Kamakou Preserve

Molokaʻi, Hawaiʻi

DRAFT Long-Range Management Plan
Fiscal Years 2013–2018

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

The Nature Conservancy
Protecting nature. Preserving life.™

Submitted by
The Nature Conservancy of Hawaiʻi

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EXECUTIVE SUMMARY

The Nature Conservancy of Hawai‘i is an affiliate of The Nature Conservancy, an international private, non-profit organization based in Arlington, Virginia. The Conservancy’s 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. Since 1980, the Conservancy has directly helped protect more than 200,000 acres of Hawai‘i’s best natural lands and established a statewide system of 10 preserves totaling almost 36,000 acres. Today, we are taking conservation to a new level in Hawai‘i by working in partnership to protect the larger landscapes and biological systems of which our preserves are a part. Together with other public and private landowners, we are protecting over 1.6 million acres of ecologically important lands through voluntary, cooperative partnerships that allow landowners to share expertise and resources and work across ownership boundaries.

The State’s Natural Area Partnership Program (NAPP) is an innovative program that aids private landowners in the management of their native ecosystems. NAPP provides matching funds ($2 state to $1 private) for the management of qualified private lands that have been permanently dedicated to conservation. On Moloka‘i, the Conservancy manages three NAPP Preserves: Kamakou, Mo‘omomi, and Pelekunu, and is the main coordinator/manager of the East Moloka‘i Watershed Partnership (EMoWP) which is directly responsible for management programs in Kamalō, Kapualei, and Kawela. The three NAPP preserves total just less than 10,000 acres and the EMoWP (including Kamakou and Pelekunu Preserves) encompasses over 30,000 acres. Kamakou was approved for NAPP funding in 1995. This long-range management plan updates the previous long range plan (FY 2007–2012). This plan was prepared in compliance with the Natural Area Partnership agreement between the State and The Nature Conservancy of Hawai‘i. The FY 2013–2018 plan documents management programs to be undertaken during the next six years at Kamakou Preserve.

The state Department of Land and Natural Resources (DLNR), which administers the NAP program, is kept apprised of our progress in the preserve through written reports and an annual inspection. Operational plans are submitted annually (the Conservancy has adopted a July 1–June 30 fiscal year). In addition, a six-month semiannual report is sent to DLNR each February. These documents are available upon request to others who are interested.

The first section of this plan is a brief overview of the native natural resources that are protected at Kamakou Preserve. In the second section are management considerations that have shaped our programs. Finally, each management program is discussed in turn. Program goals are followed by an explanation of the management method we have chosen. Annual objectives and costs for each program from FY2013–FY2018 are also listed.

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

Table 1. Overview of Kamakou Preserve Accomplishments by Programs, FY 2007–FY 2011 (5 Years)

	Indicator	Measure of Success
Ungulate Control	Total animal sweeps	247, including 29 conducted by Prohunt
	Total animal catches	293 animals (not including 92 caught in traps)
	Miles of fence inspected, maintained and/or replaced in Kamakou	5 miles consistently inspected and maintained
	Number of ungulate surveys	10
Invasive Plant Control	Acres and number of priority invasive plants treated or removed	Over 5367 acres swept total for 8 species See Table 2, Weed Control Estimates
Monitoring and Research	Percent activity on ungulate transects	From 14% activity in FY07 to 5.4% activity in FY11
	Acres swept for weed monitoring	5,367 not including aerial (addtl. 13,636)
	Moloka'i Understory Monitoring surveys	3
	Number of research projects supported in Kamakou	32
Rare Species Protection	Numbers of new rare plant locations discovered	3 PEPP targets - *Phyllostegia hispida* (3 locations), *Cyanea solanacea* (3), *P. mannii* (1) Also *Phyllostegia stachyoides (4), Joinvillea ascendens* subsp. a*scendens (2), Ranunculus mauiensis (1)*
	Number of species outplanted	*Labordia triflora* (18); *Schiedea laui* (76 individuals outplanted); *Lysimachia maxima* (3); *Phyllostegia hispida* (201); *Cyanea profuga* (34); *Platanthera holochila* (9)
Community Outreach	Number of hikes/persons	97/959
	Number of volunteers	75
	Total volunteer person hours	1990

RESOURCE SUMMARY

General Setting

Kamakou Preserve was established in September of 1982 to protect the habitat of endemic forest birds. The 2,774-acre preserve is located in the east Molokaʻi mountains and borders is adjacent to the Olokui and Puʻu Aliʻi Natural Area Reserves (NAR), Kalaupapa National Historical Park, Kamalō, Kapualei and Kawela Plantation lands, and the Conservancy's Pelekunu Preserve (Figure 1). These managed areas belong to the East Molokaʻi Watershed Partnership (EMoWP) and protect more than 25,000 acres of contiguous ecosystems that range from sea level to 4,970 feet in elevation (Figure 2). The elevation in the preserve ranges from 2,034 to 4,527 feet and the average precipitation ranges from 39 to 118 inches. Kamakou is one of the primary ground water recharge and surface water source areas feeding the State Department of Agriculture's Molokaʻi Irrigation System. The preserve is open to the public for hiking and hunting, and for educational and cultural activities. During times of extreme fire hazard, unsafe road conditions, or herbicide spraying in accessible areas, portions or all of the preserve may be closed to the public.

Flora and Fauna

Kamakou Preserve contains five vegetation zones, which contain ten natural community types, ranging from lowland mesic shrublands to montane wet forests (Figure 3). There are two rare natural communities: the ʻōhiʻa mixed montane bog community and the montane wet piping cave (known only from Molokaʻi; Appendix 1). The preserve's more common natural communities are also found in Olokuʻi and Puʻu Aliʻi NARs, and the Kamalō/Kapualei watershed project (Appendix 1).

Kamakou is home to 44 rare plant taxa, 23 of which are listed endangered. Fourteen of Kamakou's 44 rare plants have also been reported from Olokuʻi and/or Puʻu Aliʻi NARs, and seven of the preserve's rare plant taxa have been reported in Kalaupapa National Historical Park (Appendix 2). The Plant Extinction Prevention Program (PEPP) works closely with the Conservancy in Kamakou Preserve to protect the critical rare plant species found there (<50 individual plants in the wild, in the world). In 2009, they hired a permanent on-island staff dedicated to protection of these species.

Of the five native forest birds historically known from Kamakou since 1960, only ʻapapane (*Himatione sanguinea sanguinea*) and ʻamakihi (*Hemignathus virens wilsoni*) are seen frequently. In 2010, a single solitary ʻiʻiwi (*Vestiaria coccinea*) was seen in Kapualei; other occurrences of ʻiʻiwi were recorded during the 2004 Molokaʻi Forest Bird Project survey in the preserve and in Kapualei. The kākāwahie (Molokaʻi creeper, *Paroreomyza flammea*) has not been seen on Molokaʻi since 1963, and the olomaʻo (Molokaʻi thrush, *Myadestes lanaiensis rutha*) has not been seen on Molokaʻi since 1988 (one was sighted in Kamalō, just east of the preserve) (Appendix 3).

It is anticipated that there is significant invertebrate diversity in Kamakou Preserve. Although more remains to be learned about the molluscan fauna, five species of rare native land snails have been reported in Kamakou Preserve (Appendix 4).

