Hawai‘i Experimental Tropical Forest

2014 Annual Report

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May 2015

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List of Acronyms

DHHL - Department of Hawaiian Homelands
DLNR - Hawaiʻi Department of Land and Natural Resources
DOFAW - Hawaiʻi Division of Forestry and Wildlife
FR - Forest Reserve
FBS - Forest Bird Sanctuary
HETF - Hawaiʻi Experimental Tropical Forest
HIPPNET - Hawaii Permanent Plot Network
HFNWR - Hakalau Forest National Wildlife Refuge
IPIF - Institute of Pacific Islands Forestry
LAC - Laupāhoehoe Advisory Council
LAU - Laupāhoehoe Unit of the Hawaiʻi Experimental Tropical Forest
LCPCS - Laupāhoehoe Community Public Charter School
NARS - Natural Area Reserve System
PAC - Puʻu Waʻawaʻa Advisory Council
PSW - Pacific Southwest Research Station
PWW - Puʻu Waʻawaʻa Unit of the Hawaiʻi Experimental Tropical Forest
RTC - Research Technical Committee for the Hawaiʻi Experimental Tropical Forest
SP- State Parks
UHH - University of Hawaiʻi at Hilo
UHM - University of Hawaiʻi at Mānoa
USDA - United States Department of Agriculture
USGS - United States Geological Survey
USFS - United States Forest Service
HYCC – Hawaiʻi Youth Conservation Corps

Acknowledgments

The establishment and administration of the Hawaiʻi Experimental Tropical Forest (HETF) has been successful due to the support and hard work of many individuals. First, we would like to recognize Alex Friend, Ric Lopez, Lisa Hadway, and Steve Bergfeld for their leadership and support in 2014. The U.S. Department of Agriculture, Forest Service (USFS) would like to thank the State of Hawaiʻi including the Board of Land and Natural Resources, the Division of Forestry and Wildlife and State Parks for their cooperation in the administration of the HETF. In particular we would like to thank the following State staff in 2014 for their efforts to reach agreements, provide valuable feedback, and help move forward the processes needed to effectively administer the HETF's mission: Nick Agorastos, Ian Cole, Charmian Dang, Gordon Heit, Cynthia King, Sheri Mann, Joey Mello, Wesley Matsunaga, Kevin Moore, Elliott Parsons, Lyman Perry, Tanya Rubenstein, Lisa Shizuma, Hans Sin, Anya Tagawa, and Dean Takebayashi. Mahalo to Colleen Cole and Cheyenne Perry for their work with the HETF Planning Group and as HETF partners via the Three Mountain Alliance and Mauna Kea Watershed Alliance, respectively. Special thanks to the additional USFS employees who have tirelessly worked to support the HETF's success in their respective capacities in 2014 including: Jerry Carlson, Tom Cole, Susan Cordell, Sherri Eng, Kainana Francisco, Chris Ida, Christian Giardina, Susan Litteral, Dean Oshiro, William Nielson, Randy Shrank, and Jean Stoner. Special thanks to James Akau, Kainana Francisco, Cheyenne Perry and Christian Giardina for their time and energy towards education and outreach activities and guidance. Mahalo also, to Bob Masuda who continues to support HETF operations and growth. Additionally, we acknowledge the Laupāhoehoe and Puʻu Waʻawaʻa Advisory Council members for their important role in the guidance of HETF activities.

Introduction

The Hawai‘i Experimental Tropical Forest (HETF) was established in 2007 and includes two Units: the Laupāhoehoe Wet Forest, totaling 12,343 acres (4,990 ha), and the Pu‘u Wa‘awa‘a Dry Forest, totaling 38,885 acres (15,736 ha) (Figure 1). The HETF overlays existing State of Hawai‘i, Department of Land and Natural Resources (DLNR) managed lands. The USDA Forest Service (USFS), Pacific Southwest Research Station in Hilo, Institute of Pacific Islands Forestry (IPIF), works with the DLNR – Division of Forestry and Wildlife (DOFAW) and State Parks to cooperatively manage research and education activities within the HETF. The HETF is part of a network of USFS Experimental Forest and Range units across the United States (http://www.fs.fed.us/research/efr/).

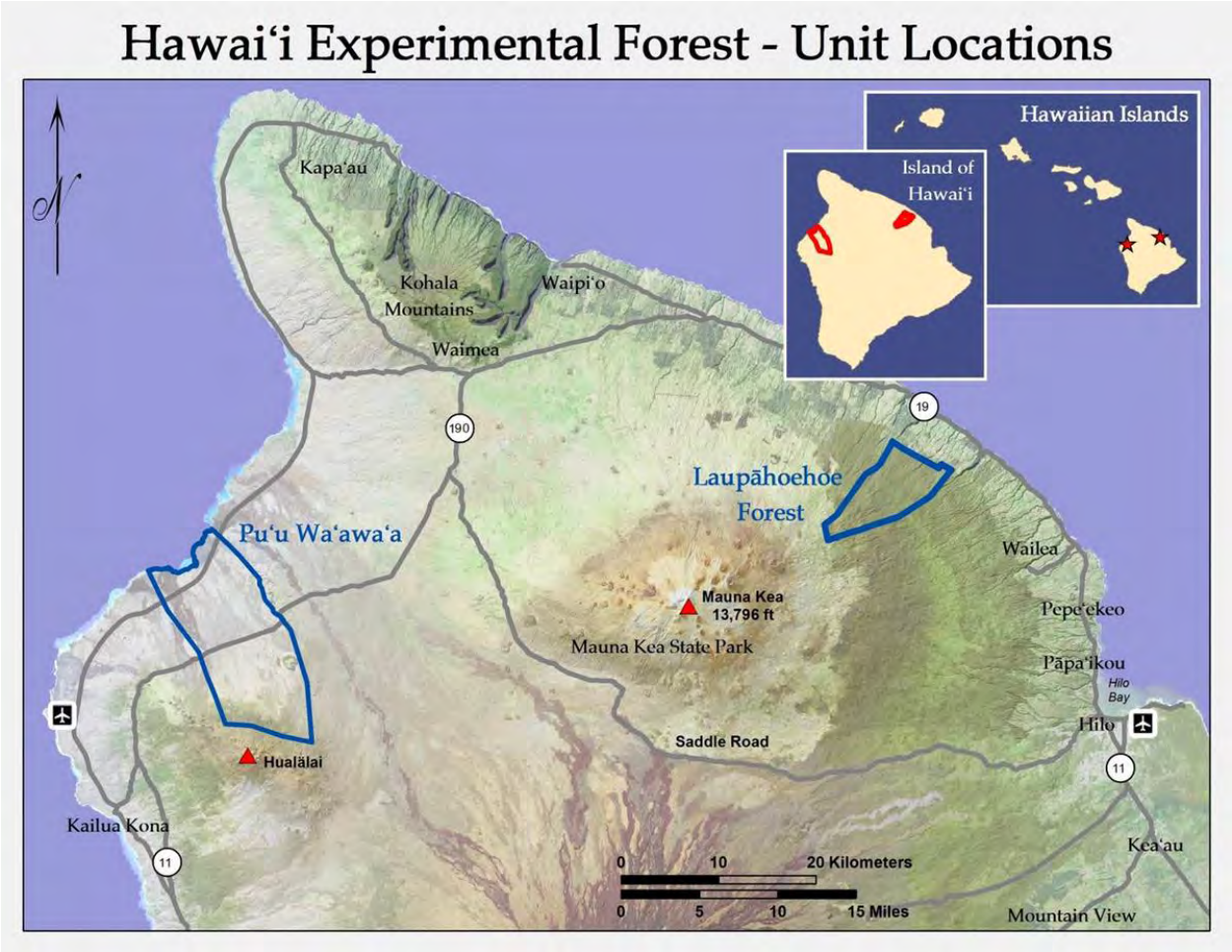


Figure 1. Map of Hawai‘i Island highlighting the Pu‘u Wa‘awa‘a and Laupāhoehoe Units of the HETF.

The Laupāhoehoe Experimental Forest Unit is located on the east side of Hawai'i Island (Figure 2) and incorporates 4,449 acres (1,800 ha) of DOFAW managed land designated as Forest Reserve and 7,894 acres (3,195 ha) of land designated as Natural Area Reserve (NAR). This Unit contains native-dominated forested landscapes from lowland forest at 2,300 feet (700 m) above sea level extending through four life zones to almost 6,200 feet (1,890 m) in elevation. Laupāhoehoe contains magnificent examples of tropical rain forest and is the habitat of numerous endangered plant and animal species.

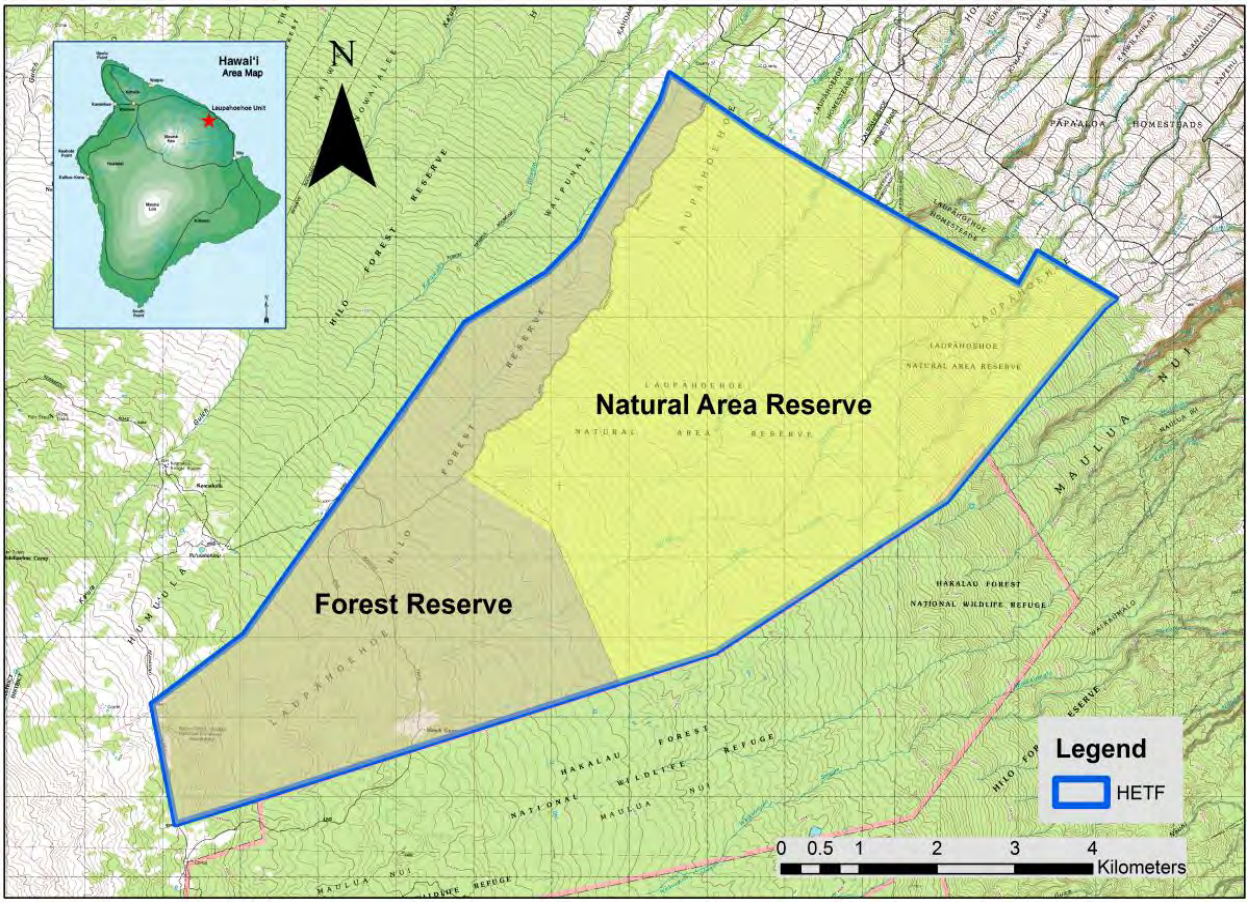


Figure 2. Map of the Laupāhoehoe Unit of the HETF, indicating State DLNR land designations.

Photos: Left - Laupāhoehoe Community Public Charter School (LCPCS) students help to remove old fencing material. Right - LCPCS staff spend the day in the forest performing restoration activities as part of a teachers retreat.

The Puʻu Waʻawaʻa Experimental Forest Unit is located on Hawaiʻi Island's North Kona coast (Figure 3) and incorporates three DLNR land designations. Approximately 31,475 acres (12,743 ha) are designated as Forest Reserve and together with the 3,806 acre (1,542 ha) Forest Bird Sanctuary (Wildlife Sanctuary), are managed through DOFAW. The remaining 3,530 acres (1,430 ha) are managed by the DLNR Division of State Parks. In addition there are approximately 74 acres (30 ha) of private in holdings within the HETF boundary. Tropical dry forests are considered among the most endangered forest types in the world, and in Hawaiʻi the few remaining remnants are severely threatened by wildfire, invasive plant species, and non-native ungulates.

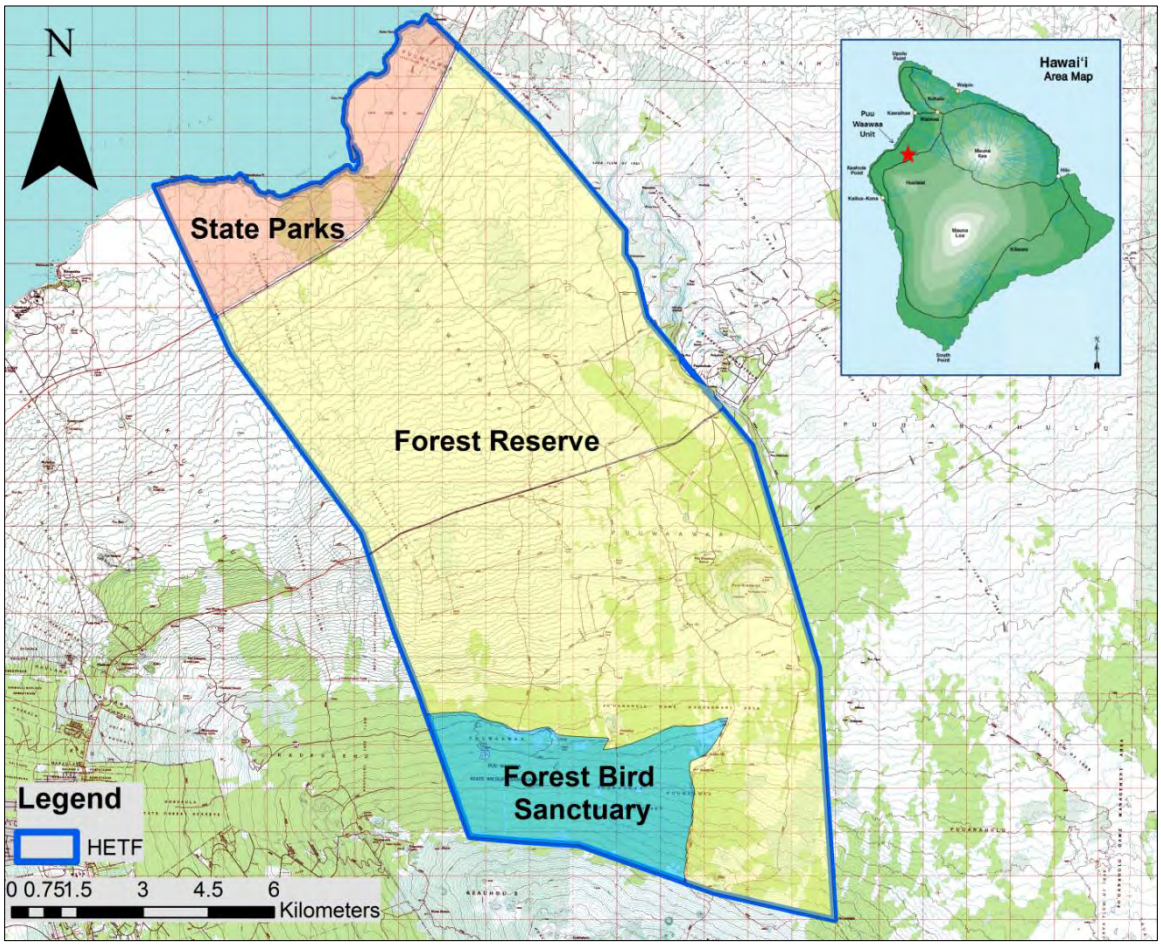


Figure 3. Map of the Puʻu Waʻawaʻa Unit of the HETF indicating State DLNR land designations.

Photos: Left - The 8th annual Run for the Dry Forest 5K & 10K run in Puʻu Waʻawaʻa. Right - Middle school students from Honokaʻa High & Intermediate School maintain a watering system built as a school project to help with restoration efforts.

The HETF's mission is to provide landscapes, facilities, and data/information to support research and education activities contributing to a better understanding of how to conserve and manage the biological diversity and functioning of tropical forest and stream ecosystems as well as to understand the human dimensions of natural resources conservation and management. The HETF represents a significant contribution in the global effort to understand and protect some of the most threatened and endangered ecosystems in the world. This can be accomplished in the following ways: facilitating research by providing research areas, facilities and information; fostering an environment for interaction and the exchange of information among scientists and to those outside the scientific community, and providing education and demonstration opportunities for those interested in tropical forest studies and management.

The report information herein is focused on the research and education activities that took place within the HETF in 2014 including annual reports received from researchers. Activity data from the previous four years is included in graphical data where relevant. Also included is information related to HETF facilities, research infrastructure and administration including concerns, comments, and challenges that took place relating to operations. Additional information regarding the HETF's history, future plans and annual reports as well as other resource documents can be found online at www.hetf.us.

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 Hawaiʻi*) 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 Hawaiʻi Island DOFAW Branch Manager, the Hawaiʻi Island Natural Area Reserves Program Manager, the Hawaiʻi Island Forestry Program Manager, East and West Hawaiʻi Island Wildlife Biologists, the Puʻu Waʻawaʻa coordinator, and two to three external partners. The HETF Planning Group is facilitated by the HETF Project Manager (USFS employee) and meets bi-monthly. See page 76, Appendix C, for a list of HETF related personnel.

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 Hawaiʻi Island DOFAW Branch Manager, the USFS-HETF Science Lead, the Natural Area Reserve Hawaiʻi Island Manager, the Forest Reserve Hawaiʻi Island Manager, East and West Hawaiʻi Island Wildlife Biologists, and the Puʻu Waʻawaʻa coordinator. Permit processing and tracking is coordinated and administered by HETF staff. Signing authority for all permits within DOFAW managed lands lies with the Hawaiʻi Island DOFAW Branch Manager. All research permits are valid for one year and require an annual report. In Puʻu Waʻawaʻa research permitting for the HETF is limited to land activities. Research activities that take place in water including the tide line are under the jurisdiction of the DLNR-Division of Aquatic Resources. Permits within State Parks are issued by, State Parks Hawaiʻi 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 Puʻu Waʻawaʻa Advisory Council (PAC) has been in existence since 2002. The Laupāhoehoe Advisory Council (LAC) was formed in December 2010. Both Councils

participate in research permit application review and their comments and/or recommendations are provided to the RTC during the review process.

Planning

In November 2013, the LAC reviewed an internal draft of the Laupāhoehoe Forest Management Plan. Plan content was solicited during public LAC meetings in 2012 and 2013. A public draft is expected for release in 2015. As part of the information gathering activities for the management plan a forest bird survey was conducted in the spring of 2013.

Funding

In addition to USFS staff time focused on HETF administration and development of the draft Laupāhoehoe Forest Management Plan, funds were expended on the HETF related activities and programs described below.

21st Century Conservation Corps (21CSC) – 21CSC is a national initiative to engage young people and returning veterans to protect, restore, and enhance America's Great Outdoors (http://21csc.org/). In 2014, the HETF was awarded $103K to support 21CSC partners in temporary professional development opportunities. Two 21CSC positions were funded in 2014 supporting a staff member working with the Mauna Kea Watershed Alliance ($11K) and the DLNR-DOFAW at Pu‘u Wa‘awa‘a ($11K). In addition, $26,000 in 21CSC funds were expended to support AmeriCorps, Hawai‘i Youth Conservation Corps, Gateway team participants though a partner organization, Kupu, who administers Youth Conservation Corps programs in Hawai‘i.

Education/Outreach/Safety – $5,000 in general operating funds were spent towards tools and canopies for education and outreach activities, supplies to create road signs at Pu‘u Wa‘awa‘a, and a flammables safety cabinet also at Pu‘u Wa‘awa‘a.

State Management and Research Activities

As mentioned previously, HETF lands are managed cooperatively by 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 available via annual reports to the Legislature. For information on the aforementioned reports, visit http://hawaii.gov/dlnr/reports-to-the-legislature.

Facilities

Laupāhoehoe Unit

HETF support facilities for the Laupāhoehoe Unit are present in two locations within the town of Laupāhoehoe but outside the forest boundary. The Laupāhoehoe Science and Education 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, kitchen, restrooms, and classroom/meeting space. The facility site offers opportunities for research, education, and demonstration. A weather station, installed in 2009, is located onsite.

Additionally, there are plans to build a covered pavilion with restrooms and parking on a three acre fenced parcel directly below the Laupāhoehoe forest boundary. This site would serve as a stepping stone for education and outreach into the forest with the potential for restoration and other forest activities within the three acre fenced area. The potential date of construction for the facilities is unknown.

Puʻu Waʻawaʻa Unit

There are plans to build dedicated HETF facilities including a bunkhouse with kitchen, restrooms and classroom/meetings space for Puʻu Waʻawaʻa. Facility locations have changed through time as information is gathered and USFS fiscal policies change. Two sites were considered in 2014 for HETF facilities, either the decommissioned landing strip located within the DLNR Forest Reserve or a DLNR Land Division site located just outside the Forest Reserve within the community of Puʻu Anahulu. After hearing community feedback about concerns related to the Land Division parcel, the focus site for the future HETF facilities at Puʻu Waʻawaʻa has been moved to the landing strip location. Non-exclusive use of specific DOFAW owned buildings are available for HETF related meetings and activities.

Research Infrastructure/Databases

Long term climate monitoring equipment has been installed in both Units and the Laupāhoehoe Unit also includes hydrology monitoring equipment. HETF specific infrastructure was installed under Categorical Exclusions, and Decision Memos are on file with the USFS. The HETF climate stations are part of the EPSCoR-ENDER (Experimental Program to Stimulate Competitive Research - Environmental Dynamics and Ecosystem Responses) Climate Network, an island-wide network of climate stations at locations across the island of Hawaiʻi.

HETF climate station.

Laupāhoehoe Unit equipment includes a stream gauge in Manowaiʻōpae, Kaiwilahilahi, and Kaʻawaliʻi streams (outside the forest boundary and managed by the USFS) and a free standing aluminum weather station located within the Forest Reserve. The purpose of the stream gauge is to measure natural stream flows, water quality and sediment in a non-destructive manner. The weather station, installed in 2009, extends 10 feet (3 m) above the forest canopy and collects daily rainfall, temperature, relative humidity, wind-speed, solar radiation (sunlight), soil moisture, soil temperature, and wind direction.

The Puʻu Waʻawaʻa Unit hosts multiple weather stations including two in the Forest Reserve, installed in 2003 (RAWS station) and 2011, and one in the Forest Bird Sanctuary, installed in 2012. In addition to the Decision Memo on file for station installation, an Office of Conservation and Coastal Lands, District Use permit is also on file at the USFS.

