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Hawaii Experimental Tropical Forest

2012 Annual Report

Photo credit: Amanda Uowolo

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List of Acronyms

DHHL - Department of Hawaiian Homelands
DLNR - Hawaii Department of Land and Natural Resources
DOFAW - Hawaii Division of Forestry and Wildlife
FR - Forest Reserve
FBS - Forest Bird Sanctuary
HETF - Hawaii Experimental Tropical Forest
HIPPNET - Hawaii Permanent Plot Network
IPIF - Institute of Pacific Islands Forestry
LAU - Laupahoehoe Unit of the Hawaii Experimental Tropical Forest
NARS - Natural Area Reserve System
PSW - Pacific Southwest Research Station
PWW - Puu Waawaa Unit of the Hawaii Experimental Tropical Forest
RAWS - Remote Automatic Weather Station
RTC - Research Technical Committee for the Hawaii Experimental Tropical Forest
SP - State Parks
USDA - United States Department of Agriculture
USFS - United States Forest Service

Acknowledgements

The establishment and administration of the Hawaii 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, Hao Tran, Pat Manley, Paul Conry and Roger Imoto for their leadership and support in 2012. The USDA Forest Service would like to thank the State of Hawaii 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 2012 for their efforts to reach agreements, provide valuable feedback, and help move forward the processes needed to effectively administer the HETF's mission: Steve Bergfeld, Ian Cole, Lisa Hadway, Sheri Mann, Joey Mello, Kevin Moore, Lyman Perry, Tanya Rubenstein, Hans Sin and Dean Takebayashi. Mahalo to Colleen Cole and Elliott Parsons for their work with the HETF Planning Group and beyond. Special thanks to the additional USDA Forest Service employees who have tirelessly worked to support the HETF's success in their respective capacities in 2012 including: Jerry Carlson, Tom Cole, Susan Cordell, Sherri Eng, Kainana Francisco, Christian Giardina, Susan Litteral, David Oldenburg, Wendy Powell, William Nielson, Paul Scowcroft, John Slown, Randy Shrank, Jean Stoner, Michael Sullivan, and Chris Wong. Special thanks to James Akau, 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 Laupahoehoe and Puu Waawaa Advisory Council members for their important role in the guidance of HETF activities.

Introduction

The Hawaii Experimental Tropical Forest (HETF) was established in 2007 and includes two Units: the Laupahoehoe Wet Forest, totaling 12,343 acres (4,990 ha), and the Puu Waawaa Dry Forest, totaling 38,885 acres (15,736 ha) (Figure 1). The HETF overlays existing State of Hawaii, Department of Land and Natural Resources (DLNR) managed lands and include the following land designations: Forest Reserve and Natural Area Reserve in Laupahoehoe and Wildlife Sanctuary (Forest Bird Sanctuary), Forest Reserve and State Parks Reserve in Puu Waawaa. 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/).

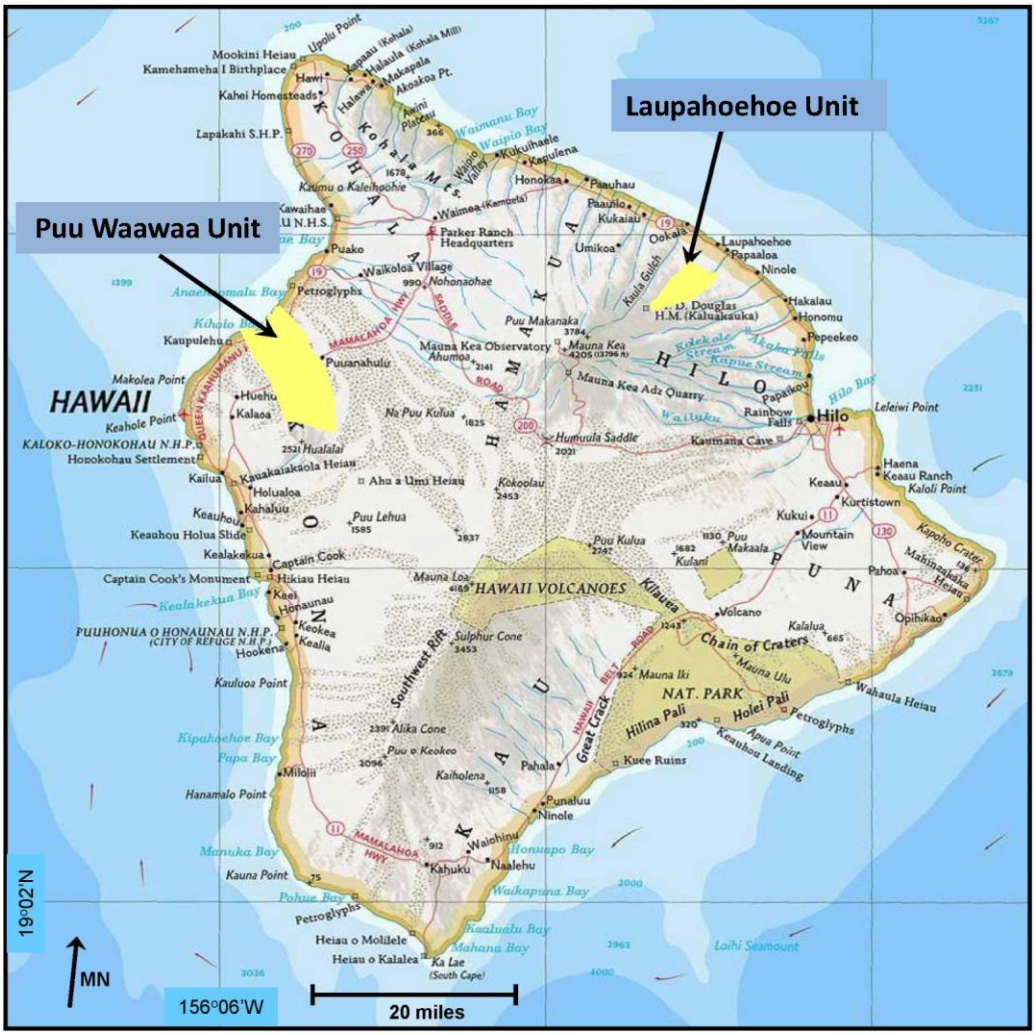


Figure 1: Map of Hawaii Island highlighting both the Puu Waawaa and Laupahoehoe Units of the HETF.

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 2012 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 Hawaii*) 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 Hawaii Island DOFAW Branch Manager, the Hawaii Island Natural Area Reserves Program Manager, the Hawaii Island Forestry Program Manager, East and West Hawaii Island Wildlife Biologists, the Puu Waawaa coordinator, and two to three external partners. The HETF Planning Group is facilitated by the HETF Coordinator (USFS employee) and meets bi-monthly.

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 Hawaii Island DOFAW Branch Manager, the USFS-HETF Science Lead, the Natural Area Reserve Hawaii Island Manager, the Forest Reserve Hawaii Island Manager, East and West Hawaii Island Wildlife Biologists, and the Puu Waawaa coordinator. Permit processing and tracking is administered by the HETF Coordinator. Signing authority for all permits lies with the Hawaii Island DOFAW Branch Manager. All research permits are valid for one year and require an annual report.

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 Puu Waawaa Advisory Council has been in existence since 2002. The Laupahoehoe Advisory Council 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 2012, planning began to outline overall and site specific goals and priorities for research, education, and demonstration within the HETF boundaries. In the Laupahoehoe Unit, progress was made on drafting the Laupahoehoe Forest Management Plan. To date, the DOFAW and the USFS have solicited feedback on focal areas such as research, education, public access, and

infrastructure from the Laupahoehoe Advisory Council. A working draft of the management plan is expected to be completed in July 2013.

