

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

October 12, 2018

Chairperson and Members
Board of Land and Natural Resources
State of Hawai'i
Honolulu, Hawai'i

Land Board Members:

**SUBJECT: PROGRESS BRIEFING FOR RESEARCH PROJECTS, EDUCATIONAL
TOURS AND ADMINISTRATIVE CHALLENGES OF THE HAWAI'I
EXPERIMENTAL TROPICAL FOREST.**

Background

On January 25, 2007 the Board of Land and Natural Resources granted the U.S. Department of Agriculture, Forest Service (USFS), Pacific Southwest Research Station a non-exclusive 35 year permit to use State lands (Appendix A) situated at Laupāhoehoe and Pu'uwa'awa'a, Hawai'i for use as the Hawai'i Experimental Tropical Forest (HETF).

The HETF includes two Units: the Laupāhoehoe Wet Forest, totaling 12,343 acres, and the Pu'uwa'awa'a Dry Forest, totaling 38,885 acres. Unit maps are provided in Appendix A. The HETF overlays existing State of Hawai'i, Department of Land and Natural Resources (DLNR) managed lands and include the following land designations: Forest Reserve and Natural Area Reserve (NAR) in Laupāhoehoe, and Wildlife Sanctuary (Forest Bird Sanctuary), Forest Reserve and State Parks in Pu'uwa'awa'a.

The USFS works with the DLNR – Division of Forestry and Wildlife (DOFAW) and State Parks to manage research and education activities within the HETF. Further information regarding HETF management is outlined in the December 6, 2006 Cooperative Agreement (Appendix B) between the USFS and the State of Hawai'i Board of Land and Natural Resources (referenced throughout this document as "HETF Cooperative Agreement").

In granting the Permit to Use State Lands (Appendix A), the USFS agreed to "consult regularly with the State including:

- a) Providing an annual report on the status of approved new and ongoing research (including the primary investigator, the research topic, the location for the research, dates of field research, date of anticipated results, and contact information for the primary investigator);
- b) Providing an annual report on the number of educational tours and total number of participants, and
- c) Annually reporting on the challenges faced in the administration of the Experimental Forest."

This submittal provides an overview of HETF administration, a summary of the research and education activities that have occurred within the HETF from 2015 through 2017, current plans for facilities and the challenges associated with HETF administration. More detailed information can be found within the annual reports available online (<http://www.hetf.us/page/home/>) or hardcopy by request.

Administration

Per the HETF Cooperative Agreement, "owing to the many values and benefits that arise from research, education and demonstration on the HETF and elsewhere, the Parties (the USFS and the State of Hawai'i) further agree they will consult and reach agreements with each other to coordinate research, management, and education activities." The HETF Planning Group was established to fulfill this objective and includes the USFS-HETF Line Officer, the USFS-HETF Science Lead, the USFS-HETF Facilities Manager, the Hawai'i Island DOFAW Branch Manager, the Hawai'i Island Natural Area Reserves Program Manager, the Hawai'i Island Forestry Program Manager, East and West Hawai'i Island Wildlife Biologists, the Pu'uwa'awa'a coordinator, and two to three external partners.

Permitting

Permit applications for research and education activities are reviewed by a subset of the HETF Planning Group, the Research Technical Committee (RTC), which includes the USFS-HETF Line Officer, the Hawai'i Island DOFAW Branch Manager, the USFS-HETF Science Lead, the Natural Area Reserve Hawai'i Island Manager, the Forest Reserve Hawai'i Island Manager, East and West Hawai'i Island Wildlife Biologists, and the Pu'uwa'awa'a coordinator. Permit processing and tracking is coordinated and administered by HETF staff. Signing authority for all permits within DOFAW managed lands lies with the Hawai'i Island DOFAW Branch Manager. All research permits are valid for one year and require an annual report. The Pu'uwa'awa'a Unit of the HETF is limited to land activities. Research activities that take place in water including up to the tide line are under the jurisdiction of the DLNR-Division of Aquatic Resources and the Office of Conservation and Coastal lands (OCCL). Permits within State Parks are issued by State Parks Hawai'i Island District Superintendent.

Community Advisory Councils

Per the HETF Cooperative Agreement, "the Parties will consult with scientists, managers, general citizens, and local community members concerning ongoing research activities. Existing State sanctioned advisory councils may be utilized for this purpose." The Pu'uwa'awa'a Advisory Council (PAC) has been in existence since 2002. The Laupāhoehoe Advisory Council (LAC) was formed in December 2010. Both councils advise on and facilitate HETF related activities, as well as participate in research permit application review and their comments and/or recommendations are provided to the RTC during the review process.

Support

USFS Staff

USFS-HETF Line Officer - Dr. Ric Lopez

USFS-HETF Science Lead - Dr. Susan Cordell

USFS-HETF Education Lead - Dr. Christian Giardina

USFS-HETF Facilities Manager - Dean Oshiro (6/2014-7/2016), position was filled by Jon Mitsuda 1/2018

HETF Resource Associate - Tabettha Block

DOFAW Staff

Hawai'i Island DOFAW Branch Manager - Steve Bergfeld

Hawai'i Island Natural Area Reserves Program Manager - Nick Agorastos

Hawai'i Island Forestry Program Manager - Jay Hatayama

East Hawai'i Island Wildlife Biologist - Joey Mello

West Hawai'i Island Wildlife Biologist - Kanalu Sproat

Pu'uwa'awa'a Coordinator - Dr. Elliott Parsons

State Parks Hawai'i Island District Superintendent - Dean Takebayashi

State Managed Research Activities

As mentioned previously, HETF lands are managed cooperatively by IPIF, DOFAW and State Parks. State management activities and research and monitoring activities performed by State staff do not require HETF permits and are not tracked within this annual report. Management activity reports for each State land designation (Forest Reserves, NARS, Wildlife Sanctuary and State Parks) are prepared by DOFAW administration and are available via annual reports to the Legislature.

Facilities

Laupāhoehoe

HETF support facilities for the Laupāhoehoe Unit are present within the town of Laupāhoehoe but outside the forest boundary. The Kahikina Learning Center (Center) is located on 55 acres of old sugar cane lands within the Laupāhoehoe community, approximately four miles from the HETF boundary. Facilities include a bunkhouse, complete with a full kitchen and classroom/meeting space, a restroom and shower building, and a workshop. The facility site offers opportunities for research, education, and demonstration. A weather station, installed in 2009, is located onsite.

Pu'uwa'awa'a

There are plans to build dedicated HETF facilities within Pu'uwa'awa'a. As part of this Construction Project – and pending availability of funds, the IPIF is proposing to:

- Construct a bunkhouse building of approximately 1,100 square feet. This building would include double occupancy bunkhouse space for up to 10 visiting scientists, restrooms, kitchen facilities, and common use areas.

Research

The HETF is utilized for research by universities, government agencies including the USFS, and private organizations, as well as others including non-profits, non-government organizations, and societies (Figure 1).

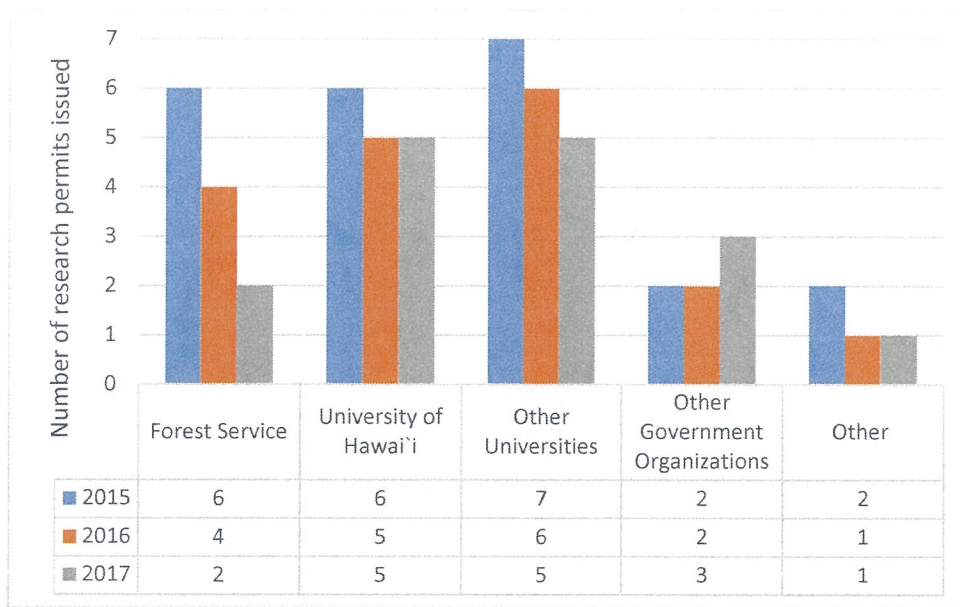


Figure 1: Affiliation for research projects initiated within the HETF from 2015 to 2017.

The HETF supported a total of 59 research projects from 2015 to 2017. Table 1 provides a breakdown of project locations within the HETF Units and yearly project totals. Research project locations may be specific to an HETF Unit or take place within both Units.

Table 1: Total number of research projects initiated in the HETF and grouped by Unit from 2015 to 2017.

Year	Laupāhoehoe Unit Only	Pu'uwa'awa'a Unit Only	Both HETF Units	Total # of Projects Initiated
2017	6 (33%)	6 (33%)	6 (34%)	18
2016	5 (28%)	9 (50%)	4 (22%)	18
2015	7 (31%)	13 (58%)	3 (11%)	23
Total	18	28	13	59

From 2015 to 2017, fifteen HETF-related journal articles were published in Science, Oecologia, Science of the Total Environment, Biogeosciences, Integrative and Comparative Biology and Ecosphere. A list of publications submitted with annual reports is included at the end of this report. Selected research projects from this period are highlighted below.

- Effects of non-native ungulate exclusion on fuel loading and modelled fire behavior - The interactions of wildfire, non-native invasions, and climate present significant threats to native species and ecosystems in Hawai'i and globally. In Hawai'i, wildfires have increased in scope and intensity from historic conditions due to human ignitions, abundant fuels associated with non-native grasses, and changing climate. For wildfire management, this presents many challenges which are exacerbated by the uncertainties of novel fuel types that occur with the invasion of non-native grasses, and the removal of non-native ungulates that at least partially control fuel loads. Although non-native ungulate removal is a general prerequisite for the effective conservation and restoration of native ecosystems in Hawai'i, it is largely unknown how their removal impacts the drivers of wildfire.

