DAVID Y. IGE
GOVERNOR OF HAWAII

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES

POST OFFICE BOX 621
HONOLULU, HAWAII 96809

CARTY S. CHANG
INTERIM CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES
COMMISSION ON WATER RESOURCE MANAGEMENT

KEKOA KALUHIWA
FIRST DEPUTY

W. ROY HARDY
ACTING DEPUTY DIRECTOR – WATER

AQUATIC RESOURCES
BOATING AND OCEAN RECREATION
BUREAU OF CONVEYANCES
COMMISSION ON WATER RESOURCE MANAGEMENT
CONSERVATION AND COASTAL LANDS
CONSERVATION AND RESOURCES ENFORCEMENT
ENGINEERING
FORESTRY AND WILDLIFE
HISTORIC PRESERVATION
KAHOOLAWE ISLAND RESERVE COMMISSION
LAND
STATE PARKS

NATURAL AREA RESERVES SYSTEM COMMISSION MEETING

DATE: April 27, 2015
TIME: 9:00 a.m.
PLACE: Department of Land and Natural Resources Boardroom, Kalanimoku Building, 1151 Punchbowl Street, Room 132, Honolulu.

AGENDA

ITEM 1. Call to order, introductions, move-ups.

ITEM 2. Approval of the Minutes of the June 9, 2014 Natural Area Reserves System Commission Meeting.

ITEM 3. Natural Area Partnership Program (NAPP).

ITEM 3.a. Recommendation to the Board of Land and Natural Resources approval for authorization of funding for The Nature Conservancy of Hawaii for $663,600 during FY 16-21 for continued enrollment in the natural area partnership program and acceptance and approval of the Kapunakea Preserve Long Range Management Plan, TMK 4-4-7:01, 4-4-7:03, Lahaina, Maui.

ITEM 3.b. Recommendation to the Board of Land and Natural Resources approval for authorization of funding for The Nature Conservancy of Hawaii for $470,802 during FY 16-21 for continued enrollment in the natural area partnership program and acceptance and approval of the Pelekunu Long Range Management Plan, TMK 5-4-3:32, 5-9-6:11, Molokai.

ITEM 4. Recommendation for continued closure of Kahauale‘a Natural Area Reserve (NAR), Hawai‘i Island, due to safety and other concerns: discussion and recommendation to the Board of Land and Natural Resources that the Reserve remain closed for another two years (July 25, 2015 – July 24, 2017).

ITEM 5. Special Use Permits.

ITEM 5.a. Dr. Norman Schorghofer for Mauna Kea Ice Age NAR, Hawai‘i Island, to conduct an investigation for possible presence of perma frost: discussion and

recommendation to the Board of Land and Natural Resources that this permit be approved, subject to any further conditions.

ITEM 5.b. Discussion on requests for core samples of fragile areas in various Reserves; possible recommendation for future actions.

ITEM 6. Management Plan Updates.
ITEM 6.a. Draft Management Plan for Nakula NAR, Maui Island: for review, discussion, and approval in concept.
ITEM 6.b. Draft Management Plan for Laupāhoehoe NAR, Hawai‘i Island: for review, discussion, and approval in concept.

ITEM 7. Revision of Administrative Rules (HAR Ch. 13-209): Discussion and to the Board of Land and Natural Resources approval of the Revisions to Ch. 13-209, Hawaii Administrative Rules, Rules Regulating Activities in Natural Area Reserves.

ITEM 8. Administrative Updates.
ITEM 8.a. Budget.
ITEM 8.b. Legislature.

ITEM 9. Staff Updates:
ITEM 9.a. Hawai‘i: Nick Agorastos.
ITEM 9.b. Maui: Fern Duvall.
ITEM 9.c. O‘ahu: Marigold Zoll.
ITEM 9.d. Kaua‘i: Chris Mottley.

ITEM 10. Announcements. Set next tentative meeting dates: NARSC; Joint Consultation between the NARSC and Forest Stewardship Advisory Committee (FSAC); NAPP Review Subcommittee.

ITEM 11. Adjournment.

Meeting materials are available for public review in advance of the meeting. If you require special assistance or auxiliary aids or services to participate in the public hearing process (i.e. sign language interpreter, wheel chair accessibility, or parking in designated stalls for the disabled, please contact NARSC staff at (808) 587-0063 at least 72 hours prior to the meeting so that arrangements can be made.

MINUTES OF THE JUNE 9, 2014 NATURAL AREA RESERVES SYSTEM COMMISSION (NARSC) MEETING, HONOLULU, O'AHU

COMMISSIONERS PRESENT: **DRAFT Subject to approval**

Dr. John Sinton, Chair
Ms. Marie Bruegmann, Vice Chair
Mr. Trae Menard
Mr. Ronald Rapanot, Sr.
Mr. Nathan Yuen
Ms. Robin Newbold
Ms. Ulalia Woodside
Dr. Carl Christensen
Dr. Jonathan Price
Ms. Janis Matsunaga, for Chair, Board of Agriculture

COMMISSIONERS ABSENT:

Mr. William Aila, Jr., Chair, Board of Land and Natural Resources
Dr. Sheila Conant, for President, University of Hawai'i
Mr. Rebecka Arbin, for Director, Office of Planning

STAFF:

Mr. Galen Kawakami, Acting Administrator Division of Forestry & Wildlife (FOFAW)
Mr. Scott Fretz, Maui DOFAW Branch Manager
Ms. Betsy Gagné, DOFAW Admin.
Ms. Emma Yuen, DOFAW Admin.
Ms. Irene Sprecher, DOFAW Admin.
Ms. Cynthia King, DOFAW Admin.
Ms. Leah Laramee, DOFAW, Admin.
Ms. Charmian Dang, DOFAW Admin.
Mr. Nicholas Agorastos, DOFAW Hawai`i NARS Manager
Mr. Christopher Mottley, DOFAW Kaua'i NARS Manager
Ms. Marigold Zoll, DOFAW O'ahu NARS Manager
Mr. James Harmon, DOFAW O'ahu
Ms. Mapuana O`Sullivan, DOFAW Kaua'i

VISITORS:

Mr. Mark Fox, The Nature Conservancy
Mr. Dan Purcell, Public

ITEM 1. Call to order: Chair Sinton called the meeting to order at 9:15 a.m., Commissioners introduced themselves, followed by others present. Mr. Dan Purcell asked if name plates could be provided for members so he knew who was speaking. Name plates will be provided at next meeting.

ITEM 2. Approval of the March 10, 2014 NARSC Meeting Minutes.

MOTION: RAPANOT/BRUEGMANN moved that the NARSC approve the Minutes of the March 10, 2014 NARSC Meeting as amended. Motion carried unanimously.

ITEM. 3. Administrative Updates.

ITEM 3.a. Budget. Staff handed out a draft budget showing National Area Reserve Fund (NARF) transfers. The big new item is the Special Land Development Fund: a portion goes into the Hawai'i Invasive Species Council (HISC) and Endangered Species Trust Fund; however this year $3.9 million, one-time cost, went to support the World Conservation Congress (WCC) in 2016, being hosted by the United States (for the first time), with Honolulu Hawai'i in 2016 as the host venue. The International Union for the Conservation of Nature (IUCN) puts this event on every four years.

There are 9 new positions, but lost 11 others for a net loss of two. Funding will be tight due to IUCN; the host committee is currently looking for other funding sources to help fund the $11 million IUCN budget (the initial $3.9 million was only seed money to get things started). This event will bring millions of dollars and a lot of exposure to the state.

ITEM 3.b. Legislative Update for 2014: Staff Yuen said that the hunters wanted no net loss of hunting areas, they were concerned about being fenced out; however more lands have been added for hunting opportunities; their bill died at the very end of session. The real issue and challenge is actually gaining access some hunting areas is more of a concern.

ITEM 3.c. Update on May 29, 2014 Joint Consultation Meeting between the Natural Area Reserves System Commission (NARSC) and the Forest Stewardship Advisory Committee (FSCA) members: for information and discussion and possible action to appoint additional NARSC member to attend future meetings. Staff Irene Sprecher reviewed the yearly meeting and what the NARF supports, particularly the Natural Area Partnership Program (NAPP) and Forest Stewardship Program (FSP). She suggested that the next meeting be scheduled for some time in May 2015.

Chair Sinton felt that these meetings have led to a better understanding of the programs and funding. Staff Sprecher said there is increased interest in FSP enrollment, particularly for conservation, native species, and forest products, so may need to increase the percentage that currently goes to FSP. Chair Sinton felt it was a good idea to hold the meeting after the current legislative session; he and Member S. Conant attended the meeting. Members Woodside and Menard expressed interest in attending the next meeting.

ITEM 3.d. IUCN. Staff Laramee reported that the Steering Committee is hard at work with local organizing for the 2016 WCC. Hawai'i has committed to provide funding to help host this event. Randy Tanaka and June Matsumoto have been hired to do the ground preparations; there will be a person hired through the Governor's Office to actually be the IUCN point person. Member Bruegmann asked about staff participation in aspects of the Congress. Staff Laramee said they would be helping with field trips as well as helping with the various commission meetings of IUCN. Mr. Dan Purcell asked how IUCN will help conservation in Hawai'i. Staff Laramee replied the WCC is an amazing opportunity to share knowledge with others across the world. Also, many

delegates are accompanied by family members and the IUCN has a very large staff that will also be present. Member Bruegmann said that it helps to raise awareness on a global scale and points to our unique position in the middle of the Pacific, not geographically part of North America or Oceania; we often fall through the cracks, IUCN emphasizes other areas; they kind of forget about us; we need more recognition on a global scale.

ITEM 3.e. Status of "Rain Follows the Forest" Watershed Initiative. Staff Yuen gave a power point presentation showing the footprint of current fences versus priority areas still needing protection. Other programs are seeking to acquire additional lands and access for hunting. Member Bruegmann asked about using Capitol Improvement Project (CIP) funds for fence maintenance. Staff Yuen responded that was a good question but she did not know.

Staff Fretz said that units are getting done on Maui and Moloka'i, but no crews yet to manage; management needs to keep up for Kanaio, Nakula, Kahikinui, Lower Hanawī, Hana Forest Reserve, Ko'olau Forest Reserve and Kīpahulu. Member Menard asked what the management status was within the units; that is, are they ungulate-free versus still need to control; need to prioritize funding for management. Member Yuen asked if hunters were allowed to hunt. Staff Fretz replied that we allow hunters where we can; however accessibility varies; they also have to follow all safety precautions. Staff Yuen said there was a special permit system for Kanaio NAR. Staff Fretz said that interest waned as animals got harder to find.

Staff Yuen added that land ownership and remoteness of the area does impact amount of hunting as well; public hunting is inefficient, which is why fences are needed as well as more control. There was push-back last year on the Big Island from hunters concerned that they were being fenced out. The Legislature wants more information, with more maps showing actual areas protected versus those open to hunting opportunities; access is the real challenge, as well as getting data from others.

Chair Sinton said it is clear that some Legislators do not understand; we need to make an effort to engage the hunters with more outreach. Staff Yuen said that DOFAW Administrator Lisa Hadway met with the Game Management County Commission on the Big Island, showed them maps of the areas available for hunting and clearly showed a net increase not loss of hunting areas. Mr. Purcell said that he worked in the office of Representative Cindy Evans and she is going to introduce the no net loss bill again next session.

Member Woodside asked if there was support for the Game Management Program. Staff Yuen said that the Wildlife Program of DOFAW put in a request for more positions. Staff Agorastos said that additional lands could be available on Agriculture zoned (Ag zoned) lands and those under the Department of Hawaiian Homestead Lands (DHHL). Staff Fretz said that the hunting and game management programs need to be consistent with the State Endangered Species laws; it is not that simple, almost all areas are open for opportunities, but access to some areas and better game management are main obstacles. That is why the Acquisition position in DOFAW Admin is so important, to help with

access to areas, creation of Game Management Areas (GMA); all needs to be integrated in to landscape planning. Member Bruegmann said that you cannot always move plants to another area as has been suggested by some hunters.

ITEM 4. NARS Enhancement.
ITEM 4.a. Results of the Public Hearing for additions to Pu`u Maka'ala and Kīpāhoehoe Natural Area Reserves. Staff Yuen said the public hearing was held June 5, 2014 to address the additional lands that were left out of the original nomination of former Kulani lands. Additional Kīpāhoehoe lands were the result of a 2001 enforcement action (illegal koa logging), and the decision was made to add it to the NAR since it is surrounded by the National Park, Kona Hema and other lands.

Nick Agorastos was the Hearing Master. Public comments included concerns that NARS was taking too much, there was no weed control (former Kulani lands), too many fences, and one person alleging that it was racism against Constitutional rights of Hawaiians. There were others present that were in support of the additions. Staff Agorastos said that it went fairly well with a small group so there was more time for informative discussion.

Member Christensen asked what the enforcement action was in 2001. Staff Agorastos explained that Damon Estate had hired a private logger to harvest koa on their own lands, but the logger veered into State land. There was a lengthy legal challenge; they finally settled out of court. Member Christensen asked why so long. Staff Agorastos said it took nearly 3 years to clear title on the land; Staff Yuen added that the appeals took a long time. Staff Agorastos added that fortunately the area was not entirely clear cut, so it is still in relatively good shape. Member Yuen asked about koa harvesting, Staff Agorastos said that they primarily targeted dead or dying koa trees. Member Menard said that the area lies between other managed areas.

ITEM 4.b. Status of other proposed areas. Staff Yuen reported that the cost of cleaning up Unexploded Ordnance (UXO) at 'Ilio Point was not in the Department's budget nor in current budget of the Army Corps of Engineers, but would need Congressional appropriation; and even though this has gone to the Land Board, UXO concerns trump anything else. Poamoho is stalled due to the areas still being under lease to the Army; it has not gone to the Land Board. Staff Yuen said that the Army is willing to take that portion out of the lease.

ITEM 5. Natural Area Partnership Program.
ITEM 5.a. Current status of East Maui Irrigation (EMI) NAPP Application and Long-Range Management Plan as approved at the March 10, 2014 meeting. Staff Yuen said that the Land Board approved it, now working on paperwork, fundraising for fencing, final ungulate control plan. Staff Agorastos asked it f it would be rolled into Waikamoi Preserve or be standalone. Staff Yuen replied that it would be standalone as far as the paperwork, but TNC will manage it as an extension of Waikamoi Preserve.

ITEM 6. Administrative Rules.
ITEM 6.a. Revisions to Hawai'i Administrative Rules Chapter 13-209): Rules Relating to Activities within Natural Area Reserves: Discussion and action to approve, deny, or make other recommendations to the Board of Land and Natural Resources. Staff Yuen said that the Attorney General (AG) needs more time to review; so they will need to be deferred to a future agenda.

Chair Sinton called for a short break; reconvening meeting at 10:47 a.m.

ITEM 7. Staff Updates.
ITEM 7.1. Big Island: Staff Agorastos said Mauna Kea has been a big focal point and that Lake Waiau in the Mauna Kea Ice Age NAR is attracting a lot of attention from cultural practitioners as well as researchers and there is interest in doing baseline measurements to measure changes with regards to climate change. He relies on others like Office of Mauna Kea to help evaluate request for core sampling and to answer concerns about cumulative impacts of research. The lowered lake levels have been an extra challenge (it has not overflowed since 2005).

Chair Sinton said that permits should be approved or denied, but also acknowledged that Waiau is complicated; how to assess impacts, both from a cultural as well as a research perspective; despite any unique research potential. Member Christensen raised a legal point that cultural practitioners are protected under the PASH (Public Access And Shoreline) decision and all agencies have to comply even if not a statute. Discussion continued about cultural assessments. Member Woodside said it depends on the action being proposed. Cultural practitioners could be doing their own research and there are overlapping groups and interests; need a consensus and a transparent process. Waiau is specific but also part of larger landscape issues.

Staff Gagne suggested a meeting on the Big Island and visiting the site to view some of the concerns. Staff Agorastos said that the Mauna Kea Rangers have been helpful reporting any problems they encounter in the NAR. Member Newbold suggested s establishing a working group of practitioners to come up with guidelines for all research proposals or other activities so they are not arbitrary. Staff Fretz thought it was a good idea to have something at a Department wide level; the Aha Moku Committee is supposed to help with such matters. Chair Sinton said there does not need to be a rush, but a careful review rather than research just for the sake of research and whether it will give us any useful information. Ground-penetrating radar may be less disturbing that core sampling.

Chair Sinton said there also needs to be guidance on offerings. Staff Agorastos said that practices such as placement of piko are still ongoing. Member Woodside felt there needs to be a process in place, clear and consistent to determine whether practices should be stopped or not. Mr. Purcell said that he attended OHA meetings and spoke to Hawaiians and suggested that they can be reached out to.

Staff Agorastos then touched on the continued closure at Kahauale'a NAR, with ¼ mile of Captains Trail lost to recent lave flows, there is a lot of continuing activity. There are also issues with commercial guides trying to access the area; but the hazards are still real. Manukā NAR has goats in Kipuka Kaua'i; evidence of old fences. Fountain grass is one of the major management priorities to control and keep it from spreading in to the rest of the NAR. Staff does aerial spraying as well as on the ground cross country surveys for small pockets that aerial work might have missed. The new technology of boom sprayers may help with efficiency and rate of coverage.

ITEM 7.3. O'ahu: Staff Zoll reported that the Ka'ena predator fence maintenance and monitoring showed an increase in mice, so back to the grid and check perimeter to see how they might be getting in. Staff is working on a new Ka'ala Boardwalk Guide to include not just plants but also invertebrates and birds. Sphagnum control in ongoing on both the NAR and Army side, with staff and volunteer trips. There are concerns about the effects of clove oil on invertebrates, so consulting with Nori Yeung to lessen potential impacts. Conducted a pig collaring study to assess their movements since it is very difficult to hike around on such steep slopes, so their movements can be monitored remotely. Pahole NAR is broken in to management units to focus on best areas, utilizing surveys, as the habitat is fragmented. Currently utilizing Adopt A Forest Program volunteers to help control strawberry guava; also have selected sites to introduce *Tectococcus* (biocontrol agent); have also deployed rat traps around rare plants (especially *Melicope kaalensis* a previously unrecorded rare species for the area) and snail trees. On February 14, 2014 Kaluanui NAR became the first reserve in the Ko'olau Range. Staff is working on the fence alignment, and made an agreement with Kamehameha Schools to hike into the area via Castle Trail since can drive to the trail head, with plans for a weather port to support remote management activities such as surveys and fence building.

Member Yuen asked about fences; she replied that funding is needed and need to go through the approval process to build a fence. For now, crews are working in other areas, such as Poamoho where the fence line is being built/cleared by Pono Pacific, and there will be a landing zone and the future NAR boundary will follow the fence.

Member Menard asked about pig activity; she responded that it is low in the upper area; Kaipapau and Kaluanui NAR have higher numbers, but it is also more difficult to get in to those areas. Ongoing work at Poamoho include collared pig study, monitoring biocontrol of strawberry, using a spray ball to hit invasive *Angiopteris* tree ferns, the cabin at Poamoho is now improved. Staff is updating the DOFAW Management Guidelines; currently the only Branch that has added a conservation class green = ungulate free, and managed to be as ungulate free as possible; with agreement from USFWS. The animal class = yellow to designate year round, open season, including bird season at Kuaokala. There are also other areas for forestry and recreation. One of the parcels for strategic acquisition is at Helemano, which is the access to Poamoho; parts of it would be suitable for a Game Management Area (GMA).

Chair Sinton asked if they would be going back to the Legacy Land Commission. Staff Zoll replied that they are looking for more funding sources, with help from Trust for Public Lands' Lea Hong. Member Bruegmann asked about non-traditional section 6 funding; Staff Zoll responded that they had not heard anything yet. Member Bruegmann asked about Pia Valley. Staff Zoll replied that the land owner wants to donate it to the State, probab.ly with a NSAR designation, but have not gotten far in the negotiation process for this 300 acre parcel, but it is definitely worth acquiring. Both Members Christensen and Yuen wanted to know who the land owner was; Staff Zoll responded that Pfluger was the owner, and the area has PEPP (Plant Extinction Prevention Program) species, snails, and other rare plants and invertebrates.

ITEM 7.4. Kaua'i: Staff Mottley reported that staff is conducting restoration at Pa'aiki, which was part of the large fire last year. Staff maintained an exclosure fence for *Pteralyxia* in Ku'ia NAR. They have a fence contractor for Hono O Nā Pali and are monitoring in Ku'ia. The Pohakea weather port is complete; working on grants and partnership proposals, Honopu'u surveys. The problem they are having with Pa'aki restoration is that no one has large quantities of native seeds or seed banks. There were large rains in December resulted in large fence blowouts. We have only a small crew so can only fence small areas not large, so it is slow; but important to protect small intact pockets.

Kaua'i Branch staff trying to improve nursery and plant propagation capacity. Sheri Mann, DOFAW Forestry Program manager in Admin is actively helping to seek funds for seed storage capacity as well as pushing other Branches to improve their nursery operations; 'a'ali'i is considered by many to be the hardiest plant to help with early restoration efforts. New Kaua'i DOFAW Botanist Adam Williams is helping to fine tune what we need to collect, what is best to propagate and what takes too long to propagate for starters. The NRCS (Natural Resources Conservation Service) Ho'olehua Plant Material Center supplied initial plants for the Pa'aiki restoration post-fire.

For the Ku'ia exclosure, using cattle panels and rubberized aprons. Terrain on Kaua'i is different with steep gulches that are hard to hike and work in. A public hunting program allows access and 5 of 9 hunts successful removing 5 pigs and one deer from inside our fences.

Steve Perlman works with our PEPP species, helped to maintain the Ku'ia rare Plant Exclosure; with its steep slopes it is hard to maintain, but he was able to discover many new plants and help with surveys and outplanting.

Monitoring in Hono O Nā Pali monitoring consists of 9 transects; the fence from Kilohana to Pihea contractors cleared the proposed fence line; there will probably be a lag between money and construction. There are still some public concerns about the fence corridor; trying to keep it away from the boardwalk so it is not visible. Member Menard asked if the fence would be retrofitted for deer from the current 4 feet largely for pigs; Staff Mottley said there were no plans at the time, but they will use deer mesh. Ken Wood form National Tro0ical Botanical Garden is surveying for deer. Having a weather

port allows more time in the field to continue weed and predator control. KIUC (Kaua'i Island Utility Cooperative) does off-site mitigation focused on predator control. Working on several proposals for funding to continue support of more fences, maintenance, and rare plant protection.

ITEM 7.2. Maui: Maui Branch Manager Scott Fretz gave an update on Nakula where there is a 420 acre demonstration unit being managed by the Maui Forest Bird Recovery Project (MFBRP); just finishing the fence; ungulates should be out by December 2014. Habitat restoration and land scape wide plantings are being done with MFBRP staff and volunteers; using existing seed bank to scatter seeds of koa and other species. Maui PEPP coordinator Hank Oppenheimer is conducting a survey for PEPP plants as well as out planting species. Restoration is all geared to future reintroduction of the kiwikiu (Maui Parrotbill); working closely with MFBRP. Bob Peck is coordinating arthropod surveys to compare Nakula with Waikamoi and Hanawī to help guide restoration and reintroduction efforts. There is also potential for seabird restoration and the USGS (United Stated Geological Survey) is also monitoring for bats; a two-year baseline to look at population trends.

At 'Āhihi-Kina'u, staff is working on plans for the ungulate control fence on the makai side of the road to exclude goats, especially from the anchialine pools; the coastal grant covers this portion immediately, but fence assessment is for entire perimeter of the Reserve so what when funds are available in the future, the mauka portion may also be fenced. Smaller exclosures are being done to protect rare plants up mauka that are threatened by deer and goats until the larger fence can be built so that restoration can continue over a broader area. Volunteers are helping staff to control *Battis* (pickleweed) in the anchialine pools to allow for native vegetation recover.

As part of the management actions, following the sustainability plan; staff is looking to revise the administrative rules to allow for parking fee revenue; which will require both a statute and rule change. Parking appears to be the best way to control numbers of cars, as well as gain revenue to help manage the effects of people on the Reserve; this will also entail construction of a parking lot to better accommodate cars while preventing runoff.

The USACE (United States Army Corps of Engineers) has completed the Remedial Investigation (RI) for Unexploded Ordnance (UXO), coming up with a Hazard level ranking of 2, based on munitions and debris found during the survey, as well as taking materials discovered earlier that triggered this broader study; also need to survey the proposed makai fenceline Next step will be for USACE to do a Feasibility Study (FS) to determine how the area may be accessed and managed for the future; what areas might need more detailed cleanup (such as trails) and what other remedial action is needed.

Member Bruegmann asked about cleanup; he replied that we need to determine where the public can go, along with staff, and how to clear those places; that is the Institutional Control being worked on now. To ultimately open all or part of the Reserve will need to create a trail system to protect the resources, aid in management capacity, allow for access, and address liability and safety concerns. We are not there yet, but continue to

work on this; therefore asking that the Reserve remain closed for another two years until FS is completed and we have a remedy. In the meantime, recruitment continues to hire a new Education and Volunteer person for the Reserve, since the current one decided not to apply for the permanent position.

ITEM 7.2.a. Action Item: Continued Closure of ʻĀhihi-Kinaʻu Natural Area Reserve for another two years (August 1, 2014 – July 31, 2016). Discussion and action to approve, deny or make other recommendations to the Board of Land and Natural Resources. Chair Sinton asked if there was any discussion. Member Christensen asked if there was any opposition to continued closure; Staff Fretz replied that the ʻĀhihi-Kinaʻu NAR/Keoneʻōʻio Advisory Group (AKKAG) unanimously approved continue closure at its February 27, 2014 meeting, with no opposition on record. With the FS in progress, we still need to determine what we can do to manage access.

MOTION: NEWBOLD/MENARD moved that the Natural Area Reserves System Commission approve continued closure for another two years (August 1, 2014 – July 31, 2016) and recommend that the Board of Land and Natural Resources approve continued closure.

ITEM 8. Announcements. No announcements.

ITEM 9. Adjournment. Chair Sinton adjourned the NARSC Meeting at 1:52 p.m.

Respectfully submitted,

Betsy Harrison Gagné, Executive Secretary
Natural Area Reserves System Commission

State of Hawaii
DEPARTMENT OF LAND AND NATURAL RESOURCES
Division of Forestry and Wildlife

April 27, 2015

Chairperson and Members
Natural Area Reserves System Commission
State of Hawai`i
Honolulu, Hawai`i

NARS Commission Enhancement Subcommittee Members:

SUBJECT: RECOMMENDATION TO THE BOARD OF LAND AND NATURAL RESOURCES APPROVAL FOR AUTHORIZATION OF FUNDING FOR THE NATURE CONSERVANCY OF HAWAII FOR $663,600 DURING FY 16-21 FOR CONTINUED ENROLLMENT IN THE NATURAL AREA PARTNERSHIP PROGRAM AND ACCEPTANCE AND APPROVAL OF THE KAPUNAKEA PRESERVE LONG RANGE MANAGEMENT PLAN, TMK 4-4-7:01, 4-4-7:03, 4-4-7:07, LAHAINA, MAUI

AND

RECOMMENDATION TO THE BOARD OF LAND AND NATURAL RESOURCES APPROVAL FOR AUTHORIZATION OF FUNDING FOR THE NATURE CONSERVANCY OF HAWAII FOR $470,802 DURING FY 16-21 FOR CONTINUED ENROLLMENT IN THE NATURAL AREA PARTNERSHIP PROGRAM AND ACCEPTANCE AND APPROVAL OF THE PELEKUNU PRESERVE LONG RANGE MANAGEMENT PLAN, TMK 5-4-3:32, 5-9-6:11, MOLOKAI

BACKGROUND:

The State's Natural Area Partnership Program (NAPP) was established in 1991 and provides matching funds ($2 State to $1 private) for the management of qualified private lands that have been permanently dedicated to conservation (Hawai'i Revised Statutes (HRS) § 195-6.5). Statewide, there are nine preserves enrolled in the program.

The attached Long-Range Management Plan (LRMP) for Fiscal Years 2016-2021 provides a detailed description of the natural resources protected in the Kapunakea and Pelekunu Preserves and the management activities planned over the next six years.

Kapunakea Budget
The total NAPP budget for Fiscal Years 2016-2021 is $995,400. Total State funding requested

over the next six years would be $663,600; The Nature Conservancy will provide the match of $331,800.

Pelekunu Budget
The total NAPP budget for Fiscal Years 2016-2021 is $706,200. Total State funding requested over the next six years would be $470,802; The Nature Conservancy will provide the match of $235,398.

Although Natural Area Partnership agreements are made in perpetuity, funding is authorized on a six-year basis to allow for regular periodic State and public review.

RECOMMENDATIONS:

That the Commission:

1) Recommend to the Board of Land and Natural Resources approval of the Kapunakea Preserve Long-Range Management Plan submitted for Fiscal Years 2016-2021;

2) Recommend to the Board of Land and Natural Resources approval of the Pelekunu Preserve Long-Range Management Plan submitted for Fiscal Years 2016-2021;

3) Recommend to the Board of Land and Natural Resources approve authorizing the matching funding for the management of the Kapunakea Preserve for the full six-year period as outlined in the Long-Range Management Plan for Fiscal Years 2016-2021; and

4) Recommend to the Board of Land and Natural Resources approve authorizing the matching funding for the management of the Pelekunu Preserve for the full six-year period as outlined in the Long-Range Management Plan for Fiscal Years 2016-2021.

Respectfully submitted,

LISA J. HADWAY, Administrator
Division of Forestry and Wildlife

Attachments

Pelekunu Preserve

Molokaʻi, Hawaiʻi

Long-Range Management Plan
Fiscal Years 2016–2021

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

Submitted by
The Nature Conservancy
Molokai Program
April 2015

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TABLES, FIGURES AND APPENDICES

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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 mission of The Nature Conservancy is to conserve the lands and waters on which all life depends. Since 1980, the Conservancy has protected more than 200,000 acres of natural lands in Hawai‘i and works with other public and private landowners to protect the islands' key watersheds. The Conservancy manages a statewide network of 11 preserves totaling 40,000 acres and works in 12 coastal communities to protect the coral reefs and near-shore waters of the main Hawaiian Islands.

The State's Natural Area Partnership Program (NAPP) is an innovative program that aids private landowners in the management of their native ecosystems. NAPP provides matching funds ($2 state to $1 private) for the management of qualified private lands that have been permanently dedicated to conservation. On Moloka‘i, the Conservancy manages three NAPP Preserves: Mo‘omomi (921 acres), Kamakou (2774 acres), and Pelekunu (5,759 acres), and is the main coordinator/manager of the East Moloka‘i Watershed Partnership (EMoWP) which is directly responsible for management programs in the South Slope at Kamalō (3,566 acres), Kapualei (1,680 acres), and Kawela (5,500 acres). The EMoWP is also expanding further east to the "East Slope" and in FY15 began focusing on the 1,300 acre Pakui unit. Management of Pelekunu Preserve has been funded by the NAPP since 1992. This long-range management plan updates the plan covering fiscal years (FY) 2010–2015 and was prepared in compliance with the Natural Area Partnership agreement between the State and The Nature Conservancy of Hawai‘i. This plan documents management programs to be undertaken in the next 6 years (FY2016 – FY2021) at Pelekunu Preserve.

The first section of this plan is a brief overview of the native natural resources that are protected at Pelekunu 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 for FY2016–FY2021 are also listed. In FY 2014, the NAPP program introduced the use of a data-driven spreadsheet to propose and report on deliverables. The spreadsheet is still being refined; a word version of the spreadsheet follows.

DELIVERABLES SUMMARY

The deliverables listed below are derived directly from the NAPP Deliverables spreadsheet (also attached), for easy reference.

UNGULATE CONTROL

Subunit	*Proposed Action*	*Goal Quantity of Action*	*Interval of Action*
Pelekunu Main Valley	# Aerial Hunts	2	Annually

WEED CONTROL

Unit	*Species Targets*	*Proposed Action*	*Goal*	*Methods*	*Goal Acres*	*Interval*
Wailau Upper	Hedgar	Ground Sweep/Control	Prevent introduction of toilet brush ginger to Pelekunu	Conduct ground sweeps to control and map outliers	10	Annually
Wailau Upper	Hedgar	Aerial Survey Only	Prevent introduction of toilet brush ginger to Pelekunu	Assist DoFAW/MoMISC with North Shore aerial surveys	10	Annually
Puu Alii	Rubarg	Ground Sweep/Control	Prevent introduction of blackberry to Pelekunu Preserve	Assist NAR with ground sweeps to eliminate blackberry	50	Annually
Pelekunu	Spacam	Ground Sweep/Control	Eliminate African tulips where feasible	Eliminate Pelekunu Populations Spacam	All	By FY2019
North Shore	Unkspp	Aerial Survey Only	Prevent introduction of Priority Invasive from North Shore Areas	Assist DoFAW/MoMISC with North Shore aerial surveys	All	Annual if feasible

TRANSECT MONITORING

Transect/Station Name	*GIS Transect Length (m)*	*Monitoring type*	*Action*	*Interval*
PEL01	672.6554	Ungulate	Check	Annually
PEL02	585.1824	Ungulate	Check	Annually
PEL03	523.5296	Ungulate	Check	Annually
PEL04	641.8471	Ungulate	Check	Annually
PEL06	544.9153	Ungulate	Check	Annually

PEL07	559.0068	Ungulate	Check	Annually
PEL08	565.6601	Ungulate	Check	Annually
PEL09	607.311	Ungulate	Check	Annually
PEL10	664.0661	Ungulate	Check	Annually
PEL11	565.0502	Ungulate	Check	Annually
PEL12	388.7804	Ungulate	Check	Annually

STREAM MONITORING

Species Name	*Species Type*	*Proposed Action*	*Proposed # Checks*	*Interval*
Nergra	Other	Check	1	Hihiwai (*Neritina granosa*); years 1, 3 & 5
SicSti	Other	Check	1	Oopu nopili (*Sicyopterus stimpsoni*); years 1, 3 & 5
Awasta	Other	Check	1	Oopu nakea (*Awaous stamineus*); years 1, 3 & 5
Lencon	Other	Check	1	Oopu alamoo (*Lentipes concolor*); years 1, 3 & 5
Elesan	Other	Check	1	Oopu okuhekuhe (*Eleotris sandwicensis*); years 1, 3 & 5

COMMUNITY OUTREACH

MEETINGS, HIKES, EVENTS and PUBLICATIONS

*Event Type**	*Proposed Action*	*Proposed Number Events/Publications*	*Proposed Num Ind. Reached*	*Interval*
Kamakou Hike	Hike	1	6	Annually
Partner's Meeting	Meeting	1	1	Annually
MoMISC Meeting	Meeting	1	1	Annually
Earth Day Event	Fair	1	800	Annually (April)
Nature's Newsflash	Publication	1	3100+	Annually

INFRASTRUCTURE

Structure	*Type*	*Action*	*Interval*
Pelekunu Trail	Trail	Maintain	Semi-Annually
Helicopter LZs	LZ	Maintain	Semi-Annually
Camps/Cabins	Facilities	Maintain	Years 2, 4, 6

* Pelekunu NAP helps to pay a portion of the community outreach activities listed here.

RESOURCES SUMMARY

General Setting

Pelekunu Preserve (Figure 1) was established in 1986 when the Conservancy purchased 5,759 acres in the northeast sector of Molokaʻi (most from Molokaʻi Ranch, Ltd.). The preserve was established to protect the perennial stream system, one of the best remaining in Hawaiʻi. Pelekunu Preserve is bordered on all sides by natural areas managed for conservation, including Kalaupapa National Historical Park, the state-owned Puʻu Aliʻi and Olokuʻi Natural Area Reserves (NARs), Molokai Forest Reserve (Wailau), the Conservancy's Kamakou Preserve and other private lands of the East Molokai Watershed Partnership. All of these are part of the East Molokaʻi Watershed Partnership (Figure 2) and protect more than 30,000 acres of contiguous ecosystems that range from sea level to 4,970 feet in elevation. The topography of Pelekunu Preserve is spectacular, with 3,000-foot valley walls dissected by a series of convoluted streams and ridges. This isolated area contains no roads and only a few rough trails.

Pelekunu Preserve encompasses the valley watershed of Pelekunu stream, its tributaries, and other smaller streams. At the coast, the preserve extends westward beyond Pelekunu Valley to include the smaller Waiohoʻokalo Valley and its stream system. Annual rainfall ranges from 80 inches near the coast to more than 180 inches at the head of Pelekunu Valley. The valley's streams have never been diverted for export outside the watershed. As a result, this stream system is a prime example of an increasingly rare aquatic natural community (Hawaiian Continuous Perennial Stream) and contains a full complement of native aquatic fauna. Aquatic biologists consider Pelekunu's stream system one of the top in the State of Hawaiʻi.[1]

Because of its isolation, Pelekunu Valley has escaped modification from modern activities such as ranching, reforestation, agriculture, and tourism, all of which have transformed other parts of Molokaʻi. Historically, Hawaiians who terraced the land for crops and diverted the streams for irrigation inhabited the valley. Native-dominated vegetation occurs mainly in steep areas, especially at the coastal sea cliffs and surrounding valley walls. Many rare plants and diverse natural communities persist in these places.

The primary threats to Pelekunu's watershed and native species are the introduced ungulates: goats (*Capra hircus*), pigs (*Sus scrofa*), and axis deer (*Axis axis*). A secondary, related threat is invasion of non-native, invasive plant species such as *Clidemia hirta* (see Weed Control section). Another potential threat to the preserve is the dewatering of the Pelekunu stream

[1] Hawaii Watershed Atlas. 2008. http://www.hawaiiwatershedatlas.com/watersheds/molokai/41009.pdf

system. However, the Molokaʻi Water Working Group, a community advisory group to the State Water Commission, has clearly stated that it does not want the undiverted north shore streams of Molokaʻi harvested in the near future. Other threats include: the over-harvesting of native fresh water snail, hihiwai *(Neritina granosa)*; invasion of the streams by non-native fish, insects, and prawns; and cataclysmic events such as landslides.

Flora and Fauna

Pelekunu Preserve contains at least 11 native natural communities (Figure 3, Appendix 1). Of these, the Hawaiian Continuous Perennial Stream community is considered rare, as it is found in fewer than 20 sites worldwide. The other communities are more widespread aquatic and terrestrial communities, including a variety of coastal, lowland, and montane grassland, shrubland, and forest types. About a third of the natural communities found in Pelekunu are also known from Puʻu Aliʻi and Olokuʻi NARs (Appendix 1).

Pelekunu Stream is one of the best remaining streams in Hawaiʻi; characterized by the presence and abundance of the full array of native aquatic species. It was given "Outstanding" status in the 1990 Hawaii Stream assessment Rank, and an overall Watershed Rating of 10 out of 10 in the Atlas of Hawaiian Watersheds and their Aquatic Resources. Many of these species exhibit a stream to ocean life cycle referred to as diadromy. These diadromous species include five native fishes (collectively referred to as ʻoʻopu), a freshwater snail, hihiwai (*Neritina granosa*), and two native crustaceans, ʻopae kalaʻole (*Atyoida bisulcata*), and ʻopae ʻoehaʻa (*Macrobrachium grandimanus*) (Appendix 2). The native ʻoʻopu are some of the most unique organisms in the world. The pelvic fins of four of the five ʻoʻopu are fused and form a "suction" cup. The ʻoʻopu literally scale waterfalls by using their suction cup pelvic fin and thus they are able to utilize the entire stream. The one species that does not have this feature is the ʻoʻopu owao (*Eleotris sandwicensis*), and thus it is confined to the lower reaches of Hawaiian rivers.

Thirty rare plant taxa have been reported from Pelekunu Preserve; eight of these are endemic to eastern Molokaʻi (Appendix 3). Eleven of these taxa have also been reported from Puʻu Aliʻi and/or Olokuʻi NARs. Of the 30 rare plant taxa reported from the preserve, 11 are federally listed endangered species and 1 is listed as threatened.

Five endemic forest birds have been reported from Pelekunu Preserve and adjacent areas. These include two federally listed endangered birds: the kakawahie (Molokaʻi creeper, *Paroreomyza flammea*), which is probably extinct, and the olomaʻo (Molokaʻi thrush,

Myadestes lanaiensis rutha), which may also now be extinct. The Molokaʻi and Oʻahu populations of ʻiʻiwi (*Vestiaria coccinea*) are considered endangered by the state (Appendix 4). Two common endemic forest bird species are also found in Pelekunu Preserve, ʻapapane (*Himatione sanguinea*) and ʻamakihi (*Hemignathus virens wilsoni*). Endangered sea birds noted from the valley include the Newell's shearwater (*Puffinus newelli*) and the ʻuaʻu or Hawaiian petrel (*Pterodroma sandwichensis*). Common shorebird species including the indigenous ʻaukuʻu, or black-crowned night heron (*Nycticorax nycticorax hoactli*), the noio or black noddy (*Anous minutus*) and the migratory ʻulili, or wandering tattler (*Tringa incana*), have been reported along the main branch and tributaries of Pelekunu Stream. Koaʻe kea, or the white-tailed tropicbird (*Phaethon lepturus dorotheae*), an indigenous seabird, can often be seen along the sea cliffs in the back of the valley. It is also likely that the endangered Hawaiian hoary bat (*Lasiurus cinereus semotus*) may exist in the valley, though currently this is unconfirmed.

Finally, two endemic achatinellid land snail species, *Partulina mighelsiana* and *Partulina tessellata*, have been reported within or near the boundary of the preserve (Appendix 5). These rare snails are also known from Kamakou Preserve, Puʻu Aliʻi and Olokuʻi NARs. In May 2002, aquatic ecologist of the Bishop Museum, Ronald Englund, observed two rare damselflies, *Megalagrion xanthomelas* and *M. pacificum*, which are now extinct on Oʻahu and Kauaʻi; one is now federally listed as endangered and the other is a candidate for federal listing. Englund also observed there one of the most rare aquatic insects in Hawaiʻi, *Campsicnemus ridiculus*.

MANAGEMENT

Management Considerations

1. Pelekunu Preserve is extremely remote and the terrain is very rugged, including the highest sea cliffs in the world. There are no roads to the valley; access is only by boat, helicopter, or a long and hazardous foot trail. To accomplish management objectives, the Conservancy relies on helicopters for year-round access. Visitors may access the front of the preserve by boats during the summer months when seas are calm. Foot access is impractical due to the long (12-hour) hike over terrain too rugged to carry necessary supplies.

2. A number of landowners retain a total of more than 350 acres in the valley. These people and other members of the Molokaʻi community exercise traditional access, gathering, and other rights within the valley, as recognized by law. Conservancy management does not alter these rights.

3. Pelekunu Preserve is part of The East Molokaʻi Watershed Partnership's "North Slope" (figure 2) that also includes Kalaupapa National Historical Park, State's Puu Alii and Olokui Natural Area Reserve and the upper portions of Wailau (Forest Reserve). With the Kamalō through Kapualei portion (South Slope) of this partnership (their boundary is the mountain divide between north and south East Molokaʻi), these two projects form the only known island profile managed for conservation of the natural resources from coast to coast. The Partnership helps to leverage effort over a larger landscape by combining resources and expertise. Our primary management activity to protect the preserve's native plants, animals, and natural communities is by protecting the watershed through the reduction of feral ungulate damage, limiting the spread of non-native, habitat-modifying plants, preventing the introduction of other invasive species, and monitoring aquatic macrofauna.

4. Pelekunu is largely dominated by non-native vegetation on the valley floor, while the steep walls are comprised of native flora that provides a high quality watershed that feeds the stream system.

Preserve Areas

The preserve is divided into *three distinct areas* (Figure 4): upper Pelekunu Valley, lower Pelekunu Valley, and the Waiohoʻokalo Valley area.

The lower valley is mainly comprised of the main stem stream and also the smaller Kailiili stream. The lower and upper valley is divided by the Papaiki ridge on the west and the adjacent ridge of Lanipuni to the east. The lower valley has one facility, an old house built by Clifford Soares in the early 1970's.

The upper Pelekunu Valley has four significant streams; Pilipililau, Lanipuni, Kawainui, and Kapuhi. These are the names that are used to refer the areas where management occurs. We

will continue to concentrate on this area to maintain and improve the integrity of the upper watershed and to prevent ungulates from entering the adjacent Olokuʻi Natural Area Reserve. There are three facilities – the former USGS Cabin and two Papakiki remote shelters.

Finally, Waiohoʻokalo Valley area is west of the Manuahi ridge along the coast and is quite steep and remote. There is one resident that resides with in this area.

Humans have substantially altered lower Pelekunu Valley, with significant terracing throughout the valley floor. Historically, the lower valley had the most inhabitants and was the most heavily cultivated part of Pelekunu Preserve. This is mainly due to this area's proximity to ocean resources and the fact that the wider valley floor is well suited for taro cultivation. Management in the floor of the valley consists of maintaining the trail systems and facilities, monitoring ungulate presence, and conducting stream monitoring. From time to time animal sweeps are conducted to address the high pig populations. However, most of the funds in the past contract were spent on aerial shooting the valley walls, which keeps animal population in the native flora at low levels while helping to prevent ingress into the State's Puu Alii and Olokui Natural Area Reserves.