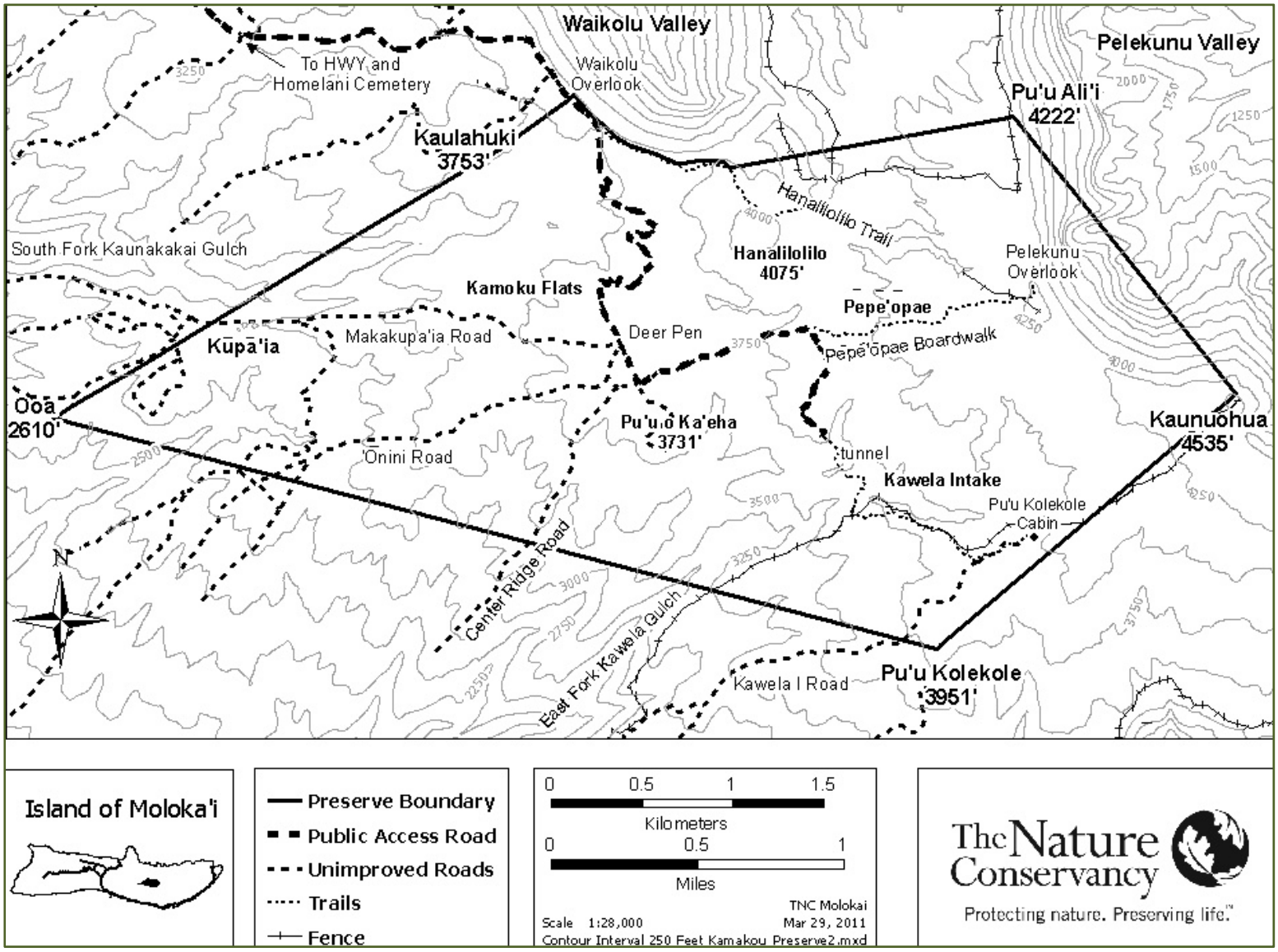


Figure 1. Kamakou Preserve

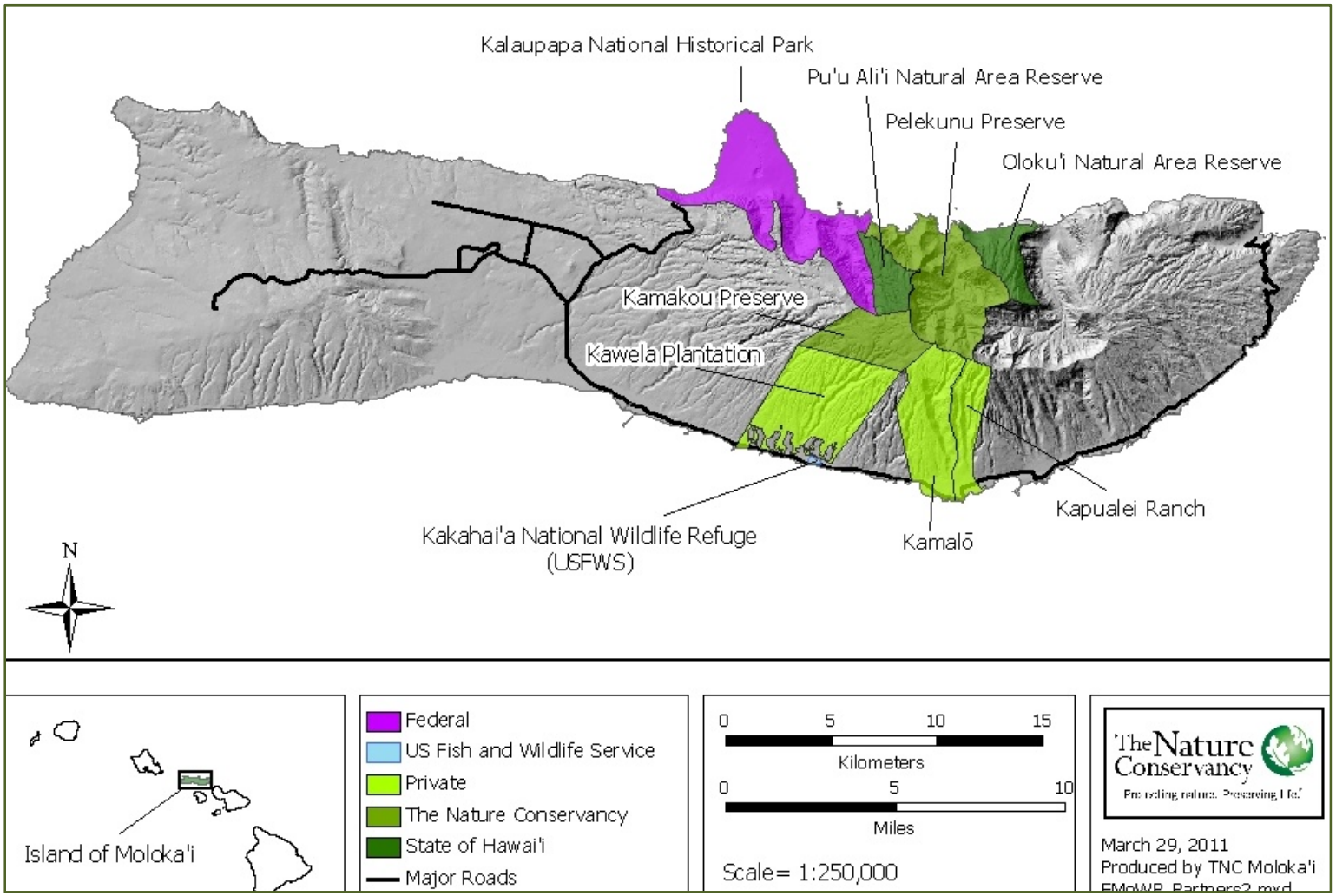


Figure 2. East Moloka‘i Watershed Partnership

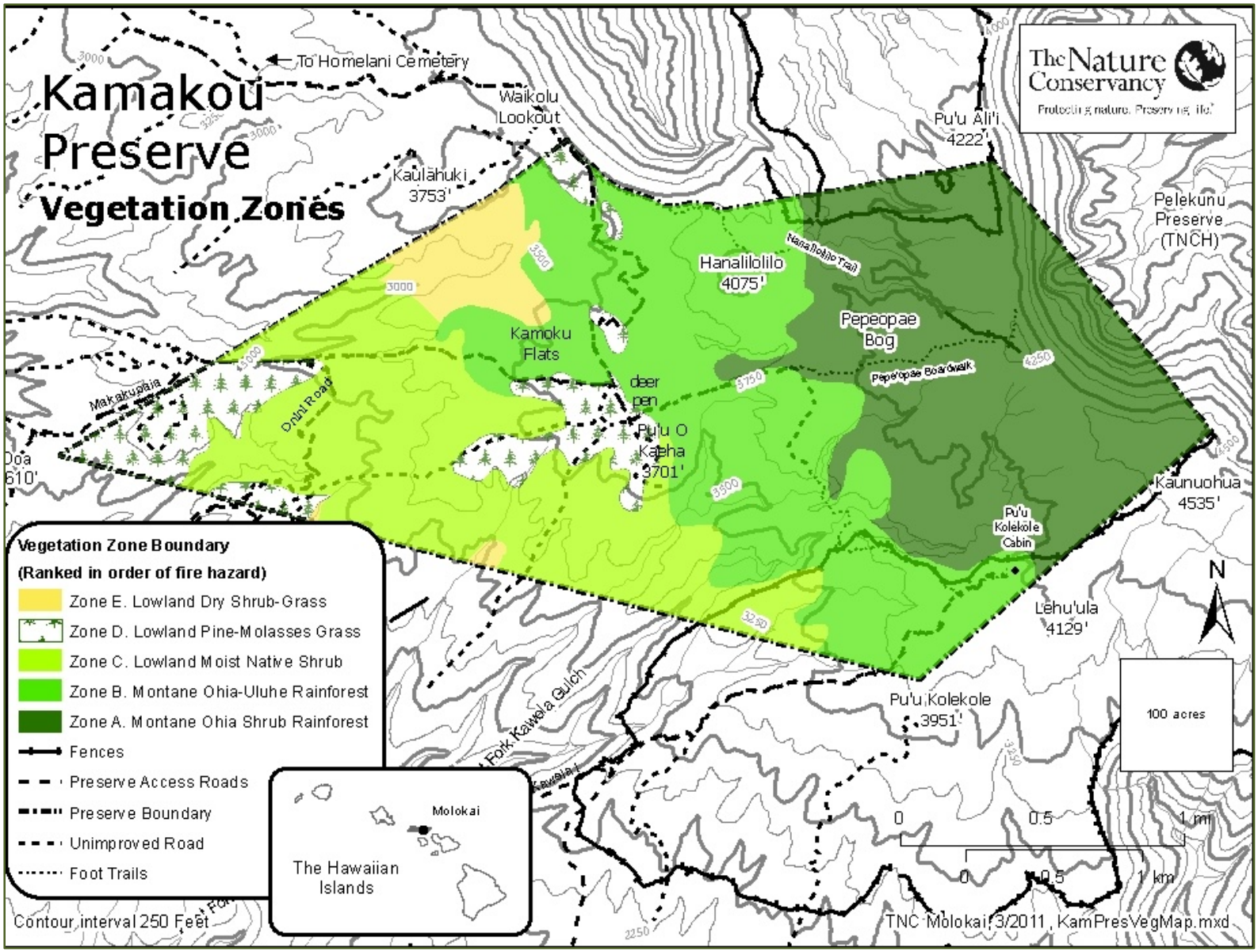


Figure 3. Kamakou Preserve natural communities

MANAGEMENT

Management Considerations

1. Our primary management activities for protecting the preserve's native plants, animals, and natural communities are to reduce feral ungulate damage, limit the spread of non-native, habitat-modifying plants, and prevent wildfire. We are committed to conducting community outreach and providing public access for compatible uses. The Conservancy provides access to the extent required by law for the purpose of allowing traditional practices in the area. Conservancy staff will develop monitoring and management strategies if impacts become apparent due to preserve visitation.

2. Prior to 1982, the Kamakou Preserve area was part of the State's Molokaʻi Forest Reserve under a surrender agreement with the landowner, Molokaʻi Ranch, Ltd, now called Molokaʻi Properties, Limited (MPL). In 1982, the Conservancy purchased a permanent conservation easement over the property from MPL. This easement supersedes the State's surrender agreement and ensures the Conservancy's rights to manage the preserve for the benefit of native species and ecosystems, and prohibits a wide range of potentially unsuitable activities by the landowner. The document also reserves certain rights for the landowner, including the right to enter and inspect, and to harvest surface water from the established water development systems, which may be expanded within clear limits described in the easement. The Conservancy began an easement compliance monitoring program in FY2005. Conservation easement monitoring is required every three years, and was completed in 2008 and 2011 to ensure the Conservancy and MPL are in compliance with the terms outlined in the conservation easement.

3. The State Division of Forestry and Wildlife (DOFAW) provides wildfire suppression, road maintenance, use of Puʻu Kolekole cabin, and assistance with other projects in the preserve. The preserve's main access road is part of the Na Ala Hele trail and access system. The Conservancy continues to allow public access to the preserve and honors the preserve as part of the Molokaʻi Forest Reserve system.

4. In 1999 the East Molokaʻi Watershed Partnership was established by through an MOU (See Appendix 5, EMoWP Fact Sheet). The first project of the EMoWP was the construction of a 5.5 mile contour fence in the Kamalō/Kapualei ahupuaʻa. This fence provides a barrier from the large goat herds that have denuded the slopes below the 3,000 foot contour. In April 2003, Kawela Plantation Homeowners Association (KPHA) signed the EMoWP MOU. Additionally, KPHA signed a Memorandum of Agreement with the Conservancy to manage their upper "common lands". The Conservancy has since constructed over two miles of fence and has maintained their mountain access roads and firebreaks.

5. Designated areas of the preserve are open for public hunting (see Status of Public Hunting Opportunities on page 9), hiking, and for educational and cultural activities. During times of extreme fire hazard, unsafe road conditions, or herbicide spraying in accessible areas, portions or all of the preserve may be closed to the public. Notification of closure will be made via a sign posted on the forest access road near the Manawainui Bridge and/or by announcements in local newspapers.

   In June 2003, the U.S. Fish and Wildlife Service designated a portion of the preserve as "critical habitat" for the endangered Blackburn's sphinx moth (*Manduca blackburni*). This designation requires the Service to consult under Section 7 of the Endangered Species Act with regard to actions carried out, funded, or authorized by a federal agency.

6. In 2010 in response to challenging economic conditions, TNCH made a commitment to outsource some of its field work in an effort to build capacity of partners, streamline operations, and focus resources toward conservation innovation and technology. Since fiscal year 2011, contracts have been awarded to implement animal and weed control over much of the south slope landscape of the EMoWP. Additionally, the Conservancy was awarded funds (USFS, WPPG, USFWS, NAPP) for FY12 and FY13 to complete a fence extension at Kamakou and Kapualei. The fence project will completely enclose the wet forest areas from Kamakou to Kapualei (Figure 4).

Management Programs

Although the following management programs are described separately, they form an integrated management approach. For each program listed in the following section, we have indicated a major goal and described the management methods chosen. Also included are highlights of past and current achievements and key management issues. Finally, key objectives to achieve the goal are listed by year for FY2013–FY2018.

Program 1: Non-Native Species Control

Ungulate Control

Program Goal: To remove all ungulates from fenced areas, prevent future invasion, and keep ungulate activity at 5% in unfenced areas (below the fence) in Kamakou Preserve.

Program Description: Over the past three decades, we have made substantial progress towards reducing ungulate activity and damage through the use of community hunting, snaring, live pig trapping, and fencing. Listed here is a summary of past major strategies and accomplishments in our ungulate control program:

- 1983–1994 (pre-NAPP): Ungulate control was conducted using public and volunteer hunting with dogs and snaring. Ungulate activity survey transects were installed and initial data showed activity levels of greater than 30% prior to snaring. Snaring

implemented between 1991–1993 reduced activity levels below 5% in the remote areas where it was applied. The Puu Alii south boundary fence was completed in 1992 (Figure 4).

- NAPP Long-Range Management Plan (LRMP) FY1995–2000: The Molokaʻi Hunting Working Group (MHWG) was established to bring activity levels below 10% using volunteer hunting alone. Volunteer hunting was able to maintain activity levels to just above 10%. The Kamakou east boundary fence was completed in 1995 (Figure 4). The East Molokaʻi Watershed Partnership was established in November 1999.

- NAPP LRMP FY2001–2006: Live trapping for pigs began in 2001; trapping began showing signs of success in 2002, and was attributed to bringing activity levels below 10% during this period. Live trapping was compatible with public hunting, as hunters help harvest the pigs around the trap or the trapped pigs themselves. The Kamalō/Kapualei fence was completed in March 2001 (Figure 4).

- NAPP LRMP FY2007–2012: Live trapping was implemented from 2007-2009 with successful results In FY 2009 traps were suspended due to low capture rates. The 2009 the Prohunt project revolutionized pig hunting techniques with the one dog/one hunter technique, GPS dog collars, systematic sweeps, and specially bred and trained dogs. TNC has been, and is continuing to train the next generation of dogs and are successfully implementing the one dog/one hunter sweep methodology. The Kawela section of the fence was completed in 2006 (Figure 4). The Mākolelau fence section was completed in 2008. Aerial shooting resumed in 2009. Aerial shoot areas occur in the steep gulches of Kawela, Kamalō and Kapualei and in the upper fenced areas. Aerial goat surveys are done annually to detect any changes in the goat populations. The numbers from the 2010 survey indicate a significant drop in goat numbers. In November of 2010, Pono Pacific was awarded a contract to conduct animal sweeps and fence surveys for the south slope areas, including Kamakou Preserve. In FY12 the Kapualei two-mile section will be completed which will completely enclose the wet forest from Kamakou East boundary to Kapualei (Figure 4). For FY13 a 1.5 mile fence is proposed to be constructed which will completely enclose the Kamakou wet forest.

In order to monitor the effectiveness of our ungulate control strategies and assess the threat level of ungulates to Kamakou Preserve, we installed a series of 8 transects in 1984 to measure ungulate activity[1]. Since then we have expanded to a total of 13 transects. We monitor semi-annually for signs of ungulate activity in contiguous 5m X 10m plots along 500m transects. This monitoring method is used to gauge the effectiveness of our control strategies and techniques. Trend data indicate that overall pig activity observed has declined from about 46% percent in 1990 to less than 6% in 2011 (Figure 5).

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

During the next six-year period (FY 2013–2018), the 1.5 mile proposed Kamakou fence will be completed(Figure 4). Contract animal control sweeps and fence surveys will continue. Contracts will focus on sweeping the newly enclosed fence areas. Staff will conduct biannual ungulate activity surveys along with "hotspot" hunt sweeps to monitor contractor progress. Live trapping will be available if needed. Annual goat surveys will continue and will be used to evaluate the level of aerial shooting needed. We will continue to have staff meetings focused on ungulate control strategies to evaluate and improve our progress toward our ungulate control goals.

Activities

Years 1–6 (FY2013–2018):

- Complete Kamakou Preserve hunting and hotspotting sweeps in priority and fenced areas.
- Survey and repair existing fences annually.
- Complete semiannual ungulate activity surveys.
- Continue live pig trapping as needed.
- Continue public hunting and Conservancy-led volunteer hunts as needed.
- Continue dog training as needed to maintain at least four fully trained dogs.*

Year 1 (2013):

- Complete contract for Kamakou fence section.

Status of Public Hunting Opportunities

The preserve is open for public hunting where and when this is compatible with management programs, and in accordance with the regulations of the adjoining Pu'u Ali'i NAR. At this time, the NAR and the preserve are open year-round to hunting of pigs, goats, and axis deer, without a bag limit. During times of extreme fire hazard, unsafe road conditions, or herbicide spraying in areas accessible to the public, portions or all of the preserve may be closed.

This program represents an estimated 25% of the overall effort and budget in this long range management plan.

*These activities may go beyond the scope of the NAPP budget due to recent budget cuts, but will be carried out if additional private funds can be raised.