Timothy Zhu at the University of Hawaii at Mānoa is studying whether non-native ungulate removal increases fuel loads, and whether potential increases in fuel loads vary as a function of mean annual precipitation (MAP). He hypothesized that ungulate exclusion would increase fuel loads at intermediate MAPs, but have no impact at low or high MAPs. He uses standard fuel transects and sampling to quantify fuel loads inside and outside of 12 non-native ungulate exclosures located across a 2,700 mm MAP gradient on the island of Hawai'i. Results demonstrate that fine fuel loads and heights, primary drivers of wildfire, were higher with ungulate exclusion. However, he found little support for his original hypothesis that this would only be true for intermediate MAPs, as increased fuel loads with ungulate exclusion increased with MAP. This research informs management attempting to balance wildfire and conservation/restoration across tropical landscapes.

- Field Investigation of the Pu'u Anahulu Lava Flows - The Pu'u Wa'awa'a volcanic cone formed ~114,000 years ago on the northern flank of Hūlalai volcano (Hawai'i Island), and it is hypothesized that the Pu'u Anahulu lava flows were produced during the same eruption. This eruption is unique in Hawai'i in that it is one of the only known eruptions that produced true pumice (a very porous glassy rock) as well as obsidian (almost exclusively made of dense glass). The erupted rock is also of a chemical composition that is very different from the typical lavas that erupt from Hawai'i (e.g. Kilauea basalts), and this type of magma has a tendency to generate explosive eruptions more readily. Thomas Shea from the University of Hawai'i at Mānoa, is working to answer this simple question: Are the cone and flows related in time (i.e. same eruption) and in nature (i.e. same magma)? The first field campaign was completed in 2013-2014 to sample the rocks from Pu'u Wa'awa'a, he now plans to sample the lava flows from the Pu'u Anahulu area for a comparative study. In particular, past reports of pumice rock possibly interbedded between different parts of the Pu'u Anahulu flow will be verified, since those may provide proof that the pumice-producing cone and the dense rock-producing flow were erupted simultaneously. Rock samples collected during field work will be used for bulk chemical analysis at the University of Hawai'i. Thin rock sections will also help determine similarities and differences in the crystal content of the Pu'u Anahulu trachyte and Pu'u Wa'awa'a samples previously collected. As part of his HETF community give back, Mr. Shea created an informational brochure about Pu'uwa'awa'a that is available to all visitors at the informational kiosk at Pu'uwa'awa'a's main gate (Appendix C).
- Phenotypic and genetic variations of *Metrosideros polymorpha* across environmental gradients on the island of Hawaii - Yusuke Onoda of Kyoto University, Japan, is studying *Metrosideros polymorpha*, the most dominant native tree species on the island of Hawaii. This study is geared to understanding how this species adapts to various environments and how the population structure is maintained over the island. This research takes a quantitative ecophysiological and genetic approach to understand the current population structure. In the last two years, field work at approximately 50 locations on the island of Hawaii has been done. In 2017, several field sites in HETF were added, in order to cover the full range of habitat conditions of this species. At each study site, a small terminal branch (20-30cm) was collected from the outer crown of 40 mature trees with a pruning pole. The collected branches were used for morphological analyses such as leaf size, leaf thickness and leaf chemistry and genetic analyses. Preliminary results suggest that 70-80% of cross-population variations in several leaf traits were explained by a combination of temperature, aridity and soil age. Within population, variations among individuals were

not explained by local micro-environmental factors such as soil depth, but rather by the harshness of environmental conditions (environmental filtering) and the level of environmental heterogeneity (indication of gene flow).

- Potential changes in infiltration in Hawaiian forests caused by climate change and invasive species - The overall objective of the study by Lucas Fortini, USGS Pacific Islands Ecosystems Research Center, and Hawaii Cooperative Studies Unit staff (under the direction of Sharon Ziegler-Chong, University of Hawaii at Hilo), was to understand how rapidly expanding invasive plant population distributions throughout Hawaii’s forests, coupled with changes in inter-species competitive dynamics (caused by projected shifting rainfall patterns) will impact water resources into the future. Local studies have highlighted how invasive plants and disturbance of the ground-cover vegetation by feral ungulates may alter soil characteristics critical to determining runoff and groundwater recharge. Other efforts have suggested that invasive species, both plant and animal, have altered whole watershed water balances and possibly landscape groundwater recharge. However, a landscape-level understanding of the impact of invasive species on water resources both island and state wide is still lacking. This project, supported by the USGS Pacific Island Climate Science Center attempts to quantify differences in groundwater recharge between native and non-native forests, providing information as to how water resources are currently affected by forest type. Information gathered will be used to project future conditions under multiple climate scenarios. This research studied the differences in key soil characteristics that control runoff and groundwater recharge across managed and relatively intact native mesic and wet forest communities. To explore the ecohydrological impact of invasion in these communities, researchers conducted similar sampling in animal disturbed and invasive-dominated community types that most frequently replace the native communities considered. Specifically, the conduction of basic vegetation and forest canopy cover assessments, ungulate surveys; measurements of water infiltration and soil hydrophobicity (repellence of water) rates; small soil samples; and temperature and humidity was collected at all sites. Project findings will be released in 2018.

Education

Both HETF Units are utilized for education and outreach activities. Table 2 contains annual data for the number of educational trips and participants within the HETF Units from 2015 to 2017. Activities are categorized as education, service, education/service (this is when an education trip also includes a service portion) and other (which includes trainings, surveys (engineer, archaeological, plot, or private) as well as site visits, tours, media visits and Hawaiian cultural practices such as Ho‘olaule‘a).

Table 2: Total number of education trips in the HETF and grouped by Unit from 2015 to 2017.

Year	Laupāhoehoe Unit		Pu‘uwa‘awa‘a Unit	
	# of participants	# of trips	# of participants	# of trips
2017	49	4	897	29
2016	0	0	671	257
2015	15	1	394	16

Some examples of educational activities from 2015-2017 are highlighted below. More detailed information on all education activities can be found within the HETF annual reports available online at <http://www.hetf.us/page/resources/>.

- **Laupāhoehoe Community Public Charter School** students, as part of the Manaulu Manowai'ōpae program, hiked up Spencer trail into the Natural Area Reserve, to the 800 plot that was set up in 2009 by the Forest Service to monitor impacts of Climate Change on C input, allocation, and loss in model forests. The focus of the trip was restoration work, mainly invasive species removal (strawberry guava, koster's curse, and ginger). Most of the work was done by hand removal with gloves, but loppers and saws were supplied to the more adept students. Discussions included forest health and restoration. (2015)
- **Pu'uwa'awa'a** hosted an 'Every Kid in a Park' event where students from the Hawai'i Technology Academy and their families (25 participants), were given the opportunity to connect with nature by spending the day planting native and endangered species. Every Kid in a Park is a national youth initiative to get all 4th graders and their families to experience the places that are home to our country's natural treasures, rich history, and vibrant culture. (2015)
- **U.S. Senator Brian Schatz** held a summit on Rapid 'Ōhi'a Death (ROD) at the Kahikina Learning Center. The summit brought together many island and state players in the fight against this fungal disease that is currently attacking and killing 'ōhi'a (*Metrosideros polymorpha*), the most abundant native tree in the state of Hawai'i. (2016)
- **The Teaching Change Program** began offering field trips to local middle and high school students to the Pu'uwa'awa'a Unit in 2016. Based on the Island of Hawaii, Teaching Change aims to inspire local youth to be environmental stewards and to pursue post-secondary educations and careers in Hawai'i in natural resource management. Through outdoor, immersive learning students get hands on exposure to locally relevant natural resource issues and their management. Teaching Change is a collaboration between the University of Hawai'i at Mānoa, the Institute of Pacific Islands Forestry, and Pacific Resources for Education and Learning, with generous support from a variety of organizations and funders. The program visited Pu'uwa'awa'a four times in 2016 and eight times in 2017. (2016 & 2017)
- The first ever "**Bio-Cultural Blitz**" was held on September 23, 2016 at the Pu'uwa'awa'a Dry Forest Unit of the Hawaii Experimental Tropical Forest (HETF). The USFS, in partnership with the Hawaii State Division of Forestry and Wildlife (DOFAW), and the University of Hawaii at Mānoa, hosted 250 fourth-graders from the west-side of Hawaii Island. Students were traditionally welcomed by Native Hawaiian descendants of Pu'uwa'awa'a and spent the day visiting stations highlighting the biocultural significance of Hawaii's endangered dry forests, from botany and soils to wildlife and insects to cultural geography and indigenous resource management, while engaging in hands-on activities.
- **Waiākea High School** students from the Early College Program visited the Pu'uwa'awa'a Unit to uncover the natural, historical, and contemporary resources of the island through place-based learning. Pu'uwa'awa'a provides a retreat-atmosphere conducive with the learning outcomes of reflection and life-planning that is reflective of the coursework of the IS101 and HWST100 courses. With the greater focus on lifestyles and behavior, the motivation for visiting Pu'uwa'awa'a was to immerse students into an atmosphere unlike what they normally experience in Hilo; for them to align their perspectives of environment with the greater Hawai'i Island, and not simply Hilo, or East Hawai'i. (2017)

- **USFS staff** escorted Kupu interns along with a Hawaiian Airlines/Anthology contractor into the Laupāhoehoe Forest for the filming of “The ‘Ōhi‘a: The story of Hawai‘i’s Tree”, a project by Kupu. The film was used as part of the airlines in-flight programming from April to July 2017, shedding light on the cultural and environmental importance of ‘Ōhi‘a and helping to spread awareness of Rapid ‘Ōhi‘a Death (ROD) on Hawai‘i Island. Featured speakers in this film included IPIF’s research ecologists Christian Giardina and Flint Hughes, along with Natural Resource Specialist Kainana Francisco. (2017)

HETF Administrative Challenges

Hawaii is experiencing a groundswell of support for environmental education, citizen science and community based collaborative stewardship. PSW staff are keen to meet the many new research, demonstration, education, and outreach needs that are emerging from this groundswell by finding the opportunities for rich and diverse knowledge exchange and engagement of creative solutions. The HETF has no permanent staff or dedicated funding streams to oversee operations and facilities. Specifically, the USFS owns the Kahikina Learning Center in Laupāhoehoe and is building additional needed facilities in the Pu‘uwa‘awa‘a unit of the HETF. The ability of the USFS to administer and maintain these facilities is constrained by limited staffing capacity and administrative limitations to hosting education and outreach activities.