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 FY2016 – FY2021.

Program 1: Non-native Species Control

A. Ungulate Control

Program Objective

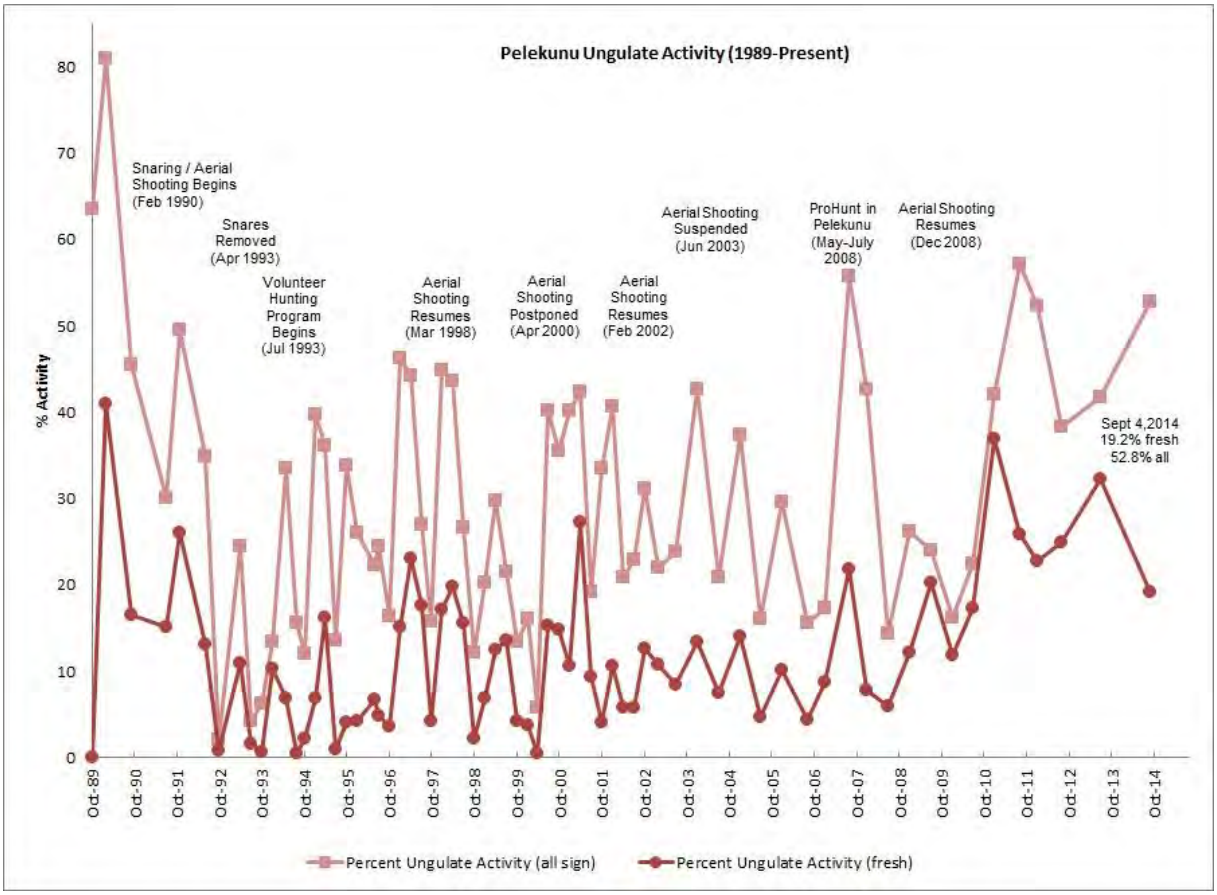
Implement ungulate control that keeps animal population low in the valley walls and to prevent ingress into the adjacent State NARS.

Program Description

Pelekunu's ungulate control priority is to support the State's NARS annual aerial shooting missions t keep animal population low on the valley walls and prevent ungulates from moving into Puu Alii and Olokuʻi NARS. Olokuʻi is thought to be the only place in Hawaiʻi that has never been damaged by feral ungulates. In the next six years, we will support the NARS staff to locate key ingress points and either construct strategic fencing or apply control methods (possibly the Pohakaunoho/Kolo ridge areas).

In 1991, we began ungulate control efforts in the valley and through a combined approach of using snaring, aerial shooting and ground hunting, we were able to reduce animal activity to less than 10% as measured by our ungulate activity surveys discussed in the monitoring and research section of this plan. While this approach was successful in achieving low ungulate activity, it also caused significant controversy about the use of snares in an area that was used

periodically by hunters with dogs. In April of 1993, TNC removed all snares from the valley in an effort to determine if hunting with volunteers using dogs could achieve the same results as the snares and aerial hunting had. This approach did not prove to be successful, so in 1998 aerial shooting was resumed in addition to ground hunting. From January 2000 – December 2007 only one aerial shoot was conducted in February of 2002. During that period we continued ground hunting and ungulate activity never reached the 10% levels. The State resumed aerial shooting in December 2007 with monthly shoots. The State's aerial shooting is considered the most effective and efficient way to remove ungulates from the steep ridges and walls of Pelekunu as is most of the north shore areas. In 2007, the Conservancy contracted with ProHunt, a hunting firm from New Zealand, to complete a series "hunt sweeps" in the preserve ProHunts systematic hunts showed some promise, as activity levels dropped. However, the 2009-2010 economic downturn (the 1st year of our current contract) resulted in funding cuts which had TNC focus the limited funds on supporting the NARS North Shore ACETA missions. Aerial shooting has been effective on the valley walls and helping to prevent ingress in the State NARS, and will be continued in the next six years. If extra funds are available, TNC will conduct hunt sweeps in the valley floor.



Ungulate Control Goals

Years 1-6 (FY2016-21)

1. Support NARS aerial shooting on Pelekunu's valley walls.
2. Support NARS staff in addressing key ingress ridges to Olokui and Puu Alii NARS.
3. Conduct ground hunt sweeps if funding available.

B. Weed Control

Program Objective

Implement weed strategies to eliminate incipient habitat-modifying weeds and prevent the spread of key established weeds.

Program Description

Habitat-modifying weeds are alien plants that have demonstrated the ability to suppress regeneration of, or displace, native vegetation. Many weeds become established when an area is disturbed by ungulates, which may also carry and spread seeds. In many areas, including Pelekunu Preserve, eliminating ungulates may be the most effective means of slowing the spread of habitat-modifying weeds.

In Pelekunu Valley, much of the valley floor was altered by human habitation and agriculture prior to the 1950s. The land was terraced for agriculture, and the streams were diverted to irrigate crops. Much of the vegetation in the lower valley was introduced by Polynesians and later by European settlers.

Our weed control program focuses on preventing the spread of habitat-modifying weeds to where native plant communities are still relatively intact and has four components: 1) developing and implementing a feasible, long-term control strategy for *Melastomes*; 2) identifying, mapping, setting management priorities and implementing control for other established habitat-modifying weeds; 3) Preventing the spread of weeds from adjacent areas into Pelekunu's watershed cliff areas; 4) preventing the establishment of new habitat-modifying weeds; and 5) Supporting Molokaʻi/Maui Invasive Species Committee (MoMISC) activities on Molokaʻi.

Clidemia hirta, a habitat-modifying weed in the *Melastome* family that has extensively invaded other natural areas in Hawaiʻi, remains our primary and immediate concern. *Clidemia* occurs throughout Pelekunu Preserve. Manual and chemical control of *Clidemia* would be difficult to apply on a large scale in Pelekunu's rugged terrain; moreover, these methods have not been effective in other natural areas in Hawaiʻi due to the seed bank created on the ground once a plant has fruited. In May of 1990 (prior to writing the FY1992–1997 long-range plan), we began a biocontrol trial using the fungal agent *Colletotrichum gloeosporioides*. This work was done in cooperation with the state Division of Forestry and Wildlife and the University of Hawaiʻi Cooperative Extension Service. To date, this agent has not been effective controlling *Clidemia* in Pelekunu. After releasing the fungal agent, we learned that the Conservancy has a nationwide policy that prohibits introducing non-native species into Conservancy preserves without in-house approval. *Tibouchina herbacea*, another *Melastome* is also present in other

disturbed areas of the valley. Other species that were located in Pelekunu valley that also function as biocontrols for *Clidemia hirta* include *Mompha trithalama*, a moth which limits fruit production, and *Liothrips urichi*, a thrip which attacks the leaves of Clidemia.

If reports become available documenting that the most recently studied biocontrols are successful and safe agents, then we will seek approval from the Conservancy's Worldwide Office to release them.

Table 1. *Priority Weed Species in Pelekunu Preserve.*

Scientific Name	Common Name	Status
Clidemia hirta	Koster's curse	Established
Tibouchina herbaceae	Glory Bush	Established
Fucraea foetida	Mauritius hemp, sisal	Established
Psidium cattleianum	Strawberry guava	Limited
Schinus terebinthifolius	Christmas berry	Established
Syzigium jambos	Rose apple	Established
Spathodea campanulata	African tulip	Limited

Additional priority weeds (Table 1) may be controlled with manual (pulling or cutting), chemical methods and/or other alternative methods that may be developed. Herbicide use will be strictly limited, and in full compliance with the state Department of Agriculture's pesticide branch. (Please note that at least one staff on Moloka'i is certified by the state Department of Agriculture's pesticide branch as a restricted herbicide applicator.) If herbicides are needed, staff will operate in strict compliance with the label and will use pesticides that are approved for aquatic sites and in limited quantities to reduce potential negative impacts to non-target plants and animals. Staff may seek to use additional herbicides as appropriate, under the direction of the state Department of Agriculture's pesticide branch. Heavy equipment is not used for weed control in Pelekunu valley.

Preventing the spread of established weeds such as *Clidemia* into intact areas is of a primary importance to The Nature Conservancy. Weed seeds from weed infested areas may "hitch-hike" on animal or human hosts, become deposited in more intact native forested areas, and may become established there. To reduce the risk that native and endangered species will suffer further habitat loss due to humans, weed and ungulate control staff adopted a "top-down" approach to management, working from more intact upper elevations to lower, more degraded systems. Staff are required to clean boots, backpacks, and other gear prior to entering the valley. Staff has dedicated gear for use in the valley to prevent weed seeds from moving in and out of the valley.

Examples of habitat-modifying weeds that have not yet made it to Pelekunu Preserve or to Moloka'i are *Miconia calvescens* and *Passiflora mollissima* (banana poka). As part of our community outreach program, during events like Earth Day and through our quarterly newsletter *Nature's Newsflash*, we educate the community about the threat these habitat-modifying weeds pose to Moloka'i's natural areas. Also, as part of our prevention program, we

enforce a protocol for alien species that includes cleaning gear and clothing prior to and after entering the preserve, and conducting annual inspections of helipads for new weeds.

While heavily impacted by *Clidemia*, Pelekunu has limited populations of a couple of notable priority species such as strawberry guava and African Tulip. Known locations of these species will be evaluated for removal based on safety and available funding. Pelekunu also lacks populations of a couple of notable priority weeds found in adjacent areas. These include an incipient 10 acre population of toilet brush ginger (*Hedychium gardenarium*) in Wailau valley and blackberry (*Rubus argutus*) established in the adjacent Puu Alii NAR. Preventing the spread of these weeds to Pelekunu and Olokui is best achieved through TNC support of NAR and DoFAW removal efforts in those areas with weed mapping and control expertise.
All incipient and limited populations of African tulip, strawberry guava and toilet brush ginger on Molokai's North Slope were identified through aerial surveys, which provide a means to detect these species before they become established.

The Conservancy led the creation of the Molokai/Maui Invasive Species Committee (MoMISC) partnership of government and private organizations in FY2001. MoMISC prevents the establishment of incipient pest populations through field activities and public education.

Weed Control Goals

1. Keep apprised of other agencies' *Melastome* biocontrol monitoring efforts and if success is documented, seek in-house approval to release.
2. Eliminate African tulip trees where feasible.
3. Support NAR staff to reduce blackberry and strawberry guava populations in the adjacent Puu Alii NAR to prevent their establishment in Pelekunu Preserve.
4. Support DoFAW and MoMISC efforts to eliminate the only known population of toilet brush ginger (*Hedychium gardenarium*) on Molokai.
5. Conduct annual aerial surveys for incipient habitat modifying weeds when feasible or in support of partners like MoMISC Miconia survey.

Program 2: Monitoring and Research

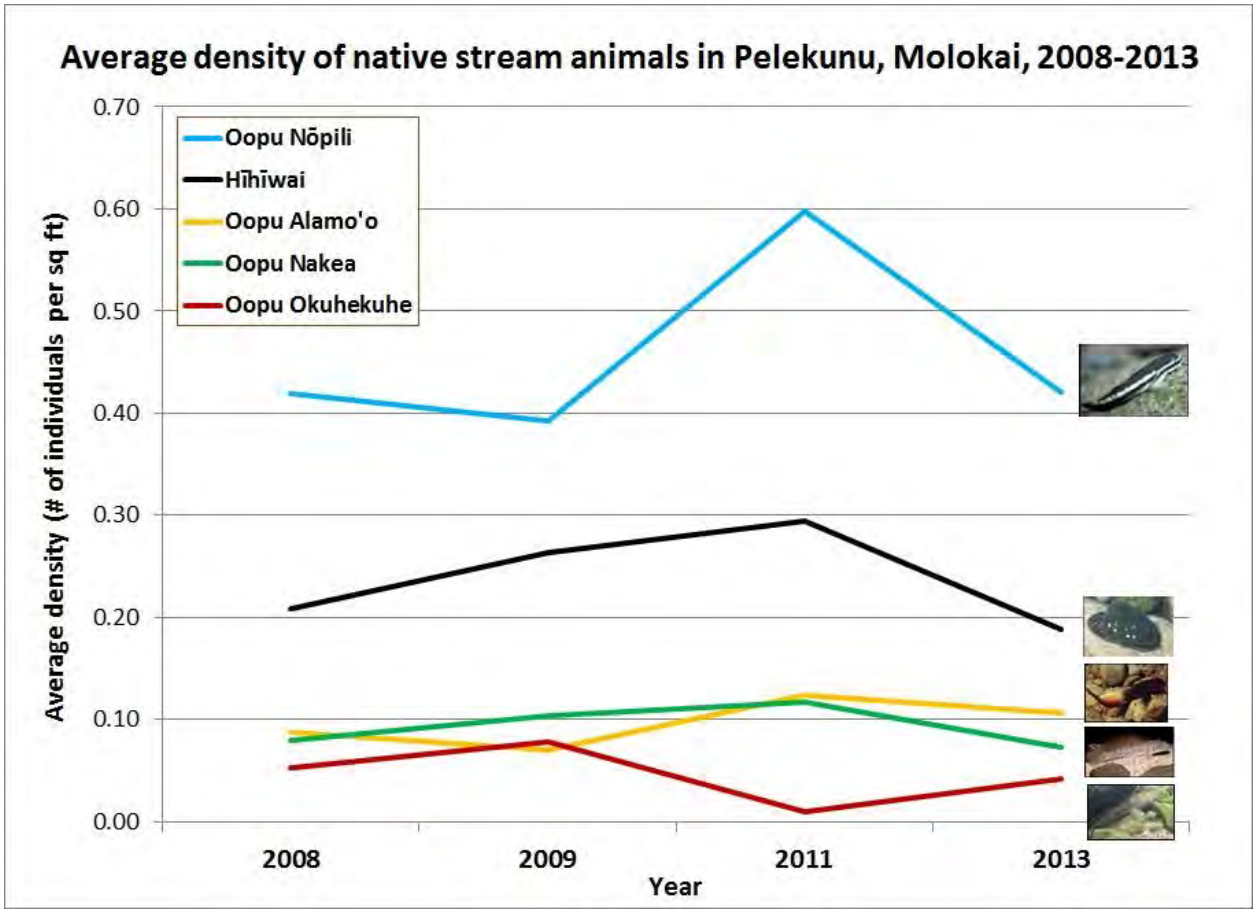
Program Objective
To track the biological and physical resources and critical threats in the preserve and evaluate changes in these resources and threats over time to guide management programs.

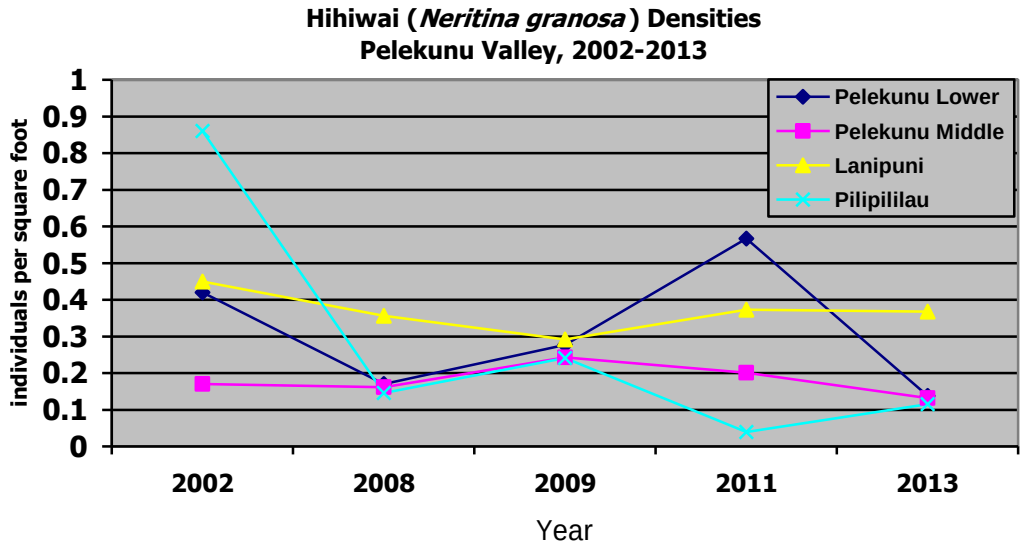
A. Monitoring
There are basically two types of monitoring, health and threat monitoring. Health monitoring tracks biological changes, while threat monitoring tracks threats to the biological resources that management is trying to protect and preserve.

Pelekunu Preserve was acquired by the Conservancy because it contains one of the best remaining biological stream systems left in Hawaii, therefore, health monitoring focuses on detecting changes in the stream system. Stream monitoring will occur every other year and

involves surveying for diadromous macrofauna (native gobies and mollusks, and native and alien crustaceans) to determine their distribution and abundance along Pelekunu stream and its tributaries in years 1, 3 & 5.

The biennial survey also offers the opportunity to engage members of the Molokai community in monitoring stream resources. Manuel Mejia (TNC Marine program) explains monitoring methods to Momi Afelin (Molokai High student), Sept 2013.





Pelekunu's known rare plants (Appendix 3) have been mapped and most exist in steep, treacherous areas. The National Tropical Botanical Gardens (NTBG) has been actively collecting rare plant propagules since the early 1990's. Molokai staff of the Plant Extinction Prevention Program (MoPEPP) regularly survey, monitor, and outplant in Pelekunu Preserve, and are currently evaluating a small portion of the preserve as a test site for reintroduction of the rare dwarf naupaka (*Scaevola coriacea*) and the rare alula (*Brighamia rockii*), see photo, right. TNC will support these efforts as requested.

Figure 1- MoPEPP staff Patricia Pali outplanting rare species in Pelekunu.

Threat monitoring focuses on invasive weeds and feral ungulates. Weeds will be monitored through aerial surveys (see weed section). Feral animals are annually monitored by eleven 500 meter ungulate activity transects throughout the valley.

<u>Monitoring Goals</u>

Years 1-6 (FY2016-2021)

1. Complete stream macrofauna monitoring in years 1, 3 and 5.
2. Monitor all ungulate activity transects annually.
3. Assist MoPEPP with staff as requested to implement rare plants species projects in Pelekunu.

Program 3: Community Outreach

Program Objective
To build community support and awareness concerning the conservation of native natural resources, and to implement effective conservation practices that are also 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 to Kamakou and Moomomi from March to October. The Kamakou hike, which ends at the Pelekunu overlook, affords the opportunity to share about that preserve as well. 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.

- 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 and Moʻomomi. 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 has three main areas; North Slope; South Slope and East Slope. TNC coordinates the activities in the South and East slope areas. The East Molokaʻi Watershed Partnership (EMoWP) was formed in 1999 when a grass roots strategic planning effort produced an application for the USDA Empowerment Zone program. The Conservancy will continue to work with partners to promote stewardship activities in forest and watershed regions of Molokaʻi.

- Papahana Kuaola Lelekamanu (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 to Moʻomomi and Kamakou.

- Aha Kiole O Molokai (Molokai Aha Moku)- TNC consults and seek support of the Aha Kiole O Molokai on major project initiatives. This relationship brings transparency and support from Molokai's indigenous/local community. Projects that were consulted on and gained support in FY13 (and continue to be supported in FY15) include: Kapualei Fence, Kamakou Fence, South Slope ACETA, and the EMoWP East Slope Startup Watershed Management Plan.

- Stream Monitoring community engagement - Key community members are invited to be part of the monitoring team. In the past, those that have been engaged become "ambassadors" for the stream and the native aquatic life that thrive in Pelekunu stream.

We do not promote the public use of Pelekunu Valley due to its remoteness and our inability to provide any emergency facilities, communication, or logistical assistance to the public users. We request that any public camping remain restricted to the beach.

Years 1-6 (FY2016-FY2021) Community Outreach Goals

1. Produce and distribute the semiannual *Nature's Newsflash*.
2. Conduct monthly and special community group hikes at Kamakou Preserve which features the Pelekunu Preserve at the end of the hike.
3. Coordinate and organize annual Molokaʻi Earth Day Celebration Event.
4. Maintain and develop intern, docent, and volunteer engagement, and conduct training

sessions as needed.

5. Support partner groups including EMoWP, MoMISC, and Molokaʻi Fire Task Force.

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. The Conservancy is a key supporting and coordinating member of the task force. Maui County Fire Department, the State Division of Forestry and Wildlife (Maui District) and the Molokai/Lānaʻi Soil and Water Conservation District are the co-leaders of the task force. Pelekunu Preserve's fire plans are embedded within The Nature Conservancy's *Moloka`i Wildland Fire Management Plan* and is updated annually.

The Nature Conservancy maintains two cabins and one remote shelter facility in Pelekunu Valley: the USGS Cabin ("Upper Camp"), the Papaiki remote shelters ("Middle Camp"), and the Kawaiiki Cabin ("Lower Camp."). A trail system connects these facilities to ungulate survey transects and remote helicopter landing zones. This infrastructure provides critical access both to and within the highly remote valley for management. When possible, TNC combines facilities and trail maintenance to reduce costs. One trip annually will be dedicated just to trail clearing, while trail clearing is also combined with the annual ungulate survey trip. Because of Pelekunu's wet

Fire, Emergency and Safety Goals

Years 1-6 (FY2016-FY2021)

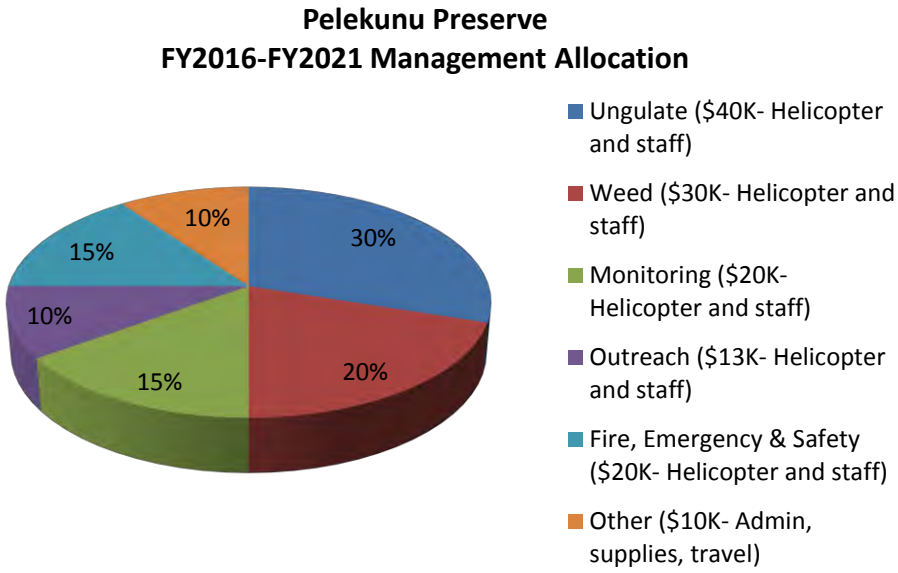
1. Annually update the TNC *Molokaʻi Wildland Fire Management Plan*.
2. Provide emergency training opportunities for staff including but not limited to maintaining current First Aid and CPR certifications.
3. Conduct annual first aid kit inventory and resupply.
4. Update staff fire suppression training.
5. Respond to emergencies or fire threats.
6. Maintain helicopter landing zones and trails twice per year.
7. Maintain facilities in years 2, 4 & 6.

Areas Needing Technical Assistance

We will seek advanced fire pre-suppression and suppression training from DOFAW. In addition we may occasionally contract the services of the Hawai'i Natural Heritage Program/CCRT/UH for assistance with rare species monitoring, vegetation monitoring, GPS mapping and other stewardship projects requiring their expertise.

Management Allocation

The following chart summarizes annual costs by program associated with management of Pelekunu Preserve for the period FY2016-FY2021:



Budget Summary

The following table summarizes the six-year budget for the Pelekunu 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 1/3.

Personnel (labor & benefits): This NAPP request will cover a portion of the costs of the Molokai Island Program staff currently has 4 that will have responsibilities in implementing the management plan. Other part-time, short-term, or year-to-year personnel may be hired periodically as the budget allows and project needs warrant. The Personnel line item includes: a combined effort of Molokai's base staff equal to about .90 FTE. The Nature Conservancy's currently negotiated (annually with our federal cognizant agency) fringe benefit rate will accrue on all salary/wage costs. The Molokai 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.

Contractual: This contractual cost is mainly the cost of helicopter needed to travel to and from the valley.

Other: Covers a portion of the Office and Baseyard, security, insurance, communications (satellite phone and radio system) and other miscellaneous project related expenses such as supplies and equipment needed for management. Also includes some travel for staff to attend training or workshops related to management.

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

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 Pelekunu NAPP budget represents a significant reduction in funding since the last LRMP (2010–2015). 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 Pelekunu Preserve and on adjacent lands regardless of funding source.

FY2016- FY2021 Pelekunu NAPP Budget Table

Pelekunu NAPP	FY2016	FY2017	FY2018	FY2019	FY2020	FY2021	TOTAL
Labor & Benefits	45,000	45,000	45,000	45,000	45,000	45,000	270,000
Contractual	60,000	60,000	60,000	60,000	60,000	60,000	360,000
Other	12,000	12,000	12,000	12,000	12,000	12,000	72,000
Subtotal	*117,000*	*117,000*	*117,000*	*117,000*	*117,000*	*117,000*	*702,000*
Overhead	11,700	11,700	11,700	11,700	11,700	11,700	70,200
TOTAL	128,700	128,700	128,700	128,700	128,700	128,700	772,200
Pelekunu Budget	128,700	128,700	128,700	128,700	128,700	128,700	772,200
Private Match (1/3 of total)	42,900	42,900	42,900	42,900	42,900	42,900	257,400
TOTAL NAPP REQUEST (2/3)	**85,800**	**85,800**	**85,800**	**85,800**	**85,800**	**85,800**	**514,800**

Figure 1. Pelekunu Preserve: Management Areas and Units

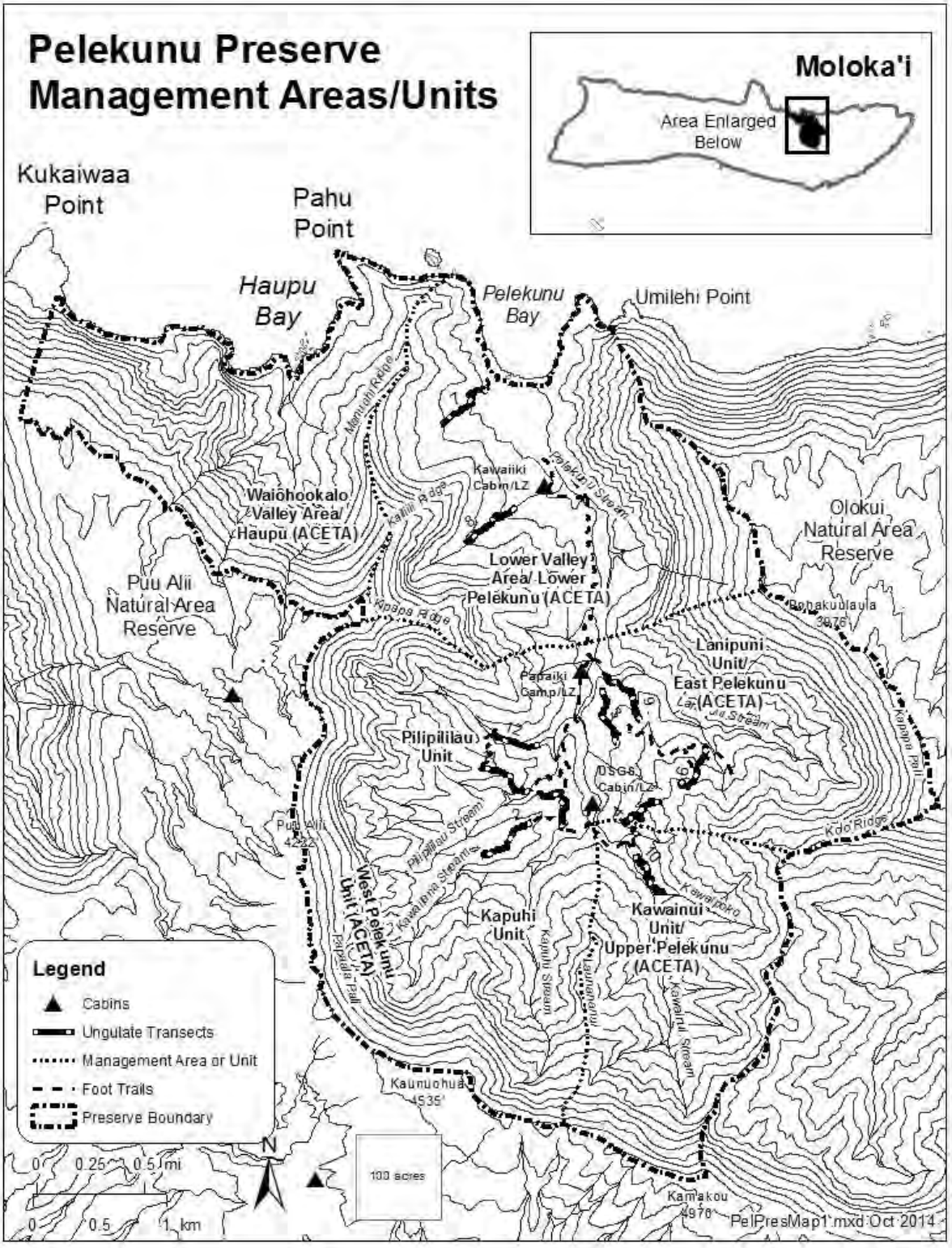


Figure 2. East Moloka‘i Watershed Partnership

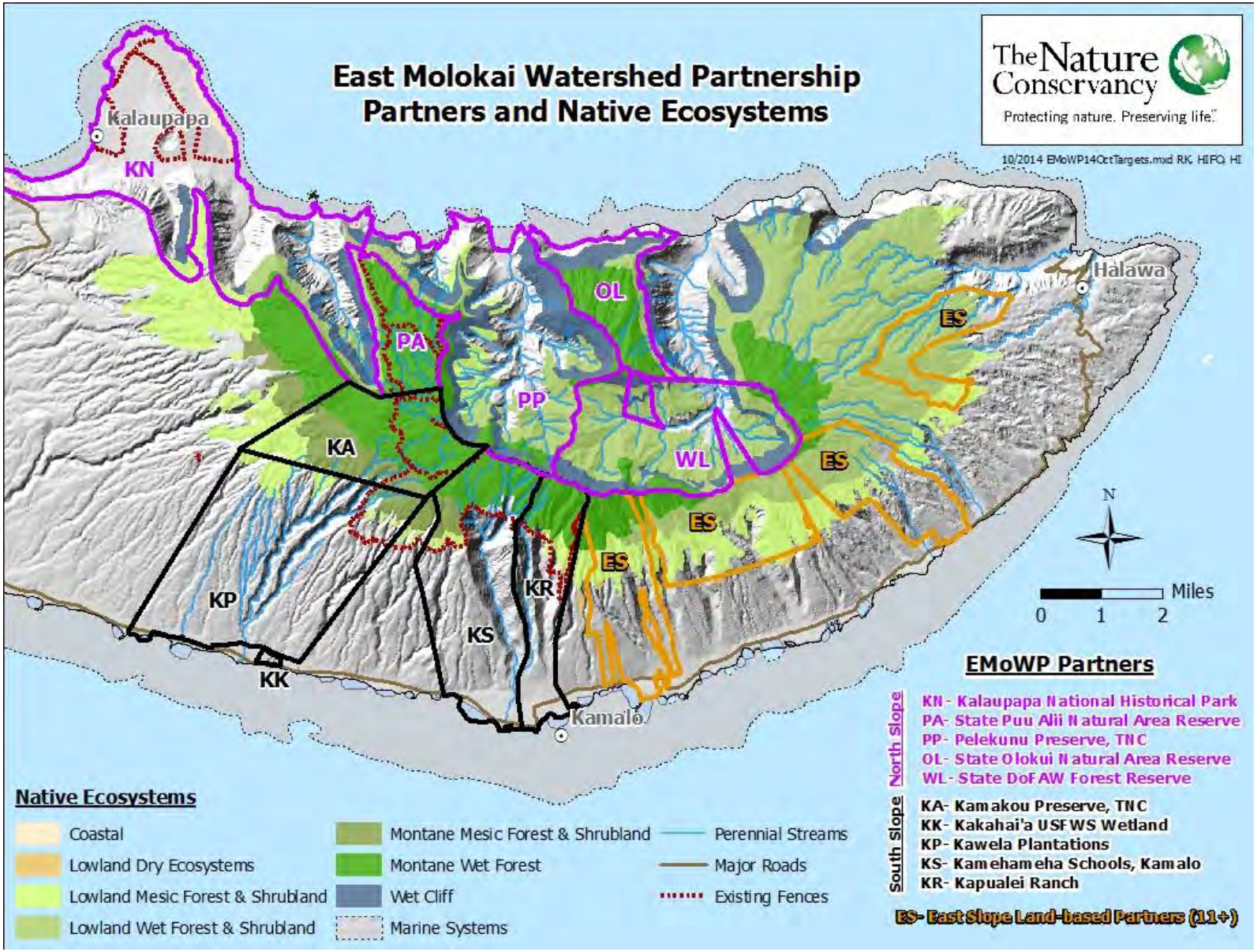
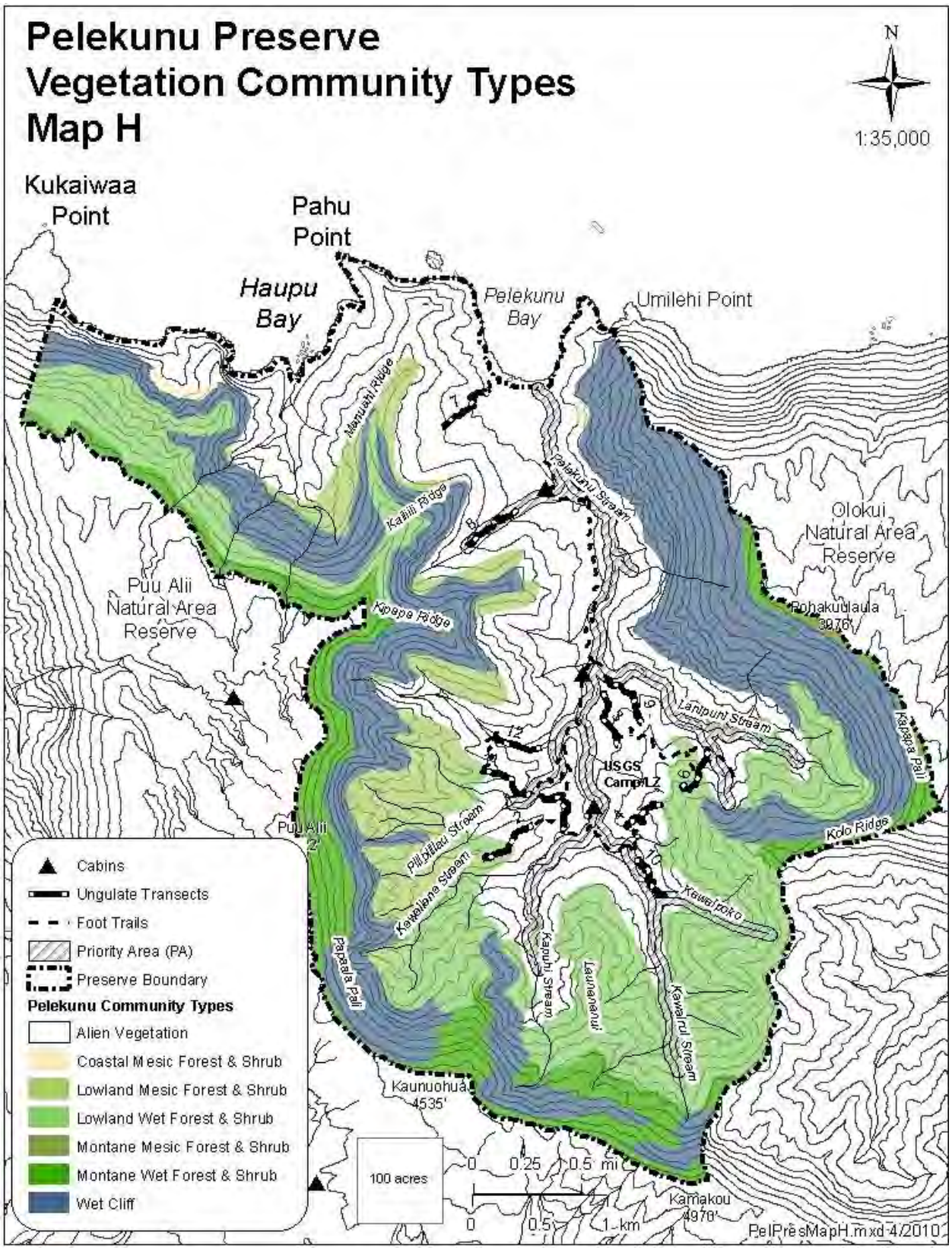


Figure 3. Native Natural Communities



APPENDIX 1
NATIVE NATURAL COMMUNITIES OF PELEKUNU PRESERVE

NATURAL COMMUNITY	GLOBAL RANK (a)*
Coastal	
Hala (*Pandanus*) Coastal Mesic Forest	G3
Hawaiian Mixed Shrub Coastal Dry Cliff#	G3
Kawelu (*Eragrostis*) Coastal Dry Grassland	G3
Lowland	
Lama/ʻOhiʻa Lowland (*Diospyros/Metrosideros*) Mesic Forest	G3
ʻOhiʻa (*Metrosideros*) Lowland Mesic Forest	G3
ʻOhiʻa/Uluhe (*Metrosideros/Dicranopteris*) Lowland Wet Shrubland	G3
Montane	
Mixed Fern/ Shrub Montane Wet Cliffs#	G3
ʻOhiʻa/Hapuʻu (*Metrosideros/Cibotium*) Montane Wet Forest#	G3
ʻOhiʻa (*Metrosideros*) Montane Wet Shrubland	G3
ʻOhiʻa/ʻOlapa (*Metrosideros/Cheirodendron*) Montane Wet Forest#	G3
Aquatic Communities	
Hawaiian Continuous Perennial Stream	G1

* These community types are no longer tracked by NatureServe.
# = Known also from adjacent NARs

(a) Key to Global Ranks as defined by the Hawaiʻi Natural Heritage Program, Mar 2008:
G1 = Critically imperiled. At very high risk of extinction due to extreme rarity (often 5 or fewer populations), very steep declines, or other factors.
G2 = Imperiled. At high risk of extinction due to very restricted range, very few populations (often 20 or fewer), steep declines, or other factors.
G3 = Vulnerable. At moderate risk of extinction due to a restricted range, relatively few populations (often 80 or fewer), 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.
G5 = Secure. Common; widespread and abundant.

APPENDIX 2
CONSPICUOUS NATIVE AQUATIC ANIMALS (EXCLUDING INSECTS)
OBSERVED IN PELEKUNU STREAM AND ITS TRIBUTARIES

TAXON	SCIENTIFIC NAME	COMMON NAME	GLOBAL RANK (a)	FEDERAL STATUS (b)
FISHES				
Eleotridae	*Eleotris sandwicensis*[1]	ʻoʻopu akupa, ʻoʻopu okuhe	G3	
Gobiidae	*Awaous guamensis*[1*]	ʻoʻopu nakea	G4	
	Lentipes concolor[1]	ʻoʻopu alamoʻo	G3	
	Sicyopterus stimpsoni[1]	ʻoʻopu nopili	G2?	
	Stenogobius hawaiiensis[2]	ʻoʻopu naniha	G3	
Kuhliidae	*Kuhlia sandvicensis*[1]	aholehole		
Mugilidae	*Mugil cephalus*[2]	ʻamaʻama	G5	
CRUSTACEANS				
Atyidae	*Atyoida bisulcata*[1]	ʻopae kalaʻole (shrimp)	G4?	
Palaemonidae	*Macrobrachium*	ʻopae ʻoheaʻa (prawn)	G3?	
MOLLUSKS				
Ancylidae	*Ferrissia sharpi*[1]	limpet		
Lymnaeidae	*Erinna aulacospira*[1]	pond snail	GH	SOC
	Pseudisidora rubella[1]	pond snail		
Melanidae	*Melanoides tuberculata*[2]			
Neritidae	*Neritina granosa*[1]	hihiwai, wi	G1	SOC
	Neritina vespertina[1]	hapawai	G1G2	

[1] = Endemic
[2] = Indigenous
Source: NatureServe.org, Sept 2014
* This species is being re-evaluated as a Hawaiian endemic, *Awaous stamineus.*

(a) Key to Global Ranks as defined by the Hawaiʻi Natural Heritage Program, Mar 2008:

GH = Possibly Extinct (species)— Missing; known from only historical occurrences but still some hope of rediscovery.

G1 = Critically imperiled. At very high risk of extinction due to extreme rarity (often 5 or fewer populations), very steep declines, or other factors.

G2 = Imperiled. At high risk of extinction due to very restricted range, very few populations (often 20 or fewer), steep declines, or other factors.

G3 = Vulnerable. At moderate risk of extinction due to a restricted range, relatively few populations (often 80 or fewer), 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.

G5 = Secure. Common; widespread and abundant.

(b) Key to Federal Status:

SOC = Taxa that available information does meet the criteria for concern and the possibility to recommend as candidate.

APPENDIX 3
RARE NATIVE PLANTS OF PELEKUNU PRESERVE

SCIENTIFIC NAME	COMMON NAME	GLOBAL RANK (a)	FEDERAL STATUS (b)
Bidens molokaiensis	koʻokoʻolau, kokoʻolau	G1	SOC
Bidens wiebkei^	koʻokoʻolau, kokoʻolau	G1	LE
*Brighamia rockii**	alula, puaupaka, ʻolulu	G1	LE
Canavalia molokaiensis^	ʻawikiwiki, puakauhi	G1	LE
Clermontia oblongifolia ssp. *brevipes*	ʻoha, ʻoha wai	G3T1	LE
*Cyanea solanacea**	ʻoha, haha, ʻoha wai, popolo	G1	SOC
Cyanea solenocalyx#^	ʻoha, haha, ʻoha wai	G2	SOC
*Cyrtandra halawensis**^	haʻiwale, kanawao keʻokeʻo	G1	SOC
*Cyrtandra hematos**^	haʻiwale, kanawao keʻokeʻo	G1	SOC
Diellia erecta		G1	LE
*Eurya sandwicensis#**	anini, wanini	G2	SOC
Gardenia remyi	nanu, naʻu	G1	C
Hedyotis elatior		G1	SOC
Hedyotis littoralis		G1	SOC
Ischaemum byrone	Hilo Ischaemum	G2	LE
Joinvillea ascendens ssp. *ascendens**	ʻohe	G5T1	C
Lobelia hypoleuca	ʻopelu, liua, moʻowahie	G3	
Lysimachia maxima#^		G1	LE
Melicope hawaiensis	alani	G2	SOC
Peucedanum sandwicense	makou	G2	LT
Phyllostegia hispida^		G1	C*
Plantago princeps var. *laxiflora**	ale	G2T1	LE
Pritchardia lowreyana^	loulu	G1	
Scaevola coriacea	dwarf naupaka	G1	LE
Schidea diffusa		G1	SOC
*Schiedea globosa**		G2	
Schidea pubescens var. *pubescens*		G2T1	C*
Stenogyne bifida#^		G1	LE
Tetramolopium sylvae		G1	SOC
Zanthoxylum hawaiiense	heaʻe, aʻe	G1	LE

Number of rare plants in Pelekunu Preserve: 30 taxa

Appendix 3 continued.