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

Laupahoehoe Unit

HETF support facilities for the Laupahoehoe Unit are present in two locations within Laupahoehoe but outside the forest boundary. The Laupahoehoe Science and Education Center (Center) is located on 55 acres of old sugar cane lands within the Laupahoehoe 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. The Center is expected to be operational by September 2013.

Additionally, there are plans to build a covered pavilion with restrooms and parking on a three acre fenced parcel directly below the Laupahoehoe 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.

Puu Waawaa Unit

There are plans to build dedicated HETF facilities including a bunkhouse with kitchen, restrooms and classroom/meetings space at the decommissioned landing strip. The environmental assessment and planning process for these facilities will begin in 2013. 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 Laupahoehoe Unit also includes hydrology monitoring equipment. 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 Hawaii.

Laupahoehoe Unit equipment includes a stream gauge in Manowaiopae Stream (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 Puu Waawaa Unit hosts multiple weather stations including two in the Forest Reserve, installed in 2003 (RAWS - Remote Automatic Weather Station) and 2011, and one in the Forest Bird Sanctuary, installed in 2012.

Long term vegetation plots are available in both Units including:

- The Hawaii 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.

- Puu Waawaa - http://www.puuwaawaa.org/index.html
- Laupahoehoe – a draft management plan is currently in progress and a working draft is expected to be available in July 2013.

2012 Research Summary

Nineteen research applications were submitted and approved in 2012. All 19 projects were initiated (12 renewals and 7 new). See Appendix A for detailed information regarding research projects. Maps indicating the 2012 active research sites grouped by primary investigator within each Unit are provided in Figures 2 and 3. Forest Inventory Analysis (FIA) plot locations are confidential and not included on the HETF research maps; only the number of plots and the State land designation are included. This confidentially is designed to protect landowner identities (applicable on private lands) as well as to encourage land owners/managers to not treat the FIA plots in any special way. A few of the 2012 research projects are highlighted here.

- *Acacia koa genetic improvement program* - Dr. Charles Michler, director of the Tropical Hardwood Tree Improvement and Regeneration Center, in partnership with the University of Hawaii and the IPIF, began an improvement program for koa, emphasizing stem form, wood quality and frost resistance as the main improvement objectives for the species. They found natural stands of good quality koa trees within the HETF Laupahoehoe Unit and collected seeds in August 2012. These seeds were processed and are currently growing in a local nursery. In spring 2013, seedlings will be transplanted and a seed orchard established at a site on Department of Hawaiian Homelands Lands (DHHL) at an elevation of 5000 feet (1524 m). The orchard seedlings will be measured every year to determine their growth rate, straightness, and potential as crop trees.
- *Conservation genetics and taxonomy* - Dr. Danica T. Harbaugh-Reynaud, Founder and Executive Director of the International Sandalwood Foundation, and researcher at the University of California, Berkeley, began a project studying Hawaiian mountain sandalwood, *Santalum paniculatum*. No island-wide population surveys or genetic or taxonomic analyses have been performed on Big Island sandalwood despite the continued human impacts on this species. Her study will assess *S. paniculatum* across Hawaii Island through population surveys (including numbers of mature trees and seedlings) and a genetic and taxonomic study, which will in turn help identify seed sources for a germplasm repository and for use in reintroduction programs throughout the island.
- *Invasive species impacts on Hawaiian Forests* - The degradation of water quality or reductions to the flow of freshwater to streams and wetlands are serious threats to native Hawaiian ecosystems and have been identified by the Natural Area Reserve system as priorities for research. On Hawaii Island invasive strawberry guava (*Psidium cattleianum*) is expanding into the forest understory, outcompeting native species and altering habitat availability and ecosystem function. Additionally, invasive ungulates, noteably feral pigs (*Sus scrofa*), disrupt the soil structure, consume native vegetation, and create wallows that mosquitoes use to breed. Both strawberry guava and feral pigs are believed to affect watershed hydrology by altering plants and soils. Rich Mackenzie (USFS) and Ayron Strauch (UH Manoa) have established long-term study sites (8 to 10 years) in the HETF Laupahoehoe Unit to measure soil erosion and runoff in strawberry guava-dominated forest and native ohia-dominated forests.
- *Impacts of rising temperature on carbon* - Carbon storage on earth exceeds that in the atmosphere by a factor of four, and represents a dynamic balance among carbon input, allocation, and loss. This balance is being altered by climate change, with important implications for terrestrial carbon storage and, hence, atmospheric CO_2 levels and global climate. However, the response of terrestrial carbon cycling to warming remains poorly quantified, especially in the tropics. This is particularly important because tropical

forests account for a ~40% of global terrestrial carbon storage and ~35% of global terrestrial productivity and, as such, tropical forests play a very important role in regulating global climate. Dr. Creighton Litton (UH Manoa) and Dr. Christian Giardina (USFS) are examining how rising mean annual temperature will impact the carbon balance of the world's most productive forests (i.e., tropical wet forests). This research has assisted in creating a model global change research platform that has attracted multiple national and international collaborators.

- *Grass/Fire cycle in Dryland ecosystems* - The Strategic Environmental Research and Development Program (SERDP) aims to improve our understanding of altered fire regimes and devise methods to break the grass/wildfire cycle, Dr. Susan Cordell (USFS) and colleagues are using both remote sensing and field-based experiments. At the landscape scale, they have developed the use of high temporal frequency satellite imagery to monitor near real-time fire fuel conditions. This product is available as a web tool and was introduced to Department of Defense (DoD) and other Hawaii based land managers. Visit the site at http://hawaiifire.stanford.edu.