Information and links to access HETF climate data is found here: http://www.hetf.us/page/climate/

Long term vegetation plots are available in both Units including:

- The Hawaiʻi Permanent Plot Network (HIPPNET), http://www.hippnet.hawaii.edu/
- Forest Inventory and Analysis (FIA), http://www.fia.fs.fed.us/

Additionally, State management infrastructure (fencing) to protect plants is found within both Units. Detailed information regarding this infrastructure is found within the management plans for each unit.

- Pu‘u Wa‘awa‘a - http://www.puuwaawaa.org/index.html
- Laupāhoehoe - a draft management plan is currently in progress. Release of a public draft is expected in 2015.

National Ecological Observatory Network (NEON)

NEON is a long-term, continental scale science and education project sponsored by the National Science Foundation (http://neoninc.org/). The goal of NEON is to enable understanding and forecasting of the impacts of climate change, land use change and invasive species on continental scale ecology by providing infrastructure to support research, education and environmental management in these areas. This approach will standardize scientific ecological efforts and will enable integrated observatory operations at a continental scale.

Twenty eco-climatic domains, each of which represents different regions of vegetation, landforms, climate and ecosystem performance, have been selected across the U.S. Within these domains, NEON infrastructure and sensor systems will be used to collect site-based data about climate and atmosphere, soils, streams and ponds, and a variety of organisms. NEON uses distributed sensor networks, coordinated airborne observations and experiments – integrated by a communications, command, and control system – to collect ecological data. Each domain will host a fully instrumented core site in a minimally managed “wildland” area to operate for the 35 year lifetime of NEON and two “relocatable” sites will operate for a limited duration of 15 years.

Hawai‘i was selected as NEON’s ‘Domain 20’. In December 2014, NEON received an ‘Approval in Concept’ from the BLNR for establishing Hawai‘i’s core site within the Upper Waiakea Forest Reserve and the relocatable sites within Pu‘u Wa‘awa‘a. The Pu‘u Wa‘awa‘a relocatable sites will help provide a baseline understanding of biotic and abiotic controls. Site selection involves selecting areas that can be contrasted with one another (e.g. grassland versus forest canopy). Two contrasting sites below the Forest Bird Sanctuary are being considered for the relocatable locations. Exact site locations are still being determined, and NEON staff is working closely with DOFAW and USFS staff in regards to location selection, and permitting and environmental compliance needs.

2014 Climate Data Summary

This section contains available summary data for the HETF climate stations located within the Forest Reserve in Laupāhoehoe and the Forest Bird Sanctuary in Pu‘u Wa‘awa‘a and associated with the Hawai‘i Permanent Plot Network (HIPPNET), http://www.hippnet.hawaii.edu/.

Laupāhoehoe Unit

Table 1. Mean annual rainfall, temperature, and relative humidity at Laupāhoehoe climate station.

Year	Rainfall (mm)	Temperature (C°)	Relative Humidity (%)
2014	4533	16.6 (+0.4)	88.3 (+1.0)
2013	3458	15.9 (+0.4)	86.5 (+0.9)
2012	3057	15.0 (+0.3)	86.2 (+1.7)
2011	4205	15.4 (+0.2)	85.1 (+1.1)
2010	2539	15.3 (+0.3)	83.7 (+0.8)
Mean	3558 (+365)	15.6 (+0.3)	86.0 (+0.8)

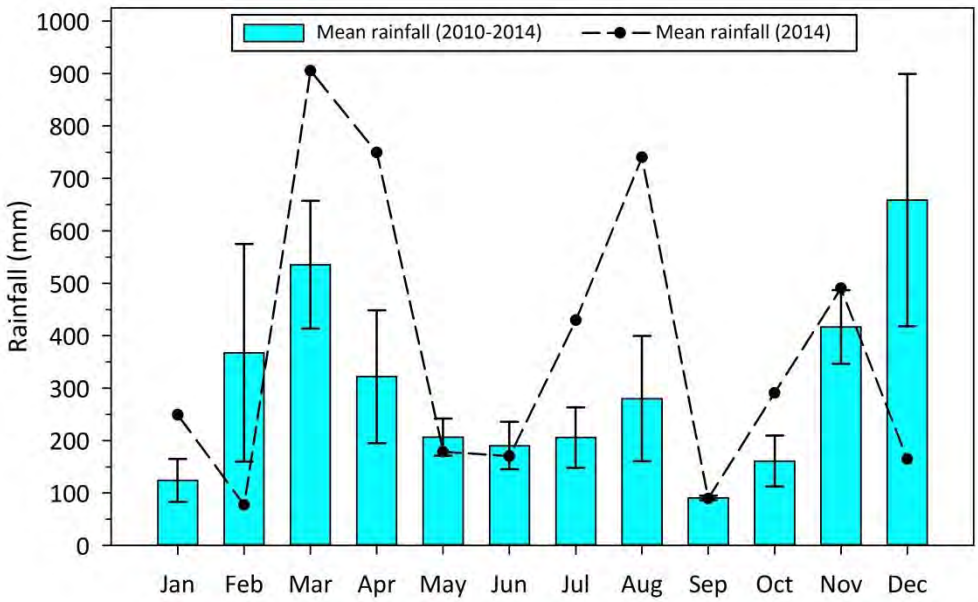


Figure 5. Mean rainfall for 2010-2014 compared to 2014 in Laupāhoehoe.

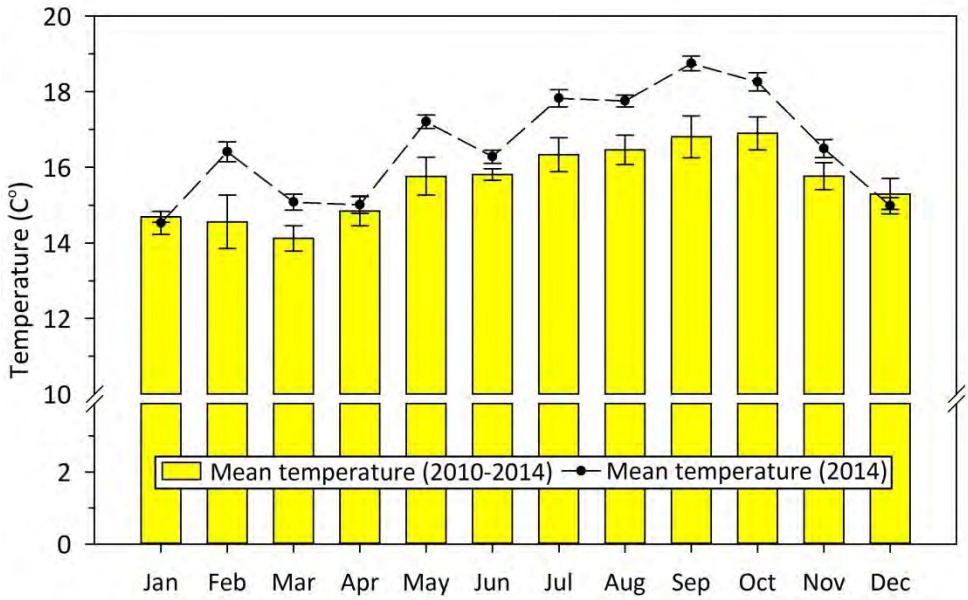


Figure 4. Mean temperature for 2010-2014 compared to 2014 in Laupāhoehoe.

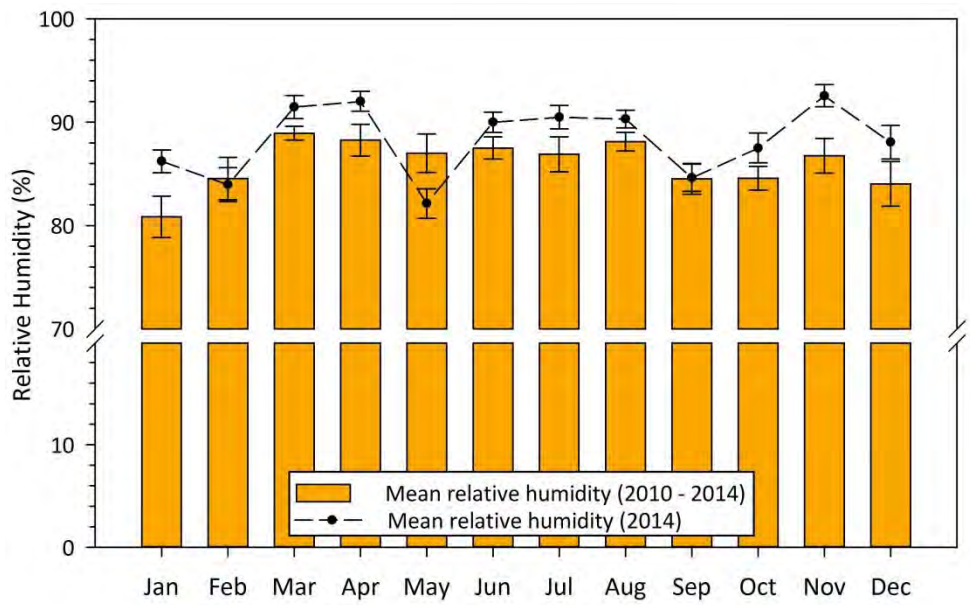


Figure 6. Mean relative humidity for 2010-2014 compared to 2014 in Laupāhoehoe.

Puʻu Waʻawaʻa Unit

Table 2. Mean annual rainfall, temperature, and relative humidity at Puʻu Waʻawaʻa climate station.

Year	Rainfall (mm)	Temperature (C°)	Relative Humidity (%)
2014	815	14.4 (±0.3)	84.0 (±2.0)
2013	477	13.8 (±0.3)	83.2 (±1.5)
Mean	646 (±169)	14.1 (±0.2)	83.6 (±1.2)

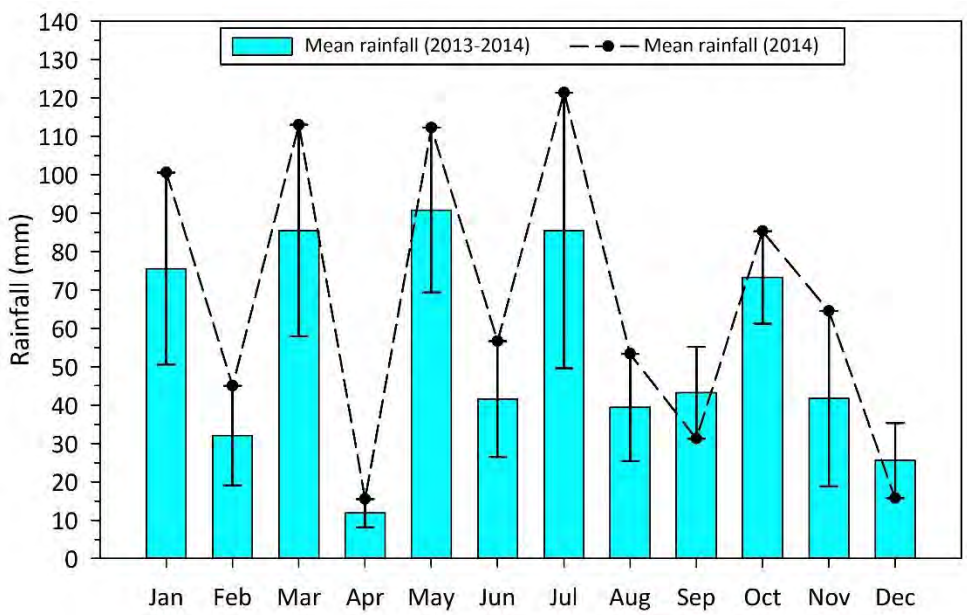


Figure 7. Mean rainfall for 2013-2014 compared to 2014 in Puʻu Waʻawaʻa.

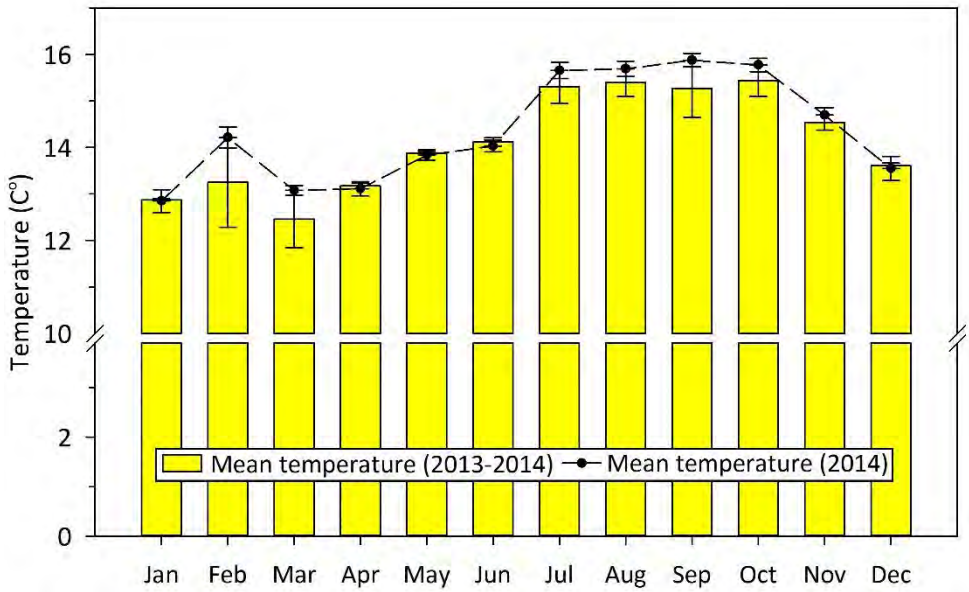


Figure 9. Mean temperature for 2010-2014 compared to 2014 in Pu‘u Wa‘awa‘a.

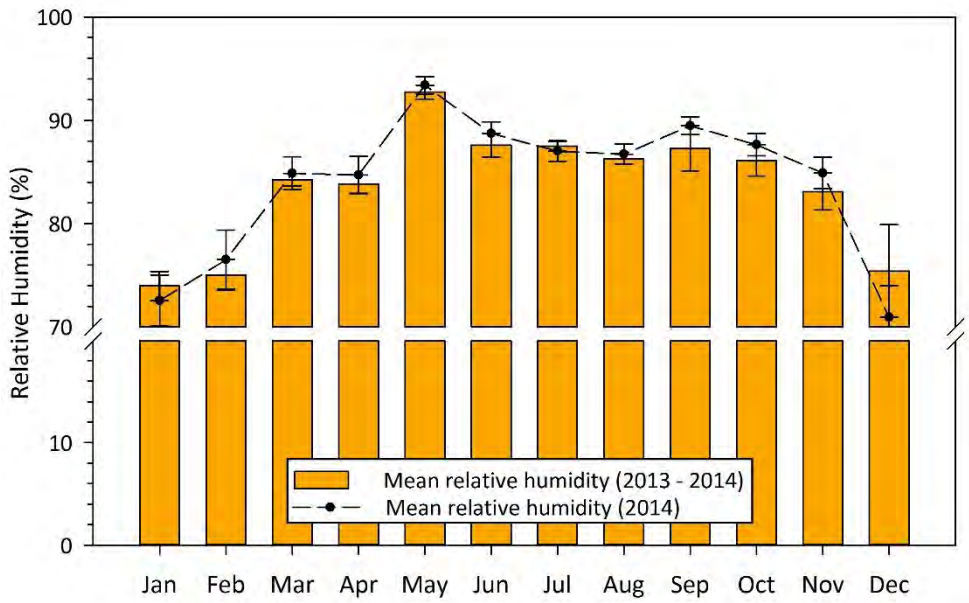
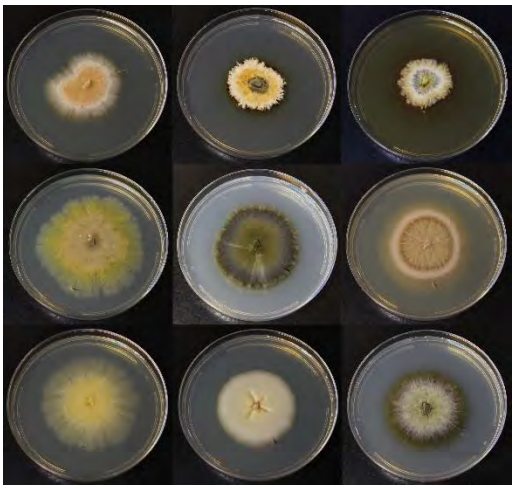


Figure 8. Mean relative humidity for 2010-2014 compared to 2014 in Pu‘u Wa‘awa‘a

2014 Research Summary

Fifteen research applications were submitted and approved in 2014. Fourteen projects were initiated (seven renewals and seven new). One project was uninitiated. See page 65 for detailed information regarding research projects. HETF-related journal articles were published in *Ecosphere, PLOS One, Biological Journal of the Linnaean Society, Oecologia, Ecological Applications, Journal of Environmental Quality, PeerJ* and more. See HETF Related Citations section of this report for a complete list. Maps indicating the 2014 active research sites grouped by primary investigator within each Unit are provided in Figure 10 and Figure 11. Projects listed in hibernation refer to inactive research plots (closed permits) but with plot markers remaining in the field in anticipation of future measurements. A few of the 2014 research projects are highlighted below.

- ***Local adaptation in an ericoid mycorrhizal symbiosis –*** Devin Leopold, a Stanford University PhD candidate, is studying local adaptation of *Vaccinium calycinum* (ʻōhelo kau lāʻau) and the beneficial ericoid mycorrhizal fungi (EMF), associated with their roots. Despite longstanding recognition of the importance of local adaptation as a fundamental evolutionary process, and increasing recognition that mycorrhizal fungi are important drivers of ecosystem productivity and diversity, understanding of local adaptation in the context of these mutualistic symbioses is limited. *V. calycinum* and EMF make an ideal study system for a number of reasons. First, *V. calycinum* occurs in many Hawaiian tropical montane forests as the only host for the specialized EMF symbionts, providing a simplified study system. Second, *V. calycinum* occurs across the Hawaiian Islands, spanning a wide range of soil conditions. Because the mycorrhizal symbiosis is important for nutrient uptake, variation in nutrient availability associated with soil age across the Hawaiian Islands is likely to drive local adaptation of the symbiosis. To date, Devin has isolated 19 unique fungal symbionts from the roots of *V. calycinum* in Laupāhoehoe Forest, including some unique to this site and others which were also found as far away as Kokeʻe State Park on the Island of Kauai. Future work will involve cultivation of plants and fungi from various sites in a greenhouse study to test for co-adaptation to soil conditions.



Fungal isolates obtained from *Vaccinium calycinum* roots. *Photo: Devin Leopold*

- ***Movement ecology of Hawaiʻi forest birds -*** Hawaiʻi's forest birds are believed to move over large areas of the forest, although little is known about how often, how far, and exactly where these birds move. If the birds are moving over large areas, then they are using lands managed by many different entities, and may encounter threats (such as disease in low elevation forests) that can impact even protected populations. Dr. Eben Paxton, of the U. S. Geological Survey, is trying to understand how birds move across the landscape. Dr. Paxton is currently tracking forest birds, iʻiwi and apapane, across the forests of Hakalau Forest National Wildlife Refuge (HFNWR). He is attempting to track birds that may move from HFNWR to Laupāhoehoe Forest. Using small radio transmitters attached temporarily to birds, and towers that automatically track the direction of the radio transmitters, he can follow birds as they move about the forest. The information will be combined across all locations to reconstruct movement patterns over a large geographic area. This will help land managers understand where they should focus their conservation efforts, what threats the birds may be facing, and to what degree land managers need to work together to protect birds that are moving across their lands. It is critical to understand these movements and the threats they face, and develop conservation plans that are at a geographic

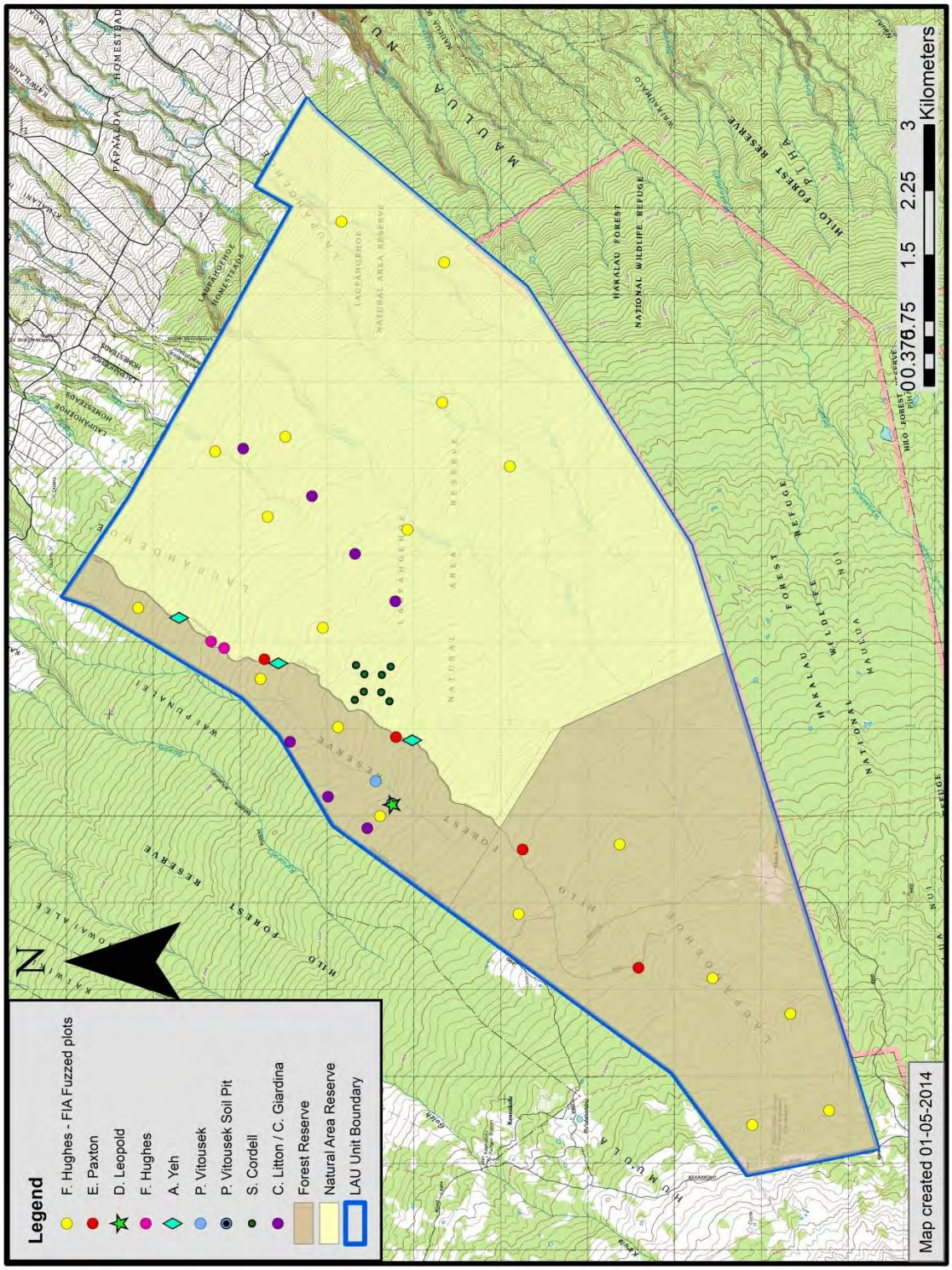


Figure 10. Map indicating active 2014 research projects within the Laupāhoehoe Unit.