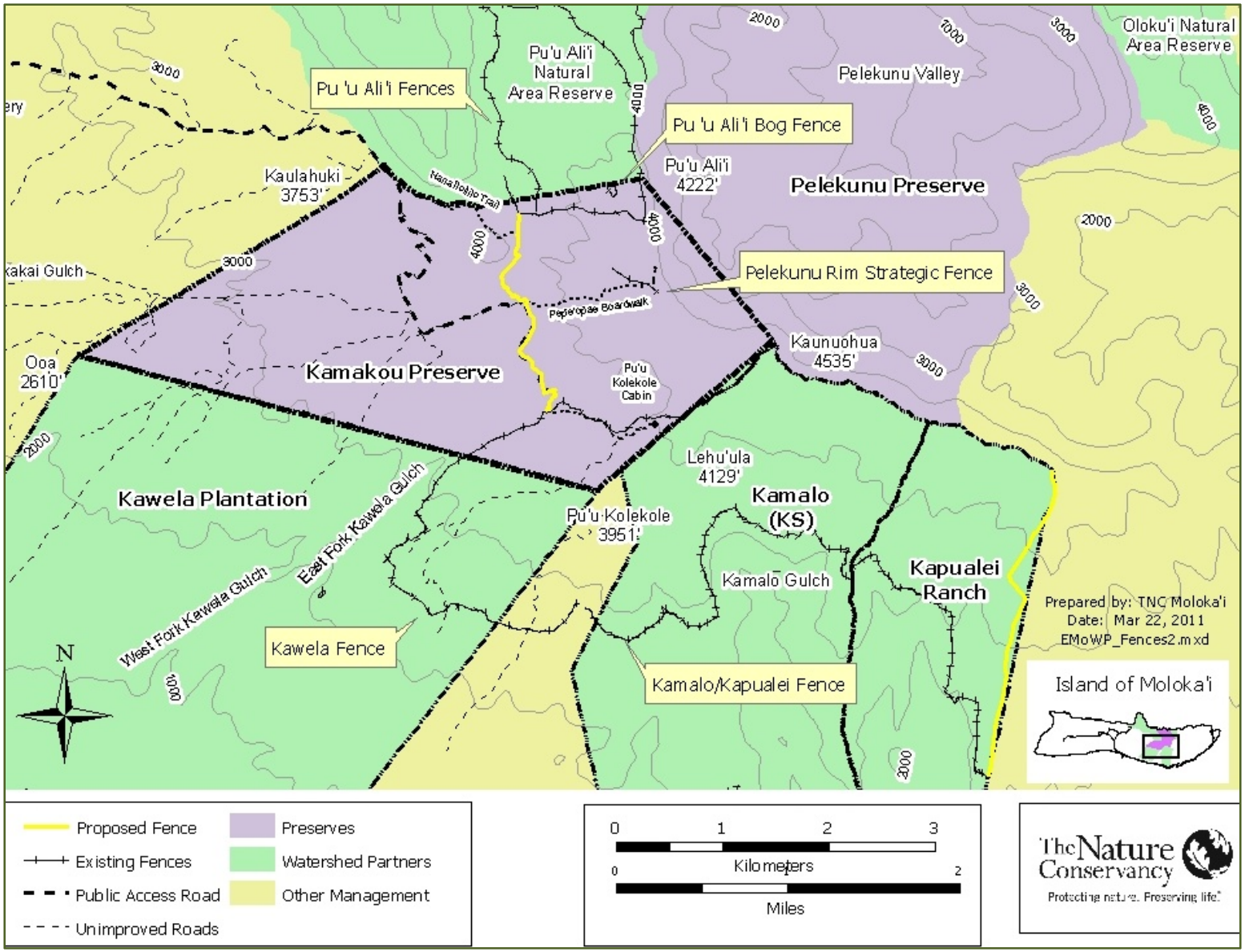


Figure 4. Kamakou Preserve management areas and fences

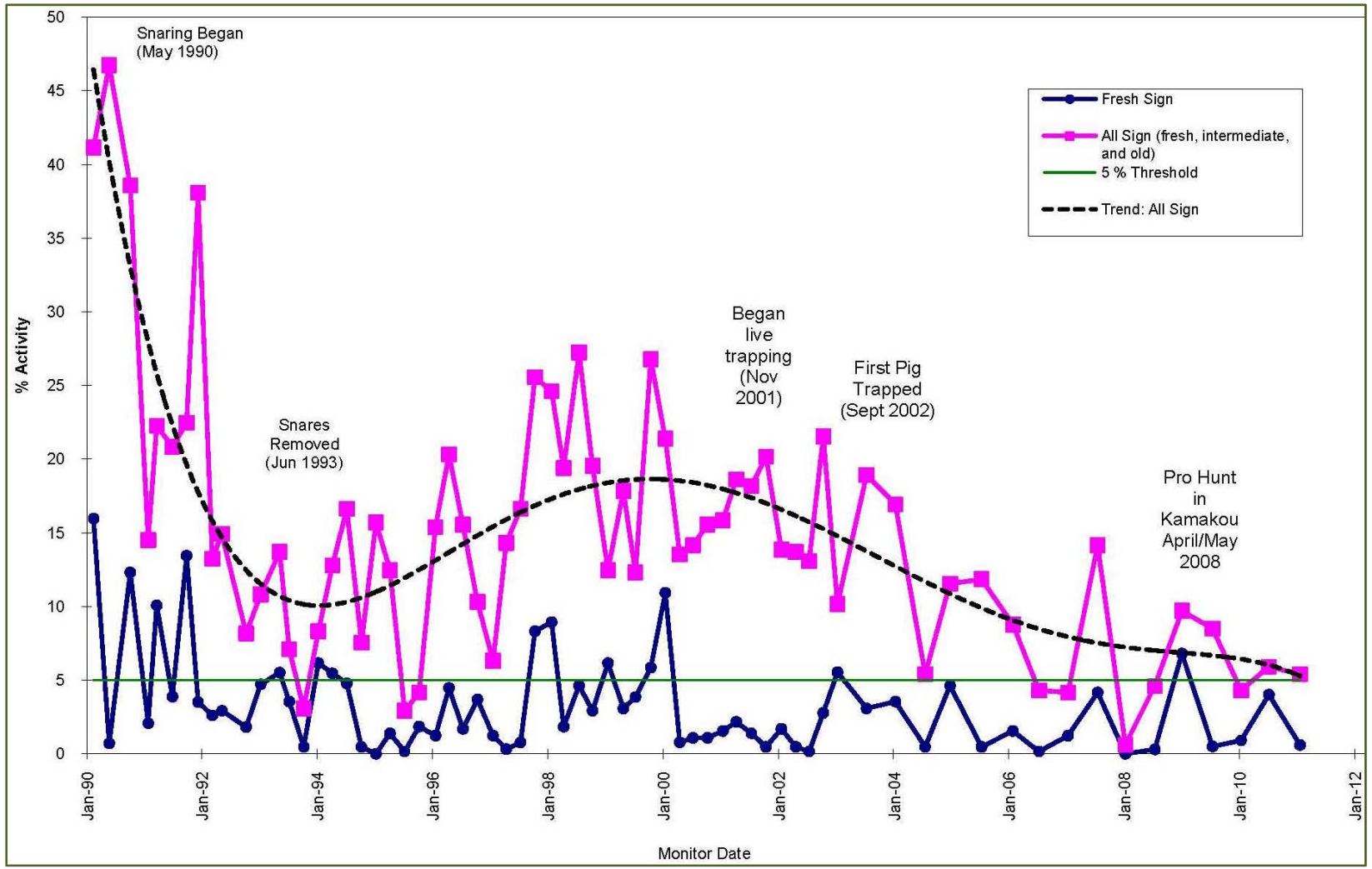


Figure 5. Ungulate activity in Kamakou, 1990 to present (all transects)

Invasive Plant Control

Program Goal: Improve or maintain the integrity of native ecosystems in selected areas of the preserve by reducing the effects of invasive plants.

Program Description: Habitat-modifying weeds are non-native plants that are known to alter natural habitat conditions and displace native vegetation. Displacement is accelerated by ungulate disturbance. Ungulates, especially pigs, impact the ground by their foraging activities (rooting and digging), and carry and spread unwanted weed seeds. Fire also accelerates invasion by certain weed species. Control of ungulates and wildfire, therefore, are among the most effective means of controlling the introduction and spread of habitat-modifying weeds in the preserve.

The wet forest is the most intact conservation target in the preserve and eliminating priority weed species from this area is our highest priority. Eliminating or suppressing priority weed species (see Table 2) in adjacent mesic forest and shrubland is also a priority since these ecosystems act as a buffer by keeping weed populations from spreading into the wet forest. For the past six years, weed control efforts have focused on removing eight priority weed species from the wet forest and adjacent mesic forest and shrubland: blackberry (*Rubus argutus*), strawberry guava (*Psidium cattleianum*), New Zealand flax (*Phormium tenax*), karakanut (*Corynocarpus laevigata),* paperbark (*Melaleuca quinquenervia*), *Tibouchina herbacea* (Glorybush), *Clidemia hirta* (Koster's curse), and three pine species (*Pinus elliotti*, *Pinus taeda*, *Pinus radiate)*.

Weed control in Kamakou Preserve has developed into an effective program through the use of handheld GPS units, GIS mapping technology, and a compatible database system. Over the past three years, the Conservancy has had success with three of our eight priority weed species. Karakanut (*Corynocarpus laevigata*), paperbark (*Melaleuca quinquenervia*) and New Zealand flax (*Phormium tenax*) have been brought down to a level of seed bank detection where staff are finding only a few immature occurrences on an annual basis.

Since 2008, staff have been implementing systematic weed sweeps wherein staff equipped with individual GPS units are spaced 10m apart in a specified area and move in unison while diligently looking for the target weed(s). Tracklines and removal data are documented with GIS, which has vastly improved the accountability of the weed removal efforts. See Table 3 for control estimate for eight priority weed species.

We strive towards an Integrated Pest Management (IPM) approach to weed control — consisting of manual/mechanical methods, herbicides, or biological control. As biological controls are developed and approved for release on our top priority weeds, we will work cooperatively with agencies mandated to monitor these agents. Cultural control (minimizing soil disturbance and new pest plant introductions) is incorporated into routine field operations through gear sanitation protocols. Herbicide use is in full compliance with the State of Hawai'i

Department of Agriculture (HDOA) Pesticide Enforcement Division, used according to the product label, and recorded in detail for reference and efficacy monitoring. Staff coordinating weed control are certified with the HDOA Pesticide Enforcement Division through a Forestry Applicators' exam and card. We may employ other techniques or tools for weed control as they are developed. Any new application methodology used regularly will be coordinated in full compliance with HDOA.

For weed prevention, staff collaborate with the Molokaʻi/Maui Invasive Species Committee (MoMISC) to prevent, detect, and eliminate incipient invasive weed species that may threaten the preserve. Data regarding new invasive plant and animal introductions will be provided by MoMISC and the information kept in a database that the Conservancy and MoMISC work cooperatively to maintain. We follow strict procedures to remove weed seeds, mud, and debris from equipment and clothing before people enter the preserve. Helicopter flights originate from areas free of priority weeds, and all equipment and clothing is inspected and cleaned.

For additional details on the weed management and control in East Molokaʻi, refer to the *East Molokaʻi Watershed Partnership 2015 South Slope Weed Management Plan.*

During the next six-year period (FY 2013–2018), systematic weed sweeps will continue for priority habitat-modifying weeds (Table 2). TNC will continue to collaborate with MoMISC to prevent, detect, and eliminate new incipient invasive weeds. In addition, the Molokaʻi South Slope Weed Management Plan will be updated in FY15.

Activities

Years 1–6 (FY2013–FY2018):

- Complete priority weed sweeps in Kamakou preserve and in adjacent south slope areas annually.
- Scout for, map, and remove priority habitat-modifying weed species from the wet forest and mesic forest and shrubland areas in Kamakou.
- Annually control non-native grasses, such as meadow rice grass (*Ehrharta stipoides*) and vasey grass (*Paspalum urvilleii),* that grow along the Pēpēʻōpae boardwalk to prevent the spread of weeds into the adjoining native areas.
- Update weed priority list as needed using the *Maui Nui Priority Weed Evaluation Criteria* when completed.
- Assist MoMISC with control work and early detection surveys for incipient invasive weed species such as Australian tree fern (*Cyathea cooperi*), mule's foot fern *(Angiopteris evecta),* gorse (*Ulex europaeus*), New Zealand flax (*Phormium tenax*), rubber vine (*Cryptostegia grandiflora*), *Miconia calvescens*, Barbados gooseberry (*Pereskia aculeata*), giant reed (*Arundo donax*), Rose *(Rosa sp.)* and fountain grass (*Pennisetum setaceum*) as requested.
- Work with MoMISC advisory council and partners to maintain a response protocol for dealing with incipient populations of alien pests on Molokaʻi, including Conservancy preserves.

- Maintain MoMISC database to track number of priority incipient, invasive species kept off the island and track the eradication of incipient species from the island.

Year 3 (2015):

- Complete 2020 South Slope Weed Management Plan.*

This program represents an estimated 35% of the overall effort and budget in this long range management plan.

*These activities may go beyond the scope of the NAPP budget due to recent budget cuts, but will be carried out if additional private funds can be raised.

Table 2. Priority Weed Species of Kamakou Preserve (in order of priority)

Scientific Name	Common Name	DP	MA	DIS	EXP	Rank *
Tibouchina herbacea	glorybush	1	1	1	1	4
Clidemia hirta	Koster's curse	1	1	1	1	4
Corynocarpus laevigata	karaka nut	2	1	1	1	5
Rubus argutus	prickly Florida blackberry	1	1	2	1	5
Schinus terebinthifolius	Christmas berry	1	2	1	1	5
Acacia mearnsii	black wattle	2	1	1	2	6
***Passiflora* sp.**	passion fruit, passion flower	3	1	1	1	6
Psidium cattleianum	strawberry guava, waiawī	1	2	3	1	7
Hedychium coronarium	white ginger	1	1	3	2	8
Phormium tenax	New Zealand flax	2	2	3	1	8
***Rosa* sp.**	rose	3	1	2	2	8
Syzygium jambos	rose apple	2	4	1	1	8
***Eucalyptus robusta* (satellite pop'n)**	swamp mahogany, eucalyptus	3	3	2	1	9
Melaleuca quinquenervia	paperbark	3	1	2	3	9
Acacia melanoxylon	blackwood acacia	3	1	3	3	10
Fraxinus uhdei	tropical ash	1	3	4	2	10
Grevillea robusta	silk oak	2	3	3	2	10
***Pinus* spp. (satellite pop'n)**	loblolly, slash, Monterey pines	3	1	4	2	10
Casuarina equisetifolia	ironwood	2	3	3	3	11
Opuntia ficus-indica	pānini, prickly pear cactus	4	1	1	5	11
Paspalum conjugatum	Hilo grass	2	2	3	4	11
Syncarpia glomeratus	turpentine tree	3	3	2	3	11
Toona ciliata	Australian red cedar	2	5	2	2	11
Alnus nepaliensis	Nepal alder	3	3	3	3	12
Grevillea banksii	kāhili flower	3	3	2	4	12
Psidium guajava	common guava	3	3	2	4	12
Traepoleus majus	nasturtium	3	3	2	4	12
Tristania confertus	brush box	3	3	3	3	12
Andropogon virginicus	broomsedge	2	3	5	4	14
Lantana camara	lantana	3	4	3	4	14

DP = disruptive potential
MA = methods available
DIS = distribution
EXP = experience

* DP+ MA+ DIS+ EXP = RANK

Scientific Name	Common Name	DP	MA	DIS	EXP	Rank *
Cupressus macrocarpus	Monterey cypress	3	4	3	4	14
Melinis minutiflora	molasses grass	1	5	5	3	14
Ageratina riparia	Maui pāmakani	3	2	5	5	15
Cryptomeria japonica	tsugi, Japanese cedar	4	5	1	5	15
***Eucalyptus robusta* (plantings)**	swamp mahogany, eucalyptus	3	3	5	4	15
Ricinus communis	castor bean	3	4	3	5	15
Thuja plicata	Western red cedar	4	5	2	4	15
Ageratina adenophora	Hamakua pāmakani	3	3	5	5	16
Cunninghamia lanceolata	China fir	5	5	1	5	16
Hibiscus elatus	Cuba blast	5	5	1	5	16
***Pinus* spp. (plantings)**	loblolly, slash, Monterey pines	2	4	5	5	16
Rubus rosifolius	Thimbleberry	3	3	5	5	16
Cirsium vulgare	bull thistle	4	4	4	5	17
Buddleia asiatica	dog tail	3	5	5	5	18
Juncus effusus	Japanese mat rush	3	5	5	5	18
Sequoia sempervirens	coast redwood	5	5	3	5	18

DP = disruptive potential
MA = methods available
DIS = distribution
EXP = experience

* DP+ MA+ DIS+ EXP = RANK

Table 3. Control Estimates (noted in acres or individuals) for eight weed targets in Kamakou Preserve, FY07–FY11

Species	Square meters or number of individuals treated/removed (FY07–FY11)
Tibouchina herbacea	16,948 individuals removed
Clidemia hirta	26,222 individuals removed
***Pinus* spp.**	2,017 individuals removed
Paperbark (*Melaleuca quinquenervia*)	99 individuals removed
Strawberry guava (*Psidium cattleianum*)	17,327 individuals removed
Flax (*Phormium tenax*)	646 individuals removed
Blackberry (*Rubus argutus*)	1189 m^2 removed
Karaka nut (*Corynocarpus laevigata*)	4 individuals removed

Invertebrate, Small Mammal, and Other Pest Control

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

Program Description: Non-native insects and small mammal damage occurs in Moloka'i's native ecosystems. Rats, mice, and other rodents pose a threat to rare native tree snails (*Partulina/Perdicella* spp.). Insects such as the aggressive, ground-dwelling carnivorous wasp *Vespula* may prey upon native insects and sting people. Other potential incipient pests, like the coqui frog, may also have unknown effects on native food webs.