* = Known from Olokuʻi NAR
# = Known from Puʻu Aliʻi NAR
^ = Endemic to East Molokaʻi

(a) Key to Global Ranks as defined by the Hawaiʻi Natural Heritage Program, Mar 2008:

GH = Possibly Extinct (species)— Missing; known from only historical occurrences but still some hope of rediscovery.

G1 = Critically imperiled. At very high risk of extinction due to extreme rarity (often 5 or fewer populations), very steep declines, or other factors.

G2 = Imperiled. At high risk of extinction due to very restricted range, very few populations (often 20 or fewer), steep declines, or other factors.

G3 = Vulnerable. At moderate risk of extinction due to a restricted range, relatively few populations (often 80 or fewer), 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.

G5 = Secure. Common; widespread and abundant.

T1 = Subspecific taxa critically imperiled globally.

(b) Federal Status:

LE = Taxa formally listed as endangered.

LT = Taxa formally listed as threatened.

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

SOC = Species of Concern that available information does meet the criteria for concern and the possibility to recommend as candidate.

APPENDIX 4
RARE NATIVE BIRDS REPORTED FROM PELEKUNU PRESERVE

SCIENTIFIC NAME	COMMON NAME	GLOBAL RANK (a)	FEDERAL STATUS (b)
Moho bishopi	Bishop's ʻOʻo	GH	SOC
Myadestes lanaiensis rutha#	Olomaʻo, Molokaʻi thrush	GHTH	LE
Palmeria dolei	ʻAkohekohe, Crested honeycreeper	G1	LE
Psittirostra psittacea	ʻOʻu	G1	LE
Pterodroma sandwichensis	ʻUaʻu, Hawaiian dark-rumped petrel	G2	LE
Puffinus newelli	ʻAʻo, Newell shearwater	G2T2	LT
Paroreomyza flammea#	Kakawahie, Molokaʻi creeper	GH	LE
Vestiaria coccinea#	ʻIʻiwi	G4T1	E, -

#=Known also from adjacent NARs.
(a) Key to Global Ranks as defined by the Hawaiʻi Natural Heritage Program, Mar 2008:
GH = Possibly Extinct (species)— Missing; known from only historical occurrences but still some hope of rediscovery.
G1 = Critically imperiled. At very high risk of extinction due to extreme rarity (often 5 or fewer populations), very steep declines, or other factors.
G2 = Imperiled. At high risk of extinction due to very restricted range, very few populations (often 20 or fewer), steep declines, or other factors.
G3 = Vulnerable. At moderate risk of extinction due to a restricted range, relatively few populations (often 80 or fewer), 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.
G5 = Secure. Common; widespread and abundant.

T1 = Subspecific taxa critically imperiled globally.
T2 = Subspecific taxa imperiled globally.
TH = Subspecific taxa historical. No recent observations, but there remains a chance of rediscovery.

(b) Federal Status:
LE = Taxa formally listed as endangered.
LT = Taxa formally listed as threatened.
SOC = Species of Concern that available information does meet the criteria for concern and the possibility to recommend as candidate.
E = Molokaʻi population considered endangered by the state only.
- = No federal status.

APPENDIX 5
RARE NATIVE INVERTEBRATES OF PELEKUNU PRESERVE

SCIENTIFIC NAME	COMMON NAME	GLOBAL RANK (a)	FEDERAL STATUS (b)
*Campsicnemus ridiculus****	Aquatic fly		
Megalagrion pacificum	Pacific Megalagrion damselfly	G2	LE
Megalagrion xanthomelas	Orange-Black Megalagrion damselfly	G2G3	C
Partulina mighelsiana#	Achatinellid Land Snail	G1	SOC
Partulina tessellata#	Achatinellid Land Snail	G1	SOC

#=Known also from adjacent NARs.
*=Source: Hawai'i Biological Survey, July 2001.

(a) Key to Global Ranks as defined by the Hawai'i Natural Heritage Program, March 2008:
G1 = Critically imperiled. At very high risk of extinction due to extreme rarity (often 5 or fewer populations), very steep declines, or other factors.
G2 = Imperiled. At high risk of extinction due to very restricted range, very few populations (often 20 or fewer), steep declines, or other factors.
G3 = Vulnerable. At moderate risk of extinction due to a restricted range, relatively few populations (often 80 or fewer), recent and widespread declines, or other factors.
UNK = Rank unavailable

(b) Federal Status:
C = Candidate taxa for which substantial information on biological vulnerability and threat(s) support proposals to list them as endangered or threatened.
SOC = Species of Concern that available information does meet the criteria for concern and the possibility to recommend as candidate.

APPENDIX 6
DOCUMENTS RELATED TO PELEKUNU PRESERVE

Ford, J. and A. Yuen. 1988. *Natural History of Pelekunu Stream and Its Tributaries, Island of Molokaʻi, Hawaiʻi*. Part 1, Summary Report. Unpublished.

Kelly, M. 1988. *Cultural History of Pelekunu Valley, Molokaʻi*. Unpublished document prepared for The Nature Conservancy.

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Englund, R. 2000. *Report on Aquatic Insect Monitoring of May 2000 in Pelekunu Valley, Molokaʻi, Hawaiʻi.* Hawaiʻi Biological Survey, Contribution No. 2000-011.

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APPENDIX 7

Research Conducted at The Nature Conservancy's Moloka'i Preserves

(July 1994 through June 2014)

Ongoing Projects

Long term climate change and carbon sequestration in Hawaiian mountain bogs: Pepe'opae, Molokai.
Dr. David W. Beilman, UH Manoa, Geography Dept. with collaboration from Niklas Schneider, Axel Timmerman (Oceanography) and assistance from Karl Hsu and Derek Ford.

Pepe'opae Bog represents a very rare community type, the Hawaiian montane bog. Aside from harboring a specific set of plants, bog systems are critical sites of long term carbon storage and provide a window to understanding past climate changes. Dave Beilman began research there on May 28th, 2013 to look at past changes to that bog and others statewide. Radiocarbon dating in FY2014 suggests the bog's age is roughly about 9,500 years before present.

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.

Genetic lineage of the Hawaiian dragonfly (Anax strenuous)

Seth Bybee, Brigham Young University, Dept. of Biology.

Research began at Kamakou Preserve in August 2012, comparing genetic sequences between samples on Molokai to others statewide to learn about potential colonization patterns.

Genetic differences in the Hawaiian Coprosma.

Jason Cantley, UH Manoa, Dept of Botany.

Molokai is home to four species of *Coprosma*, or in Hawaiian, pilo, a common native forest shrubs. These shrubs also commonly hybridize, making their identification challenging. Collections were made in Kamakou Preserve on March 2013 by Jason Cantley, UH Manoa for DNA analysis.

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.

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.

Community Assembly in Hawaiian Spiders, Adaptive Radiation in *Tetragnatha* & *Ariamnes* and Molecular Genetics & Evolution of the Hawaiian Happy Face Spider.

Cotoras, Darko, William Roderick, Andrew Rominger and Rosemary Gillespie

Investigation into adaptive radiation of many native spider species. Field research began in Kamakou preserve in June 2012. Several new species of spiders likely to be described.

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 last conducted 2009. 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 Moloka'i Preserves

William Haines, Graduate student , University of Hawai'i 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 Hawai'i. 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.

Surveying for the Kamehameha butterfly *Vanessa tameamea* at Kamakou Preserve

William Haines, Graduate student , University of Hawai'i at Mānoa

Collections began in May 2014. The objective of this project is to identify the current extent of the Hawaiian endemic Kamehameha butterfly across Hawaii. The Hawaiian nettles (family Urticaceae) on which they exclusively feed and nest were examined for signs including eggs, caterpillars and feeding damage.

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. Four species have been identified on Molokai. See publication section. A more comprehensive dissertation is underway.

Functional Trait evolution in the Hawaiian endemic *Planchonella sandwicensis*

Chris Havran, Graduate Student, *Campbell University*

Research began in June 2012 into the morphology of 'ala'a (*Planchonella sandwicensis*), a Hawaiian endemic hardwood. Examines relationship between leaf traits and local rainfall.

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 Hawai'i.

Prostostelids of Hawai'i

Drs. Don Hemmes; Fred Spiegel

Research began January 3, 2007. Report pending.

Succinea caduca sampling at Mo'omomi Preserve

Dr. Brenden Holland and Dr. Robert Cowie, Center for Conservation Research and Training University of Hawai'i, 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. Four species of *Hylaeus* are being considered for ESA listing at Mo'omomi as of 2011. Magnacca has aided with TNC staff identification of *Hylaeus* to the genus level at locations in upper Kawela and at Kawaaloa Bay, Molokai in FY13-14.

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. Medeiros, 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 Pēpēʻōpae 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 Hawaiʻi 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 Hawaiʻi, NY University, University of NY. (808) 676-4974

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

Evaluation of native invertebrates at Moʻomomi 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 (less than fifty plants in the wild, in the world).

Floral trait evolution and pollination ecology in the Hawaiian lobelia genus, *Clermontia* (Campanulaceae)

Richard Pender, Dept of Botany, UH Manoa

Kamakou Preserve; research began in July 2011 and completed in 2013. Doctoral dissertation completed in July 2013, examined genetic variation among *Clermontia* species, their floral characteristics identified their morphologically effective bird pollinators. Molokai has 5 species of *Clermontia- C. arborescens, C. kakeana, C. grandiflora, C. pallida and C. oblongifolia* subspecies *brevipes*. DNA analysis suggests that the critically rare *Clermontia oblongifolia*

subspecies *brevipes* only present in east Molokai should be removed from its current subgenus status and reclassified as its own, separate species. Its closest relative is another Molokai endemic lobeliod, *Clermontia pallida*. Results to the pollinator study suggest that the only effective bird pollinator of the all Molokai *Clermontia*, the ʻiʻiwi (*Vestiaria coccinea*), is now functionally extinct there.

Collection of propagules and/or status updates of the following plant species from Molokaʻi: *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 Kauaʻi 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 Hawaiʻi joint research project*.**

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

Nutrient limitations in Hawaiian forests.

Stephen Porder, Brown University, Field Assistant Heraldo Farrington.

Research began at Kamakou Preserve in May 2011 and concluded March 2013. Soils found in Hawaiian forests are often low in nitrogen and/or phosphorus which may affect plant growth. Experiment examined the effect of fertilization on Hawaiian forests through minimally-invasive mini-root ingrowth samples. Despite published literature suggesting the contrary, Porder found the control group's media was high in available phosphorus.. New bags with nitrogen, phosphorus or no added nutrients were placed in the field in March 2013. In July 2013, all sample root bags were removed and root growth was measured. No additional root growth was noted over control bags, suggesting that the soils at the site are limited by neither of these nutrients or co-limited by both sets of nutrients at the same time.

^{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.

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 Molokaʻi include Hālawa Valley, Pelekunu and Kamakou Preserves. First study to inventory freshwater algae in Hawaiʻi in over 50 years. Kamakou Preserve

collections began in May 2010. Specimens being analyzed to determine species.

***Partulina redfieldii* around Puu Kolekole, Molokai.**

David Sischo, UH Manoa

Began in March 2012. Survey outside the area known as "Snail Meadow" in Kamakou Preserve comparing meadow and connected-forest habitat to determine if habitat fragmentation has an effect on genetic diversity, inbreeding, and population structure of this Hawaiian tree snail.

Moore DNA Barcoding Project for *Clermontia*, *Cyrtandra,* and *Metrosideros*

Elizabeth Stacy and Donald Price, Project Technician: Jennifer Johansen, UH Hilo.

Examination of DNA sequences from *Clermontia, Cyrtandra,* and *Metrosideros* species to establish DNA barcoding as a means to facilitate plant species identification. Three species of *Cyrtandra* (*C. procera*, *C. macrocalyx*, and a taxonomically unclear *Cyrtandra*) and three species of *Clermontia* (*C. pallida*, *C. kakeana*, and *C. arborescens waikoluensis*) were sampled, and approximately ten taxa of *Metrosideros*.

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.

Hawaiian Bristletails.

Alan De Quieroz, University of Nevada, Reno (Dept. of Biology)

Very little is known about the Hawaiian bristletails, cousins to the insects known collectively as silverfish (order Archaeognatha). Bristletails were collected from Kamakou preserve by lead researcher Alan de Quieroz in early September 2012. Preliminary results suggest that the genus is highly variable, and a Molokai endemic species may exist.

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. 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.

Evolutionary Relationships, Interisland Biogeography, and Molecular Evolution in the Hawaiian Violets (Viola: Violaceae). American Journal of Botany 96(11):2087-2099. 2009

J. Christopher Havran, Kenneth J. Sytsma, and Harvey E. Ballard, Jr.

Reviews relationships in evolution among the Hawaiian violets, proposing four taxa of violets found on Molokai.

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 Moloka‘i 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 Hawai'i.

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 Hawai'i.

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, Pu'u Ali'i NAR, and Pu'u 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 Moloka'i indicates that there is a rich and diverse watermold flora. The Moloka'i 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 Pēpēʻōpae 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 Puʻu Kolekole cabin.

Collection of assorted fleshy fungi from Kamakou Preserve.

Drs. George Wong (Department of Botany, University of Hawaiʻi at Mānoa), Don Hemmes (Department of Biology, University of Hawaiʻi 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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Kapunakea Preserve, West Maui, Hawai‘i
Final Long-Range Management Plan
Fiscal Years 2016-2021

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

Submitted by
The Nature Conservancy – Hawai‘i Operating Unit
April 2015

The Nature Conservancy
Protecting nature. Preserving life.™

CONTENTS

EXECUTIVE SUMMARY

The Nature Conservancy of Hawai‘i is an affiliate of The Nature Conservancy (TNC), an international private, non-profit organization based in Arlington, Virginia. The mission of The Nature Conservancy is to conserve the lands and waters on which all life depends. Since 1980, the Conservancy has protected more than 200,000 acres of natural lands in Hawai‘i and works with other public and private landowners to protect the islands' key watersheds. The Conservancy manages a statewide network of 11 preserves totaling 40,000 acres and works in 12 coastal communities to protect the coral reefs and near-shore waters of the main Hawaiian Islands.

The State's Natural Area Partnership Program (NAPP) is an innovative program that aids private landowners in the management of their native ecosystems. NAPP provides matching funds ($2 state to $1 private) for the management of qualified private lands that have been permanently dedicated to conservation. Kapunakea Preserve is one of two state-funded Nature Conservancy of Hawai‘i (TNCH) preserves on Maui. Kapunakea was approved for NAPP funding in 1992, and soon thereafter TNCH implemented the management programs described in our initial plan, *Kapunakea Preserve FY1992 – FY1997 Long-Range Management Plan* (LRMP). In 2008, a revised Environmental Assessment was authorized. Funding was reauthorized for additional six-year periods in 1997 with an updated long-range plan and EA in 2003, and most recently in 2009 for the *Kapunakea Preserve FY2010 –FY2015 Long Range Management Plan*. In 2014, the NAPP program implemented the use of a streamlined, data-driven spreadsheet to propose and report on deliverables. The spreadsheet is attached and referred to throughout this document in the relevant programmatic sections

TNCH is currently seeking reauthorization of NAPP funding for the next six-year period for the programs described within this *Kapunakea Preserve FY2016–FY2021 Long-Range Management Plan*. This plan continues the programs implemented under the previous plans and environmental assessments. Herein, we request **$663,600** in matched state funds for the six years spanning FY2016 – 2021. This is a 15% total reduction in our request for support from the last long-range plan ($781,880). This plan was prepared in compliance with the NAPP agreement between the state, TNCH, and Hawai‘i Administrative Rules Chapter 13-210.

We successfully implemented the resource management projects of the previous six-year long-range plan. See Table 1 and Figures 1–4.

Table 1. Overview of Kapunakea Preserve Accomplishments by Programs, FY10–FY14 (5 Years)

Indicator	*Measure of Success*
Ungulate Control	
Total animal catches in upper and lower preserve	• Zero pigs removed from upper preserve (Figs. 1 & 2). Upper preserve ungulate free since 1999 • 63 pigs removed in lower preserve (Fig. 2)
Total snares checked	• All snares checked four times annually in lower preserve & semiannually in upper preserve
Miles of fence installed maintained or replaced in Kapunakea	• ~1800 meter fence maintained monthly or semi-monthly • New Honokōwai valley fence completed (72 m) & maintained • Gates improved or replaced
Invasive Plant, Invertebrate and Small Mammal Control	
Acres and total numbers of priority invasive plants treated or removed	• 646 *Tibouchina* plants removed from upper bogs • 2897 strawberry guava outliers removed • 126 Clidemia removed • 70 strawberry guava treated with Herbicide Ballistic Technology[1]
# of discovered or reported incipient, invasive species removed	• 2 *Juncus planifolius* were removed in the upper bogs along Transect 3 • A small population of *Acacia mearnsii* was detected, treated & confirmed dead
Resource Monitoring	
Frequency of ungulate sign	• 2 transects monitored semi-annually (9968 m total) • Transects stations above 3500' showed zero sign of ungulates (Fig. 3)
Acres surveyed for plant infestations	• Aerial surveys conducted for *Tibouchina* & *Psidium* mapping and priority weed outlier identification • Presence/absence of priority weeds documented on transects (Fig. 4) • 106 acres surveyed on the ground for strawberry guava, with all individuals treated • 19 acres surveyed on the ground for Tibouchina with all individuals treated • 15 acres surveyed on the ground for Clidemia with all individuals treated • Weeds controlled at LZs, campsites & upper trails • Priority weed maps have been updated quarterly
Rare Species Protection and Research	
Numbers of new rare taxa discovered and/or mapped	• Rare plant surveys conducted annually via PEP • 6 PEP targets found in Preserve • 45 new rare taxa locations for *Liparis hawaiensis* (10), *Bobea sandwicensis* (26), *Bonamia menziesii* (2), *Exocarpus gaudichaudii* (2), *Melicope hawaiensis* (2), *Partulina perdix* (2), & *Pterodroma sandwichensis* ('ua'u) (1)
Number of research projects supported in Kapunakea	• Access support was provided to PEPP for *Colubrina oppositifolia* scouting, & MNBG for *Colubrina oppositifolia* air layering trials • Access was granted to PEP for independent rare plant surveys • 2 invertebrate & 1 botanical research project conducted

[1] HBT efforts were not funded by NAPP funds

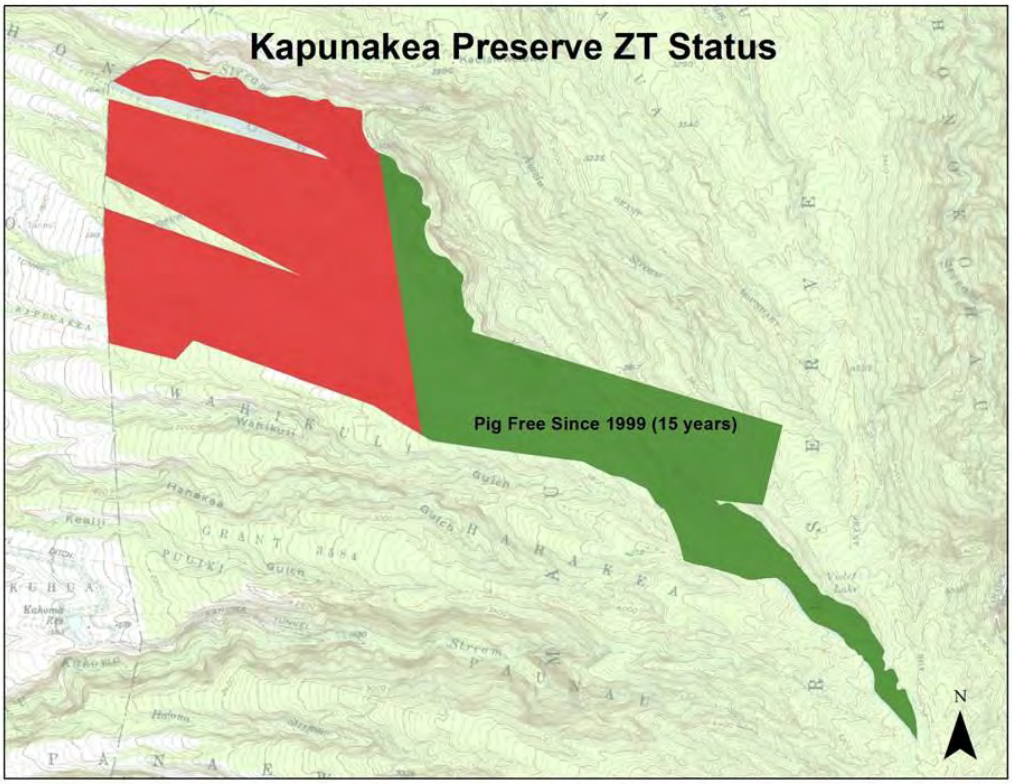


Figure 1. Kapunakea's upper areas (above 3,200') have been pig free for ~ 15 years.

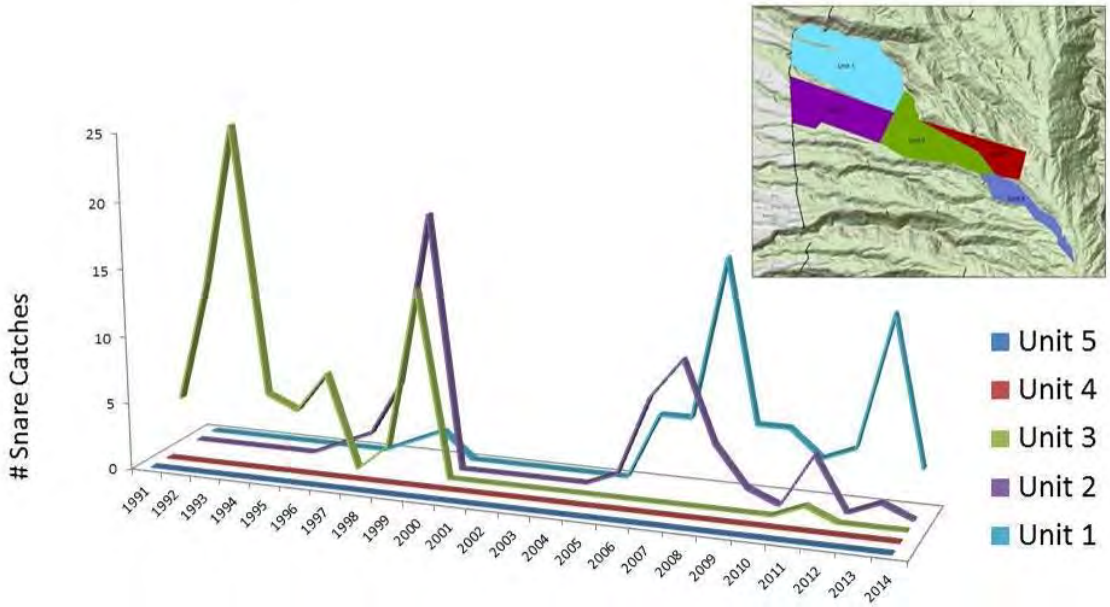
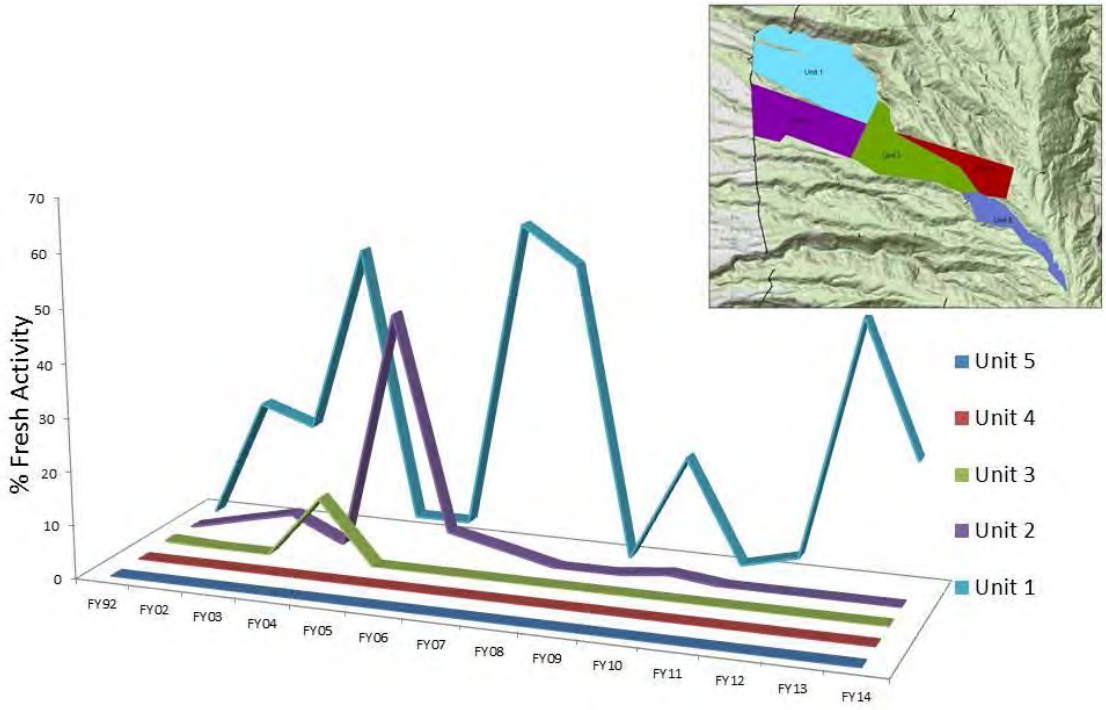


Figure 2. Kapunakea ungulate catches by unit, 1991-2014.



Unit 4 data for FY92 and FY14 only.

Figure 3. Kapunakea Ungulate Transect Activity, FY92-FY14.

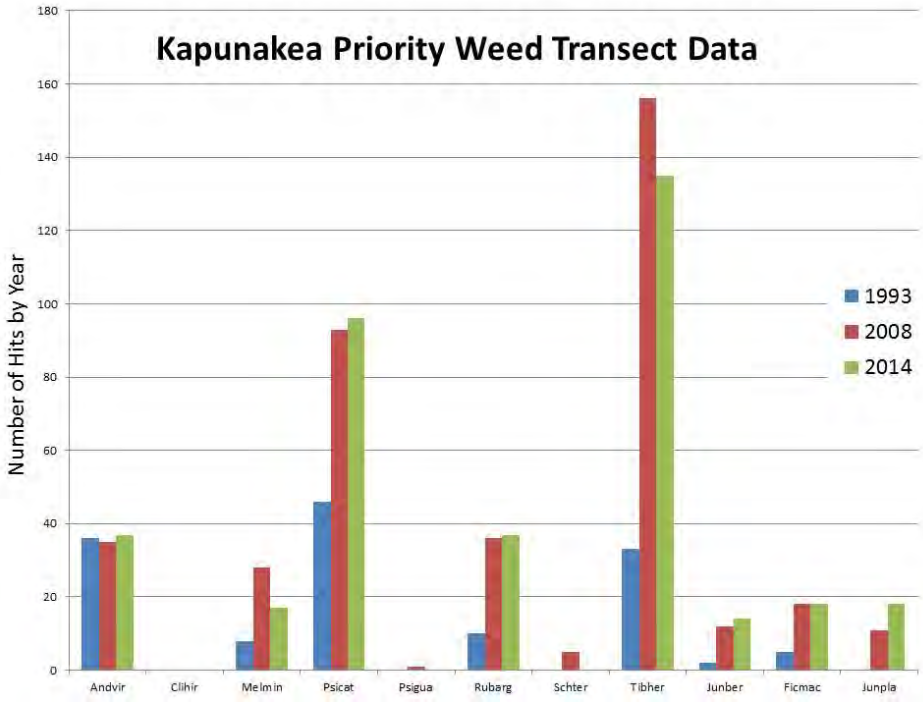


Figure 4. Kapunakea Weed Transect Presence, 1993-2014.

Over the next six years TNCH plans to continue to subaward or contract management activities at Kapunakea. During the past 8 years, the West Maui Mountains Watershed Partnership (WMMWP) helped to manage Kapunakea via a subaward to Tri-Isle RC&D. WMMWP is mandated to conserve and protect 50,000 acres of important forest lands of West Maui, which includes Kapunakea Preserve. WMMWP considers continuation of Kapunakea's management programs key to the viability of the West Maui Mountains. As such, TNC seeks to continue to subaward with WMMWP or other expert contractor to conduct primary and ongoing management activities in Kapunakea Preserve.

ANNUAL DELIVERABLES SUMMARY

The annual deliverables listed below are estimated projections, and are derived directly from the NAPP Deliverables spreadsheet (also attached), for easy reference.

UNGULATE CONTROL

Subunit	*Threat*	*Current Status*	*Goal Action*	*Goal Quantity of Action*	*Frequency*
Unit 1 Kapunakea	Pigs	Decreasing	# traps checked	186	Quarterly
Unit 2 Kapunakea	Pigs	Decreasing	# traps checked	295	Quarterly
Unit 2 Kapunakea	Pigs	Decreasing	# traps checked	39	Semiannual
Unit 3 Kapunakea	Pigs	None present	# traps checked	186	Quarterly
Unit 4 Kapunakea	Pigs	None present	# traps checked	317	Semiannual
Unit 5 Kapunakea	Pigs	None present	# traps checked	0	Semiannual
Honokowai, outside of Preserve	Pigs	Decreasing	# traps checked	61	Quarterly
Honokowai, outside of Preserve	Pigs	Decreasing	# traps checked	93	Semiannual

FENCE WORK

Fence Section	*Goal Action*	*Goal Meters for Action*	*Frequency*
W17	Inspect/maintain	590	Monthly
W17A	Inspect/maintain	150	Monthly
W22	Inspect/maintain	72	Monthly
W19	Inspect/maintain	63	Monthly
W16	Inspect/maintain	1111	Monthly
W20	Inspect/maintain	55	Semiannual
W12	Inspect/maintain	126	Semiannual

WEED CONTROL

Subunit	*Species Targets*	*Action*	*Acres of Survey*	*Weed Status*	*Frequency*
Unit 1 Kapunakea	Psicat as biocontrol target	Other	424	Constant	Annual
Unit 2 Kapunakea	Psicat biocontrol	Other	310	Constant	Annual

Unit 2 Kapunakea	Acamea	Ground sweep and control	1	Decreasing	Annual
Unit 2 Kapunakea	Clihir	Ground sweep and control	4	Decreasing	Annual
Unit 3 Kapunakea	Psicat	Ground sweep and control	20	Decreasing	Annual
Unit 4 Kapunakea	Tibher	Aerial survey, no control	50	Unknown	Annual
Unit 4 Kapunakea	Tibher	Ground sweep and control	3	Unknown	Annual
Unit 5 Kapunakea	Tibher	Ground sweep and control	6	Decreasing	Annual

MONITORING				
Transect/Station Name	*Transect length*	*Monitoring type*	*Action*	*Quantity of action*
KAPUNAKEA2	3139 m	Weed and ungulate	Check	Semiannually
KAPUNAKEA3	6829 m	Weed and ungulate	Check	Semiannually
Honokōwai	2950 m	Weed and ungulate	Check	Semiannually

SPECIES MONITORING			
Species	*# species expected*	*Proposed Action*	*Frequency*
Alemac	12	Check	Biannual
Bidmic	1	Check	Other
Bobsan	27	Check	Biannual
Bonmen	5	Check	Biannual
Cleobl	2	Check	Biannual
Colopp	2	Check	Biannual
Cyalob	2	Check	Biannual
Cyrfil	2	Check	Biannual
Cyrmun	10	Check	Other
Exogau	10	Check	Biannual
Hibkok	3	Check	Other
Liphaw	50	Check	Biannual
Parper	-	Check	Other
Partap	-	Check	Other
Plahol	1	Check	Biannual
Ptesan	-	Check	Other
Ranmau	4	Check	Other
Sanfre	2	Check	Biannual
Syccum	-	Check	Biannual
Vescoc	-	Check	Other

RESOURCE SUMMARY

General Setting

Kapunakea Preserve was established in 1992 through a perpetual conservation easement with Pioneer Mill Company, Limited. The current landowner is Kā‘anapali Land Management Corp., successor in interest to Pioneer Mill Company, Limited. The conservation easement seeks to preserve and protect the natural, ecological and wildlife features of the property. Kapunakea Preserve is 1,264 acres. The preserve's upper elevations are recognized as among the highest quality native areas in the state. Kapunakea Preserve is adjacent to two other natural areas that are actively managed: Pu‘u Kukui Watershed Preserve (which is privately owned and part of the NAP program) and the Honokōwai section of the state West Maui Natural Area Reserve (NAR). The WMMWP is mandated to conserve and protect important forest lands of West Maui, which include Kapunakea Preserve, Pu‘u Kukui and the West Maui NARs. These managed native forests and natural areas comprise more than 13,000 acres of contiguous, managed watershed. Kapunakea Preserve is an integrtal part of a continuous, managed watershed, serving as the primary source of freshwater for area residents, farms and businesses and providing essential habitat for a number of rare, native, and endangered species.

Flora and Fauna

Kapunakea contains 11 native-dominated natural communities, ranging from lowland shrublands to montane forests and bogs, including the rare ‘ōhi‘a mixed montane bog (Figure 5, Appendix 1). Four of the communities are not found in the nearby West Maui NAR, most notably koa/ ‘ōhi‘a (*Acacia koa/Metrosideros polymorpha*) lowland mesic forest and lama/‘ōhi‘a (*Diospyros sandwicensis/Metrosideros polymorpha*) lowland mesic forest. Figure 1 depicts the vegetation communities present in Kapunakea Preserve, established through TNC's Ecoregional Planning process.

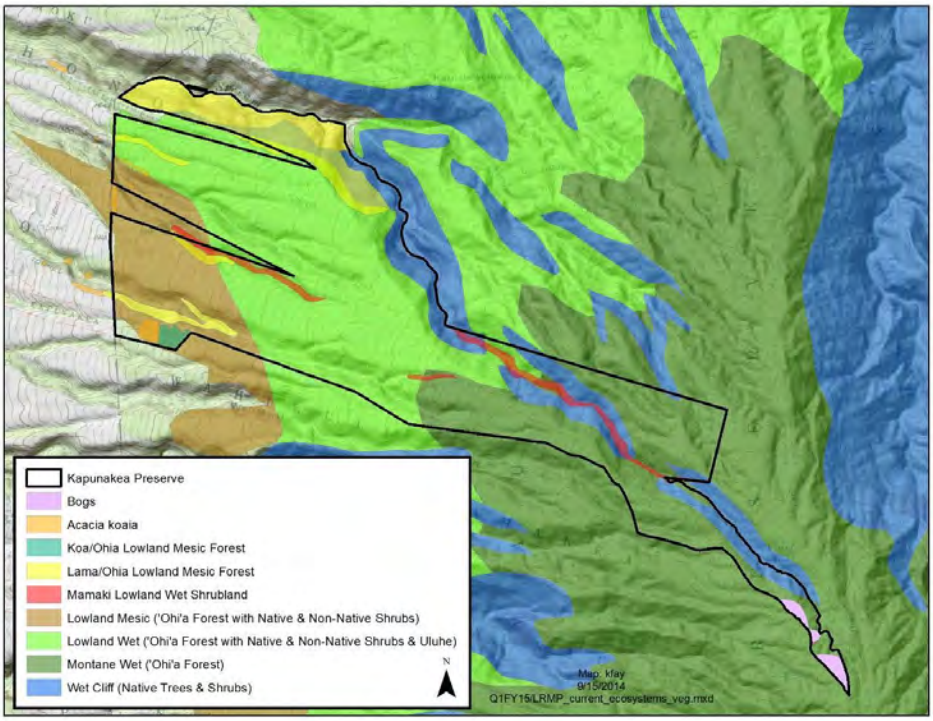


Figure 5. Kapunakea Preserve natural communities.

Kapunakea protects at least 34 rare plants (Appendix 2), including six PEP target species and thirteen endangered plant species. At least eight of Kapunakea's rare plants have not been seen in the adjacent NAR. Four native forest birds are found in Kapunakea: ʻāpapane, ʻiʻiwi, ʻāmakihi, and pueo; the white-tailed tropicbird is also found in the Preserve. ʻUaʻu have also been heard there. Populations of four species of rare Hawaiian tree snails have recently been documented at Kapunakea: *Partulina perdix, P. tappaniana, P. crocea*, and *Perdicella kuhnsi* (Appendix 3). These snails probably were once widespread and abundant on Maui, but in many areas their numbers have declined precipitously in this century due to habitat destruction, collection, and the depredation by introduced animals. A number of other snails also occur at Kapunakea, including tornatellinines and species of *Auriculella, Succinea,* and *Philonesia*.

MANAGEMENT

Management Considerations

Pig Ingress

Ungulate management at Kapunakea is focused on keeping the upper elevations entirely pig free to protect the most intact native communities and the adjacent Honokōwai NAR. However, we continue to strive for ungulate free status in the lower less native-dominated areas. Pig captures in lower Kapunakea briefly spiked in FY13 and FY14 due to pig ingress from the Honokōwai valley bottom. Ground and aerial scouts, in addition to scouting adjacent Puʻu Kukui Watershed lands, confirmed that animals were coming from the north ridges. As a result, TNC had subawardee WMMWP install a strategic wing fence in FY14. The 72 meter wing fence in Honokōwai Valley has apparently greatly reduced ingress into Kapunakea Preserve (Figures 6 and 7). Snare groups were also added in hotspot areas. In addition, Puʻu Kukui Watershed is in the process of completing a Kahana boundary fence which should prevent any ungulate ingress from the north into the Preserve. Providing there is sufficient funding, TNC plans to replace the more than 20 year old lower Preserve pig boundary fence with pig/deer fence during the six-year period, likely FY2020-FY2021. See Figures 7 and 8.

Remoteness

Kapunakea is remote and rugged. Given limited resources, the entire preserve cannot be managed equally. Management is concentrated at the most urgent threats (e.g., halting pig ingress), and in areas that contain special plants, animals, and native natural communities (e.g., the rare montane bog community).

Adjacent managed areas

Kapunakea Preserve is adjacent to two areas that are also managed to protect natural resources: Puʻu Kukui WMA (privately owned) and the Honokōwai section of the state West Maui NAR (Figure 2). TNCH works closely with both Maui Land Co., managers of Puʻu Kukui WMA, and with the State Division of Forestry and Wildlife, who are responsible for management of the NAR. Several agreements are used to coordinate management and sharing of staff, equipment, and expertise in order to maximize management efficiency.

Access

The preserve is bounded on the west (mauka) side by private agricultural lands (Figure 9), some of which recently have been transitioned into 3 to 7 acre farm lots. As a result, public access is limited, and we carefully coordinate our management and interpretive activities around the gate schedule and access limitations. See Figures 9-10.

Human-related threats

Threats related to human activities have increased in West Maui in recent years, including vandalism and trespassing. The Preserve's lower boundary fences and gates have suffered from vandalism at various times (Figure 11). Other human-related threats that are possible in or adjacent to the Preserve include dirtbike riding, illegal marijuana cultivation, and unauthorized hikers making trails, all of which can result in soil erosion and invasive species introductions.

Maui and the drier areas of leeward Maui in particular, face wildfire threats that are becoming more challenging due to increasing ignitions, drought episodes, and land use changes (Figure 12). The West Maui Mountains Watershed Partnership joined the West Maui Fire Task Force and helped to create the Western Maui Community Wildlife Protection Plan. The plan helps bring wildfire hazard information, planning, and action opportunities to all of the parties involved. We have added a program—Fire, Emergency, and Safety—to address this threat.

Mitigating impact from management

The primary strategy for protection of Kapunakea is to prevent the further introduction and/or spread of destructive alien species. Special care must be taken to avoid negative side effects of management activities. For example, trails and management activities are designed to prevent further weed and ungulate invasion. This strategy requires helicopter access to most parts of the preserve. Interpretive and educational uses are limited in scope. Guidelines are followed to minimize impacts such as trampling and weed dispersal.

Figure 6. New Honokōwai Valley fence installed in FY14.

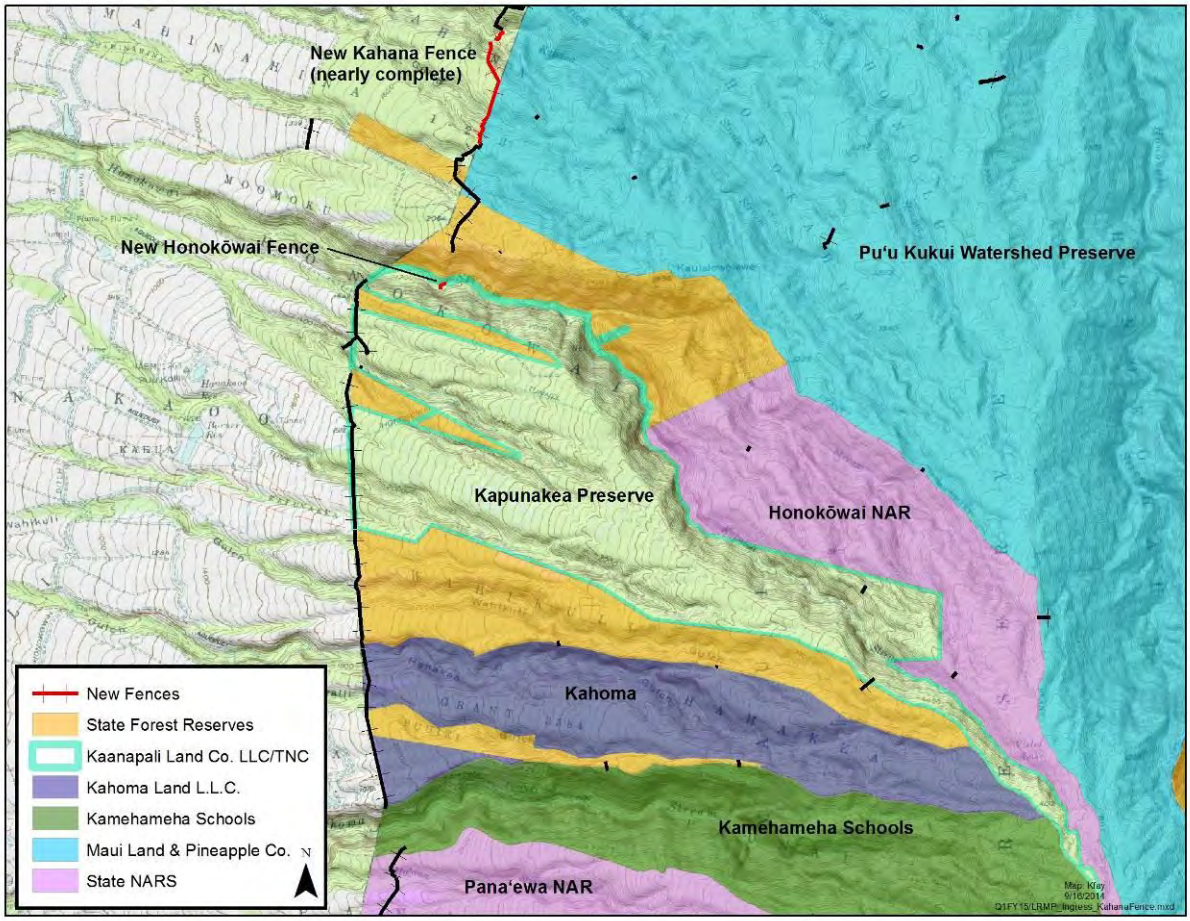


Figure 7. Kapunakea Preserve, adjacent landowners, and new Honokōwai wing fence and PKW Kahana boundary fence.