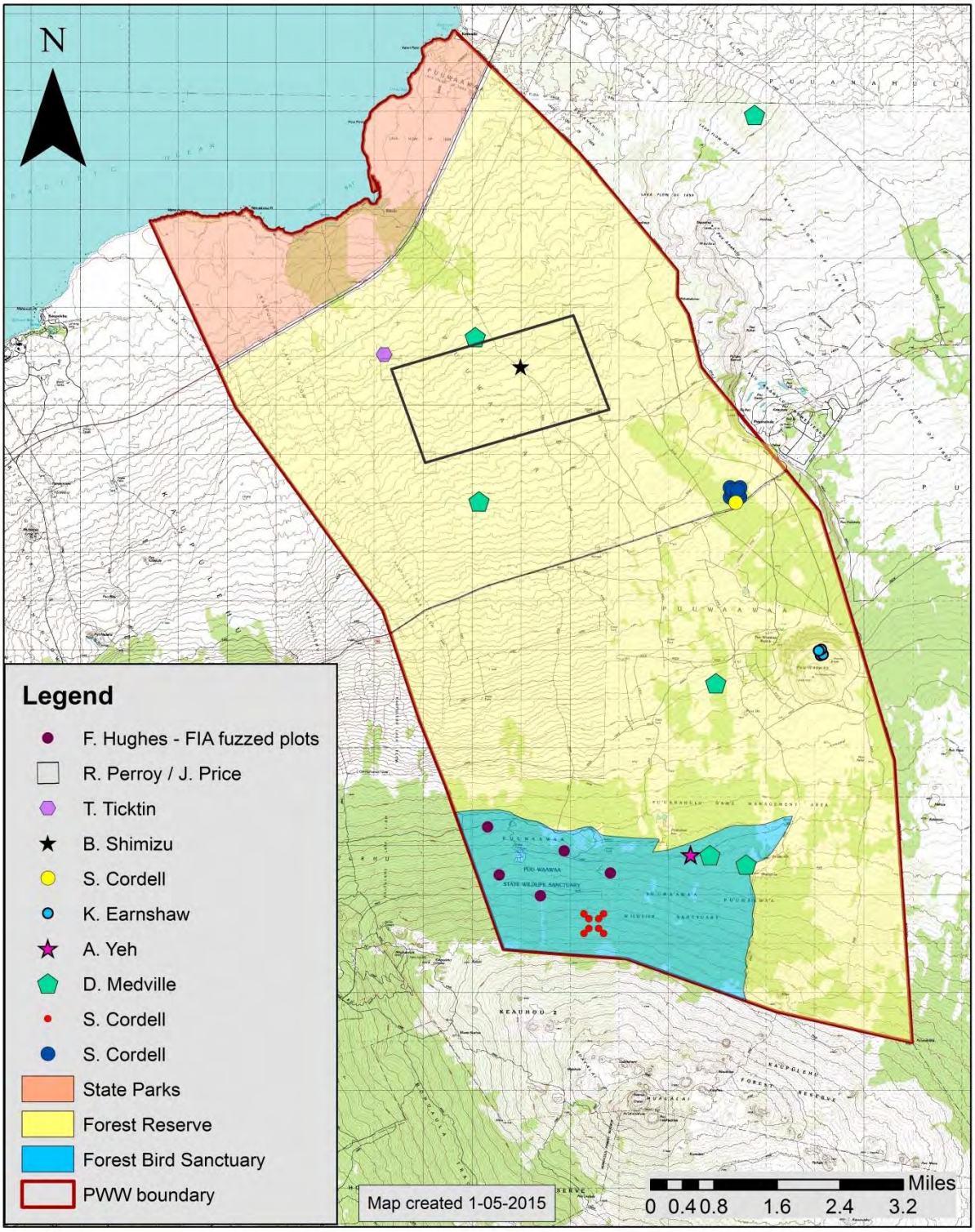


Figure 11. Map indicating active 2014 research projects within the Pu‘u Wa‘awa‘a Unit.

scale that matches the birds' scale. To date, research has indicated long-distance movement, including movement from HFNWR to Laupāhoehoe Forest. Late 2014 telemetry antennas were placed above the forest canopy on the existing climate station in Laupāhoehoe Forest, which should allow the detection of birds from high elevation forest moving into the lower portions of Laupāhoehoe Forest. Detecting long-distance moments provides important information on the ecology of the forest birds, and is important for developing effective conservation strategies.

- ***Using small unmanned aerial vehicles to map invasive and rare endemic plants and monitor vegetation health in the Pu'u Wa'awa'a Forest Reserve Makai Subunit*** – Dr. Ryan Perroy and Dr. Jon Price of the University of Hawaiʻi at Hilo (UHH), are using Unmanned Aircraft Vehicles (UAV) to capture aerial photography over Puʻu waʻawaʻa to monitor invasive species, conduct biomass estimations, evaluate vegetation health, and to assess the use of this technology for environmental monitoring. Research activities include flying a small UAV over the study area and temporarily placing portable ground control markers out in the landscape. Research questions include: What is the feasibility of identifying and detecting endemic Hawaiian plants using ultra-high resolution imagery collected with Unmanned Aircraft Systems? Can classifications of complex ecological communities be improved with the use of Unmanned Aircraft? These questions are important as UAV's have the potential to economically capture critical environmental data at spatial and temporal resolutions previously unattainable. In 2014, six FAA-sanctioned UAV flights were conducted over two days, within Puʻu waʻawaʻa, using a small fixed-wing platform carrying a modified point-and-shoot camera sensitive in either the visible or near-infrared (NIR) portions of the electromagnetic spectrum. Photo orthomosaics (high eye aerial imagining) and digital surface models were produced covering ~123 acres of the study area at <5cm resolution, focusing efforts on mapping wiliwili trees. Initial results look very promising. In addition, Dr. Jon Price identified a previously unknown small adult uhiuhi tree, displaying previous reproductive material but no seeds or flowers at the time of observation.

Dr. Ryan Perroy hand-launches a small fixed-wing unmanned aerial vehicle used to map vegetation.

- ***Linking local ecological knowledge, ecosystem services and climate change*** – Dr. Tamara Ticktin of the Botany Department at the University of Hawaiʻi at Mānoa is studying the complex inter-linkages of human and natural systems. Understanding how these 'social-ecological' systems are resilient to climate change is one of the most pressing problems of our world today. This is especially true for coastal communities in the Pacific Islands, which are extremely vulnerable to the effects of climate change. Dr. Ticktin is leading an interdisciplinary team, partnering with other scientists (working in marine ecology, anthropology, economics, and climate change modeling), resource managers, and community members to study social-ecological resilience to climate change in Hawai'i and Fiji. Using a combination of long-term existing social and ecological datasets, new data and experiments, and state-of the art climate and ecosystem service models, the research team is asking: How will different land and ocean uses affect social-ecological resilience and ecosystem services in linked ridge-reef settings, under different climate change scenarios? To answer this question, their research focuses on three watersheds - Haʻena (Kauai), Puʻu waʻawaʻa/Kaʻūpūlehu (Hawai'i), and Kubulau (Vanua Levu, Fiji). In Puʻu Waʻawaʻa, Dr. Ticktin and team tagged and measured all native and non-native trees, naturally occurring, as well as ground cover in 5 m X 5 m nested subplots. The information gathered in this study will be used to calculate indicators

of ecological resilience (including species and functional diversity, heterogeneity, and invasive species cover) and some ecosystem services (provisioning, regulating, cultural) now and under climate change scenarios. The team will use this information to examine trade-offs and synergies between ecosystem services, indicators of resilience and economic costs under different land use scenarios (for example, different restoration scenarios) and different ocean use scenarios. The goal is to inform sustainable management of resources in the future.

- ***Plasticity of heterophylly in of Acacia koa Gray in response to shade stress: towards an improved model for koa restoration and management*** – Kyle Earnshaw of the Tropical Hardwood Tree Improvement and Regeneration Center, at Purdue University, is addressing how differences in the timing and degree of heterophylly (multiple leaf forms) and heteroblasty (the transition from one form to another) in two populations of koa, *Acacia koa* Gray, affect establishment and early growth. He is examining how variability in light and water affect these characteristics based on selection pressures inherent in the ecosystems in which the specific populations evolved. Performance, expressed in growth rates, and survival will be compared for each location to begin the process of estimating the ranges of koa populations from disparate climate types. In addition to providing valuable insights on the importance of light quality, further elucidating the role of plasticity in climate adaptation, and providing improved metrics for estimating canopy structure in koa plantations, this study will, from the perspective of Hawaiian Forestry, provide data on the capacity of koa from contrasting climates to be managed under mixed (two or more dominant tree species) and uneven aged (two or more age classes) systems. In July of 2014, three to four month old koa seedlings were planted within the fenced portion of the Puʻu Waʻawaʻa cinder cone under a sparse koa canopy and marked with PVC piping so that each seedling could be identified. Results of this study are expected to help guide restoration efforts in providing koa with a proper microclimate for successful establishment and help plantation designs to account for light and competition requirements of koa to optimize growth habit and rates.

Kyle Earnshaw next to a 7 month old koa seedling.

Research project locations may be specific to an HETF Unit or take place within both Units. Likewise, research projects can be restricted to specific State land designations or occur within multiple State land designations. Five of the 14 projects initiated in 2014 were located in the Laupāhoehoe Unit, six occurred within the Puʻu Waʻawaʻa Unit, and three research projects were conducted in both Units (Table 3). Figure 12 shows the percentage of 2014 HETF research projects grouped by State land designation. In Puʻu Waʻawaʻa research permitting for the HETF is limited to land activities. Research activities that take place in water including the tide line are under the jurisdiction of the DLNR-Division of Aquatic Resources.

Figure 13 shows research affiliation for projects within the HETF over a five-year period 2010-2014. There was a significant drop in permit submittals from all affiliation categories in 2014. Permit applications from the 'Forest Service' decreased by 83%; 'University of Hawaiʻi' decreased by 75%; 'Other Universities' decreased 33%; 'Other Government Agencies' decreased 40% and 'Other' decreased by 75%. This is partially due to the completion/closeout of several projects and a decrease in university student initiated projects.

Table 3. Total number of research projects initiated in the HETF per year and grouped by Unit from 2010-2014.

Year	Laupāhoehoe Unit Only	Pu‘u Wa‘awa‘a Unit Only	Both HETF Units	Total # of Projects Initiated
2014	5 (36%)	6 (43%)	3 (21%)	14
2013	14 (55%)	10 (38%)	2 (8%)	26
2012	8 (44%)	8 (44%)	2 (12%)	18
2011	5 (42%)	5 (42%)	2 (16%)	12
2010	8 (44%)	9 (50%)	1 (6%)	18
Total	**41**	**40**	**13**	**92**

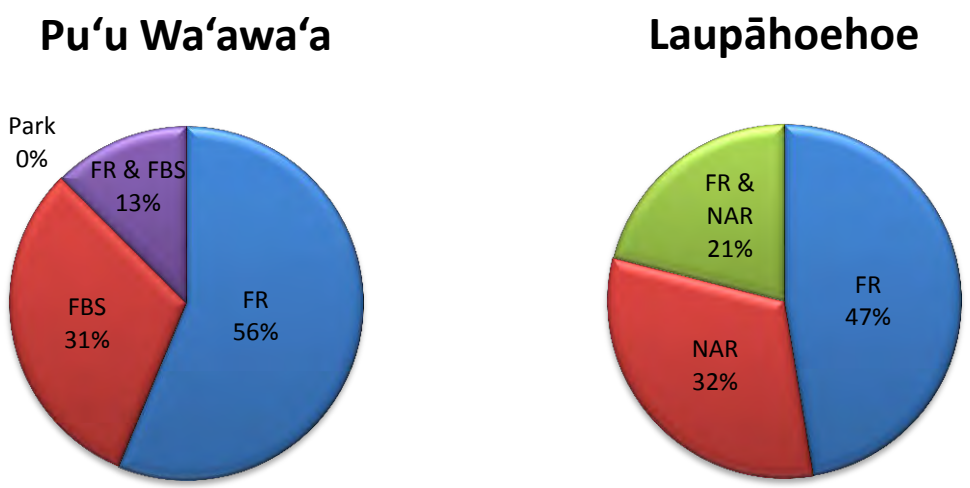


Figure 12. Percentage of HETF research projects grouped by State land designation in 2014. (NAR=Natural Area Reserve, FR=Forest Reserve, FBS=Forest Bird Sanctuary)

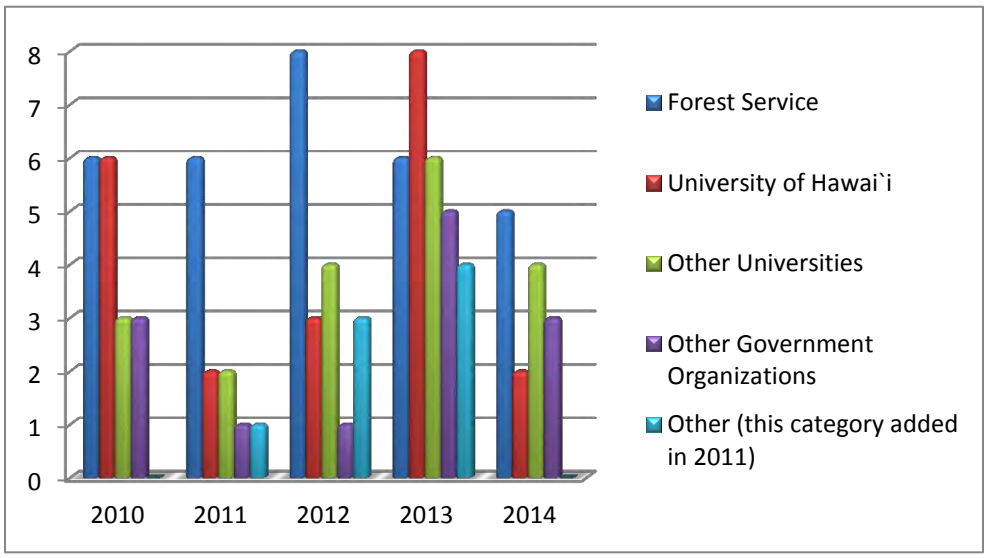


Figure 13. Affiliation for research projects initiated and ongoing within the HETF from 2010-2014.

Laupāhoehoe Science and Education Center (Center)

As mentioned previously, the Center is housed on 55 acres of old sugar cane lands. HETF infrastructure like the Center are envisioned to provide a center for demonstration, education, training, and outreach on tropical forestry, conservation biology, and natural resources research and management.

ʻŌhiʻa Common Garden

Christian Giardina and Kainana Francisco of the USFS, in collaboration with Liam Mueller, Joe Bailey, and Jennifer Schweitzer at the University of Tennessee, established an ʻŌhiʻa Common Garden at the Center in the summer of 2014. The common garden serves multiple purposes including community engagement and research platform as well as reforestation of degraded lands at the Center. The team planted over 800 native ʻōhiʻa trees in the common garden in conjunction with the education and outreach program Ulu Lehulehu (The Million ʻŌhiʻa Initiative) whose mission is to connect Hawaiʻi's youth to ʻōhiʻa trees.

The ʻŌhiʻa Common Garden will help answer interesting science questions about how long-term forest fragmentation (>100 years) affects ʻōhiʻa genetics. The trees were all created from cuttings taken from ʻōhiʻa that occur in the center and edge of forest kīpuka, or forest fragments created by lava flows, as well as from ʻōhiʻa trees colonizing the lava matrix between kīpuka. The team selected these trees because they noticed that there were differences in trees between sites, and thought these differences could be controlled genetically. Over 1000 ʻōhiʻa from these different locations were raised in a greenhouse for two years. The team found that location definitely affected genetics. Trees from kīpuka centers grew faster and taller than edge trees or matrix trees even though all the trees were grown in a common environment (same soils and greenhouse). The next step is to see how these differences continue as the trees mature into larger individuals. In the future, the common garden will allow participants to learn about ʻōhiʻa and its importance to the health of the forest, participate in service learning opportunities such as outplantings and/or caring for the ʻōhiʻa (weed/grass control), which supports both the research and education efforts of the ʻōhiʻa common garden.

HYCC members planting the ʻŌhiʻa Common Garden. Frontier member (right) and Gateway team members (left).

2014 Education, Outreach and Access Activity Summary

This section highlights various non-research program activities, as well as specific Unit education, outreach, and access details that occurred within the HETF in 2014.

Hawai'i Youth Conservation Corps (HYCC)

2014 was the third year the HETF supported HYCC Gateway teams. Gateway program members gained introductory experience in all aspects of natural resource management, working in both HETF Units, as well as other conservation areas managed by agency partners, such as the DOFAW, Mauna Kea Watershed Alliance, Hakalau National Wildlife Refuge, the Nature Conservancy and the Office of Mauna Kea Management. Additionally, IPIF supported one Gateway team as well as two Frontiers interns, and one Extended Internship Position. See page 77 for more detailed HYCC information.

Manaulu Manowai'ōpae

The USFS is a partner with Laupāhoehoe Community Public Charter School (LCPCS) and works with the school's teachers and administration on ways to integrate curriculum with hands on experience both in and out of the classroom. Graduate student James Akau has been working with the LCPCS to increase student exposure to local natural and cultural resources, and teach conservation and restoration through the Manaulu Manowai'ōpae program. Most of the program activities occur within the Laupāhoehoe Unit, the Laupāhoehoe Science and Education Center, and on the LCPCS campus. Manaulu Manowai'ōpae also provides additional resources (i.e. transportation, equipment, guest speakers, etc.) to support ongoing programs that occur at the school and within the community. Values of *aloha 'āina* (love for the land), long-term *kokua* (help; aid), *kako'o* (support) and *laulima* (many hands) are practiced when restoring the land.

HYCC participant planting native sedges along the edge of Kīholo fishpond.

Sharing *aloha 'āina* with the Ocean Warriors through the Manaulu Manowai'ōpae program.

Laupāhoehoe Unit

One hundred and nine participants on nine trips visited the Laupāhoehoe Unit in 2014 (Table 4). A further breakdown of trip totals, and affiliation and type from 2010-2014 is detailed in Figure 14, with additional details in Figure 15. A few of the 2014 HETF education trips to Laupāhoehoe Forest are detailed here.

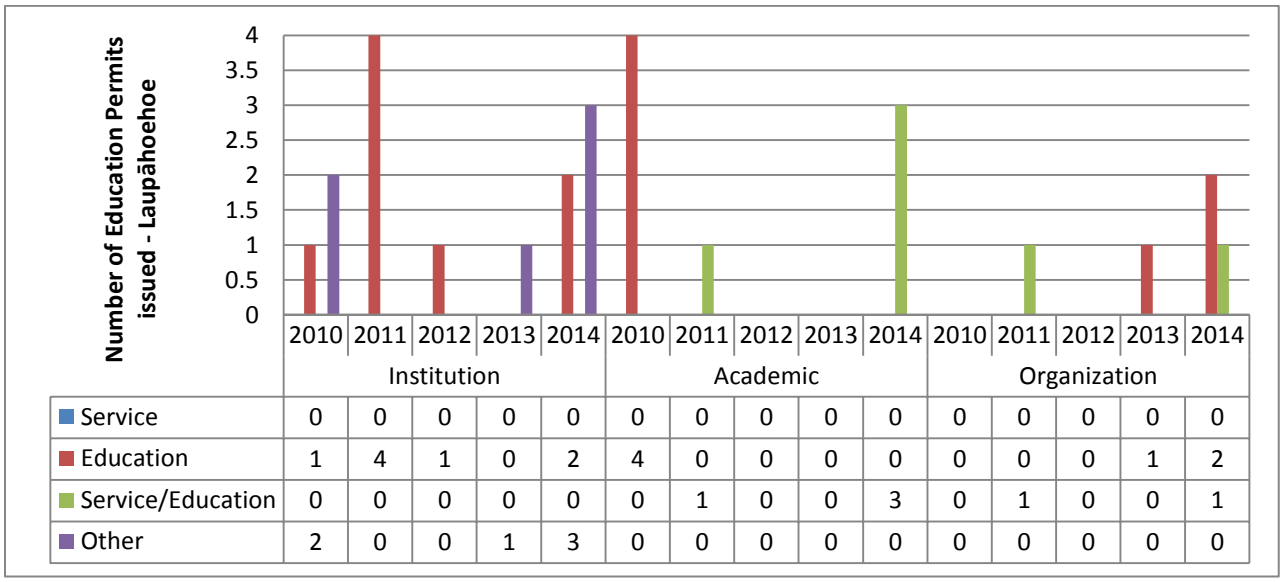
- *Laupāhoehoe Community Public Charter School (LCPCS) students* visited the forest in conjunction with their project based learning studies and the Manaulu Manowaiʻōpae program. The students were focused on looking at the connections between mosquitoes, bird diseases, and pigs. Students were able to experience an elevational gradient and how the climate and the presence or absence of native birds and mosquitoes changed depending on the elevation. The presence of native birds was connected with the absence of mosquitoes, introducing students to the mosquito line and how mosquitoes affect native birds as vectors of avian diseases. Students also visited a fenced exclosure to view how fencing protects natural habitats.

- *Retired Senator Daniel Akaka* toured Laupāhoehoe Forest and the Laupāhoehoe Science and Education Center (Center), a significant visit because Senator Akaka was instrumental in creating the HETF, through the passing of the Hawaiʻi Tropical Forest Recovery Act in 1992 and providing support for HETF establishment. During his visit to the forest, he shared his thoughts on the environment, Hawaiian culture, and the vision behind the Hawaiʻi Tropical Forest Recovery Act. Staff and students welcomed the Senator with an oli (Hawaiian chant) and lots of questions about his career. He shared his passion for conservation of Hawaiʻi's native ecosystems and culture. The visit ended with the Senator helping to plant an ʻōhiʻa tree at the Center. The ceremonial planting was both moving and inspirational, ending with the Senator sharing his life-long commitment to connecting Hawaiʻi's people to her forests.

Senator Akaka planting an ʻōhiʻa at the Center.

- *Dr. Peter Vitousek of Stanford University* led a day trip into the Laupāhoehoe Unit with a group of Stanford University students on a 10 week Hawaiʻi Island field studies course. Students visited his long-term research plot where they observed native Hawaiian vegetation and soil and discussed ecosystem development. Dr. Vitousek has been studying soil fertility across the Hawaiian Island chain, including his site within the Laupāhoehoe Unit, since 1990.

- *The USFS partnered with the Tree Climber Coalition* in a week long tree climbing training to support the educational program "Kids in Canopies". The program aims to formally train personnel to facilitate tree climbing experiences for students of all ages. On the last day of this training, five students from the LCPCS were invited to participate in the first Kids in Canopies experience. Participants were taught safe climbing techniques, the ecology of native Hawaiian forests, and how scientists use tree climbing to study forests. The students climbed a large ʻōhiʻa tree multiple times, leaving them enthusiastic about tree climbing and with new knowledge about Hawaiʻi's native forest.



	Institution					Academic					Organization				
	2010	2011	2012	2013	2014	2010	2011	2012	2013	2014	2010	2011	2012	2013	2014
Service	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Education	1	4	1	0	2	4	0	0	0	0	0	0	0	1	2
Service/Education	0	0	0	0	0	0	1	0	0	3	0	1	0	0	1
Other	2	0	0	1	3	0	0	0	0	0	0	0	0	0	0

Figure 14. Trip totals, affiliation and type of education/service/other trips taken in the HETF Laupāhoehoe Unit from 2010-2014.

Table 4. Information relating to 2014 education/service/other trips taken in the HETF Laupāhoehoe Unit.