Activities

Years 1–6 (FY2013–FY2018):

- Maintain baiting program as necessary to control rats within the entire Snail Meadow management area for native snail protection.
- Continue to collaborate with MoMISC on early detection and rapid response for key species such as coqui frogs.
- Support viable control programs for small mammals or other pests (e.g., *Vespula)* by our partners.

This program represents an estimated 2% of the overall effort and budget in this long range management plan.

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

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

Resource Monitoring

The goal of our resource monitoring program is to track the biological resources in the preserve, and evaluate changes in these resources to guide management programs. Beginning in 2006, staff developed and implemented a rapid vegetation monitoring method known as the Molokaʻi Understory Monitoring (MUM), which involved creating a plant checklist, taking photos, and ranking plot vegetation condition at stations located along known reference trails. Baseline data has been collected for 5 transects and indicates that wet forest locations in East Molokaʻi Partnership are generally in very good condition (See Figure 6).

Support will be provided as able for additional monitoring efforts conducted by other agencies such as the Hawaiʻi Forest Bird Project and survey which was conducted on Molokaʻi in 1979, 1988, 1989, 1995, 2004, and 2010. Staff provided logistical support and labor during FY2010 to assist with the completion of the same transects done in 1995.

Activities

Years 1–6 (FY2013–FY2018):

- Complete at least one Molokaʻi Understory Monitoring project (MUM) monitoring annually.*

*These activities may go beyond the scope of the NAPP budget due to recent budget cuts, but will be carried out if additional private funds can be raised.

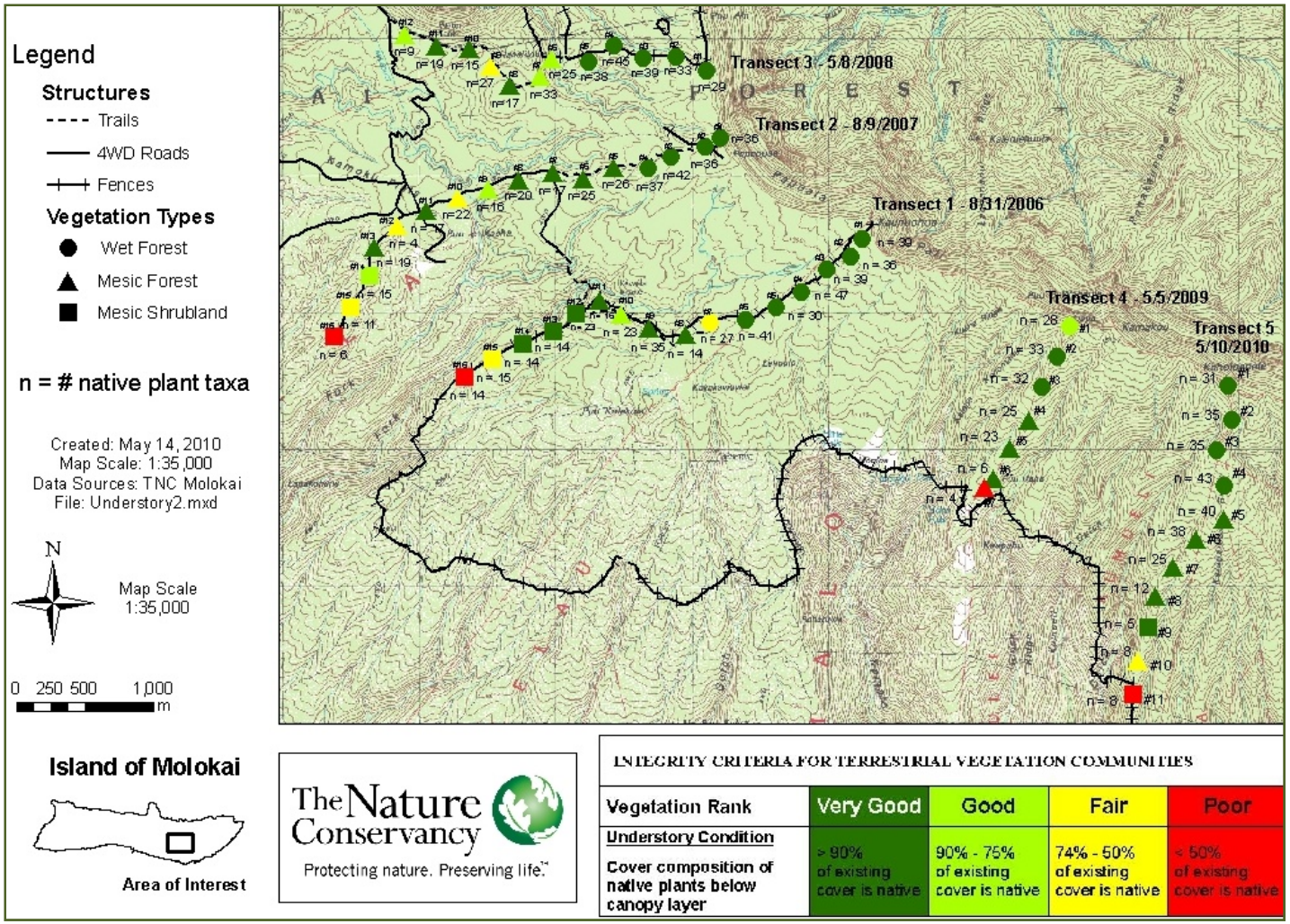


Figure 6. Moloka‘i Understory Monitoring (MUM) transects and condition

Rare Species Protection

The goal of the rare species protection program is to assist the Plant Extinction Prevention Program (PEPP) in preventing extinction of rare species in the preserve. Kamakou is home to 44 rare plant taxa, 23 of which are listed endangered. PEPP works closely with the Conservancy in Kamakou Preserve to protect the critically rare plant species found there (< 50 individual plants in the wild, in the world). In 2009, they hired a permanent on-island staff dedicated to protection of these species. Logistical assistance is provided to PEPP when possible, to coordinate outplanting, construct rare plant exclosures, or assist with rare plant surveys.

Currently, there are three rare species enclosures (*Phyllostegia mannii, Stenogyne bifida, Plathanthera holochila*) that were created in response to outside request. We will continue to look for opportunities to work with partners to identify key rare plant species that would be appropriate to restore back into the preserve. Any reintroductions would be done through partnerships and would be located within fenced areas or enclosures for protection from grazing animals. We will work cooperatively with neighboring land owners and managers to develop strategies for areas adjacent to the preserve.

No regular survey of rare invertebrates is done by the Conservancy, but partner researchers have conducted surveys in the past and we will rely on them to provide the Conservancy with management recommendations. We have and will continue to attach an updated list of research projects to our annual plan and progress report.

Activities

Years 1–6 (FY2013–FY2018):

- Assist MoPEPP in maintaining the *Platanthera holochila* fence exclosure and surveying the plants within the exclosure annually.
- Assist MoPEPP in maintaining the *Stenogyne bifida* exclosure, and controlling weeds in the exclosure as needed.
- Coordinate seed and fruit collection of critically endangered plants for ex-situ propagation with Lyon Arboretum or National Tropical Botanical Garden (NTBG). Assist approved researchers and MoPEPP with rare species monitoring and apply management recommendations when appropriate.

Research

The Conservancy encourages research that will help us better understand and thereby protect the preserve's resources. Conservancy funding for research is limited. Therefore, whenever possible, we provide logistical assistance to approved research projects by other agencies or individuals. We would like Kamakou to remain a major research site for studies dealing with conservation and protective land management in Hawai'i. See Appendix 6 for a list of research conducted at Kamakou Preserve.

Activities

Years 1–6 (FY2013–FY2018):

- Provide logistical assistance for approved research and apply research conclusions as warranted to management activities.

Year 4 (FY2016):

- Record miles of any additional firebreaks created.

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

Program 3: Community Outreach

Program Goal: To build community support and awareness for the conservation of native natural resources, and to implement effective conservation practices that are culturally sensitive.

Program Description: The Conservancy's Molokaʻi community outreach programs goes far beyond the boundaries of any single conservation site; therefore there is considerable overlap in our community outreach program among the three preserves and other projects. We have taken a multi-faceted, comprehensive approach that help bring awareness and engagement to the community about the importance of preserving Molokaʻi's natural resources and the Conservancy's role in managing those resources.

We work with a variety of conservation partners, schools, community groups, government and private funders, employment training organizations and programs, and individual volunteers and volunteer groups.

A. Community Outreach/Public Awareness Activities:
   - Monthly Preserve hikes are offered from March to October. No hikes are conducted from November to February as the seasonal winter rains make the roads impassable and unsafe. School field trips are done as requested.

Table 4. Kamakou Preserve hikes, 2007–2011

Year	Number of Hikes	Persons Reached	Volunteer Hours
2007	21	176	213.5
2008	19	192	201
2009	21	175	200
2010	16	142	232
2011	9	80	91.5

   - The Molokaʻi Earth Day Celebration occurs annually in April to coincide with the National Earth Day and has become the Conservancy's biggest public awareness event on Molokaʻi. The event engages local conservation and cultural agencies, organizations, and groups who bring awareness and engagement to their projects on Molokaʻi through interactive exhibits. The event attracts about 1,000–1,200 community members annually.

   - Volunteer/Internships – Hike docents and turtle monitors directly help with learning programs at Kamakou. Volunteers also assist with administrative needs and events like Earth Day. Interns are recruited as available and or needed. Past interns were recruited from AmeriCorp, Alu Like and the Youth Conservation Corp.

   - Nature's Newsflash is a semiannual publication that updates the community of the Conservancy's activities on Molokaʻi. The newsflash also recognizes community members who volunteer and or contribute to the Molokaʻi program. It is bulk mailed to

every address on Molokaʻi.

B. Partners include:
- Molokaʻi Advisory Council – gives advice on controversial issues and helps support and advocate decisions. MAC is made up of long-time, local community leaders and cultural practitioners.

- Molokaʻi/Maui Invasive Species Committee (MoMISC). MoMISC's goal is to prevent incipient invasive pests from becoming established or widespread on Molokaʻi. MoMISC's Island-wide activities are to detect, respond and eliminate incipient invasive pests. MoMISC's outreach and awareness activities are critical to the detection and reporting of new invasive species by the public. TNC facilitates the quarterly committee meetings that decides on how to eliminate key pests.

- Molokaʻi Fire Task Force – TNC facilitates the Task Force meetings that bring community resources to the aid of the County Fire Department and State Division of Forestry and Wildlife for wildland fires. TNC helped form the Task Force in 2003 through the "LAS-local action strategy", administered by the Molokaʻi Lānaʻi Soil and Water Conservation District as part of the national Coral Reef Task Force Program.

- East Molokaʻi Watershed Partnership (EMoWP) – The EMoWP conducts watershed management on the East Molokaʻi slopes. The EMoWP is mentioned in this plan because TNC Molokaʻi Programs is the coordinator.

- Papahana Kuaola Lelekaman (Penny Martin) – Since the early 1990's, Papahana Kuaola Lelekamanu has been TNC's main environmental and cultural educator partner. Penny helps lead school field trips at Moʻomomi.

Activities

Years 1–6 (FY2013–FY2018):
- Produce and distribute the semiannual *Nature's Newsflash*. *
- Conduct monthly and special community group hikes at Kamakou Preserve. *
- Coordinate and organize annual Molokaʻi Earth Day Celebration Event. *
- Maintain and develop intern, docent, and volunteer engagement, and conduct training sessions as needed. *
- Support partner groups including EMoWP, MoMISC, and Molokaʻi Fire Task Force.

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

*These activities may go beyond the scope of the NAPP budget due to recent budget cuts, but will be carried out if additional private funds can be raised.

Program 4: Fire, Emergency, and Safety

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

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

TNC is part of and helps to facilitate the Molokaʻi Fire Task Force (MFTF). MFTF is made up of agencies and organizations that bring knowledge and resources to aid the fire authorities (DOFAW and County of Maui Fire Department) in wildland fire prevention, pre-suppression and suppression activities. Kamakou Preserve's fire plans are embedded within The Nature Conservancy's *Moloka`i Wildland Fire Management Plan*.

Activities:

Years 1–6 (FY2013–FY2018):

- Provide emergency training opportunities for staff including but not limited to maintaining current First Aid and CPR certifications.
- Conduct annual first aid kit inventory and resupply.
- Annually update the TNC *Molokaʻi Wildland Fire Management Plan*.
- Update staff fire suppression training.
- Purchase equipment as needed to allow immediate response to fire threats.
- Respond to emergencies or fire threats.
- Maintain preserve roads as needed (Kualapuʻu Ranch).

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

Program 5: East Moloka‘i Watershed Partnership

Program Goal: To prevent further degradation to the East Moloka‘i watershed.

Program Description: The East Moloka‘i Watershed Partnership (EMoWP) was formed in 1999 when a grass roots strategic planning effort produced an application for the USDA Empowerment Zone program. Stewardship of the islands’ watersheds is one of the priorities of the application’s strategic plan. The first project of the newly formed EMoWP was the Kamalō/Kapualei Watershed Project. A contour fence (at 300’–3500’ elevation) was completed in April 2001 at Kamalō/Kapualei to prevent goats from damaging the upper native rainforest. In FY2004, plans were initiated to extend the fence across Kawela lands and join the Kamakou Preserve east boundary fence. A contested case was filed by a community member who opposed the building of the fence stalling the progress until December 2005 when the BLNR accepted the recommendations of the hearing officer to allow the fence extension with some stipulations. Construction of the Kawela portion of the fence was initiated in January 2006. Watershed partnerships are designed to leverage efforts between conservation partners. The fence is a great example of leveraging efforts between partners. Extensions off the original contour fence were completed through FY2009, by the end of FY13 in the proposed long range plan, the wet forest of the partnership’s southern slope will be completely contained, effectively protecting over 2,500 acres from feral pig or goat ingress. As the active coordinator of EMoWP, the Conservancy will continue to work with partners to promote stewardship activities in forest and watershed regions of Moloka‘i.

Activities

Years 1–6 (FY2013–FY2018):

- Complete annual aerial goat survey and aerial control.*
- Coordinate activities of the EMoWP.

This program represents an estimated 10% of the overall effort of the six staff that are funded through the NAP programs for Kamakou and Pelekunu Preserves on the island of Moloka‘i.

*These activities may go beyond the scope of the NAPP budget due to recent budget cuts, but will be carried out if additional private funds can be raised.