Other concerns, comments and challenges associated with HETF administration are provided internally by HETF Planning Group members and other USFS and DOFAW staff and externally by community members and/or research permit holders when they file annual reports.

Current Concerns, Comments and Challenges

Laupāhoehoe Unit

Submitted by researchers via annual reports:

- Difficulties measuring tree fern diameter and size consistently and accurately has complicated growth rate calculations. We are working to develop a new method of surveying tree ferns. Currently we are tracking mortality and pig damage.
- Challenges stem from safely accessing the remote regions in the HETF. Occasional access can be limited or prevented due to road wash out/ruts and fallen trees blocking the road.
 - These instances are reported to the HETF and notices to permit holders are sent out via email. DOFAW is also notified to clear/maintain the road.
- Difficulties reaching seed in Koa trees from trees that are not easily reached.
- Generating funding sources to keep project going. Due to an exceptionally wet year - some of the buried wires (of Sap-flux measurement equipment) are being uncovered due to erosion. We continue to monitor this on a regular basis and recover them with leaf litter when they become exposed.

Submitted by USFS/DOFAW staff:

- Weekend access in Laupāhoehoe can be difficult as privately leased lands must be crossed to access the forest.
 - The HETF Planning Group decided that a magnetic placards be used to identify POV’s entering Laupāhoehoe forest. Placards would be checked in and out with gate keys by DOFAW.

Pu'uwa'awa'a Unit

Submitted by researchers via annual reports:

- Routine natural challenges including avoiding native vegetation when entering the caves and crossing the flows, accessing the cave entrances (some are overhung, others are overgrown with vines and trees), and not disturbing fossil bird bones and other natural features (roots, tree trunks) found in the caves.
- Grass control is difficult within plots.
- Driving time within Pu'uwa'awa'a can be challenging, although signage and clear roads instructions were a great help, as was having access to the GPS tracks for the existing roads. One piece of information that could have helped reduce travel time would have been knowing the positions of the gates for the mauka fenced areas.
- Difficulty collecting data from plants that are exposed to ungulates.
 - The State is currently writing a Habitat Conservation Plan to address the impacts of ungulates on native plants.
- Incomplete data collection due to seedlings located along the bulldozed road unintentionally getting sprayed by herbicide during weed control efforts.
- 2015 was a wet year with unusually high rainfall compared with the past five years. Many of the species show signs of high levels of flowering and fruiting. A severe high wind and lightning storm occurred January 2nd 2015 with sustained winds over 70 km/hr.
- In March 2016 a lightning ignited fire burned all around the uhiuhi enclosure.
- Fruit that was counted from mature trees may not be as accurate since some fruit is collected by the State and other researchers.

Submitted by USFS/DOFAW staff:

- As with Laupāhoehoe Unit, magnetic placards will be issued to all POV's with HETF permits accessing Pu'uwa'awa'a Unit.

HETF Related Citations

Submitted with 2015 annual reports:

Dudley, BD, Hughes, RF, Ostertag, R. Groundwater availability mediates the ecosystem effects of an invasion of *Prosopis pallida*. *Ecological Applications*, 24.8 (2014): 1954–1971

Murphy, M.J., Inman-Narahari, F., Ostertag, R., Litton, C.M. 2014. Invasive feral pigs impact native tree ferns and woody seedlings in Hawaiian forest. *Biological Invasions* 16.1 (2014): 63-71.

Lawson SS, Michler CH, Inman-Narahari F, and Friday JB. *Acacia koa* gene expression along elevation and precipitation gradients. September 2014. Tropical Hardwood Tree Improvement and Regeneration Center E-Newsletter Fall 2014. (<http://www.trophirc.org/projects/acacia-koa-gene-expression-along-elevation-and-precipitation-gradients.html#.VEp9WfnF9MU> Site visited: October 24, 2014)

Lawson SS. Remember Koa? We Have Updates! May 2014. Hardwood Tree Improvement and Regeneration Center E-Newsletter 7:1. (<http://htirc.org/> Site visited: October 24, 2014)

Sakihara, TS, Dudley, BD, MacKenzie RA, Beets JP. 2015. Endemic grazers control benthic microalgal growth in a eutrophic tropical brackish ecosystem. *Marine Ecology Progress Series* Vol. 519 (2015): 29–45.

Thompson, A., Amistadi, M.K., Chadwick, O.A., and J. Chorover. Fractionation of yttrium and holmium during basaltic soil weathering. *Geochimica et Cosmochimica Acta* 119 (2013): 18-30.

Tweiten, M., S. Hotchkiss, P. Vitousek, J. Kellner, O. Chadwick, and G. Asner. Volcanic substrate and canopy disturbance influence the species composition and resilience of a Hawaiian montane wet forest. *Journal of Vegetation Science*, 25.3 (2014): 734-749.

Submitted with 2016 annual reports:

Bern, C.R., O.A. Chadwick, C. Kendall, and M.J. Pribil. 2015. Steep spatial gradients of volcanic and marine sulfur in Hawaiian rainfall and ecosystems. *Science of the Total Environment* 514: 250-260.

Cleveland, C.C., S. Reed, A. Keller, D. Nemergut, S. O'Neill, R. Ostertag, P. Vitousek. 2014. Litter quality versus microbial community controls over decomposition: a quantitative analysis. *Oecologia* 174: 283-294

Cordell, S., E. J. Questad, G. P. Asner, J. R. Kellner, K. M. Kinney, J. M. Thaxton, A. Uowolo, S. Brooks, and M. W. Chynoweth. 2016. Remote sensing for restoration planning: how the big picture informs stakeholders. *Restoration Ecology Early View Online*, DOI: 10.1111/rec.12448

Johnson, M.O., M. Gloor, M.J. Kirkby, and J. Lloyd. 2014. Insights into biogeochemical cycling from a soil evolution model and long-term chronosequences. *Biogeosciences* 11: 6873-6894

Selmants, P.C., Adair, K.L., Litton, C.M., Giardina, C.P., Schwartz, E. 2016. Increases in mean annual temperature do not alter soil bacterial community structure in tropical montane wet forests. *Ecosphere* 7:e01296.

Submitted with 2017 annual reports:

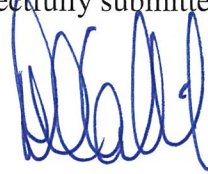
Ritzenthaler, C.A. 2017. The effect of soil micronutrient variation along an elevational gradient in a wet montane forest. MS Thesis. Bowling Green State University, Bowling Green, OH.

Ritzenthaler, C.A., Litton, C.M., Giardina, C.P. and Pelini, S.L. 2016. Soil moisture and millipede abundance are more important drivers of macroinvertebrate diversity than temperature in Hawaiian forest. *Integrative and Comparative Biology* 56: E357.

Selmants, P.C., Adair, K.L., Litton, C.M., Giardina, C.P., Schwartz, E. 2016. Increases in mean annual temperature do not alter soil bacterial community structure in tropical montane wet forests. *Ecosphere* 7:e01296.

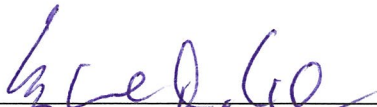
In closing, the Hawaii Experimental Tropical Forest (HETF), with its objective to provide information and tools to land managers through research, demonstration and education, is among the most remarkable and unique of experimental forests on earth. Further, the establishment of the HETF represents one of the most important and significant events in the history of the long and close relationship between the Hawaii Department of Land and Natural Resources', Division of Forestry and Wildlife (DOFAW) and the USDA Forest Service (USFS) - Institute of Pacific Islands Forestry. The HETF has completed its first decade of service, and the USDA Forest Service has accomplished much in developing this research, demonstration and education resource for Hawaii. Critical investments have been made by US Congress via the USDA Forest Service, but also by partners such as the University of Hawaii, which has directed substantial NSF-based EPSCoR infrastructure resources to developing the HETF. Additional funding from the DOD, other NSF program areas, and the State of Hawaii, among others have provided critical resources to support research, demonstration and education within the HETF. As a result of these investments, the USFS and DOFAW are able to enhance leadership roles in the science of tropical resource management.

Respectfully submitted,



DAVID G. SMITH, Administrator
Division of Forestry and Wildlife

APPROVED FOR SUBMITTAL:



SUZANNE D. CASE, Chairperson
Board of Land and Natural Resources

1. Attachment

LINDA LINGLE
GOVERNOR OF HAWAII



STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES

POST OFFICE BOX 621
HONOLULU, HAWAII 96809

PETER T. YOUNG
CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES
COMMISSION ON WATER RESOURCE MANAGEMENT

ROBERT K. MASUDA
DEPUTY DIRECTOR

DEAN NAKANO
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
KARUOLAWA ISLAND RESERVE COMMISSION
LAND
STATE PARKS

PERMIT TO USE STATE LANDS

Pursuant to the authority granted by the Board of Land and Natural Resources at its meeting of January 25, 2007, (Item C-2), the U.S. Department of Agriculture, Forest Service, Pacific Southwest Research Station, ("USDA Forest Service" or "Permittee"), is hereby granted a non-exclusive permit to use State lands situated at Laupāhoehoe and Pu'u Wa'awa'a, Hawai'i, identified by tax map key parcel numbers: (3) 3-7-001:002; (3) 3-7-001:012; (3) 7-1-001:001; (3) 7-1-001:004; (3) 7-1-001:004; (3) 7-1-001:006; (3) 7-1-001:007; (3) 7-1-002:001; (3) 7-1-002:013; (3) 7-1-002:002; (3) 7-1-002:008, and as shown on the attached maps, for use as the Hawai'i Experimental Tropical Forest (Laupāhoehoe and Pu'u Wa'awa'a units), in compliance with the herein referenced Cooperative Agreement. The USDA Forest Service is acting through the Institute of Pacific Islands Forestry located in Hilo, Hawaii.

Definitions:

"Assigns" means the employees, contractors, agents, and consultants.

"Cooperative Agreement" means the Cooperative Agreement between the State of Hawaii, Board of Land and Natural Resources and the U.S. Department of Agriculture, Forest Service, dated December 12, 2006.

"Hazardous Material" means any pollutant, toxic substance, hazardous waste, hazardous substance, or oil as defined in pursuant to applicable federal law, including, but not limited to, the Comprehensive Environmental Response, Compensation, and Liability Act ("CERCLA"), 42 U.S.C. §§ 9601, et seq., the Resource Conservation and Recovery Act, 42 U.S.C. §§ 6901, et seq., the Clean Water Act, 33 U.S.C. §§ 1251, et seq., Clean Air Act, 42 U.S.C. §§ 7401, et seq., the Safe Drinking Water Act, 42 U.S.C. §§ 300f, et seq., the Oil Pollution Act, 33 U.S.C. §§ 2701, et seq., the Toxic Substances Control Act, 15 U.S.C. §§ 2602, et seq., and the Federal Insecticide, Fungicide, and Rodenticide Act, 7 U.S.C. §§ 136, et seq., or any state law or regulation promulgated pursuant to such federal law.

