Kapalilua- Kona Hema, Hawai'i*: A Cultural Study of Kīpāhoehoe and neighboring lands in Kapalilua, South Kona, island of Hawai'i.

Prepared by Kumu Pono Associates LLC for State of Hawai‘i Department of Land and Natural Resources, Division of Forestry and Wildlife, Natural Area Reserves Program.

Maly, K. 2001. Pu‘u Anahulu and Pu‘u Wa‘awa‘a (Napu‘u) at Kona, Hawai‘i: A collection of historical accounts of the lands, families, and history of a native community. Kumu Pono Associates, Hilo, Hawai‘i.

Maly, K. 1999. Volume I: Pu‘u Anahulu and Pu‘u Wa‘awa‘a (Napu‘u), At Kekaha – Kona Hawai‘i. A Report on Archival-Historical Documentary Research, and Oral History Interviews. Cultural-Historical Documentation for Ahupua‘a Based Planning in the lands of Pu‘u Anahulu and Pu‘u Wa‘awa‘a (Napu‘u); District of Kona, Island of Hawai‘i. Kumu Pono Associates, Hilo, Hawai‘i.

‘Ōla‘a-Kīlauea Management Group. 1999. ‘Ōla‘a-Kīlauea Management Area: Natural Resources Management Plan. Prepared by ‘Ōla‘a Kīlauea Partnership.

‘Ōla‘a-Kīlauea Management Group. 1999. Final Environmental Assessment for the ‘Ōla‘a-Kīlauea Management Area: Natural Resources Management Plan. Prepared for State of Hawai‘i Department of Land and Natural Resources Division of Forestry and Wildlife Natural Area Reserves System as part of the ‘Ōla‘a-Kīlauea Partnership.

‘Ōla‘a Kīlauea Management Group. 2007. Final Environmental Assessment: North Kona Protective Fencing Project: North Kona District, Island of Hawai‘i. Prepared by ‘Ōla‘a Kīlauea Partnership.

‘Ōla‘a Kīlauea Management Group. November 2004. Final Environmental Assessment: Keauhou Ranch Upper Boundary Protective Fencing Project. Prepared by ‘Ōla‘a Kīlauea Partnership.

‘Ōla‘a-Kīlauea Management Group. 2003. Final Environmental Assessment for Fence Construction, Wright Road Unit, ‘Ōla‘a Kīlauea Partnership. Prepared for State of Hawai‘i Department of Land and Natural Resources Division of Forestry and Wildlife Natural Area Reserves System as part of the ‘Ōla‘a Kīlauea Partnership.

Parham, J.E., Higashi, G.R., Lapp, E.K., Kuamo‘o, D.G.K., Nishimoto, R.N., Polhemus, D.A., and W.S. Devick. 2006. *Atlas of Hawaiian Watersheds & their Aquatic Resources (Draft)*, Bishop Museum & Division of Aquatic Resources. 1721 pp.

Rock, J. 1913. *Indigenous Trees of the Hawaiian Islands*. Published under patronage, Honolulu, Territory of Hawai‘i. 517 pp.

State of Hawai‘i DBEDT Information Resources: <http://www.Hawai‘i.gov/dbedt/info/> (last accessed February 2007).

State of Hawai‘i DBEDT Office of Planning. 2006. Ocean Resources Management Plan.

Available at:

http://www.hawaii.gov/dbedt/czm/czm_initiatives/orm_pdf/2006_Ocean_Resources_Management_Plan.pdf.

- State of Hawai‘i Department of Land and Natural Resources Division of Aquatic Resources. 2003. State of Hawai‘i: Aquatic Invasive Species Management Plan. Prepared through A. Schlucker of The Nature Conservancy-Hawai‘i. Available at: http://www.hawaii.gov/dlnr/dar/pubs/ais_mgmt_plan_final.pdf.
- State of Hawai‘i Department of Land and Natural Resources Division of Forestry and Wildlife Natural Area Reserves System. 1989a. Pu‘u Maka‘ala Natural Area Reserve Management Plan. Available at: <http://www.dofaw.net/nars/files/PuumakaMgmtPlan.doc>.
- State of Hawai‘i Department of Land and Natural Resources Division of Forestry and Wildlife Natural Area Reserves System. 1989b. Kīpāhoehoe Natural Area Reserve Management Plan. Available at: <http://www.dofaw.net/nars/files/kipaplan.doc>.
- State of Hawai‘i Department of Land and Natural Resources Division of Forestry and Wildlife Natural Area Reserves System. 1992a. Kahaualea Natural Area Reserve Management Plan. Available at: http://www.dofaw.net/nars/files/kahau92plan_changed.doc.
- State of Hawai‘i Department of Land and Natural Resources Division of Forestry and Wildlife Natural Area Reserves System. 1992b. Manukā Natural Area Reserve Management Plan. Revised plan under preparation (2007).
- State of Hawai‘i Department of Land and Natural Resources Division of Forestry and Wildlife. 2003a. Draft Management Guidelines. Available at: http://www.state.hi.us/dlnr/dofaw/guidelines/mg_jw03/index.html (last accessed February 2007).
- State of Hawai‘i Department of Land and Natural Resources Division of Forestry and Wildlife and Division of State Parks. 2003b. The Management Plan for the Ahupua‘a of Pu‘u Wa‘awa‘a and the Makai Lands of Pu‘u Anahulu: <http://www.state.hi.us/dlnr/dofaw/puuwaawaa/planv6.pdf>.
- State of Hawai‘i Department of Land and Natural Resources Division of Forestry and Wildlife. 2003c. Pu‘u Wa‘awa‘a Biological Assessment: Pu‘u Wa‘awa‘a, North Kona, Hawai‘i. Prepared by Jon Giffin. Available at: www.state.hi.us/dlnr/dofaw/pubs/PWW_biol_assessment.pdf.
- State of Hawai‘i Department of Land and Natural Resources Division of Forestry and Wildlife. 2005. *Hawai‘i’s Comprehensive Wildlife Conservation Strategy*. Written by C. Mitchell, C. Ogura, D.W. Meadows, A. Kane, L. Strommer, S. Fretz, D. Leonard, and A. McClung. Honolulu, Hawai‘i. 722 pp. Available at: www.dofaw.net/cwcs/.
- State of Hawai‘i Department of Land and Natural Resources Division of Forestry and Wildlife. 2007a. Technical Report No. 07-01. Review of methods and approach for control of non-native ungulates in Hawaii. Available at: http://www.state.hi.us/dlnr/dofaw/pubs/Ungulate_Control_Methods_FINAL_Mar_2007.pdf.