BUDGET SUMMARY

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

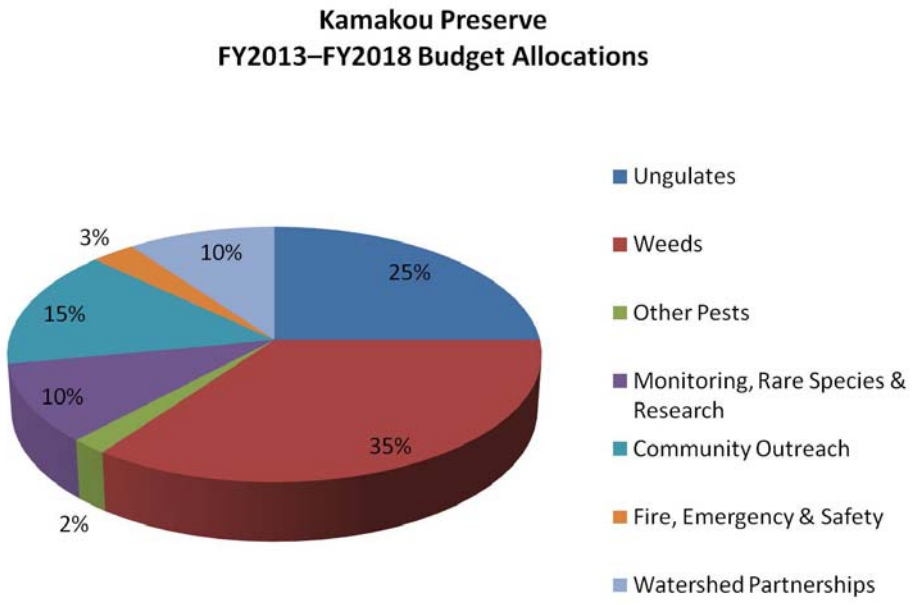


Figure 7. Kamakou NAPP Budget/Effort by Program, FY13–FY18

The Conservancy's Moloka'i operation maintains a full-time base staff of four. Other part-time, short-term, or year-to-year personnel, in addition to staff overtime, are covered in this budget and will be utilized as project needs warrant. The Moloka'i Program is now part of Maui Nui and reports to the Maui Program Director, consequently, technical and annual planning support is provided by both the Honolulu and Maui offices of the Conservancy. As budget and needs allow, these support staff members may charge a small portion of their time to this project. The Nature Conservancy's annually negotiated fringe benefits rate will also accrue on all salary costs.

This budget includes NAPP renewal costs such as an Environmental Assessment and Cultural Impact Assessment, project-related supplies, subcontract expenses to conduct fence checks/maintenance and weed/ungulate control , and other miscellaneous project related costs including vehicle expenses both as equipment purchases and equipment leases. The Conservancy routinely provides trainings for staff to improve job performance, and in addition to these trainings, supervisory staff regularly attend meetings in Honolulu. Travel and training

funds are included within this budget to cover airfare, board and lodging, and training expenses.

An overhead rate is included (subject to slight change each year) to recognize the Conservancy's indirect costs for facilities, accounting, legal, and other administrative support. Although the Conservancy's overhead rate is currently 22.53% (the annual rate changes each year per negotiations with DOI), the NAPP program will currently pay only 10%, leaving the remainder as a portion of the Conservancy's one-third match.

Budgetary Constraints: This Kamakou NAPP budget represents a significant reduction in funding since the last LRMP (2007–2012). As such, TNC has modified deliverables in some areas to accommodate the lower funding amount. We have identified objectives above that will not be covered by NAPP funds. However, should TNC receive significant private funds in addition to the NAPP funds, we hope to complete these specific management activities. This will depend entirely on TNC's statewide priorities and its ability to raise additional funds. We will report on progress on all accomplishments in Kamakou Preserve and on adjacent lands regardless of funding source.

BUDGET TABLE

	FY2013	FY2014	FY2015	FY2016	FY2017	FY2018	TOTAL
Labor & Benefits	97,435	116,062	116,062	116,062	116,062	116,062	677,745
Contractual	130,000	130,000	130,000	130,000	130,000	130,000	780,000
Communications	0	0	0	0	0	0	0
Travel	1,000	1,000	1,000	1,000	1,000	1,000	6,000
Supplies	9,000	9,000	9,000	9,000	9,000	9,000	54,000
Other	64,000	5,500	5,500	5,500	5,500	5,500	91,500
Subtotal	*301,435*	*261,562*	*261,562*	*261,562*	*261,562*	*261,562*	*1,609,245*
Overhead	30,144	26,156	26,156	26,156	26,156	26,156	160,925
TOTAL	331,579	287,718	287,718	287,718	287,718	287,718	1,770,170
	Year 1	**Year 2**	**Year 3**	**Year 4**	**Year 5**	**Year 6**	**Total**
Kamakou Budget	331,579	287,718	287,718	287,718	287,718	287,718	1,770,170
Private Match (1/3 of total)	110,526	95,906	95,906	95,906	95,906	95,906	590,057
TOTAL NAPP REQUEST (2/3)	**221,052**	**191,812**	**191,812**	**191,812**	**191,812**	**191,812**	**1,180,113**

Appendices

Appendix 1. Native Natural Communities Of Kamakou Preserve

NATURAL COMMUNITY	GLOBAL RANK(a)
Lowland	
ʻŌhiʻa/Uluhe (*Metrosideros/Dicranopteris*) Lowland Wet Forest[1,2]	G3
Uluhe (*Dicranopteris*) Lowland Wet Shrubland[1,2]	G4
ʻŌhiʻa (*Metrosideros*) Lowland Mesic Shrubland	G3
Montane	
ʻŌhiʻa/ʻŌlapa (*Metrosideros/Cheirodendron*) Montane Wet Forest[1,2]	G3
ʻŌhiʻa (*Metrosideros*) Mixed Montane Bog Dwarf-shrubland	G2
ʻŌhiʻa (*Metrosideros*) Mixed Shrub Montane Wet Forest[1,2]	G3
ʻŌhiʻa (*Metrosideros*) Montane Wet Dwarf-shrubland	G3
Hawaiian Mixed Fern and Shrub Assemblage on Montane Wet Cliffs	G3
Aquatic Community	
Hawaiian Continuous Perennial Stream	G1
Hawaiian Intermittent Stream[1,2]	G4
Subterranean Community	
Small-eyed Rock Centipede/Ground Beetle (*Lithobius*/*Carabid*) Montane Wet Piping Cave	G1

1 =Known also from Puʻu Aliʻi NAR
2 =Known also from Olokuʻi NAR

(a) Key to Global Ranks as defined by NatureServe.org:
G1 = **Critically imperiled**: Very high risk of extinction due to extreme rarity (typically 1-5 populations).
G2 = **Imperiled**: High risk of extinction or elimination due to restricted range, few populations, steep declines, or other factors.
G3 = **Vulnerable:** Moderate risk of extinction or elimination due to restricted range, relatively few populations, recent and widespread declines, or other factors.
G4 = **Apparently Secure:** Uncommon but not rare; some cause for long-term concern due to declines or other factors.

Appendix 2. Rare Native Plants Of Kamakou Preserve

SCIENTIFIC NAME	COMMON NAME	GLOBAL RANK (a)	FEDERAL STATUS (b)
Adenophorus periens [*Oligadenus periens*]		G1	LE
Alectryon macrococcus var. *macrococcus*[3]	ʻalaʻalahua, māhoe	G1T1	LE
Bidens wiebkei	koʻokoʻolau, kōkoʻolau	G1	LE
Canavalia molokaiensis[3]	ʻāwikiwiki, puakauhi	G1	LE
Clermontia oblongifolia ssp. *brevipes*[1]	ʻōhā, ʻōhā wai	G3T1	LE
Cyanea mannii	ʻōhā, hāhā, ʻōhā wai	G2	LE
Cyanea procera[1]	ʻōhā, hāhā, ʻōhā wai	G1	LE
Cyanea solanacea[1,2]	ʻōhā, hāhā, ʻōhā wai, pōpolo	G1	SOC
Cyanea solenocalyx[1,2]	ʻōhā, hāhā, ʻōhā wai	G2	SOC
Cyperus fauriei	-	G1	LE
Cyrtandra halawensis[2]	haʻiwale, kanawao keʻokeʻo	G1	SOC
Cyrtandra hematos[2]	haʻiwale, kanawao keʻokeʻo	G1	SOC
Cyrtandra macrocalyx	haʻiwale, kanawao keʻokeʻo	G2	SOC
Diellia erecta	-	G1	LE
Dissochondrus biflorus	-	G2	SOC
Eurya sandwicensis[1,2]	ānini	G2	SOC-
Exocarpos gaudichaudii[3]	heau	G1	SOC
Hedyotis mannii[3]	-	G1	LE
Hillebrandia sandwicensis	ʻakaʻakaʻawa	G2	-
Joinvillea ascendens ssp. *ascendens*[2]	ʻohe	G5T1	C
Lobelia dunbariae ssp. *paniculata*	ʻōhā, hāhā, ʻōhā wai	G1T1	SOC
Lobelia hypoleuca	ʻōpelu, liua, moʻowahie	G3	
Lysimachia maxima[1]		G1	LE
Melicope hawaiensis	alani, manena	G2	
Melicope mucronulata	alani	G1	LE
Melicope reflexa	alani	G1	LE
Nothocestrum latifolium	ʻaiea	G1	C
Phyllostegia hispida[1]		G1	LE
Phyllostegia mannii[1]	-	G1	LE
Phyllostegia pilosa[4]	-	G1	LE
Phyllostegia stachyoides	-	G1	-
Plantago princeps var. *laxiflora*[2,3]	laukahi kuahiwi, ale	G1T1	LE
Platanthera holochila	-	G1	LE
Ranunculus mauiensis[1,3]	makou	G2	C
Schiedea diffusa	-	G1	SOC
Schiedea laui	-	G1	LE
Schiedea nuttallii	-	G1	LE
Schiedea pubescens	-	G2	PS
Schiedea sarmentosa	-	G1	LE
Sicyos cucumerinus	ʻānunu, kūpala	G1	SOC

SCIENTIFIC NAME	COMMON NAME	GLOBAL RANK (a)	FEDERAL STATUS (b)
Stenogyne bifida[1]	-	G1	LE
Vigna o-wahuensis	-	G1	LE
Zanthoxylum kauaense	hea‘e, a‘e	G2	
Zanthoxylum hawaiiense[3]	hea‘e, a‘e	G1	LE

Number of Rare Plant Species in Kamakou: 44
1 = Also known (currently or historically) from Pu‘u Ali‘i NAR
2 = Also known (currently or historically) from Oloku‘i NAR
3 = Also known (currently or historically) from Kalaupapa National Historical Park
4 = Formerly known as *Phyllostegia mollis*.

(a) Key to Global Ranks as defined by NatureServe.org:
G1 = **Critically imperiled**: Very high risk of extinction due to extreme rarity (typically 1-5 populations).
G2 = **Imperiled**: High risk of extinction or elimination due to restricted range, few populations, steep declines, or other factors.
G3 = **Vulnerable:** Moderate risk of extinction or elimination due to restricted range, relatively few populations, recent and widespread declines, or other factors.
GH = **Possibly Extinct**, little known about species, still some hope of rediscovery
T1 = Subspecies or variety critically imperiled globally.
T2 = Subspecies or variety imperiled globally (typically 6-20 current occurrences).
PS = Partial status. Endangered only across a portion of the range, referring to an infraspecific taxon.

(b) Key to Status (Federal):
LE = Taxa formally listed as endangered under Endangered Species Act.
LT = Taxa formally listed as threatened under Endangered Species Act.
C = Taxa proposed for listing as threatened or endangered under Endangered Species Act.
SOC = Taxa not formally listed, but concerns remain over the long-term viability of the species.

Appendix 3. Rare Native Birds Of Kamakou Preserve

SCIENTIFIC NAME	COMMON NAME	GLOBAL RANK (a)	FEDERAL STATUS (b)
Myadestes lanaiensis rutha	Oloma‘o, Moloka‘i thrush	GHTH	LE
Paroreomyza flammea	Kākāwahie, Moloka‘i creeper	GH	LE
Vestiaria coccinea	‘I‘iwi	G4T1	SE,-

(a) Key to Global Ranks as defined by the Hawai‘i Biodiversity and Mapping Program, Aug 2001:
G4 = Widespread, abundant, and apparently secure, but with cause for long-term concern.
GH = Historical. No recent observations, but there remains a chance of rediscovery.
T1 = Subspecific taxa critically imperiled globally; 1-5 occurrences and/or fewer than 1,000 individuals remaining; or more abundant but facing extremely serious threats range-wide.
TH = Subspecific taxa historical. No recent observations, but there remains a chance of rediscovery.

(b) Federal Status:
LE = Taxa formally listed as endangered.
SE = Moloka‘i population considered endangered by the state only.
- = No federal status.

Appendix 4. Rare Land Snails Of Kamakou Preserve

SCIENTIFIC NAME	COMMON NAME	Biodiversity and Mapping RANK (a)	FEDERAL STATUS (b)
Partulina mighelsiana[1,2]	Achatinellid Land Snail	G1	SOC
Partulina proxima[1]	Achatinellid Land Snail	G1	SOC
Partulina redfieldii[1]	Achatinellid Land Snail	G1	SOC
Partulina tessellata[1,2]	Achatinellid Land Snail	G1	SOC
Perdicella helena	Achatinellid Land Snail	G1	SOC

1= Also known (currently or historically) from Pu‘u Ali‘i NAR
2= Also known (currently or historically) from Oloku‘i NAR

(a) Key to Global Ranks as defined by the Hawai‘i Biodiversity and Mapping Program, Aug 2001:
G1 = Critically imperiled globally; 1-5 occurrences and/or fewer than 1,000 individuals remaining; or more abundant but facing extremely serious threats range-wide.
(b) Federal Status:
SOC = Taxa that available information does meet the criteria for concern and the possibility to recommend as candidate.