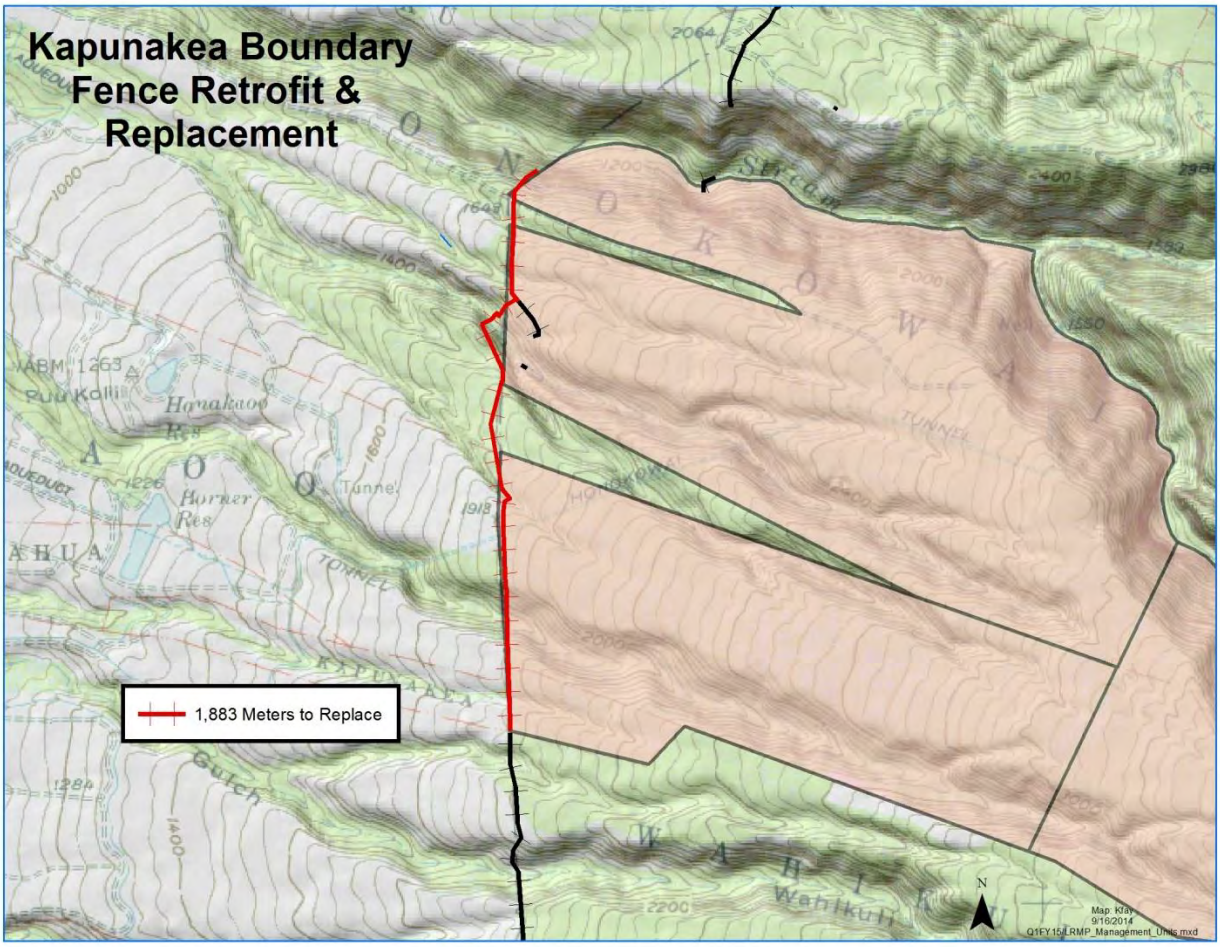


Figure 8. The now 20 year old lower Kapunakea Preserve boundary fence needs to be replaced with 8' deer fence by year 5 of this plan.

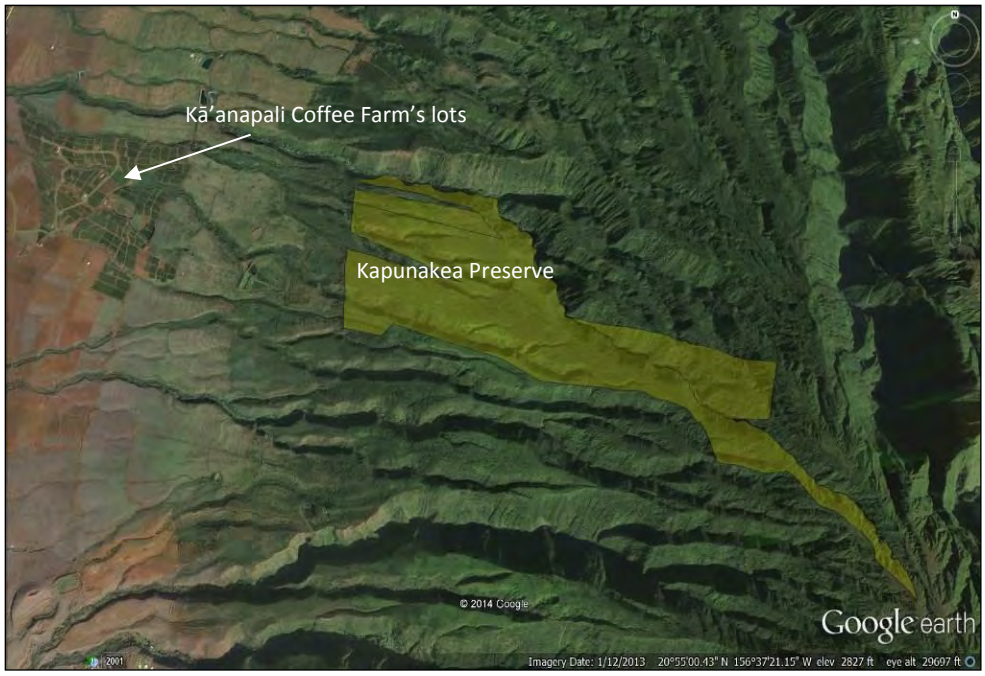


Figure 9. Kapunakea Preserve lies above Kā‘anapali Coffee Farms agricultural lands.


Figure 10. Kā‘anapali Coffee Farms lies just below Kapunakea Preserve, and is the main access to the Preserve. Access is through a gate that is closed daily at 4pm.

Figure 11. The Honokōwai ditch gate was vandalized in FY12, and repaired with fencing material.

Figure 12. Wildfire threats are increasing across the West Maui landscape.

Management Units

Kapunakea is managed as five units (Figure 13) defined by topographic boundaries, similarity of natural community types, and threats.

- Unit 1 consists of the lowland (up to 3,000 feet elevation) portion of the preserve that is closest to Kapāloa Stream. It's native portions are is primarily comprised of ʻōhiʻa lowland mesic forest and uluhe (*Dicranopteris linearis*) lowland mesic shrubland. Non-native vegetation is dominant in the gulch bottoms and some ridge tops. This unit is approximately 50% native dominant.
- Unit 2 encompasses the remainder of the preserve's lowland elevations. It contains five native communities, and non-native vegetation is dominant in the gulch bottoms and some ridge tops. Because *Tibouchina* and strawberry guava are prevalent throughout the unit, we aim to prevent their spread into other units, rather than eliminate them from Unit 2 (as the costs would be prohibitive). This unit is approximately 60% native dominant.
- Unit 3 comprises the majority of the preserve's mid-elevations (3,000 – 4,000 feet) and follows Kapāloa Stream along its northeast boundary. The four montane communities in Unit 3 are dominated by uluhe or ʻōhiʻa; māmaki (*Pipturus albidus*) lowland wet shrubland occurs along the streambed. The uluhe and ʻōhiʻa-dominated communities are intact above 3,400 feet, with minimal weed problems. Our management focus in this unit is to eliminate ungulates and control weed invasions. This unit is approximately 90% native dominant.
- Unit 4 begins on the east side of Kapāloa Stream, and continues to the preserve's eastern boundary. The upper elevations in this unit must be reached by helicopter, due to the steep gulch walls. Management focuses on preventing new invasions. This unit is comprised entirely of native vegetation with only occasional weed presence.
- Unit 5, encompassing the highest elevations of the preserve, is Kapunakea's most pristine unit. Initial survey data and more recent monitoring results have shown that this area contains only a few scattered alien plants (including *Tibouchina*). The management priority is to remove threats from this area before they damage the rare ʻōhiʻa bogs. Access is by helicopter only. Travel is conducted from the upper elevations down to avoid transport of weeds that occur in lower elevations.

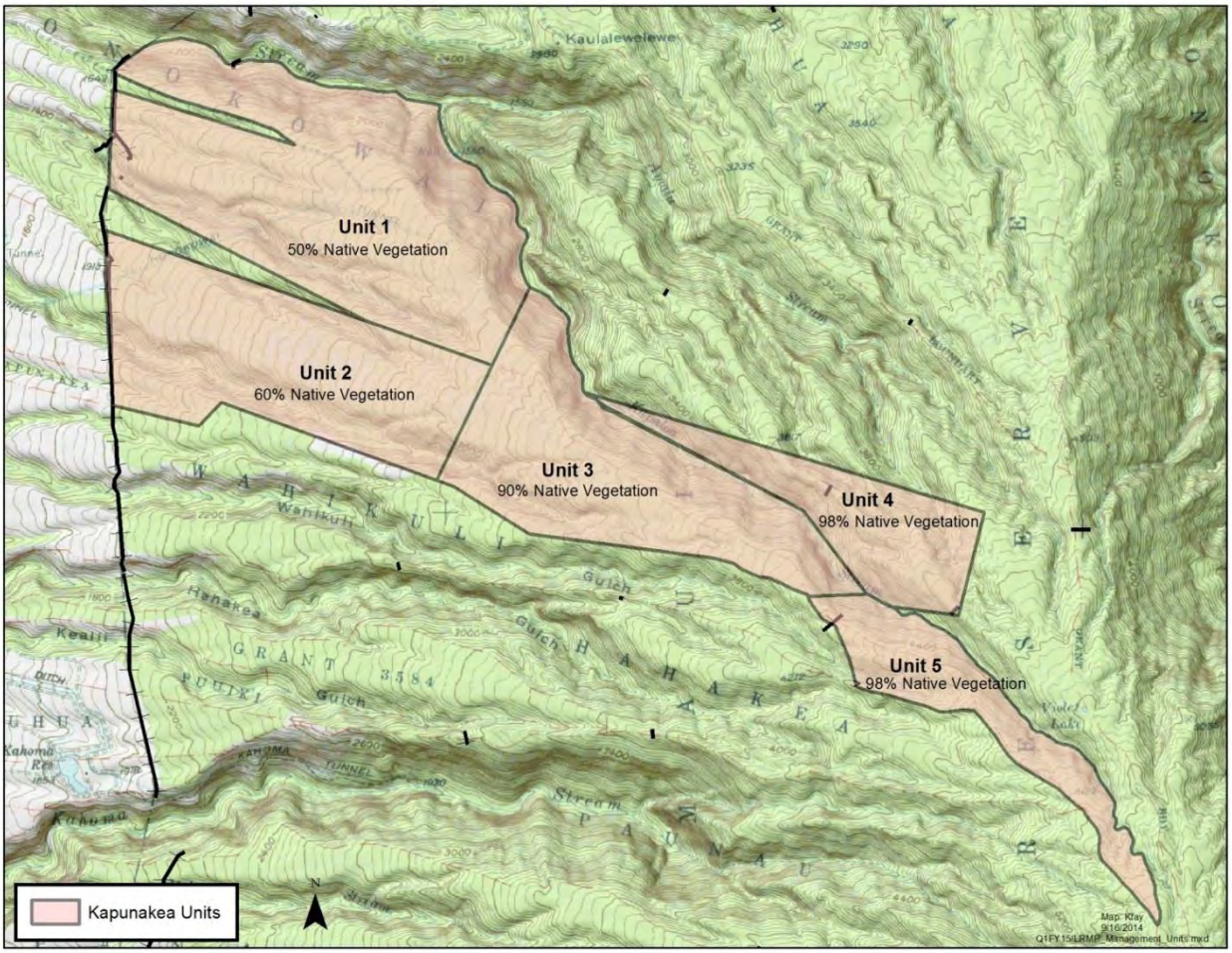


Figure 13. Kapunakea Preserve boundaries and management units.

Management Programs

Although the following management programs are described separately, they form an integrated management approach. For each program listed in the following section, we have indicated a major goal and described the management methods chosen. Also included are highlights of past and current achievements and key management issues. Finally, key objectives to achieve the goal are listed by year for FY2016–FY2021.

Program 1: Non-native Species Control

A. Ungulate Control

Pigs destroy the native understory and groundcover, exposing bare soil.

Program Goals

- Remove all ungulates from fenced, native-dominant areas
- Prevent ungulate ingress into native-dominant areas
- Enhance the effectiveness of boundary and strategic fences

Program Description

The elimination of ungulates in Kapunakea Preserve and on adjacent partnership lands continues to be our highest priority. Ungulate damage has been substantially reduced since 1994, especially in upper elevation areas. However, it is known that pigs continue to find their way into the preserve from adjacent lands. During the period FY10-FY14, pigs entered the Preserve at one time or another due to one or a combination of: 1) a fence breach in Hāʻenanui in FY10, 2) a fence breach in the Powerline fence in FY13, 3) Honokōwai valley south wall ingress, and 4) vandalism along lower boundary fences periodically. Each one of these issues was addressed immediately via fence repairs or new fencing. See Figure 14. We will continue consistent scouting, ungulate removal, and monitoring efforts as needed. Some resources may be shifted to weed control should we deem ungulate levels low enough to justify this shift.

The ungulate control program utilizes a combination of fencing, snaring, and hunting to bring pig populations down to zero as rapidly as possible and prevent them from re-establishing. The lower

boundary of the preserve was constructed in FY1993-1995, and replaced an aging Forest Reserve boundary fence. This fence is key to preventing ungulate ingress into the Preserve; as such it is likely that ongoing maintenance and possible additions to this lower boundary fence will be necessary during the next six years. In FY14, TNC had subawardee WMMWP install a strategic 72 meter wing fence in Honokōwai Valley. In the coming years similar short strategic fences may be necessary at possible points of pig ingress. In addition, the fence and snare check schedule and associated labor may be shifted if deemed necessary for the most effective management program over the six year period. Figure 7 depicts current and proposed fences in Kapunakea Preserve and on adjacent lands, and Figure 14 depicts recent fence improvements.

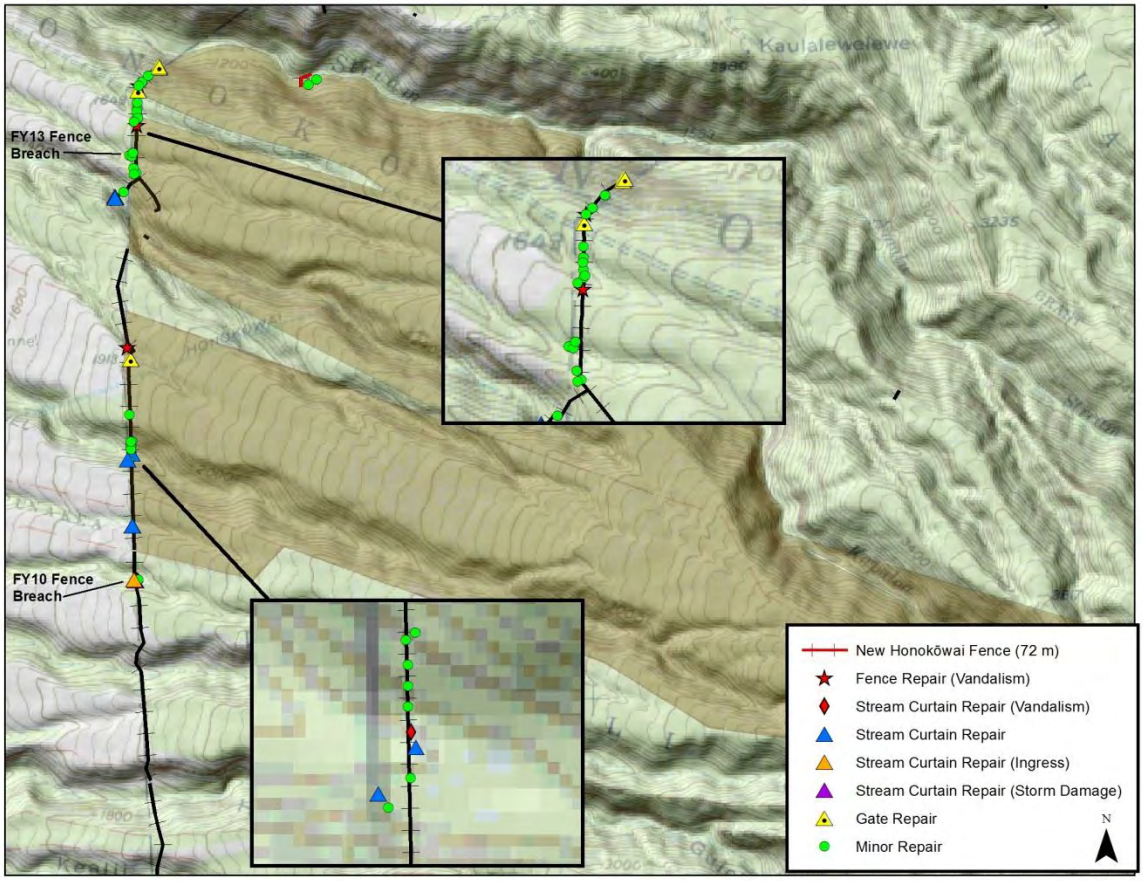


Figure 14. FY14 fence improvements at Kapunakea.

Snaring is still the most effective and feasible technique for controlling pigs in areas too remote, rugged, and/or fragile for frequent hunting, and where hunting cannot remove low-density pig populations from sensitive sites. Until an effective alternative can be found, snares will continue to be placed in pig-damaged areas. Additionally, if warranted by high levels of pig activity, we will snare other areas of the preserve (and other strategic areas). Traps in the upper areas of the Preserve are checked semi-annually, and traps in the lower areas of the Preserve are checked quarterly. In addition, through our subawardee the West Maui Mountains Watershed Partnership, we have begun installing and maintaining a trap network on area just north of the Preserve on State Forest Reserve land. Additional traps may be installed in this area in the short-term as needed.

In the past few years, axis deer (*Axis axis*) have greatly expanded their range on Maui to include West Maui areas near Ukumehame, Kapalua, and Kahakuloa. Control efforts for axis deer may be needed in the near future to protect the preserve, and existing hogwire fences may need to be retrofitted to be 8' high deer fence. Such retrofits are currently underway throughout the West Maui Watershed. The existing lower boundary fence in the Preserve is more than 20 years old, degraded, and only 48". This fence will need to be replaced in the next six year period with deer/pig fencing, pending available funding (Figure 8). The boundary fence crosses both state and private land. We hope to fund this fence replacement with state CIP funds, Department of Water supply, NAPP or another funding source.

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

Ungulate Control Activities

Years 1–6 (2016–2021):

- Conduct monthly inspections and repairs of Kapunakea's lower elevation fences, making repairs as necessary. Inspect fences in Units 3, 4, and 5 and upper elevation strategic fences semiannually, making repairs as necessary. Map and document breaches and record time between observed breach and repair.
- Check animal control traps semi-annually in the mid and upper elevations of the preserve.
- Check animal control traps quarterly in the lower section of the preserve.
- Implement contract hunting in key areas if needed.
- Complete one ground scout in any "hotspot" areas to determine whether pigs are present or entering the preserve through boundary fences or natural barriers.
- Replace lower Preserve boundary fence with deer fencing (1883 meters) in FY2020 or FY2021.[2]

Status of Public Hunting Opportunities: The conservation easement between TNC and Kā'anapali Land Management Corp. requires that there be no unaccompanied public hunting. Kapunakea Preserve is closed to hunting with dogs due to increased animal control efforts in the Preserve. However, TNC staff may accompany public hunters hunting without dogs upon request, on a case-by-case basis. Limited public hunting opportunities that will not interfere with other management are available in coordination with scheduled work trips.

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

[2] Replacement of lower boundary fence will not be funded by NAPP

B. Invasive Plant Control

Program Goals

- Remove habitat-modifying weeds from high-quality native habitats
- Prevent the introduction or spread of problem weeds
- Prevent the establishment and spread of habitat-modifying priority weeds

Program Description

The most important aspects of our weed control program are to control established weeds in intact native communities, and to prevent the introduction of new species of alien plants. We focus on containment and suppression of priority weed species that threaten intact high elevation native forests, and attempt to reduce their established cover. In some cases, when weeds are considered a direct threat to rare plant populations occurring in alien-dominant habitat, localized control actions may be taken.

In order to prevent weed establishment, we will continue to enforce strict procedures to remove weed seeds from equipment and clothing before people enter the preserve. Helicopter flights will originate from areas free of aggressive weeds, and all equipment and clothing will be inspected and cleaned. Of the alien plants already established in the preserve, many are shade intolerant and pose no major problem if the native forest canopy and ground cover remain intact. There are other alien plants, however, that displace native vegetation over large areas; these habitat-modifying plants are considered **priority weeds** for management (Table 2).

Table 2. Priority Weed Species for Management Above 3200' in Kapunakea Preserve

Scientific Name	Common Name
Tibouchina herbacea	Tibouchina
Psidium cattleianum	Strawberry guava
Clidemia hirta	Koster's curse

Table 3. Other important weed species to monitor in Kapunakea Preserve

Other Important Weed Species	
Melinis minutiflora	Molasses grass
Rubus argutus	Blackberry
Paspalum conjugatum	Hilo grass
Holcus lanatus	Velvet grass
Ficus spp.	Banyan
Buddleia asiatica	Butterfly bush
Juniperus bermudiana	Juniper
Grevillea robusta	Silk oak
Andropogon virginicus	Broomsedge
Juncus planifolius	Bog rush
Hedychium coronarium	White ginger
Cortaderia jubata	Giant Andean Pampas
Acacia mearnsii	Black wattle
Passiflora suberosa	Passiflora

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

As the project evolves, we may employ other techniques or tools for weed control as they are developed. No new application methodology will be employed without full compliance with HDOA.

Target Species:

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

In FY12, support was given to Dr. James Leary to test Herbicide Ballistic Technology (HBT) for strawberry guava treatment. 70 guava were treated in a 44 minute window. Monitoring in FY13 indicated a high mortality rate and the experiment was deemed successful (Figure 15). Secondary impacts to non-target native plants surrounding the treated guava seemed minimal.

Figure 15. Herbicide ballistic technology (HBT) was successful in treating invasive strawberry guava trees, with no non-target native trees negatively affected.

In the past 15 years, we have halted the spread of strawberry guava (*Psidium cattleianum)* in lower Unit 3 by treating thousands of trees with herbicide, and pulling thousands of seedlings. As feral pigs are a

primary source for spreading strawberry guava, and we have significantly reduced pig numbers, the spread has slowed considerably. We continue to scout for this pest tree in critical areas above 3,200 feet, where the spread is very limited. However, short-term efforts spent on controlling strawberry guava at high elevations in Kapunakea will be shifted towards biocontrol during FY16. Recently a Brazilian scale (*Tectococcus ovatus*) was selected as a candidate for biocontrol of strawberry guava, after many years of research. *Tetracoccus* is currently being tested and Kapunakea Preserve will likely be a release site in FY16 to test efficacy at various elevations. TNC will assist with site selection, pre-release monitoring, release efforts, and post-release monitoring.

After finding 11 *Clidemia hirta* (1 mature and 9 immature) individuals in a discrete location in FY10, TNC and WMMWP decided to conduct *Clidemia* sweeps twice per year. This is a classic example of early detection-rapid response (EDRR), when action was taken to remove the initial mature plants and monitor vigilantly for localized recruitment. No other populations have been found, and recruited individuals regularly pulled have not reached reproductive maturity.

Black wattle (*Acacia mearnisii*) was found at limited locations years back and has been routinely monitored after initial control to ensure no seedlings survive. No history on its location has been verified, though it is suspected it was part of Territorial Forestry planting decades back and that these trees were survivors from that period; this species normally does not thrive in the dry shrubland, low elevation habitat where it was found. The action taken on this was another good example of selected EDRR to ensure the species did not become established at this site.

Florida blackberry (*Rubus argutus)* is widespread and continues to spread (primarily via birds), although our prior treatment of trailside plants has prevented it from gaining density along those routes. Blackberry continues to dominate habitat along steep gulches to 4,000' elevation, especially pig-disturbed terraces, where chemical control is impractical. Compared to other priority weeds, the behavior of this species does not show it outcompeting native species. That combined with its huge range and impracticality of physical control deems this species as unmanageable.

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

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

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

As part of our routine management program, we will continue to: 1) monitor for and control new weeds at landing zones, campsites, and upper trails; 2) train staff in the proper handling and application of herbicides; 3) participate as a member of the Maui Invasive Species Committee; 4) update aerial survey and range maps for *Tibouchina* and guava; and 5) cooperate with DOCARE in marijuana control as needed. We may employ innovative remote technologies such as remote sensing or high resolution aerial photography for weed mapping when deemed effective for detecting our highest priority weeds.

Invasive Plant Control Activities

Year 1 (FY2016):

- Continue treatment of top habitat-modifying weeds above 3200' (especially *Tibouchina* and strawberry guava). Physical control of guava will be opportunistic only along infrastructure in FY16 while efforts are being focused on biocontrol releases.

Years 1–6 (2016–2021):

- Continue treatment of top habitat-modifying weeds above 3200' (especially *Tibouchina* and strawberry guava).
- Conduct *Clidemia* sweeps twice per year in "core area" below Mud camp.
- Monitor weeds as needed according to management priorities.
- Respond to new priority weed threats and map efforts.
- Update and maintain priority weed maps annually.
- Carryout localized weed control in landing zones, camps, key microhabitats and trails.
- Follow strict protocols to prevent inadvertent introduction and spread of priority weeds.
- Support State and County legislation, outreach, and funding efforts to develop and release biological controls for priority habitat-modifying weed species; cooperate with USFWS and DLNR to provide Kapunakea as a potential release site for new biocontrol agents.
- Support the Maui Invasive Species Committee (MISC) for programs pertaining to invasive species on West Maui, including pampas grass, fountain grass, and other target species as relevant.
- Monitoring and help develop, when feasible, innovative technological developments in invasive plant identification, mapping, and control. Implement when possible.
- Assist in site selection, pre-release monitoring, and post-release monitoring of strawberry guava biocontrol (*Tectococcus ovatus*).

This program represents an estimated 17% of the overall effort and budget in this long range management plan.

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

Program Goals

- Increase our understanding of threats posed by small mammals
- Prevent the introduction and spread of small mammals, non-native insects, mollusks, pathogens, and other pests deemed to be a significant threat, and reduce their negative impact where possible

Program Description

Non-native insects and small mammal damage is evident throughout Maui's native ecosystems. Rats, mice, cats, and mongoose pose a threat to many native birds including the endangered ground nesting nēnē. Prior research and management attempts have shown intensive rat control to exceed realistic budgets in terms of staff and logistics. In addition the long-term impact from maintaining intensive rat trapping can cause significant damage to native plant communities. However, TNC supports a long-term program aiming at protecting larger landscapes from small mammal depredation and has contributed toward trials that may result in the aerial application of rodenticide. We also implement protocols for cleaning and monitoring to prevent the accidental introduction of new alien species.

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

Since *Puccinia psidii* was first found on Maui and the conservation community became vigilant about mapping location on ʻōhiʻa, staff observes anything resembling this rust and reports if needed. Staff also are aware of unusual arthropod sightings, and anything new is reported, identified, and evaluated for management action.

Small Mammal, Pest, and Pathogen Control Activities

Years 1–6 (2016–2021):

- Support viable control programs for small mammals or other pests by our partners.
- Support other scientific research into effects of small mammals and their effective control.
- Support research on *Puccinia rust* or other forest pathogens; continue to monitor for presence.

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

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

Program Goals

- Conduct and support monitoring and research to track the status of biological and physical resources of the preserve
- Maintain spatial and other data sufficient to measure success and inform adaptive management, policy makers, and funders
- Prevent the extinction of rare species in the preserve
- Encourage and assist with research that increases our understanding and management of the area's natural resources

Bonamia menziesii. Photo Forest & Kim Starr.

Program Description

The goal of our resource monitoring program is to track biological and physical resources of the preserve, evaluate changes in these resources over time, and improve efficacy of management responses. TNCH uses data from the U.S. Fish and Wildlife Service to identify rare and endangered species and those that are listed as "candidate" or "species of concern". Biological surveys have shown that the preserve protects numerous rare species, many of which are federally listed as endangered (Appendices 2 and 3).

We have established a network of monitoring plots to quantify and better understand Kapunakea's baseline vegetation. We completed a monitoring report for Kapunakea in 1995. The monitoring transects established at that time included: 1) 10,000 meters of permanent belt transects for monitoring the distribution, frequency, and relative abundance of feral ungulates and alien plant species, and 2) 41 permanent, 250 square meter plots for obtaining in-depth quantitative data on forest vegetation (Figure 16). A few of the permanent 250 m^2 plots were revisited in FY15 to assess passive recovery of native vegetation following ungulate reduction. TNC will begin systematic annual vegetation monitoring to establish "snapshot" looks at the quality and rate of vegetation recovery over time, using existing 250 m^2 plots located along transects.

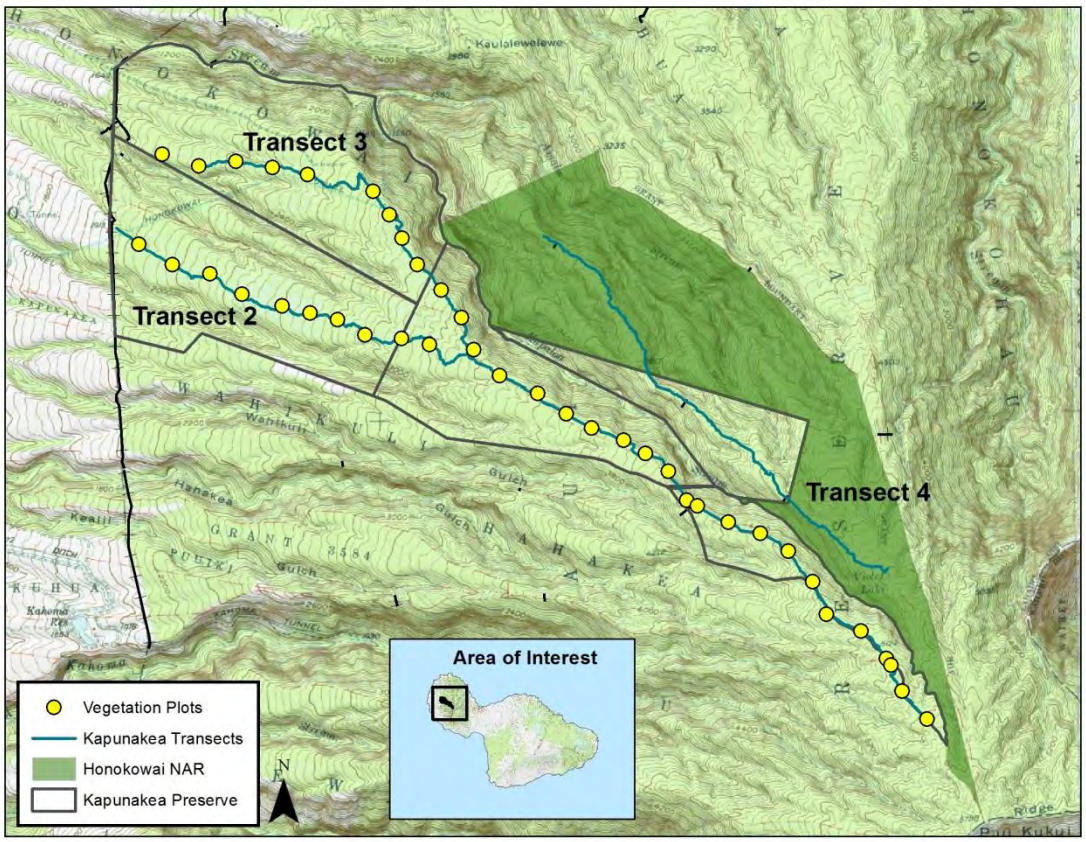


Figure 16. Vegetation monitoring plots are located along existing ungulate monitoring transects.

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

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

TNC Maui staff also routinely monitor various rare plants. Staff will continue to identify, map, and recover rare plant populations during routine management activities. When available, fruit will be collected and given to PEPP for propagation. We will continue to support and assist PEPP with outplanting and monitoring of rare plants, in addition to sharing GIS data on rare plant locations in West Maui.

Bird surveys were conducted during various years along the same transects by observers trained in the U.S. Fish and Wildlife Service's Hawai'i Forest Bird Survey methodology. The purpose of these surveys is

to document the relative abundance of all bird species in the forest. In the future, we will conduct bird surveys only during the state's routine bird surveys (every 5 years).

We will continue to encourage independent research in Kapunakea by offering necessary application materials to researchers online. Although no Conservancy funding for research is provided to projects, we provide technical guidance and logistical support to approved research.

Resource Monitoring, Rare Plant, and Research Activities

Years 1–6 (2016–2021):

- Undertake annual vegetation plot monitoring.
- Monitor and maintain threat monitoring transects – Kapunakea transects 2 and 3 twice per year, and Honokōwai "Transect 4" once per year.
- Continue to support PEPP in search and assessment of rare species populations to determine protection needs and to reduce threats.
- Maintain and update current maps of rare species populations. Update database regularly.
- Provide logistical support to researchers.

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

Program 3: Community Outreach

Program Goal
To build public understanding and support for the management of the watershed and preservation of natural areas.

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

Currently, there is limited on-site public outreach at Kapunakea Preserve. TNC no longer provides scheduled monthly access to Kapunakea Preserve and other interpretive hikes. However, individuals may accompany staff and assist on field projects if they have relevant experience. The WMMWP implements a public education and awareness program including environmental education and volunteer assistance programs. There is not current funding to employ a volunteer and community outreach coordinator; however, TNC will continue to research the best way to engage the community through available and potential future resources.

Community Outreach Activities
Years 1–6 (2016–2021):

- Participate in one or two community events per year to encourage constituents to support our work, such as the Maui Ag Fest in Waikapū.
- Present slide shows and talks as requested by community and school groups.
- Lead special hikes for targeted community members.

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

Program 4: Fire, Emergency, and Safety

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

Program Description: All staff are trained in basic first aid and CPR. Other training may include advanced wilderness first aid, fire suppression and pre-suppression, helicopter safety, and hunter's education. Field staff are provided with first aid kits and required to use proper personal protective equipment (PPE) when conducting field work. The TNC Maui fire plan enables an immediate multi-agency response to wildfires within and adjacent to Kapunakea Preserve.

A recent fire that burned over 50 acres just below the Preserve in September 2014 highlights the necessity and urgency of fire prevention and protection efforts. We will need to be prepared to undertake fire prevention practices that will are outlined in the West Maui Task Force Fire Plan, such as fire breaks and bulldozing fire lanes.

Access roads below the Preserve are maintained by the landowner regularly, about once per year. The landowner periodically offers to grade the two access roads to Kapunakea (Eucalyptus and Powerline roads). We will continue to coordinate with the landowner to have access roads in Kapunakea maintained as much as possible. In addition, because the *Andropogon* (broomsedge) poses a fire hazard in the dry season, we will mow and treat the grass annually prior to the dry season.

Fire, Emergency, and Safety Activities
Years 1–6 (2016–2021):

- Provide emergency training opportunities for staff including but not limited to maintaining current First Aid and CPR certifications.
- Conduct annual first aid kit inventory and resupply.
- Maintain fire suppression training for key staff.
- Purchase equipment as needed to allow proactive prevention and immediate response to fire threats.
- Respond to emergencies or fire threats.[3]
- Maintain and improve access roads and firebreaks in high risk areas of preserve.

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

[3] TNC staff will respond to fire threats only as requested by the State

Program 5: Watershed Partnerships

Program Goal

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

Program Description

TNC helped to found the WMMWP and continues to play an active role in the partnership. The WMMWP provides protection for about 50,000 acres on West Maui administered by a coordinator and field crew (first hired in 2000). Activities include fencing, ungulate removal, and resource monitoring programs for all of West Maui's native forests. As a partner, we helped set management priorities, fundraise and administer projects. TNC Maui will continue to provide the WMMWP with guidance and training, and we will participate in management activities on partnership lands as needed. We will likely also continue to contract with the WMMWP or another viable entity for ungulate and weed removal and monitoring.

Watershed Partnership Activities

Years 1–6 (2016–2021):

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

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

Table 1. Approximate person days for FY16 for contracted Kapunakea management activities

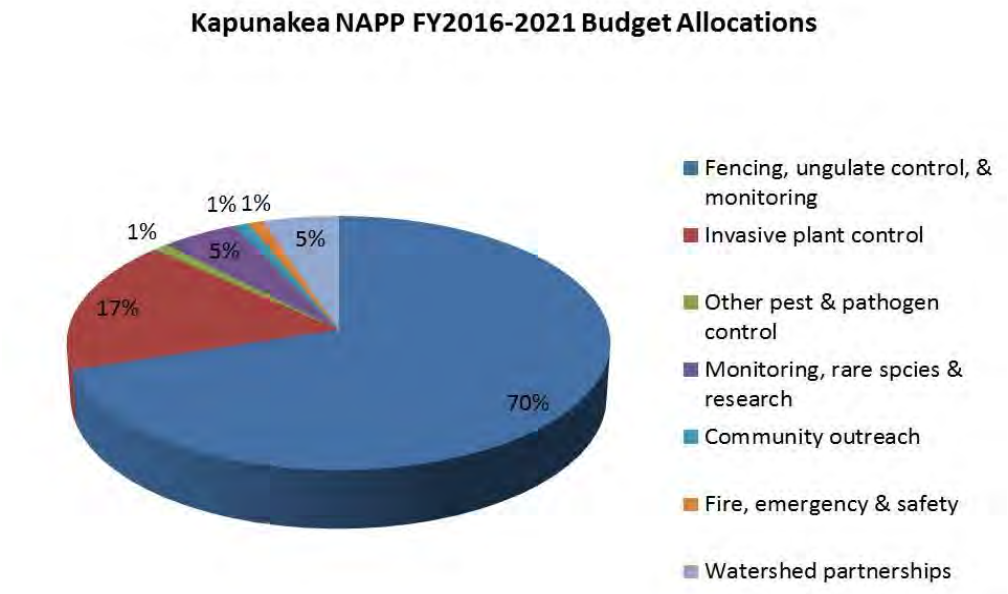
Description:		When	PD	Annual Freq.	PD Annual Total	Annual Helicopter Hours estimate
Snare Checks All	Unit 1 & Honokowai	Q1,2,3,4	10	4	40	0
	Unit 2	Q1,2,3,4	8	4	32	0
	Unit 3	Q2,Q4	7	2	14	3
	Unit 4	Q2, Q4	2	2	4	3
	Unit 5	Q2,Q4	2	2	4	3
	Prep time & decon & data				24	
Ungulate Scouting		Q2,Q4	4	2	8	2
Weed control		Q2,Q4	4	2	8	2
Biocontrol release & monitoring (5 sites) Top of powerline, eucalyptus, below mud camp, kapu 3, honokowai valley			2		10	
Pictometry analysis Unit TBD (Psicat, ficus, juniper)			2		2	
Resweep Psicat control areas, Fence LZ to Mud camp			8	1	8*	
	Prep time & decon & data				8	
Planning meetings: weeds, mgmt., etc.		Q1,Q3	2	2	4	
Fence/gate inspection and routine repair		Q1-4			47	2
Significant maintenance / repair for fences/gate					6*	
Monitoring:						
Ungulate (TR 2 & 3 2x, TR 4 1x) & weed transects (1x)		Q2,Q4	9	2	18	4
Veg plot monitoring 9 plots Unit 1			2	3	6	
8. Research support		Q1-4	2	1	2	
9. GIS/maps		Q1-4	4	2	8	
Access road/parking mowing and treatment		Before dry season	6	1	6	
10. Reporting NAPP reports and Annual plan		Q3-4	5	2	10	
				Totals:	**251**	**16**
				*If extra funding secured for FY16:	**272**	**19**

ENVIRONMENTAL REVIEW COMPLIANCE

All actions being proposed for reauthorization in this Long-Range Management Plan are substantially similar to, and relevant to, the actions previously considered in the *Final Environmental Assessment of Kapunakea* for which we received a "Finding of No Significant Impact" in 2008.

BUDGET SUMMARY

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



The Conservancy's Maui operation maintains a full time base staff of seven. These staff also periodically work on Lāna'i and Molokai whose programs are supervised by the Maui Nui office. An estimated .53 FTE of Maui base personnel costs for managing Kapunakea Preserve are funded by the Kapunakea NAPP budget. However, this number may fluctuate depending on the use of contractors vs. staff to complete deliverables. Technical and annual planning support is also included, and other island support staff may charge a small portion of their time to this project. The Nature Conservancy's annually negotiated fringe benefits rate will also accrue on all salary costs.

The NAPP portion of this budget does not include miscellaneous project-related costs such as vehicle expenses. NAPP funds will cover a portion of staff or subaward expenses to conduct fence checks/maintenance and ungulate/weed removal and miscellaneous project-related field supplies. Note that the contractual line item includes some helicopter time. The Conservancy routinely provides

trainings for staff to improve job performance, and in addition to these trainings, supervisory staff regularly attend meetings in Honolulu.

An overhead rate is included (subject to slight change each year) to recognize the Conservancy's indirect costs for facilities, accounting, legal, and other administrative support. The NAPP program will pay only 10% of the Conservancy's overhead rate of 22.48% (FY15), leaving the remainder as a portion of the Conservancy's one-third match.

Budgetary Constraints: This Kapunakea NAPP budget represents a significant reduction in funding since the last LRMP (2010–2015). 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 Kapunakea Preserve and on adjacent lands regardless of funding source.