- State of Hawai‘i Department of Land and Natural Resources Division of Forestry and Wildlife. 2007b. Draft Environmental Assessment Honua‘ula Forest Reserve Reforestation Project. Available at <http://www.hawaii.gov/dlnr/dofaw/announcements/Honuau%20Reforestation%20Draft%20EA%209%2021%2007.pdf>.
- State of Hawai‘i Department of Land and Natural Resources Na Ala Hele Trail & Access System. Available at: <http://www.hawaiiitrails.org/island.asp?island=Hawaii>.
- Stone, C.P., Cuddihy, L.W., and J.T. Tunison. 1992. Responses of Hawaiian ecosystems to the removal of feral pigs and goats. Pp. 666-704 in C.P. Stone, C.W. Smith, and J.T. Tunison (eds.). *Alien plant invasions in native ecosystems of Hawai‘i: management and research*. University of Hawai‘i Cooperative National Park Resources Studies Unit, University of Hawai‘i Press, Honolulu.
- Stone, C.P. 1985. Feral Ungulates in Hawai‘i: Toward Controlling the Adverse Effects of Introduced Vertebrates. In Stone, C.P. and J.M. Scott (eds.). *Hawai‘i’s Terrestrial Ecosystems: Preservation and Management*.
- The Nature Conservancy - Hawai‘i. 1992. An Ecoregional Assessment of Biodiversity Conservation for the Hawaiian High Islands.
- The Nature Conservancy-Hawai‘i. 2004. Kona Hema Preserve Forest Stewardship Plan.
- The Nature Conservancy-Hawai‘i. 2005. Mauna Loa Trail System Feasibility Study. Available at: <http://www.nature.org/wherewework/northamerica/states/hawaii/projects/>.
- The Nature Conservancy-Hawai‘i. 2006a. Ka‘ū Preserve, Hawai‘i Island: Long Range Management Plan: Fiscal Years 2007-2012.
- The Nature Conservancy - Hawai‘i. 2006b. An Ecoregional Assessment of Biodiversity Conservation for the Hawaiian High Islands II. Available at: <http://www.hawaiiectoregionplan.info/home.html>.
- Tunison, J.T. and C.P. Stone. 1992. Special ecological areas: an approach to alien plant control in Hawai‘i Volcanoes National Park. Pp. 781-798 In C.P. Stone, C.W. Smith, and J.T. Tunison. (eds.). *Alien plant invasions in native ecosystems of Hawai‘i: management and research*. University of Hawai‘i Cooperative National Park Resources Studies Unit, University of Hawai‘i Press, Honolulu.
- United States Department of the Interior Fish & Wildlife Service. 2007. Cultural Resource Investigation for Boundary and Cross Fences at Kona Forest of the Big Island NWRC.
- United States Department of the Interior Fish & Wildlife Service. 2007. Draft Environmental Assessment for Fencing of the Kona Forest Unit of the Hakalau Forest National Wildlife Refuge Hawai‘i County, Hawai‘i.