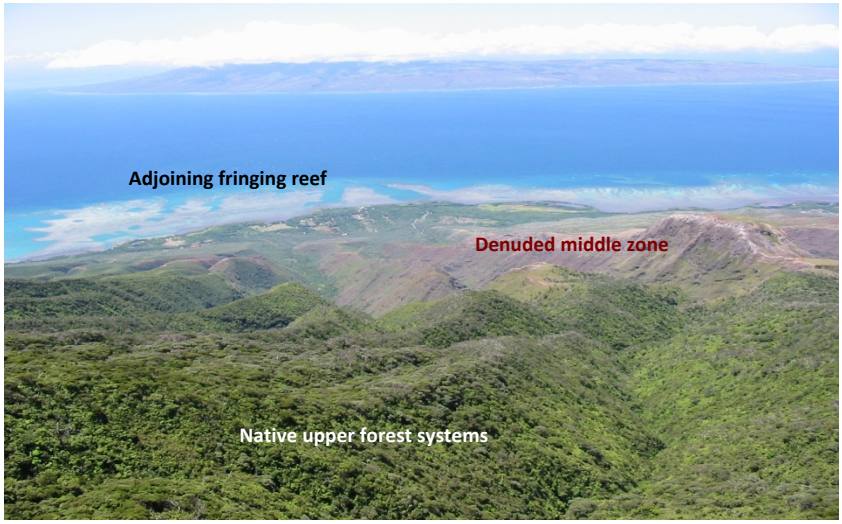
Appendix 5. East Molokaʻi Watershed Partnership Fact Sheet

East Molokaʻi Watershed Partnership (EMoWP)

The East Molokaʻi Watershed Partnership was formed in November 1999, to protect the best remaining native forest watershed areas on the East Molokaʻi Mountains. A grass roots community effort which eventually led to Molokaʻi being designated an USDA "Enterprise Community (EC)" designation, played a key role in the formation of the partnership. The EC also called, "Ke Aupuni Lokahi (KAL) helped kick off the partnership's first project, the Kamalō/Kapualei Watershed Project. The Nature Conservancy's Molokaʻi Program is the coordinator of the EMoWP.

Our Approach

The partnership uses the traditional Hawaiian land division, or ahupuaʻa, approach to protecting the EMoWP watershed landscapes, with the upper native forests systems as the highest priority. Such an approach tries to protect watershed areas from the mountain top to the sea. Controlling threats such as hoofed animals and invasive weeds are key strategies to protecting the best remaining native forest areas and to increase vegetation to the highly denuded, eroding mid-elevation slopes and thus reducing the sedimentation rate that severely impacts the adjoining fringing reefs.



Key Strategies

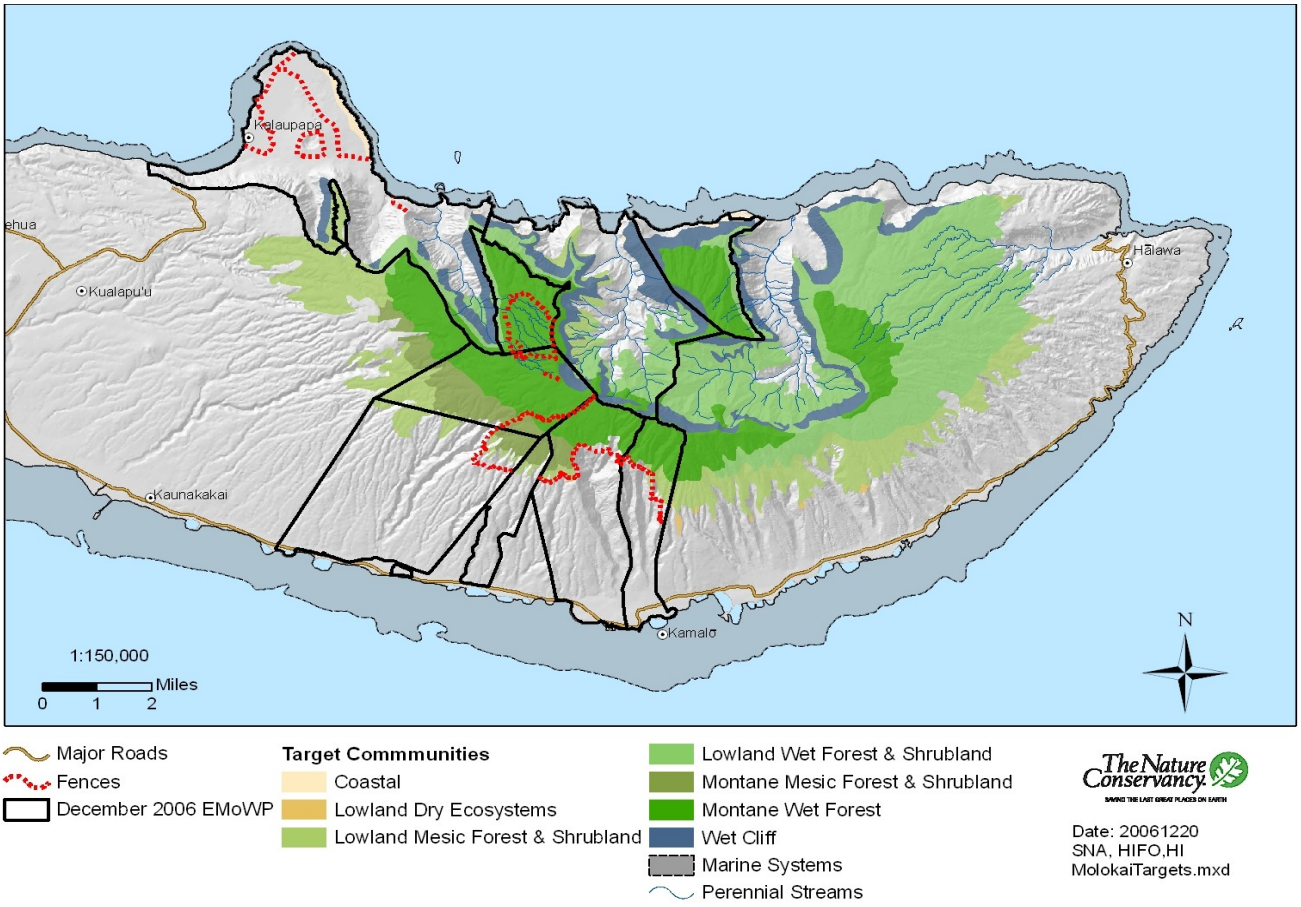
- Fences to protect the upper forests systems.
- Reduction of feral animal populations
- Monitoring systems that help guide and document management actions.
- Community outreach that engages, educates and gain supports of the local communities.
- Continual development of the partnership through fundraising, capacity building and landowner expansion.
- Involvement with fire (Molokaʻi Fire Task Force) and island invasive species efforts (Molokaʻi subcommittee of the Maui Invasive Species Committee).

Land based Partners (32,983 Acres)

- Kamehameha Schools Bishop Estate, Kamalō Ahupua'a (3,566 acres)
- Kapualei Ranch, Kapualei Ahupua'a (1680 acres)
- Kawela Plantation Homeowner's Association, Kawela Ahupua'a (5,500 acres)
- State Division of Forestry and Wildlife, Pu'u Ali'i (1,330 acres) and Olokui (1,620 acres) Natural Area Reserves
- National Parks Service, Kalaupapa National Historical Park (10,800 acres)
- The Nature Conservancy, Kamakou (2,774 acres) and Pelekunu Preserves (5,714 acres)

Agency Partners

- Ke Aupuni Lokahi, Enterprise Community Governance Board – community, funder
- Maui County (DWS & OED) -- funders
- Moloka'i/Lanai Soil and Water Conservation District - erosion experts
- USDA Natural Resource Conservation Services -- erosion experts, funder
- US Fish & Wildlife Service – funder, rare species/ecosystem experts
- US Geological Services, Hydrological, erosion and sedimentation experts
- EPA – non-point source pollution expert, funder
- Hawai'i Department of Health, non-point source pollution expert, funder



Contact: The Nature Conservancy Moloka'i Program, 808 553-5236, emisaki@tnc.org

Key Plans: EMoWP 2015 South Slope Management Plan; EMoWP 2015 Weed Control Plan; Pelekunu Preserve Long Term Management Plan; Kamakou Preserve Long-Range Management Plan

Appendix 6. Research conducted at The Nature Conservancy's Moloka'i Preserves, July 1994-June 2011

Ongoing Projects

Biodiversity Survey of Freshwater Algae of the Hawaiian Islands

Alison Sherwood, UH Mānoa, Botany Dept.

Part of a National Science Foundation project to inventory freshwater algae of the Hawaiian Islands. Areas surveyed on Moloka'i include Hālawa Valley, Pelekunu and Kamakou Preserves. First study to inventory freshwater algae in Hawai'i in over 50 years. Kamakou Preserve collections began in May 2010. Specimens being analyzed to determine species.

Lineage diversification in the Hawaiian flowering plant genus *Astelia* (Astelicaceae)

Joanne L. Birch PhD Candidate, UH Mānoa, Botany Dept.

Research began June 22, 2007. Sudy of the evolutionary relationships of Hawaiian *Astelia* sp.

Role of orb web-building in the adaptive radiation of the Hawaiian Tetragnatha (Tetragnathiadae) and Cyclosa (Araneidae) spider.

Dr. Todd Blackledge, University of California, Berkeley. Blackledge_todd@hotmail.com

Research began Aug. 7-9, 2000. Kamakou Preserve. Collected *Tetragnatha* sp. And *Cyclosa* sp. and made photo vouchers of webs. Collections to be deposited in the Essig Museum of Entomology, University of California, Berkeley. Holotype material to be deposited at Bishop Museum. Initial results supports the hypothesis that evolutionary diversification of web building has been an important contributor to the speciation of Hawaiian *Tetragnatha*. Continued study will determine the factors contributing to the biodiversity of Hawaiian spiders and how they function in Hawaiian ecosystems.

Evolutionary relationships and ecology of the endemic Hawaiian tephritid flies in the genus *Trupanea*.

Dr. Johnathan Brown, *Grinnell College*. brownj@grinnell.edu

Research began in May 2002. Last visit was October 21-22, 2010. Kamakou Preserve. Collections will be deposited at Bishop Museum. The goals are to understand the evolution of host plant use, including any role that host switching has had on speciation, and the rate of evolution in behavioral and morphological characters that distinguish species of flies. The seed predators' hosts include endemic Hawaiian plants from at least 3 radiations: the silversword alliance (*Dubautia, Agyroxiphium*), *Bidens*, and *Artemisia.* Dimorphism identified on the wings of the *Trupanea* and a difference in diet, indicate that there may be a Moloka'i endemic species which infests seed heads of *Dubautia plantaginea*. DNA comparison pending.

Microhabitat selection and morphological constraint in the insect visual system

Butler-Higa, Marguerite and Jeffrey Scales, University of Hawai'i at Mānoa

Study began April 5, 2011, looking at morphological differences in the eye structure of *Megalagrion* damselflies.

Color variation and species distributions of *Megalagrion* damselflies.

Idelle Cooper, Zoology Dept, Michigan State University

Study began in Sept 2010. Collections of *M. calliphya* and *M. hawaiiense*, indicate that color morphs of the same species vary between different islands in the main Hawaiian islands.

Understanding the way that organic matter moves from the organic litter layer to the underlying mineral soil.

Oliver Chadwick, University of California

Research began June 19, 2007 and is an extension of soil studies being conducted by Peter Vitousek.

A study of Aquatic insects as indicators of stream health in Pelekunu Valley.

Dr. Ron Englund, Bishop Museum.

Research initiated May 24-25, 2000 and is expected to continue annually. Pelekunu Preserve. Collections of aquatic insects as a part of Pelekunu stream monitoring effort in conjunction with TNCH and State Dept. of Aquatic Resources (DAR). Final deposition of collected specimen at Bishop Museum.

Vespula project

Megalagrion damselfly survey

David Foote (Hawai'i Volcanoes National Park).

Vespula research began August 1998.

Megalagrion damselfly surveys were conducted in August 2005 and August 2006.

Hawai'i Forest Bird Interagency Database Project.

Dr. Scott Fretz, et. al., Hawai'i Department of Land and Natural Resources, Division of Fish and Wildlife.

Research conducted March 9 to April 2, 2004. Kamakou and Pelekunu Preserves. Forest Bird surveys are conducted on each of the five main islands on a five year rotation basis in key native forest bird habitat including those lands being actively managed to enhance forest bird habitat. Data is entered into a centralized database and analyzed for trends. Web site information is available at http://biology.usgs.gov/pierc/HFBIDSite/HFBIDPHome.htm

Origin and stabilization mechanisms of organic nitrogen forms in soil.

Dr. Georg Guggenberger, Martin Luther University Halle-Wittenberg, Germany

Research began June 19, 2007 and is an extension of soil studies being conducted by Peter Vitousek.

Mark and recapture of *Partulina redfieldi* and *Perdicella helena* (tree snails) at Kamakou Preserve.

Dr. Mike Hadfield, Department of Zoology, University of Hawai'i.

Research began January 1984 and is in progress. Last visit May 2006 Kamakou Preserve. Long-term monitoring of populations of *P. redfieldi* on and at the base of five trees has occurred for 20 years and is critical to major conservation planning for the entire group. Monitoring results guide management actions.

Captive breeding of *Partulina redfieldii* and release at Kamakou Preserve.

Dr. Mike Hadfield, Department of Zoology, University of Hawai'i.

Research began January 1984 and is in progress.

Collecting Hawaiian *Omiodes* moths from TNCH Molokaʻi Preserves

William Haines, Graduate student , University of Hawaiʻi at Mānoa

Collections began July 2005, Last visit was December 31, 2005. The objective of this project is to relocate populations of presumed extinct species of *Omiodes* moths, as well as those species considered "species of concern". This project will result in a rigorous assessment of the taxonomic and conservation status of this genus in Hawaiʻi. If surviving populations of extinct *Omiodes* are discovered, further steps can be taken towards determining population health and developing a management plan for Hawaiian leafroller moths.

Reproductive biology, ecology, and genetics of Hawaiian violets

Chris Havran, Graduate Student, *Ohio University Dept. of Environmental and Plant Biology*

Research began July 2006 and is ongoing. The study is looking at environmental characterization, reproductive characterization, physiological characterization, and ecological genomics.

Reconstructing the patterns of host-plant utilization in the evolutionary history of *Nesosydne* planthoppers.

Gerald Luke Hasty, University of California, Berkeley, Ph.D. program.

Research began March 24-27, 2001. Kamakou Preserve. Collections will be deposited at the Bernice P. Bishop Museum or E.O. Essig Museum, Berkeley, CA. Diversification in host-plant use in Nesosydne planthoppers was important for the proliferation of species found in Hawaiʻi.

Prostostelids of Hawaiʻi

Drs. Don Hemmes; Fred Spiegel

Research began January 3, 2007. Report pending.

Succinea caduca sampling at Moʻomomi Preserve

Dr. Brenden Holland and Dr. Robert Cowie, Center for Conservation Research and Training
University of Hawaiʻi, Mānoa bholland@hawaii.edu

Collections occurred on March 10, 2005. As part of an ongoing NSF-funded evolutionary biology study of the endemic succineid land snail fauna of the Hawaiian Islands. Collections will be deposited in the Malacology Collection at the Bishop Museum.

Taxonomy and ecology of Hawaiian Rotifera: a contribution to the biodiversity and zoogeography of oceanic islands.

Dr. Christian D. Jersabek, Academy of Natural Sciences. Jerswabek@acnatsci.org

Research began March 5-6, 2001. Kamakou Preserve. Assess the biodiversity of freshwater invertebrates (micrometazoa) in wetland ecosystems that are currently considered to be at special risk.

Evolutionary biology, genetics, ecology, and behavior of Hawaiian Drosophilidae.