BUDGET TABLE

	FY2016	FY2017	FY2018	FY2019	FY2020	FY2021	TOTAL
Labor and Fringe	20,000	20,000	20,000	20,000	20,000	20,000	*120,000*
Supplies/ Equipment	2,000	2,000	2,000	2,000	2,000	2,000	*12,000*
Travel	2,000	2,000	2,000	2,000	2,000	2,000	*12,000*
Subcontracts	124,818	124,818	124,818	124,818	124,818	124,818	*748,908*
Baseyard	2,000	2,000	2,000	2,000	2,000	2,000	*12,000*
Subtotal	150,818	150,818	150,818	150,818	150,818	150,818	*904,908*
Overhead @ 10%	15,082	15,082	15,082	15,082	15,082	15,082	*90,491*
TOTAL	**165,900**	**165,900**	**165,900**	**165,900**	**165,900**	**165,900**	***995,400***
	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	*Total*
Kapunakea Budget	165,900	165,900	165,900	165,900	165,900	165,900	*995,400*
Match (1/3 of total)	55,300	55,300	55,300	55,300	55,300	55,300	*331,800*
TOTAL NAPP REQUEST (2/3 of total)	**110,600**	**110,600**	**110,600**	**110,600**	**110,600**	**110,600**	***663,600***

Appendix 1
Natural Communities of Kapunakea Preserve

NATURAL COMMUNITY
Koa/ʻŌhiʻa (Acacia/Metrosideros) Lowland Mesic Forest^†
Lama/ʻŌhiʻa (Diospyros/Metrosideros) Lowland Mesic Forest^
Māmaki (Pipturus) Lowland Wet Shrubland
ʻŌhiʻa (Metrosideros) Lowland Mesic Forest^†
ʻŌhiʻa (Metrosideros) Lowland Mesic Shrubland
ʻŌhiʻa/Uluhe (Metrosideros/Dicranopteris) Lowland Wet Forest^
Uluhe (Dicranopteris) Lowland Wet Shrubland
ʻŌhiʻa (Metrosideros) Mixed Montane Bog
ʻŌhiʻa (Metrosideros)/Mixed Shrub Montane Wet Forest
ʻŌhiʻa /ʻŌlapa (Metrosideros/Cheirodendron) Montane Wet Forest
Hawaiian Intermittent Stream

^ = Not known from West Maui NAR
* = Not known from Puʻu Kukui WMA

Appendix 2
Rare Native Species of Kapunakea Preserve

SCIENTIFIC NAME	COMMON NAME	FEDERAL STATUS	IUCN STATUS
Acacia koaia[†]	koai'a, koai'e, koa'oha		VU
Alectryon macrococcus var. macrococcus[^]	'ala'alahua, māhoe	E	CE
Alphitonia ponderosa	kauila, kauwila, o'a		VU
Anoectochilus sandvicensis		SOC	VU
Argyroxiphium caliginis	'eke silversword		VU
Bobea sandwicensis[^†]	'ahakea		VU
Bonamia menziesii[^†]	-	E	CE
Calamagrostis expansa	-	C	VU
Euphorbia olowaluana	'akoko	SOC	NT
Clermontia oblongifolia sbsp. *Mauiensis*	'ōhā wai	E	VU
Colubrina oppositifolia[^†]	kauila	E	CE
Ctenitis squamigera	pauoa	E	CE
Cyanea lobata subsp. *lobata*[1]	Hāhā	E	
Cyrtandra filipes[1]	ha'iwale	E	
Cyrtandra munroi		E	
Eurya sandwicensis	ānini, wānini		VU
Exocarpos gaudichaudii[†]	heau		EN
Geranium hillebrandii (formerly *humile*)	Nohoanu, hinahina	E	
Melicope orbicularis[*]	alani		EN
Myrsine vaccinioides	kōlea	E	
Neraudia melastomifolia[^†]	ma'aloa, 'oloa		VU
Nothocestrum latifolium[*^†]	'aiea	C	EN
Platanthera holochila[1]	-	E	
Ranunculus mauiensis[1^†]	makou	C	
Sicyos cucumerinus[†]	'ānunu, kūpala	SOC	

Number of rare plants in Kapunakea	34
[1] = Current PEP target	6
[^] = Not known from West Maui NAR	8
[†] = Not known from Pu'u Kukui WMA	12
[*] = Known from preserve historically (pre-1975)	3

Federal Status:
E = Endangered
SOC = Special concern
C = Candidate

IUCN Status:
CR = Critically Endangered
EN = Endangered
VU = Vulnerable
LR/cd = Lower Risk/conservation dependent
NT = Near Threatened

Appendix 3
Other Rare Species of Kapunakea Preserve

SCIENTIFIC NAME	SPECIES TYPE	FEDERAL STATUS	IUCN STATUS
Partulina perdix	Land snail	n/a	EN
Partulina tappaniana	Land snail	n/a	EN
Perdicella kuhnsi		n/a	dd
Pterodroma phaeopygia sandwichensis	Forest bird	E	n/a
Vestiaria coccinea	Forest bird	Under review	VU

† = Not known from Pu‘u Kukui WMA

Federal Status:
E = Endangered
SOC = Special concern
C = Candidate

IUCN Status:
CR = Critically Endangered
EN = Endangered
VU = Vulnerable
LR/cd = Lower Risk/conservation dependent
NT = Near Threatened
dd = data deficient

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From Date	7/1/2016	To Date	6/30/2021	
	Staff Hours	Volunteer Hours	Partner Hours	Other Hours
Total Weed Control Person Hours				

			*Proposed				Accomplished	
Program	Weed Control Unit Name	GIS Unit Acres	Proposed Action	Goal Target (6 letter code)	Goal Acres	Frequency	*Weed Species Trend (Whole unit not just control Area)	Comments
Kapunakea	Unit 1 Kapunakea		Other	Psicat as biocontrol target	424	Annual	Constant (Present)	If released, Psi biocontrol success will be monitored and documented in collaboration with Dofaw and DOA
Kapunakea	Unit 2 Kapunakea		Other	Psicat as biocontrol target	310	Annual	Constant (Present)	If released, Psi biocontrol success will be monitored and documented in collaboration with Dofaw and DOA
Kapunakea	Unit 2 Kapunakea		Ground Sweep/Control	Acamea	1	Annual	Decreasing	Acacia mearnsii may be eliminated but revisits due to long-lived seed bank. Focus is on "early detection, rapid response".
Kapunakea	Unit 2 Kapunakea		Ground Sweep/Control	Clihir	4	Annual	Decreasing	EDRR target being successfully contained; regrowth numbers stable with each visit
Kapunakea	Unit 3 Kapunakea		Ground Sweep/Control	Psicat	20	Annual	Decreasing	Action-strategic physical control of outlier populations; Weed status native dominant, trailside and outlier weeds, most not consider habitat modifiers
Kapunakea	Unit 4 Kapunakea		Ground Sweep/Control	Tibher	50	Annual	Unknown	No control-logistically difficult to survey and control; Weed status: native dominant, mostly scattered low priority herbaceous weeds

Kapunakea	Unit 4 Kapunakea		Ground Sweep/Control	Tibher	3	Annual		
Kapunakea	Unit 5 Kapunakea		Ground Sweep/Control	Tibher	6	Annual	Decreasing	Control as encountered in bog habitat only; Weed status: native dominant, mostly scattered low priority herbaceous weeds

From Date	7/1/2016	To Date	6/30/2021	
	Staff Hours	Volunteer Hours	Partner Hours	Other Hours
Total Monitoring Person Hours				

				Proposed			
Program	Transect Name	Transect or Station Type	GIS Transect Length (m)	Proposed Action	Proposed Num Checks	Frequency	Accomp Mon Action
Kapunakea	KAPUNAKEA3	Weed and Ungulate	6829	Check	1	Annual	
Kapunakea	KAPUNAKEA2	Weed and Ungulate	3139	Check	1	Annual	
Kapunakea	Honokowai	Weed and Ungulate	2950	Check	1	Annual	
Kapunakea		Native Vegetation		Install	1	Annual	
Kapunakea		Native Vegetation		Install	1	Annual	

From Date	7/1/2016	To Date	6/30/2021

	Staff Hours	Volunteer Hours	Partner Hours	Other Hours
Ungulate Control Person Hours				

			*Proposed				
Program	Ungulate Control Unit	GIS Acres(m)	Proposed Action	Goal Quantity of Action	Frequency	*Ungualte Threats Separate by comma (G= goat, P= Pig, S= Sheep, D = Deer, C= cow)	*Current Ungulate Population Trend
Kapunakea	Unit 1 Kapunakea	424	# Traps Checked	315	Quarterly	P	Decreasing
Kapunakea	Unit 2 Kapunakea	310	# Traps Checked	37	Semiannual	P	Decreasing
Kapunakea	Unit 2 Kapunakea	310	# Traps Checked	158	Quarterly	P	Decreasing
Kapunakea	Unit 3 Kapunakea	300	# Traps Checked	306	Quarterly	P	Not present
Kapunakea	Unit 4 Kapunakea	108	# Traps Checked	0	Quarterly	P	Not present
Kapunakea	Unit 5 Kapunakea	90	# Traps Checked	85	Semiannual	P	Not present
Kapunakea	Honokowai, outside of Preserve		# Traps Checked	68	Quarterly	P	Decreasing

From Date	7/1/2016	To Date	6/30/2021		
			*Proposal Actions		
Program	Fence Section Name	GIS Fence Length (meters)	Proposed Action	Goal (meters)	Frequency
Kapunakea	W17	590	Inspect/Maintain	590	Monthly
Kapunakea	W17A	150	Inspect/Maintain	150	Monthly
Kapunakea	W22	72	Inspect/Maintain	72	Monthly
Kapunakea	W19	63	Inspect/Maintain	63	Monthly
Kapunakea	W20	55	Inspect/Maintain	55	Semiannual
Kapunakea	W12	126	Inspect/Maintain	126	Semiannual
Kapunakea	W16	1111	Inspect/Maintain	1111	Semiannual

From Date	7/1/2016	To Date	6/30/2021	
	Staff Hours	Volunteer Hours	Partner Hours	Other Hours
Total Monitoring Person Hours				

Link To Pop Ref Code Web Map

Link To Pop Ref Code Shapefile Download

				Proposed				Accomplished
Program	Species Name (6 letter code)	Species Type	Pop Ref Or Population Name	Proposed Action	Proposed Num Checks	Number Species Expected	Frequency	Comments
Kapunakea	Alemac	Plant	HON, HNG,KOO	Check	1	12	Biannual	Monitored FY13; Down to 2 (PEPP), in decline; KAP had majority of WM population @ 13
Kapunakea	Bidmic subsp mic	Plant	HNG	Check	1	1	Other	Record from 1993
Kapunakea	Bobsan	Plant	HON, HNG	Check	1	27	Biannual	SOC; Persistent, on steep slopes
Kapunakea	Bonmen	Plant	HON	Check	1	5	Biannual	Monitored FY14
Kapunakea	Cleobl	Plant	KOO	Check	1	2	Biannual	PEP
Kapunakea	Colopp	Plant	HON, HNG	Check	1	2	Biannual	PEP; Monitored fy15; outplants. Surviving; propagules at Lyon and MNBG
Kapunakea	Cyalob	Plant	HON, HNG	Check	1	2	Biannual	Monitored FY12
Kapunakea	Cyrfil	Plant	HON	Check	1	2	Biannual	PEP
Kapunakea	Cyrmun	Plant	HON, HNG,KOO	Check	1	10	Other	
Kapunakea	Exogau	Plant	HON, HNG	Check	1	10	Biannual	SOC; Occasional in Unit 2 slopes; Monitored FY14
Kapunakea	Hibkok	Plant	HON	Check	1	3	Other	Monitored 2008;
Kapunakea	Liphaw	Plant	HON	Check	1	50	Biannual	SOC; Thriving in recovered units; Monitored FY14
Kapunakea	Parper	Snail	HON	Check	1		Other	document as encountered
Kapunakea	Partap	Snail	HON	Check	1		Other	document as encountered
Kapunakea	Plahol	Plant	HON	Check	1	1	Biannual	PEP. Last seen 20 years ago; PEP will search for it in FY15
Kapunakea	Ptesan	Seabird	HON	Check	1		Other	document as encountered
Kapunakea	Ranmau	Plant	HON KOO	Check	1	4	Other	Known from 2004 Lau report; 2 pops
Kapunakea	Sanfre var. lan	Plant	HNG	Check	1	2	Other	
Kapunakea	Syccum	Plant	HON	Check	1		Other	widespread
Kapunakea	Vescoc	Forest Bird		Check	1		Other	document as encountered

	From Dat	7/1/2016	To Date	6/30/2021
	Staff Hours	Volunteer Hours	Partner Hours	Other Hours
Outreach Hours				

			Proposed			Accomplished	
Program Name	Audience Type	Description of Events	Proposed Num Events	Proposed Num Individuals Reached	Frequency	Accomp Num Events	Accomp Ind Reached
Kapunakea	Fairs	Maui Agricultural Festival; East Maui Taro Festival	2		Annual		

From Date	7/1/2016	To Date	6/30/2021	
	Staff Hours	Volunteer Hours	Partner Hours	Other Hours
Total Infrastructure Hours				

				Proposed		Accomplished			
Program Name	Structure Name (Name in shapefile)	Infrastructure Type	Action	Proposed Number of Action	Frequency	Accomplished number of Action	Last action date	Last check condition	Comments
Kapunakea	Eucalyptus	Road	Maintain	1	Other				dependent upon coordination with landowner

State of Hawai`i
DEPARTMENT OF LAND AND NATURAL RESOURCES
Division of Forestry and Wildlife
Honolulu, Hawai`i 96813

April 27, 2015

Chairperson and Members
Natural Area Reserves System Commission
State of Hawai'i
Honolulu, Hawai'i

NARS Commission Members:

SUBJECT: REQUEST TO EXTEND THE CLOSURE OF KAHAUALE'A NATURAL AREA RESERVE, ISLAND OF HAWAI'I, TO THE PUBLIC PURSUANT TO HAR § 13-209-4.5 FOR PUBLIC SAFETY PURPOSES

This Commission Submittal outlines the status of the volcanic hazards in Kahauale'a Natural Area Reserve (NAR), island of Hawai'i and requests the Commission approve and recommend that the Board extend the closure of this area to the public, pursuant to HAR § 13-209-4.5.

BACKGROUND:

Kīlauea Volcano has been erupting continuously since January 1983. The Kahauale'a NAR has been inundated by lava flows several times during the 28+ year eruption of the middle east rift zone vents, namely Pu'u 'Ō'ō, Kupaianaha, and the Thanksgiving Eve Breakout (TEB) vents. As recently as March 2011 flows were still active within the Natural Area Reserve that originated from the TEB vent (its official name) that commenced erupting in July, 2007. On March 5th, 2011 the floor of Pu'u 'Ō'ō vent collapsed, dropping at least 370 ft. Subsequently, the Kamoamoa fissure eruption ensued for 4 days, stalling activity in the TEB vent. Large land cracks up to 6 ft wide were opened during this event, and sulfur dioxide concentrations exceeded 11,000 tons per day. Since the cessation of the Kamoamoa fissure eruption, lava has returned to the Pu`u `Ō`ō vent and is slowly filling the crater floor. As of June 1, 2011, the lava was within 130 ft of the eastern vent wall. The lava could stay within the Pu'u 'Ō'ō crater, erupt to the east, as it did between 2007 and 2011, or erupt to the west, as it did with the March, 2011 Kamoamoa eruption. Another eruption to the east will directly impact the NAR.

The U.S. Geological Survey – Hawaiian Volcano Observatory (USGS-HVO) website provides updated status reports on the activity of Kīlauea. The June 8th, 2011 report provided the following activity summary:

> "Past 24 hours at the middle east rift zone vents and flow field:
> The tiltmeter on the north flank of Pu'u 'Ō'ō Cone recorded continued slowing deflation. The GPS network around Pu'u 'Ō'ō recorded long-term extension since

mid-April. Seismic tremor levels near the middle east rift zone vents remained low. The most recent (preliminary) sulfur dioxide emission rate measurement was 1,100 tonnes/day on June 3, 2011, from all east rift zone sources.

A lava lake, fed continuously by sources near the west and northeast edges of the lake, remained perched in the center of the crater floor. The rim of the perched pond was elevated more than 2-3 m (6-10 ft) higher than the surrounding crater floor, which was 39 m (130 ft) below the eastern crater rim when measured on June 1. The lake level remained high with one small breach through the western lake edge. There was also minor lava activity from at least one source at the base of the southwest crater wall. The only lava currently erupting in the east rift zone is within Pu'u 'Ō'ō Crater.

Before the July 21, 2007 eruption, public use of Kahauale'a was steadily increasing. A hiking trail (known as the Captain's Trail, Kahauale'a Trail, or Pu'u 'Ō'ō Trail) developed over years of use is widely publicized in visitor publications such as *Hawaii Revealed* and encourages people to use the trail to illegally access Pu'u 'Ō'ō, the current eruption source. The northern slope of Pu'u 'Ō'ō is within the Kahauale'a NAR, with the majority of the vent within Hawai'i Volcanoes National Park (HAVO); the National Park Service (NPS) continues to restrict access to Pu'u 'Ō'ō. Over the years, in response to the number of rescues and incidents at Kahauale'a, NARS staff have partnered with the Hawai'i Fire Department to increase signage and make minor trail improvements to minimize the number of hikers who become lost by going off-trail. The Hawai'i County Fire Department (HCFD) has responded to 14 separate incidents of lost parties in the Kahauale'a NAR area since May 2008, most of which occurred in 2010-2011. A number of closure signs and fenced barriers have been placed across the trail. There now seems to be an increased draw to try and view lava in Pu'u 'Ō'ō vent, as it is the only active lava in the east rift zone. Prior to March 2011, lava was entering the ocean near Kalapana and viewing activity was closely monitored by the County of Hawai'i.

Due to public safety concerns relating to unprepared visitors attempting to visit an active lava flow and an active volcanic area and the heightened risk of sulfur dioxide inhalation, and after discussions with staff from USGS-HVO, the Board closed Kahauale'a NAR to public access effective July 25, 2007. Since that time, NARS staff has communicated with USGS-HVO staff on a regular basis about the status and condition of the area to confirm that the area continues to pose a safety risk to visitors. In May 2008, a Memorandum of Understanding between the Board and the USGS-HVO was entered into that allows USGS-HVO access to Kahauale`a, for the purposes of volcanic hazard monitoring and provides the Board with hazard assessments and recommendations. Staff regularly attends weekly updates at the USGS-HVO headquarters in Hawai'i Volcanoes National Park. In addition, Division staff regularly monitors the signage and barricade at the Captain's Trail, and DOCARE officers patrol the area.

The Division requests the Board to continue the closure initiated July 25, 2007 and to extend it for another two years, through July 25, 2017. This closure is supported by the USGS-HVO and the County of Hawai'i Civil Defense. Should conditions change during the next years so that public access can again be safely restored, the Division will return to the Board to re-open the NAR.

During the current closure, Special Use Permit Applications to conduct research, filming, cultural practice, and other uses have been considered on a case-by-case basis with restrictive conditions, as necessary, clearly defined.

ANALYSIS:

Hawai'i Revised Statutes § 195-5 provides that the Department of Land and Natural Resources may make rules governing the use, control and protection of the areas included within the natural area reserves system. Hawai'i Administrative Rule § 13-209-4.5 provides:

> The board or its authorized representative, with the approval of the commission, may close or restrict the public use of all or any portion of a natural area reserve for up to two years, when deemed necessary by the commission for the protection of the natural, geological, or cultural resources of the area or the safety and welfare of persons or property, by the posting of appropriate signs indicating the duration, extent, and scope of closure. Closures may be renewed with the approval of the board or its authorized representative and the commission.

The proposed closure is requested for the safety and welfare of the public. The Commission approved the previous closure extension at its meeting April 6, 2009, recommended the Board extend the closure until July 24, 2011, and recommended another two year closure from July 25, 2011 through July 25, 2013, and most recently from July 2013 to July 25 2015.

The Division is seeking approval to close the entire NAR, TMK 311001002 Parcel 1 & 2 (22,521 acres), based primarily on information from USGS-HVO. The vent areas and lava channels are hazardous and conditions can change rapidly including collapse of existing features. Lava flows advancing through vegetation are hazardous and can produce fire and methane explosions that propel chunks of lava and rock several feet in the air. Fume emissions in the area can exceed 1000 tons per day of sulfur dioxide, and exceeded 11,000 tons per day during the Kamoamoa eruption event. Downwind exposure to these fumes can be hazardous, and have been known to reach concentrations that can be lethal. Finally, because of previous volcanic activity in Kahauale'a in the 1980s and 1990s, the entire NAR is marked by old lava tubes and cracks, now partially covered by vegetation, making the holes and gaps difficult to see and extremely dangerous to anyone venturing off established trails. Based on the current volcanic activity and the known dangers, the Division recommends closing the entire NAR, rather than just a portion. Natural Area Reserve Special Use Permit Applications to conduct research, filming, cultural practice, and other uses, such as hunting, will continue to be considered on a case-by-case basis with restrictive conditions, as necessary, clearly defined.

The Division requests the Commission approve and recommend that the Board extend the closure of Kahauale'a NAR for a term of two years commencing on July 25, 2015 through July 24, 2017, with the possibility of renewal should the current volcanic conditions continue. Should the current conditions change before July 25, 2017, so that public access can be safely accommodated, the Division will return to the Board to remove the closure. The exact duration of the closure is currently uncertain, as it is entirely dependent on the volcanic activity. The

Division is concerned about posting a specific date on signage, based upon a belief that visitor publication will then re-publicize that date as a date upon which the NAR will be re-opened, building expectations and creating management problems if the closure needs to be extended. After further discussion with the Attorney General's office and the Division of Conservation and Resources Enforcement (DOCARE), the Division has installed signage indicating that the area is *Closed until further notice*, or other appropriate language indicating the duration of the closure.

RECOMMENDATION:

That the Commission approve and recommend that the Board extend the closure of the Kahauale`a NAR for an additional term of two years commencing from July 25, 2015 to July 24, 2017.

Respectfully submitted,

LISA HADWAY
Administrator
Division of Forestry and Wildlife

Attachments: USGS-HVO letter
MOU between USGS – HVO and the State of Hawai'i BLNR

United States Department of the Interior

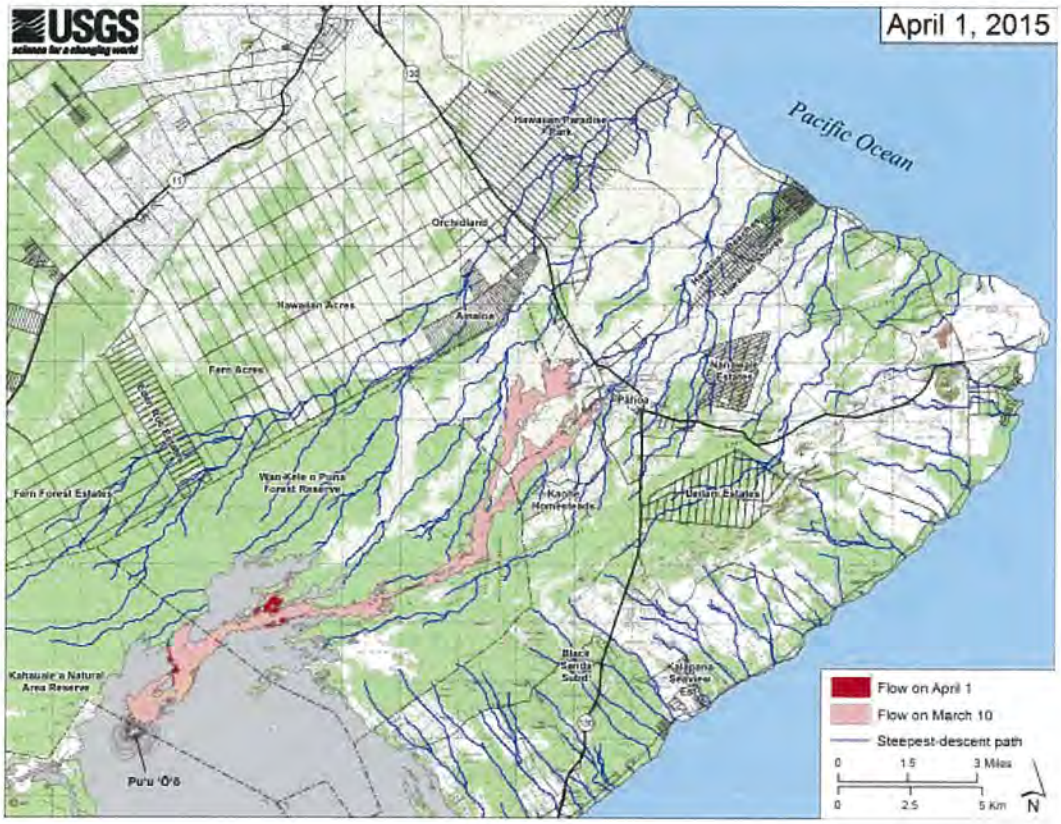
U.S. GEOLOGICAL SURVEY
Hawaiian Volcano Observatory
Post Office Box 51
Hawaii National Park, Hawai'i 96718-0051

IN REPLY REFER TO:

To:	Betsy Gagne, Department of Land and Natural Resources
From:	Christina Neal, Scientist-in-Charge
Date:	April 16, 2015
Subject:	Current Hazard Assessment of the Kahauale'a NAR

Due to the ongoing eruptive activity along Kīlauea Volcano's East Rift Zone , several volcanic hazards persist in the Kahauale`a NAR. They include lava flows, explosions, collapse of recently constructed topographic structures, and ground cracks.

Lava Flows: The NAR has been inundated by lava flows several times during the 32+ year eruption of middle East Rift Zone. The entire southeastern arm of the NAR has been covered multiple times by 'a'ā and pāhoehoe flows. Currently, active lava flows from the June 27 breakout on the north flank of Pu'u 'Ō'ō are proceeding northeast through the central portion of the NAR and into the adjoining Wao Kele o Puna Forest Reserve (Figure 1). Unless there is a radical shift in eruption site, we would expect continued activity from this vent and any additional breakouts to continue to impact both areas.



Lava flows from 1983-2014 in grey. Lava from the June 27 breakout in pink. Red indicates flows active

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as of April 1, 2015.

Gas Emissions: Throughout this eruption, Pu'u 'Ō'ō has been emitting elevated and variable amounts of volcanic gases, the most noxious of which is sulfur dioxide (SO_2). These gas emissions, along with fine particles – collectively called vog – are most dangerous in areas near the emission sources such as Pu'u 'Ō'ō and skylights in the upper lava tube system. Currently, SO_2 emissions from East Rift Zone vents are less than 1,000 tonnes per day. During previous episodes of activity along the East Rift Zone, however, emissions have been as high as 10,000 tonnes per day and this could happen again. Smoke from burning forest is also an issue.

During normal trade winds, these emissions immediately depart the NAR and move to the southwest through Hawai`i Volcanoes National Park. However, during kona or weak winds, these emissions can accumulate around Pu'u 'Ō'ō and/or move out into the northwestern section of the NAR. The areas in close proximity to the sources will experience high concentrations of sulfur dioxide. An SO_2 sensor on the north rim of Pu'u 'Ō'ō vent has recorded peak values of 150 ppm occasionally during kona wind conditions. The State of Hawaii Department of Health regards 15-minute-average sulfur dioxide concentrations above 1 ppm as Unhealthy and above 5 ppm as Hazardous.

Ground Cracks: The area north of the rift zone and the current flow field is mostly tube-fed pāhoehoe flows at least 400-500 years old. There are large cracks in this area often extremely well-hidden by vegetation. The few that are known but not located are near the southern boundary of this area abutting the rift zone. These are a significant hazard to anyone walking in the area.

Ground Collapse: The active vents of Pu'u 'Ō'ō and numerous structures built by lava flows over the active lava tube system all pose significant potential of collapse and inundation by lava.

Explosions: Active flows running through forests can generate dangerous blasts as trapped combustible gas (including methane), formed by lava-cooked vegetation, ignites and explodes. These are sudden, unpredictable, and can hurl blocks of lava into the air posing a significant hazard to those nearby.

If you have any questions, please feel free to contact me.

MEMORANDUM OF UNDERSTANDING

between the

UNITED STATES GEOLOGICAL SURVEY –
HAWAIIAN VOLCANO OBSERVATORY

and the

STATE OF HAWAII
BOARD OF LAND AND NATURAL RESOURCES

This **MEMORANDUM OF UNDERSTANDING,** between the **United States Geological Survey, Hawaiian Volcano Observatory**, hereinafter referred to as "USGS-HVO", and the **State of Hawaii Department of Land and Natural Resources**, hereinafter referred to as "DLNR," (together "the Parties"), outlines an agreement for volcanic hazard monitoring on State lands on the island of Hawaii.

RECITALS:

Whereas, USGS is Congressionally mandated to issue volcano hazard warnings by the 1974 Robert T. Stafford Disaster Relief and Emergency Assistance Act (Stafford Act) (Public Law 100-707); and

Whereas, one of the missions of USGS-HVO, as part of the Volcano Hazards Program of the U.S. Geological Survey, is to enhance public safety and reduce losses from volcanic events through effective forecasts and warnings of volcanic hazards, and that to accomplish this objective, USGS-HVO conducts research on the volcanoes of Hawai'i, maintains accurate data and visual information for outreach and emergency response situations, and communicates with emergency response officials; and

Whereas, USGS-HVO works to reduce the risks of volcano-related hazards through monitoring volcanoes and earthquakes to track their behavior before, during, and after eruptions, through studying the eruption histories of Hawaii's volcanoes in order to achieve a long-term perspective that can help anticipate their future behavior and identify potentially hazardous areas, and through communicating results of their studies with the public, emergency managers, educators, and students through the media, presentations, and workshops; and

Whereas, Kīlauea has been erupting continuously since January 1983, and since July 21, 2007 has been erupting as fissure lava flows into the State lands of Kahaualea Natural Area Reserve, Wao Kele o Puna Forest Reserve, and other unencumbered State lands; and

Whereas, due to public safety concerns of unprepared visitors attempting to visit the active lava flow, the State closed Kahaualea NAR to public access, effective July 25, 2007; and

Whereas, the study and monitoring of this volcanic eruption by USGS-HVO staff, contractors, and collaborators is of high importance to public safety, both immediately and over the long-term to understand volcanic processes; and

Whereas, effective monitoring and management of the current eruption while on State land will best be achieved through coordinated action between USGS-HVO and DLNR; and

Whereas, the Parties deem a Memorandum of Understanding to be the best way to clarify the common goals and cooperative benefits of the relationship;

NOW, THEREFORE, in consideration of the mutual benefits of cooperative effort and the other terms and conditions of this agreement, the Parties agree as follows:

I. ACCESS.

The Parties agree that USGS-HVO staff, contractors, and collaborators are expressly granted unlimited access via ground or by air to the State lands identified in Exhibit A ("Project Area") for the purpose of volcanic hazard monitoring. Ground access would be via the existing Captain's trail in Kahaualea Natural Area Reserve, through State parcel TMK 3-1-2-008-001, or through other mutually agreed-upon ground routes. All flights for any USGS passengers will adhere to USGS standards, including flight following and the wearing of appropriate personal protective equipment (PPE).

For purposes of this agreement, the term "contractors" means persons or entities under contract to USGS-HVO. For purposes of this agreement, the term "collaborators" means persons or entities under the control and supervision of the USGS-HVO Scientist in Charge (SIC), including those companies with whom USGS-HVO has USGS Research Associate Agreements (such as Volcano Video Productions and Tropical Visions Video, Inc.).

All requests for third party access (e.g., anyone other than USGS-HVO staff, contractors, or collaborators) will be handled by DLNR pursuant to existing permit requirements. It is anticipated that these third-party requests may be by film, video, or still photographers and researchers unaffiliated with USGS-HVO. DLNR agrees to circulate any applications for access or research into the Project Area to USGS-HVO for review and comment to ensure consistency with USGS-HVO sponsored monitoring and research.

II. COOPERATIVE RESEARCH AND MANAGEMENT.

The Parties agree to exchange relevant information regarding the results of volcanic monitoring and research to enhance land management. In addition, USGS-HVO may provide additional guidance/assistance regarding the assessment of fire hazards, which may include developing flow direction projections and other volcano hazard tools, and may provide assistance in mapping volcanic hazards.

The Parties agree that USGS-HVO shall acquire appropriate DLNR permits for the installation of monitoring equipment for long-term hazards. The Parties agree that during a crisis situation that threatens public safety, USGS-HVO may install temporary instrumentation to address that crisis. Unless the Parties agree otherwise on a case-by-case basis, USGS-HVO will maintain any monitoring equipment installed in the project area and be responsible for its removal when no longer needed.

The Parties agree that DLNR will remain primarily responsible for normal land management functions including, but not limited to, control of public access, fire suppression, and law enforcement.

III. COMMUNICATION.

Owing to the many values and benefits that arise from research and volcanic monitoring, the Parties further agree they will consult and communicate with each other regarding research, observations, and management activities within the project area. In addition, the Parties will consult with other affected agencies, including the Hawaii County Civil Defense Agency and the Office of Hawaiian Affairs.

IV. TERM.

The Parties agree that this instrument is effective as of the date of the last signature. This instrument will remain in effect as long as the current lava eruption on Kīlauea remains active, unless terminated earlier by the withdrawal of either Party with 30 days notice in writing.

V. PRINCIPAL CONTACTS.

The principal contacts for administering this MOU are:

A. *USGS-HVO:*
Jim Kauahikaua, Scientist-in-Charge
USGS Hawaiian Volcano Observatory
PO Box 51
Hawaii National Park, HI 96718

B. *State of Hawaii:*
Roger Imoto, Branch Manager
Division of Forestry and Wildlife, Hawaii Island
Department of Land and Natural Resources
19 E. Kawili Street
Hilo, HI 96720

IN WITNESS WHEREOF, the parties hereto have executed this Memorandum of Understanding as of the last date written below.

U.S. GEOLOGICAL SURVEY, HAWAIIAN VOLCANO OBSERVATORY

By _____ May 22, 2008
Jim Kauahikaua, Scientist-in-Charge Date

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES

By _____ MAY 14 2008
Laura Thielen Date
Chairperson

APPROVED AS TO FORM

_____
Deputy Attorney General

NAKULA NATURAL AREA RESERVE
DRAFT MANAGEMENT PLAN

2015

DEPARTMENT OF LAND AND NATURAL RESOURCES
DIVISION OF FORESTRY AND WILDLIFE

TABLE OF CONTENTS

Summary of Acronyms

BLNR	Board of Land and Natural Resources
CIP	Capital Improvement Project
DHHL	Department of Hawaiian Homelands
DLNR	Department of Land and Natural Resources
DOFAW	Division of Forestry and Wildlife
FR	Forest Reserve
FY	Fiscal Year
GIS	Geographic Information System
HISC	Hawai'i Invasive Species Committee
HRS	Hawai'i Revised Statutes
LHWRP	Leeward Haleakalā Watershed Restoration Partnership
MISC	Maui Invasive Species Committee
MFBRP	Maui Forest Bird Recovery Project
NARF	Natural Area Reserve Fund
NAR	Natural Area Reserve
NARS	Natural Area Reserves System
NEPM	Native Ecosystems Protection and Management
NIP	Native Invertebrate Program
NPS	National Park Service
PEPP	Plant Extinction Prevention Program
RCUH-PCSU	Research Corporation of UH -Pacific Cooperative Studies Unit
T&E	Threatened and Endangered
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
YCC	Youth Conservation Corps

Executive Summary

Figure 1. View of Nakula Natural Area Reserve from the highway.

Nakula Natural Area Reserve (NAR or Reserve) is situated on lands within the upper portions of Nakula and Kahikinui Ahupuaʻa in the Hana District on the south slope of Haleakalā, Maui. The Reserve was formally established in 2011 by Governor's Executive Order 4365 from lands withdrawn from the Kahikinui Forest Reserve (FR). The 1,500 acre (ac) (607 hectare (ha)) Reserve was created to protect leeward Haleakalā koa (Acacia koa) forest and natural communities, including rare and endangered plants and animals.

This type of forest once covered an estimated 40,000 ac, extending from Makawao to Kaupo. It has been so badly impacted by human activities (primarily logging and cattle ranching) that it has been reduced to approximately 5% of its original range, and even this has been severely degraded. Active management is needed to protect this last remnant of forest from disappearing and to restore it to its former extent.

The overall management goal of the Nakula Management Plan is to protect, maintain, and enhance the Reserve's unique natural and cultural resources. Management programs have been developed to support this overall goal and include the following:

1. Restoration
    - Reforestation
    - Forest Bird Recovery
    - Seabird Recovery
    - Bat Recovery
    - Invertebrate Recovery
2. Threat Abatement
    - Ungulate control
    - Invasive plant control
    - Predator control
    - Fire prevention and response
    - Non-native insects and disease
3. Information and Education
4. Research and Survey
5. Infrastructure Management

This Management Plan outlines the types of management activities planned in Nakula NAR for the foreseeable future. Specific activities will be updated based on accomplishments and available funding over time. Adaptive management will allow the prioritization of different goals and approaches as restoration of the NAR progresses with feedback from ongoing field monitoring of management activities.

Section 1 of the Management Plan provides background information on the physical setting, land use and condition of resources in the NAR. Section 2 describes the planned management actions including overall goals and objectives and planned short term and long term management actions. Section 3 summarizes planned management actions and the associated budget proposed to complete those actions. Section 3 is intended to be regularly updated (approximately every two years) and will be used by NARS staff for operational and biennium budget planning.

1 Background and Current Condition

Long-term management of Nakula NAR provides multiple benefits to the state. The natural communities within the Reserve provide habitat for a diverse range of native plants and animals, from rare birds to endemic invertebrates, preserving the biodiversity of Hawai‘i. The subalpine and alpine habitats of the Reserve are an important component of the larger landscape of protected and managed public and private lands stretching across the leeward slope of Haleakalā.

The Natural Area Reserves System (NARS) was created in 1971 by the Hawai‘i State Legislature to "preserve in perpetuity specific land and water areas which support communities, as relatively unmodified as possible, of the natural flora and fauna, as well as geological sites, of Hawai‘i (HRS § 195-1)." The legislature further found that these unique natural assets should be protected and preserved, both for the enjoyment of future generations and to provide baselines against which changes to Hawaii's environment can be measured. The NARS is administered by the Hawai‘i Department of Land and Natural Resources (DLNR) Division of Forestry and Wildlife (DOFAW) Native Ecosystem and Management (NEPM) Section. NARS Commission members act in an advisory capacity for the Board of Land and Natural Resources, which sets policies for the Department. Hawai‘i Administrative Rules 13-209 relate to the management of the NARS.

The NARS is based on the concept of protecting ecosystems – not merely single species. Because the natural resources of Hawai‘i are under constant threat from invasive species, human encroachment, feral ungulates, climate change, and other threats, the NARS seeks to protect the best remaining examples of the State's unique ecosystems. In addition to setting aside these areas as reserves, the NARS strives to actively manage these reserves in order to preserve the unique characteristics that make these areas an integral part of the natural heritage of Hawai‘i. Reflecting this, the mission of the NARS is: "The NARS exists to ensure the highest level of stewardship for Hawaii's natural resources through acquisition, active management, and other strategies."

The NARS presently consists of 21 reserves on five islands, encompassing more than 123,000 ac (49,776 ha) of the State's most unique ecosystems. The diverse areas found in the NARS range from marine and coastal environments to alpine desert, and from fresh lava flows to wet forests. These areas often serve as habitat for rare native plants and animals, many of which are on the verge of extinction. The NARS also includes important watersheds and is an integral part of the scenic landscape and natural beauty of Hawai‘i.

The NARS website at http://dlnr.hawaii.gov/ecosystems/nars/ provides general information on NARS management across the state as well as other NEPM Section programs and policies.

1.1 Site Description (Physical and Biological Resources)

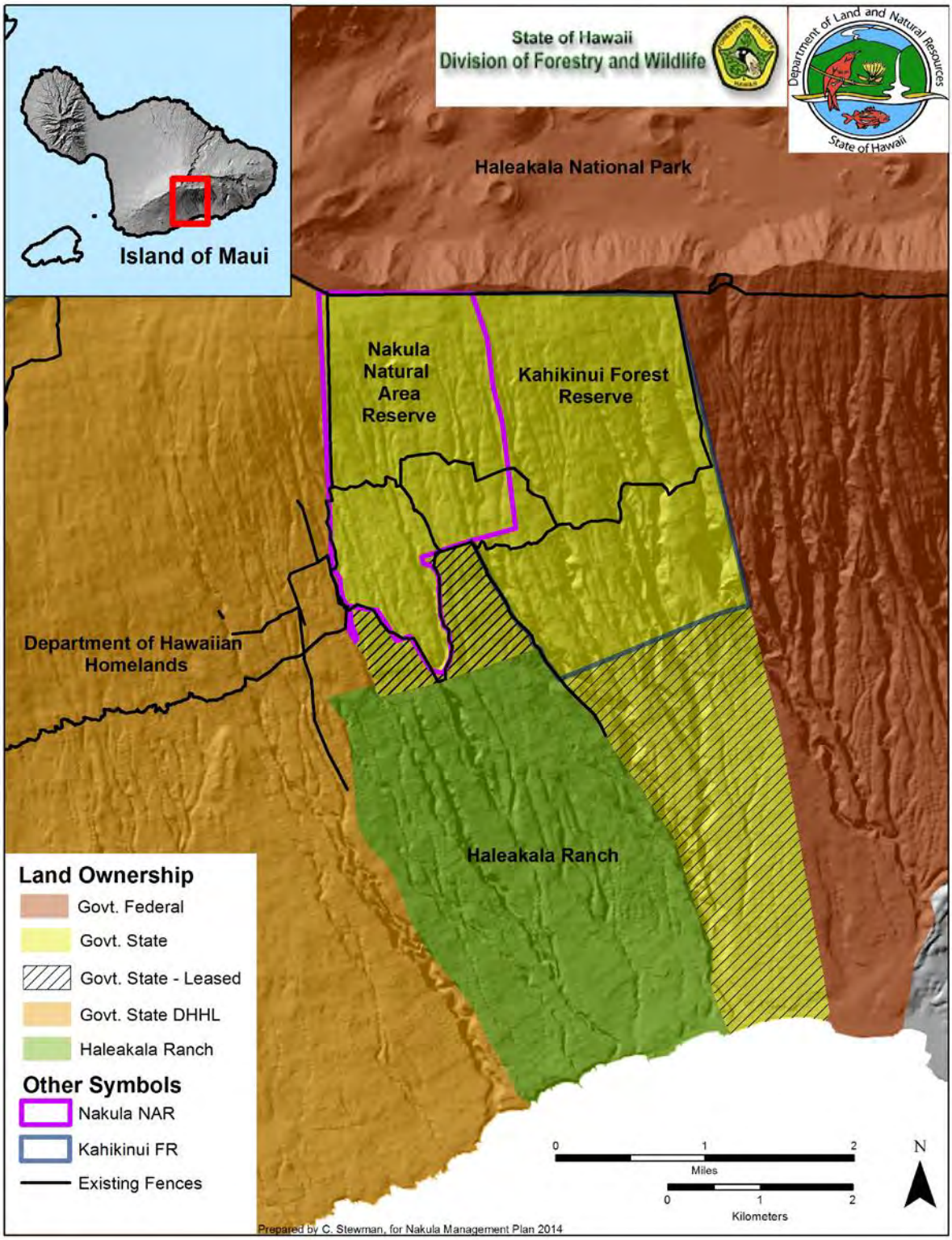
1.1.1 Location

Nakula NAR is located on the southern slope of Haleakalā on Maui in the Hana District, and includes approximately 1,500 ac (607 ha) (Figure 3). The NAR boundaries encompass a wide elevational gradient from 3,600 ft (1,097 meters (m)) - 9,200 ft (2,804 m). The western boundary follows the canyon carved by Waiʻōpai stream; a ridge between the two forks of Pāhihi stream forms the eastern boundary. The upper elevation boundary is marked by Haleakalā National Park's boundary perimeter fence. The lower elevation boundary of the Reserve on the eastern side is at the 5,000 ft (1,525 m) elevational contour. The lower boundary dips downhill to include the area between major forks of Wailaulau gulch and then goes back up to about 5,000 ft (1,525 m) on the western side.

Neighboring lands include Kahikinui Forest Reserve to the east, lands administered by the Department of Hawaiian Homelands (DHHL) to the west, Haleakalā National Park to the north, and state-owned lands leased to Haleakalā Ranch for pasture to the south.

Figure 2. View from camp over lower Nakula NAR and surrounds.

Figure 3. Land ownership of Nakula NAR and surrounding lands.



1.1.2 Climate

The Reserve is on the drier leeward side of Haleakalā. A primary consideration in the design of the Reserve boundaries was to capture the dramatic elevation change (5,600 vertical feet in 2½ miles), and the corresponding change in moisture regimes (from the moist forest of the afternoon fog belt at the Reserve's lower elevations up to the harsh dry desert conditions at the summit). These climatic differences result in a variety of native habitats across a relatively small area. A secondary consideration in the Reserve design was to capture as much lateral variation along the mountain contour as possible. Geologic and climatic factors also influence forest composition across the mountain slope. Koa dominated forest is prevalent on the western side of the Reserve, while a dry ʻōhiʻa (*Metrosideros polymorpha*) forest persists to the east.

Average annual rainfall in the mid-elevation sections of leeward Haleakalā is 35-50 inches (89 – 127 centimeters (cm)) (Giambelluca et al. 2013), with prevailing winds from the northeast. The temperature inversion, which fluctuates from 5,000 - 7,000 ft (1,500 -2,134 m), results in cloud formation trapping warmer moist air with the area below the temperature inversion being substantially moister (UH-Hilo, Dept. of Geography 1998; Figure 4). Clouds at the inversion layer also result in increased moisture through fog drip, from moisture collecting on trees.

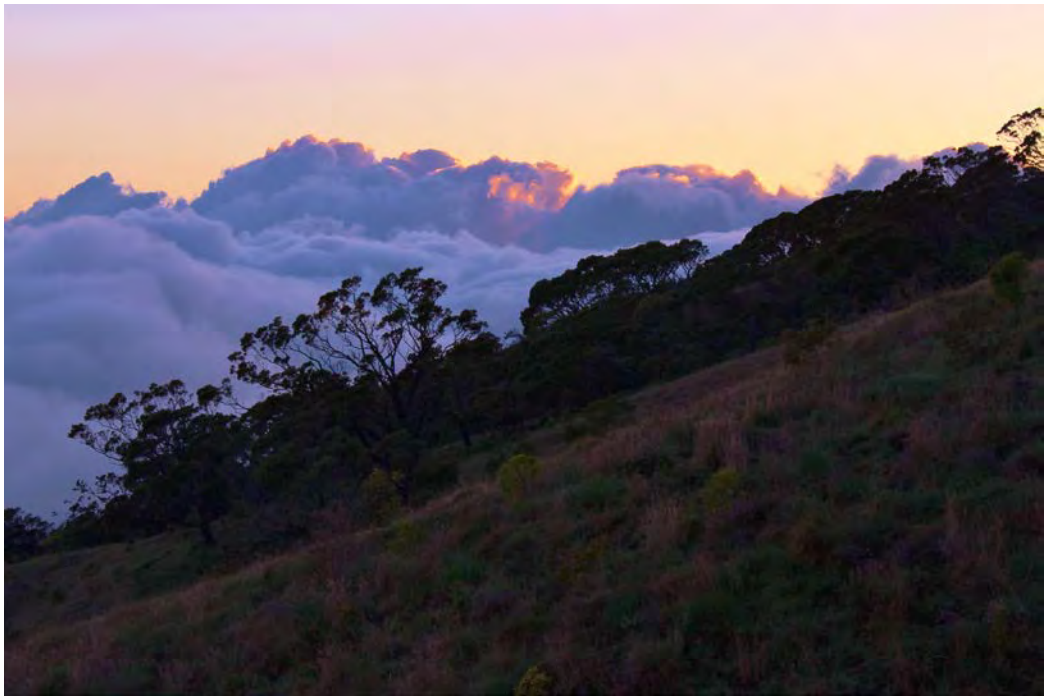


Figure 4. Cloud formation along the inversion layer.

1.1.3 Geology

The surface geology of the area consists of lava flows from Haleakalā Volcano, mostly Pleistocene in age (Kula Volcanic Series) with some Holocene (Hana Volcanic Series) in the southwest (MacDonald et al. 1986). A few cinder cones, including Puʻu Aliʻi, are also present. Lava tubes may be present in some areas.