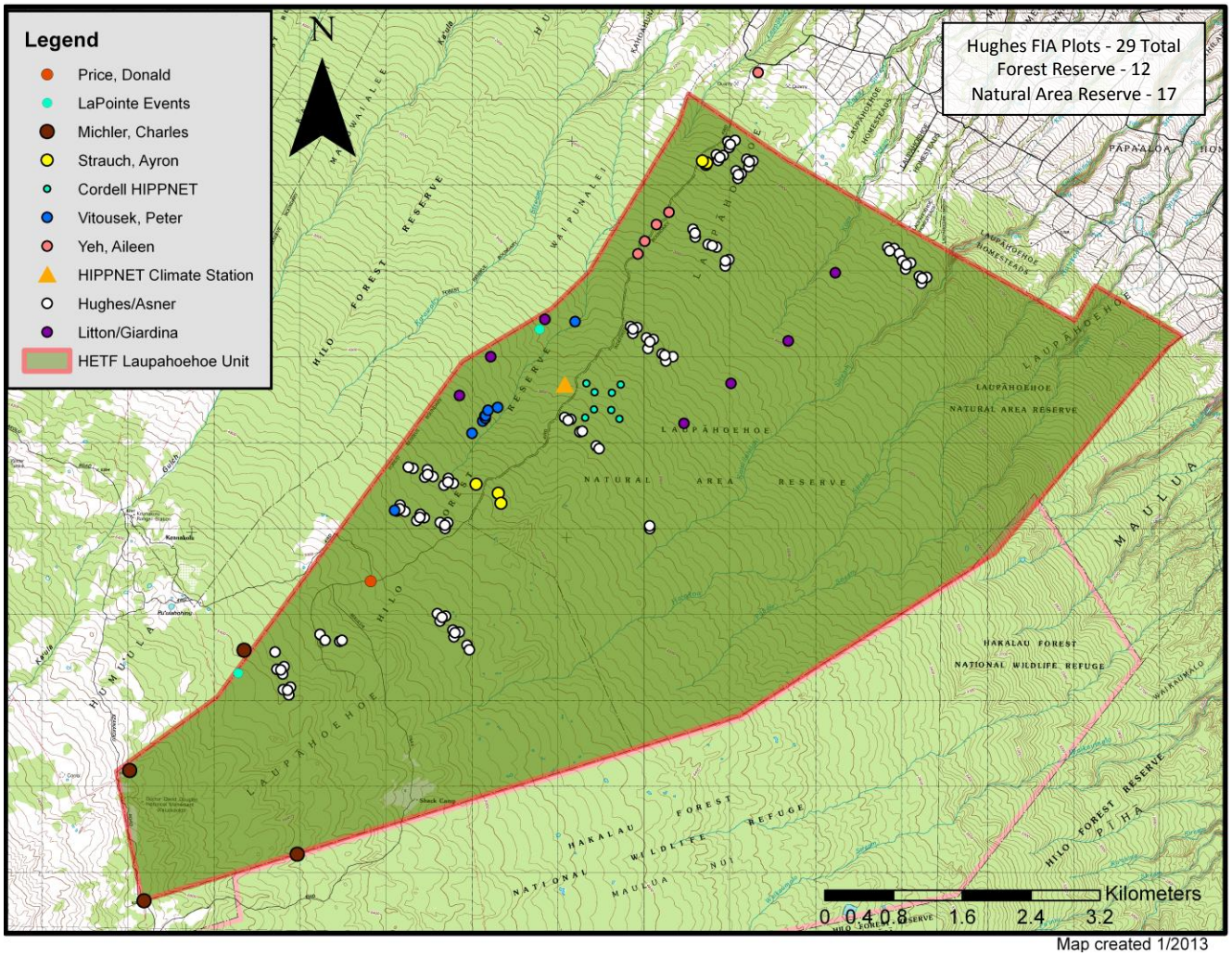


Figure 2: Map indicating all active research projects that occurred within the Laupahoehoe Unit in 2012.

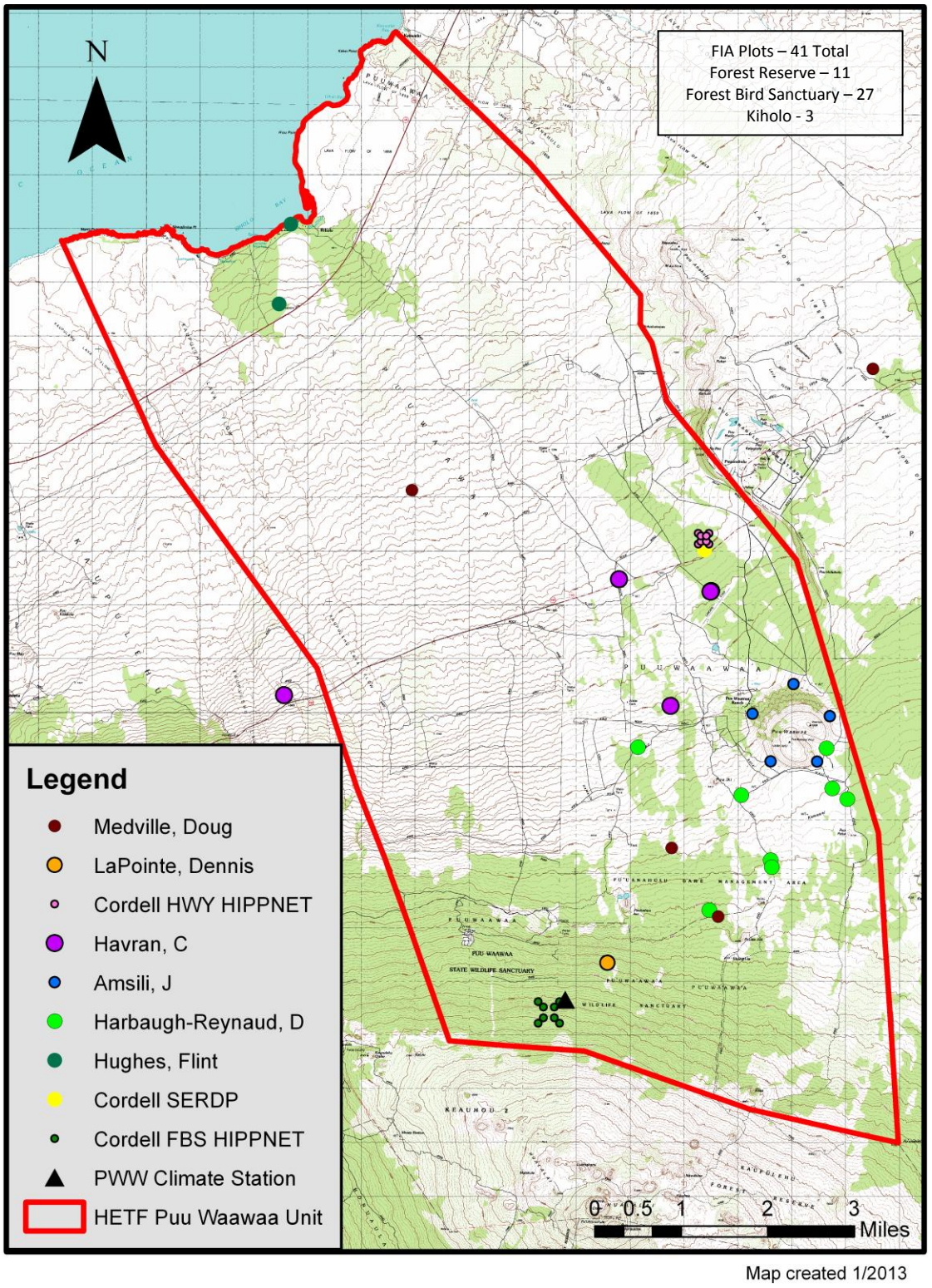


Figure 3: Map indicating all active research projects that occurred within the Puu Waawaa Unit in 2012.

HETF-related journal articles were published in *Remote Sensing of the Environment, Ecosystems, Soil Biology and Biochemistry, Ecological Monographs* and more. See the "HETF Related Citations" section of this report for a complete list.

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. Eight of the 19 projects initiated in 2012 were located in the Laupahoehoe Unit, nine occurred within the Puu Waawaa Unit, and two research projects were conducted in both Units (Table 1). Figure 4 shows the percentage of 2012 HETF research projects grouped by State land designation. Figure 5 shows research affiliation for projects within the HETF over a five-year period 2008-2012.

Table 1: Total number of research projects initiated in the HETF per year and grouped by Unit from 2008-2012.