Dr. Ken Kaneshiro, University of Hawai'i. kykaneshi@hawaii.edu

Research began 1963 and is in progress. On March 1999 trip, *D. differens* was collected at a higher elevation than previously collected. Until now, this unique Moloka'i species had not been seen in over 15 years. Combined with other data from the Big Island, this significant finding indicates that some *Drosophila* species may be "moving" upland, perhaps in response to environmental changes.

Reproductive Biology of Solanum nelsonii in the Mo'omomi Preserve, Hawai'i.

Emi Kuroiwa, University of Illinois at Chicago

Research began March 23, 2011, looking breeding systems, pollination and population structure in *Solanum nelsonii* at Mo'omomi Preserve.

A Comparative Approach to the Evolutionary Biology of Hawaiian Insects: Population Genetic and Phylogenetic Studies

Rick LaPoint,UC Berkeley

Research began Jan 10, 2011, studying speciation in leafhoppers and flys, with potentially 5 new species discovered in the genus *Campsicnemus*.

Taxonomic studies of Hawaiian predatory ground beetles (Carabidae).

James Lieberr, Cornell University & Dan Polhemus, U.S. National Museum of Natural History, Smithsonian Institution.

Research initiated in Spring 1991. Last visit on May 10-16, 2005. Hawai'i hosts about 350 native Carabid beetle species exclusive to the islands – 55 species are exclusive to Moloka'i. Species distributions on Moloka'i exist in two natural areas including Kawela-Pu'u Kolekole and Wailau-Kainalu. Speciation has occurred repeatedly between these areas and this study will investigate how these species behave in their natural habitats. Voucher specimen will be deposited at Cornell University, Bishop Museum, or the Smithsonian.

Hawaiian Monk Seal Foraging and Epidemiology Study

Charles Littnan, Ph.D.Research Ecologist Hawaiian Monk Seal Research Program
Pacific Islands Fisheries Science Center, NOAA Fisheries

Research began April 12, 2004. Last research conducted September 18- 22, 2005 Mo'omomi Preserve. Flipper tag, health screen, seals to get a better idea of population size and health of seals in the main Hawaiian Islands.

Collecting Hylaeus yellow-faced bees in Kamakou and Mo'omomi Preserves to determine which species are extant.

Karl Magnacca, Cornell University.

Research began in March 1999. Kamakou and Mo'omomi Preserve. Collections are deposited at the Cornell University Insect Collection and the Bishop Museum. Conduct phylogenetic studies using molecular and morphological methods, and determine feeding preferences by examination of pollen in larval provisions. Conservation aspect of study is to determine extant species of Nesoprosopis and their distribution in protected areas. Collected in June, August 1999, June 2001. Identification of 4 species of *Hylaeus* being considered for ESA listing at Mo'omomi as of 2011.

The Utility of DNA Barcoding in Hawaiian Insects.

Karl Magnacca and Donald Price, University of Hawai'i-Hilo,

Began field work Dec 14-16, 2010. Research to see if the Hawaiian *Drosophila* (fruit flies) can be identified using various processes of DNA/mitochondrial analysis. Collections in and around Kamakou Preserve in Dec 2010 resulted in 2 new island records: *D. odontophallus* and *D. orphnopeza*, and relocation of the rare Maui Nui species, *D. sodomae*.

Inter-island population genetics of *Dubautia laxa* within the Hawaiian Archipelago.

Mitchell McGlaughlin, Rancho Santa Ana Botanic Garden / Claremont Graduate University, Ph.D.

program.

Research initiated Sept. 27-30, 2002. Kamakou Preserve. Document the extent of genetic variability and sub-division among populations and islands to formulate hypotheses about D. laxa diversification and adaptation over time. Also gathering data on the number and location of extant populations and major threats.

Community dynamics and long-term conservation potential of Mo'omomi dunes (NW Moloka'i) and related strand areas of Maui County.

Arthur C. Mederios, Pacific Island Ecosystem Research Center.

Research initiated June 21, 2004. Mo'omomi Preserve. Document long-term changes in vegetation communities and document the current stand structure of the plant communities to be used as a proposed template for restoration of coastal sites in various substrate types elsewhere in Maui County. Collected propagules will be grown in collaboration with Maui Nui Botanical Gardens, and used as a gene bank for restoration of other Maui County sites.

Biogeography and Repeated Evolution of Flightlessness in Cave and Alpine Hawaiian Moths.

Matt Medeiros, UC Berkeley, Dept. of Integrative Biology PhD dissertation.

Revising two genera of Hawaiian moths, *Shrankia* (Noctuidae) and *Thyrocopa* (Oecophoridae). Mites (Parasitengona: Trombellidae) appear to be infecting larger moth species (esp., *Scotorythra*). Researcher to contact TNC if control method is identified.

Comparative fern diversity at Kamakou preserve, Moloka'i

Dr. Klaus Mehltreter.

Project executed May 24-30, 2010. Fern diversity surveyed on 10 transects in Kamakou Preserve around the Pēpē'ōpae Boardwalk. No introduced fern species were found on transects. The fern species richness index of 33 species/1000 m^2 in the study is among the highest in the Hawaiian Islands, only comparable with some sites on Maui with 35-42 species on sampled areas twice as large as in Kamakou. Nineteen fern species were vouchered and deposited at UH Mānoa.

Phylogeny and geographical relation in the fern genus Elaphaglossum.

Dr. John Mickel, New York Botanical Garden, Robbin Moran, Timothy Motley.

Project initiated Feb. 4, 2004. Kamakou Preserve. Determine the phylogenetic and geographical relationships of the genus world-wide using molecular techniques. The Hawai'i origins are likely from the South Pacific but one species may originate from Mexico. Project support from the National Science Foundation. Voucher specimen deposited at the New York Botanical Garden herbarium.

Breeding ecology and oviposition preferences of the Hawaiian Drosophilidae.
Drs. Steven L. Montgomery, Michael Kambysellis, and Elysse Craddock, and David Baer. University of Hawai'i, NY University, University of NY. (808) 676-4974

Research began July 1998 and is in progress. Kamakou Preserve.

Evaluation of native invertebrates at Mo'omomi for listing under the Endangered Species Act.
Dr. Steven L. Montgomery, Anita Manning. (808) 676-4974

Research began December 1997 and is in progress. Collections of specimens will be deposited in Bishop Museum (Honolulu).

Catalog of Hawaiian Drosophilidae and their host plants and study of the phylogenetic relationships among the major groups of the family Drosophilidae.
Dr. Patrick O'Grady

Research began in April 2002 and is in progress. Kamakou Preserve. The research goals are: (1) to catalog of the endemic Hawaiian Drosophilidae and their host plants, making specific notes on abundance, distribution, and ecological associations; (2) to infer the phylogenetic relationships among the major groups of the family Drosophilidae, especially the endemic Hawaiian species, using molecular character data and phylogenetic methodology.

Plant Extinction Prevention Program
Hank Oppenheimer

This project began in May 2006. The Maui Nui Genetic Safety Net focuses on stabilizing, seed collection and storage and propagation of endangered plants on the brink of extinction.

Collection of propagules and/or status updates of the following plant species from Moloka'i: ***Adenophorus periens, Cyanea dunbarii, Cyanea procera, Gouania hillebrandii, Phyllostegia manii (or P. hispida), Platanthera holochila, Stenogyne bifida, Pritchardia munroi.***
Steve Perlman, Natalia Tangalin, Ken Wood of National Tropical Botanical Garden.

Plant propagules collected for ex-situ propagation at the National Tropical Botatical Gardens on Kaua'i and other appropriate facilities. Collection trips began in February 1991. Collections are on-going. "Genetic Safety Net" Program began in Jan 2001 and later became the Plant Extinction Prevention Program.

Survey of *Metrosideros polymorpha* arthropod fauna across the long substrate age gradient in the Hawaiian Islands.
Dr. Dan A. Polhemus, Daniel S. Gruner, Curtis P. Ewing, Smithsonian Institution, Bishop Museum and

University of Hawai'i joint research project.

Research began in October 1997 and is in progress. Kamakou Preserve.

^{15}N Natural abundance of soil microbial biomass as a tool for assessing controls on N-cycling processes in ecosystems.
Egbert Schwartz, Paul Dijkstra, Steve Hart & Bruce Hungate, Northern Arizona University.

Research initiated Oct 10, 2004 and will be in progress for the next 3 years. Kamakou Preserve. This study will research the effect of substrate age on the natural abundance stable N isotope composition of the soil microbial biomass and will relate this to ecosystem level N-cycling processes. Results from this project will open a window in soil microbial activity and provide a better understanding of how ecosystem processes of disturbance, alien invasion and succession (ecosystem and soil health) affect soil microbial life, and *vice versa*. Support provided by the National Science Foundation (DEB-0416223) and in collaboration with Peter Vitousek.

Biological survey of endangered species throughout the Hawaiian archipelago.

Ken Wood, National Tropical Botanical Garden [Conservation Dept.] kenwood@ntbg.org

Research began in Dec. 1997. The main goal is to establish conservation collections of all endangered taxa in order to conserve their unique line of evolutionary divergence. Biological survey focus on the collection of endangered species throughout the Hawaiian archipelago including the collection of seed, tissue, and genetic collections. This project is being funded by the Weathertop Foundation.

<u>On-going Projects (unsure of status)</u>

The critically endangered endemic fern genus Diellia (Aspleniaceae): its population structure and ecology.

Ruth Aguraiuja, Institute of Botany and Ecology, University of Tartu.

Research began in July 8-11, 2003. Kamakou Preserve. Population stage structure will describe the condition of all local population for the endemic fern taxa of Diellia on the Hawaiian Islands and will be used to understand the regional dynamics of the species. Since these species are endangered, this information is needed for conservation purposes. No final report on file.

Multi-temporal, hyperspectral mapping of landforms, surface deposits, and vegetation in the Mo‘omomi Dunes Preserve.

Dr. Ray E. Arvidson, Thomas Stein, Maggie Grabow, Julie Mintzer, Eric Frye, Meredith Berwick, Rachel

Torrey, Washington University.

Research began on August 18-27, 2004. Mo‘omomi Preserve. This project is supported by the Pathfinder Program in Environmental Sustainability in which 5 undergraduate senior year thesis projects will be completed at the end of this year. Their analyses of digital images and maps acquired from spectrometry (MASTER, AVIRIS, and ASTER) will result in a better understanding of nature and distribution of landforms, deposits and vegetative covers on the dunes. Analyses of maps from 20 years ago will show how the dunes changed over time.

Defining units of conservation: Genetic distinctiveness of the Moloka‘i Amakihi.

Dr. Robert Fleischer and Cheryl Tarr, National Zoological Park, Smithsonian Institution.

Objectives: 1) assess the extent of genetic differentiation between the Moloka‘i amakihi and other amakihi populations (primarily Maui) through analysis of nucleotide sequence variation in a hypervariable region of mitochondrial DNA; 2) determine the level of variability within the

Moloka‘i amakihi population relative to other amakihi populations; and 3) compare the differentiation between populations to the average divergence within populations. If the Moloka‘i amakihi is distinct, then the average divergence between it and its sister population (presumably Maui) will exceed the average divergence within each population. Research began March 1995 and is in progress.

The impact of Tropical ash (*Fraxinus uhdei*) on understory vegetation composition in a native forest on Moloka‘i and prospects for management of this invasive species.
Lyman Perry, Geography Department, University of Hawai‘i at Mānoa

Research began in 1992 and is in progress (draft summary to be sent, Dec. 2000). Kamakou Preserve.

Mycofloristic, revisionary, and monographic studies in the Xylariaceae.
Dr. Jack D. Rodgers, Washington State University

This mycofloristic study of this family of fungus (Xylariaceae) was proposed in order to assess this mycobiota while it is still available. Research began in January 1996 and is in progress.

Ecological Diversity, Systematics and Conservation of Hyposmocoma (Cosmopterigidae).
Daniel Rubinoff, University of Hawai‘i.

Research initiated May 18-20, 2004. Kamakou Preserve. Develop a systematic framework for examining ecological and phylogenetic patterns of ecological diversification, and enable a conservation assessment to be made for the group. Vouchers will be deposited at the University of Hawai‘i Insect Museum.

Characterization of the diversity of egg-case morphologies from Hawai‘i *Tetragnatha* species.
Joseph Spagna, University of California, Berkeley, Ph.D. program.

Research began March 24-26, 2001. Kamakou Preserve. Voucher specimen will be deposited at the Essig Museum of Entomology, UC Berkeley. This study will characterize the diversity of egg-case morphologies from Hawai‘i Tetragnatha species and placement of this data in phylogenetic and biogeographical contexts.

Population genetic study of the Hawaiian endemic *Hillebrandia sandwicensis* (Begoniaceae).
Dr. Mark Tebbitt, Brooklyn Botanic Garden; Dr. Susan Swenson, Ithaca College;
Dr. James Yeadon, Brooklyn Botanic Garden; Zeke Nims, Ithaca College student;
Wendy Clement, Ithaca College student.

Research initiated May 19, 2000 and is in progress. Kamakou Preserve. Collected leaf samples of *Hillebrandia sandwicensis*. One herbarium specimen deposited at Bishop Museum; Silica dried material will be deposited at Brooklyn Botanical Garden.

Evaluation of below-ground patterns of primary succession and community development in the Hawaiian archipelago.
Dr. David Wardle, Landcare Research Surface; Dr. Richard Bardgett, Landcasle University; Gustavo

Hormiga.

Research initiated on June 22, 2000. Kamakou Preserve. Collections of soil and plant litter from site near Pu‘u Kolekole cabin.

Terrestrial Orchid Conservation by Symbiotic Seed Germination.

Dr. Larry W. Zettler, Illinois College. lwzettle@hilltop.ic.edu

Research initiated Aug. 8, 2003. Kamakou Preserve. Set up field trials for *Platanthera holochila* seed germination with naturally occurring symbiotic mycorrhizal fungi, with goal of improving propagation efforts to ensure that orchids persist in the natural setting. Zettler reports that growing Platanthera with non-native fungi was successful, as was growing the orchid in a sterile medium. Growing with the associated Hawaiian fungi was not successful. Nine seedlings of the rare orchid were reintroduced from Dr. Zettler's lab to an unoccupied exclosure in the Kamakou Preserve in March 2011.

Completed Projects and Pending Reports

Inventory and documentation of the current distribution and systematic status of a few Moloka‘i plants with screening for novel therapeutic activity.

Carol Annable, New York Botanical Garden. (808) 261-7397

Research began February 1998 and is complete. Kamakou and Mo‘omomi Preserve. Collections to be deposited in NYBG, BPBM. Collected *Clermontia grandiflora, Alnus nepalensis, Lycopodium venustulun* at Kamakou*; Chamaesyce degeneri, Heliotropium anomalum var. argenteum*, and *Fimbristylis cymosa* at Mo‘omomi. No published report will be made.