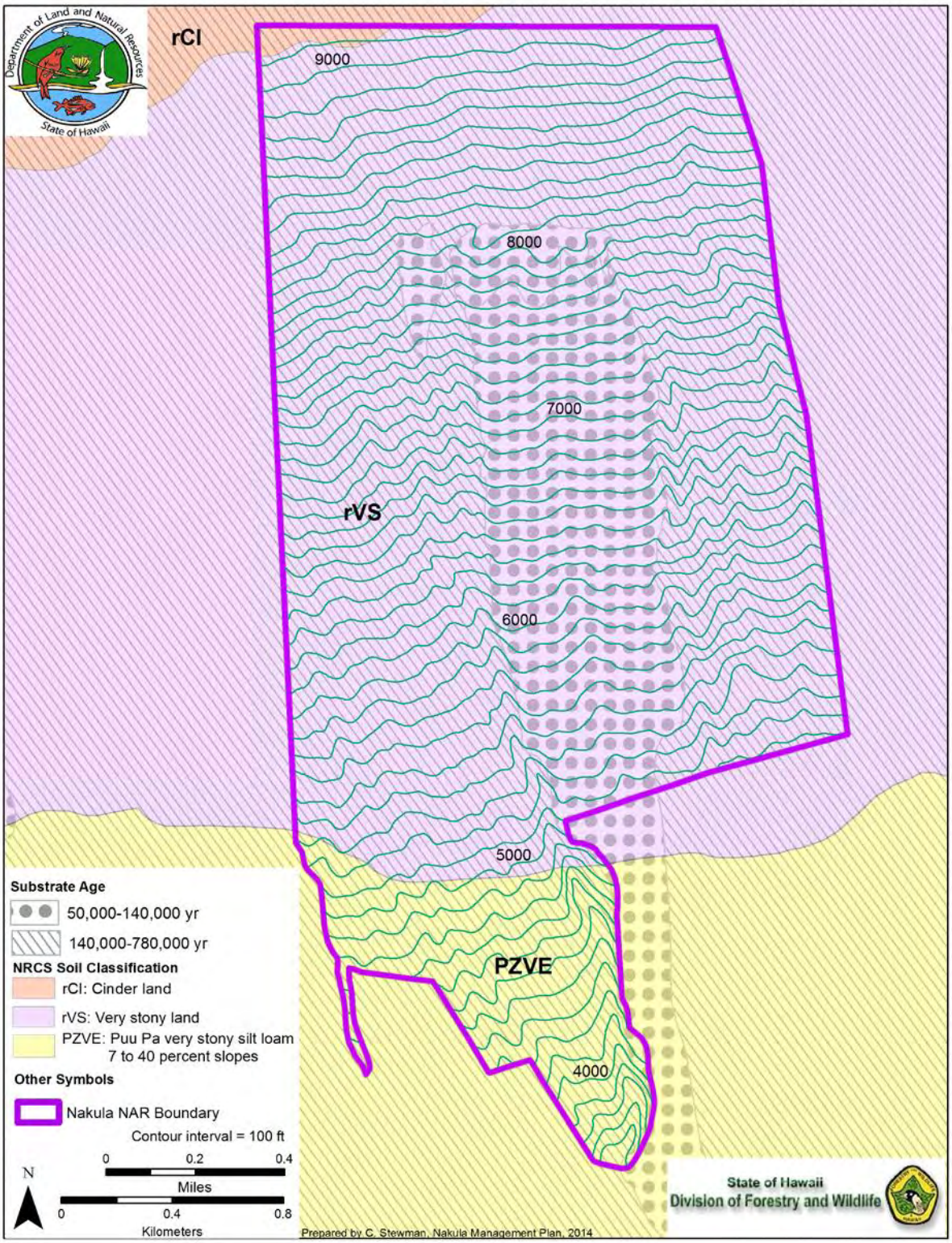
Noteworthy geologic features include highly dissected exposures of the Kula volcanic series, mantled with soils derived from ash and cinder deposits. The Pu'u Ali'i cinder cone is a prominent feature located at 8,000 ft (2,438 m) elevation. The numerous gullies and gulches along the heavily dissected mountain slope provide sheltered micro-habitats that allow forest vegetation to extend upslope into the subalpine region. These drainages also hold numerous springs and seeps which may provide habitat for native invertebrates.

Surface flow of water on the leeward slopes is minimal and generally restricted to short-duration flash events. There are no perennial streams within the study area and the large gulches that develop further downslope are dry most of the year.

1.1.4 Soils

Natural Resource Conservation Service soil maps classify soils in the Reserve as: Very stony land; Puu Pa very stony silt loam, 7 to 40 percent slopes; and Cinder land (Figure 5). Soil erosion has been greatly accelerated by the presence of introduced ungulates, particularly cattle and goats and subsequent reduction of forest cover (Figure 6).

Figure 5. Substrate age and soil classification of Nakula NAR.



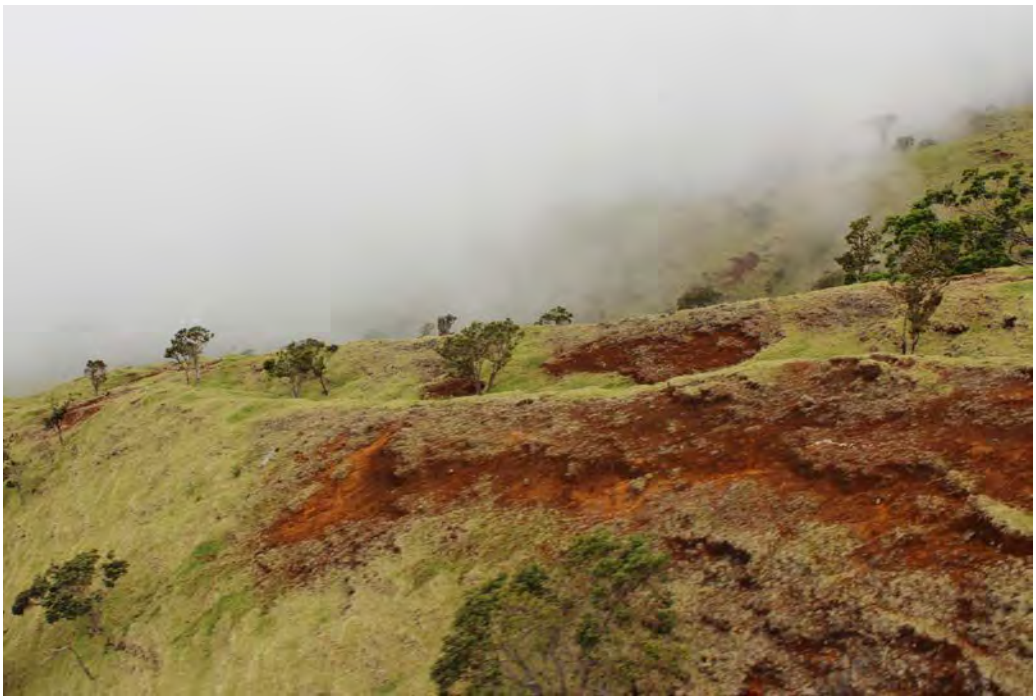


Figure 6. Erosion scars from feral ungulate damage.

1.1.5 Native vegetation

There are six native vegetation communities within Nakula NAR. Most of the native habitats in the Reserve have been degraded to a large degree; primarily by grazing animals such as cattle and goats and the spread of introduced pasture grass. Examples of native vegetation persist at higher elevations and on the walls of canyons too steep for ungulates to access. Generalized past native vegetation zones, which existed prior to disturbance have been mapped using elevational gradients described for these communities, rather than vegetation currently present in the Reserve (Figure 7). Currently existing vegetation has been mapped by Jacobi (in prep.) as a revision of the Hawai‘i GAP Analysis land cover map (Figure 8). Broad vegetation conditions have also been described (Figure 9).

Plant community classifications follow Gagne and Cuddihy in Wagner et al., 1999. Vegetation communities include dry subalpine shrubland, two dry subalpine forest types, and three types of montane mesic forests. Areas above 5,247 ft (1,600 m) elevation are classified as subalpine, with the remainder of the Reserve in the montane mesic zone.

Pūkiawe (Styphelia tameiameiae)/‘Ōhelo (Vaccinium spp.) Subalpine Dry Shrubland - Between the top of the Reserve at 9,200 ft (2,804 m) and approximately 8,000 ft (2,438 m) a dense *pūkiawe* shrubland predominates, interspersed with native grass and fern patches.

ʻŌhiʻa (Metrosideros polymorpha) Subalpine Dry Forest/*Māmane (Sophora chrysophylla) Subalpine Dry Forest* - Between 8,000 ft (2,438 m) and 6,500 ft (1,981 m), the vegetation has been severely impacted by goats and the mountain has been mostly denuded of native vegetation. However, remnants of these two forest types can still be found in some of the steeper gulches, or in areas where the underlying substrate has resisted erosion.

Koa/ʻŌhiʻa Montane Mesic Forest - This forest type is found below the temperature inversion layer at about 6,500 ft (1,981 m) elevation. Leeward koa forests are unique in that the forest depends largely on precipitation and fog drip from afternoon clouds created by convection and diurnal heating. At the upper reaches, this forest is a dry subtype, with a koa canopy and an understory of tall ʻaʻaliʻi shrubs (*Dodonaea viscosa*). As moisture increases with decreasing elevation, species diversity and tree size increase, with this community being best expressed between 3,500 ft (1,069 m) and 4,500 ft (1,372 m) elevation. Due to ungulate grazing, the natural forest understory has been largely eliminated and replaced by non-native, perennial pasture grasses. However, gulches, cliff faces and other protected areas still contain a diverse assemblage of native ferns and other understory plants. These gulches provide a unique sheltered microhabitat, and also contain springs and seeps that feed intermittent streams.

ʻŌhiʻa Montane Mesic Forest – This forest type is dominated by ōhiʻa with native understory trees and shrubs. This forest type is found in the same elevational zone as the Koa/ʻŌhiʻa forest described above but is predominant in drier areas with shallower, less well-developed soils.

Olopua (Nestegis sandwicensis) Montane Mesic Forest - Below 3,500 ft (1,069 m) elevation, moisture decreases, and the vegetation grades into a much degraded remnant of what was once a diverse forest. This community is found in a very small area at the lower extent of the Reserve; within the canyon of Wailaulau gulch.

Figure 7. Potential native vegetation of Nakula NAR.

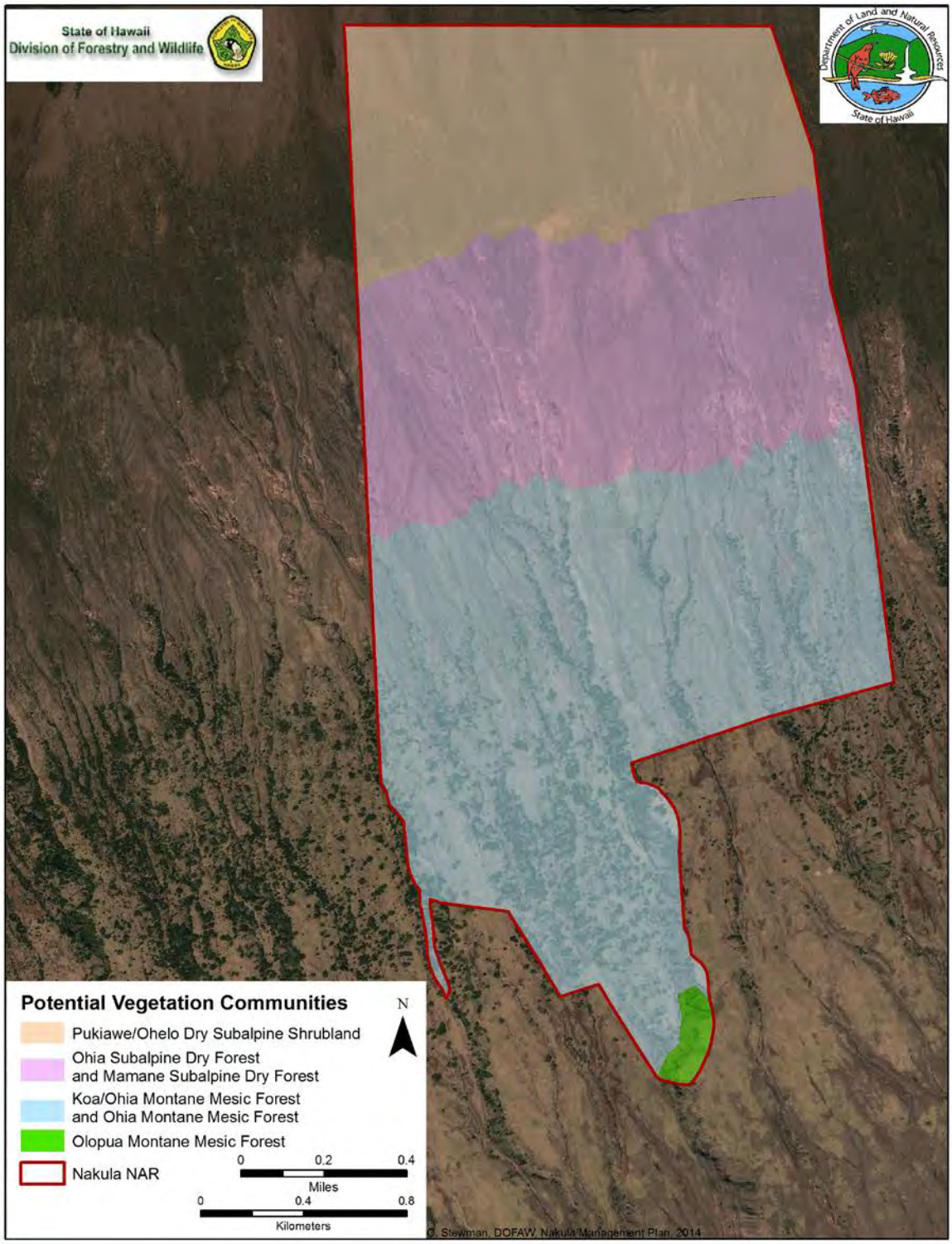


Figure 8. Existing vegetation (land cover analysis) of Nakula NAR.

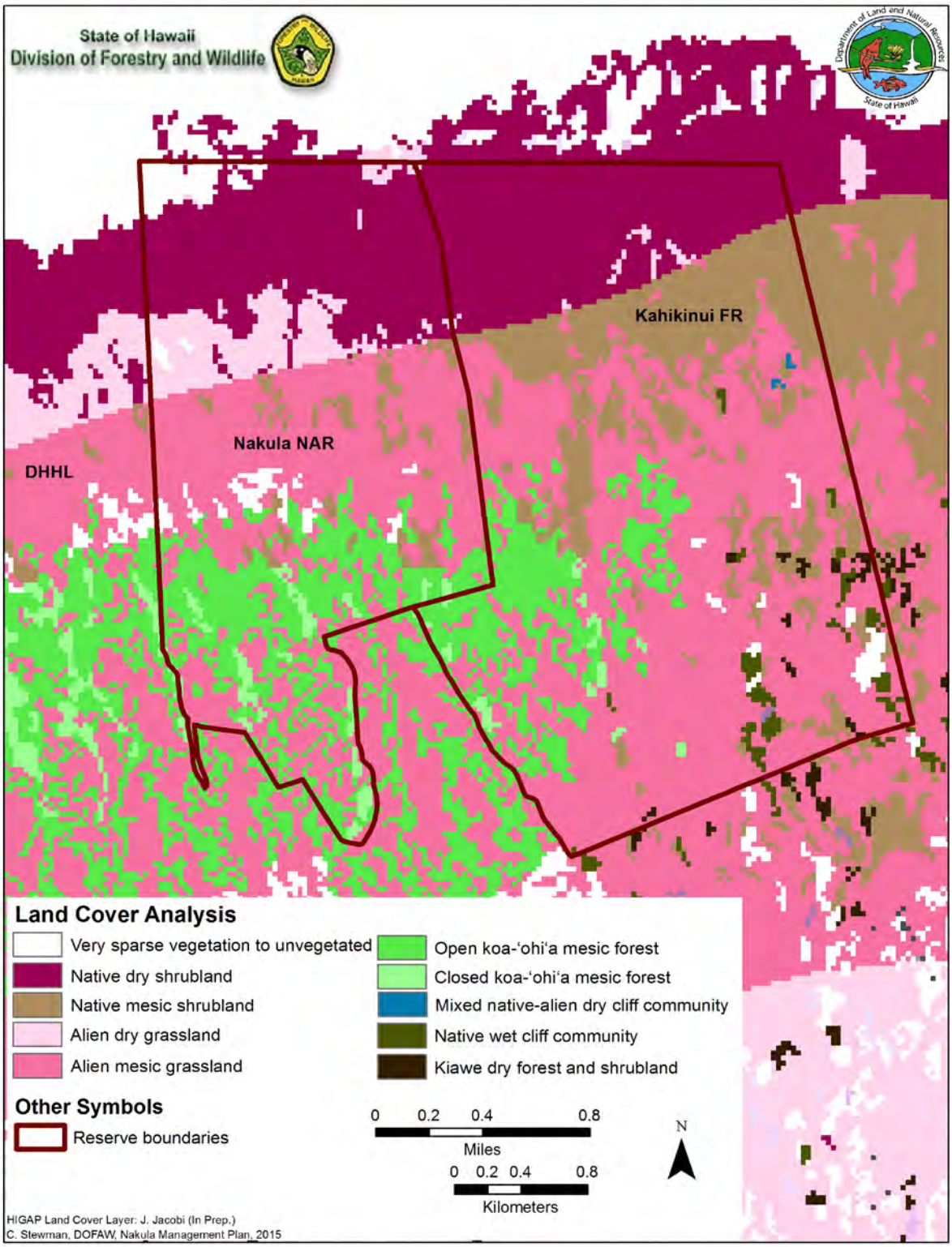


Figure 9. Existing vegetation conditions of Nakula NAR.

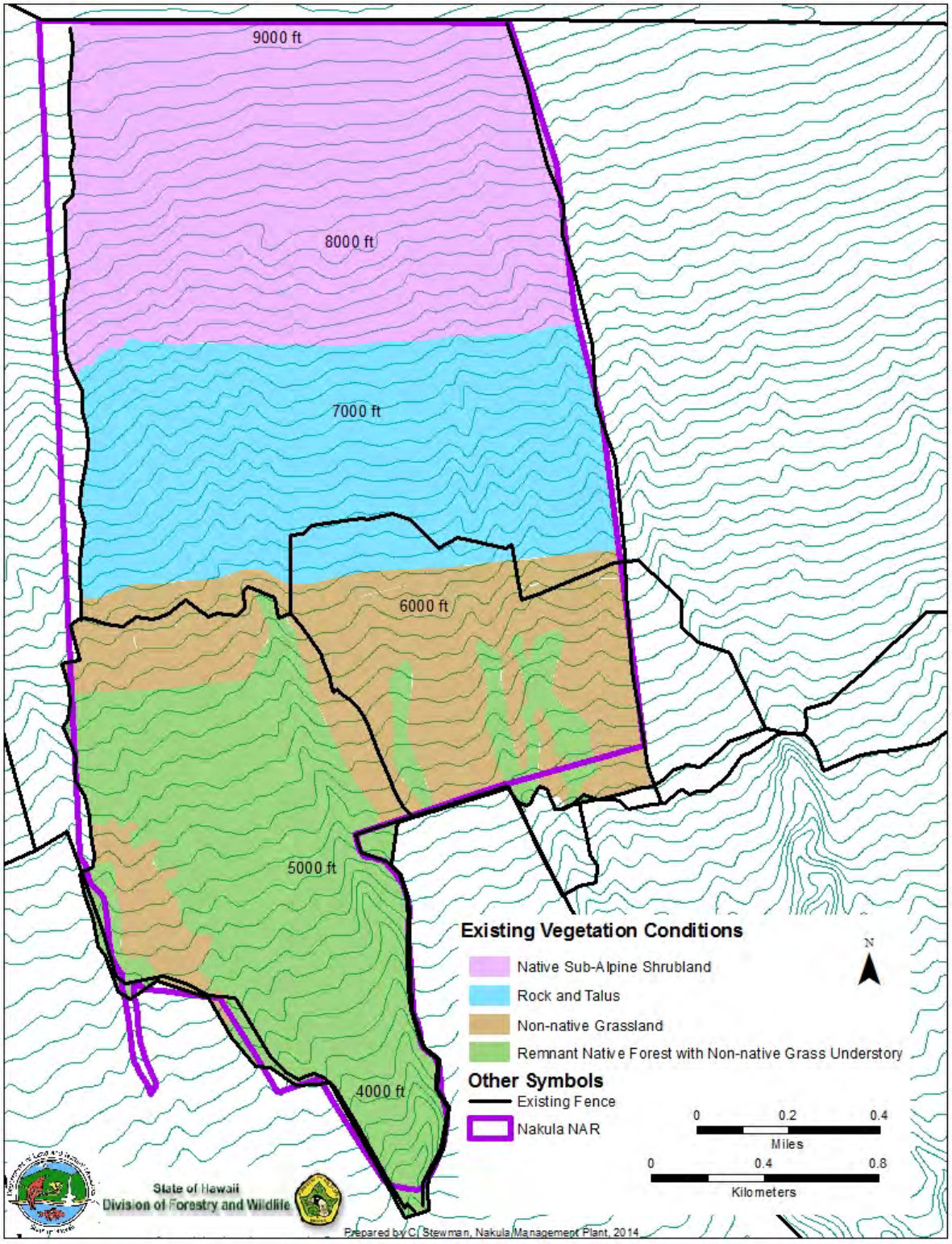


Figure 10. Diplazium molokaiense *(Endangered).*

There are numerous endangered and/or rare plant species in the NAR as well as a number of species recorded from similar habitat in the immediate surrounding area that could potentially occur within the NAR, that would be appropriate for reintroduction in the NAR (Table 1).

Areas with similar habitat adjacent to the Reserve are designated critical habitat for various plant species including *Argyroxiphium sandwicense* ssp. *macrocephalum, Bidens micrantha* ssp. *kalealaha*, *Neraudia sericea, Diellia erecta, Diplazium molokaiense* (Figure 10) and *Huperzia mannii*.

Table 1. Endangered and rare plant species historically and/or currently found in or near Nakula NAR (Hank Oppenheimer, personal communication).

Scientific Name	Common Name	Status*	Location**
Argyroxiphium sandwicense ssp. macrocephalum	ʻahinahina, Haleakalā silversword	E	2
Asplenium peruvianum var. insularum		E	1
Bidens micrantha ssp. kaleaha	koʻokoʻolau	E	1
Cyanea comata		SOC	?
Cyanea obtusa	haha	C	2
Cyrtandra bisserata	haʻiwale	SOC	1
Cytrandra oxybapha	haʻiwale	C	2
Diellia erecta		E	1
Diplazium molokaiense		E	1
Geranium arboreum		E	2
Hillebrandia sandwicensis		SOC	1
Huperzia mannii		E	2
Neraudia sericea		E	2
Kadua foliosa		SOC	?
Ochrosia haleakalae	holei	C	2
Phyllostegia ambigua		SOC	2
Phyllostegia haliakalae		SOC	1
Ranunculus hawaiensis	makou	C	2
Ranunculus mauiensis	makou	C	2
Sanicula sandwicensis		SOC	2
Santalum halekalae	ʻiliahi	SOC	1
Schidea inflexa		SOC	?
Sisyrinchium acre		SOC	2
Stenogyne haleakalae		SOC	?
Zanthoxylum hawaiʻiensis	ʻaʻe	E	2

* Status E = Federally listed as Endangered, C = Candidate for listing, SOC = Species of Concern

**Location 1 = recorded from NAR, 2 = recorded from lands adjacent to NAR with similar habitat; could occur within NAR or be restored in the NAR. ? = possibly extinct, recorded from NAR vicinity

1.1.6 Native wildlife

The Reserve currently supports several endemic native forest birds (Table 2), including the endangered Maui ʻalauahio or Maui creeper (*Paroreomyza montana*). The area is identified as a future recovery site for three endangered forest bird species: kiwikiu or Maui parrotbill (*Pseudonestor xanthophrys;* Figure 11), Maui ʻalauahio, and ʻakohekohe or crested honeycreeper (*Palmeria dolei*) by the U.S. Fish and Wildlife Service (USFWS) Forest Bird Recovery Plan (USFWS 2006) and the State Comprehensive Wildlife Strategy (State of Hawaiʻi 2005), although kiwikiu and ʻakohekohe are not currently present in the Reserve. Recovery areas are habitat that will allow for the long-term survival and recovery of endangered Hawaiian forest birds.

The endangered nēnē or Hawaiian goose (*Branta sandvicensis)* occurs in the area (Figure 12). The endangered ʻuaʻu or Hawaiian petrel (*Pterodroma sandwichensis*) is also known from the region, but is probably present only in very small numbers in subalpine areas within the Reserve due to impacts of feral ungulates and non-native predators such as cats (*Felis cattus*) and rats (*Rattus species*). Baseline surveys in 2012 and 2013 discovered eight burrows in upper elevation portions of Nakula NAR and Kahikinui Forest Reserve (Maui Nui Seabird Recovery Project internal report).

Figure 11. Kiwikiu (Endangered).

Figure 12. Nēnē (Endangered).

Hawai'i's only endemic land mammal, the 'Ōpe'ape'a, or endangered Hawaiian hoary bat (*Lasiurus cinereus semotus*; Figure 13), is found in the Reserve. The Hawaiian hoary bat is an endangered species found on all the Main Hawaiian Islands except Ni'ihau. Current population estimates range from a few hundred to a few thousand, but the actual number remains essentially unknown. According to the state Comprehensive Wildlife Conservation Strategy (2005), primary threats include habitat loss (especially tree cover), pesticides, predation, and roost disturbance.

Figure 13. Hawaiian hoary bat (Endangered).

Invertebrates in the area are poorly studied, but the Reserve is likely to be important habitat for native insects and further research and survey is needed. Arthropod abundances were assessed at the Reserve as part of a study to assess the arthropod prey base for potential bird reintroduction (Peck et al., manuscript in prep). *Manduca blackburni,* the endangered Blackburn's sphinx moth, is present on the south slope of Haleakalā and has critical habitat near (although not within) the Reserve. However, suitable habitat for the moth's native food plant tree, *Nothocestrum latifolium* ('aiea) usually occurs at lower elevations areas below 4,000 ft, and the Reserve contains only a small portion of habitat at that elevation.

Table 2. Native birds historically and/or currently found in or near Nakula NAR.

Taxon	Common Name	Status
Asio flammeus sandwichensis	Pueo, Hawaiian owl	endemic
Branta sandvicensis	Nēnē or Hawaiian goose	endemic - endangered
Hemignathus virens	'Amakihi	endemic
Himatione sanguinea	'Apapane	endemic
Palmeria dolei	'Akohekohe or crested honeycreeper	endemic - endangered
Paroreomyza Montana	Maui 'alauahio or Maui creeper	endemic - endangered
Pluvialis fulva	Kōlea or Pacific golden plover	indigenous
Pseudonestor xanthophrys	Kiwikiu or Maui parrotbill	endemic - endangered
Pterodroma sandwichensis	'Ua'u or Hawaiian petrel	endemic - endangered
Vestiaria coccinea	'I'iwi	endemic

Appendix B contains a summary of all bird species known from the Reserve, both native and non-native.

1.2 LAND USE

1.2.1 Land designation and history

The NAR was established in 2011 by Governor's Executive Order 4365 from lands withdrawn from the Kahikinui Forest Reserve (FR). The NAR lies within the State Conservation District, Resource (R) Subzone.

The FR System was created by the Territorial Government of Hawai`i in 1903 to provide the necessary water requirements for lowland agriculture demands and surrounding communities by protecting and enhancing important forested mauka lands for their abundance of public benefits and values. Nakula NAR was formerly part of a larger tract established as the Kahikinui FR on December 22, 1928. The original Kahikinui FR included *mauka* (mountain) lands at Kahikinui, Nakula, Kaupo, Nu'u, Wailaulau, and Papa'anui. These lands totaled approximately 16,013 acres that are now owned by the State of Hawai'i, private entities and the DHHL. Management responsibility was originally given to the Territorial Department of Forestry.

Correspondence dating from this time repeatedly mentions that large herds of feral goats, as well as cattle trespassing from neighboring ranches, were considered a critical threat to the survival of this forest. Numerous attempts were made over the years to address threats posed by feral goats and cattle, including construction of cattle fences along forest boundaries, and establishing access for goat hunters. However success was very limited due to the remoteness of the location and limited resources available. Some level of goat control was achieved through public hunting; primarily in the western portion of the Forest Reserve via a road and trail that started near the lower Skyline Trail above Polipoli State Park and ended at Wai'ōpae Gulch 3.5 miles away. Access was managed and maintained by DOFAW through a cooperative agreement with the DHHL that established the Kahikinui Game Management Area. In 1984, 8,747 acres of DHHL land was withdrawn from the FR in accordance with Attorney General Opinion No. 75-3, dated March 21, 1975.

In 1994, the DHHL rescinded its access and management agreement with DOFAW. While the intent of this action was to allow DHHL to manage forest lands for the benefit of settlers, it restricted general public access to the Nakula region, including access for public hunting.

1.2.2 Related planning documents

Table 3. Summary of related planning documents

Plan/Cooperative Effort	Comment
Kahuku Wind Power Hawaiian Hoary Bat Mitigation Plan (May 2014)	Nakula NAR project will mitigate for permitted take and provide a net benefit by increasing population numbers of the Hawaiian hoary bat via the creation/restoration of available foraging and roosting habitat.
Maui Forest Bird Recovery Project Workplan (2014-2015)	Summarizes restoration research planned for Nakula NAR
Maui Forest Bird Recovery Project Protocols for Restoration Trials in Nakula NAR (2012)	Description of restoration research protocols planned for Nakula NAR
The Rain Follows the Forest - A Plan to Replenish Hawaii's Source of Water (DLNR, November 2011)	Portions of the Reserve are identified as a priority watershed area on the island of Maui.
DOFAW Statewide Assessment and Resource Strategy (SWARS) 2010	Identifies areas of greatest need and opportunity for forests in Hawaii and develops a long-term strategy for management. Objectives include: 1.1. Identify and conserve high-priority forest ecosystems and landscapes; 2.2. Identify, manage and reduce threats to forest and ecosystem health; 3. 3. Enhance public benefits from trees and forests; 3.1. Protect and enhance water quality and quantity; 3.5. Protect, conserve and enhance wildlife and fish habitat; 3.7. Manage and restore trees/forests to mitigate and adapt to global climate change.
Leeward Haleakalā Watershed Restoration Partnership Management Plan (2006)	The plan describes threats and general management actions for DOFAW lands within the partnership.
U.S. Fish and Wildlife Revised Recovery Plan for Hawaiian Forest Birds (2006)	Supports recovery actions 1 and 2: protect and manage ecosystems for the benefit and recovery of forest birds.
Hawai'i Comprehensive Wildlife Conservation Strategy (2005)	Implements objectives 1, 2, 3, 4, and 5
Kahikinui Koa Forest Protection and Restoration Final Environmental Assessment (2004)	Environmental compliance for existing management actions at Kahikinui FR, including fencing of portions now designated Nakula NAR
U.S. Fish and Wildlife Service Recovery Plan for the Multi-Island Plant Cluster (1999)	Summarizes biological information and recovery actions needed for Neraudia sericea
U.S. Fish and Wildlife Service Recovery Plan for the Maui Plant Cluster (1997)	Summarizes biological information and recovery actions needed for Argyroxiphium sandwicense ssp. Macrocephalum, Bidens micrantha ssp. Kaleaha, Geranium arboretum, and Huperzia mannii
U.S. Fish and Wildlife Recovery Plan for the Hawaiian Hoary Bat (1998c)	Supports objective 2: protect and manage current populations and identify and manage threats

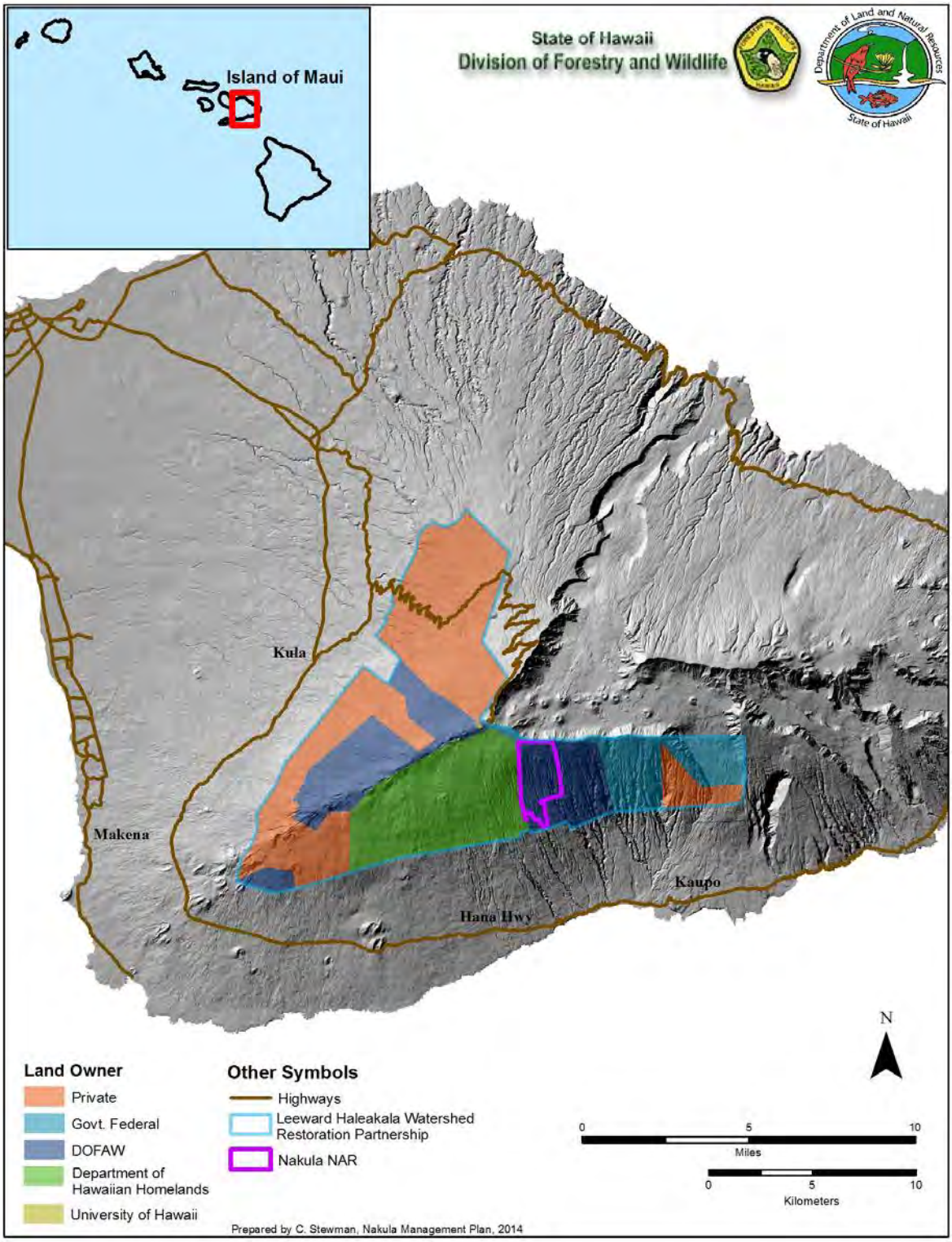
1.2.3 Partnerships

DOFAW works closely with numerous partners in order to increase the effectiveness and efficiency of management with limited resources. Many of the threats to the Reserve's resources, such as feral ungulates, invasive weeds, fire, invasive insects, and introduced plant and animal diseases, occur across land ownership boundaries. Landscape scale reforestation and recovery of endangered plants and animals also benefits from a partnership approach.

DOFAW is a member of the Leeward Haleakalā Watershed Restoration Partnership (LHWRP), and Nakula NAR is included within the partnership land area (Figure 14). The LHWRP includes 12 partners as well as 10 associate partners. Formed in 2003 and covering 43,000 ac (17,401 ha), the goal of LHWRP is to restore koa forests on Haleakalā from Makawao through ʻUlupalakua to Kaupō between 3,500 and 6,500 ft (1,067 - 1,981 m) elevation. Continued collaboration with the LHWRP, particularly adjacent landowners will enhance the effectiveness of reforestation efforts as well as the response to regional threats like feral ungulates, weeds and fire.

NAR staff will continue to work closely other partners including the Maui Invasive Species Committee (MIISC) to jointly address incipient invasive species of plants and animals that threaten the Reserve; the Plant Extinction Prevention Program (PEPP) on rare plant recovery; and the Maui Forest Bird Recovery Project (MFBRP) on forest bird recovery.

Figure 14. Land ownership and management of the Leeward Haleakalā Watershed Restoration Partnership area.



1.2.4 Public use

Although the public is allowed in the NAR for recreational and cultural uses; the Reserve is extremely remote and there are no available public access routes. With landowner permission, the Reserve can be accessed through the DHHL lands to the east; or through lands owned/leased by Haleakalā Ranch to the south. These accesses are not available to the general public. The upper portion of Nakula cannot be reached from Haleakalā National Park as the park requires the public to stay on designated trails.

Some uses of the Reserve, including hiking or nature study with groups larger than ten, research, scientific collecting, gathering (including Native Hawaiian religious and customary gathering rights) and commercial uses require a Special Use Permit (Hawai'i Administrative Rules 13-209).

Hunting is regulated by Chapter 13-123, Hawaii Administrative Rules (Rules Regulating Game Mammal Hunting). The NAR is currently designated as part of Hunting Unit C.

1.2.5 Infrastructure

Infrastructure primarily consists of fencing and temporary management infrastructure (e.g. management shelter, helicopter landing zones, and management trails).

1.3 Cultural Resources, Archaeological and Historic Sites

The Environmental Assessment for the Kahikinui Koa Forest Restoration Project (State of Hawai'i 2004) provided background information on the cultural resources of the broader Kahikinui area. Although Nakula NAR encompasses a much smaller area, much of the information in that document is relevant, and portions of the document are summarized below.

> "Kahikinui is one of the traditional moku, or land divisions, of Maui. It is located on the southwest slope of Maui and sweeps from the dry, cliffed coastline through the better-watered uplands before terminating in the dry uplands on the southern rim of Haleakalā Crater. The origin of the name Kahikinui is not entirely certain, as it has been translated as "the great rising" Handy (1972), as well as the "Great Tahiti" (Pukui and Elbert 1974), perhaps because of the similarities in shape and appearance between the islands of Tahiti and Maui. It may also refer to a

navigational star (Pukui and Elbert 1986). Perhaps the name is meant to evoke a rich variety of meanings.

Kahikinui, along with Kaupō and other moku on the west and south of Haleakalā, was extensively developed for dryland farming of ʻuala (sweet potato) and taro. Water was a limiting factor and ingenious agricultural methods were devised to conserve soil moisture. ʻUala was often grown in makali`i (Handy 1972), which were rocky areas specially prepared for planting. The arduous and risky nature of farming the ʻaina maloʻo – or dry lands – may account for the numerous temples to Lono, the deity responsible for rainfall and thunder (Kirch 1997). Abundant natural resources were present, including a wide variety of dryland forest trees. Perhaps even more important were marine resources such as fish, shellfish and crustaceans, and the fresh water springs that emerged near the coastline.

Kahikinui and Kaupō, although not untouched during the 19th century, did not experience the intense changes in land use and population that occurred in many locations in Hawai`i. One of the few visitors was the French explorer Jean-François de Galoup de la Pérouse, who reported only a few small villages along the coast. Archaeological work reported in Kirch (1997) indicates that a much larger population was still living mauka, around 1,000 feet in elevation, which were hidden by distance and topography from la Pérouse.

In the Mahele of 1848, which installed a Western system of land title that ultimately disenfranchised many commoners, Kahikinui wound up in the hands of the government and in the personal holdings of Princess Ruth Ke`elikolani. Very few kuleana were awarded in the Kahikinui area. Just as disease began to decimate the population and more and more rural Hawaiians were drawn to the attractions of the growing port cities, cattle ranching began to dominate Kahikinui, no doubt aided by the ability to secure title to land. By the 1880s, a Portuguese named M. Pico (also called "Paiko") was ranching Kahikinui, and much of Kaupō was also being ranched. The Hawaiian Homes Commission Act of 1920 established lands held in trust for the benefit of Native Hawaiians, and the government lands in Kahikinui were part of this trust. Lands above 4,000 feet in elevation were placed in the forest reserve of the territorial government, and lands below 4,000 feet were leased to cattle ranchers. The traces of a long Hawaiian occupation were gradually obscured but not erased by alien vegetation, cattle trampling and soil erosion. The forest resources that sustained the Hawaiian culture also gradually degraded, and as late as 1910 the forest was much denser (Rock 1913).

According to the planning practicum cited previously (UH-Manoa, DURP 2000), the preserved, hidden resources of Kahikinui (and, for that matter, parts of Kaupō) offer special, almost unique values for the perpetuation of Hawaiian culture:

"Aside from the abundance of natural resources, Kahikinui is endowed with a wealth of cultural assets, gifts left by the ancestors. Because Kahikinui has experienced relatively little physical impact from the post-contact period such as urban development and large-scale agricultural use, it contains an abundance of intact sites, which include villages, heiau, agricultural structures and shrines. Sites are scattered across the moku in relative abundance with particularly high concentrations along the coastline and in the upland areas. Kahikinui may well be the only area in the State where this kind of concentration and variety of sites exist and as such it is an excellent living laboratory to study past Hawaiian life and land usage" (UH-Manoa, DURP 2000).

According to an ethnobotanical study of a site in leeward Haleakalā (Medeiros at al 1994), forest restoration is of cultural importance because many plants with traditional uses are rapidly disappearing from the area. One example is the famed mature koa trees of Haleakalā, which are prized for canoes (Fielding 2003) but are failing to regenerate.

Preserving and enhancing the cultural resources of Kahikinui, Kaupō, and other regions of leeward Haleakalā – which are increasingly seen as including biological resources - is the goal of a number of governmental and non-profit organizations. DHHL, in response to request from beneficiaries, awarded a number of homesteads in Kahikinui. The Kahikinui homesteaders have a community organization, Ka ʻOhana O Kahikinui, and are active in programs that promote conservation and cultural preservation. There is growing recognition that cultural perpetuation is inextricably tied to the preservation and restoration of the unique biological resources that Hawaiians utilized and husbanded for a wide variety of purposes over the course of centuries" (State of Hawaiʻi 2004).

Although a number of archaeological investigations have been conducted in the general region over the years, very few have extended to the higher elevations of the Reserve. An archaeological reconnaissance study and cultural practices assessment of the area was conducted in 2004 as part of the Environmental Assessment for the Kahikinui Koa Forest Restoration Project (State of Hawaiʻi 2004). The archeological survey primarily covered the area around the parcel perimeter, and no historic sites were recorded there. The report states that due to the steep terrain and high elevation in the area, it would be "expected to contain few sites, especially given the rugged topography of the area. If present, sites would include rock shelters, cairns, quarry sites,

petroglyphs, ridge trails or other temporary-use sites." No ongoing cultural practices were identified.

1.4 Summary of Major Threats and Management Issues

1.4.1 Invasive species - Ungulates

The primary ungulates of concern in Nakula are feral goats (*Capra hircus;* Figure 15); however, feral cattle (*Bos taurus*), feral pigs (*Sus scrofa*), and axis deer (*Axis axis*) also pose a threat.

Medeiros et al. (1986) reported that goats had the most destructive impact on native vegetation on the south slope of Haleakalā as a whole under present conditions and have the greatest impacts in the Koa and Koa/ʻŌhiʻa zone, limiting reproduction of most native species and resulting in loss of forest and watershed deterioration.

Feral pigs destroy native vegetation and prevent its regeneration by eating, trampling, and digging up plants, and may accelerate the invasion of weed species by dispersing seeds on their coats and in their droppings. Pig disturbance of native ground cover through rooting and wallowing facilitates the invasion and establishment of weeds. In addition, pig wallows provide mosquito-breeding sites that can promote the spread of avian diseases such as avian malaria and pox – the two most deadly diseases for native forest birds. The continued presence of feral pigs contributes to loss of native plants and loss of ground cover that adversely affects groundwater retention.

Feral cattle are present on adjacent DHHL lands to the west and were present in Nakula NAR and Kahikinui FR previously, but were removed when the fences were completed (2005-2013).

Axis deer were introduced to East Maui in 1959 and populations have greatly increased and spread across the island, negatively impacting farmers, ranchers, native forests and watersheds through browse and bark stripping (USGS 2008). Deer have been observed in and near the Reserve. A Maui Axis Deer Working Group, comprised of local farmers, ranchers, state and local agency personnel, tourist industry representatives, and hunters, formed in 2010 to address the axis deer problem on Maui. The Working Group is developing a plan and initiating axis deer management to reduce negative impacts.

Figure 15. Feral goats in the canyon near the eastern boundary of Nakula NAR.

1.4.2 Invasive Species - Plants

Invasive non-native plants, or weeds, constitute a severe threat to the native ecosystems in the NAR. Certain priority weeds are problematic because they can establish and survive in undisturbed native forest; disperse long distances via wind or birds; affect large portions of land; displace native vegetation; grow and reproduce rapidly; convert diverse assemblages of native plants to monocultures of alien species; and encourage fire by increasing fuels on formerly natural fire breaks (i.e. lava flows). These weeds can displace distinctive native flora, resulting in a loss of species diversity and eventually in more pronounced and permanent changes to ecosystem function such as alteration of primary productivity, nutrient cycling, and hydrology. Many invasive weed species completely replace native vegetation resulting in total loss of native habitats thereby negatively affecting native bird, arthropod and snail communities.