- United States Department of the Interior National Park Service, Hawai‘i Volcanoes National Park. 1996. Resources Management Plan: Hawai‘i Volcanoes National Park. Unpublished plan.
- United States Department of the Interior National Park Service, Hawai‘i Volcanoes National Park. 2007a. Archaeological Reconnaissance Survey Report for Proposed Hienaloli Road Corridor, Hienaloli 1 Ahupua‘a, North Kona, Hawaii (TMK 3-7-5-013:013,022).
- United States Department of the Interior National Park Service, Hawai‘i Volcanoes National Park. 2007b. Archaeological Reconnaissance Survey Report for Proposed Koa Reforestation Site, Honuaula Forest Reserve, Tract 2, North Kona, Hawaii (TMK 3-7-4-001:003).
- United States Department of the Interior National Park Service Pacific West Region. 2007c. Draft Comprehensive Management Plan and Environmental Impact Statement: Ala Kahakai National Historic Trail. Available at: <http://www.nps.gov/alka/>.
- United States Department of the Interior Geological Survey. 2005. Biocomplexity of Introduced Avian Diseases in Hawai‘i: Threats to Biodiversity of Native Forest Ecosystems. Prepared by B.L. Woodworth, C. T. Atkinson, M. D. Samuel, D. A. LaPointe, P. C. Banko, and J. A. Ahumada. USGS Fact Sheet 2005-3139. Available at: <http://biology.usgs.gov/pierc/Biocomplexity/Biocomplexity.pdf>.
- United States Department of the Interior Geological Survey. 2006a. Feral Cats: Too Long a Threat to Hawaiian Wildlife. Prepared by S.C. Hess and P.C. Banko. USGS Fact Sheet 2006-3006. Available at: http://biology.usgs.gov/pierc/Fact_Sheets/Feral_cats.pdf.
- United States Department of the Interior Geological Survey. 2006b. Hawaii Forest Bird Interagency Database Project: Collecting, Understanding, and Sharing Population Data on Hawaiian Forest Birds. Prepared by T.K. Pratt, B.L. Woodworth, R.J. Camp, P.M. Gorresen. USGS Fact Sheet 2006-3013. Available at: http://biology.usgs.gov/pierc/Native_Birds/Forest_birds.pdf.
- United States Department of the Interior Geological Survey. 2006c. Feral Pigs, Introduced Mosquitoes, and the Decline of Hawai‘i’s Native Birds. Prepared by D.A. LaPointe. USGS Fact Sheet 2006-3029. Available at: http://biology.usgs.gov/pierc/Fact_Sheets/Pigs_and_mosquitoes.pdf.
- United States Department of the Interior Geological Survey. 2006d. Palila Restoration: Lessons from Long-term Research. Prepared by P.C. Banko. USGS Fact Sheet 2006-3104. Available at: http://biology.usgs.gov/pierc/Fact_Sheets/Palila.pdf.
- U.S. Fish and Wildlife Service. 1984. Hawaiian Hawk Recovery Plan. U.S. Fish and Wildlife Service, Portland, OR. 56 pp. Available at: http://ecos.fws.gov/docs/recovery_plans/1984/840509.pdf.
- U.S. Fish and Wildlife Service. 1994a. *Vicia menziesii* Recovery Plan. U.S. Fish and Wildlife Service, Portland, OR. 54 pp.

- U.S. Fish and Wildlife Service. 1994b. Recovery Plan for the Mauna Kea Silversword (*Argyroxiphium sandwicense* ssp. *sandwicense*) U.S. Fish and Wildlife Service, Portland, OR. 56 pp. Available at: http://ecos.fws.gov/docs/recovery_plans/1993/930930a.pdf.
- U.S. Fish and Wildlife Service. 1995. Recovery Plan for the Kā'u Silversword, *Argyroxiphium kauense*. U.S. Fish and Wildlife Service, Portland, OR. 62+ pp. Available at: http://ecos.fws.gov/docs/recovery_plans/1995/951121.pdf.
- U.S. Fish and Wildlife Service. 1996. Big Island Plant Cluster Recovery Plan. U.S. Fish and Wildlife Service, Portland, OR. 202+ pp. Available at: http://ecos.fws.gov/docs/recovery_plans/1996/960926a.pdf.
- U.S. Fish and Wildlife Service. 1998a. Big Island II: Addendum to the Recovery Plan for the Big Island Plant Cluster. U.S. Fish and Wildlife Service, Portland, OR. 115 pp. Available at: http://ecos.fws.gov/docs/recovery_plans/1998/980511a.pdf.
- U.S. Fish and Wildlife Service. 1998b. Final Recovery Plan for Four Species of Hawaiian Ferns. U.S. Fish and Wildlife Service, Portland, OR. 89 pp. Available at: http://ecos.fws.gov/docs/recovery_plans/1998/980410e.pdf.
- U.S. Fish and Wildlife Service. 1998c. Recovery Plan for the Hawaiian Hoary Bat (*Lasiurus cinereus semotus*). U.S. Fish and Wildlife Service, Portland, OR. 59 pp. Available at: http://ecos.fws.gov/docs/recovery_plans/1998/980511b.pdf.
- U.S. Fish and Wildlife Service. 1999. Recovery Plan for the Multi-island Plants. U.S. Fish and Wildlife Service, Portland, OR. 305 pp. Available at: http://ecos.fws.gov/docs/recovery_plans/1999/990710.pdf.
- U.S. Fish and Wildlife Service. 2002. Addendum to the Recovery Plan for the Multi-island Plants. U.S. Fish and Wildlife Service, Portland, OR. 133 pp. Available at: http://ecos.fws.gov/docs/recovery_plans/2002/020919.pdf.
- U.S. Fish and Wildlife Service. 2003. Draft Revised Recovery Plan for the 'Alalā (*Corvus hawaiiensis*). U.S. Fish and Wildlife Service, Portland, OR. 92 pp. Available at: http://ecos.fws.gov/docs/recovery_plans/2003/031218b.pdf.
- U.S. Fish and Wildlife Service. 2005. Recovery Plan for Blackburn's Sphinx Moth (*Manduca blackburni*). U.S. Fish and Wildlife Service, Portland, OR. 137 pp. Available at: http://ecos.fws.gov/docs/recovery_plans/2005/050926.pdf.
- U.S. Fish and Wildlife Service. 2006a. Draft Revised Recovery Plan for Hawaiian Waterbirds: Second Draft of Second Revision. U.S. Fish and Wildlife Service, Portland, OR. 173 pp. Available at: http://ecos.fws.gov/docs/recovery_plans/2006/061213.pdf.
- U.S. Fish and Wildlife Service. 2006b. Revised Recovery Plan for Hawaiian Forest Birds. U.S. Fish and Wildlife Service, Portland, OR. 474 pp. Available at: http://ecos.fws.gov/docs/recovery_plans/2006/060922a_docs/doc760.pdf.