Organization		Participant Age	Activity	Service Provided	Contact	Date	Group Size
Laupāhoehoe Community Public Charter School	School	Adult	Education/Service	Removal of invasive species	James Akau	1/25/2014	7
US Forest Service	Government Agency	Adult	Other		Christian Giardina	1/31/2014	9
Ocean Warriors	Non-profit	Ages 11-17	Education/Service	Watershed restoration	Christian Giardina	4/11-4/13/2014	21
US Forest Service	Government Agency	Adult	Education/Other		Susan Cordell	5/5-6/2/2014	7
Mauna Kea Watershed Alliance	Non-profit	Ages 11-17	Education		Cheyenne Perry	7/21/2017	11
US Forest Service	Government Agency	Ages 11-17	Education/Other		Kainana Francisco	8/25-8/29/2014	12
Stanford University	School	College	Education/Service	removal of old research materials	Peter Vitousek	9/29/2014	23
Akaka Foundation for Tropical Forests	Non-profit	Adult	Education		Ric Lopez	10/31/2014	12
Laupāhoehoe Community Public Charter School	School	Ages 11-17	Education/Service	Removal of invasive species & old research materials	Mel Dean	11/10/2014	7

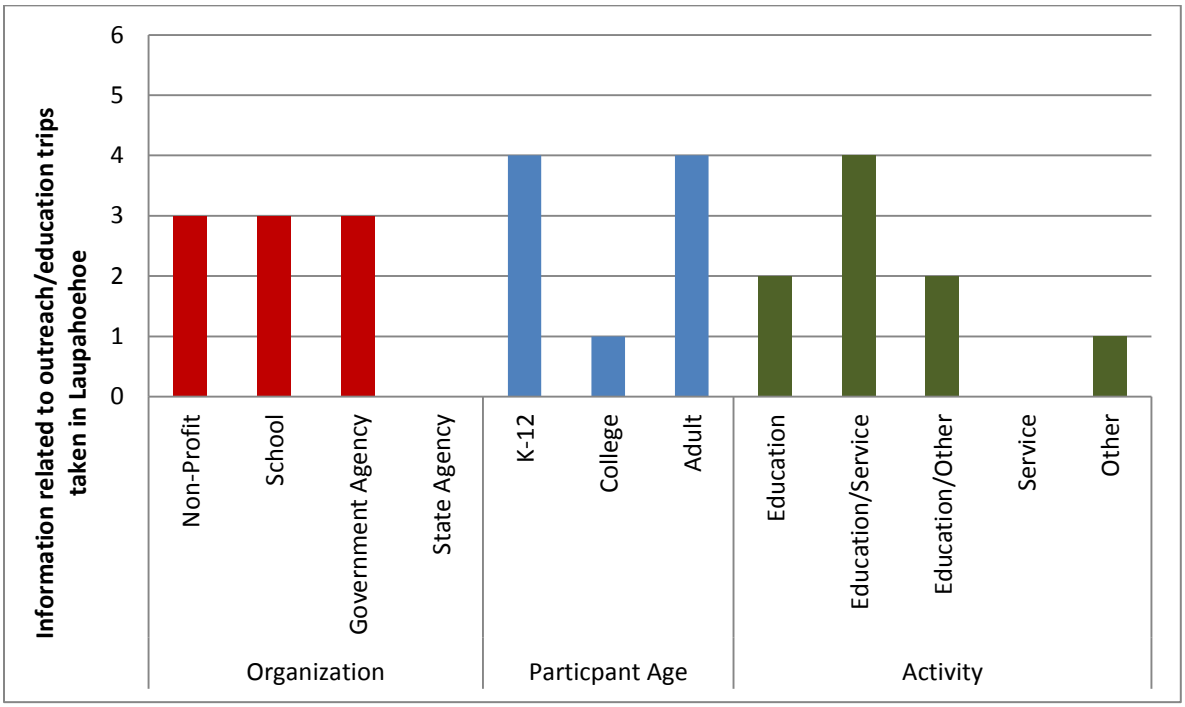


Figure 15. Information relating to the types of groups, age of participants, and types of activities performed during outreach/education trips taken within the HETF Laupāhoehoe Unit in 2014.

Puʻu Waʻawaʻa Unit

Six hundred and thirty-five participants on 25 trips visited the Puʻu Waʻawaʻa Unit in 2014 (Table 5). The high number of participants, compared to the Laupāhoehoe Unit, who are able to visit, work, and learn in Puʻu Waʻawaʻa is in a large part due to the presence and availability of onsite DOFAW staff that lead, participate in, and facilitate these activities. The existing road and facility infrastructure in Puʻu Waʻawaʻa Forest Reserve also play an important role in making these trips possible. The continued presence and availability of onsite staff is necessary for Puʻu Waʻawaʻa to be able to continue to support this level of public interaction. A further breakdown of trip totals, and affiliation and type from 2010-2014 is detailed in Figure 16, with additional details in Figure 17. A few of the 2014 HETF education trips to Puʻu Waʻawaʻa are detailed here.

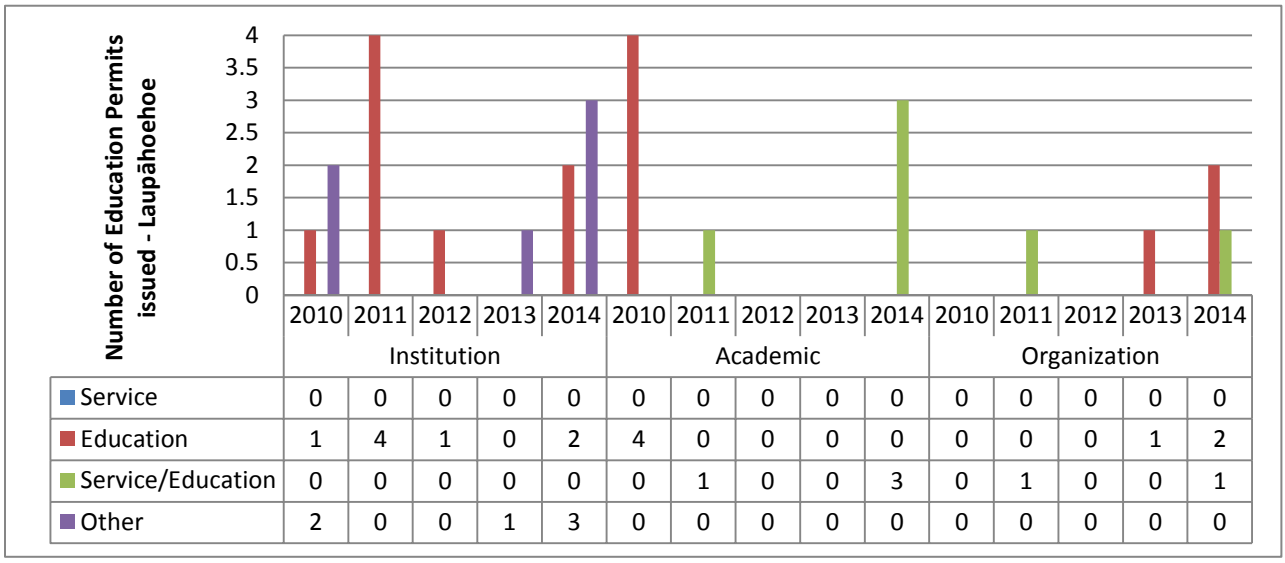
- *HOPE Services Hawaiʻi, Inc.* visited Puʻu Waʻawaʻa in June and participated in an outplanting of native Hawaiian trees and shrubs. HOPE Service's provides service opportunities to low income housing teens/pre-teens.
- *University of Hawaiʻi at Hilo, Department of Geography and Environmental Studies* visited Puʻu Waʻawaʻa as part of a week-long field methods course. Students participated in various field activities including making vegetation observations, examining the potential toxicity of an old dumpsite and assessing fire distribution.
- *'Imi Pono no ka 'Āina Environmental Education Program* spent a summer overnight in Puʻu Waʻawaʻa. Activities/discussion included: mo'olelo wahi pana (stories of legendary places), the natural history of the area, threats to the ecosystems, current conservation efforts and a rare plant outplanting inside the reservoir exclosure.
- *Hualālai Academy* students visited the Hauaina Restoration Unit and participated in planting native aʻaliʻi seedlings in a common garden experiment to study the environmental and genetic effects on aʻaliʻi growth rates and size. Students had previously collected seeds and propagated them in a greenhouse before outplanting them. Students plan to return at a later time to collect data.

'Imi Pono no ka 'Āina Environmental Education Program participants planting native species at Pu'u Wa'awa'a

Hualālai Acadamy students planting a'ali'i seedlings for a common garden at Pu'u Wa'awa'a

Table 5. Information relating to 2014 education/service/other trips taken in the HETF Pu‘u Wa‘awa‘a Unit.

Organization		Participant Age	Activity	Service Provided	Contact	Date	Group Size
Honoka'a High & Intermediate School	School (DOE)	Intermediate grades 6-8	Education/Service	Outplanting, clearing around plants	Cindy Navarro-Bowman	1/2-2/3/2014	30
US Forest Service	Government Agency	Adult	Other		Lori Tango	1/6/2014	6
Hualalai Academy	School (Private)	Elementary grades 4-5	Education/Service	Outplanting	Tina Flower	1/27/2014	26
American Association of University Women	Non-profit	Adult	Education		Susan Hicks	2/15/2014	20
Honoka'a High & Intermediate School	School (DOE)	Intermediate grades 6-8	Education/Service	Outplanting, clearing around plants	Cindy Navarro-Bowman	2/24/2014	34
Waiakea High School & Hawaii Community College	School	High school/College	Education/Service	Outplanting	Lokelani Brandt	3/18-3/19/2014	20
Kamehameha Schools - HI Island campus	School (Private)	High school	Education		Leimomi Hooper	3/18/2014	5
UH Hilo	School	College	Education		Jonathan Price	3/22-3/30/2014	18
Cornell University	School	College	Service	Outplanting	Alexandra Moore	4/1/2014	21
Hualalai Academy	School (Private)	Elementary grades 4-5	Education/Service	Outplanting	Tina Flower	4/8-4/9/2014	30
Honoka'a High & Intermediate School	School (DOE)	Intermediate grades 6-8	Education/Service	Outplanting, clearing around plants	Cindy Navarro-Bowman	4/11-4/12/2014	35
US Forest Service	Government Agency	Adult	Education/Other		Susan Cordell	5/5-6/2/2014	7
Honoka'a High & Intermediate School	School (DOE)	Intermediate grades 6-8	Education/Service	Outplanting, clearing around plants	Cindy Navarro-Bowman	6/3/2014	30
Na Pua No'eau Summer Camp	Non-profit	Ages 11-17	Education/Service	Outplanting	Lokelani Brandt	6/9-6/10/2014	13
Imi Pono	Non-profit	Ages 11-17	Education/Service	Outplanting	Lahela Camara	6/10-6/11/2014	15
Hope Services Hawaii	Non-profit	Ages 11-17	Service	Outplanting	Gideon Ramos	6/25/2014	12
DLNR/Division of Conservation & Resources Enforcement	State Agency	Ages 10-13	Education/Service	Outplanting	Andrew Choy	7/9-7/13/2014	33
Honoka'a High & Intermediate School	School (DOE)	Intermediate grades 6-8	Education/Service	Outplanting, clearing around plants	Cindy Navarro-Bowman	8/28/2014	34
Kona Pacific Public Charter School	School (DOE)	Intermediate grades 6-8	Education/Service	Outplanting	Mary Elizabeth Sharma	9/24-9/26/2014	26
American Forests	Non-profit	Adult	Education		Matthew Boyer	10/27/2014	26
Innovation Charter School	School (DOE)	Intermediate grades 6-8	Education		Megan Learned	10/30/2014	77
Honoka'a High & Intermediate School	School (DOE)	Intermediate grades 6-8	Education/Service	Outplanting	Cindy Navarro-Bowman	11/20/2014	34
Kanu o ka ‘Āina Learning ‘Ohana	Non-profit	Intermediate grades 6-8	Education		Ku‘ulei Keakealani	11/26/2014	60
UH - Windward Community College (WCC)	School	College	Education		Floyd McCoy	12/1/2014	17
Puu Waawaa Advisory Council Recreation Sub-committee	State Agency	Adult	Other	Surveying trails	Tara Seeley	12/9/2014	6



	Institution					Academic					Organization				
	2010	2011	2012	2013	2014	2010	2011	2012	2013	2014	2010	2011	2012	2013	2014
Service	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Education	1	4	1	0	2	4	0	0	0	0	0	0	0	1	2
Service/Education	0	0	0	0	0	0	1	0	0	3	0	1	0	0	1
Other	2	0	0	1	3	0	0	0	0	0	0	0	0	0	0

Figure 16. Trip totals, affiliation and type of education/service/other trips taken in the HETF Pu'u Wa'awa'a Unit in 2010-2014.

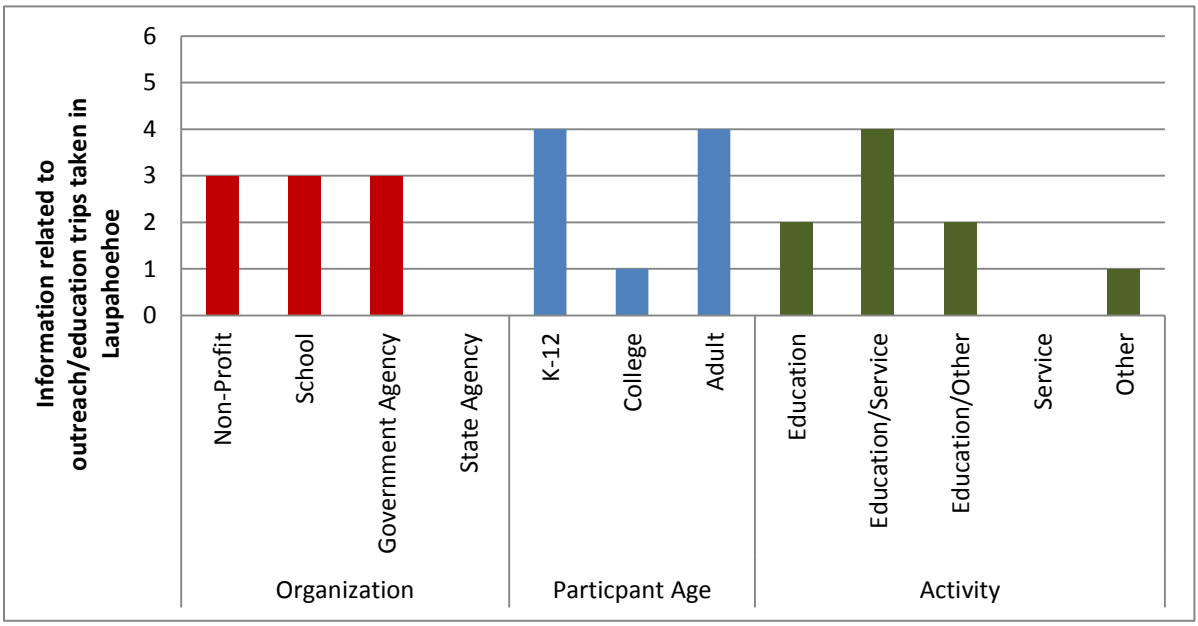


Figure 17. Information relating to the types of groups, age of participants, and types of activities performed during outreach/education trips taken within the HETF Pu'u Wa'awa'a Unit in 2014.

Laupāhoehoe Science and Education Center

One hundred and thirty-three participants on eight trips visited the Laupāhoehoe Science and Education Center (Center) in 2014 (Table 6). A few of the 2014 Center activities are detailed here.

- *The USFS* hosted the UHH, Pacific Internship Programs for Exploring Science (PIPES) summer interns for a service learning trip. Participants took part in forest restoration activities within Laupāhoehoe Forest, focusing on invasive species removal. Participants who overnighted at the Center and took part in a traditional luʻau, pounding poi, preparing laulau, sharing stories and spending quality time together as their summer internship experience came to end.
- The ʻŌhiʻa Common Garden hosted a total of 55 participants since its establishment in the summer of 2014. Participants took part in outplantings and/or care for the ʻōhiʻa seedlings, supporting both the research and education efforts of the garden. Participants included HYCC Gateway teams, Kupu EIP (Extended Internship Program) interns and a visiting group from the Haskell Indian Nations University.
- *The Institute of Pacific Islands Forestry* held a staff and volunteer retreat. Staff and volunteers spent the day focusing on team building and learning more about Laupāhoehoe as a place and the cultural context for the commemorative ʻulu (breadfruit) tree which was planted at the Center entrance at the end of the day.

Participants take part in a team building activity at the IPIF staff retreat.

Planting the ʻulu.

Table 6. Information relating to 2014 activities held at the Laupāhoehoe Science and Education Center.

Permit Applicant	Organization/Project	Participant Age	Activity Description	Chaperone	Requested Dates	# of People
Christian Giardina	ʻŌhi'a Common Garden	High School/College	Ouplanting	Kainana Francisco	6/24/2014	11
Tabetha Block	YCC	High School/College	Ouplanting, Invasive weed control, fence erection	James Akau	7/14-15/2014	6
Christian Giardina	ʻŌhi'a Common Garden	High School/College	Outplanting	Kainana Francisco	7/18/20104	24
Noelani Puniwai	PIPES	High School/College	Invasive weed control	Christian Giardina	7/25-26/2014	28
Mel Dean	Institute of Pacific Islands Forestry (IPIF)	Adult	IPIF staff retreat	Ric Lopez	8/1/2014	24
Christian Giardina	ʻŌhi'a Common Garden	High School/College	Outplanting	Kainana Francisco	9/16/2014	20
Senator Daniel Akaka	Akaka Foundation for Tropical Forests	Adult	Other/tour	Christian Giardina	10/31/2014	13
Christian Giardina	Giardina Staff Retreat	Adult	Staff Retreat	Christian Giardina	11/18/2014	7

2014 HETF Concerns, Comments, and Challenges

Laupāhoehoe Unit

Submitted by researchers via annual reports:

- No extra challenges beyond the normal difficulties of working in the field.
- Getting through all four gates by oneself can be cumbersome.
- The rough terrain and the weather conditions were expected and we were prepared for them.
- Other researchers apparently have made collections in the area of our core site, as evidenced by litter screen on the surface (reported previously) and changes in the structure of the soil pit.
- Logistical challenge encountered was inaccessibility to the site due to heavy rains that washed out the river crossing on Blair Road just below several residences and the Eucalyptus belt. We did not know if the crossing was overflowing until we drove out there to see it, so this resulted in the loss of staff time and additional costs in fuel. An informational phone recording or email to researchers regarding road conditions would be helpful in eliminating lost time and resources.

Puʻu Waʻawaʻa Unit

Submitted by researchers via annual reports:

- Aside from the prolonged drought we have faced no atypical challenges.
- One challenge we encountered at Puʻu Waʻawaʻa was dangerous road conditions. There is a section along the Southeastern boundary fence that was very steep and muddy and our truck slid backwards off the road and almost down into an embankment.
- We encountered 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.
- While working in the HETF, my biggest challenge has been trying to collect data from plants that are exposed to ungulates.

Prior HETF Concerns, Comments and Challenges still ongoing:

- How do the new Wildlife Administration rules apply to the existing USFS permit to use State lands?

2014 Annual Reports Received

Annual reports received from researchers are listed alphabetically in this section. Annual reports are due within one year of project initiation. The included annual reports were submitted either with renewal applications or at the termination of a research project and pertain to the previous year's work. All information submitted in these annual reports, are included as is. Report citations are limited to the current year, for a complete list of citations please visit the HETF citations list online at http://hetf.us/page/major_topics/.

We do not add any diacritical marks, correct punctuation, capitalization or grammatical errors.

Bonaccorso, Frank - Hawaiian Hoary Bat habitat occupancy, population demographics and diet.

Submitted: July 1, 2014

CLOSE OUT REPORT

Project Location(s): Laupahoehoe Forest Reserve & NAR
HETF Annual Report for Project Period: 06/2013-06/2014

Status Update *(including any significant findings):*
USGS staff monitored ultrasonic bat calls for three months coinciding with the koa looper moth outbreak from July through September 2013 for comparison to 5 years of previous bat monitoring.

Table 1. Geo-coordinates in NAD83 Datum Zone 5N, elevation, and nights sampled of the three-station ultrasonic recording array within the Laupahoehoe HETF, deployed during monthly surveys between July and September 2013.

Station	*Easting*	*Northing*	*Elevation (m)*	*Nights Sampled*	*Start Date*	*End Date*
1B	260083	2205461	1170	41	7/1/2013	9/26/2013
2B	260259	2205848	1122	63	7/1/2013	9/26/2013
3B	260633	2206122	1069	74	7/1/2013	9/26/2013

Table 2. Sampling details and results per monitoring station for the three months that acoustic surveys of bat activity were conducted within the Laupahoehoe HETF from July through September 2013. Events represent the number times an echolocation bat flew past the microphone at the station; pulses are the total number of echolocation pulses recorded during the events; feeding buzzes are the number of events which contained foraging activity. Monthly activity rates can be described by Call Events/Night Sampled. Pooled column represents the activity of bats for each month for all monitoring stations combined. Minus signs represent no data collected during that survey due to equipment malfunctions.

Laupahoehoe HETF	**1A**			
Blair Road	Events	Pulses	Feeding Buzzes	Call Events/Night
July	9	68	1	0.45
August	-	-	-	-
September	12	31	0	0.57
	2B			
	Events	Pulses	Feeding Buzzes	Call Events/Night
July	111	802	12	0.35
August	67	392	5	3.94
September	0	0	0	0.00
	3B			
	Events	Pulses	Feeding Buzzes	Call Events/Night
July	821	12,755	18	26.48
August	57	665	1	2.59
September	182	1,660	14	8.67
				Pooled
				Call Events/Night
			July	9.09 ± 15.05
			August	3.26 ± 0.95
			September	3.08 ± 4.85

Figure 1. Point locations of bat acoustic monitoring stations along Blair Road in Laupahoehoe HETF.