Invasive weeds with great potential for spreading and causing habitat modification are identified in this plan as high priority for control or eradication. Weed species were prioritized based on observed invasiveness and other criteria including growth form, dispersal mechanisms, ability to displace native vegetation and ability to alter ecosystem cycles (water, nutrients and succession).

High priority invasive weeds currently present in Nakula include:

- Tree poppy (*Bocconia frutescens*)

- Australian tree fern (*Sphaeropteris cooperi*)
- Prickly Florida blackberry (*Rubus argutus*)
- Fire tree (*Morella faya*)
- Hill raspberry (*Rubus niveus*)
- Molasses grass (*Melinis minutiflora*)
- Velvet grass (*Holcus lanatus*)
- Vernal grass (*Anthoxanthum odoratum*)
- Kikuyu grass (*Pennisetum clandestinum*)

The rhizomatous mat or thatch forming perennial grasses listed above, while providing excellent forage for introduced ungulates, form largely monotypic (single species) ground layers that prevent natural regeneration and establishment of native herbs, shrubs and trees. The combination of long-term ungulate grazing with the dominance of these grass species have contributed significantly to deforestation of the Reserve (Figure 16). A focus of planned management actions will be to re-establish a native canopy to shade out these grass species and replace them with a more diverse native understory.

Additional weed species that are a serious concern to land managers are present in adjoining areas and have not yet been detected in the Reserve. It is a high priority to prevent the establishment of these species in the NAR. Other weed species may be added to the Reserve priority weed list if monitoring shows their range and abundance increasing in native ecosystems targeted for management.

Figure 16. Invasive grass in upper Nakula NAR.

1.4.3 Invasive Species - Other Animals

A variety of non-native small animals have the potential to become serious pests to the biodiversity found in Nakula. Feral cats, rats, mice, mongoose, dogs and birds are known to consume or compete with native species and may contribute the spread of invasive weeds. Feral cats kill birds, which nest, feed, and roost in trees, as well as native sea birds and other species that nest on the ground or in burrows. Rats prey on native birds (particularly females on the nest), eggs, nestlings, native land snails and endemic invertebrates and are also known to eat the seeds, fruits and/or strip the bark of native plants. Non-native birds may compete with native forest birds for food, nesting sites and other resources and act as reservoirs for avian diseases. Non-native birds also contribute to the spread of weeds by eating the fruits of weedy species and spreading seeds.

Non-native invertebrates are present, but largely undocumented, and can consume native plants, interfere with plant reproduction, predate or act as parasites on native species, transmit disease, affect food availability for native birds, and disrupt ecosystem processes. For example, the black twig borer (*Xylosandrus compactus*) is harmful to numerous native tree species. The invasion of the yellowjacket wasp (*Vespula pennsylvanica*), voracious predators of numerous species of native invertebrates, is of concern. Slugs (*Milax gagates*, *Limax maximus*, and *Veronicella* spp.) consume fruit from native plants and prey on seedlings and mature plants. Mosquitoes (*Aedes albopictus* and *Culex quinquefasciatus*) transmit deadly diseases to native birds.

1.4.4 Fire

Wildfires leave the landscape bare and vulnerable to erosion and non-native weed invasions. Hawaii's flora evolved with infrequent, naturally-occurring episodes of fire, so most native species are not fire-adapted and are unable to recover well after wildfires. Recent fires at Kahikinui in 2009 burned up to approximately 4,000 ft (1,219 m) elevation. The abundance and biomass of non-native grasses in the NAR will increase over the short-term due to removal of feral ungulates. This will increase the Reserve's vulnerability to the threat of fire, particularly during periods of extended drought. Invasive, non-native plants, particularly grasses, are often more fire-adapted than native species and will quickly exploit suitable habitat after a fire. The principal human-caused ignition threats are catalytic converters and other hot surfaces of vehicles or heavy equipment. The principal natural ignition source in this area is lightning.

1.4.5 Disease

Introduced diseases and pathogens can threaten both native animals and plants. The introduction of new diseases and pathogens, in addition to those currently known, is possible. Avian pox and avian malaria are mosquito-transmitted diseases that currently affect native Hawaiian birds. In the extreme isolation of the Hawaiian Islands, birds evolved in the absence of these diseases and lost their natural immunity. Avian pox is caused by a virus (*Avipoxvirus*) and avian malaria by a single-celled parasite (*Plasmodium relictum*). For some bird species infection with these diseases is almost always fatal.

Other diseases also pose threats to the watershed, humans and wildlife. Cats are host of a potentially fatal disease called toxoplasmosis. In Hawai'i, toxoplasmosis has killed native Hawaiian birds and also poses a threat to marine mammals. In addition to threatening wildlife, toxoplasmosis poses a significant health risk to pregnant women. Feral pigs can serve as reservoirs and vectors of diseases such as brucellosis and pseudorabies which are transmissible to humans, wildlife, pets and livestock. Pigs also spread fatal diseases such as fecal bacteria (*Enterococcus*) and *Escherichia coli* (*E. coli*), while pigs and other small mammals spread leptospirosis.

Introduced plant diseases such as 'ōhi'a rust (*Puccinia psidii*) and koa wilt (*Fusarium oxysporum* f. sp. *koae*) have the potential to impact the major components of the forest throughout the NAR. 'Ōhi'a rust affects other taxa of the Myrtaceae or myrtle family. In severe infections, growing tips wither and die back. Koa wilt is a serious, often fatal fungal disease of the native koa tree. Trees affected with the disease rapidly lose their canopies and may die within a few months.

1.4.6 Climate Change

Climate change may affect the NAR through altering rainfall patterns and amounts. Changing climate may affect the abundance and seasonality of precipitation, thereby altering forest composition, growth and structure. Long-term shifts in the inversion height may accompany global climate change (Giambelluca and Nullet 1991). Rare ecosystems and species may be affected by relatively rapid changes in precipitation, temperature, and humidity that result from a rapid and drastic change in regional or local climate patterns. Detrimental invasive species may change their distribution and abundance due to changes in the climate (e.g. mosquitoes may be more frequently found at higher elevations due to warming temperatures). Increases in mosquito populations in the upper elevations would increase the incidence of avian disease, negatively affecting remaining native forest bird populations.

1.5 Overview of Existing Management

In general, existing and ongoing management has consisted primarily of threat abatement (fencing and ungulate management, non-native invasive plant control), restoration (reforestation and rare plant restoration), and research and monitoring. Major accomplishments are summarized below.

1.5.1 Fencing and Ungulate Management

DOFAW has installed several fences in Nakula NAR (Figure 17) after environmental compliance and community outreach (State of Hawai'i 2004). The fences exclude ungulates, allowing regrowth of koa forest and other native habitat, and will allow for subsequent reintroduction of endangered forest birds to an improved habitat on leeward Haleakalā. The following fences and ungulate management projects have been completed:

- In 2005, DOFAW completed a fence for a portion of the Nakula tract. The project was undertaken in cooperation with neighboring landowner DHHL, as the fence protected forest on their lands as well.
- In July 2012, a fence was completed to enclose a management unit of 420 acres (170 ha), and all ungulates were removed from within the unit by November 2012. This unit (Wailaulau Unit) enclosed the best remaining forest in the NAR.
- In 2013, additional portions of the lower NAR were fenced in a management unit which also includes adjacent DOFAW lands of upper Kahikinui FR (Mauka Unit), which is 2,350 acres. Ungulate control in this unit started in 2014 and is ongoing.
- In 2014, staff is planning on completing construction of a 254 ac (103 ha) unit. This unit (West Pāhihi Unit) enclosed mesic Koa/'Ōhi'a forest habitat in both the Reserve and Kahikinui FR.
- Fence inspections and maintenance of all existing NAR fences occurs 2-4 times/year as well as after major storms.

Figure 17. Installation of fence unit in upper Nakula NAR.

1.5.2 Reforestation

In October 2013, NAR staff started reforestation in portions of the Wailaulau Unit with no existing tree canopy. At upper elevations within the Wailaulau Unit plantings occurred in areas with a higher native component of native grasses including hairgrass (*Deschampsia nubigena*) and native shrubs and also in a large cinder erosion scar. These areas had more interstitial spaces in the ground layer to allow for the establishment of plantings without spraying non-native pasture grasses prior to planting. In a 15 ac portion of the Wailaulau Unit on a ridgeline near the eastern fence of the unit restoration included removal of the thick layers of non-native pasture grasses to reduce competition between non-native grasses and newly planted seedlings and enhance the success of restoration planting efforts. The invasive grassland was sprayed in October 2013 with an herbicide using a boom sprayer mounted on a helicopter (at an approximate cost of $300/ac) to enhance the success of reforestation efforts.

From February - August, 2014, staff planted 15,920 trees and shrubs in total into the Wailaulau Unit, with 13,750 planted into the 15 ac sprayed grassland and 2,170 planted into the upper elevation erosion scar and unsprayed grassland. Species planted included koa, ʻōhiʻa (Figure 18), aʻaliʻi, māmane and naio, which were grown by a contract nursery from seed collected from the area. Planting techniques involved removing dead grass biomass from the immediate planting site and then drilling a hole for planting with

an auger drill (Figure 19). Different species of trees were interspersed, with a tree spacing of 20-30 ft for koa, 15-20 ft for ʻōhiʻa, 10 ft for māmane, 20-30 ft for naio, and 5-10 ft for ʻaʻaliʻi.

Initial six month survivorship monitoring of a representative sample of plantings has shown high survivorship (over 90%) for all species planted and regular monitoring will continue to inform management efforts.

*Figure 18. ʻŌhiʻa (*Metrosideros polymorpha*) seedling.*

Figure 19. Volunteer outplanting seedlings.

1.5.3 Rare Plant Restoration

Figure 20. Gulch habitat with more intact native vegetation.

Hawai'i State Plant Extinction Prevention Program (PEPP) has been actively working in the Reserve conducting management actions specific to rare plant recovery. PEPP is focused on preventing the extinction of taxa with fewer than 50 individuals in the wild. Activities include rare plant surveys to locate wild individuals, collection of propagation and genetic storage materials, reintroduction through outplanting and monitoring the growth and survival of outplanted individuals. Reintroduction is occurring within the fenced Wailaulau Unit in the gulch bottoms, as these areas provide more intact native habitat. Outplanting is dependent on the availability of nursery stock, and PEPP has outplanted the following rare species in the Reserve: *Geranium arboretum, Phyllostegia ambigua, Phyllostegia haliakalae* and *Ranunculus mauiensis*.

1.5.4 Non-Native Invasive Plant Control

Invasive plant mapping and control efforts using a combination of mechanical and focused chemical control methods were initiated in the spring of 2014 and have primarily targeted tree poppy (*Bocconia*) and limited occurrences of Australian tree fern in the Wailaulau Unit. The Unit was surveyed on foot or by helicopter for the presence of *Bocconia*. All populations were mapped and as much as possible, controlled immediately. Tree poppy stems are cut and then herbicide is applied to the freshly cut stem to prevent resprouting. PEPP staff has also done opportunistic control of tree poppy and Australian tree fern encountered while searching for, reintroducing and monitoring rare plants.

1.5.5 Research and Survey

Maui Forest Bird Recovery Project (MFBRP) has been researching forest restoration in the Reserve within the Wailaulau Unit. The main goal of the MFBRP work in the Reserve is to determine the best methods to

restore forest for release of endangered forest birds, particularly the kiwikiu or Maui parrotbill. The project has accomplished the following activities between 2012 and 2014:

- Finalized a plan for restoration trials with the American Bird Conservancy.
- Set up a field camp and weather station.
- Established restoration trial plots and collected seeds for propagation and outplanting.
- Applied experimental treatments to the plots. Trials include outplanting, seed scatter and natural regeneration in plots with four treatments for non-native grass (control (no treatment), scarification (manually clearing grass with weed-eater or mattock), herbicide, and herbicide with scarification.
- Monitored trial plots and collected information including slope, aspect, planting pot (dibble tube) size, presence of tree protection shelter, rainfall, and temperature and examined it for correlation with survival. This information will allow subsequent planting protocols and locations to be refined to increase seedling survival.
- Installed predator abundance grid.
- Conducted experimental trials of infill planting within existing canopy gaps in remnant forest corridors.

Maui Nui Seabird Recovery Project conducted baseline surveys in 2012 and 2013 to assess the distribution and abundance of ʻuaʻu or Hawaiian petrel. These surveys also confirmed the presence of non-native predator species that are one of the key limiting factors in the survival of this species.

ʻŌpeʻapeʻa or endangered Hawaiian hoary bat presence and abundance was monitored in the Reserve in 2012-2013 by USGS Biological Resources Division and a report is under preparation. The objective of the research was to determine species distribution, areas of habitat occupancy (high, low or zero), seasonal habitat through an annual cycle, identification of bat foraging areas and recommendations for bat management. Portions of Nakula NAR and the adjacent FR are included in the Kahuku Wind Power Hawaiian Hoary Bat Mitigation plan, finalized in 2014. The objective of the mitigation effort is to implement measures that will not only mitigate for the permitted take, but provide a net benefit to the species by increasing population numbers of the Hawaiian hoary bat via the creation/restoration of available foraging and roosting habitat. Management actions (fencing, ungulate control and reforestation) in the West Pāhihi Unit will increase bat habitat and are included in the bat mitigation plan.

Arthropod prey resources at Nakula NAR were studied by Peck et al (2015) to assess the suitability of the Reserve for potential bird endangered bird reintroductions of kiwikiu and Maui ʻalauahio. This study compared arthropod prey abundances at Nakula to those at Hanawi NAR and Waikamoi Preserve, where

those birds are currently found. To aid in the assessment of the arthropod prey base, the study also determined the diets of kiwikiu and Maui ʻalauahio by identifying arthropods in fecal samples.

1.5.6 Infrastructure Management

NEPM staff and partners have established and manage infrastructure critical for NAR management and research. There is currently a cabin in the Wailaulau Unit primarily used by the MFBRP. The NAR also contains a dozen strategically placed and regularly maintained helicopter landing zones (Figure 21) used for resources management, staff safety and transport of staff and volunteers. In 2015, NEPM staff will be installing a 1,000 gallon water tank with a roof catchment in the West Pāhihi Unit. This water will be used for emergency fire response as well as for watering of reforestation plantings in times of drought.

Figure 21. Helicopter landing zone to the south of the Reserve, used for transporting supplies to support management activities,

2 Planned Management Actions

This section describes the planned management actions. Each section includes background, objectives, a summary of planned short term and long term management actions, and a more detailed narrative description for each of the planned actions.

2.1 RESTORATION

2.1.1 Reforestation

Background: The forests of the NAR have been negatively impacted by years of feral ungulate activity. Although natural forest regeneration through the existing seed bank and koa root suckering is occurring rapidly in many areas following feral ungulate removal, more degraded areas will require active management through reforestation of common native species as well as rare species. Reforestation is needed to restore Reserve ecosystems to a level than can support healthy and sustainable populations of native species, including rare and endangered plants and animals.

Objectives: Restore native forest ecosystems through reforestation.

Actions:

1. Seed collection and propagation

2. Implement reforestation of common native species in targeted priority sites to reestablish native forest and shrubland (see Table 4 and Figure 22)

    - Re-establish forest canopy
    - Increase canopy cover and native species diversity in remnant native forest with non-native grass understory
    - Establish vegetation in barren areas
    - Increase native species diversity in native sub-alpine shrubland

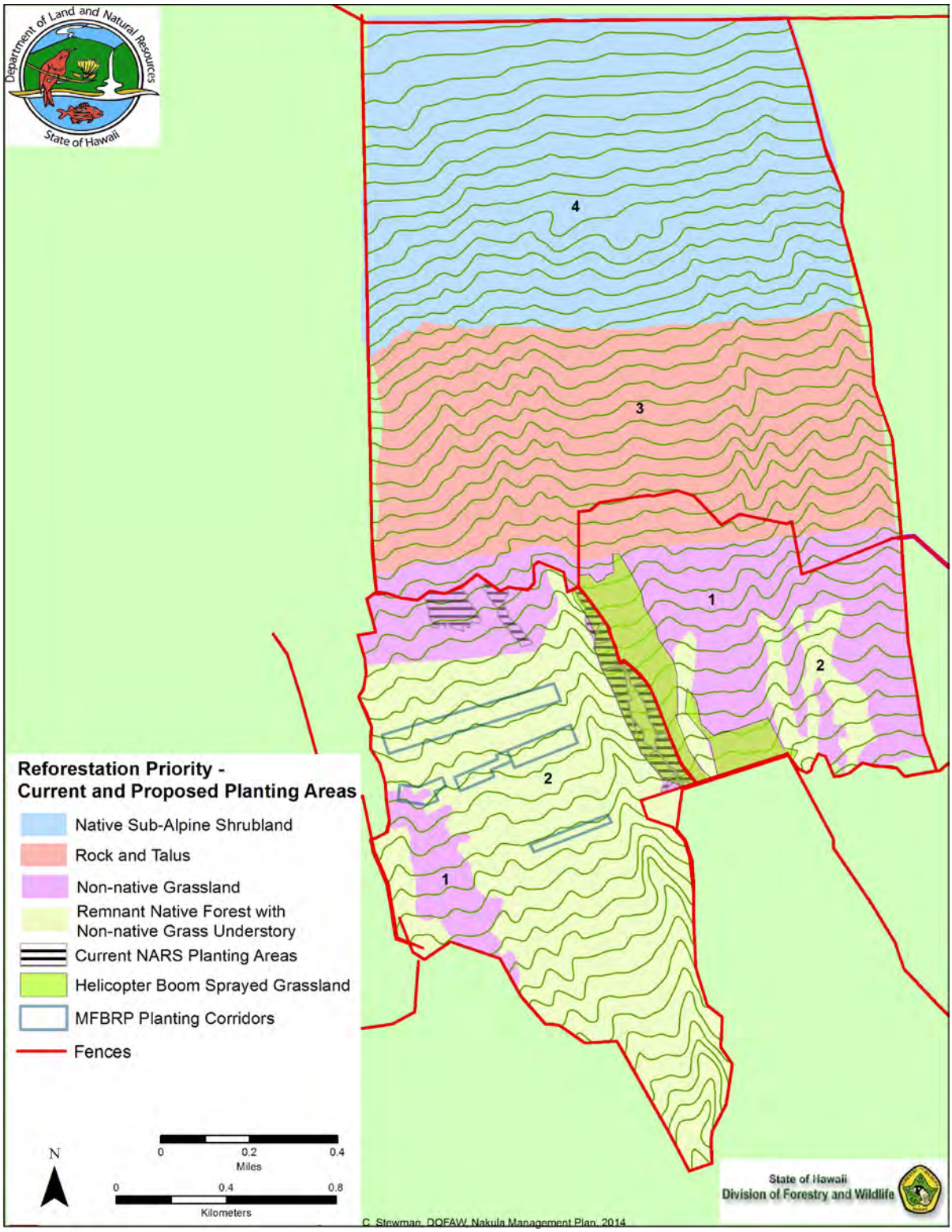
3. Rare plant restoration - Map, monitor and protect existing wild populations of rare and endangered plant species to contribute to their population stabilization and recovery and restore certain species of rare and endangered plants in appropriate protected habitat

4. Monitor success of reforestation actions and improve restoration strategies and techniques, as needed

Table 4. Reforestation Summary (see Figure 22 for associated map).

	Vegetation type			
	Non-native grassland	**Remnant native forest with non-native grass understory**	**Native sub-alpine shrubland**	**Rock and talus**
Priority Level (1 = Highest, 4 = Lowest)	1	2	3	4
Objective	Reestablish canopy	Increase canopy cover and diversity to improve habitat for native wildlife	Increase diversity	Establish vegetation in barren areas Improve connectivity between smaller areas of existing forest and/or reforestation areas
Reforestation approaches for existing vegetation conditions	Grass control and dense planting of 'pioneer' canopy species in large areas	Natural Regeneration Infill 'pioneer' planting to close gaps in canopy Planting of subcanopy species, especially bird & bat forage Conversion of grass to native understory Planting rare plants into appropriate habitat	Small scale plantings of rare/uncommon species and experimental techniques (e.g. seed scattering)	Small scale plantings of common species in soil pockets and experimental techniques (e.g. seed scattering)

Figure 22. Current and proposed planting areas within Nakula NAR.



Narrative Description of Actions:

1. Seed Collection and Propagation

Partner cooperation and collaboration will be critical to the collection of adequate numbers and variety of seeds to accomplish reforestation objectives. By combining efforts with LHWRP and other partners we will be able to pool resources to do the work more efficiently and effectively. Seed collection requires a lot of time in the field monitoring seed development and then a large staff commitment to cover as much ground as possible when the seeds are ripe. In addition, seeds of appropriate species may not all be available from within the Reserve. Seed collection with partners across a larger landscape will enable collection from a greater variety of individual plants as well as species, increasing genetic variability as well as species diversity. In general, seed from local sources within or close to the NAR or from leeward Districts of Haleakalā are prioritized as seed sources. Species used in reforestation will generally be common, widespread species native to the Reserve. Seeds will be taken from as many founders as practicable. Propagation will be done using a contract nursery.

2. Implement Reforestation

Results from numerous other reforestation research studies in Hawai'i, including LHWRP and MFBRP demonstration have informed the planned approach for reforestation of Nakula. Additional research and future monitoring by NEPM staff and partners will also continue be used to refine and adapt reforestation methods to increase success in achieving management objectives. Reforestation will provide habitat for the critically endangered kiwikiu (Maui parrotbill), and enable establishment experimental reintroductions for this species as well as restore habitat for many other endangered plant and animal species.

- Re-establish forest canopy – Priority sites include Wailaulau Unit and West Pāhihi Unit. Although the seedbank and koa root suckering is expected to provide rapid regeneration in many areas once grazing animals are removed, more degraded areas will require large-scale non-native grass control followed by reforestation planting of common native species to re-establish a forest canopy. Planting will help jump-start natural regeneration of a native ecosystem by providing nurse trees and habitat for native insects and birds that will pollinate and disperse native seeds. Dense planting of native species will also help reduce widespread establishment of non-native invasive weed species and reduce non-native grass cover.

- Increase canopy cover and native species diversity in remnant native forest with non-native grass understory – Priority sites include the Wailaulau Unit and gulches, which already have remnant canopy tree cover and are expected to have additional natural regeneration of canopy species

through koa root suckering and the existing seedbank. Targeted planting of subcanopy and rare species in appropriate habitat will increase plant and animal species diversity and reduce cover of non-native grass understory.

- Establish vegetation in barren areas – Planting and other experimental techniques will be used to re-establish vegetation (Figure 23). Certain areas will be targeted to increase connectivity between existing forest and reforestation areas as well as to decrease erosion.

- Increase native species diversity in native sub-alpine shrubland – Sub-alpine shrubland contains more intact native habitat than lower elevation, formerly forested areas. These areas lack some of their likely diversity due to impacts from feral ungulates. Certain rare and depleted plant species will be restored to these areas, primarily through planting.

Figure 23. Reforestation team at work.

3. Rare Plant Restoration

NEPM staff will work cooperatively with other organizations and agencies on rare plant recovery including the Hawai‘i State Plant Extinction Prevention Program (PEPP), other DOFAW botanical staff

and FWS. NEPM staff will assist PEPP with reintroduction plantings and other threat management, as needed. PEPP is focused on preventing the extinction of taxa with fewer than 50 individuals in the wild but staff is also occasionally able to work on other rare species.

Numerous species of rare plants have been propagated and reintroduced into fenced, ungulate-free areas of the NAR to contribute to their overall recovery in the wild. In general, rare species reintroduction will occur in areas with more intact habitat, such as gulches. These species (Table 1) will continue to be a focus for the NAR rare species program. Management actions specific to rare plant recovery includes surveys to locate wild individuals, collection of propagation and genetic storage materials and reintroduction through outplanting. All staff (both DOFAW and cooperating partners) working with rare plants will follow rare plant collection and reintroduction guidelines recommended by the Hawaii Rare Plant Restoration Group (interagency group of rare plant experts) http://www.hear.org/hrprg/. Outplanted plants will be mapped, tagged and monitored to assess their survival and growth. Staff and partners will do additional management of threats to wild and/or reintroduced populations, as needed (e.g. fencing wild plants that are not within fenced management units, control of damaging weeds, insects, slugs, plant disease and/or mammalian predators).

PEPP priorities include continuing to survey the NAR as well as adjacent lands for additional rare species, obtaining material (seeds and cuttings) for propagation and genetic storage and reintroduction of rare species into protected habitat. PEPP staff will also continue to opportunistically control targeted priority weed species that threaten wild or reintroduced PEPP species. Species priorities include *Cyanea obtusa* and *Neraudia sericea* (both only known from a single individual), *Diellia erecta* and *Diplazium molokaiense*. PEPP will also opportunistically collect propagation materials from other species that are appropriate for reintroduction into protected habitat in the NAR including *Asplenium peruvianum* var. *insularum*, *Hillebrandia sandwicensis*, *Cytrandra oxybapha*, *Cyrtandra bisserata* and *Santalum halekalae*.

4. Monitor success of reforestation actions and improve restoration strategies and techniques, as needed

Regular monitoring of a subset of reforestation plantings will help guide future plantings in terms of the success of specific pre-planting site treatments (e.g. non-native grass control), species specific establishment patterns and the types of habitats being reforested (e.g. erosion scars lacking topsoil and ground cover vs. infill planting in remnant canopy corridors vs. sprayed grassland areas with thick topsoil and grass mats but no overstory species). Monitoring will also determine overall success in achieving restoration goals.

Gathering plot data with ocular estimates of percent cover by species in restoration areas will provide trends in native and non-native plant cover and diversity over time. This type of monitoring will be continued, as resources permit, to assess the long-term results of management actions and to determine

the effectiveness of reforestation approaches at suppressing invasive grasses, establishing overstory and understory species and replacing multi-tiered functional forest communities in the Reserve.

NEPM staff will continue to work with partners such as MFBRP and LHWRP to encourage research, improve restoration strategies and develop techniques to address various potential restoration challenges (discussed in Medeiros et al. 1986) and summarized below:

- Changes in microclimate, due to loss of native overstory and/or understory, which lead to unsatisfactory conditions for germination and/or establishment of native species.
- Alteration of the soil environment (e.g. disruption of mycorrhizal relationships, introduction of exotic soil microorganisms).
- Absence of suitable sites for germination and establishment of native species due to the presence of introduced species.
- Loss of pollinators (native birds and insects) resulting in lack of reproduction, inbreeding depression and/or loss of genetic diversity.
- Lack of native plant seed dispersal due to extirpation of native birds.
- Introduced insects or pathogens which may impact native plant species health.
- Predation of seeds by introduced rodents, birds, or insects.

2.1.2 Forest bird recovery

Background: The Reserve currently provides habitat for several endemic native forest birds and is also identified as a possible future recovery site for three endangered forest bird species: kiwikiu or Maui parrotbill, Maui ʻalauahio or Maui creeper, and ʻakohekohe or crested honeycreeper. NEPM goals include protecting, maintaining, and enhancing the Reserve's unique natural and cultural resources, including native forest birds. While reforestation actions described above are one of the most important management activities needed to enhance habitat for the protection and recovery of forest birds, other actions are needed to enhance the recovery of endangered bird species and/or to address specific threats to forest birds.

Objectives: Manage native forest birds, including rare and endangered species to ensure their long-term survival and recovery in secure and self-sustaining wild populations.

Actions:

1. Monitor forest birds

2. Control small non-native mammalian predators - Remove predators such as rats, mongoose, and cats that pose a major threat to forest birds

3. Assess other threats to forest birds and determine appropriate management actions

4. Restore endangered birds to Reserve - Release endangered birds in appropriate habitat within the Reserve

Narrative Description of Actions:

1. Monitor forest birds

Native forest birds in the Reserve will be regularly monitored to determine baseline population densities and trends. Monitoring will help determine how the Reserve's management actions such as reforestation affect bird recovery or detect decline in populations that may be due to ongoing or new threats. Monitoring data will be provided to the Hawai'i Forest Bird Interagency Database Project for analysis.

- The Wailaulau Unit of the Reserve will be part of a larger long-term monitoring effort across forest bird habitat on Maui. Establishment of transects and monitoring of forest birds is planned on an annual basis starting in 2015

- Monitoring of experimental releases of endangered birds (see #4)

2. Control non-native mammalian predators

Small mammalian predator removal (e.g., removal of rats, mongoose, cats) may provide significant benefits to endangered birds, plants, and endemic invertebrates, but is extremely difficult and costly to implement on a large-scale using currently existing methods. DOFAW staff will implement predator removal in certain high priority areas (e.g. kiwikiu release sites etc.) using existing, approved methods. New methods for widespread control across large conservation areas are currently being developed and will be implemented if they are approved and offer a cost-effective way to remove predators.

3. Assess other potential threats to forest birds and determine appropriate management actions

Other threats include spread of mosquito-borne avian disease, non-native invertebrates which can transmit disease and affect food availability, competition from non-native birds for food, nesting sites and other resources, and non-native birds acting as reservoirs for avian diseases. Experimental management actions for these threats could be developed and the effectiveness of these analyzed. For example, mosquitoes could be controlled in wet areas or where water is pooling. Populations of non-native species could be reduced or eliminated if they pose a threat.

4. Restore endangered birds to Reserve

The MFBRP will be developing a reintroduction plan for kiwikiu or Maui parrot bill at Nakula NAR, and MFBRP staff will be taking the lead on release efforts, which are planned within the next five years (by 2020). NEPM staff will be supporting this effort through the implementation of ongoing and planned management actions to maintain and improve native forest ecosystem habitat (e.g. fence maintenance, reforestation). This work is part of DOFAW's overall strategy to integrate habitat protection and restoration with species research, management, and reintroduction programs.

The short-term goal of these experimental releases is to attempt to create a separate disjunct population of kiwikiu which survives through multiple years. The long-term objective of the overall reintroduction effort is for the newly established population of kiwikiu to be self-sustaining, successfully breeding, and achieve sufficient size to provide significant protection from extinction in case the source population is threatened or extirpated.

The kiwikiu is currently restricted to a population found at high elevations on the windward side of Haleakalā Volcano in Hanawi NAR and Waikamoi Preserve. Fossil evidence shows this species once occurred in low elevation, dry forests on Maui (James and Olson 1992). Leeward East Maui is drier, has less severe storms, and less occurrence of malaria carrying mosquitoes than the wet, windward slopes. Kiwikiu were once found in this area prior to forest destruction by feral ungulates. The forest was predominately koa (*Acacia koa*), a tree that Kiwikiu was historically noted to prefer.

In order to increase the range and population size, the MFBRP is hoping to establish an experimental population on the leeward slopes of Haleakalā. In 2009, the USFWS and provided funds to collect data necessary to initiate the establishment of population on leeward east Maui, which was recommended by the Forest Bird Recovery Plan (USFWS 2006). Other state, private and federal funding supported fencing and restoration of the Kahikinui Forest Reserve and the Nakula NAR, the area selected to establish the population. A captive propagation program has reared kiwikiu, both from wild collected eggs and from captive pairs (Kueler et al 2001).

While the exact makeup of a release cohort has not yet been determined, two options exist for the source of the birds to be released: individuals from the captive flock and translocation of wild individuals from elsewhere in the species' range. Currently, a base camp has been established from which to conduct the releases, but additional infrastructure, including a variety of field aviaries and hack towers will also need to be established. Additional facilities may be needed at the current camp, in order to facilitate the introduction and monitoring of the released birds.

Once the release occurs, the MFBRP will intensively monitor released kiwikiu movements, breeding and habitat use to assess the success of release efforts and develop improved protocols for future releases. Released birds will also be monitored for disease.

While kiwikiu will be the focus of experimental releases, other rare species such as ʻakohekohe and Maui ʻalauahio will be a focus for similar efforts in the future.

2.1.3 Seabird recovery

Background: The Hawaiian Petrel or ʻuaʻu (*Pterodroma sandwichensis*; Figure 24) is a federally endangered seabird. A host of anthropogenic factors, including harvesting, habitat conversion, and introduction of non-native predators has drastically reduced the population size and range of this species. Breeding colonies, previously distributed across all the main islands, are currently restricted to remote montane habitats on a few islands. The largest population of ʻuaʻu exists on Haleakalā, and consequently is critical for the conservation of this species. The Maui Nui Seabird Recovery Project conducted baseline surveys in Kahikinui FR and Nakula NAR and documented the presence of ʻuaʻu nesting burrows as well as non-native invasive predator species. Reflective taping is installed on all NAR and FR fences to provide visual cues to nocturnal seabirds help them avoid fences and reduce incidents of seabird injury or mortality.

Objectives: Manage seabird populations at the Reserve to help contribute to their stabilization and overall recovery.

Actions:

1. Monitor ʻuaʻu to determine relative abundance, activity, reproductive success and effectiveness of management
2. Determine strategy and develop and implement control program for predators

Narrative Description of Actions:

1. Monitor ʻuaʻu to determine relative abundance, activity, reproductive success and effectiveness of management

Initial surveys have detected eight known burrows in the upper elevations of both the Reserve and adjoining Kahikinui FR. Follow-up monitoring will be needed to detect any changes in population status as well as the effectiveness of management actions.

2. Determine strategy and develop and implement control program for introduced predators

One of the key limiting factors in the survival of ʻuaʻu is predation of chicks and adults at breeding burrows by mammalian predators and barn owls. To counter the severe and immediate threat of predation a predator control program in seabird habitat is needed. Information on relative abundance, activity and seasonality of the predator population is not currently known and quantifying these factors will increase the effectiveness of a predator control program.

Figure 24. Hawaiian Petrel or ʻuaʻu (Endangered).

2.1.4 Bat recovery

Background: Bats are currently present at Nakula NAR, and effective forest management and reforestation proposed in this plan is expected to increase the amount of habitat available for bats thereby increasing bat populations and contributing to the overall recovery of the species.

Objectives: Provide a net benefit to the species by increasing population numbers of the Hawaiian hoary bat via the creation and restoration of available foraging and roosting habitat.

Actions:

1. Implement proposed general habitat management actions such as reforestation and threat abatement to protect and restore native habitat to benefit bats at the Reserve

2. Perform surveys to monitor changes in bat activity levels over time

Narrative Description of Actions:

1. Implement general habitat management actions such as reforestation and threat abatement to protect and restore native habitat to benefit bats at the Reserve

Reforestation and threat abatement actions proposed in this plan will increase habitat available for bats. In particular, the 254 acre West Pāhihi Unit, is planned to serve as a mitigation site for bats impacted by wind power projects elsewhere. The unit is located between the 4,800 to 6,200 foot elevation contours in the Kahikinui FR (Mauka Unit) and the Nakula NAR. Currently, vegetation in this area consists of about 80 percent non-native grassland, and 20 percent remnant mesic koa-ʻōhiʻa forest with grass understory. Over time, restoration efforts are intended to increase native vegetation cover and provide a forest structure suitable for bat foraging, roosting, and breeding. Additionally, the restoration of native forest is expected to improve the functional connectivity of habitat within the greater Kahikinui area across the FR, NAR, and the adjacent DHHL lands.

2. Perform surveys to monitor changes in bat activity levels over time

Long-term monitoring of bats is needed to assess levels of bat activity in response to management, particularly reforestation, and monitoring to measure net benefit to bats is required as part of the mitigation project. DOFAW will work in collaboration with USGS Biological Resources to develop a monitoring plan and implement bat monitoring. The mitigation plan recommends monitoring after the start of habitat restoration activities with subsequent monitoring occurring at five year intervals. Monitoring should consist of 3-month continual sampling efforts in the same three months of each sampling year. A 5-year cycle of feedback will be very important in planning new restoration parcels for other mitigation activities in Kahikinui as well as for adaptive management of the current project.

2.1.5 Invertebrate recovery

Background: Very little is currently known about invertebrates at Nakula NAR, however, in general, Hawaiian ecosystems are dependent upon the ecological services completed by a diverse assemblage of

native invertebrate species. Hawaiian tree and plant species could not exist without pollination and nutrient cycling which native invertebrate communities provide, and native invertebrates are essential food resources for native bird and bat populations. Consequently, conservation and management efforts which protect native invertebrate communities are needed to protect the native plants and animals which depend upon them. Threats to native invertebrates include, but are not limited to, habitat destruction and alteration, loss of native host plants, and the invasion and establishment of non-native species.

Objectives: Ensure protection and management of native invertebrate species at Nakula NAR and facilitate additional survey and research on invertebrates to more effectively target management actions.

Actions:

1. Implement proposed general habitat management actions such as reforestation and threat abatement to protect and restore native habitat for invertebrates at the Reserve

2. Work with DOFAW's Native Invertebrate Conservation Program to facilitate additional survey and research on invertebrates to more effectively target management actions

Narrative Description of Actions:

1. Implement proposed general habitat management actions such as reforestation and threat abatement to protect and restore native habitat for invertebrates at the Reserve

In the absence of specific information targeted towards management of invertebrates, general management to protect and restore native forest habitat is assumed to benefit invertebrate species that use these native plants as food and as host plants. Threat abatement actions proposed will also likely be beneficial to native invertebrates as they will further restore native habitat and species.

2. Work with DOFAW's Native Invertebrate Conservation Program to facilitate additional survey and research on invertebrates to more effectively target management actions

DOFAW's Native Invertebrate Conservation Program partners with state and federal research and management agencies, non-profits and the public to facilitate research, management and protection of native threatened and endangered invertebrate species across the Hawaiian Islands. The objective of the Program is to expand the knowledge and resources available to effectively direct resource management, monitoring, research, conservation, and policy relating to Hawaiian invertebrate species.

Figure 25. The Koa bug (Coleotichus blackburniae) is a native species whose host plants are koa and ***'aali'i***

2.2 THREAT ABATEMENT

2.2.1 Ungulate management

Background: Eliminating threats from introduced ungulates, primarily for feral goats and pigs, is a high priority management program and management units in the Reserve have been fenced and feral ungulates removed. Ungulate control requires ongoing effort, due to continued ingress from adjacent properties. Continued ungulate management is needed to ensure the success of restoration efforts.

Objective: Preserve and protect native forest and watershed from feral ungulate damage by maintaining existing fenced units, completely removing ungulates from all fenced management areas and monitoring.

Actions:

1. Maintain integrity of existing fenced management units (Table 5 and Figure) through regular inspection, maintenance and replacement of fencing
2. Remove all ungulates from fenced management units
3. Monitor existing fenced ungulate-free units for ungulate ingress, and control ungulates

Narrative Description of Actions:

1. Maintain integrity of existing fenced management units through regular inspection, maintenance and replacement of fencing

Maintenance of existing fences will limit reinvasion of ungulates into ungulate-free areas as well as areas with ongoing ungulate control. NEPM staff will inspect and maintain all fences in the Reserve west of Pāhihi gulch. Portions of joint fenced units with Kahikinui FR will be inspected by DOFAW Forestry staff to the east of Pāhihi gulch.

2. Remove all ungulates from fenced management units

Various approved methods will be used to remove all the ungulates from the fenced management units including aerial shooting and staff control. Ungulate control will be ongoing due to occasional ingress of ungulates into ungulate-free areas.

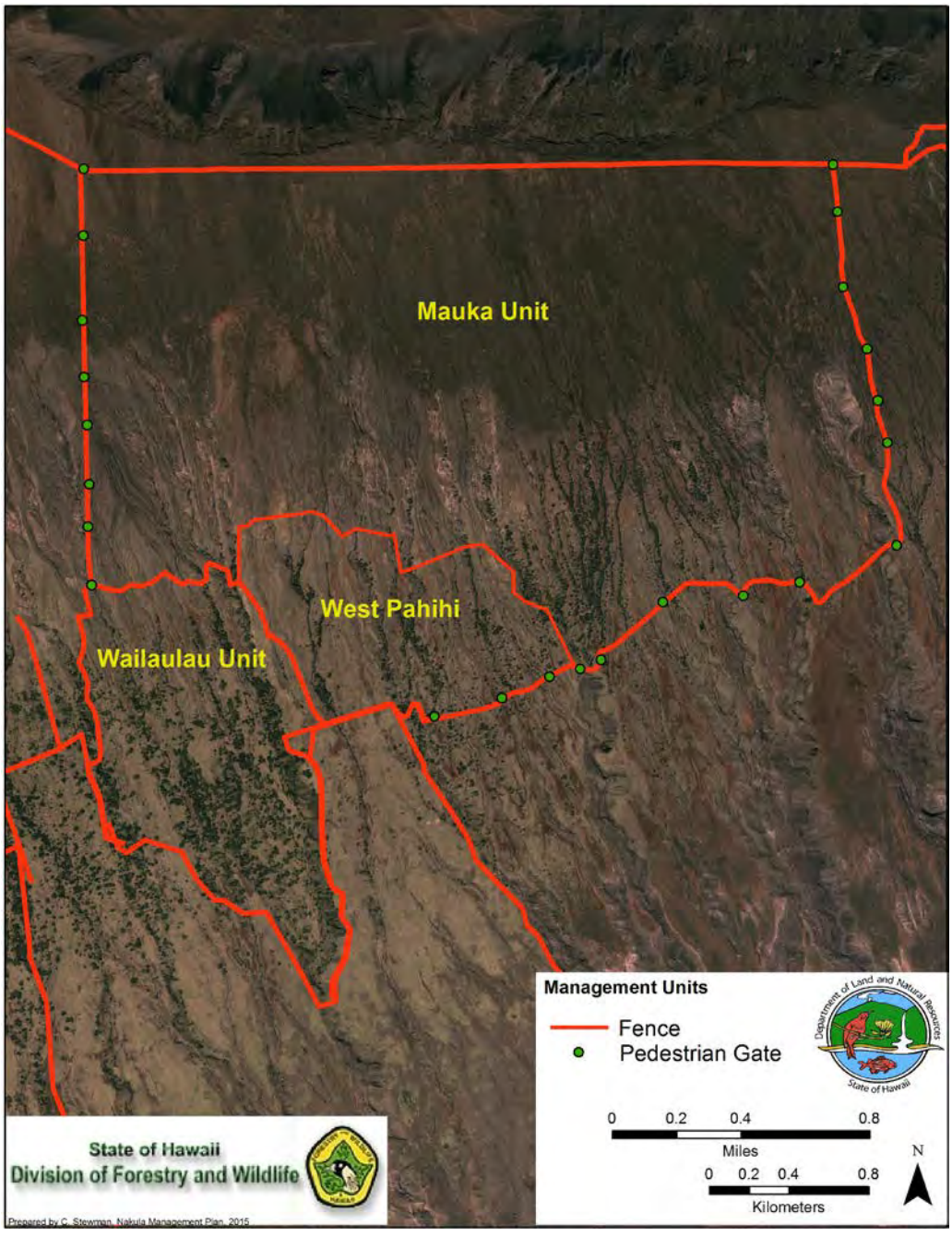
3. Monitor existing fenced ungulate-free units for ungulate ingress, and control ungulates, if necessary

Regular monitoring on units for ungulate presence will inform staff of ungulate ingress so ungulates can be removed promptly, preventing population growth and re-establishment in management units.

Table 5. Management unit summary.

Management unit	Size (acres)	Year fencing completed
Wailaulau Unit	420	2012
Mauka Unit	2,350	2013
West Pāhihi Unit	254	2014

Figure 26. Fenced management units of Nakula NAR.



2.2.2 Invasive plant control

Background: Invasive plants, or weeds, constitute a severe threat to the native ecosystems in the NAR. Invasive weeds with great potential for spreading and causing habitat modification are identified in this plan as high priority for control or eradication.

Objective: Protect intact native areas within the NAR by eradicating incipient weeds, and if possible, eradicate or contain select high priority weeds in fenced units within the NAR.

Actions:

1. Monitor and map the distribution of high priority weeds and develop a control strategy
2. Control weeds along invasion corridors (e.g., trails, fences) and within management units using approved methods (chemical, manual and/or biocontrol)
3. Prevent introduction of new weeds and invertebrates
4. Monitor weeds to detect changes in long term distribution and abundance and determine the effectiveness of management
5. Support state-wide weed early detection and prevention programs and weed control research including new chemical, mechanical and biological control techniques, and participate, where appropriate, in experimental weed control management methods

Narrative Description of Actions:

1. Monitor and map the distribution of high priority weeds and develop a control strategy

Weed monitoring and mapping provides a valuable baseline for weed distribution and abundance and is also essential to developing a comprehensive control strategy. Distribution mapping includes compiling transect monitoring data, incidental observations and reconnaissance surveys to map the distribution and abundance of weeds. Results from surveys will then be used to better delineate the weed populations core extent and outlying individuals, and permit the development of an effective monitoring and control strategy.

2. Control weeds along invasion corridors (e.g., trails, fences) and within management units using approved methods (chemical, manual and/or biocontrol)

NAR priority areas for weed management are generally fenced, ungulate-free management units. Removal of ungulates from fenced units is a critical first step in weed control because it allows for the recovery of native vegetation by minimizing ground disturbance and reducing the spread of weeds by ungulates.