Agency websites:

Big Island Invasive Species Council

<http://www.hear.org/biisc/>

Hawaiian Ecosystems at Risk (HEAR) Project

<http://www.hear.org/>

Hawai'i Association of Watershed Partnerships

<http://www.hawp.org/>

Kamehameha Schools

<http://www.ksbe.edu/>

State of Hawai'i, Department of Land & Natural Resources, Division of Forestry and Wildlife

<http://www.dofaw.net/>

State of Hawai'i, Department of Land & Natural Resources, Natural Area Reserves System

<http://www.dofaw.net/nars/>

State of Hawai'i, Department of Public Safety

http://www.hawaii.gov/psd/psd_home.php

The Nature Conservancy

<http://www.nature.org/>

US Department of Agriculture, Forest Service, Institute of Pacific Islands Forestry

<http://www.fs.fed.us/psw/programs/ipif/>

US Department of Agriculture, Natural Resources Conservation Service

<http://www.nrcs.usda.gov/>

US Department of the Interior, National Park Service, Hawai'i Volcanoes National Park

<http://www.nps.gov/havo>

US Fish and Wildlife Service, Pacific Region

<http://www.pacific.fws.gov/>

US Geological Survey, Pacific Island Ecosystems Research Center

<http://biology.usgs.gov/pierc/>

IX. Appendices

A. TMA MOU

THREE MOUNTAIN ALLIANCE

MEMORANDUM OF UNDERSTANDING

THIS MEMORANDUM OF UNDERSTANDING (MOU), made by and between the U.S. Department of the Interior (U.S. DOI) National Park Service, Trustees of the Estate of Bernice Pauahi Bishop dba Kamehameha Schools (KS), State of Hawai‘i Department of Land and Natural Resources, State of Hawai‘i Department of Public Safety, The Nature Conservancy, U.S. Department of Agriculture (U.S.D.A.) U.S. Forest Service Institute of Pacific Islands Forestry, U.S. Department of Interior U.S. Fish and Wildlife Service, U.S. Department of Interior U.S. Geological Survey (U.S.G.S) Pacific Island Ecosystems Research Center, and the U.S. Department of Agriculture Natural Resources Conservation Service herein known collectively as the “**THREE MOUNTAIN ALLIANCE**” (TMA), and hereinafter individually constituted of its “**MEMBERS**”, agree to participate in cooperative management activities across the Three Mountain Alliance area on the Island of Hawai‘i (Exhibit A).

WHEREAS, the three mountains of Kīlauea, Mauna Loa and Hualalai are ancient and sacred to Hawaiians, and critically important to the life, health and well being of the native ecosystems and human communities that inhabit them; and

WHEREAS, the MEMBERS have a responsibility (kuleana) to care for these mountains, including native ecosystems and human communities that share this landscape; and

WHEREAS, management is needed to maintain healthy forested watersheds on the slopes of Kīlauea, Mauna Loa and Hualalai to sustain the future quality and quantity of fresh water; and

WHEREAS, other lands (e.g., younger lava flows, grasslands, crop land and coastal lands) within the TMA area also contribute to water quality and quantity; and

WHEREAS the health of the nearshore ocean resources are intimately connected to the health of the uplands in the traditional ahupua‘a; and

WHEREAS, management of these lands would benefit Hawai‘i’s native flora and fauna; and

WHEREAS, many of the lands managed by the MEMBERS share common boundaries (see attached Exhibit A); and

WHEREAS, many of the threats to the watershed, such as ungulates, fire, insects, diseases, and invasive non-native plants, occur across common land ownership boundaries; and

WHEREAS, effective management is best achieved through the coordinated actions of all major landowners in the TMA area irrespective of property lines; and

WHEREAS, it is not the intent of the TMA to benefit individual MEMBERS, except where such benefit may be incidental to the primary purpose of maintaining healthy watershed areas for the benefit of the public.

A. NOW THEREFORE, the MEMBERS hereby agree as follows:

3. To identify, jointly, TMA management goals, objectives and operational protocol.
4. To identify and develop strategies to address the high priority management issues that affect multiple landowners and biological resources across the TMA landscape.
5. To exchange relevant information needed to implement management strategies and apply the results of scientific research to management action.
6. If allowable by law and internal policy, to join in cooperative efforts to raise funds to implement these management strategies.
7. MEMBERS are not obligated to commit resources, the use of their lands or participate in obtaining funds unless such commitments are a part of a specific and separate agreement. MEMBERS can enter into specific agreements and working plans for implementation of individual projects, for the use of specialized equipment, hiring of personnel, transfer of funds, purchasing of supplies, and other matters. No such agreement shall provide for Federal Financial Assistance (as defined in Paragraph B. (5) of this MOU) to Kamehameha Schools (KS).
6. That other landowner(s), lessee(s) or organizations may participate in joint efforts to address high priority management issues and/or may enter into the TMA officially with the approval of all the MEMBERS and by signing the MOU.

B. IT IS MUTUALLY AGREED AND UNDERSTOOD BY ALL MEMBERS THAT:

1. During the performance of this MOU as entered under the authorities contained in Exhibit B, the MEMBERS agree to abide by the terms of Executive Order 11246 on non-discrimination and will not discriminate against any applicant for employment because of race, color, religion, sex, or national origin. The MEMBERS will take affirmative action to ensure that applicants are employed without regard to their race, color, religion, sex, or national origin.
2. This MOU in no way restricts any MEMBER from participating in similar activities with other public or private agencies, organizations, and individuals.
3. FREEDOM OF INFORMATION ACT (FOIA). Any information furnished to federal agencies who are MEMBERS is subject to the FOIA (5 U.S.C. 552).
4. NON-FUND OBLIGATING DOCUMENT. This instrument is neither a fiscal nor a funds obligation document. Any endeavor or transfer of anything of value involving reimbursement or contribution of funds between the MEMBERS will be handled in accordance with applicable laws, regulations, and procedures including those for

Government procurement and printing. Such endeavors will be outlined in separate agreements that shall be made in writing by representatives of the MEMBERS and shall be independently authorized by appropriate statutory authority. This instrument does not provide such authority. Specifically, this instrument does not establish authority for noncompetitive award to the cooperator of any contract or other agreement. Any contract or agreement for training or other services must fully comply with all applicable requirements for competition.