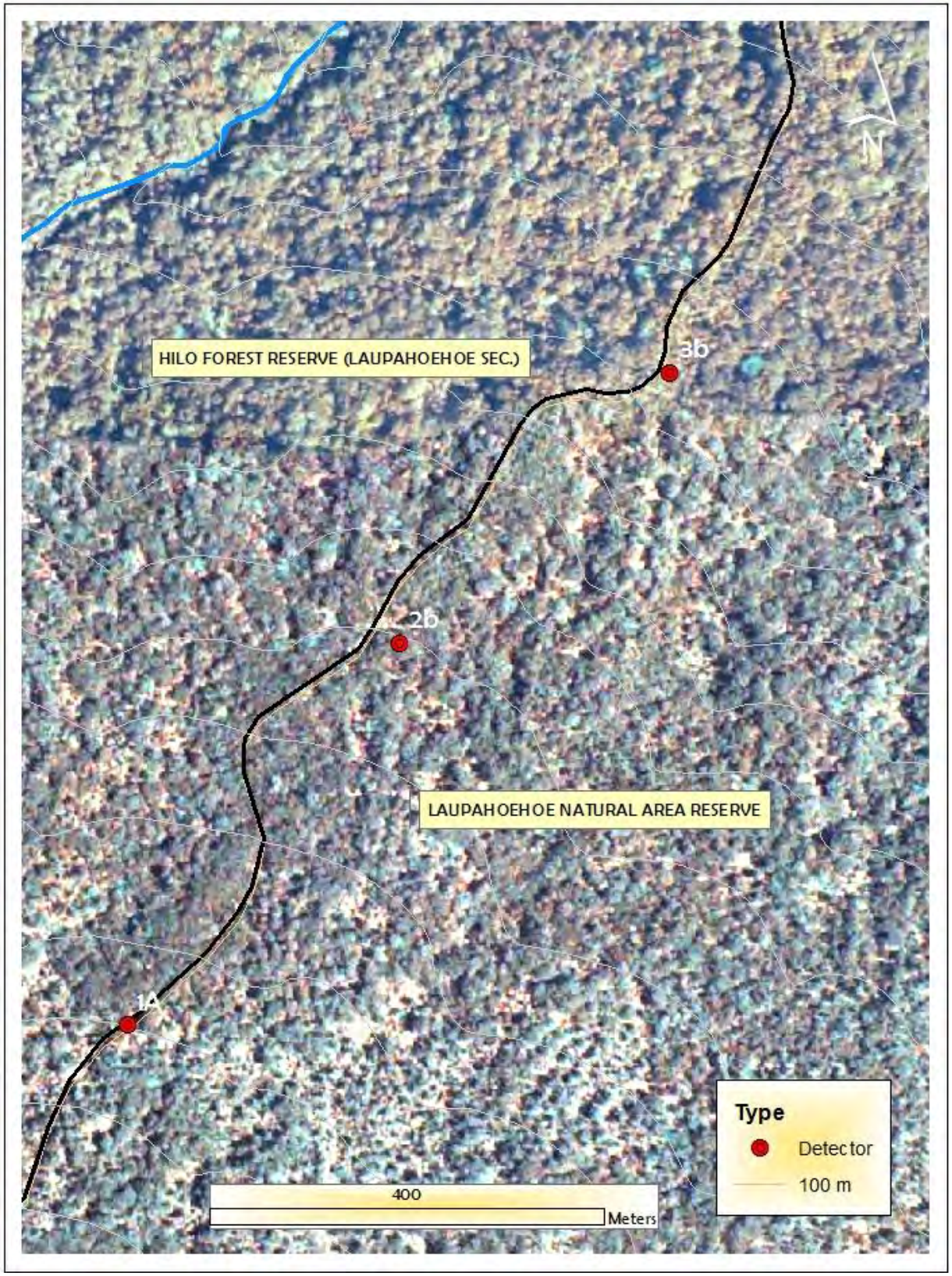


Figure 2. Detectability of Hawaiian hoary bats by month within the Laupahoehoe HETF. Bars represent the mean frequency of bat detections (with standard deviation) from the three survey periods during July, August, and September of 2013.

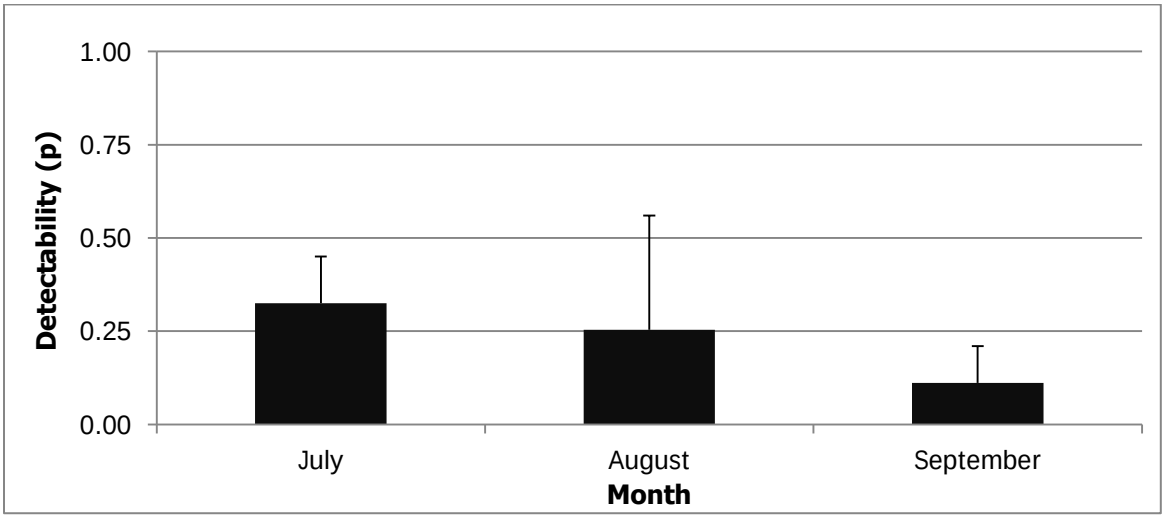
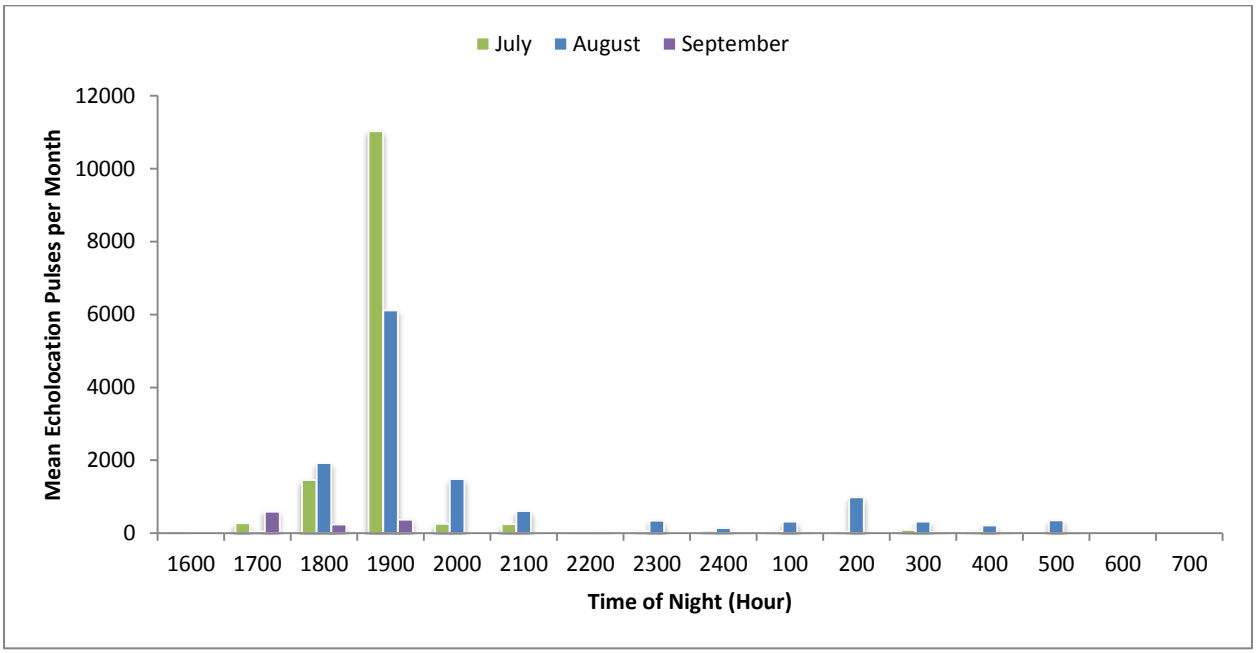


Figure 3. Nightly activity as mean echolocation pulses recorded per hour of the night for bats during the three months surveyed at Laupahoehoe HETF.



Timeline *(including overall expected completion date):*
We have completed all acoustic monitoring research pertaining to the koa looper moth defoliation study. No further research is planned at the time.

Changes to Methodology *(or other aspects of the project):*
None. We used the same equipment and station sites to record and store information on the echolocation activity of bats in the HETF as requested in our application.

Noteworthy Observations *(including the presence of T&E species, new observances of invasive species, and/or human activity or disturbances in the area):*
The Laupahoehoe NAR unit continues to be an important refuge for the endangered Hawaiian hoary bat (Lasiurus cinereus semotus). Bats continue to forage there, even during changes to the forest strucutre and changes in prey abundance, such as the recent defoliation and moth outbreak event.

Challenges *(encountered while working in the HETF):*
No significant challenges were encountered while working in the HETF.

Bibliography of Publications *(Publications should include work that was done in the HETF, including gray literature, conference presentations/posters, etc.):*

Publications:

(In Preperation) Banko, P. C., R. W. Peck, S. G. Yelenik, E. H. Paxton, F. Bonaccorso, and D. Foote. 2014. Dynamics and ecological consequences of the 2013−2014 koa moth outbreak at Hakalau Forest National Wildlife Refuge. Hawai‘i Cooperative Studies Unit Technical Report HCSU-0XX. University of Hawai‘i at Hilo.

Presentations:

Banko, P., S. Yelenik, E. Paxton, D. Foote, and F. Bonaccorso. 2014. Effects of the koa looper (Scotorythra paludicola) outbreak at Hakalau Forest National Wildlife Refuge. USDA Forest Service Hilo Seminar Series, 1 April 2014, Hilo, HI.

Chang, Paul - Sandalwood Core Sampling

CLOSE OUT REPORT

Submitted: April 21, 2014

Note: Although the project title uses the term "Core", no core sampling was employed in retrieving S ellipticum samples.

Project Location(s): Pu'u Wa'awa'a Forest Reserve
HETF Annual Report for Project Period: 07/23/13 - 07/22/14

Status Update *(including any significant findings):*
I collected twenty samples of S ellipticum consisting of a section of a dead attached branch approximately 8 inches long and 1 to 1.5 inch in diameter. These samples were sent to the Clark R. Bavin Forensics Laboratory in Ashland Oregon. The Forensics Lab is operated by the US Fish & Wildlife Service, Office of Law Enforcement which is employing direct analysis in real time time-of-flight mass spectrometry (DART-TOFMS) to analyze samples .

Timeline *(including overall expected completion date):*
Some time delays have occurred at the Lab including the passing of one of the investigators whom was conducting the analysis. Additional time is required to complete testing of the samples obtained from Pu'uwa'awa'a. In addition, samples from other parts of Hawaii of S ellipticum and S paniculatum, as well as samples from other sandalwood species from other parts of the world are being analysed. Therefore it is difficult to say exactly when the analysis will be completed. Earlier projections of completion were by this summer. However, the delays mentioned above have pushed a completion date back. At this point, I do have the samples I need but intend to request renewel of the permit in case additional sampling is desired. Should that happen, I will coordinate with Mr. Elliott Parsons if additional sampling is anticipated.

Changes to Methodology *(or other aspects of the project):*
I anticipate no modifications of sampling design which will involve removing a section of a dead attached branch. All sampled trees were photographed and marked via GPS coordinates (see photo log and spreadsheet. No flagging of trees or other forms of marking were employed. The field has been left as it was found minus the samples taken.

Noteworthy Observations *(including the presence of T&E species, new observances of invasive species, and/or human activity or disturbances in the area):*
Nothing noteworthy to mention other than what has been observed by others…… lots of ungulate sign and the diminutive nature of the trees in the area when compared to what is thought to be S ellipticum to the North on Queen Emma lands.

Challenges *(encountered while working in the HETF):*
No challenges to report. Working with HETF has been a pleasure. Coordination with Mr. Elliott Parsons was easy and allowed me quick access and facilitated my sampling needs.

Bibliography of Publications *(Publications should include work that was done in the HETF, including gray literature, conference presentations/posters, etc.):*
I have communicated the importance of including all work done in the islands in any publications to the Forensics Laboratory who will be publishing the results.

Cordell, Susan - The Potential for Restoration to Break the Grass / Fire Cycle in Dryland Ecosystems in Hawaii

Submitted: April 7, 2014

Project Location(s): Pu'u Wa'awa'a Forest Reserve
HETF Annual Report for Project Period: 06/2013-06/2014

Status Update *(including any significant findings):*
Our study continues to provide basic scientific information and practical tools for managing and restoring tropical dry forest landscapes on military lands in the Pacific. Results benefit natural resource land managers in the Pacific by increasing capacity and knowledge to restore native forests, thereby reducing wildfire and enhancing habitat for threatened and endangered species. Through remote sensing we have assessed the historical and current condition of the two major dry forest landscapes on the island of Hawaii and have created high resolution restoration potential maps to help guide land managers to more efficiently and effectively use resources to reduce fire and enhance biodiversity across the landscape. Products developed this past year include the publication of the habitat suitability model which is currently being used to guide restoration and management in tropical dry forests. Specifically, the model is currently being used to guide outplanting efforts of federally listed threatened and endangered species at PWW and PTA. This project is funded through the DoD ESTCP program. Analysis of our restoration project at PWW is on-going with a final report on the SERDP funded plots due in the summer of 2014. We have selected outplanting plots for the ESTCP project and will be outplanting close to 2500 plants in the next 2 months. Following outplanting we will be following survival and productivity as they relate to habitat suitability. Finally, through this project we have provided numerous opportunities for local students and volunteers. We will support several interns this summer through HCC and the PIPES program. Our student hire Kealoha Kinney is now a PhD student at Brown University and has submitted a publication on our collaborative work on tropical dry forest succession and the natural and anthropogenic role of fire.

Timeline *(including overall expected completion date):*
The SERDP funded restoration plots will continue to be monitored - but with less frequency in 2014 and beyond. The endangered species demonstration project will consume most of our time at this PWW site in the foreseeable future (funded through 2016 with a commitment to monitor beyond that).

Changes to Methodology *(or other aspects of the project):*
As mentioned above - new methodology will include outplanting of threatened and endangered species into high and low suitability habitat. This was proposed last year - but we are in full swing in 2014.

Noteworthy Observations *(including the presence of T&E species, new observances of invasive species, and/or human activity or disturbances in the area):*
Rabbits have been observed at the PWW site - Elliott is working to resolve the issue.

Challenges *(encountered while working in the HETF):*
Aside from the prolonged drought we have faced no atypical challenges.

Bibliography of Publications *(Publications should include work that was done in the HETF, including gray literature, conference presentations/posters, etc.):*

Questad, E., Kellner, J.R., Kinney, K, Cordell, S., Asner, G.P., Thaxton, J., Diep, J., Uowolo, A., Brooks, S., Inman-Narahari, N., Evans, S., and Tucker, B. 2014. Ecological Applications. Mapping habitat suitability for at-risk plants and its implications for restoration and reintroduction. 24:385-395

Cram, D., Cordell, S., Giardina, C., Litton, C.M., Moller, E., Pickett, E., and Friday, J.B. 2013. Fire and Drought in Paradise – Say It Isn't So, Smokey. Rural Connections. 7:19-22.

Tools:
Asner, Greg; Kellner, James; Cordell, Susan; Questad, Erin; Kinney, Kealoha; Thaxton, Jarrod. 2011. Hawaii vegetation fire risk web tool. http://hawaiifire.stanford.edu/.

Dykstra, Brian - The effect of pollination on fruit and seed yields of Māmane (Sophora chrysophyla)

Submitted: July 28, 2014

CLOSE OUT REPORT

Project Location(s): Pu'u Wa'awa'a Unit Forest Reserve
HETF Annual Report for Project Period: 06/2013 to 05/2014

Status Update *(including any significant findings):*
I was unable to begin the research due to financial constraints. This is my close out report.

Timeline *(including overall expected completion date):*

Changes to Methodology *(or other aspects of the project):*

Noteworthy Observations *(including the presence of T&E species, new observances of invasive species, and/or human activity or disturbances in the area):*

Challenges *(encountered while working in the HETF):*

Bibliography of Publications *(Publications should include work that was done in the HETF, including gray literature, conference presentations/posters, etc.):*

Earnshaw, Kyle – Phenotypic plasticity and adaptation of two *Acacia koa* Gray ecotypes in response to light availability.

Project Location(s): Pu'u Wa'awa'a Unit: Forest Reserve
HETF Annual Report for Project Period: 07/2013 - 12/2015

Submission Date: 04/22/2014

Status Update *(including any significant findings, please limit to 600 words)*:
This past year, activities were limited to seed collection and site preparation for planting. The original plan consisted of replicating the study at contrasting sites, including Keauhou Ranch and Kona Hema. However, we could not follow this plan because of permit constraints and our inability to obtain seeds at the original sites due to koa moth defoliation. Consequently, seeds were collected at Pu'u Wa'awa'a and Kaumana City, the latter of which represented a wet ecotype. Site preparation was performed by Elliott Parsons in October of 2013 in order to be ready for a January 2014 planting. This was delayed, however, while we searched for a second, wet site where we could replicate the study. We were unable to find one and the seedlings were germinated in January and February of 2014 at Waimea State Tree Nursery. The currently plan is to test the effects of selection and light availability for two ecotypes, one hypothetically adapted to Pu'u Wa'awa'a and one not adapted, on survival and form. In March and April of 2014, the site was revisited to confirm that site preparation was successful. Outplanting is scheduled for the last week of June.

Timeline *(including overall expected completion date)*:
June 2014 - Planting
June 2014 - June 2016 - Data Collection

Changes to Methodology *(or other aspects of the project)*:
We do not expect major changes to methodology

Noteworthy Observations *(including the presence of T&E species, new observances of invasive species, and/or human activity or disturbances in the area)*:
None

Challenges *(encountered while working in the HETF)*:
The koa moth defoliation at Pu'u Wa'awa'a limited seed collection to seeds from the previous year. We also noted this month that very few seeds will be produced this year, probably due to defoliation and stress from last year's defoliation event.

Bibliography of Publications *(Publications should include work that was done in the HETF, including gray literature, conference presentations/posters, etc.)*:
None

Gillespie, Rosemary - Adaptive radiation in Hawaiian spiders

Submitted: April 9, 2014

CLOSE OUT REPORT

Project Location(s): Laupāhoehoe Forest Reserve & NAR

HETF Annual Report for Project Period: 06/2013 - 06/2014

Status Update *(including any significant findings):*
Tetragnatha adaptive radiation (Darko Cotoras)
All the Tetragnatha samples that we collected during 2013 were identified and organized. During the last year, we did 3 hybridization experiments of Exon Capture using a total of 104 specimens corresponding to 4 different species (T. brevignatha, T. anuenue, T. waikamoi and T. macracantha). The procedure was performed successfully and we are currently on the stage of data analysis. It generated a total of 94 Gb of data on DNA sequences. As there is no spider genome, the analysis work has been more challenging that working with other organisms. We are currently working on implementing custom created scripts to analyze all these data.

In parallel, I did DNA extractions and PCR amplification for three mitochondrial genes (COI, ND12 and CytB) for all the specimens of T. brevignatha, T. waikamoi and T. anuenue. For T. anuenue it was not possible to get ND1. The total amount of sequences is presented on Table 1. All the data files are ready for the analysis and we are currently in the process of doing that work.
Also as part of the fieldwork, I took pictures of the dorsum of all the Tetragnatha specimens. In many cases I have more than one angle for the same individual. I have a preliminary plan for the analysis and I am currently starting with that work.

In all the sites visited in June 2013 we recorded observations of plants where the spiders were collected. The database with all the observations from 2013 and the previous years is ready and we started with the first analysis in collaboration with Erin Wilson (UC Riverside).

Patterns of diversification across different spider lineages (Andrew Rominger)
Over the past two years I have been collecting data on the distribution, abundance and diversity of five groups of native spiders on Hawaii Island and Maui Nui. These groups are Tetragnatha, a classic adaptive radiation; Ariamnes, a putative adaptive radiation; Mecaphesa and Pagiopalus, two groups whose diversity patterns seem dominated by between island dispersal; and Orsonwelles, an island gigantic sheet weaver spider with a strong gradient of diversity, peaking on Kaua'i and declining to a single species on Hawaii Island. I am working in the lab to develop a DNA sequence data set for all five groups, focusing at present on Pagiopalus and Mecaphesa.

Timeline *(including overall expected completion date):*
Tetragnatha adaptive radiation (Darko Cotoras)
During the coming year, I will be working on the data analysis of the specimens collected during fieldwork. These data correspond to: Exon Capture data, mitochondrial data, plan association data and dorsal pictures.

Patterns of diversification across different spider lineages (Andrew Rominger)
In the next two years I will extend my sampling efforts to Kaua'i to give a more complete picture of the evolutionary trajectories of these five spider groups across the different aged high islands of the Hawaiian Archipelago. I will also continue to build sequence data in the lab and use these data to understand why these five different groups have undergone such different diversification on the islands.

Changes to Methodology *(or other aspects of the project):*
No changes

Noteworthy Observations *(including the presence of T&E species, new observances of invasive species, and/or human activity or disturbances in the area):*
No observations on that regard.

Challenges *(encountered while working in the HETF):*
No extra challenges beyond the normal difficulties of working in the field.

Bibliography of Publications *(Publications should include work that was done in the HETF, including gray literature, conference presentations/posters, etc.):*

Armstrong, E., Rominger, A.J., Gillespie, R.G. Phylogeography and speciation dynamics of a highly vagile, island endemic spider genus. 99th Annual Meeting of the Ecological Society of America, Sacramento, CA, August 15, 2014.

Cotoras D. and Gillespie R.G. (accepted Oral presentation) Preliminary identification of protected areas with high diversity of Tetragnatha spiders on Big Island and Maui Nui. 22st Hawai'i Conservation Conference. July 15th -17th, 2014. Honolulu, HI. USA

Cotoras D. and Gillespie R.G. (accepted Oral presentation) Understanding the initiation of adaptive radiation using comparative phylogeography of spiders. Island Biology. July 7th-11th, 2014. Honolulu, HI. USA

Cotoras D., Lindberg D. and Gillespie R. (Oral presentation) Phylogeography of the spider Tetragnatha brevignatha in the context of an adaptive radiation. Hawai'i Ecosystems Meeting. July 7th and 8th 2013. Hilo, HI. USA

LaPointe, Dennis - Distribution and prevalence of knemidokoptic mange in Hawaii amakihi on the Island of Hawaii.

CLOSE OUT REPORT

Submitted: December 23, 2014

Project Location(s): Pu'u Wa'awa'a Forest Bird Sanctuary
HETF Annual Report for Project Period: December 2013 – December 2014

Status Update *(including any significant findings):*
We have completed all field work, data entry, data analysis and the final report for this project. All field equipment and flagging have been removed from the site. This report can be considered a "close-out" report for our HETF permit held for this project.

During 2013-2014, we captured and banded 146 new birds (73.3% native, 26.7% non-native) over a total of 91 net hours during 2 three-day trips (12/12/13 & 4/2/14) (TABLE 1) at Puu Waawaa Forest Bird Sanctuary (UTMs: X:199121, Y:2184726). We collected a total of 153 avian blood samples. We did not find knemidokoptic mange to be present on any of the birds we examined, and there was an overall 0.7% (1/146) prevalence of active pox. We determined the prevalence of avian malaria to be an overall prevalence of 6.2% (9/146) for all species, and 5.8% (6/102) for Hawaii Amakihi. We collected a total of 3 Aedes japonicus mosquitoes over 27 trap nights during the two trips. We did not trap any Culex mosquitoes (known avian malaria vector) so there were no mosquito dissections conducted. Of note, this site has the highest capture rate of Hawaii Amakihi of all of our sites on Hawaii Island. For more detailed results on the island-wide study of the overall prevalence and distribution of knemidokoptic mange, refer to HCSU technical report #55 (see abstract below).

TABLE 1.