Year	Laupahoehoe Unit Only	Puu Waawaa Unit Only	Both HETF Units	Total # of Projects Initiated
2012	8 (44%)	9 (44%)	2 (12%)	19
2011	5 (42%)	5 (42%)	2 (16%)	12
2010	8 (44%)	9 (50%)	1 (6%)	18
2009	10 (59%)	6 (35%)	1 (6%)	17
2008	6 (46%)	5 (39%)	2 (15%)	13
Total	**37**	**34**	**8**	**79**

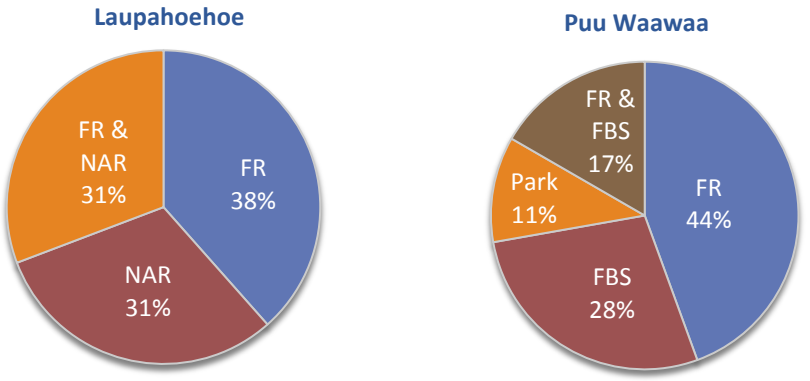


Figure 4: Percentage of HETF research projects grouped by state land designation in 2012. (NAR=Natural Area Reserve, FR=Forest Reserve, FBS=Forest Bird Sanctuary, and Park=State Park Reserve)

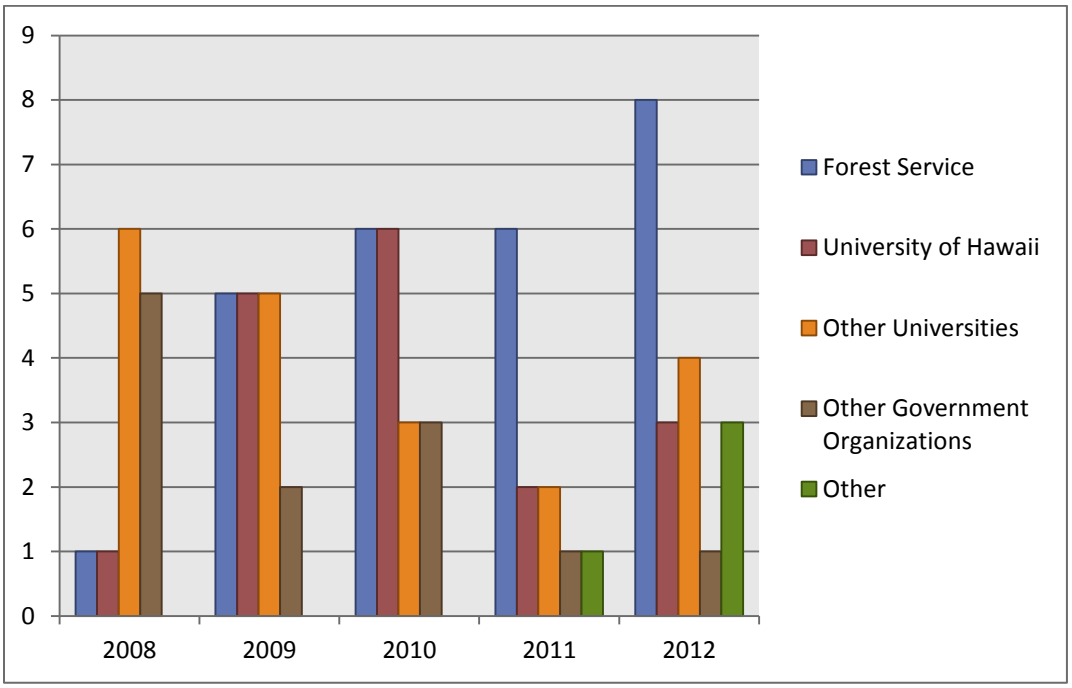


Figure 5: Affiliation for research projects initiated and ongoing within the HETF from 2008-2012.

2012 Education, Service, and Other (Access, etc.) Summary

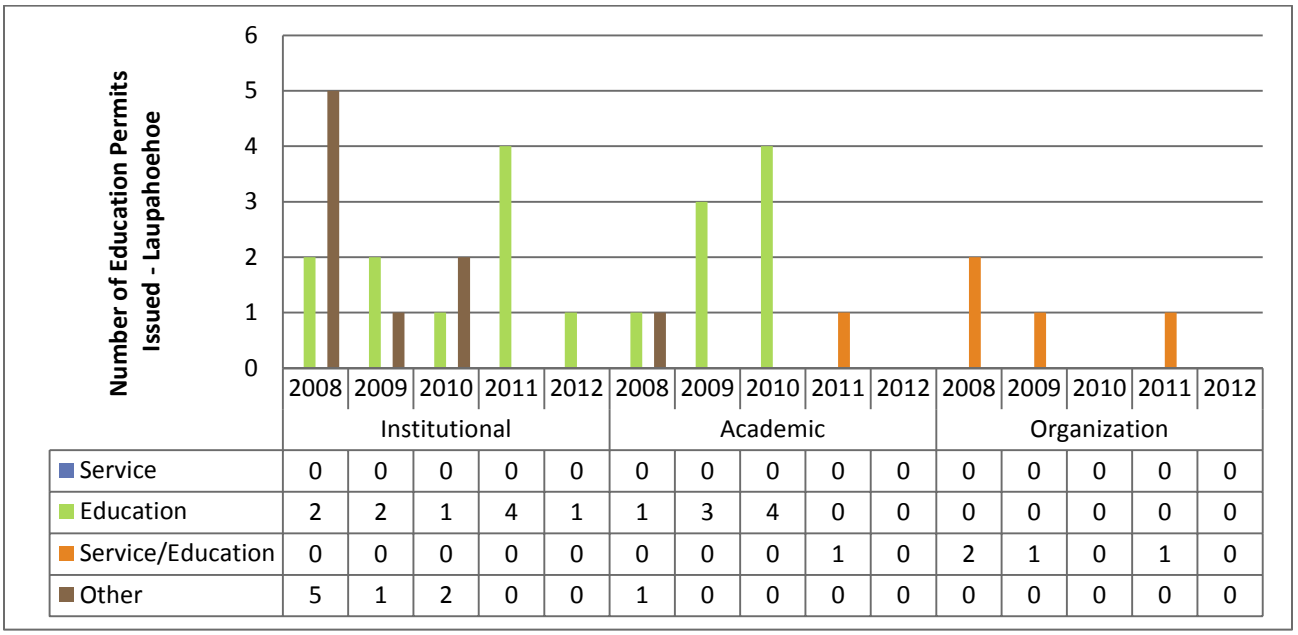
Hawaii Youth Conservation Corps

2012 marks the first year national Forest Service dollars ($51K) were distributed to Hawaii to support Youth Conservation Corps. The presence of the HETF opened the door for these funds to be available to Hawaii. Grant funds were matched by Kupu, a local non-profit that administers the Hawaii Youth Conservation Corps programs (HYCC). For five weeks of the program, two HYCC teams of six local youth worked with local land managers to remove invasive plant species, replant native species, collect native plant seeds, build fences for native plant species protection, census previous outplanting efforts, and participat in the installation of research plots which will track the effects of ungulates and invasive strawberry guava on forest hydrology. Each HYCC team focused their efforts in one of the HETF Units, but also had the opportunity to work together on adjacent public lands on ongoing watershed restoration projects.

2012 Hawaii Youth Conservation Corps Team: (L-R) Back row- Timothy DeAntonio, Paul Martin, Jensen Kohashi, Julian Agnese, Cheyenne Perry (*Mauna Kea Watershed Alliance Coordinator*); Middle row- Kawehi Lara-Aguirre, Travis Basford, Gared Taira, Kalyn Kanaeholo, Elsie Andaya-Bohol; Front row- HYCC team leaders Erin Kawakami and Magdalena Berger. Missing from picture: Hannah Pickett

Laupahoehoe Unit

Three participants on one trip visited the Laupahoehoe Unit in 2012 (Table 2). Christian Giardina (USFS) took two professors from the University of British Columbia, School of Forestry into the Laupahoehoe Unit to discuss the Tropical Forest Management program in British Columbia. The possibility of doing an exchange program was discussed as well as the topic of Hawaii's diverse ecosystems, plantations, and the HETF. A breakdown of trip totals, affiliation and type from 2008-2012 is detailed in Figure 6.