5. The MEMBERS recognize that Kamehameha Schools (KS) cannot be a recipient of federal financial assistance, either directly or indirectly, under this MOU or any specific agreements and working plans for individual TMA projects. In the event that KS determines that the terms of this MOU and/or any specific agreements and working plans for individual TMA projects may result in receipt by KS of Federal Financial Assistance, KS reserves the right to immediately terminate its participation in this MOU and/or any individual TMA agreement or working plan. Upon termination, KS will notify the MEMBERS.

Nothing in this MOU is intended to require KS to comply with federal laws applicable to recipients to federal financial assistance, including without limitation Title VI of the Civil Rights Act of 1964, Title IX of the Education Amendments of 1972, Section 504 of the Rehabilitation Act of 1973, the Age Discrimination Act, each as amended, or their respective implementing regulations. Nothing in this MOU shall affect KS' obligations under other federal and state laws and regulations, including without limitation Title VII of the Civil Rights Act of 1964, Executive Order 11246, the Americans with Disabilities Act, and Hawaii nondiscrimination laws.

For purposes of this MOU, "Federal Financial Assistance" shall have the meaning set forth in Title VI of the Civil Rights Act of 1964, as amended, and the applicable implementing regulation. As of the date of the MOU, regulations of U.S. Department of the Interior implementing Title VI define "Federal Financial Assistance" to include "(1) grants and loans of Federal funds, (2) grants or donations of Federal property and interests in property, (3) the detail of Federal personnel, (4) the sale and lease of, and the permission to use on other than a casual or transient basis, Federal property or any interest in such property without consideration or a nominal consideration, or at a consideration which is reduced for the purpose of assisting the recipient, or in recognition of the public interest to be served by such sale or lease to the recipient, and (5) any Federal agreement, arrangement, or other contract which has as one of its purposes, the provision of assistance."

- 6. This MOU has been approved or executed by the Trustees of the Estate of Bernice Pauahi Bishop as said trustees in their fiduciary capacities, and not in their individual capacities. No personal liability or obligation under this MOU shall be imposed or assessed against said Trustees in their individual capacities.*
- 7. The MEMBERS recognize that KS: (a) is not acting under the direction or compulsion of any governmental agency or performing a public function that such agency would otherwise be required to perform and, (b) is not a governmental actor or acting under color of state or federal law.*

8. *Neither this MOU, nor any other actions or documents executed by any or all of the MEMBERS related to TMA, shall establish a legal partnership or a partnership of a joint venture relationship between the MEMBERS. No MEMBER shall have either the liability of a partner or the power to bind any other MEMBER as a partner. Furthermore no MEMBER shall be liable for any expenses or costs incurred by any other MEMBER without that MEMBER's express written agreement.*

9. *MODIFICATION. With the exception of the adding of new MEMBERS as provided in Paragraph A.(6), modifications within the scope of the instrument shall be made by mutual consent of the MEMBERS, by the issuance of a written modification, signed and dated by all MEMBERS, prior to any changes being performed.*

10. *TERMINATION. Any MEMBER may withdraw from this MOU at any time, by providing written notice to the other MEMBERS.*

11. *COMMENCEMENT/EXPIRATION DATE. The instrument is executed and shall commence as of the date of the last signature and is effective for five years at which time it will expire unless extended.*

12. *PRINCIPAL CONTACTS. The principal contacts for this MOU are listed in Exhibit C.*

13. *This MOU may be signed in counterparts, each of which shall be considered an original, and the counterparts shall together constitute one MOU, binding all of the MEMBERS to the MOU, notwithstanding that all of the MEMBERS are not signatory to the original or the same counterparts. Duplicate unexecuted and unacknowledged pages of counterparts may be discarded and the remaining pages assembled as one document.*

IN WITNESS WHEREOF, the MEMBERS hereto execute this MOU by way of participant signatures and date below.

MEMBERS:

STATE OF HAWAII
 DEPARTMENT OF LAND
 AND NATURAL RESOURCES

By: _____

Title: _____

Date: _____

KAMEHAMEHA SCHOOLS

By: _____

Title: _____

U.S. DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE

Date: _____

By: _____

Title: _____

Date: _____

STATE OF HAWAII
DEPARTMENT OF PUBLIC
SAFETY

By: _____

Title: _____

Date: _____

THE NATURE CONSERVANCY
A FOREIGN NON-PROFIT CORPORATION

By: _____

Title: _____

Date: _____

U.S. DEPARTMENT OF INTERIOR
U.S.G.S. PACIFIC ISLAND ECOSYSTEMS
RESEARCH CENTER

By: _____

Title: _____

Date: _____

U.S. DEPARTMENT OF INTERIOR
U.S. FISH AND WILDLIFE SERVICE

By: _____

Title: _____

Date: _____

U.S. DEPARTMENT OF AGRICULTURE
U.S. FOREST SERVICE
INSTITUTE OF PACIFIC ISLANDS
FORESTRY

By: _____

Title: _____

Date: _____

U.S. DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES
CONSERVATION SERVICE