This Permit is subject to the following conditions:

1. This permit to use State lands shall be effective from the last date shown below and extend for thirty-five years from December 12, 2006, the date the parties entered the Cooperative Agreement.
2. This permit to use State lands is a non-exclusive authorization for the USDA Forest Service and its assigns to occupy and use the Hawaii Experimental Tropical Forests for

the purpose of research, education, demonstration, and related purposes. This permit shall be effective for the following general purposes:

- a. To conduct long-term ecological, forestry, hydrological, and other natural resources-related research;
- b. To conduct long-term studies at scales from the plot to the watershed on forestry, conservation biology, endangered species, and invasive species;
- c. To conduct baseline studies and monitor results and benefits of forest management practices on important issues facing Hawaii including but not limited to: weed control, invasive pest control, forest restoration, aquatic ecology, hydrology, ungulate management, forest recreation, recreational hunting, fire control, cultural subsistence gathering, and protection and reintroduction of native plants and animals;
- d. To conduct studies on forest silviculture and sustainable management and to develop new commercial forest products;
- e. To conduct global climate change research;
- f. To attract and conduct multidisciplinary research studies by scientists from federal and state agencies, non-governmental organizations, and universities;
- g. To provide for environmental education and demonstration for groups ranging from school children to continuing education for land managers, natural resource professionals, and the general public;
- h. To form a management/research partnership where information needs and new findings are freely exchanged between the USDA Forest Service and the State; and
- i. To construct, maintain, and improve needed infrastructures, including: a new field station facilities at Laupāhoehoe and renovation of existing structures for use as a field station at Pu'u Wa'awa'a consisting of dormitories, work areas, demonstration/education buildings, and storage facilities, gaging stations in streams, weather stations, eddy covariance towers, and similar devices, maintenance of the existing trail system and development of new trails for access, and maintenance and improvement of existing roads.
- j. To engage in the specific activities listed on Exhibit A to this permit.

Research or activities requiring additional Federal, State, or county permits or approvals, including but not limited to environmental assessments or conservation district use permits, will be subject to the procedures in effect for obtaining such permits or authorizations.

The USDA Forest Service must obtain the prior written consent of the Board before construction of infrastructure or making any major improvements, as outlined in section IV.I of the Cooperative Agreement. Any major improvements, including but not limited to buildings and fences, erected on or moved onto the Premises by the USDA Forest Service shall remain the property of the USDA Forest Service and the USDA Forest Service shall have the right, prior to the termination or revocation of this Permit, or within an additional period the Board in its discretion may allow, to remove the improvements from the Premises.

3. This permit to use State lands constitutes an authorization for the USDA Forest Service and its assigns to conduct activities described herein as authorized under the Cooperative Agreement. For activities conducted by entities other than the USDA Forest Service and its assigns permits to conduct those activities shall be secured as outlined in Sections III and VI through IX of the Cooperative Agreement. The permit or any rights hereunder shall not be sold, conveyed, leased, mortgaged, or otherwise transferred or disposed of. Persons acting under this permit shall carry a copy of the permit or a signed authorization from the USDA Forest Service indicating their name, purpose, and dates of authorization with them at all times while in the permit area and

shall, upon request, show the permit or signed authorization to any law enforcement officer, or the authorized representative of the Board of Land and Natural Resources.

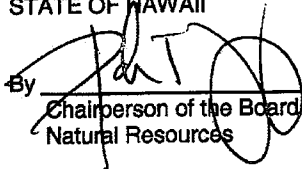
4. USDA Forest Service shall insure that in the exercise of this permit to use State lands, it shall comply with all laws, statutes, ordinances, rules and regulations of the Federal, State, and county governments affecting the permit area. In addition, prior to activities in Laupāhoehoe Natural Area Reserve, USDA Forest Service shall ensure that proposed activities are to be performed in a manner which is consistent with NARS management objectives, HRS § 195-1 and in consultation with the Hawaii Island Natural Area Reserves System Area Manager to ensure that proposed activities remain consistent with NARS objectives and management actions. Prior to activities in Pu'u Wa'awa'a, USDA Forest Service shall ensure that proposed activities are to be performed in a manner consistent with the Pu'u Wa'awa'a Management Plan and in consultation with the Pu'u Wa'awa'a Coordinator.
5. In the event any unanticipated sites or remains such as bone or charcoal deposits, human burials, rock or coral alignments, pavings or walls are encountered USDA Forest Service, its contractors, and consultants shall immediately stop work and contact the State Historic Preservation Division in Kapolei at (808) 692-8015.
6. USDA Forest Service agrees to consult regularly with the State, including the appropriate DLNR land manager, on proposed and ongoing activities within the permit area, to ensure open and full communication and to minimize conflicts and maximize benefits between planned and ongoing research projects and between research projects and land management.
7. USDA Forest Service, through the Hawaii Experimental Tropical Forest Research Committee established under the Cooperative Agreement, agrees to consult regularly with the State, including:
 - a. Providing a copy of the annual report submitted to Congress as required by section 607 of the International Forestry Cooperative Act of 1990, as amended by the Hawaii Tropical Forest Recovery Act;
 - b. Providing an annual report on the status of approved new and ongoing research (including the primary investigator, the research topic, the location for the research, dates of field research, date of anticipated results, and contact information for the primary investigator);
 - c. Providing an annual report on the number of educational tours and total number of participants; and
 - d. Annually reporting on the challenges faced in the administration of the Experimental Forest.
8. The USDA Forest Service will maintain the improvements on the land that are being used by the Forest Service or its assigns. The USDA Forest Service will keep the permit area and improvements in a clean, sanitary, and orderly condition. Disturbance of native vegetation and native wildlife shall be avoided as much as possible. The USDA Forest Service will not make, permit, or suffer, any waste, strip, spoil, nuisance or unlawful, improper, or offensive use of the permit area. Precautions shall be taken to prevent introductions of plants and animals not naturally present in the permit area, including inspection and cleaning of clothing, equipment, and vehicles. At all times with respect to the permit area, USDA Forest Service will use due care for public safety and will use appropriate precautions and measures to minimize inconveniences to surrounding residents, landowners, lessees, and the public in general.

9. The State will remain primarily responsible for normal land management functions, including but not limited to control of public access, fire suppression, law enforcement, regulation of hunting and grazing activities, invasive species management, and forest disease, insect, and ungulate control. The Board will be responsible for maintenance of all improvements not used, built or placed on the land by the USDA Forest Service. The Board reserves the right for its employees, agents or representatives to enter or cross any portion of the permit area at any time.
10. Liability for any loss, damage, claim, demand, or action, caused by, arising out of or connected with the operations authorized by the Cooperative Agreement shall be governed by applicable State and Federal law. To the extent that the USDA Forest Service requires third parties, including but not limited to its contractors or consultants, to procure liability insurance or to indemnify the Forest Service, the USDA Forest Service shall also require such third parties to insure and indemnify the State.
11. This permit may be modified at any time by mutual agreement of the Director, Institute of Pacific Islands Forestry, USDA Forest Service, and the Board of Land and Natural Resources.
12. Permittee and its assigns shall not cause or permit the escape, disposal or release of any hazardous materials except as permitted by applicable federal and state law. Proposed use of hazardous materials in research activities will be disclosed to the State through the research review and approval procedures of the Hawaii Experimental Tropical Forest Research Committee and the processes for activities authorizations prescribed by the Cooperative Agreement. Permittee and its assigns shall store and use hazardous materials only as prescribed by federal law. Liability for release of a hazardous material shall be in accord with applicable Federal and state law.

To the extent that the Permittee requires its contractors or consultants to indemnify, defend, and hold the Permittee harmless from any damages and claims resulting from the release of hazardous materials on the permit area occurring while Permittee or its contractors are in possession of the permit area, or elsewhere if caused by Permittee's contractors acting for or on Permittee's behalf, Permittee shall also require such contractors or consultants to indemnify the State. These covenants shall survive the expiration or earlier termination of this permit.
13. In the event of an alleged violation of this permit, the State will contact the Director of the Institute of Pacific Islands Forestry (or other designated official of the USDA Forest Service) with notice of such violation and a reasonable time permitted to cure the violation.
14. Disputes shall be resolved by the Station Director, Pacific Southwest Research Station, USDA Forest Service, and the Board of Land and Natural Resources. Disputes involving Laupāhoehoe Natural Area Reserve shall be taken to the Natural Area Reserve System Commission first for their recommendation to the Board of Land and Natural Resources.

IN WITNESS WHEREOF, the STATE OF HAWAII, by its Board of Land and Natural Resources, has caused the seal of the Department of Land and Natural Resources to be hereunto affixed and the parties hereto have caused these presents to be executed the day, month and year first above written.

STATE OF HAWAII


By  _____
Chairperson of the Board of Land and
Natural Resources

Approved by the Board of
Land and Natural Resources
at its meeting held on JAN 26 2007

USDA FOREST SERVICE

 _____
James Sedell, Station Director
Pacific Southwest Research Station

APPROVED AS TO FORM:

 _____
Deputy Attorney General
State of Hawaii

Dated: 1/26/07

Exhibit A to Permit

The following activities, when undertaken by the Forest Service or its assigns pursuant to actions authorized in accordance with the provisions of the Cooperative Agreement for research between the State of Hawaii and the Forest Service, are authorized by this Permit. For purposes of this Exhibit A, "nondestructive" means an activity that does not destroy or harm the object of analysis.