	Institutional					Academic					Organization				
	2008	2009	2010	2011	2012	2008	2009	2010	2011	2012	2008	2009	2010	2011	2012
Service	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Education	2	2	1	4	1	1	3	4	0	0	0	0	0	0	0
Service/Education	0	0	0	0	0	0	0	0	1	0	2	1	0	1	0
Other	5	1	2	0	0	1	0	0	0	0	0	0	0	0	0

Figure 6: Trip totals, affiliation and type of education/service/other trips taken in the HETF Laupahoehoe Unit from 2008-2012.

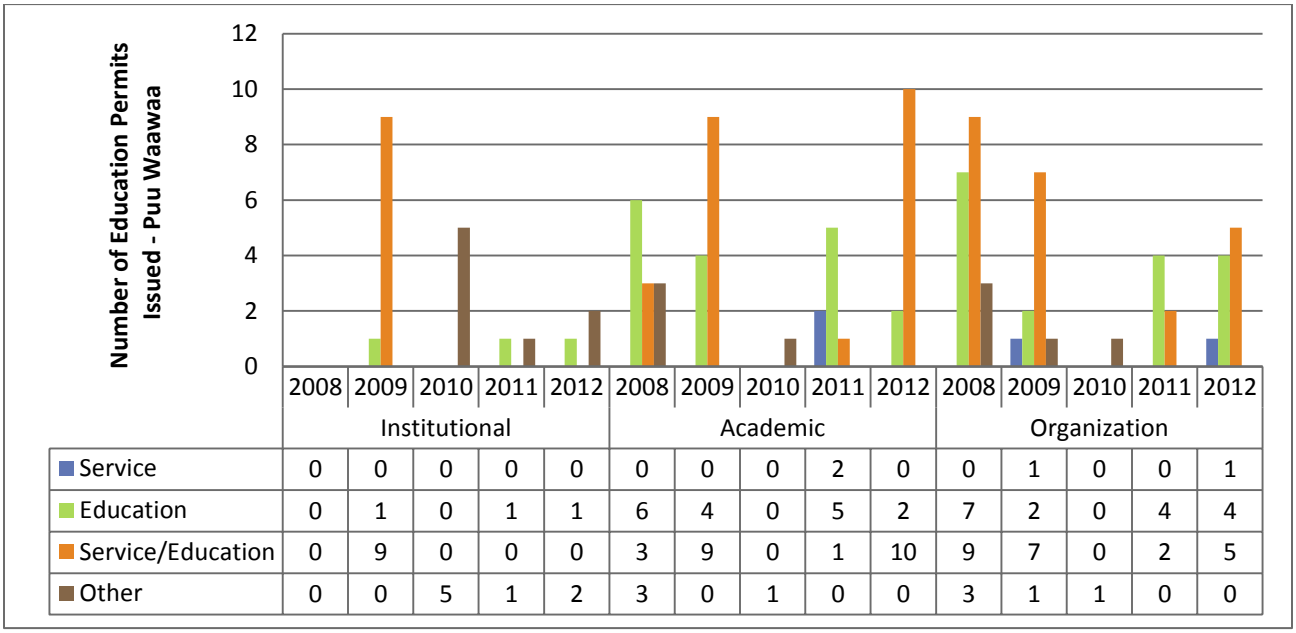
Table 2: Information relating to education/service/other trips taken in the HETF Laupahoehoe Unit in 2012.

Organization	Activity	Contact	Date	Group Size
USFS	Education	Christian Giardina	2/26/2012	3

Puu Waawaa Unit

Four hundred and eighty participants on 26 trips visited the Puu Waawaa Unit in 2012 (Table 3). A further breakdown of trip totals, affiliation and type from 2008-2012 is detailed in Figure 7. A few of the 2012 HETF education trips are detailed here.

- *Christopher Havran Ph.D. of Campbell University's Biology Department* led a Hawaiian Natural History class, introducing the students to the biotic diversity of Hawaiian forest ecosystems as well as threats and conservation practices within Hawaiian dry forests.
- *Scott Rowland of the University of Hawaii at Manoa* took a group of 22 participants into kipuka Oweowe to conduct invasive weed control and dryland forest restoration. This visit to the HETF was a part of the American Geophysical Union's Chapman Conference, celebrating 100 years of the Hawaiian Volcano Observatory. Part of this trip included a visit to the quarry to examine and discuss eruptive products.
- Several public and private schools from around the island visited the Unit in 2012. Individual classes from *Hualalai Academy, Malamalama Waldorf School, Honokaa Intermediate and High School; and Innovations Public Charter School* all held educational discussions in the Unit, on many current topics, such as, climate change, humans impact on the environment, reducing carbon footprints, endangered species, natural resource management, the history of Puu Waawaa, native plants, ecology and evolution of Hawaiian flora and fauna, ahupuaa land management systems, watersheds, dry forest ecosystems and their interconnections, geology of the Hawaiian islands, and the importance of preservation, conservation, restoration. Classes also participated in outplanting endangered native seedlings.



	Institutional					Academic					Organization				
	2008	2009	2010	2011	2012	2008	2009	2010	2011	2012	2008	2009	2010	2011	2012
Service	0	0	0	0	0	0	0	0	2	0	0	1	0	0	1
Education	0	1	0	1	1	6	4	0	5	2	7	2	0	4	4
Service/Education	0	9	0	0	0	3	9	0	1	10	9	7	0	2	5
Other	0	0	5	1	2	3	0	1	0	0	3	1	1	0	0

Figure 7: Trip totals, affiliation and type of education/service/other trips taken in the HETF Puu Waawaa Unit from 2008-2012.

Table 3: Information relating to education/service/other trips taken in the HETF Puu Waawaa Unit in 2012.

Organization	Activity	Contact	Date	Group Size
Weed Science Society of America	Education	James Leary	2/8/2012	50
Honokaa High & Intermediate School	Education/Service	Cindy Navarro-Bowman	2/10-11 2012	29
Hualalai Academy	Education/Service	Tina Flower	2/16/2012	20
USFS	Education	Alex Friend	3/19/2012	2
Honokaa High & Intermediate School	Education/Service	Cindy Navarro-Bowman	4/3/2012	52
Cornell University Earth & Atmospheric Sciences	Education/Service	Alexandra Moore	4/6/2012	19
Hualalai Academy	Education/Service	Tina Flower	4/26-27/2012	13
Campbell University, NC	Education/Service	Christopher Havran	6/10 - 12, 2012	12
Imi Pono no ka Aina	Education/Service	Lahela Camara	6/19/2012	12
Hope Services Hawaii	Education/Service	Gideon Ramos	6/20/2012	15
CA State Polytech University, Pomona	Education/Service	Erin Questad	7/11/2012	13
Napuu Water Inc.	Education	Rick Strojny	7/15/2012	14
Imi Pono no ka Aina	Education/Service	Lahela Camara	7/17/2012	16
Hope Services Hawaii	Education/Service	Gideon Ramos	7/18/2012	15
E Mau Na Ala Hele	Education/Service	Barbara Schaeffer	7/22/2012	14
Stani Franklin Film Production	Other	David Cunningham	7/30/2012	10
Sierra Club Moku Loa Group	Service	Linda Burnham Larish	8/11-12 2012	7
Stani Franklin Film Production	Other	Joel Angyal	8/21/2012	19
UH Manoa	Education	Scott Rowland	8/22/2012	22
Puu Waawaa Advisory Council	Education	Alan Nakagawa	8/23/2012	3
Three Mountain Alliance	Education	Elliott Parsons	8/30/2012	3
Hualalai Academy	Education/Service	Mary Elizabeth Sharma	9/19-21/2012	15
Malamalama Waldorf School	Education/Service	Tabetha Block	10/4/2012	15
The Kohala Center	Education/Service	Erica Perez	11/20/2012	38
UH – Windward CC	Education	Floyd W. McCoy	11/26/2012	17
UH Center at West Hawaii	Education/Service	Richard Stevens	12/1/2012	35

2012 HETF Concerns, Comments, and Challenges

Reported in 2012:

- Researchers had a slightly worrying sighting of crossbow hunters entering the park at the upper Kiholo carpark. ***Note: Kiholo State park is a no hunting zone (State of Hawaii, DLNR, DOFAW Map No. FW-0457:2002).***
    - *Researchers will wear high visibility vests to work in the park in the future*.
- Access constraints due to fire danger and drought affected project timing.