By: _____

Title: _____

Date: _____

Exhibit A: Map of Alliance Area

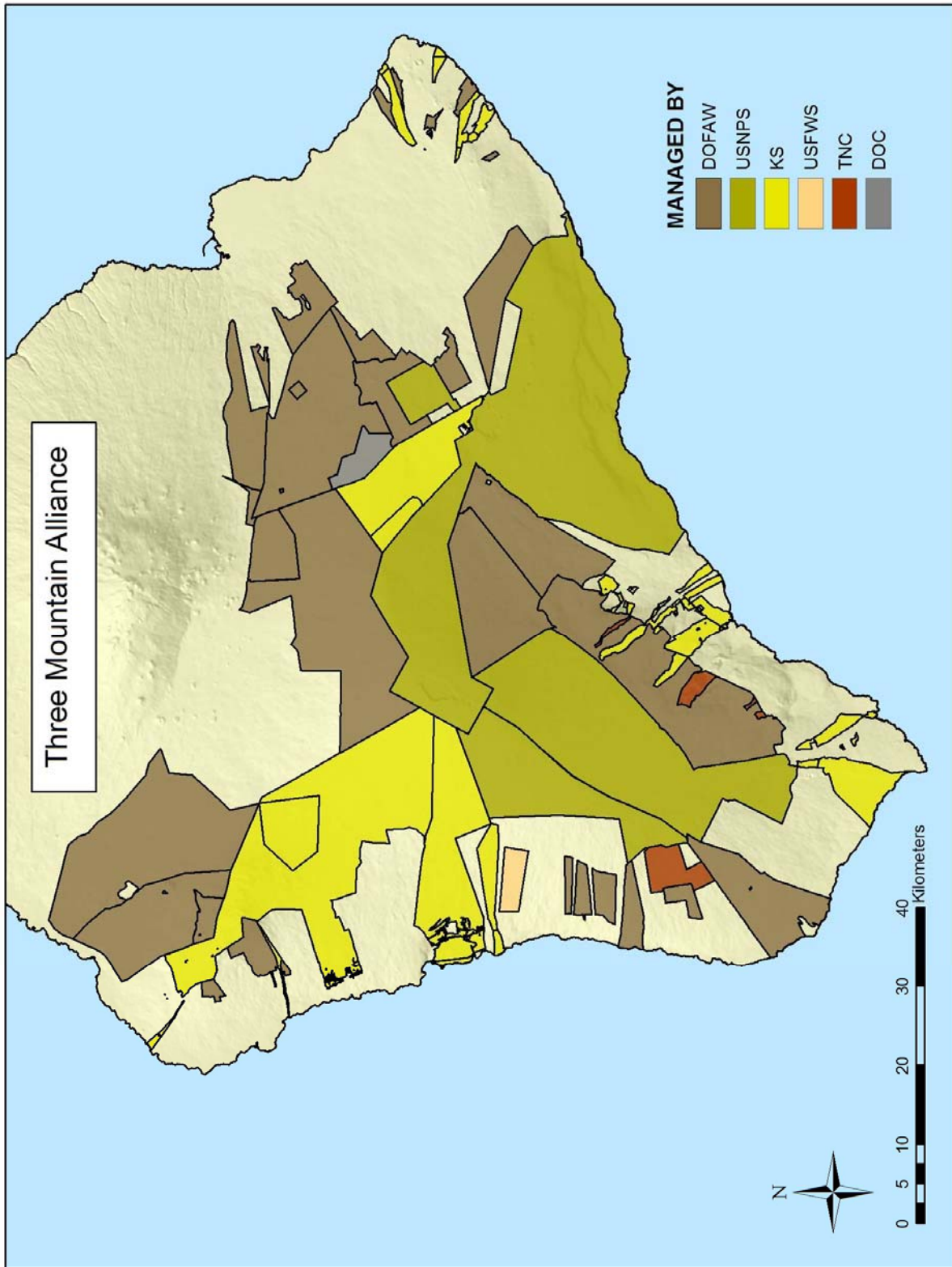


Exhibit B: Statement of Authorities

1. The **State of Hawai'i Department of Land and Natural Resources**, under Title 12, Hawai'i Revised Statutes (HRS) including but not limited to Chapters 171, 183, 195, 195D, and 195F manages a portion of the subject area as Natural Area Reserves, Wildlife Sanctuaries and Forest Reserves; and
2. The mission of the **Kamehameha Schools** is to fulfill Ke Ali'i Pauahi's desire to create educational opportunities in perpetuity to improve the capability and well-being of people of Hawaiian ancestry. It is the policy of KS to manage their lands and resources to optimize the balance of educational, cultural, economic, environmental, and community returns and steward resources in an ethical, prudent and culturally appropriate manner.
3. The mission of the **U.S. Department of the Interior, U.S. Fish and Wildlife Service** is to work with others to conserve, protect, and enhance fish, wildlife, and plants and their habitats for the continuing benefit of the American people; and
4. The **State of Hawai'i, Department of Public Safety, Corrections Division**, under Title 20, HRS, Chapter 353, operates Kulani Correctional Facility and has an interest in participating in the active preservation of natural habitat in the area and providing meaningful training and employment for its inmates; and
5. Under this document, Agreement # G8306-06-2001, the **U.S. Department of the Interior, National Park Service** manages Hawaii Volcanoes National Park and is charged with the responsibility to conserve the scenery and the natural and historic objects and wildlife of the areas under its jurisdiction and to provide for the enjoyment of the same by the public in such manner as will leave the areas unimpaired for the enjoyment of future generations (16 U.S.C. 1); and a MOU is used to document mutually agreed upon policies, procedures, objectives, and/or assistance relationships that do not involve funding. The enabling park legislation or the general management authorities under 16 U.S.C. 1-3 are the legal authorities for this type of agreement.
6. The **U.S. Department of Interior, U.S.G.S. Pacific Island Ecosystems Research Center** is actively involved with scientific research in support of protecting the biological resources in the TMA area and adjacent lands; and
7. The **U.S. Department of Agriculture, U.S. Forest Service, Institute of Pacific Islands Forestry**, conducts research on interactions of non-native invasive plants with native ecosystems and actively assists cooperators in management of non-native invasive species and improvement of forest health on federal, state and private lands, under authority of the Forest and Rangeland Renewable Resources Research Act of 1978, the Cooperative Forestry Assistance Act of 1978, and the Hawai'i Tropical Forestry Recovery Act of 1992; and
8. The mission of **The Nature Conservancy**, a non-profit organization, is to preserve the plants, animals, and natural communities that represent the diversity of life on Earth by protecting the lands and waters they need to survive.