Systematics and Evolution of Hawaiian Planthoppers (Insecta: Hemiptera: Fulgoromorpha: Delphacidae and Cixiidae).

Drs. Manfred Asche, Hannelore Hoch, Museum fur Naturkunde Berlin manfred.asche@rz.hu-berlin.de

Research began March 1998. Evaluation of song patterns is in progress. Kamakou Preserve. Collected *Oliarus* sp.aff *hevahva, O. morai, O. similis molokaiana, Iolania* sp*., Leialoha* sp. aff *mauiensis, Nesosydne* sp., *Siphanta acuta*. Collections to be deposited in Bishop Museum (Honolulu), Museum fur Naturkunde Berlin. Created "Love songs from Paradise" compact disk (Hawaiian planthopper mating calls from 5 islands; copy at Moloka‘i and HFO).

Risk Assessment for selected avian diseases in Hawaiian and Pacific Parks.

Dr. Carter Atkinson, Dr. Denis A. LaPointe, Sam Aruch, USGS-BRD, Pacific Island Ecosystem Research Center.

Research was conducted January 2003- November 2003 and is completed. Kamakou and Pelekunu Preserves, Kalaupapa National Historical Park, Haleakalā National Park (NP), and the NP of American Samoa. Assess severity and urgency of avian disease risks at the three national parks and feasibility of controlling mosquito vectors. Report pending.

Origin and evolutionary diversification of the Hawaiian silversword alliance (Argyroxiphium, Dubautia, Wilkesia).

Dr. Bruce Baldwin, University of California, Berkeley. Bbaldwin@uclink4.berkeley.edu

Research began June 2002 and is in progress. Kamakou Preserve. Voucher specimen will be deposited at the University of California, Berkeley and Jepson Herbaria. Evidence from comparisons of nuclear rDNA and chloroplast DNA show that introgressive hybridization and

even hybrid speciation have occurred on Kaua‘i but the degree to which these phenomena have influenced evolution of the group on the younger islands remains uncertain. Comparing unlinked molecular markers between populations on different islands is a powerful method for detecting whether hybridization has had a lasting impact on the genetic composition of populations. Research has lead to identification of two new species: a Moloka‘i endemic, *Dubautia carrii*, and a Maui endemic, *Dubautia hanaulaensis*.

Status and Biogeography of *Rhyncogonus* weevils in the Pacific.
Elin Claridge, Dr. George Roderick, U.C. Berkeley, Ph.D. program.

Research initiated June 28-July 1, 2003. Kamakou and Mo‘omomi Preserves. Conducting phylogenetic analysis of the group to understand the processes of ecological diversification and colonization processes on islands. Final deposition of collected specimen at Bishop Museum.

Genetic diversity and population structure of *Sesbania tomentosa*
David Cole, Pacific Island Ecosystem Research Center, USGS-BRD

Research Conducted February 7, 2006. Mo‘omomi Preserve.
Use randomly amplified polymorphic DNA (RAPD) marker analysis to address the following questions: How much genetic variability exists (remains) in HAVO populations of *S. tomentosa*, as compared against a wider geographical sampling? Are all relic populations and taxonomic varieties equally diverse (how is genetic variability structured)? How genetically similar or dissimilar are the six existing population nodes and the varieties they contain? How does this population structure relate to the occurrence of the species on the islands of Maui and Oahu? The results and conclusions are expected by December 2007 and will be used to design an augmentation and recovery plan for *S. tomentosa*.

Documentation of distribution and taxonomic resolution of reptile and amphibian fauna in Hawai‘i.
Ron Crombie, National Museum of Natural History.

Research began February 1998 and is complete. Kamakou and Mo‘omomi Preserve. Collections to be deposited in the SI herp collection at USNM. Collected one gecko from near TNC office. No published report will be made.

Japanese Bush-Warbler: Population growth spread and impacts.
Jeffrey Foster, University of Illinois.

Research initiated July 17, 2004 and field collection has been completed. Kamakou Preserve and Moloka‘i Forest Reserve. This study will assess the degree of morphological and genetic adaptation that occurs following founder events, and will provide insight into the population ecology of the invading bird species, Japanese bush-warbler (*Cettia diphone)*. Analysis of the bird’s diet will be done to assess the potential for resource competition with native bird species.

Taxonomic study and phylogenetic relationships among species of Hawaiian *Dryopteris* (Dryopteridaceae) ferns.
Jennifer Geiger, University of Colorado at Boulder, Ph.D. program.

Research began June 14, 2001. Kamakou Preserve. Collections will be deposited at NTBG and the University of Colorado herbarium (COLO). Morphological and molecular data will be used to delimit species of *Dryopteris*. This study will determine the actual number and distributions of *Dryopteris* species in Hawai‘i.

Phylogenetic relationships and breeding system evolution of insular Pacific *Pittosporum* (Pittosporaceae).
Dr. Chrissen Gemmil, Postdoctoral visiting scientist at Smithsonian Institution, working with Drs. Warren L. Wagner and Elizabeth Zimmer.

Research began June 1997. Kamakou Preserve. Collections *of P. argentifolium* specimens will be deposited at US and/or BISH.

Remote Sensing in Tropical Dry Forests in Hawai‘i
Dr. Thomas W. Gillespie University of California, Los Angeles

Research was conducted from June 26- July 27 2005. Kamakou preserve. There is currently no comparative data on species richness, floristic composition, or the conservation status of woody plant species or remaining fragments of tropical dry forest. Therefore, this endangered forest type is ideal for testing a number of remote sensing, biogeographic, and conservation theories related to such parameters in severely endangered and fragmented systems. At the stand level, data on species richness, floristic composition, and forest structure at each study site was collected will following Gentry (1982, 1988). Woody plant biodiversity will be quantified at the stand and patch level in tropical dry forests of the Pacific.

Collection and documentation of fungi in Kamakou Preserve.
Drs. Don Hemmes (University of Hawai‘i at Hilo), Robert Gilbertson (University of Arizona), Jack Rogers (Washington State University), and Fred Spiegel (University of Arkansas).

Studies are a part of surveys and inventories to document the types of fungi that are found in Hawai‘i. Collected wood rotting species polypores and Xylariaceae. Collected January 2000; final report pending.

Biological pattern of diversification of Hawaiian linyphiid spiders of the genus *Labulla.*
Drs. Gustavo Hormiga, Jonathan A. Coddington, Rosemary Gillespie (collaborator in Hawai‘i), Department of Entomology, National Museum of Natural History, Smithsonian Institution

This research required the collection of a small number of adults of *Labulla* spp. for detailed studies of their morphological features and if possible, their DNA sequence character information. Research included one field trip on Moloka‘i in August 1995; report pending.

Taxonomic and phylogenetic studies of Cryptograms (bryophytes).
Hiroyuki Kashiwadani, Masanobu Higuchi, Tatsuwo Furuki, Yoshihito Ohumura, Dr. Clifford Smith, University of Tokyo, National Science Museum, University of Hawai‘i. hkashiwa@kahaku.go.jp

Research began July 1997 and is in progress. Kamakou Preserve. Collections of bryophytes will be deposited in National Science Museum, Bishop Museum (Honolulu).

Identifying key environmental factors that might influence the parasitoid community and parasitism levels of the endemic non target moth, *Udea stellata*
Leyla V. Kaufman Graduate Research Assistant Plant & Environmental Protection Sciences University of Hawai‘i at Mānoa leyla@hawaii.edu

Research began April 2006 in Kamakou preserve and is in progress. Species to be deposited at University of Hawai'i at Mānoa - Insect Museum. This study aims to identify key environmental factors that might influence the parasitoid community and parasitism levels of the endemic non target moth, *Udea stellata* (Butler) (Lepidoptera: Crambidae), by purposely introduced biological control agents and adventive parasitoids in remote native habitats in Hawai'i. *Pipturus* spp. (Urticacea), are the host plants of *U. stellata*. These endemic plant species are distributed across a wide range of habitats in Hawai'i, creating the opportunity to investigate various environmental gradients that might influence the infiltration of exotic parasitoids into natural ecosystems, and their parasitism levels and potential impact on non-target species. By doing this they aim to elucidate the factors that might be playing a role in the infiltration of exotic biocontrol agents on native areas.

Genetic diversity within and among populations of *Sophora chrysophylla* across the Hawaiian Islands.
Shelley Lammers, Dr. Clifford Morden, University of Hawai'i, M.S. Program.

Research initiated Oct. 21-22, 2002. Kamakou Preserve. Characterization of genetic diversity within and among populations of *mamane* (*Sophora chrysophylla)* across the Hawaiian Islands to elucidate patterns of evolution. DNA will be accessioned in the Hawaiian Plant DNA Library at the University of Hawai'i, Mānoa. Voucher specimen will be deposited at the UH Botany Dept. herbarium.

Field survey and collection of the rare *Hillebrandia sandwicensis* (Begoniaceae) in Hawai'i.
Maya LeGrande, Nellie Sugii, University of Hawai'i / Harold L. Lyon Arboretum.

Research initiated Oct. 21-22, 2002. Kamakou Preserve. Survey existing populations and document the number of individuals, locality, general health and threats. The plant material will be propagated and established as *ex situ* accessions within Lyon Arboretum greenhouse, garden plantings at the Arboretum, or as *in vitro* cultures as a part of the Micropropagation Laboratory-Hawaiian Rare Plant Project. DNA samples will be accessioned in the Hawaiian Plant DNA Library at the University of Hawai'i, Mānoa. Voucher specimen will be deposited at the UH Botany Dept. herbarium. Excess seed will be given to the Hawai'i Seed Storage Facility at Lyon Arboretum for storage trials.

Invasive arthropods in Hawai'i: closing the biotic gap
Russell Messing, and Mark Wright, University of Hawai'i at Mānoa.

Collection conducted on March 18, 2005 Kamakou Preserve. Collected samples for use in a semi-quantitative ranking method to analyze and prioritize target pest species for biological control. This will be based on four main criteria: biological feasibility; economic assessment; institutional assessment; and risk assessment. Results will provide a roadmap for focusing biocontrol resources, and a system for rapid evaluation of new invasive species.

Evolution of breeding systems in Hawaiian *Psychotria*: A phylogenetic approach.
Drs. Molly Nepokroeff and Kenneth J. Sytsma (PI), Department of Botany, University of Wisconsin-

Madison

National Science foundation Doctoral Systematic Biology Dissertation Improvement Program. This research required the collection of *Psychotria* spp. leaves for genetic work. Research

included one field trip on Molokaʻi in July 1995. Suggests a pattern for radiation of the various species of *Psychotria*.

Phylogenetic studies on Cydia (Lepidoptera: Tortricidae) moths.

Peter Oboyski, University of California, Berkeley, CA. poboyski@nature.berkeley.edu

Research initiated July 24-28, 2003. Kamakou Preserve. Moths will be analyzed for morphological and molecular characters that provide evidence for relationships among species. Phylogeny will be constructed and biological characters assessed to determine the likely processes that lead to the diversification of this genus. Collections will be deposited in the Entomology collection at Bishop Museum.

Collecting samples of *Drosophila* species at Kamakou to examine patterns of ovarian development and ovipostition behavior, and determining phyllogenetic relationships from DNA and morphology. (collaborative effort with Dr. Kaneshiro.)

Drs. Patrick O'Grady, Michael Kambysellis, and Elysse Craddock.

Began in September 1997. Collected in July.

Predicting invasiveness of non-native plants in Hawaiʻi.

Drs. Gordon Orians and Sarah Reichert, Washington State University

Ecosystem Research Program-funded project. Research included one field trip in July 1995; report pending.

Relationship between the relative abundance of introduced ungulates and their adverse impacts on indigenous forest ecosystems in Hawaiʻi.

Mr. Graham O'Reilly-Nugent, Landcare Research, New Zealand; Dr. Peter Sweetapple, Landcare Research, New Zealand; Dr. Peter Bellingham, Landcare Research, New Zealand.

Research is developed and funded in part by TNC Ecosystem Research Program. Research initiated May 1998 and is in progress. Kamakou Preserve, Puʻu Aliʻi NAR, and Puʻu O Hoku Ranch. Final report received in 2001 through Secretariat for Conservation Biology; "A Simple Method for Assessing Ungulate Impacts and the Relationship Between Ungulate Densities and Impacts in Hawaiian Forests."

Monographic revision of representatives of the Protistan order Saprolegniales (watermolds).

Dr. David Padgett, The University of North Carolina at Wilmington. Padgett@uncw.edu

Research began in July 2004 and is in progress. Kamakou Preserve. Samples taken in 1970's from Molokaʻi indicates that there is a rich and diverse watermold flora. The Molokaʻi specimen will be used to expand the universities' collection of representatives of the Protistan order Saprolegniales from worldwide sources for monographic revision of the order. Samples will be sent to the American Type Culture Collection in Maryland for cryopreservation. Project completion is scheduled to be completed in 2008. This research is funded by the US National Science Foundation (grant # DEB 0328316).

Collection of ferns in Kamakou Preserve for taxonomic classification.

Dr. Dan Palmer.

Looking at *Dryopteris podosorus, D. unidentata, Polypodium pellucidum, Microlepia strigosa, M. speluncae* and their hybrids to determine status of these ferns. Collected in October 1999; report pending.

Study of Hawaiian Orangeblack Damselfly (*Megalagrion xanthomelas*) in Pelekunu Valley and Leeward Coastal Systems of Moloka'i.
Dr. Dan A. Polhemus and David Preston, Bernice Pauahi Bishop Museum

Survey included one field trip on Moloka'i in August 1995; report pending.

Diversity and radiation in Australasian and Pacific Triozidae (Psylloidea, Hemiptera): evidence from morphological, molecular, behavioral and acoustic data.
Dr. Diana Percy, SCIRO Entomology, Australia, and University of California, Berkeley.

Diana.percy@csiro.au

Research initiated Aug. 17-18, 2003. Kamakou Preserve. Endemic psyllids are closely associated with the endemic Hawaiian flora. This project will investigate the extent to which the psyllid insects and plants may have co-diversified or co-evolved. Collections will be deposited at Bernice

Speciation in genus Cyrtandra.
James Smith (Biology Department, Boise State University).

Studying the process of speciation in genus Cyrtandra. Kamakou Preserve. Collected *Cyrtandra procera* specimen in October 1999 along Pēpē'ōpae boardwalk; final report pending.

Evaluation of below-ground patterns of primary succession and community development in the Hawaiian archipelago.
Dr. David Wardle, Landcare Research Surface; Dr. Richard Bardgett, Landcasle University; Gustavo Hormiga.

Research initiated on June 22, 2000. Kamakou Preserve. Collections of soil and plant litter from site near Pu'u Kolekole cabin.

Collection of assorted fleshy fungi from Kamakou Preserve.
Drs. George Wong (Department of Botany, University of Hawai'i at Mānoa), Don Hemmes (Department of Biology, University of Hawai'i at Hilo), and Dennis Desjardin (Department of Biology, San Francisco State University)

Research began in March 1991 and completed January 1996; final report pending.

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