1. Operations and maintenance of buildings, dormitories, work areas, demonstration/education buildings, storage facilities, and management structures on experimental forest lands or other state lands encumbered under lease, license or permit.
2. Minor modification of existing buildings, work areas, demonstration/education facilities, and storage facilities to improve their usefulness as per the cooperative agreement, or to provide for public and worker safety.
3. Maintenance or modification of landscaping and other minor land and vegetation improvements around buildings, work areas, storage facilities on experimental forest lands to improve site use or public safety, including cutting and/or removal of vegetation, and use of pesticides and herbicides to maintain landscaping.
4. Cutting and/or removal of exotic/nonnative vegetation and animals or use of pesticides and herbicides to control or prevent the establishment or spread of invasive species.
5. Maintenance and operation of all facilities and improvements that are used by the U.S. Forest Service or its assigns, or those installed under research permits as per agreement of the Forest Service.
6. Maintenance of existing roads to facilitate access and diminish ecological damage from roads in poor condition, including the cutting or removal of roadside vegetation, and use of herbicides and pesticides in road right-of-way.
7. Maintenance of the existing trail system facilitate access, minimize trampling damage and insure safety of users, including the cutting or removal of roadside vegetation, and use of herbicides and pesticides in the trail corridor.
8. To participate in or conduct hikes, nature study, or other passive recreational activities.
9. Non-destructive inventory and monitoring of basic resources of experimental forest lands.
10. To lead site tours or provide access to school children, land managers, natural resource professionals, and the general public for forest education purposes and demonstration projects.

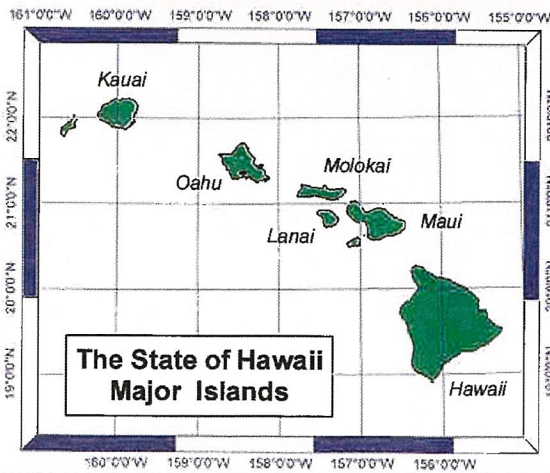
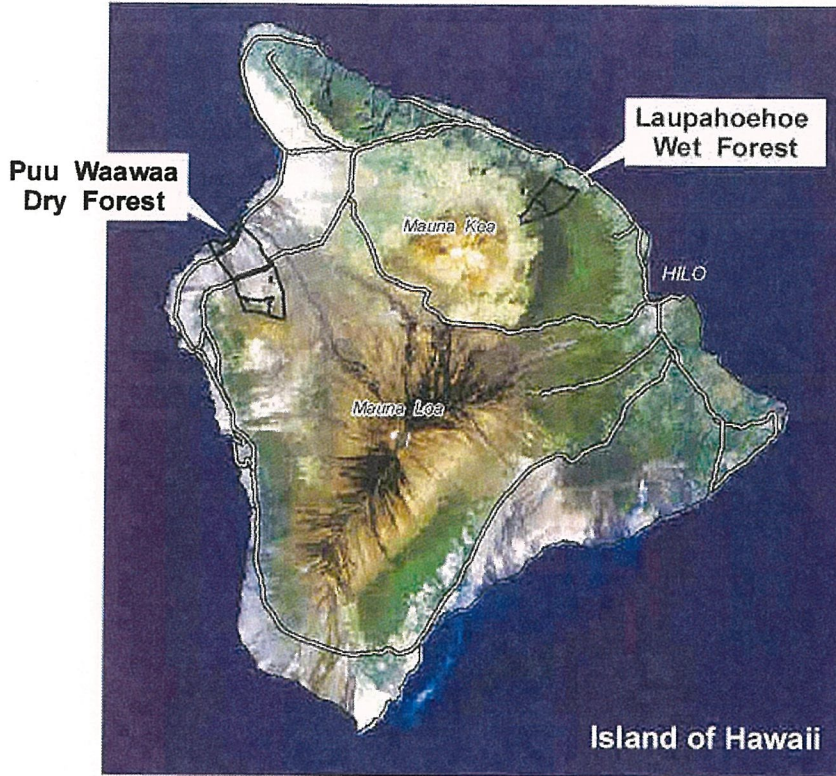
11. Installation and maintenance of directional and informational signs for worker, visitor, and public use and safety.
12. Monitoring of public use and environmental conditions in and around public use facilities, including placement of temporary electronic devices for environmental monitoring or sampling (for periods ≤ 36 months), and the sampling of air and gasses (plant and soil respiration) within the experimental forest.
13. Use of motorized or unmotorized vehicles and equipment off established roads and trails or other designated vehicle-areas for approved management and research plan activities or to respond to emergency situations.

The following eleven activities are also authorized by this permit when undertaken by the Forest Service or its assigns pursuant to research actions authorized by the Hawaii Experimental Tropical Forests Research Committee in accordance with the provisions of the Cooperative Agreement for research between the State of Hawaii and the Forest Service.

14. Non-destructive inventory, measurements, censuses, and monitoring of trees, ferns, understory plants, birds, mammals, insects, and aquatic organisms where there is no harm to the organisms (includes both ground-based and remotely sensed measures).
15. Non-destructive inventory, measurements, and monitoring of the forest floor, dead and downed wood, and soils.
16. Non-destructive inventory, measurements, and monitoring of streams, ponds, and other aquatic ecosystems.
17. Nondestructive hydrological and geomorphic studies which do not involve the erection of structures or long term placement of equipment.
18. Erection of small protective fences and barriers ≤ 10 acre in area (and the removal of exotic species within such plots).
19. Construction of temporary blinds and field observation structures.
20. Soil and plant nutrient cycling research.
21. Biocontrol research to control invasive plants and animals - manipulate densities of state and federally permitted biocontrol agents through redistribution and experimental methods, including caging plants or parts of plants.
22. Introduction and use of carbon, oxygen, nitrogen and other isotopes for research.

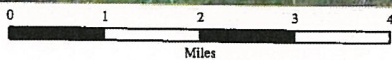
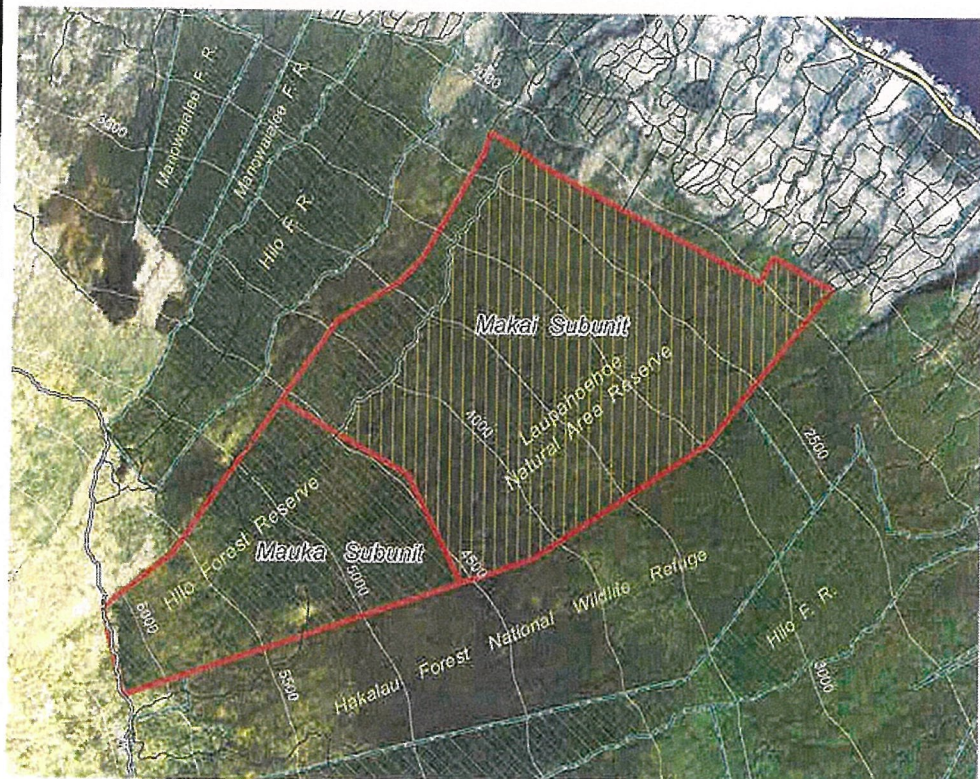
23. Non-destructive collection of plant material (excluding all listed T&E plants), soils, and water samples for laboratory analysis.
24. Collection of plant and insect samples that are from common, exotic, and abundant taxa for laboratory, greenhouse, or herbarium sampling (excluding all listed T&E species).

MAP 1. Location



State of Hawaii
Department of Land and Natural Resources
Division of Forestry and Wildlife
Map No. FW - 0869 (08/2006)
Contact: Ronald Cannarella
Telephone: (808) 383-3077
Email: Ronald.J.Cannarella@hawaii.gov

MAP 2. Laupahoehoe Wet Forest : Subunits and Geography



Legend

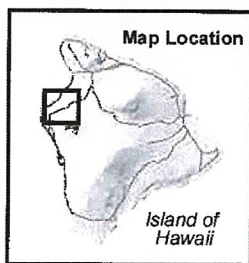
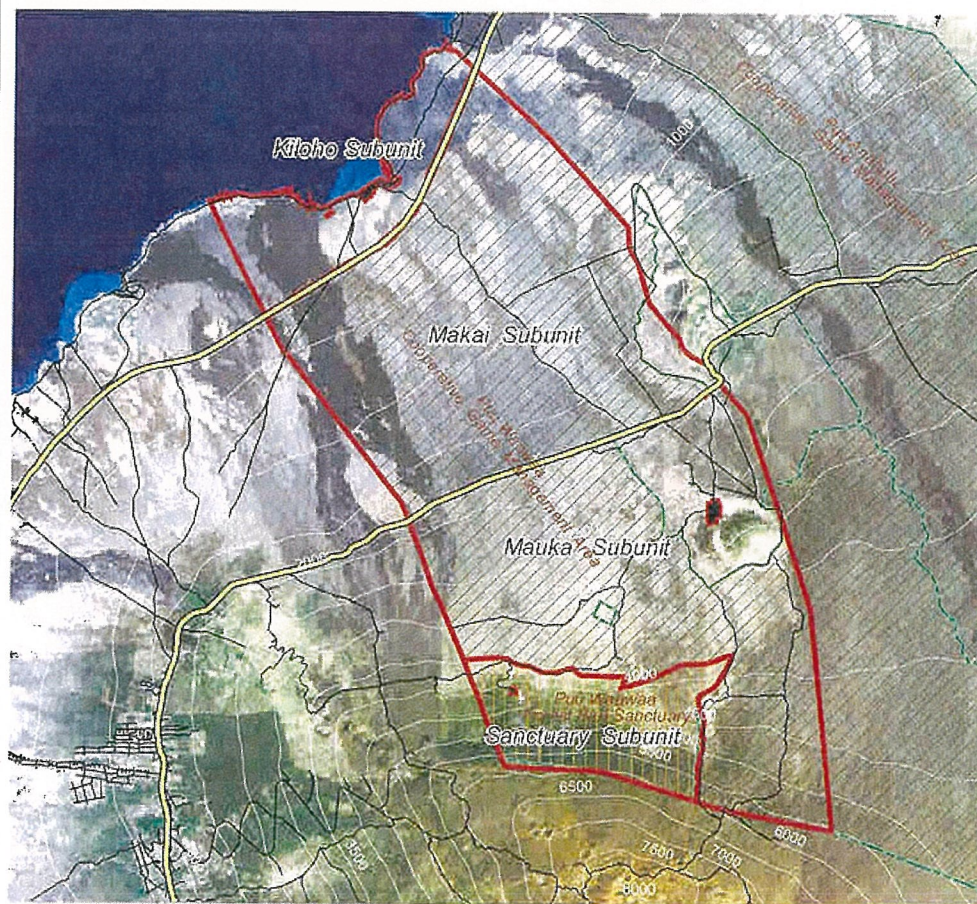
- HETF Boundary
- Forest Reserve
- Natural Area Reserve
- Major Road
- Secondary Road
- Minor Road and Trail
- Stream
- 500-Foot Contour