9. The **U.S. Department of Agriculture, Natural Resources Conservation Service** provides leadership to help America's private land owners and managers conserve their soil, water, and other natural resources. NRCS employees provide technical and financial assistance to land-users, communities, and units of State and local government for planning and implementing conservation activities

Exhibit C. Principal Contacts (Members Representatives)

1. State of Hawai'i Department of Land and Natural Resources

Roger Imoto, Division of Forestry and Wildlife
Hawai'i Island Manager
P.O. Box 4849
Hilo, HI 96720-0849
Ph: (808) 974-4221 FAX: (808) 974-4226

2. Kamehameha Schools

Kamakani Dancil
Hawai'i Island Land Asset Manager
Kamehameha Schools
78-6831 Ali'i Dr, Suite 234
Kailua-Kona, HI 96740
Ph: (808) 322-5307 FAX: (808)322-9446

3. U.S. DOI National Park Service

Rhonda Loh
Acting Chief, Natural Resources Division, Hawai'i Volcanoes National Park
P.O. Box 52
Hawai'i National Park, HI 96718
Ph: (808) 985-6098 FAX: (808) 985-6029

4. State of Hawai'i Department of Public Safety

Beryl Iramina
Warden, Kulani Correctional Facility
HCI Stainback Highway
Hilo, HI 96720
Ph: (808) 933-1922 FAX: (808) 969-9107

5. The Nature Conservancy

Robert J. Shallenberger
Hawai'i Island Director
The Nature Conservancy
P.O. Box 6779
Kamuela, HI 96743
Ph: (808) 885-1786 FAX: (808) 885-4219

6. U.S. DOI U.S.G.S. Pacific Island Ecosystems Research Center

Jim Jacobi
Botanist
U.S.G.S. Pacific Island Ecosystems Research Center
P.O. Box 44
Hawai'i National Park, HI 96718
Ph: (808) 967-7396 ext. 229 FAX: (808) 967-8568

7. U.S. DOI U.S. Fish and Wildlife Service

Patrick Leonard
Field Supervisor
Pacific Islands Fish and Wildlife Office
U.S. Fish and Wildlife Service
300 Ala Moana Blvd., Rm. 3-122
Honolulu, HI 96850
Ph: (808) 792-9400 FAX: (808) 792-9581

8. U.S.D.A. Forest Service

Julie Denslow
Research Ecologist and Team Leader, Invasive Species Unit
Institute of Pacific Island Forestry
USDA Forest Service
60 Nowelo St., Hilo, HI 96720
Tel: 808-933-8121 Ext. 118 FAX: 808-933-8120

9. U.S.D.A. Natural Resources Conservation Service

Steve Skipper, Big Island RC&D Coordinator
Hilo Lagoon Centre Suite 229 - A
101 Aupuni St., Hilo HI 96720
Office - (808)933-6996
Fax - (808)933-6995

B. TMA Operating Guidelines

OPERATING GUIDELINES **Three Mountain Alliance**

These Guidelines are to serve as general operating procedures with wide latitude for flexibility as determined by the Members. As time and experiences are gained, these guidelines may be refined.

MEMORANDUM OF UNDERSTANDING (MOU)

The Three Mountain Alliance (TMA) MOU, (Exhibit A) provides for Members to work together across the TMA landscape to sustain adequate quality and quantity of water and to protect and enhance native flora and fauna.

TMA MEMBERS

- Membership is secured by consensus of the existing TMA Members and by signing the MOU.
- Large landowners and/or lessees as well as public and private agencies/organizations that support the TMA in principle and can provide technical expertise, financial or other assistance will be invited to participate in TMA projects and/or become official Members of the TMA.
- Members are responsible for all major decisions including setting of priority programs and projects, financial and personnel matters and the overall operations of the TMA.
- All Members are granted full discussion and participation rights in TMA programs, projects and activities, including regular meetings.

EXECUTIVE COMMITTEE (EC)

Purpose:

- Provide leadership and recommend action for decision by the Members.
- Encourages involvement from all TMA members, by providing an opportunity for all to serve on the EC.
- Provide guidance, counsel and oversight to the TMA Coordinator as appropriate.
- Reviews management strategies for identification of priority programs and projects and identifies areas requiring updates for TMA action.
- Develops and recommends annual budgets, annual program objectives, fiscal needs, and priority management areas and projects for implementation.