Species	#Captured
Apapane	4
Hawaii Amakihi	102
Iiwi	1
House Finch	1
Japanese White-eye	19
Lavender Waxbill	1
Northern Cardinal	2
Nutmeg Manikin	5
Red-billed Leothrix	5
Warbling Silverbill	4
Yellow-fronted Canary	2
TOTAL	146

ABSTRACT
Knemidokoptic mange was first observed on two Hawai'i 'Amakihi (Hemignathus virens) mist netted in Manuka Natural Area Reserve (NAR) on the Island of Hawai'i in June 2007. Microscopic examination of skin scrapings from lesions of the infested individuals revealed the scaley-leg mite, Knemidokoptes jamaicensis. Continued surveillance at Manuka NAR (2007–2009) documented a 24% (15/63) prevalence of mange among Hawai'i 'Amakihi distributed from coastal habitat to 1,500 m above sea level (asl). From 2012–2014, we conducted an island-wide survey of wild passerine birds from several leeward sites (Manuka NAR, Kahuku Unit

of Hawai‘i Volcanoes National Park (HAVO), Pu‘u Wa‘awa‘a Forest Bird Sanctuary, and Kīpāhoehoe NAR) and windward sites (Hakalau Forest National Wildlife Refuge, ‘Āinahou Ranch of HAVO, Malama Kī Forest Reserve, and Keauohana Forest Reserve) to determine the current distribution and host range of knemidokoptic mange. We also determined the prevalence of malaria in Hawai‘i ‘Amakihi populations where mange was present and treated a subset of infested Hawai‘i ‘Amakihi mange with a single, topical dose of moxidectin. We mist netted and examined a total of 1,733 passerines, including 738 Hawai‘i ‘Amakihi. Mange was present in Hawai‘i ‘Amakihi at Manuka NAR (595 and 305 m asl), Kahuku Ranch Unit of HAVO (Glover site: 1,201 m asl and Kīpuka Akala site: 1,532 m asl), Malama Kī Forest Reserve and Keauohana Forest Reserve (293 m asl). No other passerine birds (n = 995) were infected. Mange prevalence ranged from a high of 69% (40/58) in Keauohana Forest Reserve to a low of 2% (1/65) in the Kahuku Ranch Unit of HAVO (Kīpuka Akala). At Manuka NAR prevalence had decreased from 26% in 2010 to 10% (7/81) in 2012–2014. We found no significant relationship between the prevalence of mange and the prevalence of avian malaria in mesic habitats at Manuka NAR ($P = 0.59$ (FET, $n = 81$)), but there was a significant association between the prevalence of mange and the prevalence of malaria in lowland wet forests in Puna Forest Reserves ($P < 0.01$ (FET, $n = 72$)). This apparent association may be a reflection of the high prevalence of malaria (>80%) in these areas. There was no difference in the frequency of recapture of birds that were infested versus un-infested at first capture at our long-term sites (Manuka NAR and Puna sites) ($\chi2(1, n = 227) = 1.51$, $P = 0.22$, but when all sites with mange present were pooled, there was a significant difference in the frequency of recaptures between infested and un-infested birds ($\chi2(1, n = 424) = 7.13$, $P = 0.01$). There was a significant association between parasitemia level (per 10,000 RBCs) and the ranked stage of mange present in infested individuals. We treated 24 Hawai‘i ‘Amakihi with moxidectin and upon recapture (n = 2), found a reduction in both the size and stage of mange lesions, such that a single dose, topical treatment of moxidectin appears to be an effective treatment for knemidokoptic mange in wild populations. Our results suggest that knemidokoptic mange is currently limited to Hawai‘i ‘Amakihi and prevalent in low elevation sites on both the windward and leeward sides of the island.

Timeline *(including overall expected completion date):*
Fieldwork: Completed.
Data Entry and Proofing: Completed.
Data Analysis: Completed.
Final Report Writing: Completed.
Final Report Submission to funding Source (USFWS): Submitted

Changes to Methodology *(or other aspects of the project):*
There were no changes made to the methodology as described in the research application for this project.

Noteworthy Observations *(including the presence of T&E species, new observances of invasive species, and/or human activity or disturbances in the area):*
We did not hear or see any endangered birds while working at our site within the Puu Waawaa Forest Bird Sanctuary. Of note, this site has the highest abundance of Hawaii Amakihi (based on capture rates) of all of our study sites on Hawaii Island, and it is a thriving source population of Hawaii Amakihi for the leeward side of the island. While we did not capture Culex at our mist-netting site, we did observe abundant larvae of the species in cattle water troughs at the corral at the intersection of Waihou Road and Pipe-Corral Road in the

lower-elevation (approx. 700m) pasture land.Considering the dispersal abilities of this species, it is possible that Culex mosquitoes may disperse to higher-elevation forested areas.

Challenges *(encountered while working in the HETF):*
One challenge we encountered at Puu Waawaa was dangerous road conditions. There is a section along the Southeastern boundary fence that was very steep and muddy and our truck slid backwards off the road and almost down into an embankment.

Bibliography of Publications *(Publications should include work that was done in the HETF, including gray literature, conference presentations/posters, etc.):*

The data collected at Puu Waawaa Forest Bird Sanctuary was included on the poster presented at the Annual Hawaii Conservation Conference in July, 2014. The poster was entitled :Knemidokoptic mange in Hawai`i `Amakihi on the island of Hawaii: current distribution and prevalence of an emerging disease. The data from Puu Waawaa was also included in the HCSU Technical Report #055 entitled: Distribution and prevalence of knemidokoptic mange in Hawai`i `amakihi on the island of Hawai`i. Access to the full report can be found here: http://hilo.hawaii.edu/hcsu/documents/TR55_Gaudioso_Avian_mange.pdf

Bibliography:
Gaudioso, J.M., D. A. LaPointe, C.T. Atkinson, and C. Apelgren. 2014. Distribution and prevalence of knemidokoptic mange in Hawai`i `amakihi on the island of Hawai`i. HCSU Technical Report #055.

July, 2014. Knemidokoptic Mange in Hawai`i `Amakihi (Hemignathus virens) on the Island of Hawai`i: Current Distribution and Prevalence of an Emerging Disease. Hawaii Conservation Conference. Honolulu, Hawaii. (poster)

LaPointe, Dennis - Assessment of mosquito-borne avian disease risk in non-breeding habitat for foraging iiwi (Vestiaria coccinea) adjacent to Hakalau Forest NWR.

Submitted: December 23, 2014

CLOSE OUT REPORT

Project Location(s): Laupāhoehoe Forest Reserve
HETF Annual Report for Project Period: 1/2014-12/2014

Status Update *(including any significant findings):*
All field work for this project has been completed as of November, 21, 2014. All field equipment and flagging has been removed from our two study sites in Laupahoehoe Forest Reserve. This is a "close-out" report for the HETF permit held for this project.

During 2014, we captured and banded 89 new birds (57.3% native and 42.7% non-native) over 902 net hours during five trips over the period of 2/18/14 - 10/23/14 from Laupahoehoe Forest Reserve (TABLE 1). We had two sites, one at lower elevation (UTMs: X:259747, Y:2204931) and one at higher elevation (UTMs: X: 257811, Y: 2203463). We collected a total of 110 avian blood samples over the five trips. The laboratory diagnostics for avian malaria have been completed and the prevalence will be reported in our final report to the USFWS. We captured 76 Culex quinquefasciatus and 8 Aedes japonicus mosquitoes over 218 trap nights from 2/19/14 - 10/23/14. The infection status determined from dissections of live mosquitoes has been determined and will be reported in the final report to USFWS. We completed a total of 8 belt transects (4 per site) for the survey of mosquito larval habitat and one (750 meters) stream survey along the Kaawalii Stream at the lower elevation site. All banding data, mosquito trapping data, and mosquito transect data has been entered into our Access Database at Kilauea Field Station.

TABLE 1.

Site	Species	# Captured
Lower Laupahoehoe		
	Apapane	2
	Hawaii Amakihi	16
	Hawaii Elepaio	2
	Iiwi	4
	Omao	1
	Japanese White-eye	10
	Melodious Laughing Thrush	1
	Red-billed Leothrix	16
Upper Laupahoehoe		
	Apapane	5
	Hawaii Amakihi	11
	Hawaii Elepaio	4
	Iiwi	5
	Omao	1
	Japanese White-eye	4
	Northern Cardinal	1
	Red-billed Leothrix	6
	TOTAL	89

Timeline *(including overall expected completion date):*
Field work : Completed

Data Entry and Proofing : Data entry is completed and data proofing is in progress
Data Analysis: to begin in early January, 2015
Final Report Writing: to begin in February, 2015
Final Report Submission to Funding Source (USFWS): by April, 2015

Changes to Methodology *(or other aspects of the project):*
There were no changes to the methodology as described in the annual renewal application for this project.

Noteworthy Observations *(including the presence of T&E species, new observances of invasive species, and/or human activity or disturbances in the area):*
We had two aural detections of Akepa (Observer: Jackie Gaudioso; UTMs X: 0257762, Y: 2203624) at the higher elevation site during our first site visit in May, 2013. There were several aural and one visual detection of Akiapoloaau (Observer: Nolan Lancaster; UTMs: X:257916, Y:2203484) at the upper elevation site by the upper mosquito traps during October and November, 2014. There were two aural detections of Hawaii Creeper (Observer: Nolan Lancaster; UTMs: X: 257887, Y: 2203487) at the top of mosquito transect 4 in the upper elevation site during October and November, 2014. While we did not capture any endangered species at this upper elevation site, it is clear from the relaible aural detections of trained observers that all three endangered honeycreepers are present. We did not observe any new invasive or introduced species during our field work. The human activity we did encounter are explained more in detail in the Challenges section (i.e., vandalism and theft).

Challenges *(encountered while working in the HETF):*
An ongoing challenge of working in Laupahoehoe Forest Reserve was the tampering of field equipment left in place while not present at the sites. On at least three occasions in 2013, our mist-net pole guylines and/or the mosquito trap guylines were cut or untied. Also, on one occasion in 2013, we encountered hunters taking equipment from the back of our truck. Another logistical challenge we encountered was inaccessibility to the site due to heavy rains that washed out the river crossing on Blair Road just below several residences and the Eucalyptus belt. We did not know if the crossing was overflowing until we drove out there to see it, so this resulted in the loss of staff time and additional costs in fuel. An informational phone recording or email to researchers regarding road conditions would be helpful in eliminating lost time and resources.

Bibliography of Publications *(Publications should include work that was done in the HETF, including gray literature, conference presentations/posters, etc.):*
To date, there are no publications or conference presentations that include our data collected from Laupahoehoe. We will notify HETF once any publications or conference presentations are produced that include the data collected from Laupahoehoe Forest Reserve. We will be sure to include HETF in the acknowledgements section of any such publications and/or presentations.

Litton, Creighton M. and Christian P. Giardina - An experimental test of the impacts of rising temperature on carbon input, allocation, and loss in model forests

Submitted: May 24, 2014

Project Location(s): Laupāhoehoe Forest Reserve & NAR
HETF Annual Report for Project Period: 06/2013 - 06/2014

Status Update (*including any significant findings):*
Results from this study are providing an increasingly detailed picture of how carbon cycling in tropical wet forest will respond to rising mean annual temperature. First, we found that total carbon input (GPP) increases with mean annual temperature, which supports several prior global, cross-site analyses. Second, we found that all component carbon fluxes increase with mean annual temperature. Third, we found that as temperature increases, the fraction of GPP that is partitioned to belowground decreases, most likely in response to an increase in nutrient cycling and availability at higher mean annual temperatures. This is important because carbon that is partitioned belowground has the greatest chance of being stabilized as long-lived soil carbon, where it can reside for hundreds to thousands of years and buffer atmospheric CO2 concentrations. One common prediction of the impact of rising temperature for terrestrial carbon cycling has been that rising temperatures will increase soil carbon decomposition, and thus result in a positive feedback between warming and increased decomposition of soil carbon. Soil carbon is a particularly important component of forest carbon cycling because soils store more carbon than vegetation and the atmosphere combined on a global scale and, thus, soils are critical in regulating global climate. Importantly, we found that the flux of carbon into (litterfall; belowground carbon flux) and out of (soil respiration) soil increases with mean annual temperature, indicating that soil carbon cycling will increase as temperature rises. However, contrary to prior predictions we found that soil carbon storage does not vary with mean annual temperature, indicating that rising temperature will not result in increased soil carbon decomposition and a positive feedback to climate change, at least in tropical montane wet forests.

Timeline *(including overall expected completion date):*
The research being conducted with this permit is long-term, and ongoing. As such, no specific completion date for the research exists at this point.

Changes to Methodology *(or other aspects of the project):*
No changes in methodology or other aspects of the project occurred over the past year.

Noteworthy Observations *(including the presence of T&E species, new observances of invasive species, and/or human activity or disturbances in the area):*
No noteworthy observations or challenges were observed during the past year.

Challenges *(encountered while working in the HETF):*
Nothing noteworthy.

Bibliography of Publications *(Publications should include work that was done in the HETF, including gray literature, conference presentations/posters, etc.):*

Giardina, C.P., Litton, C.M., Crow, S.E., and Asner, G.P. Increased total belowground carbon flux, and not soil carbon loss, drives temperature related increases in soil respiration. Nature Climate Change: In review.

Selmants, P.C., C.M. Litton, C.P. Giardina and G.P. Asner (In Press). Ecosystem carbon storage does not vary with mean annual temperature in Hawaiian tropical montane wet forests. Global Change Biology doi:10.1111/gcb.12636

Mascaro, J., Litton, C.M., Hughes, R.F., Uowolo, A., Schnitzer, S.A. 2014. Is logarithmic transformation necessary in allometry? Ten, one-hundred, one-thousand-times yes. Biological Journal of the Linnean Society 111:230-233.

Iwashita, D.K., Litton, C.M., Giardina, C.P. 2013. Coarse woody debris carbon storage across a mean annual temperature gradient in tropical montane wet forest. Forest Ecology and Management 291:336-343.

MacKenzie, Rich and Ayron Strauch - Quantifying the effects of ungulates and invasive strawberry guava (Psidium cattleianum) on sediment runoff in Hawaiian wet forests

Submitted: December 1, 2014

Project Location(s): Laupāhoehoe Unit Forest Reserve & NAR
HETF Annual Report for Project Period: 07/2013-12/2014

Status Update *(including any significant findings):*
Paired (fenced and unfenced) runoff plots where installed July-Sept 2012 with runoff collectors, connectors, and buckets. Throughfall gages were installed on fence posts to monitor throughfall at each plot. Plot activation occurred monthly from Oct 2012 to June 2014. Soil samples were taken for bacterial analysis bimonthly. Successful runoff collection occurred during storm events in both 2013 and the first three months of 2014, however there were many activations with too little rainfall limiting our success. Runoff volume, turbidity, and bacteria were analyzed. Additionally, soil moisture, bulk density, and % organic matter were quantified at 4 cm intervals from 20 cm soil cores from each plot.

Timeline *(including overall expected completion date):*
Study will continue for the forseable future with quarterly activation and data collection. Project is anticipated to continue to 2020.

Changes to Methodology *(or other aspects of the project):*
No changes to the methodology have been made

Noteworthy Observations *(including the presence of T&E species, new observances of invasive species, and/or human activity or disturbances in the area):*
None

Challenges *(encountered while working in the HETF):*
Getting through all four gates by oneself can be cumbersome.

Bibliography of Publications *(Publications should include work that was done in the HETF, including gray literature, conference presentations/posters, etc.):*
None

Medville, Douglas and Peter Bosted - Lava tube location, survey, and resource evaluation on Pu`u Wa`awa`a and Pu`u Anahulu

Submitted: October 3, 2014
Project Location(s): Pu'u Wa'awa'a Unit Forest Reserve & Forest Bird Sanctuary
HETF Annual Report for Project Period (mm/yyyy – mm/yyyy): 01/2014-12/2014

Status Update *(including any significant findings):*
In 2014, surveys were conducted in 20 lava tubes with 21,418 feet (4.05 miles) of passage surveyed in these lava tubes. The caves are in four general areas in accordance with the permit.

1. Forest Bird Sanctuary. A survey at the makai end of Ambigua Cave resulted in its extension makai and connection to another cave just below it (Lower Ambigua Cave). As a result, the cave now has nearly two miles of surveyed passages and a vertical extent of over 1,000 feet. The entire cave complex is within the FBS. Its location and extent are shown on the first attached image.

2. Mauka Subunit. This area extends from Rt 190 mauka to the makai boundary fence of the FBS and contains a very high concentration of entrances and passages in a 3,000-5,000 year old flow.Over a mile of passages were added to the extensive Hapu`u Cave complex. In a parsallel cave (Lower Delissea), 3,800 feet were surveyed with fossil Hawaiian Goose (Branta Rhuax) bones found. Further east, 2,200 feet of braided passages were surveyed in a cave (Bee Flat Cave) that closely approaches a previously surveyed cave (Henahena Cave) containing over a mile of surveyed passages. The locations and extent of these caves are shown on the second attached image.

3. Makai Subunit. Access is via the Old Kiholo Road on the makai side of Rt 190 and via the mauka side of Rt 19. During 2014, 1.6 miles of passages were surveyed in 12 caves. Below Rt 190 and in a 5,000-11,000 year old flow, two massive stone walls, each 15' - 20' long and 3' - 4' high were found in one of these caves (Two Wall Cave). No other cultural materials were observed in this cave. The largest of the caves surveyed, Wave Cave, contains over a half mile of passage, generally a single large conduit, and has not been followed to a makai end. No cultural materials were seen in this cave. In another cave (Tripwire Cave), 2,000 feet above the mauka side of Rt 19, a stone wall partially blocking the passage at a constriction was observed. The caves surveyed are shown on the third attached image.

4. Puu Anahulu. Only one cave as surveyed on the Puu Anahulu ahupua`a. This cave, containing just over 1,000 feet of passage, is in the same flow as the well known Paniolo cave, on the mauka side of Rt 19 at milepost 79 but about 1/4 mile mauka. On the floor on the makai side of the cave's single entrance, two parallel lines of rocks that are 2' to 3' high were seen, giving the appearance of being an enclosure of sorts, although this could be natural. Aside from some charcoal fragments seen on the passage floor, this is the only cultural feature seen in the cave. This cave's location and outline are shown on the fourth attached image.

Timeline *(including overall expected completion date):*
January 1, 2015-December 31, 2015; actual completion date is open ended, depending on the needs of the HETF.

Changes to Methodology *(or other aspects of the project):*

GPS units continue to be used to locate entrances. Cave passages are now being surveyed using a single instrument that records distance, compass bearing, and inclination and stores this information. As a result the surveys are proceeding more rapidly and are more accurate.

Noteworthy Observations *(including the presence of T&E species, new observances of invasive species, and/or human activity or disturbances in the area):*
Threatened and endangered species were not seen in the lava tubes. Fossil bird bones were observed in some of the caves in the mauka subunit; this is not unexpected in this area. Further makai, we observed a greater incidence of lithic cultural materials: stone walls across passages, stone enclosures, and stepping stone alignments. The occasional pieces of charcoal (but no torch materials) were also seen.

Challenges *(encountered while working in the HETF):*
We encountered 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.

Bibliography of Publications *(Publications should include work that was done in the HETF, including gray literature, conference presentations/posters, etc.):*
The focus of the work continues to be the documentation of the extent and contents of the caves on P`uu Wa`awa`a and Pu`u Anahulu through the completion of cartographic surveys, overlays of passages and entrances onto topographic maps and aerial images, and maintenance of spreadsheets that document cave names, locations, and features. This information is provided to the HETF and DOFAW on a routine periodic basis.

Michler, Charles - *Acacia koa* environmental genomics

Submitted: November 26, 2014

Project Location(s): Laupahoehoe Forest Reserve
HETF Annual Report for Project Period: 12/01/2012-12/01/2014

Status Update (*including any significant findings):*
In the past year, samples of 5-7 phyllodes were collected from ~ 20 trees in the Laupahoehoe HETF according to original permit specifications. Currently, DNA and RNA are being extracted at the Purdue University Hardwood Tree Improvement and Regeneration Center (HTIRC). Preliminary analysis shows that there is substantial variation in the expression of genes (RNA) across environmental gradients. In particular, genes found to be related to drought tolerance in other species are mosre highly expressed in the trees growing in dryer regions.

The previous permit stated that up to 100 seeds would be collected, however, the sampled trees were not seeding this year. Additional trips will need to be made to the area to collect seeds and other measurements from the trees.

Timeline *(including overall expected completion date):*
It is expected that the completion of this project will rely primarily on environmental conditions that will induce flowering and seeding in the higher elevation trees so that seeds can be collected. Additional measurements of phenology and physiology are expected to be completed in summer 2015.

Provided the trees produce seed, this upcoming year should be the final year of the permit. If the trees have still not seeded, then an additional year after 2015 may be necessary.

Changes to Methodology *(or other aspects of the project):*
The use of the BigShot (which is a tool that is made up of a large pole with an adapter similar to a large slingshot at the top) was not used. All others methods were carried out as described in the original permit request.

Noteworthy Observations *(including the presence of T&E species, new observances of invasive species, and/or human activity or disturbances in the area):*

Challenges *(encountered while working in the HETF):*
We did not find any unusual challenges in the area. The rough terrain and the weather conditions were expected and we were prepared for them.

Bibliography of Publications *(Publications should include work that was done in the HETF, including gray literature, conference presentations/posters, etc.):*

Presentations / Posters / Publications thus far using information gleaned from research in the HETF:

Presentations:
Lawson SS. July 2014. Invited Presentation "Acacia koa gene expression profiles: Analysis of environmental stress tolerance using NextGeneration Sequencing. Annual American Society for Plant Biology (ASPB) meeting in Portland, OR.

Posters:
Lawson SS, Inman-Narahari F, Friday JB, and Michler CH. July 2014. Changes in gene expression of Acacia koa along elevation and precipitation gradients. 22nd Annual Hawai'i Conservation Conference. Hawai'i Convention Center, Honolulu, HI.

Publications:
Lawson SS, Inman-Narahari F, Friday JB, and Michler CH. 2014. Analysis of naturally abundant stable isotopes in Acacia koa populations on Hawaii. (In preparation)

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.trophtirc.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)

Shea, Thomas - Field investigation of the volcanic history of Pu'u Wa'awa'a

Submitted: December 8, 2014

CLOSE OUT REPORT

Project Location(s): Pu'u Wa'awa'a Unit Forest Reserve
HETF Annual Report for Project Period: 10/2013-09/2014

Status Update *(including any significant findings):*
Field work involved collecting volcanic rock samples from the abandoned quarry at the base of the PWW cone, as well as from three locations that were selected to dig small pits. Sampling in the quarry was performed exactly according to plan, and rock analyses are currently being carried out at the University of Hawaii. We are testing the hypothesis that the geological features represented by the Pu'u Wa'awa'a cone and the nearby Pu'u Anahulu lava flow were generated by the same eruption 114ka.

Timeline *(including overall expected completion date):*
The majority of the work that was planned for this area has been completed. There is a chance that a second field campaign may be needed in the future, if this is the case another permit application will be submitted for review.

Changes to Methodology (*or other aspects of the project):*
Out of the three pits, only one could be dug, but after reaching the first 10-15in, it became clear that the type of material was not appropriate for the purpose of this study (material has been heavily remobilized since its deposition 114ka ago, and is thus not suitable for stratigraphic observations). This part of the project (i.e. digging pits) was therefore abandoned. The first pit, from which a little bit of material was removed, was reconstructed and the thin soil veneer was replaced on top.