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?

Prior HETF Concerns, Comments, and Challenges that were addressed in 2012:

- A Management Plan is needed for the Laupahoehoe Unit in order to guide decision making.
    - *This plan is currently in progress and a working draft plan expected July 2013.*

2012 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. We do not remove any diacritical marks, correct punctuation, capitalization or grammatical errors.

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

Submitted: June 2012

Project Location(s): Puu Waawaa Forest Reserve
HETF Annual Report for Project Period: 06/2011-06/2012

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 current and historical maps, a publication related to dry forest change and the development of a topographic suitability index to guide restoration and management in tropical dry forests. The topographic habitat suitability model is also capable of predicting the locations of some threatened and endangered species at PTA, ecosystem productivity, and ungulate movement patterns. Products from this suitability model effort include a publication (now in preparation) and the attainment of an ESTCP award to further validate the approach and model using field demonstrations and readily available satellite imagery. To improve our understanding of altered fire regimes and devise methods to break the grass/wildfire cycle, we are using both remote sensing and field based experiments. At the landscape scale, we have developed the use of high temporal frequency satellite imagery to monitor near real-time fire fuel conditions. This product is available as a web tool and was introduced to DoD and other Hawaii based land managers through a one day workshop held in November 2011. Results from this project have also catalyzed 2 important efforts related to altered fire regimes; 1) we have secured funding to expand our fire modeling efforts at PTA to include scenario building comprising the anticipated role of climate change on fire in dry systems in Hawaii (led by post-doctoral researcher Dr. Andrew Pierce); and 2) the formation of the Pacific Fire Science Consortium – A means of transferring knowledge between scientists, resource managers, decision-makers, fire suppression agencies, and communities in Hawaii and the U.S. affiliated Pacific and a structured forum and process for identifying and prioritizing critical new areas of fire research. The consortium was recently funded (December 2011) by the Joint Fire Science Program. Field experiments now underway will provide baseline information on small-scale fuel conditions and potential fire behavior within a range of remnant dry forest community types. Field experiments are designed to simultaneously develop strategies for restoration of native species and test the effectiveness of restoration as a tool to reduce fine fuel loads and potential fire danger. Several of these studies are in the monitoring phase (greenstrip and restoration experiment) and several are in the analysis stage (post fire burn study, fire history/succesional study). However, early results point to a long history of fire (pre-human contact) as a driver of dry forest succession in Hawaii. Our post-fire seeding project (following a devastating fire in 2010) indicates that water may not be the only limiting resource for native forest restoration. Finally, through this project we have provided numerous opportunities for local students and volunteers. We have recently hired two local students from the Hawaii Community College with Natural Resource majors and we will support several interns this summer through the Pacific Internship Programs for

Exploring Science (PIPES).Our NSF-REU student Jenni Diep is completing a manuscript to be submitted to the Journal for Young Investigators based on her research project this summer validating the habitat suitability model. Mark Chynoweth, a UHM graduate student funded through this grant will defend and receive his Master's degree in spring 2012 and will submit several manuscripts for publication based on his PTA ungulate research. Our student hire Kealoha Kinney is now a PhD student at the University of Maryland and is submitting a publication on our collaborative work on tropical dry forest succession and the natural and anthropogenic role of fire. SERDP funded post-docs Erin Questad and Jim Kellner have recently both obtained jobs; Erin as an Assistant Professor, in the Biological Sciences Department from California State Polytechnic University, Pomona; and Jim, as an Assistant Professor, in the Department of Geography, from the University of Maryland.

Timeline *(including overall expected completion date)***:**
We have secured funding to expand the scope of this project to include an endangered species outplanting demonstration. Our current research will end 12/2013 - but with our additional project we anticipate using the site until 2016.

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.

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

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

Bibliography of Publications *(Publications should include work that was done in the HETF, including gray literature, conference presentations/posters, etc.)***:**
2008

Cordell, S. Asner, G.P., Thaxton, J., Kellner, J.R., Knapp, D.E., Kennedy-Bowdoin, T., Ambagis, S. Kinney, K.M., Questad, E., Selvig, M., Biggs, M., and Johansen, J. 2008. The Potential for Restoration to Break the Grass/Fire Cycle in Dryland Ecosystems in Hawai`i. SERDP/ ESTCP Partners in Environmental Technology Technical Symposium & Workshop, December 2-4. Washington D.C. (Published Abstract)

2009

Cordell, S., Asner, G.P., Thaxton, J. The Potential for Restoration to Break the Grass/Fire Cycle in Dryland Ecosystems in Hawai`i. SERDP 2009 Annual Report. Submitted February 12, 2009

Kellner, J.R., Asner, G.P., Kinney, K.M., Loarie, S.R., Knapp, D.E., Kennedy-Bowdoin, T., Questad, E., Cordell, S., and Thaxton, J.M. 2009. Seasonal dynamics and woodland community type regulate the fire fuel properties of the invasive grass Pennisetum setaceum. SERDP/ ESTCP Partners in Environmental Technology Technical Symposium & Workshop, December 1-3. Washington D.C. (Published Abstract)

Questad, E.J., S. Cordell, and D. Sandquist. Functional diversity and invasive species in Hawaiian forests. The 10th International Congress of Ecology. Brisbane, Australia. August 16-21, 2009. (Published Abstract)

2010

Chynoweth, M.W., Litton, C.M., Lepczyk, C.A., Cordell, S., and Kellner, J.R. 2010. Movement Ecology of Nonnative Feral Goats in Hawaiian Dryland Ecosystems. The Wildlife Society Conference, Snowbird, UT (Poster Presentation)

-Vertebrate Pest Conference: February 2010, Sacramento, CA. (Published Abstract)

-Tester Symposium: March 2010, University of Hawai'i at Manoa, HI

-Ecology Evolution and Conservation Biology Evoluncheon, University of Hawaii at Manoa, HI (Oral Presentation)

-CTAHR Symposium: April 2010, University of Hawai'i at Manoa, HI

-Hawai'i Conservation Conference: August, 2010, Honolulu, HI (Published Abstract).

Cordell, S., Asner, G.P., Thaxton, J. The Potential for Restoration to Break the Grass/Fire Cycle in Dryland Ecosystems in Hawai`i. SERDP 2009 Annual Report. Submitted February 1, 2010

Cordell, S., Kellner, J.R. 2010. The Potential for Restoration to Break the Grass/Fire Cycle in Dryland Ecosystems in Hawai`i. DoD Pacific Islands Threatened, Endangered, and At-Risk Species Workshop II, February 2-4, 2010. Honolulu, HI (Published Abstract)

Cordell, S. Restoration of ecosystems invaded by arid perennial grasses. Western Society of Weed Science, 2010 Annual Meeting. Waikoloa, HI. (Invited oral presentation).

Kellner, J.R. 2010. Remote sensing landscape fuel loads and an annual forb invasion. Western Society of Weed Science, 2010 Annual Meeting. Waikoloa, HI. (Invited oral presentation).