- Identifies and seeks public and private funds for operations, programs and projects.
- Reviews operational guidelines as needed.

Members:

- The EC shall consist of four (4) members and a NPS representative (point of contact to the Pacific Cooperative Studies Unit (PCSU)/Research Corporation of the University of Hawai'i (RCUH)).
- The NPS representative is responsible for TMA Coordinator's job performance evaluation required by PCSU/RCUH administration guidelines with collaboration from the EC and Members.
- EC members will be voluntarily solicited from the general TMA membership by consensus of all the Members.
- Term of office shall be for a two-year period, from January 1 to December 31, the following year. Initial EC membership shall have two members with 1-year terms to ensure membership will have staggered terms.
- EC decisions will be made by consensus.
- The TMA Coordinator may participate in discussions and decisions on all EC matters except for personnel matters involving the TMA Coordinator.

MEETINGS

- Regular TMA meetings shall be held on a quarterly basis.
- The EC or TMA Coordinator may call special meetings as needed.
- Standing and Ad Hoc Committees may be formed at the discretion of the Members. Committees may include, but are not limited to Budget and Finance, Education and Community Outreach, staff recruitment, program/project development, review of Management Strategies, etc.
- The Members will host meetings on a rotational basis.
- The EC and the TMA Coordinator shall coordinate meeting agendas.
- Members may highlight their organizational activities of interest to the TMA; arrange field trips, office visits and guest speakers.
- Meetings will be conducted by an informal version of Robert's Rules of Order.
- TMA business will be conducted at regular meetings. However, the EC or TMA Coordinator may call for discussion and votes via email, providing reasonable response time is provided appropriate to the business item.
- The TMA will operate by consensus of all the Members.

PERSONNEL MATTERS

Staff Hiring:

- Hiring of the TMA Coordinator will involve all Members. A selection committee will be formed to interview candidates. All Members are invited to observe interviews. The selection committee will recommend a candidate for approval by the Members.
- Project-specific employment protocol will be conducted at the discretion of project Members.
- TMA staff members: The TMA Coordinator and a selection committee shall recommend selection of other TMA staff. Final decisions will be approved by the Members.

Performance Reviews:

- TMA Coordinator annual performance review shall be conducted by the Chair based on PCSU/RCUH administrative procedures, with input from the EC and Members.
- TMA Staff performance review shall be conducted by the TMA Coordinator with input from other Members, as appropriate.
- Disciplinary action shall follow PCSU/RCUH protocol.
- EC shall evaluate staffing needs on an annual basis to include other positions such as office manager/logistics/finance specialists and field staff.

TMA COORDINATOR

- The TMA Coordinator is a paid position, hired by the Members through administrative procedures.
- The duties and responsibilities of the TMA Coordinator are described in Exhibit C.

TMA STAFF

Staffing to be added over time as funding secured and duties and responsibilities specified and approved by the Members. Some potential staffing positions may cover the following areas:

- Planning: Management Strategies, Meetings, Field Trips, Guest Speakers
- Operations: Coordinate Projects, Field Work
- Logistics: Service and Support
- Finance: Grant Applications, Budget Management

COMMUNICATION AND DECISION MAKING

- The ultimate decision-making body is comprised of the Members for all major decisions such as changes to management strategies, hiring and performance reviews of the TMA Coordinator, setting of priority programs and projects, etc.

- The Members may delegate authority to the EC to make certain types of decisions as agreed to by Members. Such decisions may include day-to-day matters such as communications with PCSU/RCUH, recommendations on TMA Coordinator selection and performance reviews, signing of documents approved by the Members, etc.
- The Members may delegate decisions on administrative matters to the TMA Coordinator such as recommending staff hires, preparing and submitting grant applications, supervising management staff, representing the TMA in community affairs and government programs.
- The TMA Coordinator serves as the center of communication within the TMA.
- Email shall be the official communication vehicle supplemented by written letters and phone calls as necessary.

#

Approved:

Amended: _____ (date)

Exhibit A: TMA MOU

Exhibit B: TMA Map

Exhibit C: TMA Coordinator, MAJOR DUTIES AND RESPONSIBILITIES

1. Program Leadership
 - a) Works routinely with TMA Members to identify and prioritize watershed and ecosystem protection projects based on management strategies and plans.
 - b) Coordinates meetings of the TMA and keeps accurate and timely records.
 - c) Keeps detailed records on work progress and areas managed.
 - d) Leads in recruiting, hiring and training of any future staff and volunteer leaders.

2. Project Implementation
 - a) Works with field crew, volunteers or work program participants to oversee and carry out fencing, ungulate and weed control, and other watershed management projects.
 - b) Works with landowners to obtain permission to carry out management efforts.
 - c) Ensures that proper NEPA/SEPA documentation is prepared for all projects and that all permits and regulatory approvals are obtained.
 - d) Assures that all employees work in a safe manner consistent with RCUH standards and procedures.

3. Finances

- a) Seeks out and raises funds for watershed protection projects and coordination of the TMA.
- b) Identifies and works with public and private funding agencies on a regular basis to ensure continued project funding.
- c) Writes grants, proposals and carries out routine awareness raising events to ensure ongoing project funding.
- d) Write grants and progress reports on a regular basis as needed.
- e) Ensures proper accounting of expenditures.

4. Public Outreach

- a) Leads public outreach efforts, working with media, community organizations, civic leaders and individuals through an effective program using personal contact, media briefings, brochures, press releases, presentations and public service announcements.
- b) Coordinates with cooperators, volunteers and the public to establish new collaborative efforts to protect the TMA area.