Noteworthy Observations *(including the presence of T&E species, new observances of invasive species, and/or human activity or disturbances in the area):*
None

Challenges *(encountered while working in the HETF):*
None

Bibliography of Publications *(Publications should include work that was done in the HETF, including gray literature, conference presentations/posters, etc.):*

Leonhardi T, Shea T, Giachetti T, Larsen J, Lindoo A (2014) From pumice to obsidian: eruptive behaviors that produce tephra-flow dyads. II- The 114ka trachyte eruption at Pu'u Wa'awa'a (Hawai'i). American Geophysical Union Fall Meeting, San Francisco, Abstract V21B-4751

Vitousek, Peter - Sources and fates of nutrients on a substrate age gradient across the Hawaiian archipelago and their consequences for forest dynamics

Submitted: January 27, 2014

Project Location(s): Laupāhoehoe Forest Reserve
HETF Annual Report for Project Period: 1/1/13 - 12/31/13

Status Update *(including any significant findings):*
We collected forest floor and surface mineral soil from our long-term plot in the July 2013, and used it (together with soil from other sites on gradients of nutrient availability and soil mineralogy) to evaluate microbial growth efficiency and carbon stabilization. We found that microbial growth efficiency was greatest when labelled sucrose alone was added; it was reduced when sucrose plus nutrients were added. We also found that C storage on mineral surfaces was greatest in the low-C sites (not Laupahoehoe), which we interpret as reflecting the importance of not-fully-saturated mineral surfaces early in the sorption process.

Timeline *(including overall expected completion date):*
We expect to continue our work on soils and C storage in 2014, and to survey the trees we fertilized in the mid-1990s to evaluate their current condition and to remove inappropriate markings from them. We plan to continue to work in HETF as part of a substrate age gradient across the Hawaiian Islands, including sites on Kilauea, Kohala, Molokai, and Kauai.

Changes to Methodology *(or other aspects of the project):*
In addition to the work outlined in the timeline above, we plan to focus on cleaning up our long-term site, which has accumulated flagging and soil respiration chambers etc from multiple sites over many years of work, by multiple researchers.

Noteworthy Observations *(including the presence of T&E species, new observances of invasive species, and/or human activity or disturbances in the area):*
No new problems observed in the area of our ongoing research, other than the extremely low water level in the stream near our site.

Challenges *(encountered while working in the HETF):*
Other researchers apparently have made collections in the area of our core site, as evidenced by litter screen on the surface (reported previously) and changes in the structure of a soil pit.

Bibliography of Publications *(Publications should include work that was done in the HETF, including gray literature, conference presentations/posters, etc.):*

An abstract from the AGU meeting in 2013 that includes results from our 2013 sampling will be attached separately; as will a publication reporting results of earlier field research on the site. The references are:

Cusack, D., S. Reed, W. Wieder, P. Taylor, C. Cleveland, O. Chadwick, and P. Vitousek. 2013. How do gradients in mineralogy and nutrient availability alter links between microbial growth efficiency and soil carbon storage? Poster B51D-0306, American Geophysical Union.

Cleveland, C.C., S. Reed, A. Keller, D. Nemergut, S. O'Neill, R. Ostertag, P. Vitousek. 2013. Litter quality versus microbial community controls over decomposition: a quantitative analysis. Oecologia 10.1007/s00442-013-2758-9%T

Yanger, Corie - Investigating the level and rate of invasive thrips infestation on spatially varied natural and planted Hawaiian Myoporum seedlings

Submitted: November 14, 2014

Project Location(s): Pu'u Wa'awa'a Forest Reserve
HETF Annual Report for Project Period: 12/2013-12/2014

Status Update *(including any significant findings):*

As of October 30, 2014 I have collected seven months of naio tree data and six months of natural naio seedling data at Pu'u Wa'awa'a Forest Reserve. Naio trees with less than 33 percent infestation (Class 0 and Class 1) yielded an average of 1.5 flowers per branch. Mean flower count was significantly lower for trees with greater than 33 percent infestation (Class 2: 0.5-0.8 flowers/branch/tree, Class 3: 0.1-0.5 flowers/branch/tree). Monthly infestation ratings per branch per tree displayed an inverse relationship to flower count. Trees in Classes 0 and 1 maintained 33 percent or less infestation, while trees in Class 2 displayed average infestation ratings between 33 to <66 percent. Trees in Class 3 maintained 66 percent and higher infestation ratings. This data suggests that naio reproductive output (in the form of flower production) is maintained, though at a lower amount for trees with higher thrips infestation levels than for less infested trees. Monthly infestation patterns for naio in Classes 0 and 1 suggest that (despite a 5-6 year infestation) there are some naio trees at Pu'u Wa'awa'a Forest Reserve which sustain relatively little damage from thrips.

I have monitored a total of 139 seedlings at Pu'u Wa'awa'a Forest Reserve. The maximum height recorded was 40.5 centimeters, with mean seedling height at 12.5 cm. More than half of seedlings have been damaged by thrips, and more than 90 percent of seedlings also sustain damage from other insects such as aphids, leaf miners, and chewing insects. Taller seedlings appeared to have more thrips damage than shorter seedlings. Average monthly growth rates were calculated for three seedling height classes: 3.3 cm (seedlings <10 cm in height), 5.3 cm (seedlings 10-25 cm in height), and 2.3 cm (seedlings >25 cm in height). After six months, seedling survival rate was 84 percent. These data suggest that naio seedlings are able to survive for months despite damage from one or more insects. Due to confounding factors (e.g., multiple insect damage, water stress) the impact of thrips on natural naio seedling survival and growth rate is still unclear. Greenhouse studies will attempt to control for these other factors to better understand thrips impact to naio seedlings.

Timeline *(including overall expected completion date):*

I will conduct the remaining naio tree monitoring each month from November 2014 to March 2015. I will also continue to monitor natural naio seedlings monthly until April 2015. Greenhouse naio seedlings will be monitored from December 2014 to June 2015. I expect that all monitoring will be completed and materials/equipment will be removed and properly disposed of by the end of June 2015.

Changes to Methodology *(or other aspects of the project):*

For naio tree monitoring, I ended up monitoring 40 trees, with ten representative individuals for each of four infestation classes. I also marked branches with aluminum tags and flagging. Changes were approved by the Pu'u Wa'awa'a Coordinator, Elliott Parsons. For seedling monitoring, I had to tag most seedlings in the recently bulldozed road because seedlings beyond the road were too sparse. All seedling locations were marked with a GPS unit and tags were covered to avoid attracting ungulates. These changes were also approved by Elliott Parsons. Due to logistical constraints, planting of naio seedlings will not be conducted. Instead, I have consulted with Elliott Parsons to arrange for an greenhouse study of naio seedlings.

Noteworthy Observations *(including the presence of T&E species, new observances of invasive species, and/or human activity or disturbances in the area):*
I have observed that despite the presence of ungulates, seedlings (of Dodonaea viscosa, Sophora chrysophylla, Osteomeles anthyllidifolia, and Myoporum sandwicense) seem to readily sprout.

Challenges *(encountered while working in the HETF):*
While working in the HETF, my biggest challenge has been trying to collect data from plants that are exposed to ungulates.

Bibliography of Publications *(Publications should include work that was done in the HETF, including gray literature, conference presentations/posters, etc.):*

Yanger, C., and R. Ostertag. July 2014. Impacts of an invasive introduced insect on Hawaiian Myoporum reproduction and seedling growth and survival. Association for Tropical Conservation Biology Annual Meeting, Cairns, Australia. Oral presentation.

Yanger, C., and R. Ostertag. June 2014. Impacts of invasive thrips infestation on Hawaiian Myoporum reproduction and seedling establishment. Island Biology Meeting, Manoa, Hawaii. Poster presentation.

Yeh, Aileen - Forest Disease Monitoring for Rust Disease affecting ʻōhiʻa Lehua

Submitted: January 22, 2014

Project Location(s): Laupāhoehoe Forest Reserve
HETF Annual Report for Project Period: 01/2013 - 12/31/2013

Status Update *(including any significant findings):*
Puccinia rust was present on a few young seedlings , but it was unclear if the fungus was the cause of death when death occurred. Tissue samples were sent to the UH Manoa plant pathology lab (Dr. janice Uchida). More frequent monitoring is planned, at 2 month intervals, or more frequently if rain persists. We will be increasing to 20, the number of monitored trees with diameter breast height, in each tree plot. Four sites were selected in the Laupahoehoe Forest Reserve, which included seedlings. A circle plot was set up at 2 sites to monitor mature trees, and the mature trees there saw no change in canopy vigor, until the koa moth population explosion.

ʻŌhiʻa saplings and trees in monitored plots had very low levels of rust. Rust was difficult to locate in most cases, or effects were not able to be confirmed as to be caused by rust. More noticeable damage to ʻōhiʻa was done by an insect that was eating the leaves of the ʻōhiʻa . It was observed there was some damage to the ʻōhiʻa from the koa caterpillar/moth if they were under defoliated koa trees.
Above the 4,000+ ft elevation, rust was not found on ʻōhiʻa or any other Myrtaceae.
Rose apple is the only other myrtaceae that I've seen with rust. Guava, strawberry guava, is not affected.

We plan to continue and expand the monitoring plots to include 20 ʻōhiʻa per plot, with partial funding from the Invasive Species Council. ʻōhiʻa seedlings will continue to be monitored for effects of Puccinia psidii, and if heavy infestations are observed, samples are sent to Dr. Janice Uchida at UH Manoa for confirmation and genetic testing.

Timeline *(including overall expected completion date):*
04/2011 - 12/2016

Changes to Methodology *(or other aspects of the project):*
Current plot size is 60 feet in diameter, with ʻōhiʻa trees within the plot being monitored. This permit will be renewed in March 2014, and will call for the monitored plots to be expanded outward if necessary to include 20 ʻōhiʻa trees (with measureable dbh and with reachable leaves) per plot. Each tree will be banded and tagged with dendrometer bands to monitor dbh. If the permit to continue this montoring is approved, Pots with ʻōhiʻa seed from the area will be set out to see whether seedlings will germinate and grow, and whether they will be impacted by rust.

Noteworthy Observations *(including the presence of T&E species, new observances of invasive species, and/or human activity or disturbances in the area):*
ʻōhiʻa affected by Puccinia psidii was more common in the pasture areas. ʻōhiʻa shrubs and small trees along the roadside in the pasture at around 1,600 feet elevation were observed to be infected with rust causing spotting on the leaves. This was more prevalent after rain events. ʻōhiʻa browsed by ungulates also tended to flush with new growth which is more prone to infection. These ʻōhiʻa were growing in sunny areas, not under thick canopy like seedlings in the monitoring plots. Roseapple, the resevoir host is found growing along the gulch in the lower areas of the pasture.

At 1,957 ft, next to the yellow gate, there is one large mature ‘ōhi‘a tree that has had rust severely affect its lower branches on the makai side of the tree. The upper canopy is healthy, and has no dead or rust infected leaves which can be seen from the ground.

Species which are in and around the monitored plots are olomea, mamaki, olapa, maile, akala, strawberry guava, hapu'u, clidemia, painu, ieie, koa, ala ala wainui, Dubautia, and Oha (Clermontia).

During the koa moth invasion, it was noted that The Koa moth did eat ‘ōhi‘a , akala, and strawberry guava, but did not eat the olapa , kopiko, hame, clermontia, rubber tree, maile, or olomea.

Challenges *(encountered while working in the HETF):*
No challenges. Everything has gone well.

Bibliography of Publications *(Publications should include work that was done in the HETF, including gray literature, conference presentations/posters, etc.):*
None

HETF Related Citations

Citations listed below have been submitted since the publication of the 2013 HETF Annual Report through either project annual reports or direct submission. Only published research is listed below; see specific researcher annual reports for publication in press or preparation, presentations, poster information, etc. Visit the HETF website (http://www.hetf.us/page/major_topics/) for a complete list of citations received to date.

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Schulten, Jodie R., T. Colleen Cole , Susan Cordell , Keiko M. Publico , Rebecca Ostertag , Jaime E. Enoka, and Jené D. Michaud. Persistence of Native Trees in an Invaded Hawaiian Lowland Wet Forest: Experimental Evaluation of Light and Water Constraints. Pacific Science 68(2):267-285. 2014

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Strauch, Ayron M., Richard A. Mackenzie, Gregory L. Bruland, Ralph Tingley III, and Christian P. Giardina. Climate Change and Land Use Drivers of Fecal Bacteria in Tropical Hawaiian Rivers. Journal of Environmental Quality (2014), pp. 1475-1483.

Appendix A – 2014 Research Detail

Laupāhoehoe Unit

Laupāhoehoe Forest Reserve Sub-Unit

Principle Investigator: Cordell, Susan	**Permit Duration:** Feb 26, 2014 to Feb 25, 2015
☐ **New Permit** ☐ **Renewal** ☒ **Permanent (contingent upon approval)** ☐ **No Valid Permit**	
Project Location(s): ☒ LAU-NAR ☒ LAU-FR ☒ PWW-FR ☒ PWW-FBS ☐ PWW-Park	
Research Title: Hawaii Permanent Plot Network	
Affiliation: USDA Forest Service	
PI Contact Info: scordell01@fs.fed.us; (808) 854-2628	
Dates of Anticipated Results: Indefinite	**Publications, etc. Received:** Yes ☒ No ☐
Annual Report Received: ☒ Yes ☐ No ☒ Renewal ☐ Completion ☐ New Permit	

Principle Investigator: Hughes, Flint	**Permit Duration:** May 2, 2014 to May 1, 2015
☐ **New Permit** ☒ **Renewal** ☐ **Permanent (contingent upon approval)** ☐ **No Valid Permit**	
Project Location(s): ☐ LAU-NAR ☒ LAU-FR ☐ PWW-FR ☐ PWW-FBS ☐ PWW-Park	
Research Title: Forest disease monitoring for the Ōhiʻa rust disease affecting Ōhiʻa trees	
Affiliation: USDA Forest Service	
PI Contact Info: fhughes@fs.fed.us; (808) 933-8121 ext. 117	
Dates of Anticipated Results: 2015	**Publications, etc. Received:** Yes ☐ No ☐
Annual Report Received: ☒ Yes ☐ No ☐ Renewal ☐ Completion ☐ New Permit	

Principle Investigator: Hughes, Flint	**Permit Duration:** Oct 28, 2014 to Oct 27, 2015
☒ **New Permit** ☐ **Renewal** ☐ **Permanent (contingent upon approval)** ☐ **No Valid Permit**	
Project Location(s): ☒ LAU-NAR ☒ LAU-FR ☐ PWW-FR ☒ PWW-FBS ☐ PWW-Park	
Research Title: Using FIA plots to determine degree and distribution of Koa tree (Acacia koa) mortality and under-story vegetation change in response to current, widespread outbreaks of Scotorythra paludicola on Hawaii Island	
Affiliation: USDA Forest Service	
PI Contact Info: fhughes@fs.fed.us; (808) 933-8121 ext. 117	
Dates of Anticipated Results: 2015	**Publications, etc. Received:** Yes ☐ No ☒
Annual Report Received: ☐ Yes ☒ No ☐ Renewal ☐ Completion ☒ New Permit	

Principle Investigator: Johns, Chris	**Permit Duration:** May 28, 2014 to May 27, 2015
☒ **New Permit** ☐ **Renewal** ☐ **Permanent (contingent upon approval)** ☐ **No Valid Permit**	
Project Location(s): ☒ LAU-NAR ☒ LAU-FR ☒ PWW-FR ☒ PWW-FBS ☐ PWW-Park	
Research Title: Evolutionary history, biogeography, and conservation status of Philodoria, the endangered leaf mining micromoths of Hawaii	
Affiliation: University of Florida, Florida Museum of Natural History	
PI Contact Info: johns.chris.a@gmail.com; (352) 328-6200	
Dates of Anticipated Results: June 2015	**Publications, etc. Received:** Yes ☐ No ☒
Annual Report Received: ☐ Yes ☒ No ☐ Renewal ☐ Completion ☒ New Permit	

Principle Investigator: Leopold, Devin	**Permit Duration:** Aug 4,2014 to Aug 3, 2015
☒ **New Permit** ☐ **Renewal** ☐ **Permanent (contingent upon approval)** ☐ **No Valid Permit**	
Project Location(s): ☐ LAU-NAR ☒ LAU-FR ☐ PWW-FR ☐ PWW-FBS ☐ PWW-Park	
Research Title: Local adaptation in an ericoid mycorrhizal symbiosis	
Affiliation: Stanford University	
PI Contact Info: devin.leopold@gmail.com; (603) 702-1203	
Dates of Anticipated Results: Aug 2016	**Publications, etc. Received:** Yes ☐ No ☒
Annual Report Received: ☐ Yes ☒ No ☐ Renewal ☐ Completion ☒ New Permit	

Principle Investigator: Litton, Creighton et al.	**Permit Duration:** June 25, 2014 to June 24, 2015
☐ **New Permit** ☒ **Renewal** ☐ **Permanent (contingent upon approval)** ☐ **No Valid Permit**	
Project Location(s): ☒ LAU-NAR ☒ LAU-FR ☐ PWW-FR ☐ PWW-FBS ☐ PWW-Park	
Research Title: An Experimental Test of the impacts of rising temp on C input, allocation, and loss in model forests	
Affiliation: University of Hawaiʻi at Mānoa, Department of Natural Resources and Environmental Management	
PI Contact Info: litton@hawaii.edu; (808) 956-6004	
Dates of Anticipated Results: June 23, 2015	**Publications, etc. Received:** Yes ☒ No ☐
Annual Report Received: ☒ Yes ☐ No ☒ Renewal ☐ Completion ☐ New Permit	

Principle Investigator: Paxton, Eben	**Permit Duration:** June 25, 2014 to June 24, 2015
☒ **New Permit** ☐ **Renewal** ☐ **Permanent (contingent upon approval)** ☐ **No Valid Permit**	
Project Location(s): ☒ LAU-NAR ☒ LAU-FR ☐ PWW-FR ☐ PWW-FBS ☐ PWW-Park	
Research Title: Movement ecology of Hawai‘i forest birds	
Affiliation: US Geological Survey, Pacific Island Ecosystems Research Center	
PI Contact Info: epaxton@usgs.gov; (808) 985-6423	
Dates of Anticipated Results: Dec 2016	**Publications, etc. Received:** Yes ☐ No ☒
Annual Report Received: ☐ Yes ☒ No ☐ Renewal ☐ Completion ☒ New Permit	

Principle Investigator: Vitousek, Peter	**Permit Duration:** Feb 26, 2014 to Feb 25, 2015
☐ **New Permit** ☒ **Renewal** ☐ **Permanent (contingent upon approval)** ☐ **No Valid Permit**	
Project Location(s): ☐ LAU-NAR ☒ LAU-FR ☐ PWW-FR ☐ PWW-FBS ☐ PWW-Park	
Research Title: Sources and fates of nutrients on a substrate age gradient across the Hawaiian archipelago and their consequences for forest dynamics	
Affiliation: Stanford University	
PI Contact Info: vitousek@stanford.edu; (650) 814-6812	
Dates of Anticipated Results: 2020	**Publications, etc. Received:** Yes ☒ No ☐
Annual Report Received: ☒ Yes ☐ No ☒ Renewal ☐ Completion ☐ New Permit	

Principle Investigator: Yeh , Aileen	**Permit Duration:** Feb 26, 2014 to Feb 25, 2015
☒ **New Permit** ☐ **Renewal** ☐ **Permanent (contingent upon approval)** ☐ **No Valid Permit**	
Project Location(s): ☒ LAU-NAR ☒ LAU-FR ☒ PWW-FR ☒ PWW-FBS ☐ PWW-Park	
Research Title: Operational Disease Screening Program for Resistance to Wilt in Acacia Koa in Hawaii	
Affiliation: Hawai‘i Agriculture Research Center	
PI Contact Info: ayeh@hawaii.edu; (808) 936-2671	
Dates of Anticipated Results: Feb 2015	**Publications, etc. Received:** Yes ☐ No ☒
Annual Report Received: ☐ Yes ☒ No ☐ Renewal ☐ Completion ☒ New Permit	

Laupāhoehoe Natural Area Reserve Sub-Unit

Principle Investigator: Cordell, Susan	**Permit Duration:** Feb 26, 2014 to Feb 25, 2015
☐ **New Permit** ☐ **Renewal** ☒ **Permanent (contingent upon approval)** ☐ **No Valid Permit**	
Project Location(s): ☒ LAU-NAR ☒ LAU-FR ☒ PWW-FR ☒ PWW-FBS ☐ PWW-Park	
Research Title: Hawaii Permanent Plot Network	
Affiliation: USDA Forest Service	
PI Contact Info: scordell01@fs.fed.us; (808) 854-2628	
Dates of Anticipated Results: Indefinite	**Publications, etc. Received:** Yes ☒ No ☐
Annual Report Received: ☒ Yes ☐ No ☒ Renewal ☐ Completion ☐ New Permit	

Principle Investigator: Hughes, Flint	**Permit Duration:** Oct 28, 2014 to Oct 27, 2015
☒ **New Permit** ☐ **Renewal** ☐ **Permanent (contingent upon approval)** ☐ **No Valid Permit**	
Project Location(s): ☒ LAU-NAR ☒ LAU-FR ☐ PWW-FR ☒ PWW-FBS ☐ PWW-Park	
Research Title: Using FIA plots to determine degree and distribution of Koa tree (Acacia koa) mortality and under-story vegetation change in response to current, widespread outbreaks of Scotorythra paludicola on Hawaii Island	
Affiliation: USDA Forest Service	
PI Contact Info: fhughes@fs.fed.us; (808) 933-8121 ext. 117	
Dates of Anticipated Results: 2015	**Publications, etc. Received:** Yes ☐ No ☒
Annual Report Received: ☐ Yes ☒ No ☐ Renewal ☐ Completion ☒ New Permit	

Principle Investigator: Johns, Chris	**Permit Duration:** May 28, 2014 to May 27, 2015
☒ **New Permit** ☐ **Renewal** ☐ **Permanent (contingent upon approval)** ☐ **No Valid Permit**	
Project Location(s): ☒ LAU-NAR ☒ LAU-FR ☒ PWW-FR ☒ PWW-FBS ☐ PWW-Park	
Research Title: Evolutionary history, biogeography, and conservation status of Philodoria, the endangered leaf mining micromoths of Hawaii	
Affiliation: University of Florida, Florida Museum of Natural History	
PI Contact Info: johns.chris.a@gmail.com; (352) 328-6200	
Dates of Anticipated Results: June 2015	**Publications, etc. Received:** Yes ☐ No ☒
Annual Report Received: ☐ Yes ☒ No ☐ Renewal ☐ Completion ☒ New Permit	

Principle Investigator: Litton, Creighton et al.	**Permit Duration:** June 25, 2014 to June 24, 2015
☐ **New Permit** ☒ **Renewal** ☐ **Permanent (contingent upon approval)** ☐ **No Valid Permit**	
Project Location(s): ☒ LAU-NAR ☒ LAU-FR ☐ PWW-FR ☐ PWW-FBS ☐ PWW-Park	
Research Title: An Experimental Test of the impacts of rising temp on C input, allocation, and loss in model forests	
Affiliation: University of Hawai'i at Mānoa, Department of Natural Resources and Environmental Management	
PI Contact Info: litton@hawaii.edu; (808) 956-6004	
Dates of Anticipated Results: June 23, 2015	**Publications, etc. Received:** Yes ☒ No ☐
Annual Report Received: ☒ Yes ☐ No ☒ Renewal ☐ Completion ☐ New Permit	

Principle Investigator: Paxton, Eben	**Permit Duration:** June 25, 2014 to June 24, 2015
☒ **New Permit** ☐ **Renewal** ☐ **Permanent (contingent upon approval)** ☐ **No Valid Permit**	
Project Location(s): ☒ LAU-NAR ☒ LAU-FR ☐ PWW-FR ☐ PWW-FBS ☐ PWW-Park	
Research Title: Movement ecology of Hawai'i forest birds	
Affiliation: US Geological Survey, Pacific Island Ecosystems Research Center	
PI Contact Info: epaxton@usgs.gov; (808) 985-6423	
Dates of Anticipated Results: Dec 2016	**Publications, etc. Received:** Yes ☐ No ☒
Annual Report Received: ☐ Yes ☒ No ☐ Renewal ☐ Completion ☒ New Permit	