Kinney, K.M., Kellner, J.R., Selvig, M., Asner, G.P., Cordell, S., Questad, E., Thaxton, J.M. Knapp, D.E., Kennedy-Bowdoin, T. 2010. An Eye on Restoration: New Remote Sensing Approaches that Change the Way We See Dryland Ecosystem Restoration in Hawai`i. Environmental Management Publication. Volume 49, pg 4-5. (Non-Refereed Article)

Kinney, K.M., Asner, G.P. Kellner, J.R., Knapp, D.E., Kennedy-Bowdoin, T., Questad, E.J., Cordell, S., Thaxton, J.M. Remote sensing of potential restoration in a Hawaiian subalpine dry forest. Ecological Society of America Annual Meeting (2010), Pittsburgh, PA. (Published Abstract)

Moseley, R., Selvig, M., Questad, E., Cordell, S., and Thaxton, J. Restoration Potential of Three Hawaiian Dryland Ecosystems. 2010. Hawaii Conservation Conference, Honolulu, HI, (Published Abstract)

Questad, E.J., J. Kellner, K. Kinney, S. Cordell, J. Thaxton, and G. Asner. 2010. Increasing the impact and success of ecological restoration in Hawaiian dryland ecosystems. Partners in environmental technology technical symposium, US Department of Defense (Published Abstract).

Questad, E.J., J. Thaxton, and S. Cordell. 2009. Invasion resistance in Hawaiian tropical dry forests. Ecological Society of America (Published abstract).

Thaxton, J.M., Cole, T.C., Cordell, S., Cabin, R.J., Sandquist, D.R., and Litton, C.M. 2010. Native species regeneration following ungulate exclusion and non-native grass removal in remnant Hawaiian Dry Forest. Pacific Science. 64, 533-544. (Refereed Journal Article)

2011

Chynoweth, Mark; Litton, Creighton M.; Lepczyk, Christopher A.; Cordell, Susan. 2010. Feral goats in the Hawaiian Islands: understanding the behavioral ecology of nonnative ungulates with GPS and remote sensing technology. In: Timm, R.M.; Fagerstone, K.A., eds. Proceedings of the 24th Vertebrate Pest Conference; 2010, 41-45. (Refereed Journal Article)

Chynoweth, Mark W.; Litton, Creighton M.; Lepczyk, C.A.; Cordell, Susan; Asner, Greg P.; Kellner, James 2011. Habitat use by nonnative feral goats in Hawaiian dryland montane landscapes. Hawai'i Ecosystems Meeting, June 30-July 1, 2011, Hilo, HI (Oral presentation).

Chynoweth, Mark W.; Lepczyk, Chris A.; Litton, Creighton M.; Cordell, Susan. 2011. Movement patterns and habitat utilization of nonnative feral goats in Hawaiian dryland montane landscapes. Ecological Society of America Annual Meeting; 2011 August 7-12; Austin, TX. (Published abstract)

-Hawaii Conservation Conference--Island Ecosystems: The Year of the Forest; 2011 August 2-4; Honolulu, HI. Honolulu, HI: Hawaii Conservation Alliance: 39. (Oral Presentation). *awarded best student presentation of the conference

- Tester Symposium, March 16-18, 2011, University of Hawaii Honolulu, HI (Oral presentation).

- University of Hawaii, College of Tropical Agriculture and Human Resources Student Symposium, April 8-9, 2011, Honolulu, HI (Oral presentation).

-US Chapter of the International Association for Landscape Ecology 2011 Annual Symposium; 2011 April 3-7; Portland OR. Frostburg, MD; US-International Association for Landscape Ecology. (Published abstract)

Chynoweth, Mark 2011. Feral goats in Hawaiian dryland ecosystems - ecology and impacts. Nahelehele Dry Forest Symposium, February 25, 2011, Kailua-Kona, HI (Invited oral presentation).

Cordell, Susan; Questad, Erin J.; Kinney, Kealoha; Kellner, James R.; Thaxton, Jarrod; Asner, Greg P. 2011. Guiding ecological restoration in invaded landscapes. In: 96th Ecological Society of America Annual Meeting, 2011 August 7-12; Austin, TX. Poster abstract.

- Hawai'i Ecosystems Meeting, June 30-July 1, 2011, Hilo, HI (Oral presentation).

Cordell, Susan; Asner, Greg P.; Thaxton, Jarrod 2011. The potential for restoration to break the grass/fire cycle in dryland ecosystems in Hawai`i. SERDP 2010 Annual Report.

Cordell, Susan; Giardina, Christian; Nakahara, Miles; *Pickett Fee, Elizabeth; Stewart, Carolyn 2011. Development of Hawaii and U.S. Affiliated Pacific Island Fire Science Consortium. In: 2011 Hawaii Conservation Conference--Island Ecosystems: The Year of the Forest; 2011 August 2-4; Honolulu, HI. Honolulu, HI: Hawaii Conservation Alliance: 73. (Poster Abstract).

Kellner, J.R. Asner, G.P., Ambagis, S., Cordell, S., Thaxton, J, Kinney, K.M., Kennedy-Bowdoin, T., Knapp, T., Questad, T. In press Potential and limitations of historical aerial photography to

quantify vegetation dynamics in a tropical dry forest in Hawaii. Pacific Science. (Refereed Journal Article)

Kellner, J.R., Asner, G.P., Kinney, K.M., Loarie, S.R., Knapp, D.E., Kennedy-Bowdoin, T., Questad, E., Cordell, S., and Thaxton, J.M. 2011. Remote analysis of biological invasion and the impact of enemy release. Ecological Applications. 21(6) 2094-2104. (Refereed Journal Article)

Questad, Erin J. 2011. Restoration: the only hope for native plants in invaded drylands? Nahelehele Dry Forest Symposium, February 25, 2011, Kailua-Kona, HI (Invited oral presentation).

Questad, Erin J.; Cordell, Susan; Kinney, Kealoha; Kellner, James R.; Thaxton, Jarrod; Asner, Greg P. 2011. Guiding ecological restoration in invaded landscapes. In: US Chapter of the International Association for Landscape Ecology 2011 Annual Symposium; 2011 April 3-7; Portland OR. Frostburg, MD; US-International Association for Landscape Ecology. (Published abstract).

Questad, Erin J.; Cordell, Susan; Thaxton, Jarrod. 2011. Invasion and native species loss through local extinction. In: 96th Ecological Society of America Annual Meeting, 2011 August 7-12; Austin, TX. (Published abstract)

Questad, E.J.; Cordell, Susan; Uowolo, Amanda; 2011. A test of invasion mechanisms and restoration strategies in a subalpine dryland forest following a fire. Hawai'i Ecosystems Meeting, June 30-July 1, 2011, Hilo, HI (Oral presentation).

Thaxton, J.M., Cordell, S., Cabin, R.J., Sandquist, D.R. In press Non-native grass Pennisetum setaceum decreases water availability and seedling performance during Hawaiian dry forest restoration. Restoration Ecology. doi: 10.1111/j.1526-100X.2011.00793. (Refereed Journal Article)

Tools:

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

Cordell, Susan and colleagues - Hawaii Permanent Plot Network – Mamalahoa Site.