State of Hawaii
 Department of Land and Natural Resources
 Division of Forestry and Wildlife
 Map No. FW - 0670 (08/2006)
 Contact: Ronald Cannarella
 Telephone: (808) 383-3077
 Email: Ronald.J.Cannarella@hawaii.gov

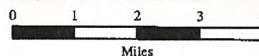
Data Source : Landsat; State of Hawaii GIS.

MAP 3. Puu Waawaa Dry Forest : Subunits and Geography



Legend

- HETF Boundary
- Game Management Area
- Bird Sanctuary
- Major Road
- Minor Road and Trail
- Stream
- 500-Foot Contour



State of Hawaii
 Department of Land and Natural Resources
 Division of Forestry and Wildlife
 Map No. FW - 0673 (08/2006)
 Contact: Ronald Cannarella
 Telephone: (808) 383-3077
 Email: Ronald.J.Cannarella@hawaii.gov

Data Source : Landsat; State of Hawaii GIS.

COOPERATIVE AGREEMENT

between the

**UNITED STATES DEPARTMENT OF AGRICULTURE
FOREST SERVICE**

and the

**STATE OF HAWAII
BOARD OF LAND AND NATURAL RESOURCES**

THIS COOPERATIVE AGREEMENT is between the **United States Department of Agriculture, Forest Service**, hereinafter referred to as the "Forest Service", and the **State of Hawaii**, by its Board of Land and Natural Resources, hereinafter referred to as the "Board". The Forest Service and the Board are jointly referred to as the "Parties".

RECITALS:

Whereas, the Hawaii Tropical Forest Recovery Act of 1992 (Public Law 102-574) authorizes the establishment of the Hawaii Experimental Forest as a center for long-term research and a focal point for developing and transferring knowledge and expertise for the management of tropical forests.

Whereas, the unique biological diversity, resources, and threats to Hawaii's tropical forests pose a critical need to establish experimental forests in Hawaii, where currently none exist.

Whereas, there are areas of State land which are uniquely suited to the conduct of tropical research and, therefore, for designation as the first two units of the Hawaii Experimental Tropical Forests.

Whereas, the Forest Service, through its Pacific Southwest Research Station and its affiliated Institute of Pacific Islands Forestry in Hilo, Hawaii, is authorized to implement the Hawaii Tropical Forest Recovery Act of 1992 on behalf of the United States Department of Agriculture.

Whereas, the Parties deem a cooperative Federal and State research program to be the best way to effect the purposes of the Hawaii Tropical Forest Recovery Act of 1992 and, to that end, to execute and implement this Cooperative Agreement.

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

I. AUTHORITIES.

A. *For the Forest Service:* This Cooperative Agreement is authorized by section 606(d)(1)(B) of the International Forestry Cooperation Act of 1990, as amended by the Hawaii Tropical Forest Recovery Act of 1992 (Public Law 102-574).

B. *For the State:* This Cooperative Agreement is authorized by Hawaii Revised Statutes (HRS) §§ 171-6, 183-1.5, 195-4, and 195-7.

II. HAWAII EXPERIMENTAL TROPICAL FORESTS.

A. Within 90 days of execution of this Cooperative Agreement, the Secretary of Agriculture will designate pursuant to the Hawaii Tropical Forest Recovery Act (Public Law 102-574), two units of the Hawaii Experimental Tropical Forests located on the island of Hawaii, generally depicted on the map appended hereto as Map 1, as follows:

1. Laupāhoehoe Experimental Forest comprising approximately 12,343 acres on the Island of Hawaii and generally depicted on the map appended hereto as Map 2.
2. Pu'u Wa'awa'a Experimental Forest comprising approximately 38,885 acres on the Island of Hawaii and generally depicted on the map appended hereto as Map 3.

B. The Laupāhoehoe and Pu'u Wa'awa'a Experimental Forests are collectively referred to herein as the "Hawaii Experimental Tropical Forests".

C. The purposes of the Hawaii Experimental Tropical Forests are:

1. To learn how to better restore, preserve, and sustainably manage native tropical forests, streams and entire watersheds of the Pacific, and to provide information to land managers challenged with management of these important landscapes;
2. To be a center for demonstration, education, training, and outreach on tropical forestry, conservation biology, and natural resources research and management;
3. To provide sites dedicated to long term research on tropical forestry, ecology, hydrology, conservation biology, and natural resource management; and

4. To promote research cooperation and collaboration between State, Federal agencies, educational, and other institutions in tropical forestry research in Hawaii.

D. Additional lands may be incorporated into the Experimental Forests with the written concurrence of the Parties in accordance with section 606 of the International Forestry Cooperation Act of 1990, as amended by the Hawaii Tropical Forest Recovery Act of 1992.

III. LAND USE AUTHORIZATION.

On or about the date hereof, the Board of Land and Natural Resources ("Board") will issue to the Department of Agriculture, Forest Service, a permit to use the Hawaii Experimental Tropical Forests in accordance with this Cooperative Agreement.

A. The permit is a non-exclusive authorization for the Forest Service and its assigns to use the Hawaii Experimental Tropical Forests for the purpose of research, education, demonstration, and related purposes.

B. Entities conducting research activities requiring additional federal, state, or county permits or approvals, including but not limited to environmental assessments or conservation district use permits, will be required to acquire those permits through the procedures in effect for obtaining such permits.

C. In the event that the Forest Service needs to build valuable improvements and support facilities in furtherance of activities contemplated under this Cooperative Agreement, then the State shall issue a lease for such purposes on terms and conditions necessary to meet the requirements of 7 U.S.C. § 2250a and HRS §§ 171-95 and 183-11.

D. All research activities to be conducted on the Hawaii Experimental Tropical Forests shall be administered by the Hawaii Experimental Tropical Forests Research Committee as provided in Part VI of this Cooperative Agreement.

IV. COOPERATIVE RESEARCH AND MANAGEMENT.

In furtherance of a long-term philosophy for cooperation at the Hawaii Experimental Tropical Forest and to implement the purposes of the Hawaii Experimental Tropical Forests and Section 606 of the International Forestry Cooperation Act of 1990, as amended by the Hawaii Tropical Forest Recovery Act, the Parties agree:

A. To conduct long term ecological, forestry, hydrological and other natural resources-related, research;

B. To conduct long term studies at scales from the plot to the watershed on forestry, conservation biology, endangered species, and invasive species;

C. To conduct baseline studies and monitor results and benefits of forest management practices on important issues facing Hawaii including but not limited to: weed control, invasive pest control, ungulate management, forest recreation, recreational hunting, fire control, cultural subsistence gathering, protection and reintroduction of native plants and animals, hydrology, and water quality;

D. To conduct studies on forest silviculture, restoration, and sustainable management;

E. To conduct global climate change research;

F. To attract and conduct multidisciplinary research studies by scientists from federal and state agencies, non-governmental organizations, and universities;

G. To provide for forest education and demonstration for groups ranging from school children to continuing education for land managers, natural resource professionals, and the general public;

H. To form a management/research partnership where information needs and new findings are freely exchanged between the Parties; and

I. To construct, maintain and improve needed infrastructure, including:

1. New field station facilities at Laupāhoehoe and renovation of existing structures for use as a field station at Pu'u Wa'awa'a consisting of dormitories, work areas, demonstration/education buildings, and storage facilities on experimental forest lands or other state lands encumbered under lease, license or permit.
2. Gaging stations in streams, weather stations, eddy covariance towers, and similar research structures. Gaging stations can be placed at the lower reaches of Ka'awali'i Stream, Laupāhoehoe Stream, Kilau Stream, Kiwilahiahi stream, Ha'ako'a Stream, and Pahale Stream within the Laupāhoehoe Natural Area Reserve.
3. Development and maintenance of the existing trail system and the development of a limited network of new trails to achieve access, minimize trampling damage and insure safety of users
4. Maintenance and improvement of existing roads to facilitate access and diminish ecological damage from roads in poor condition.

V. CONSULTATION.

A. *In General.* Owing to the many values and benefits that arise from research, education, and demonstration on the Hawaii Tropical Forests and elsewhere, the Parties further agree they will consult and reach agreements with each other to coordinate research, management, and educational activities and to:

1. Jointly develop research and management plans for the Hawaii Experimental Tropical Forests and to update these plans at least every five years;
2. Consult and reach agreement prior to implementing any written policy or plan that may affect the management of or research within the Hawaii Experimental Tropical Forests;
3. Consult and reach agreement during planning for the development of facilities or any major ground disturbing activities;
4. Consult and reach agreement before any major ground disturbing activities that may affect the conduct of research or the biological integrity of the area such as logging, scarification, chemical applications, fencing, etc.

B. *External Consultation.* The Parties will consult with scientists, managers, general citizens, and local community members concerning ongoing research activities. Existing State sanctioned advisory councils may be utilized for this purpose.

VI. HAWAII EXPERIMENTAL TROPICAL FORESTS RESEARCH COMMITTEE.

A. There is hereby established a Hawaii Experimental Tropical Forests Research Committee ("Committee") which will be chaired by the Forest Service. The Committee will consist of one Federal representative and one State representative who will review and recommend for approval research, education, and demonstration activities on lands designated as the Hawaii Experimental Tropical Forests, and recommend such terms and conditions for the conduct of such research as the Committee deems in the public interest consistent with this Cooperative Agreement.