Principle Investigator: Yeh , Aileen	**Permit Duration:** Feb 26, 2014 to Feb 25, 2015
☒ **New Permit** ☐ **Renewal** ☐ **Permanent (contingent upon approval)** ☐ **No Valid Permit**	
Project Location(s): ☒ LAU-NAR ☒ LAU-FR ☒ PWW-FR ☒ PWW-FBS ☐ PWW-Park	
Research Title: Operational Disease Screening Program for Resistance to Wilt in Acacia Koa in Hawaii	
Affiliation: Hawai'i Agriculture Research Center	
PI Contact Info: ayeh@hawaii.edu; (808) 936-2671	
Dates of Anticipated Results: Feb 2015	**Publications, etc. Received:** Yes ☐ No ☒
Annual Report Received: ☐ Yes ☒ No ☐ Renewal ☐ Completion ☒ New Permit	

Puʻu Waʻawaʻa Unit

Puʻu Waʻawaʻa Forest Reserve Sub-Unit

Principle Investigator: Cordell, Susan	**Permit Duration:** Feb 26, 2014 to Feb 25, 2015
☐ **New Permit** ☐ **Renewal** ☒ **Permanent (contingent upon approval)** ☐ **No Valid Permit**	
Project Location(s): ☒ LAU-NAR ☒ LAU-FR ☒ PWW-FR ☒ PWW-FBS ☐ PWW-Park	
Research Title: Hawaii Permanent Plot Network	
Affiliation: USDA Forest Service	
PI Contact Info: scordell01@fs.fed.us; (808) 854-2628	
Dates of Anticipated Results: Indefinite	**Publications, etc. Received:** Yes ☒ No ☐
Annual Report Received: ☒ Yes ☐ No ☒ Renewal ☐ Completion ☐ New Permit	

Principle Investigator: Cordell, Susan	**Permit Duration:** May 28, 2014 to May 27, 2015
☐ **New Permit** ☒ **Renewal** ☐ **Permanent (contingent upon approval)** ☐ **No Valid Permit**	
Project Location(s): ☐ LAU-NAR ☐ LAU-FR ☒ PWW-FR ☐ PWW-FBS ☐ PWW-Park	
Research Title: The potential for restoration to break the grass/fire cycle in dryland ecosystems in Hawaiʻi	
Affiliation: USDA Forest Service	
PI Contact Info: scordell01@fs.fed.us; (808) 854-2628	
Dates of Anticipated Results: 2016	**Publications, etc. Received:** Yes ☒ No ☐
Annual Report Received: ☒ Yes ☐ No ☒ Renewal ☐ Completion ☐ New Permit	

Principle Investigator: Earnshaw, Kyle	**Permit Duration:** May 28, 2014 to May 27, 2015
☐ **New Permit** ☒ **Renewal** ☐ **Permanent (contingent upon approval)** ☐ **No Valid Permit**	
Project Location(s): ☐ LAU-NAR ☐ LAU-FR ☒ PWW-FR ☐ PWW-FBS ☐ PWW-Park	
Research Title: Phenotypic plasticity and adaptation of two Acacia koa Gray ecotypes in response to light availability	
Affiliation: Tropical Hardwood Tree Improvement and Regeneration Center, Purdue University, West Lafayette, IN	
PI Contact Info: kearnsha@purdue.edu;	
Dates of Anticipated Results: June 30, 2016	**Publications, etc. Received:** Yes ☐ No ☒
Annual Report Received: ☒ Yes ☐ No ☒ Renewal ☐ Completion ☐ New Permit	

Principle Investigator: Johns, Chris	**Permit Duration:** May 28, 2014 to May 27, 2015
☒ **New Permit** ☐ **Renewal** ☐ **Permanent (contingent upon approval)** ☐ **No Valid Permit**	
Project Location(s): ☒ LAU-NAR ☒ LAU-FR ☒ PWW-FR ☒ PWW-FBS ☐ PWW-Park	
Research Title: Evolutionary history, biogeography, and conservation status of Philodoria, the endangered leaf mining micromoths of Hawaii	
Affiliation: University of Florida, Florida Museum of Natural History	
PI Contact Info: johns.chris.a@gmail.com; (352) 328-6200	
Dates of Anticipated Results: June 2015	**Publications, etc. Received:** Yes ☐ No ☒
Annual Report Received: ☐ Yes ☒ No ☐ Renewal ☐ Completion ☒ New Permit	

Principle Investigator: Medville, Doug	**Permit Duration:** Jan 1, 2014 to Dec 31, 2014
☐ **New Permit** ☒ **Renewal** ☐ **Permanent (contingent upon approval)** ☐ **No Valid Permit**	
Project Location(s): ☐ LAU-NAR ☐ LAU-FR ☒ PWW-FR ☒ PWW-FBS ☐ PWW-Park	
Research Title: Lava Tube location, survey, and resource evaluation on Puʻu Waʻawaʻa and Puʻu Anahulu	
Affiliation: Hawaiʻi Speleological Survey	
PI Contact Info: medville@verizon.net; (703) 860-0134	
Dates of Anticipated Results: Dec 2014	**Publications, etc. Received:** Yes ☐ No ☒
Annual Report Received: ☒ Yes ☐ No ☒ Renewal ☐ Completion ☐ New Permit	

Principle Investigator: Perroy, Ryan	**Permit Duration:** May 28, 2014 to May 27, 2015
☒ **New Permit** ☐ **Renewal** ☐ **Permanent (contingent upon approval)** ☐ **No Valid Permit**	
Project Location(s): ☐ LAU-NAR ☐ LAU-FR ☒ PWW-FR ☐ PWW-FBS ☐ PWW-Park	
Research Title: Using small unmanned aerial vehicles to map invasive and rare endemic plants and monitor vegetation health in the Pu'u Wa'awa'a Forest Reserve Makai Subunit	
Affiliation: University of Hawaiʻi at Hilo, Department of Geography and Environmental Science	
PI Contact Info: rperroy@hawaii.edu; (808) 932-7259	
Dates of Anticipated Results: Feb 2016	**Publications, etc. Received:** Yes ☐ No ☒
Annual Report Received: ☐ Yes ☒ No ☐ Renewal ☐ Completion ☒ New Permit	

Principle Investigator: Shimizu, Ben	**Permit Duration:** May 28, 2014 to May 27, 2015
☒ **New Permit** ☐ **Renewal** ☐ **Permanent (contingent upon approval)** ☐ **No Valid Permit**	
Project Location(s): ☐ LAU-NAR ☐ LAU-FR ☒ PWW-FR ☐ PWW-FBS ☐ PWW-Park	
Research Title: Operation and maintenance of the Kīholo rain gage	
Affiliation: U.S. Geological Survey, Pacific Islands Water Science Center	
PI Contact Info: bhshimz@usgs.gov; (808) 587-2434	
Dates of Anticipated Results: March 31, 2015	**Publications, etc. Received:** Yes ☐ No ☒
Annual Report Received: ☐ Yes ☒ No ☐ Renewal ☐ Completion ☒ New Permit	

Principle Investigator: Ticktin, Tamara	**Permit Duration:** May 28, 2014 to May 27, 2015
☒ **New Permit** ☐ **Renewal** ☐ **Permanent (contingent upon approval)** ☐ **No Valid Permit**	
Project Location(s): ☐ LAU-NAR ☐ LAU-FR ☒ PWW-FR ☐ PWW-FBS ☐ PWW-Park	
Research Title: Linking local ecological knowledge, ecosystem services and climate change	
Affiliation: University of Hawai‘i at Mānoa	
PI Contact Info: ticktin@hawaii.edu; (808) 956-3928	
Dates of Anticipated Results: June 2015	**Publications, etc. Received:** Yes ☐ No ☒
Annual Report Received: ☐ Yes ☒ No ☐ Renewal ☐ Completion ☒ New Permit	

Principle Investigator: Yeh , Aileen	**Permit Duration:** Feb 26, 2014 to Feb 25, 2015
☒ **New Permit** ☐ **Renewal** ☐ **Permanent (contingent upon approval)** ☐ **No Valid Permit**	
Project Location(s): ☒ LAU-NAR ☒ LAU-FR ☒ PWW-FR ☒ PWW-FBS ☐ PWW-Park	
Research Title: Operational Disease Screening Program for Resistance to Wilt in Acacia Koa in Hawaii	
Affiliation: Hawai‘i Agriculture Research Center	
PI Contact Info: ayeh@hawaii.edu; (808) 936-2671	
Dates of Anticipated Results: Feb 2015	**Publications, etc. Received:** Yes ☐ No ☒
Annual Report Received: ☐ Yes ☒ No ☐ Renewal ☐ Completion ☒ New Permit	

Pu'u Wa'awa'a Forest Bird Sanctuary Sub-Unit

Principle Investigator: Cordell, Susan	**Permit Duration:** Feb 26, 2014 to Feb 25, 2015
☐ **New Permit** ☐ **Renewal** ☒ **Permanent (contingent upon approval)** ☐ **No Valid Permit**	
Project Location(s): ☒ LAU-NAR ☒ LAU-FR ☒ PWW-FR ☒ PWW-FBS ☐ PWW-Park	
Research Title: Hawaii Permanent Plot Network	
Affiliation: USDA Forest Service	
PI Contact Info: scordell01@fs.fed.us; (808) 854-2628	
Dates of Anticipated Results: Indefinite	**Publications, etc. Received:** Yes ☒ No ☐
Annual Report Received: ☒ Yes ☐ No ☒ Renewal ☐ Completion ☐ New Permit	

Principle Investigator: Hughes, Flint	**Permit Duration:** Oct 28, 2014 to Oct 27, 2015
☒ **New Permit** ☐ **Renewal** ☐ **Permanent (contingent upon approval)** ☐ **No Valid Permit**	
Project Location(s): ☒ LAU-NAR ☒ LAU-FR ☐ PWW-FR ☒ PWW-FBS ☐ PWW-Park	
Research Title: Using FIA plots to determine degree and distribution of Koa tree (Acacia koa) mortality and under-story vegetation change in response to current, widespread outbreaks of Scotorythra paludicola on Hawaii Island	
Affiliation: USDA Forest Service	
PI Contact Info: fhughes@fs.fed.us; (808) 933-8121 ext. 117	
Dates of Anticipated Results: 2015	**Publications, etc. Received:** Yes ☐ No ☒
Annual Report Received: ☐ Yes ☒ No ☐ Renewal ☐ Completion ☒ New Permit	

Principle Investigator: Medville, Doug	**Permit Duration:** Jan 1, 2014 to Dec 31, 2014
☐ **New Permit** ☒ **Renewal** ☐ **Permanent (contingent upon approval)** ☐ **No Valid Permit**	
Project Location(s): ☐ LAU-NAR ☐ LAU-FR ☒ PWW-FR ☒ PWW-FBS ☐ PWW-Park	
Research Title: Lava Tube location, survey, and resource evaluation on Pu'u Wa'awa'a and Pu'u Anahulu	
Affiliation: Hawai'i Speleological Survey	
PI Contact Info: medville@verizon.net; (703) 860-0134	
Dates of Anticipated Results: Dec 2014	**Publications, etc. Received:** Yes ☐ No ☒
Annual Report Received: ☒ Yes ☐ No ☒ Renewal ☐ Completion ☐ New Permit	

Principle Investigator: Yeh , Aileen	**Permit Duration:** Feb 26, 2014 to Feb 25, 2015
☒ **New Permit** ☐ **Renewal** ☐ **Permanent (contingent upon approval)** ☐ **No Valid Permit**	
Project Location(s): ☒ LAU-NAR ☒ LAU-FR ☒ PWW-FR ☒ PWW-FBS ☐ PWW-Park	
Research Title: Operational Disease Screening Program for Resistance to Wilt in Acacia Koa in Hawaiʻi	
Affiliation: Hawaiʻi Agriculture Research Center	
PI Contact Info: ayeh@hawaii.edu; (808) 936-2671	
Dates of Anticipated Results: Feb 2015	**Publications, etc. Received:** Yes ☐ No ☒
Annual Report Received: ☐ Yes ☒ No ☐ Renewal ☐ Completion ☒ New Permit	

Puʻu Waʻawaʻa State Park Reserve (Kīholo) Sub-Unit

There were no HETF research permits for Kīholo in 2014.

Appendix B – Metadata

- All information submitted by researchers, i.e. annual reports, research affiliation, title, etc., are included as is. We do not add any diacritical marks, correct punctuation, capitalization or grammatical errors.
- Research affiliations are broken down into five groups: Forest Service, University of Hawai‘i (Hilo and Mānoa campuses), other Universities, other Government Organizations, and Other. The ‘other’ category was added in 2011 and includes societies, organizations, museums, institutions, and clubs, etc.
- Educational permits are grouped into three categories: Academic (Universities, K-12 grade schools, home schools, etc.), Institution (all federal and state agencies) and Organization (i.e. Boy Scouts of America, Media visits, E Mau Nā Ala Hele, Three Mountain Alliance, Mauna Kea Watershed Alliance, etc.).
- Within the educational permit categories the activities include: 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‘olaulea).
- All new and renewal permit applicants are required to submit an annual report within one year of completion or at the time of renewal.
- Any amendments applied for are rolled into the original HETF permit.

Appendix C – 2014 HETF staff and related members

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

HETF Project Manager – Mel Dean

HETF Resource Associate – Tabetha 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 - The Forestry Manager's position was vacant in the year 2014. The following people acted in rotation during the interim.

- Christopher Graper: December 30, 2013 - January 3, 2014
- Don Yokoyama: January 21 - January 31, 2014
- John Perry: February 3 - February 14, 2014
- Christopher Graper: February 18 - February 28, 2014
- Jay Hatayama: March 3 - March 14, 2014
- Don Yokoyama: March 17 - March 28, 2014
- John Perry: March 31 - April 11, 2014
- Christopher Graper: April 14 - April 25, 2014
- Jay Hatayama: April 28 - May 9, 2014
- Don Yokoyama: May 19 - June 13, 2014
- John Perry: June 16 - July 11, 2014
- Christopher Graper: July 14 - August 8, 2014
- Jay Hatayama: August 11 - September 5, 2014
- Don Yokoyama: September 8 - October 3, 2014
- John Perry: October 6 - October 30, 2014
- Christopher Graper: November 3 - November 28, 2014
- Jay Hatayama: December 1 - December 26, 2014

East Hawai'i Island Wildlife Biologist – Joey Mello

West Hawai'i Island Wildlife Biologist – Hans Sin

Pu'u Wa'awa'a coordinator – Elliott Parsons

State Parks Hawai'i Island District Superintendent – Dean Takebayashi

Appendix D – Youth Conservation Corps 2014 Summary

YCC Summary 2014

AmeriCorps programs in Hawai'i are administered by Kupu, a nonprofit community organization (kupuhawaii.org). IPIF participates in three Kupu AmeriCorps/Youth Conservation Corps (YCC) programs: The ***Gateway Program*** is a 7 week summer team experience designed for young adults (ages 17-20). Team members complete hands-on fieldwork at various worksites. The ***Frontiers Program*** provides a more in-depth individual 8-week summer experience at a single worksite that best matches the individual's interests. The ***Extended Internship Program (EIP)*** offers an intensive entry-level 11-month experience in preparation for a career in the conservation field. Individuals work one-on-one with an environmental agency that best matches their interests.

2014 USFS YCC Crew

Acronyms:

- DOFAW - Hawai'i Division of Forestry and Wildlife
- EIP - Extended Internship Program
- HETF - Hawai'i Experimental Tropical Forest
- HFNWR - Hakalau Forest National Wildlife Refuge
- IPIF - Institute of Pacific Islands Forestry
- KMR - Keaukaha Military Reserve
- LSEC - Laupāhoehoe Science and Education Center
- MKWA - Mauna Kea Watershed Alliance
- NARS - Natural Area Reserves System
- PSW - Pacific Southwest Research Station
- USDA - United States Dept. of Agriculture
- USFS - United States Forest Service
- YCC - Youth Conservation Corps

The Pacific Southwest Research Station, Institute of Pacific Islands Forestry supported a total of 19 AmeriCorps members in 3 Youth Conservation Corps programs in 2014. The USFS Gateway team was supported via funding from the 21st Century Conservation Service Corps.

Contents:

YCC Program Overview, Accomplishments & Acronyms 1

USFS Team Activities & Overview 2-3

Frontier & EIP member highlights 4

Gateway Team Accomplishments:

Completed 1,965 service hours to the community; removed hundreds of invasive species (holly, fountain grass, banana poka, lantana, Himalayan raspberry, and blackberry) from sites around the Big Island; restored degraded landscapes by planting native ōhi'a and koa trees, and learned valuable natural resource management techniques from the USFS and assisting agencies. See pages 2 and 3 for more details.

Frontier & EIP Accomplishments:

Members gained valuable work experience in restoration, research, management and environmental education. See page 4 for highlights.

It has been an unreal experience working for the Forest Service and seeing the many hands that come together to take care of our environment. I have learned to understand how important it is that we continue to observe our relationship to the environment and build a healthier connection to it. My experience has helped me to connect to my community and the classrooms I get to teach in. I look forward to the many connections I make as I grow from these experiences. - Aleysia-Rae Kaha, Frontier & EIP Member

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USFS Gateway Team Activities

Gateway team members gained hands on experience in many aspects of natural resource management, working in both HETF units, as well as other conservation areas managed by agency partners, such as DOFAW, MKWA and HFNWR. To compliment this, members were also exposed to unique cultural experiences. Activities included: weed control & eradication, reforestation/outplanting, fence maintenance and harvesting kalo and pounding it into poi. For more details, see below.

June 16-18

Site Host: USFS
Site Location: HETF Laupāhoehoe Unit
Activities:

- Estimated species percent cover of invasive plants and eradicated invasives over a 3 hectare area
- Participated in an educational orientation of the Hawai'i Permanent Plot Network, part of a worldwide forest monitoring program

June 19

Site Host: DOFAW
Site Location: Hawai'i Island NARS
Activities:

- Laupāhoehoe - removed old fence enclosures
- Kahauale'a - performed boundary fence maintenance

June 23-25

Site Host: USFWS
Site Location: HFNWR
Activities:

- Removed invasive plants
- Constructed fences
- Planted 500 native trees (common and endangered species)
- Toured the greenhouse and discussed plant identification
- Observed and identified different native birds while hiking

June 26

Site Host: USFS
Site Location: LSEC
Activities:

- Outplanted 150 'ōhi'a in previous pasture land
- Erected fence-line, enclosing 1 acre to protect new 'ōhi'a plantings

June 30 - July 3

Site Host: The Nature Conservancy
Site Location: Kīholo
Activities:

- Discussed the area of Kīholo (history, landscape, fishpond, ecology, restoration)
- Completed annual Kīholo fishpond vegetation survey
- Completed larval fish sampling to help understand the connections between the reef and the fishpond
- Assisted visiting researchers with night surveys of anchialine pool fauna

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July 7

Site Host: USFS
Site Location: Keanakolu Plantation
Activities:

- Measured (total height, height to first fork, stem length, and diameter at breast height) of approximately 130 koa trees that were 34 years old
- Collected increment cores to estimate the amount of heartwood present in different koa families and to determine if faster growing trees have more heartwood than slower growing trees

July 8-10

Site Host: MKWA
Site Location: Waipahoehoe
Activities:

- Controlled gorse in a 25 acre buffer area of new management unit
- Outplanted 738 native plants, including:
  - a'ali'i (*Dodonaea viscosa*)
  - kupaoa (*Dubautia arborea*)
  - pawale (*Rumex giganteus*)
  - 'iliahi (*Santalum paniculatum*)
  - koa (*Acacia koa*)

July 14-15

Site Host: USFS
Site Location: LCPCS, HETF, & LSEC
Activities:

LCPCS:

- Performed routine agricultural and garden activities to support the LCPCS Farm to School Program

HETF:

- Manually removed invasive species (strawberry guava, koster's curse, and small ginger) by hand and with hand tools
- Selected strawberry guava for the purposes of crafting an implement, in this instance a staff and lomi stick

LSEC:

- Learned how to harvest kalo and pounded it into poi, a Hawaiian food staple

July 16-18

Site Host: USFS
Site Location: KMR
Activities:

- Participated in an educational orientation/talk-story session, discussing the plight of the lowland wet forest and current restoration attempts
- Removed invasive species via hand pulling, clearing 1000 meters squared
- Sorted leaf litter and learned how to identify different plant species (lab work)
- Discussed how a decomposition experiment works

USFS Gateway Team Activities

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Frontier members:

Aleysia-Rae Kaha & Abcde Zoller

Mentor: Christian Giardina, USFS Research Ecologist

In the summer of 2014, the USFS in collaboration with a team from the University of Tennessee established the ʻÕhiʻa Common Garden, which will be used as a research and education platform at the Laupāhoehoe Science and Education Center. As Frontier members, Aleysia and Abcde assisted with the installation of the ʻÕhiʻa Common Garden by preparing the site for fencing (putting in wood posts, pounding in t-posts) removing weeds and ground covering, and planting seedlings. They also learned how to propagate ʻōhiʻa in the greenhouse as part of Ulu Lehulehu or the Million ʻÕhiʻa Initiative. Ulu Lehulehu is a collaboration of schools, students/parents, local growers, public officials and entire communities working towards reintroducing ʻōhiʻa into the landscape. Most lowland ʻōhiʻa forests have been disappearing due to agriculture and urban development.

In addition to the Frontier member contributions to the common garden, the USFS YCC Gateway team members were an integral part of the preparation and planting of the common garden.

Aleysia Abcde

EIP members:

Aleysia-Rae Kaha & Jeselyn Calderón-Ayala

Jeselyn

Mentors: Christian Giardina, USFS Research Ecologist | Tracy Johnson, USFS Research Entomologist

- Aleysia transitioned into an EIP position with the USFS and will continue to work with the Ulu Lehulehu project through August of 2015.
- Jeselyn works with Tracy Johnson and the USFS biological control team evaluating and monitoring use of insect natural enemies for managing miconia and strawberry guava, two of Hawai'i's worst forest invaders.

Kahoʻolawe

As part of the Gateway team experience, members participate in a Department of Defense (DOD) funded restoration effort on the island of Kahoʻolawe. The entire island had been controlled by the DOD and used for military training. Decades of bombing exercises had denuded the island of vegetation and resulting erosion stripped much of the island's top soil. The island was placed under the management of the Kahoʻolawe Island Reserve Commission, which holds the island in trust for eventual full control by a Native Hawaiian led organization. Members spend one week, on Kahoʻolawe participating in active restoration, as well as learning about the cultural geography of Kahoʻolawe and natural resources focused on native Hawaiian cultural practices.

Gateway team members on the high ropes course. Members challenge themselves mentally and physically to unite as a team.

Safety Training & Team Building

In additional to the hands-on job experience, members spend their first week at Camp Erdman on Oahu. During the week members participated in team building exercises, CPR/first aid training, a high/low ropes courses and an environmental fair and luncheon, as well as a talent show before flying to their host island.

Additional Gateway Information

In addition to supporting 1 full Gateway team for 7 weeks (USFS team) the USFS/IPIF supported 2 additional Gateway teams for 1 week each (regular teams). One regular team worked with Mauna Kea Watershed Alliance controlling gorse in Pi'i Honua, and the second team performed restoration activities including out-plantings, weed control and clearing the fire fuel break around the Hauaina exclosure in Pu'u Wa'awa'a.

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