Weed control goals for Nakula management units include early detection and preventing the establishment of incipient, habitat modifying weeds that are not currently present in the NAR or are still localized. Widespread weeds such as non-native pasture grasses are targeted for control to enhance the success of reforestation and native forest restoration efforts. For priority weeds already present in the NAR, the goal is to eliminate all known occurrences within targeted control areas and/or to contain the spread of priority species. Due to limited resources for monitoring and control, NAR staff will focus control efforts in high priority reforestation areas, disturbed areas such as trails, and fence lines as these often serve as corridors for weed establishment and spread.

A combination of control techniques including manual, mechanical and targeted herbicides are used to remove weeds. The technique used is based on the characteristics of the target species, the sensitivity of the area in which the species is found, and the effectiveness of the control technique.

Weed control projects

- Control non-native grass in Wailaulau Unit to enhance restoration efforts and reduce grass native forest areas ultimately replacing non-native grasses with native understory and ground-cover species.

- Control priority weeds such as *Bocconia* by sweeping management units as funding and resources become available. Units are divided into management blocks, and these blocks are prioritized for control based on weed density, proximity to managed sites, and logistical feasibility. Blocks are systematically swept at 3 – 5 year intervals, although highly weed infested sites may be re-visited annually for follow-up control.

3. Prevent introduction of new weeds and invertebrates

Prevention is a critical component of the weed management program, and it is important to avoid and/or reduce the inadvertent introduction and spread of weeds by researchers, managers and students working in and visiting the area. Procedures include checking and decontaminating all boots, clothing or equipment prior to bringing crews and equipment into the Reserve using visual inspections, scrub brushes or other cleaning techniques to remove any loose dirt or organic matter from boots and clothing or resource management equipment (e.g. helicopter slingload nets). Prevention protocols will be followed and implemented by all staff, partners, volunteers and researchers working within the NAR.

4. Monitor weeds to detect changes in long term distribution and abundance and determine the effectiveness of management

NAR staff monitor weed control areas to evaluate the effectiveness of control efforts and conduct follow-up control of new seedlings and/or resprouts.

5. Support state-wide weed early detection and prevention programs and weed control research including new chemical, mechanical and biological control techniques, and participate, where appropriate, in experimental weed control management methods

DOFAW is collaborating with the LHWRP, Maui Invasive Species Committee (MISC), and researchers on weed control research into new monitoring, mapping (including remote sensing) and control methods. These methods will be tested and integrated into the weed management program, as appropriate. For example, DOFAW is working with partners to develop and refine Herbicide Ballistic Technology (HBT) or using a helicopter mounted spray ball for control of *Bocconia* on steep, inaccessible slopes or from the air. HBT is an emerging technology that involves firing of an encapsulated, herbicide-filled projectile from a modified paint ball gun. Due to widespread and heavy infestations of certain weeds (e.g. fireweed) and limited resources, NARS staff and partners intend to test the efficacy of approved biocontrol agents within the Reserve, when available.

2.2.3 Predator control

Background: Mammalian predators pose a threat to numerous species at Nakula NAR including forest birds, seabirds, native invertebrates and plants. Removal of predators, while difficult, will provide significant benefits to native species and ecosystems.

Objectives: Control predators to benefit native species and ecosystems

Actions:

1. Develop a predator control program and implement in high priority areas
2. Expand predator control to implement on a larger-scale when more effective control methods are developed and approved

Narrative Description of Actions:

1. Develop a predator control program and implement in high priority areas

NEPM staff will work with partners to implement predator control in high priority areas such as endangered forest bird reintroduction sites and seabird nesting areas. Staff will remove predators such as rats, mongoose, and cats that pose a major threat to birds. Predator control will be targeted to these high priority sites due to the limitations of current approved control methods.

2. Expand predator control to implement on a larger-scale when more effective control methods are developed and approved

New methods for widespread control across large conservation areas are currently being developed and will be implemented if they are approved and offer a cost-effective way to remove predators.

2.2.4 Fire prevention and response

Background: Fire management is incorporated as part of this management plan because of the threat it poses to the Reserve native forests and neighboring forests across leeward Haleakalā.

Objective: Employ appropriate fire management strategies including pre-suppression, suppression, and post-suppression rehabilitation to reduce wildfire occurrence and minimize wildfire impacts.

Actions:

1. Implement fire prevention measures, including fire breaks, educational outreach to neighbors and signage along roads
2. Suppress fires safely and aggressively using appropriate means
3. Continue NAR staff training and certifications for effective and safe fire response

Narrative Description of Actions:

1. Implement fire prevention measures, including fire breaks, educational outreach to neighbors and signage along roads

Many fires are caused by humans, so fire prevention measures will include increased educational efforts for those accessing the property, road or area closures in the event of extreme fire danger and suppression of non-native grasses in fire prone areas. Weed control and planting of common native species will be used to restore certain disturbed areas to prevent fire and/or following damage from fire. DOFAW will work to create vegetated fuel breaks under regenerated and/or planted koa by shading-out and/or

spraying non-native grasses so ground-cover is primarily leaf litter. This type of fuel break would likely reduce fire intensity and the rate of fire spread compared to non-native grass.

2. Suppress fires safely and aggressively using appropriate means

In the event of fire, DOFAW will respond to fires in the Reserve. The most effective control of a fire will be through measures that result in the least amount of impact or disturbance to natural and archeological resources. The method of suppression will be determined by the on-site situation, with special regard to the potential expansion of fire damage to the resources within the Reserve. Minimum impact methods of suppression will be applied whenever such methods are sufficient.

3. Continue NAR staff training and certifications for effective and safe fire response

Training of existing and new staff is a critical component of effective response to fire. NEPM staff will maintain current fire response certifications by attending regular required staff trainings.

2.2.5 Non-native insects and disease

Background: While introduced diseases and pathogens threaten both native animals and plants, little is currently known about presence and/or specific impacts on species and ecosystems at Nakula. In addition, effective management for most of these threats is generally not available except under certain very limited circumstances.

Objectives: Prevent and reduce the negative impacts of non-native insects and disease on species and ecosystems at Nakula NAR.

Actions:

1. Prevent the introduction of new diseases and pathogens through effective biosecurity
2. Monitor native species and ecosystems to detect presence of harmful invasive insects, diseases and pathogens
3. Encourage additional research and survey at Nakula on impacts of introduced insects and disease and effective management of these threats

Narrative Description of Actions:

1. Prevent the introduction of new diseases and pathogens through effective biosecurity

Biosecurity is a set of precautions that aim to prevent the introduction and spread of harmful organisms (pests, pathogens or invasive species). New plants and animals arrive in the islands on a continual basis from the mainland, other islands in the Hawaiian archipelago or even other areas from the same island. Preventing the introduction of new invasive species is a high priority as these introductions only serve to increase the funding needed to control these species and further put Hawai'i's native forests at risk. Organism introduction can occur via transportation by animals or humans, the wind and/or through species nearby expanding their range. There is also the risk of introductions from management work such as outplanting native plants grown in a nursery. Staff will implement sanitation to prevent the introduction of harmful species such as invertebrates (ants, wasps, pathogens, etc.) by cleaning and inspecting boots, clothing, equipment and materials (including plants for outplanting and seeds) to ensure they are free of dirt or organisms to lessen the chance of introductions.

2. Monitor native species and ecosystems to detect presence of harmful invasive insects, diseases and pathogens

Ongoing monitoring by DOFAW and partners planned and discussed in other sections for reforestation areas, rare plants, birds, etc. will assist in early detection of new potential threats.

3. Encourage additional research and survey at Nakula on impacts of introduced insects and disease and effective management of these threats.

See research and survey section below.

2.3 INFORMATION AND EDUCATION

Background: DOFAW's mission includes facilitating partnerships, community involvement and education. DOFAW outreach staff uses a variety of methods to connect with communities across demographics and islands including: websites, social media, press releases, public outreach events, educator workshops, field trips, classroom visits, and the youth programs. Due to the remote and inaccessible location of Nakula NAR, limited educational activities are feasible on site. Educational goals will be integrated with other aspects of natural resource management and research and will be accomplished through a strong reliance on partnerships.

Objectives: Build public understanding and support for the NAR and the state's unique native resources.

Actions:

1. Maintain and expand opportunities for youth internships
2. Provide the public with information about the Reserve and ongoing management
3. Work with partners to support joint educational and volunteer efforts
4. Install educational signage in the Reserve

Narrative Description of Actions:

1. Maintain and expand opportunities for youth internships

The NEPM program is planning on continuing participation in the State of Hawaii Youth Conservation Corp (YCC) Program, which enables young adults to gain entry-level experience as they work with natural resource professionals to conduct natural resources management. Internships often lead to future jobs or advanced degrees in natural resource management.

2. Provide the public with information about the Reserve and ongoing management

As it is difficult for the public to actually visit the Reserve, Maui NEPM staff will work with DOFAW Outreach staff to share information on Reserve resources and management through the web, social networking, video, and traditional media. NEPM staff will also provide presentations and outreach to researchers and managers, schools and community groups to communicate research findings and

management goals. Dissemination of information learned from reforestation projects will help inform other reforestation efforts on Maui and around the state.

3. Work with partners to support joint educational and volunteer efforts

Partners such as LHWRP and MFBRP have ongoing educational and volunteer programs and have a greater capacity to support such programs with on-site activities at Nakula and elsewhere on Maui. Maui NEPM staff will work with these partners to integrate information about ongoing Nakula NAR management into these existing programs.

4. Install educational signage in the Reserve

Educational signage will increase public knowledge about the NAR, and will be installed in areas along the boundary adjacent to proposed trails when developed.

Figure 27. Hawaii Youth Conservation Corps (YCC) interns learning about helicopter safety prior to outplanting trip.

2.4 Research and Survey

Background: Nakula NAR offers unique opportunities for research and staff review all research permits before they are approved. NEPM staff will continue to collaborate with partners, interested researchers, and students so their research can better address critical management needs.

Objective: Encourage additional surveys and research to better address critical natural resource management needs in the Reserve.

Actions:

1. Refine and modify existing inventory and monitoring programs (monitoring protocols, data management and analysis)

2. Encourage research including applied research with direct relevance to land management issues such as forest restoration, effective management of invasive plants and animals, and recovery of native plants and animals

3. Encourage basic research and survey to establish historical baselines of all natural resources and collect data on other topics relevant to land management

Narrative Description of Actions:

1. Refine and modify existing inventory and monitoring programs (monitoring protocols, data management and analysis)

Existing monitoring for ungulates, birds, weeds, reforestation and rare plants will be refined as needed to ensure monitoring is providing information relevant to informing management.

2. Encourage research including applied research with direct relevance to land management issues such as forest restoration, effective management of invasive plants and animals, and recovery of endangered native and animals

Research aimed at effective ecosystem restoration is of great relevance to other areas in Hawai‘i. The Reserve also provides an ideal site in which to test hypotheses about how invasive species impact ecosystems and determine the most effective methods of controlling or eliminating invasive species. Examples of priority research topics include:

- Methods to most effectively convert a koa forest with a grass understory into a native understory or native leaf litter that effectively out-competes grass.

- Research on potential issues with key matrix forest restoration species (e.g. lack of flowering and seed production).

- Effective control techniques and alternative methods for control of priority weed species.

- Assess overall arthropod resource base at the landscape level by performing vegetation surveys to estimating the amount of each foraging substrate available.

- Monitor for changes in arthropods as restoration proceeds to determine whether arthropods respond favorably to increased host plant density and diversity.

- Bird reintroduction research topics as outlined in MFBRP 2014.

3. Encourage basic research and survey to establish historical baselines of all natural resources and collect data on other topics relevant to land management

Information on the basic natural history and abundance of the endemic and often endangered plants and animals in the Reserve is needed to understand how species may respond to a changing environment (e.g., as a result of climate change) and how management and conservation measures can be used to enhance recovery and adaptation. Baselines research / survey needs include:

- Identify critical gaps in natural resource inventories for the NAR and initiate additional surveys and monitoring (e.g. invertebrate surveys).

- Weather, climate and hydrologic research and monitoring, in cooperation with partners.

- Additional research and survey at Nakula on presence and impacts of introduced insects and disease and effective management of these threats.

2.5 INFRASTRUCTURE MANAGEMENT

Background: A limited amount of essential infrastructure is needed to protect and effectively manage the NAR and support staff research and management actions. Existing and planned infrastructure includes items such as water catchment, management and public access trails, helicopter landing zones, field camps and bird release aviaries. Infrastructure and facilities development will be limited, small-scale and in many cases temporary to ensure minimal impacts on the environment and natural and cultural resources.

Objectives: Develop and maintain needed infrastructure to protect and effectively manage the NAR.

Actions:

1. Develop and maintain needed infrastructure to support staff research and management actions
2. Develop and maintain infrastructure for bird reintroduction actions
3. Develop and maintain public trails

Narrative Description of Actions:

1. Develop and maintain needed infrastructure to support staff research and management actions

NEPM staff has existing temporary camps and helicopter landing zones in the Wailaulau Unit and other areas primarily used for fence construction and reforestation projects (Figure). Other camps and landing zones will be developed on an as needed basis as restoration continues in other areas. Camps are generally mobile, temporary structures with light impacts and minimal development. One camp (a temporary shelter built on a wooden deck with water catchment) to support reforestation projects is planned for the eastern portion of the NAR at approximately 5,200 ft elevation.

2. Develop and maintain infrastructure for bird reintroduction actions

The MFBRP currently has existing infrastructure in the Wailaulau Unit of the Reserve including a cabin, water catchment and management trails. Additional infrastructure such as bird release aviaries may be needed in the future to support bird reintroduction efforts. Holding or release aviaries will need to be erected at release sites. These will most likely be placed on scaffolding to minimize predator access.

3. Develop and maintain public trails

DOFAW has previously proposed increased public access to the Kahikinui FR and Nakula NAR area through construction of a trail system and backcountry cabins located at Kahikinui FR (DOFAW 2012). Most of the proposed infrastructure is located in the FR; however a couple of trails are proposed to cross the NAR. Trail alignments are provisional, pending development of access agreements with neighboring landowners, field confirmation of the absence of threatened or endangered species and cultural resource sites and topographical considerations.

Figure 28. Temporary camp to support restoration activities.

3 Management Action Summary and Budget

This section of the plan summarizes planned short term management actions and the associated budget proposed to complete those actions (Table 6). This section is intended to be regularly updated (approximately every two years) and will be used by NARS staff for operational and biennium budget planning.

NEPM staff for the island of Maui work on all seven NAR on the island, including Nakula. In 2015, NEPM staff included four DOFAW staff, three University of Hawai'i contractors (Pacific Cooperative Studies Unit) and two YCC interns. The budget below assumes current budget levels/existing staff will provide labor, materials and supplies for many of the ongoing and proposed management actions. New funding will be required to hire additional NAR staff and/or contractors to complete major new proposed projects including reforestation and the expansion of weed management.

Figure 26. Staff member leading volunteer outplanting activities.

Table 6. Budget required to implement management actions in the Nakula NAR (Financial Years 2016 and 2017). Shaded cells show where budget is included under general / other organizations' budgets or is to be addressed in the future.

Action	Description	Budget	
		FY16	FY17
3.1 RESTORATION			
3.1.1 Reforestation			
1. Seed collection and propagation		TBD	TBD
2. Implement reforestation of common native species in targeted priority sites to reestablish native forest and shrubland	Outplanting using NEPM funds (tree purchases)	$0	$30,000
	Outplanting using US Forest Service State and Private Forestry FY15-16 grant funds (tree purchases)	$100,000	$0
	Supplemental water (water catchments to supplement planting)	$2,500	$2,500
	Helicopter transport for outplanting (1 trip every second month)	$21,000	$21,000
3. Rare plant restoration		TBD	TBD
4. Monitor success of reforestation actions and improve restoration strategies and techniques, as needed		TBD	TBD
3.1.2 Forest Bird Recovery			
1. Monitor forest birds	Helicopter transport to support Maui Forest Bird Recovery Project work	$7,500	$7,500
2. Control small non-native mammalian predators	(Refer to action 2c)	$0	$0
3. Assess other threats to forest birds and determine appropriate management actions	(Part of NEPM and Maui Forest Bird Recovery Project regular operations budgets)	$0	$0
4. Restore endangered birds to the Reserve		TBD	TBD
3.1.3 Seabird Recovery			
1. Monitor 'ua'u to determine relative abundance, activity, reproductive success and effectiveness of management	(Part of Maui Nui Seabird Recovery Project regular operations budget)	$0	$0

2. Determine strategy and develop and implement control program for introduced predators	(Refer to action 2c)	$0	$0
3.1.4 Bat Recovery			
1. Implement proposed general habitat management actions	(Refer to actions 1a and 2a,b)	$0	$0
2. Perform surveys to monitor changes in bat activity levels over time		TBD	TBD
3.1.5 Invertebrate Recovery			
1. Implement proposed general habitat management actions	(Refer to actions 1a and 2a,b)	$0	$0
2. Work with DOFAW's Native Invertebrate Conservation Program to facilitate additional survey and research to more effectively target management actions		TBD	TBD
Restoration Subtotal		**$131,000**	**$61,000**
3.2 THREAT ABATEMENT			
3.2.1 Ungulate control			
1. Maintain integrity of existing fenced management units through regular inspection, maintenance and replacement of fencing	Helicopter transport for fence maintenance (1 per quarter)	$10,000	$10,000
2. Remove all ungulates from fenced management units	Aerial Capture, Eradication and Tagging of Animals (ACETA) follow up	$30,000	$30,000
	Animal control, to be determined by animal activity (survey, trapping, Judas goats etc.)	TBD	TBD
3. Monitor existing ungulate-free units for ungulate ingress and control ungulates	(Part of NEPM regular operations budget)	$0	$0
3.2.2 Invasive plant control			
1. Monitor and map the distribution of high priority weeds and develop a control strategy	(Part of NEPM and Leeward Haleakala Watershed Restoration Partnership regular operations budgets)	$0	$0

2. Control weeds along invasion corridors and within management units using approved methods (chemical, manual and / or biocontrol)	Herbicide used for *Bocconia* control and to prepare outplanting sites	$10,000	$10,000
	Helicopter transport for *Bocconia* control (1 trip every quarter)	$14,000	$14,000
	Helicopter transport to support Leeward Haleakala Watershed Restoration Partnership work	$7,500	$7,500
3. Prevent introductions of new weeds and invertebrates	(Part of NEPM and Leeward Haleakala Watershed Restoration Partnership regular operations budgets)	$0	$0
4. Monitor weeds to detect changes in long term distribution and abundance and determine the effectiveness of management	(Part of NEPM and Leeward Haleakala Watershed Restoration Partnership regular operations budgets)	$0	$0
5. Support state-wide weed early detection and prevention programs and weed control research		TBD	TBD
3.2.3 Predator control			
1. Develop a predator control program and implement in high-priority areas	(Research and development being done by Maui Nui Seabird Recovery Project)	$0	$0
2. Expand predator control to implement on a larger-scale when more effective control methods are developed and approved.	(For future implementation)	$0	$0
3.2.4 Fire prevention and response			
1. Implement fire prevention measures, including fire break, educational outreach to neighbors and signage along roads		TBD	TBD
2. Suppress fires safely and aggressively using appropriate means	(Part of DOFAW fire budget)	$0	$0
3. Continue NAR staff training and certifications for effective and safe fire response	(Part of DOFAW fire and NEPM regular operations budgets)	$0	$0
3.2.5 Non-native insects and disease			
1. Prevent the introduction of new diseases and pathogens through effective biosecurity		TBD	TBD

2. Monitor native species and ecosystems to detect presence of harmful invasive insects, diseases and pathogens	(Part of NEPM regular operations budget)	$0	$0
3. Encourage additional research and survey at Nakula on impacts of introduced insects and disease and effective management of these threats		TBD	TBD
Threat Abatement Subtotal		**$71,500**	**$71,500**
3.3 INFORMATION AND EDUCATION			
1. Maintain and expand opportunities for youth internships	(Part of NEPM regular operations budget; $3,000 per year for supplies)	$0	$0
2. Provide the public with information about the Reserve and ongoing management		TBD	TBD
3. Work with partners to support joint educational and volunteer efforts	(Part of NEPM regular operations budget)	$0	$0
4. Install educational signage in the Reserve		TBD	TBD
Information and Education Subtotal		**$0**	**$0**
3.4 RESEARCH AND SURVEY			
1. Refine and modify existing inventory and monitoring programs	(Implement long term vegetation monitoring plots. Outplanting monitoring part of NEPM regular operations budget and trips)	$0	$0
2. Encourage research with direct relevance to land management issues		TBD	TBD
3. Encourage basic research and survey to establish historical baselines		TBD	TBD
Research and Survey Subtotal		**$0**	**$0**
3.5 INFRASTRUCTURE MANAGEMENT			
1. Develop and maintain needed infrastructure to support staff research and management actions	Construction of management shelter (headquarters for reserve operations)	$0	$15,000
	Installation of rain shed / tank at 'Flat camp'	TBD	TBD

2. Develop and maintain infrastructure for bird reintroduction actions		TBD	TBD
3. Develop and maintain public trails		TBD	TBD
Infrastructure Management Subtotal		**$0**	**$15,000**
3.6 GENERAL OPERATIONAL COSTS			
1. Subsistence for field crews	$100 per week per crew member (6) for 12 weeks	$7,200	$7,200
General Operational Costs Subtotal		**$7,200**	**$7,200**
TOTAL		**$209,700**	**$154,700**

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APPENDICES

APPENDIX A NAKULA NAR PLANT SPECIES LIST (DEVELOPED BY HANK OPPENHEIMER, MAUI PEPP)

Family	Genus	Species	Subtaxon	Common name	Distribution	Abundance
Pteridophytes						
Adiantaceae	*Adiantum*	*hispidulum*			naturalized	common
Adiantaceae	*Adiantum*	*raddianum*			naturalized	common
Aspleniaceae	*Asplenium*	*acuminatum*			endemic	occasional
Aspleniaceae	*Asplenium*	*adiantum-nigrum*				occasional
Aspleniaceae	*Asplenium*	*contiguum*				occasional
Aspleniaceae	*Asplenium*	*diellerectum*	alexandri		endemic	rare
Aspleniaceae	*Asplenium*	*macraei*				common
Aspleniaceae	*Asplenium*	*peruvianum*	insulare		endemic	rare
Aspleniaceae	*Asplenium*	*polyodon*				occasional
Aspleniaceae	*Asplenium*	*trichomanes*	subsp. densum		endemic	occasional
Aspleniaceae	*Asplenium*	*unilaterale*				occasional
Athyriaceae	*Deparia*	*petersenii*			naturalized	occasional
Athyriaceae	*Athyrium*	*microphyllum*		akolea	endemic	common
Athyriaceae	*Diplazium*	*molokaiense*			endemic	rare
Athyriaceae	*Diplazium*	*sandwicianum*		pohole	endemic	common
Blechnaceae	*Blechnum*	*appendiculatum*			naturalized	occasional
Blechnaceae	*Sadleria*	*cyatheoides*			endemic	
Blechnaceae	*Sadleria*	*souleyetiana*			endemic	occasional
Cibotiaceae	*Cibotium*	*glaucum*		hapuu	endemic	occasional
Dennstaedtiaceae	*Hypolepis*	*hawaiiensis*	var. hawaiiensis		endemic	occasional
Dennstaedtiaceae	*Pteridim*	*aquilinum*	var. decompositum	kilau	endemic	common
Dryopteridaceae	*Cyrtomium*	*caryotidium*		ka apeape	endemic	occasional
Dryopteridaceae	*Dryopteris*	*glabra*	var. glabra		endemic	common
Dryopteridaceae	*Dryopteris*	*fusco-atra*	var. fusco-atra		endemic	occasional
Dryopteridaceae	*Dryopteris*	*wallichiana*			endemic	common
Dryopteridaceae	*Polystichum*	*bonseyi*			endemic	occasional

Family	Genus	Species	Subtaxon	Common name	Distribution	Abundance
Dryopteridaceae	*Polystichum*	*haleakalense*			endemic	occasional
Dryopteridaceae	*Polystichum*	*hillebrandii*			endemic	occasional
Gleicheniaceae	*Dicranopteris*	*linearis*		uluhe	indigenous	rare
Grammitidaceae	*Oreogrammitis*	*hookeri*			endemic	rare
Hymenophyllaceae	*Vandenboschia*	*davallioides*			endemic	oc
Lomariopsidaceae	*Elaphoglossum*	*paleaceum*			indigenous	occasional
Marattiaceae	*Marattia*	*douglasii*		pala	endemic	occasional
Polypodiaceae	*Lepisorus*	*thunbergianus*		pakahakaha	indigenous	occasional
Polypodiaceae	*Polypodium*	*pellucidum*		ae	endemic	occasional
Psilotaceae	*Psilotum*	*nudum*		moa	indigenous	occasional
Pteridaceae	*Coniogramme*	*pilosa*		loulu	endemic	common
Pteridaceae	*Pellaea*	*ternifolia*		kalamoho laulii	endemic	occasional
Pteridaceae	*Pityrogramma*	*austroamericana*		gold fern	naturalized	occasional
Pteridaceae	*Pteris*	*cretica*		oali	indigenous	common
Pteridaceae	*Pteris*	*excelsa*		waimakanui	indigenous	common
Pteridaceae	*Pteris*	*irregularis*		iwa puakea	endemic	occasional
Thelypteridaceae	*Amauropelta*	*glomuliferum*		palapalai o Kamapuaa	endemic	occasional
Thelypteridaceae	*Christella*	*parasitica*			naturalized	occasional
Thelypteridaceae	*Pneumatopteris*	*sandwicensis*		hoio kuka	endemic	occasional
Thelypteridaceae	*Pseudophegopteris*	*keraudreniana*		waimakanui	endemic	occasional
Dicotyledons						
Apocynaceae	*Alyxia*	*oliviformis*		maile	indigenous	common
Aquifoliaceae	*Ilex*	*anomala*		kawau	indigenous	occasional
Araliaceae	*Cheirodendron*	*trigynum*		olapa	endemic	occasional
Asteraceae	*Ageratina*	*adenophora*		mexican devil	naturalized	occasional
Asteraceae	*Ageratina*	*riparia*			naturalized	occasional
Asteraceae	*Artemisia*	*australis*			endemic	occasional
Asteraceae	*Artemisia*	*mauiensis*			endemic	rare
Asteraceae	*Bidens*	*pilosa*		beggars tick	naturalized	occasional
Asteraceae	*Dubautia*	*plantaginea*			endemic	rare

Family	Genus	Species	Subtaxon	Common name	Distribution	Abundance
Asteraceae	*Dubautia*	*platyphylla*			endemic	occasional
Asteraceae	*Dubautia*	*reticulata*			endemic	rare
Asteraceae	*Hypochaeris*	*radicata*		hairy cats ear	endemic	common
Asteraceae	*Lapsana*	*communis*		nipplewort	naturalized	occasional
Asteraceae	*Prunus*	*vulgaris*		bull thistle	naturalized	occasional
Asteraceae	*Senecio*	*madagascariensis*		fireweed	naturalized	rare
Asteraceae	*Youngia*	*japonica*			naturalized	common
Begoniaceae	*Hillebrandia*	*sandwicensis*			endemic	rare
Campanulaceae	*Clermontia*	*kakeana*		oha wai	endemic	occasional
Campanulaceae	*Lobelia*	*sps.*		opelu, kuhi'aikamo'owahie	endemic	occasional
Caryophyllaceae	*Cerastium*	*fontanum*	subsp. triviale	common mouse-eared chickweed	naturalized	occasional
Celastraceae	*Perrottetia*	*sandwicensis*		olomea	endemic	common
Epicridaceae	*Leptecophylla*	*tameiameiae*		pukiawe	indigenous	common
Ericaceae	*Vaccinium*	*calycinum*		ohelo ka laau	endemic	occasional
Ericaceae	*Vaccinium*	*dentatum*		ohelo	endemic	occasional
Euphorbiaceae	*Euphorbia*	*peplus*		petty spurge	naturalized	occasional
Fabaceae	*Acacia*	*koa*		koa	endemic	common
Fabaceae	*Sophora*	*chrysophylla*		mamane	endemic	rare
Fabaceae	*Trifolium*	*repens*		white clover	naturalized	occasional
Gentianaceae	*Centaurium*	*erythraea*			naturalized	occasional
Geraniaceae	*Geranium*	*homeanum*			naturalized	common
Gesneriaceae	*Cyrtandra*	*biserrata*		haiwale	endemic	rare
Gesneriaceae	*Cyrtandra*	*grayi*		haiwale	endemic	common
Lamiaceae	*Prunella*	*vulgaris*		self-heal	naturalized	rare
Lythraceae	*Lythrum*	*maritimum*		pukamole	naturalized	common
Myrsinaceae	*Myrsine*	*lessertiana*		kolea lau nui	endemic	occasional
Myrtaceae	*Metrosideros*	*polymorpha*	var. incana	ohia lehua	endemic	common
Myrtaceae	*Metrosideros*	*polymorpha*	var. glaberrima	ohia lehua	endemic	common
Onagraceae	*Epilobium*	*billardierianum*		willow herb	naturalized	occasional

Family	Genus	Species	Subtaxon	Common name	Distribution	Abundance
Oxalidaceae	*Oxalis*	*corniculata*		yellow wood sorrel	Polynesian introduction?	common
Papaveraceae	*Bocconia*	*frutescens*		tree poppy	naturalized	common
Piperaceae	*Peperomia*	*cookiana*		ala ala wainui	endemic	occasional
Plantaginaceae	*Plantago*	*lanceolata*		narrow-leaved plantain	naturalized	common
Primulaceae	*Anagalis*	*arvensis*		scarlet pimpernel	naturalized	occasional
Ranunculaceae	*Ranunculus*	*mauiensis*		makou	endemic	rare
Rosaceae	*Osteomeles*	*anthyllidifolia*		ulei	indigenous	occasional
Rosaceae	*Rubus*	*hawaiiensis*		akala	endemic	common
Rosaceae	*Rubus*	*rosifolius*		thimbleberry	naturalized	common
Rubiaceae	*Coprosma*	*ernodioides*		kukaenene		occasional
Rubiaceae	*Coprosma*	*foliosa*		pilo		occasional
Rubiaceae	*Coprosma*	*montana*		pilo		rare
Rubiaceae	*Coprosma*	*ochracea*		pilo		occasional
Rubiaceae	*Kadua*	*affinis*		manono	endemic	occasional
Rubiaceae	*Kadua*	*centranthoides*			endemic	rare
Rubiaceae	*Psychotria*	*sp.*			endemic	rare
Rutaceae	*Melicope*	*clusiifolia*				rare
Rutaceae	*Melicope*	*volcanica*		alani		occasional
Santalaceae	*Santalum*	*haleakalae*	var. haleakalae	iliahi	endemic	rare
Sapindaceae	*Dodonaea*	*viscosa*		aalii		common
Solanaceae	*Physalis*	*peruvianum*		poha	naturalized	occasional
Solanaceae	*Solanum*	*americanum*		popolo	Polynesian introduction?	occasional
Urticaceae	*Pilea*	*peploides*			endemic	occasional
Urticaceae	*Pipturus*	*albidus*		mamaki	endemic	common
Urticaceae	*Urera*	*glabra*		opuhe	endemic	occasional
Monocotyledons						
Asteliaceae	*Astelia*	*menziesiana*		painiu	endemic	rare
Cyperaceae	*Carex*	*alligata*			endemic	occasional

Family	Genus	Species	Subtaxon	Common name	Distribution	Abundance
Cyperaceae	*Carex*	*meyenii*			indigenous	occasional
Cyperaceae	*Carex*	*wahuensis*	subsp. wahuensis		endemic	occasional
Juncaceae	*Juncus*	*effusus*		Japanese mat rush	naturalized	rare
Juncaceae	*Luzula*	*hawaiiensis*			endemic	occasional
Poaceae	*Andropogon*	*virginicus*		broomsedge	naturalized	occasional
Poaceae	*Anthoxanthum*	*odoratum*		vernalgrass	naturalized	common
Poaceae	*Axonopus*	*fissifolius*		narrow-leaved carpet grass	naturalized	common
Poaceae	*Cenchrus*	*clandestinum*		kikuyu grass	naturalized	common
Poaceae	*Deschampsia*	*nubigena*			endemic	common
Poaceae	*Eragrostis*	*brownei*		sheep grass	naturalized	common
Poaceae	*Festuca*	*rubra*			naturalized	occasional
Poaceae	*Holcus*	*lanatus*			naturalized	common
Poaceae	*Melinis*	*minutiflora*		molasses grass	naturalized	common
Poaceae	*Paspalum*	*conjugatum*		Hilo grass	naturalized	occasional
Poaceae	*Sporobolus*	*africanus*		smutgrass	naturalized	occasional
Smilacaceae	*Smilax*	*melastomifolia*		hoi kuahiwi	endemic	occasional

APPENDIX B NAKULA NAR BIRDS (BIRDS HISTORICALLY/CURRENTLY FOUND IN OR NEAR THE NAR).

Taxon	Common Name	Status
Acridotheres tristis	common myna	non-native
Alauda arvensis	Eurasian skylark	non-native
Asio flammeus sandwichensis	pueo, Hawaiian owl	endemic
Branta sandvicensis	nēnē, Hawaiian goose	endemic - endangered
Callipepa californica	California quail	non-native
Cardinalis cardinalis	northern cardinal	non-native
Carpodacus mexicanus	house finch	non-native
Cettia diphone	Japanese bush warbler	non-native
Chasiempis sandwichensis	ʻelepaio	endemic
Francolinus erckelii	Erckel's francolin	non-native
Garrulax canows	hwamei, melodious laughing thrush	non-native
Geopelia striata	zebra dove	non-native
Hemignathus virens	ʻamakihi	endemic
Himatione sanguinea	ʻapapane	endemic
Leiothrix lutea	red-billed leoithrix	non-native
Lonchura punctulata	nutmeg mannikin	non-native
Lophura leucomelanos	kalij pheasant	non-native
Loxops coccineus	Hawaiʻi ʻākepa	endemic - endangered
Oceanodroma castro	ʻakēʻakē, band-rumped storm petrel	indigenous - candidate
Phasianus colchicus	ring-necked pheasant	non-native
Pluvialis fulva	kōlea, Pacific golden plover	indigenous
Pterodroma sandwichensis	ʻuaʻu or Hawaiian petrel	endemic - endangered
Vestiaria coccinea	ʻiʻiwi	endemic
Zosterops japonicus	Japanese white-eye	non-native

LAUPAHOEHOE FOREST DRAFT MANAGEMENT PLAN

Download it here:

http://dlnr.hawaii.gov/ecosystems/files/2013/07/DRAFT_Laupahoehoe_mngt_plan_04162015_small.pdf

DEPARTMENT OF LAND AND NATURAL RESOURCES
DIVISION OF FORESTRY AND WILDLIFE

Amendments to Chapter 13-209
Hawaii Administrative Rules

DATE

1. Section 13-209-4, Hawaii Administrative Rules, is amended to read as follows:

§ 13-209-4 Prohibited activities. The following activities are prohibited within a natural area reserve:

(1) To remove, injure, or kill any form of plant or animal life, except game mammals and birds hunted according to department rules;

(2) To introduce any form of plant or animal life, except dogs when permitted by hunting rules of the department and service animals accompanying their handlers;

(3) To remove, damage, or disturb any geological or paleontological features or substances;

(4) To remove, damage, or disturb any historic or prehistoric remains;

(5) To remove, damage, or disturb any notice, marker, or structure;

(6) To engage in any construction or improvement;

(7) To engage in any camping activity or to establish a temporary or permanent residence;

(8) To start or maintain a fire;

(9) To litter, or to deposit refuse or any other substance;

(10) To operate any motorized or unmotorized land vehicle or air conveyance of any shape or form in any area, including roads or trails, not designated for its use;

(11) To operate any motorized water vehicle of any shape or form in freshwater environments, including bogs, ponds, and streams, or marine waters, except as otherwise provided in the boating rules of the department;

(12) To enter into, place any vessel or material in or on, or otherwise disturb a lake or pond;

(13) To engage in commercial activities of any kind in a natural area reserve without a written special-use permit from the board or its authorized representative;

(14) To have or possess the following tools, equipment, or implements: fishing gear or devices within Ahihi-Kinau natural area reserve, including but not limited to any hook-and-line, rod, reel, spear, trap, net, crowbar, or other device that may be used for the taking, injuring, or killing of marine life; cutting or harvesting tools or gear, including but not limited to chainsaws, axes, loppers, any mechanized or manual sawtooth tool, seed pickers, or machete, that may be used for the taking, injuring, or killing of plant life; and hunting gear or tools that may be used for the taking, injuring, or killing of wildlife, except as permitted by the hunting rules of the department;

(15) To hike, conduct nature study, or conduct any activity with a group larger than ten in size;

(16) To be present in an area closed pursuant to section 13-209-4.5 or after visiting hours established pursuant to section 13-209-4.6;

(17) To anchor any motorized or nonmotorized water vehicle of any shape or form in the marine waters of Ahihi-Kinau natural area reserve;

(18) To enter into any cave, as defined in section 6D-1, Hawaii Revised Statutes, or any portion thereof;

(19) To conduct any other activity inconsistent with the purpose and intent of the natural area reserves system.

(20) To use or possess narcotics or drugs, provided that a person may use or possess drugs legally prescribed by a physician. No person shall enter or remain within the premises when under the influence of alcohol or illegal narcotics or drugs.

(21) To use or possess alcohol, except with the written permission of the board or its authorized representative. [Eff 6/29/81; am 12/9/02; am 7/3/03; am 1/26/07; am](Auth: HRS § 195-5) (Imp: HRS § 195-5)

2. Section 13-209-5, Hawaii Administrative Rules, is amended to read as follows:

§ 13-209-5 Special-use permits. (a) The board or its authorized representative, with the approval of the commission or its authorized representative, may issue permits to conduct activities otherwise prohibited by section 13-209-4 for research, education, management, or for any other purpose consistent with chapter 195, Hawaii Revised Statutes.

(b) No permit may be valid for more than one year from date of issuance. The board may waive this restriction for permits [~~issued to other governmental agencies~~] where the board determines such a waiver to be in the best interest of the State.

(c) All special-use permits shall be subject to standard conditions, as approved by the board, including but not limited to the following:

(1) The permittee shall adhere to specifications given in the permit application;

(2) Disturbance of vegetation and wildlife shall be avoided as much as possible;

(3) Precautions shall be taken to prevent introductions of plants or animals not naturally present in the area. The permittee is responsible for making sure that participants' clothes, equipment, and vehicles are free of seeds or dirt to lessen the chance of introducing any non-native plants or soil animals. Should an infestation develop attributable to permittee, the permittee is responsible for eradication by methods specified by the department;

(4) This permit is not transferable;

(5) This permit does not exempt the permittee from complying with any other applicable rule or statute;

(6) The State of Hawaii shall be released and held harmless from any and all liability for injuries or death, or damage or loss of property however occurring during any activity related to this permit.

(d) The board or its authorized representative may attach special conditions on the special-use permit, including but not limited to reporting requirements, limitations on the size of groups or the length of time for which the permit is valid. Failure to comply with any of these conditions shall render a permit void.

(e) All permittees shall carry the permit with them at all times while in the reserve and shall, upon request, show the permit to any law enforcement officer or the board or its authorized representative.

(f) Permits are not transferable. If the permittee is a partnership, joint venture, or corporation, the sale or transfer of 25 percent or more of ownership interest or stocks by dissolution, merger, or any other means, shall be deemed a transfer for purposes of this subsection and subject to the right of the department to terminate this permit effective the date of the sale or transfer.

(g) The board or its authorized representative may revoke or cancel a permit without prior notice when an emergency is declared by the department or other proper authority or when the special-use poses an immediate threat to the health, safety, and welfare of the public or natural, geological, or cultural resources of the reserve.

(h) The board or its authorized representative may revoke or cancel any permit with thirty days written notice:

(1) For any infraction of the terms and conditions of the permit;

(2) Upon a finding that the special-use threatens to damage the integrity or condition of the natural, geological, or cultural resources in the reserve;

(3) Upon a finding that the special-use poses a threat to the health, safety, or welfare of the general public or otherwise negatively impacts the general public's use and enjoyment of the reserve; or

(4) Upon closure of a reserve pursuant to section 13-209-4.5.

(i) The provisions of this section shall not exempt the applicant from complying with any other applicable rule or statute.[Eff 6/29/81; am 1/26/07; am] (Auth: HRS § 195-5)(Imp: HRS § 195-5)

3. Section 13-209-4, Hawaii Administrative Rules, is amended to read as follows:

§ 13-209-5.5 Applications for special-use permits. (a) All applications for special-use permits shall be submitted in writing to the board or its authorized representative on the form prescribed by the department. The application shall contain the following information:

(1) Name of applicant, and if relevant, affiliation and title;

(2) Contact information, including name of primary contact, mailing address, phone number, and if available, email address;

(3) The period of time for which the permit is requested, not to exceed one year unless seeking a waiver pursuant to section 13-209-5(b);

(4) The reserve(s) involved;

(5) A map illustrating the reserve and the location within the reserve of the proposed special-use;

(6) A description of the proposed special-use;

(7) A discussion of how the proposed special-use satisfies subsections (b)(1) through (b)(6);

(8) An assessment of the potential environmental impact the special-use may have on the reserve or the surrounding area;

(9) Signature of the applicant;

[~~(10) An application fee of $50, however, the board or its authorized representative may waive the application fee if, in their opinion, the waiver is in the public interest or benefits the State; and~~

~~(11)~~](10) Any other information as determined by the department.

(b) In evaluating the merits of an application for a special-use permit, the board or its authorized representative shall apply the following criteria:

(1) The proposed special-use cannot be conducted elsewhere;

(2) The proposed special-use is consistent with the purpose and objectives of the natural area reserve system;

(3) The proposed special-use is consistent with the management plan developed for the reserve;

(4) The proposed special-use provides a benefit (direct or indirect) to the natural area reserve system or to the individual reserve(s) or both;

(5) The proposed special-use will not damage or threaten to damage the integrity or condition of the natural, geological, or cultural resources in the natural area reserve and adjacent area or region;

(6) The proposed special-use complies with provisions and guidelines contained in Chapter 205A, Hawaii Revised Statutes, entitled "Coastal Zone Management", where applicable; and

(7) The applicant shall have complied with, or be in compliance with, the conditions of any previously approved permit.

(c) The applicant shall have the burden of demonstrating that the proposed special-use is consistent with the criteria in subsection (b).

(d) The board or its authorized representative may hold a public hearing on an application where determined by the chairperson that the scope of the proposed special-use or the public interest requires a public hearing on the application. Notice of the hearing shall be given not less than twenty days prior to the date set for the hearing. Notice of the time and place of the hearing shall be published at least once in a newspaper in the county where the natural area reserve is located.

(e) If within two hundred seventy days after the department's acceptance of a completed application, the board or its authorized representative shall fail to render a decision thereon, the application for a special-use permit shall be automatically approved with the standard conditions outlined in section 13-209-5(c), provided that the board may revoke this approval pursuant to section 13-209-5(g) and (h). The two-hundred-seventy-day time period provided shall not commence until a completed application is accepted by the department. Physical receipt of an application by the department does not constitute acceptance. The two-hundred-seventy-day time period for decision may be extended for another one hundred eighty days at the request of the applicant to give the board additional time to review and make a decision on the application. [Eff 1/26/07; am] (Auth: HRS §§ 195-5, 91-13.5) (Imp: HRS §§ 195-5, 91-13.5)

4. Chapter 13-209, Hawaii Administrative Rules, is amended by adding a new section to read as follows:

§ 13-209-5.6 Parking fees.

(a) The fee for non-residents parking a vehicle in Ahihi-Kinau Natural Area Reserve in a space designated for its use shall be: $5.00 per entry.

(b) Residents with a valid state of Hawaii identification card or Hawaii drivers license will not be charged a fee.

(c) No person shall park a vehicle in the Reserve outside of a designated parking area designated by posted signs unless authorized by the department.

(d) In the event a vehicle is parked in a manner that interferes with the safe or orderly management of the premises, or is parked in violation of any provision in this section, it may be impounded by the board or its authorized representative at any time.

(e) All impounded vehicles shall be towed to a place of storage. Towing, storage, and other related costs shall be assessed pursuant to section 290-11, HRS. [Eff] (Auth: HRS §§ 195-5, 91-13.5) (Imp: HRS §§ 195-5, 91-13.5)

5. Material, except source notes, to be repealed is bracketed and stricken. New material is underscored.

6. Additions to update source notes to reflect this amendment is not underscored.

7. The amendments to chapter 13-209, Hawaii Administrative Rules, shall take effect ten days after filing with the Office of the Lieutenant Governor.

I certify that the foregoing are copies of the rules, drafted in the Ramseyer format pursuant to the requirements of section 91-4.1, Hawaii Revised Statutes, which were adopted on _____ by the Board of Land and Natural Resources, and filed with the Office of the Lieutenant Governor.

_____

Chairperson

Board of Land and Natural Resources

APPROVED FOR PUBLIC HEARING:

_____

Deputy Attorney General