B. The Committee will establish its own procedures and guidelines consistent with this Cooperative Agreement, including the establishment of subcommittees which may be composed of staff or consultants to deal with specific proposals for the Pu'u Wa'awa'a and Laupāhoehoe Experimental Forest Units.

C. The Committee shall be comprised of persons familiar with the on-going management, research, and education activities on the Experimental Tropical Forests:

1. The Director of the Institute of Pacific Islands Forestry in Hilo, Hawaii, or such alternative Federal official as may be named by the Station Director of the Pacific Southwest Research Station, and
2. The Hawaii Island Branch Manager of the Division of Forestry and Wildlife, or such alternative as may be named by the Board of Land and Natural Resources.

D. Additional members of the Committee may be added by mutual agreement by way of an amendment to this Cooperative Agreement.

E. The Committee will act by unanimous agreement to recommend research activities, including any recommended terms and conditions set forth in writing in an agreement with each research proponent. Research and other activities will follow State guidelines and management plans specific for the land area designation and experimental forest where the research will be conducted.

F. The Committee will provide mechanisms for public information and oversight of research activities, and will provide such information to the Secretary of Agriculture for inclusion in the annual reports to Congress as required by section 607 of the International Forestry Cooperation Act of 1990, as amended by the Hawaii Tropical Forest Recovery Act of 1992. A copy of this annual report will also be sent to the Board of Land and Natural Resources and Natural Area Reserves Commission.

G. Committee members shall serve such renewable terms as determined at the pleasure of the Station Director of the Pacific Southwest Research Station and the Board, as the case may be.

VII. AUTHORIZATION OF RESEARCH ACTIVITIES.

A. The Parties agree that the procedures of the Committee in administering, reviewing, and approving research activities, and the State procedures for issuance of permits for State lands should be streamlined and, to the extent possible, consolidated.

B. For areas of the Hawaii Experimental Tropical Forests outside the Natural Area Reserves System (NARS), within 90 days of this agreement, the Board will delegate to its representative on the Committee the authority to approve and issue permits for the use of state lands for research activities approved by the Committee. It is recognized that this delegation will be subject to terms and conditions as the Board may prescribe, and is subject to modification or revocation at the sole discretion of the Board.

C. For areas of the Hawaii Experimental Tropical Forests inside the Natural Area Reserves System, the Parties agree to encourage the NARS Commission to adopt policies and procedures to meet the objectives of paragraph A. It is recognized that any delegation would be subject to terms and conditions as the Commission may prescribe, and is subject to modification or revocation at the sole discretion of the Commission. It is recognized that, as of the date of this Cooperative Agreement, the NARS Commission lacks legal authority to delegate permit approval authority.

D. Forest Service research activities which the State determines to be within the scope of the permit issued pursuant to Part III of this Cooperative Agreement may not require additional authorizations.

VIII. RESEARCH ON THE LAUPĀHOEHOE NATURAL AREA RESERVE.

A. The Laupāhoehoe Experimental Forest will be a site where long term research at the landscape or ahupua'a scale will be made possible. Within this ahupua'a will be a field station on State-leased agriculture lands, a Natural Area Reserve (NAR), and a Forest Reserve (FR).

B. In addition to the other requirements of this Cooperative Agreement, any research conducted on the Laupāhoehoe Natural Area Reserve shall be performed in a manner which is consistent with NARS management objectives, HRS § 195-1.

C. Prior to issuing a recommendation for approval of any proposed research on the Laupāhoehoe NAR, the Committee will consult with the Hawaii Island NARS Area Manager. The Area Manager will be consulted regularly on ongoing research activities to insure research activities remain consistent with NARS objectives and management actions.

IX. RESEARCH ON THE PU'U WA'AWA'A EXPERIMENTAL FOREST UNIT .

A. The Pu'u Wa'awa'a Experimental Forest Unit will be a site where long term research at the landscape or ahupua'a scale will be made possible.

B. In addition to the other requirements of this Cooperative Agreement, any research conducted on the Pu'u Wa'awa'a Experimental Forest Unit shall be performed in a manner which is consistent with or provides information that would improve the Pu'u Wa'awa'a management plan.

X. RESEARCH RESULTS.

A. Unless the Parties agree otherwise on any given project, the rights to publication, patent, or otherwise to any research results shall accrue to the respective party(s) conducting the research.

B. Each agency shall be acknowledged in publications and audiovisuals as a result of this Cooperative Agreement.

C. Within a reasonable period after completion of research or management activities, the Committee shall require that all information be included in an Experimental Forest data base.

D. Metadata including weather and streamflow data will be made available to the Parties as soon as is practically possible.

XI. MANAGEMENT ACTIVITIES ON HAWAII EXPERIMENTAL TROPICAL FORESTS.

A. *Occupancy and Use.* By this Cooperative Agreement and the permit referenced in Section III.A, persons employed by the Forest Service, are authorized general entry upon the Hawaii Experimental Tropical Forests for research, education, demonstration, and related purposes as set forth herein.

B. *Assignees, contractors and cooperators.* Either Party may authorize entry to the Hawaii Experimental Tropical Forests to assignees and contractors to carry out activities authorized under any permit or authorization, insofar as such entry and activities undertaken do not interfere with any ongoing or planned research or management activities. This Cooperative Agreement does not restrict the Forest Service or the Board from participating in similar research activities with other public or private agencies, organizations, and individuals.

C. *Public Access.*

1. If so authorized, public access will be regulated by the Board to accommodate, in a manner compatible with, ongoing research or management activities. The Board will appropriately manage public access so that threats to public safety are minimized.
2. The Board shall be primarily responsible to utilize its authorities under state law to enforce regulations and permit requirements.

D. *State Management.* The Board will be primarily responsible for normal land management functions including, but not limited to, control of public access, fire suppression, law enforcement, regulation of hunting and grazing activities, invasive species management, and

forest disease, insect, and ungulate control. The Parties will consult with each other and reach an agreement prior to implementing any activity which may impede ongoing management or research activities.

E. *Emergencies.* Nothing in this Cooperative Agreement shall be interpreted to impede the State's prerogatives in dealing with immediate emergencies such as fire or other immediate threats to human safety, which may be undertaken without prior consultation with the Forest Service or the Committee.

F. *Environmental Compliance.* The Committee shall assure that all research activities fully comply with the requirements of all applicable state and federal environmental laws and regulations.

G. *Maintenance of Improvements.* Unless the Parties agree otherwise on a case-by-case basis, the Forest Service will maintain the improvements on the land that are being used by the Forest Service or its assigns for research purposes. The Board will be responsible for maintenance of all other improvements.

XII. FUNDING.

A. *No Obligations of Funds.* This Cooperative Agreement is neither a fiscal nor a funds obligation document. Any endeavor involving reimbursement or contribution of funds, transfer of property, services or anything of value between the parties will be handled in accordance with applicable regulations, and procedures including those for Governmental procurement or printing. Such endeavors will be outlined in separate agreements that shall be made in writing by representatives of the parties and shall be independently authorized by appropriate statutory authority. Any contract or agreement for training or other services must fully comply with all applicable procurement procedures.

B. *Anti-deficiency.* All activities and operations of the Forest Service and the Board are subject to the availability of appropriated funds. Nothing in this Cooperative Agreement shall be interpreted as obligating unappropriated funds by either entity.

XIII. LIABILITIES.

The Parties agree that liability for any loss, damage, claim, demand, or action, caused by, arising out of or connected with the operations authorized by this Cooperative Agreement shall be governed by applicable state and federal law. For the Forest Service, tort claims will be governed by the provisions of the Federal Tort Claims Act (28 U.S.C. §§ 2671, *et seq.*).

XIV. TERM, EVALUATION AND MODIFICATION.

A. *Term.* This instrument is executed as of the last date shown below which shall be the commencement date. This instrument will remain in effect for Thirty Five (35) years after which it is renewable at the option of the Parties.

B. *Evaluation.* This Cooperative Agreement may be reviewed, evaluated, and updated at any time, but no later than ten (10) years from the commencement date.

C. *Modification.* This Cooperative Agreement may be modified at any time by mutual agreement of the Parties. Modifications shall be in writing executed by the authorized officer representing the Forest Service and the Board respectively. For purposes of this modification provision, such authorized officers are the Station Director of the Pacific Southwest Research Station, and the Board of Land and Natural Resources for all substantive changes and the Chairperson of the Board for nonsubstantive changes to facilitate processing such changes.

XV. DISPUTES.

A. *Laupāhoehoe Natural Area Reserve.* Disputes that cannot be resolved within the Committee concerning research permission on the NAR will be taken to the Natural Area Reserves System Commission for their recommendation to the Board of Land and Natural Resources.

B. *Other Disputes.* Any other dispute among the parties in implementation of the Permit or this Cooperative Agreement shall be elevated to the Station Director, Pacific Southwest Research Station, and the Board of Land and Natural Resources, State of Hawaii.

XVI. TERMINATION.

Either party, in writing, may terminate the instrument in whole, or in part, at any time before the date of expiration. Unless otherwise by mutual agreement, two years advance notice shall be provided prior to termination.

XVII. PRINCIPAL CONTACTS.

The principal contacts for administering this Cooperative Agreement are:

- A. *U.S. Department of Agriculture:*
Director, Institute of Pacific Islands Forestry
Pacific Southwest Research Station
Department of Agriculture, Forest Service

**Delegation of Selected Permitting Approval Authority for Research Activities
Undertaken on the Hawaii Experimental Tropical Forest**

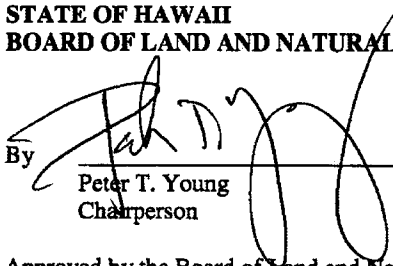
The authority to approve permits and permit terms and conditions for the following research activities conducted on the Hawaii Experimental Tropical Forest is hereby delegated to the Hawaii Island Branch Manager of the Division of Forestry and Wildlife when performing duties as authorized by the Cooperative Agreement for research between the State of Hawaii and the U.S. Forest Service. For purposes of this Exhibit A, "non-destructive" means an activity that does not destroy or harm the object of analysis.

1. Non-destructive inventory, measurements, censuses, and monitoring of trees, ferns, understory plants, birds, mammals, insects, and aquatic organisms where there is no harm to the organisms (includes both ground-based and remotely sensed measures).
2. Non-destructive inventory, measurements, and monitoring of the forest floor, dead and downed wood, and soils.
3. Non-destructive inventory, measurements, and monitoring of streams, ponds, and other aquatic ecosystems.
4. Nondestructive hydrological and geomorphic studies which do not involve the erection of structures or long term placement of equipment.
5. Research involving cutting and/or removal of exotic/nonnative vegetation that does not directly disrupt native forest species, forest composition, or forest structure (limited to test plots ≤ 10 acres in area).
6. Research on the use of pesticides/herbicides/prescribed fire/grazing animals to control invasive species (does not directly disrupt native forest species, composition, or structure, and limited to test plots ≤ 10 acres in area).
7. Erection of small protective fences and barriers ≤ 10 acre in area (and the removal of exotic species within such plots).
8. Construction of temporary blinds and field observation structures.
9. Soil and plant nutrient cycling research.
10. Biocontrol research to control invasive plants and animals - manipulate densities of state and federally permitted biocontrol agents through redistribution and experimental methods, including caging plants or parts of plants.

11. Sampling air and gasses (plant and soil respiration) within the experimental forest.
12. Placement of temporary electronic devices for environmental monitoring or sampling (for periods \leq 36 months).
13. Introduction and use of Carbon, Oxygen, Nitrogen and other isotopes for research.
14. Non-destructive collection of plant material (excluding all listed T&E plants), soils, and water samples for laboratory analysis.
15. Collection of plant and insect samples that are from common, exotic, and abundant taxa for laboratory, greenhouse, or herbarium sampling (excluding all listed T&E species).
16. Maintenance of a trail system for access.

**STATE OF HAWAII
BOARD OF LAND AND NATURAL RESOURCES**

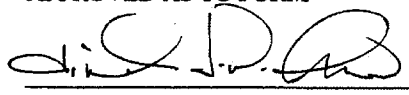
By


Peter T. Young
Chairperson

Date

Approved by the Board of Land and Natural Resources
at its meeting held on DEC 08 2006.

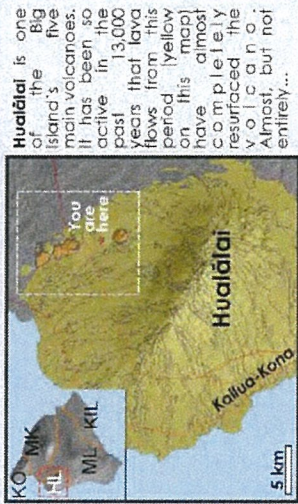
APPROVED AS TO FORM


Deputy Attorney General

Date: 12/8/06

Appendix C

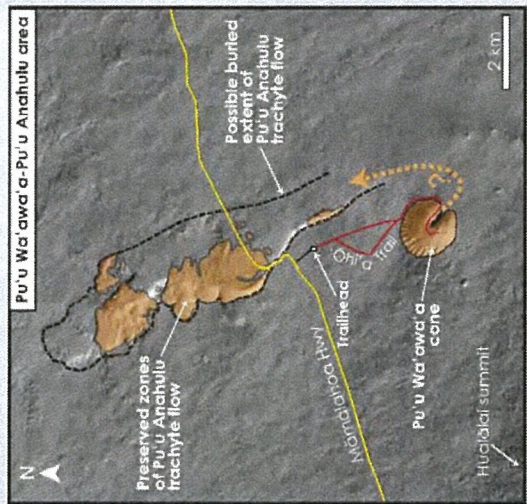
P'u'u Wa'awa'a Geological Information Sheet



HL=Hualalai; KO=Kohala; MK=Mauna Kea;
ML=Mauna Loa; KIL=Kilauea

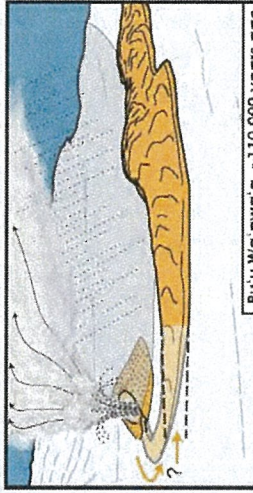
Pu'u Wa'awa'a and Pu'u Anahulu (orange in the map below) are two much older features (~110,000 years) that have resisted burial by the more recent lavas and provide a unique window into the ancient history of Hualalai.

This ancient history is marked by eruptions that were very different from the typical gentle eruptions we often think of when envisioning Hawaii volcanoes...these eruptions involved non-traditional magmas called **trachytes**, different from the typical basalt we are more familiar with.



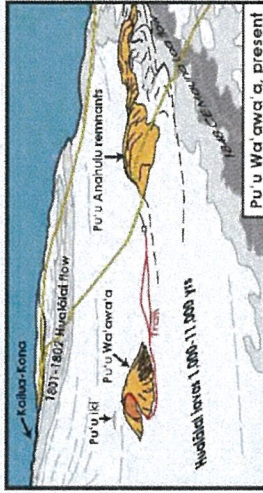
Wa'awa'a: an explosive character

Both **Pu'u Wa'awa'a** and **Pu'u Anahulu** are trachytes and have a similar chemical 'make up'. Pu'u Wa'awa'a is known as a pyroclastic cone and Pu'u Anahulu is made from very thick (>600 ft) viscous lavas. They were produced by very different types of eruptions.



Pu'u Wa'awa'a, ~110,000 years ago

The **Pu'u Wa'awa'a** cone was built during a series of explosive eruptions that emitted tephra (fragments of pumice scoria and ash). The tephra was likely deposited over a large area towards the west of Wa'awa'a. Note the asymmetrical shape of the cone (open mouth, or horse-shoe); this asymmetry may tell us something about wind direction at the time of the eruption; more tephra was deposited to the west (the cone is higher on that side), meaning the wind was probably blowing west.



Pu'u Wa'awa'a, present

Anahulu: A voluminous eruption

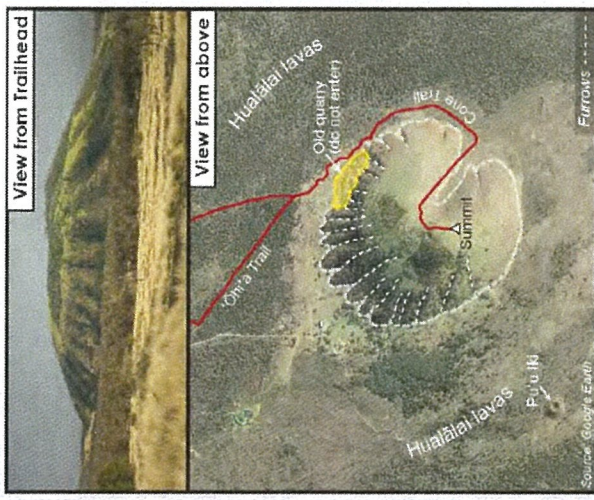
The **Pu'u Anahulu** flows were erupted **AFTER** Pu'u Wa'awa'a formed. These flows were probably slow-moving and took weeks-to-months to solidify. The total volume of magma emitted during this single eruption is similar to the total volume that has been emitted by Kilauea over the **past 35 years!**

Since Wa'awa'a and Anahulu formed ~110,000 years ago, Hualalai lavas have covered most of the products from this eruption. Only the thickest parts of the flows and the cone remain.

Note: Hiking to the top of Pu'u Wa'awa'a allows for a great panoramic view of the different localities mentioned here!

Features of the cone

Pu'u Wa'awa'a is distinct from many other younger cones around Big Island by its larger size and its numerous furrows. Pu'u Wa'awa'a translates to "the many-furrowed hill". These furrows likely formed by gullying and erosion from rainfall water over the past 110,000 years.



Unique Hawaiian rocks

The cone is made up of layers of tephra, composed dominantly of light **pumice** and darker **scoria** (bubbly rock fragments). Black **obsidian** fragments (mostly volcanic glass) are also frequently found within the tephra. This is the only location where true pumice or obsidian has been found so far in the Hawaiian Islands. Obsidian from Pu'u Wa'awa'a was a valuable resource and was heavily traded by Hawaiians to make various stone artifacts since at least 1400 CE (Current Era).



Note: Please, do not collect rocks, mahalo for your kōkua

Pu'u Wa'awa'a Questions & Answers

Q. What is so special about Pu'u Wa'awa'a?

A. It is an unusual volcanic cone with unusual eruption materials (pumice, obsidian) that produced along with the Pu'u Anahulu flows, one of the largest single eruptions known in Hawaii (~3.5 km³). It is also the only surface remnant of the ancient history of Hualālai volcano (prior to 13,000 years ago). The Wa'awa'a area also offers a unique opportunity to observe an active Hawaiian dryland forest (www.puu-waawa'a.org/files/Halapepe.pdf and www.puu-waawa'a.org/files/Ohiacone.pdf for more information).

Q. How dangerous were eruptions like Pu'u Wa'awa'a?

A. Very dangerous. The tephra falling from the eruption plume and accumulating on the ground may have been several meters thick for several kilometers around the Pu'u Wa'awa'a cone. There is also evidence that "pyroclastic density currents" (rapidly-moving, ground-hugging mixtures of hot gas and tephra) were produced during these eruptions.

Q. Can similar explosive eruptions occur around Hualālai in the near future?

A. Very unlikely. Several similar eruptions have occurred at Hualālai (now covered by younger lavas) from ~90,000-120,000 yr BP (Before Present), but none since. Other smaller explosive eruptions (those that generate the smaller basaltic cones scattered around Hualālai) are more likely to occur.

Help preserve Pu'u Wa'awa'a by not disturbing plants or animals or picking up rocks. Do not enter the quarry (very frequent rockfalls).

Questions? comments?

tshea@hawaii.edu

More information on Pu'u Wa'awa'a (history, trails) available at:

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

<https://www.facebook.com/PuUWaawa>

http://www.heif.us/page/puu_waa_xaa/

<http://air.hawaii.gov/forestry/fs/reserves/hualai-island/puuwaawa/>

Use barcodes below for quick website access



Acknowledgements

- Project supported by the National Science Foundation (NSF-EAR grant 1250366)
- Field collaboration from Division of Forestry and Wildlife's Elliott Parsons and the Hawaiian Experimental Tropical Forest (HETF)



PWW main site



PWW Facebook



DOI Page

Pu'u Wa'awa'a



A window into Hualālai's Explosive Past

A geological pamphlet by **Thomas Shea**
Dept. of Geology & Geophysics
University of Hawai'i at Mānoa



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MĀNOA