Submitted: October 2012

Project Location(s): Puu Waawaa Forest Reserve
HETF Annual Report for Project Period: 1/1/2011 - 12/31/2012

Status Update *(including any significant finding):*
Our long-term goal in the Hawai'i Permanent Plot Network (HIPPNET) is to establish several large-scale, permanent ecosystem monitoring plots in native-dominated forest across elevation and precipitation gradients throughout the Hawaiian Islands. Long-term forest dynamics plots have been established worldwide; these plots establish Hawaii as part of the Center for Tropical Forest Science (CTFS) network (www.ctfs.si.edu). The 100m by 100m plot in the PWW forest reserve and associated climate station (completed in May 2011) serves as a representative plot of tropical dry forests occurring on young lava flows. Stand density of the plot is approximately 80 trees. Metrosideros polymorpha is the dominant with other species such as Diospyros sandwicensis and Psydrax odorata present but less common. Currently the climate station at this site is recording a variety of climate related information including: air temperature, relative humidity, solar radiation, soil moisture and temperature, and others. Data is now being downloaded remotely via modem on a daily basis. Efforts are underway to create an automated QA/QC procedure to screen and organize data so it can be made available publicly.

Timeline (including overall expected completion date):
Indefinitely - this is a permanent forest dynamics plot.

Changes to Methodology (or other aspects of the project):
None

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 observances of T & E species – however the non-native tree species, Jacaranda and silk oak are relatively abundant. We would like to remove these from the plots as we hope to reduce the spread of the many non-native species present in the area.

Challenges *(encountered while working in the HETF):*
We had some difficutly connecting to our climate station via the remote cellular modem, although, with a new antenna the problem was resolved.

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

1. Hawai'i Conservation Conference, July/August 2012, Honolulu: VanDeMark, Joshua, Cordell, Susan, Giambelluca, Thomas, Giardina, Christian, Litton, Creighton, Inman-Narahari, Faith, Ostertag, Rebecca, Sack, Lawren. Annual patterns of demography in Hawaiian forests: The first two years of re-census in the Hawai'i Permanent Plot Network (HIPPNET).

2. Ecological Society of America conference, August 2012, Portland: Ostertag, Rebecca,Cordell, Susan, Giambellucca, Thomas,Giardina , Christian, Inman-Narahari, Faith, Litton, Creighton, Sack, Lawren. Decoupling of tropical forest structure and diversity: Stand characteristics, growth, and mortality in wet and dry Hawaiian forests and global comparisons

3. Hawai‘i Conservation Conference, August 2011, Honolulu: Ostertag, Rebecca, Inman-Narahari, Faith, Cordell, Susan, Giardina, Christian, Sack, Lawren. Structure of wet and dry Hawaiian forests of low diversity: global comparisons across tropical forests.

4. Hawai‘i Conservation Conference, August 2011, Honolulu: VanDeMark, Joshua, Cordell, Susan, Giambelluca, Thomas, Giardina, Christian, Litton, Creighton, Inman-Narahari, Faith, Ostertag, Rebecca, Sack, Lawren. Long term dynamics in Hawaiian forests: The first glimpse of forest demography from the Hawai’i Permanent Plot Network (HIPPNET).

5. Hawai‘i Conservation Conference, August 2011, Honolulu: Inman-Narahari, Faith, Ostertag, Rebecca, Cordell, Susan, Giardina, Christian, Murphy, Molly, Wailani-Nihipali, Kahealani, Sack, Lawren. What's going down and what's coming up: seed rain and seedling establishment of native species in Hawaiian wet forest.

6. Nāhelehele Dry Forest Symposium, February 2011, Keauhou: Inman-Narahari, Faith, Ostertag, Rebecca, Cordell, Susan, Giardina, Christian, Murphy, Molly, Wailani-Nihipali, Kahealani, Sack, Lawren, Pālamanui: a native dominated dry forest.

7. Botanical Society of America, August 2010, Providence, RI: Inman-Narahari, Faith, Ostertag, Rebecca, Cordell, Susan, Giardina, Christian, Sack, Lawren. Hawai'i permanent plot network: first census results and ongoing research.

8. Botanical Society of America, August 2010, Providence, RI: Inman-Narahari, Faith, Ostertag, Rebecca, Cordell, Susan, Giardina, Christian, Sack, Lawren. Seedling dynamics in native dominated Hawaiian rain forest.

9. Hawai'i Ecosystems Meeting, July, 2010, Hilo: Inman-Narahari, Faith, Ostertag, Rebecca, Cordell, Susan, Giardina, Christian, Sack, Lawren. Tree regeneration and physiology across forest types.

10. Ecological Society of America, August 2009, Albuquerque, NM: Nelson-Kaula, Kehauwealani, Inman-Narahari, Faith, Ostertag, Rebecca, Giardina, Christian, Cordell, Susan, Sack, Lawren. Electronic data collection methods for tree and seedling census data in forest dynamics plots.

11. Ecological Society of America, August 2009, Albuquerque, NM: Inman-Narahari, Faith, Nelson-Kaula, Kehauwealani, Ostertag, Rebecca, Cordell, Susan, Giardina, Christian Sack, Lawren. Regeneration patterns in a native dominated Hawaiian montane wet forest.

Publications:

1. Inman-Narahari, F., Giardina, C., Ostertag, R., Cordell, S. and Sack, L. 2010. Digital data collection in forest plots. Methods in Ecology and Evolution 1: 274-279.

2. Sack, L. Inman-Narahari, F., Cordell, S., Giardina, C., and Ostertag, B. 2010. Forest Dynamics Plots Established in Hawai‘i to Track Tree Regeneration Patterns and Climate Change Responses. UCLA Institute of the Environment, Center for Tropical Science Newsletter. http://www.ioe.ucla.edu/ctr/news/article.asp?parentID=6406

3. Ostertag, R., Inman-Narahari, F.M., Cordell, S., Giardina, C.P., and Sack, L. In review. Structure of wet and dry Hawaiian forests of low diversity: global comparisons across tropical forests.

4. Inman-Narahari, Ostertag, R., Cordell, S. F., Giardina, C. and Sack, L., In preparation. Recruitment limitation of tropical forest trees: seedling abundance and distribution across microhabitats in relation to seed abundance.

Hughes, Richard Flint - Assessing forest structure, community composition, diversity, carbon mass, and biomass on a landscape scale in the Hawaii Experimental Forest.

Submitted: February 2012

Project Location(s): Laupahoehoe Unit Forest Reserve and NAR
HETF Annual Report for Project Period: 01/2011-01/2012

Status Update *(including any significant findings)*:
None to report that have not been reported already. The significant milestone is that all the rebar marking the sites has been replaced with blunt nails for safety sake.

Timeline *(including overall expected completion date)*:
Plots are not planned to be remeasured in the near future, but will be remeasured again as time and funding permits.

Changes to Methodology *(or other aspects of the project)*:
None, except again to say that all rebar and PVC has been removed completely.

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

Challenges *(encountered while working in the HETF)*:
None that are noteworthy.

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

Asner GP, Hughes RF, Mascaro J, Uowolo AL, Knapp DE, Jacobson J, Kennedy-Bowdoin T, Clark JK. 2011. High-resolution carbon mapping on the million-hectare Island of Hawai'i. Frontiers in Ecology and the Environment doi:10.1890/100179

Asner GP, Powell GVN, Mascaro J, Knapp DE, Clark JK, Jacobson J, Kennedy-Bowdoin T, Balaji A, Paez-Acosta G, Victoria E, Secada L, Valqui M, Hughes RF. 2010. High-resolution forest carbon stocks and emissions in the Amazon.

Asner GP, Hughes RF, Varga TA, Knapp DE, Kennedy-Bowdoin T. 2009. Environmental controls over aboveground biomass throughout a tropical rain forest. Ecosystems 12:261-278.

Asner GP, Hughes RF, Vitousek PM, Knapp DE, Kennedy-Bowdoin T, Boardman J, Martin RE, Eastwood M, Green RO. 2008. Invasive plants transform the three-dimensional structure of rain forests. Proceedings of the National Academy of Science 105:4519-4523

Asner GP, Jones MO, Martin RE, Knapp DE, Hughes RF. 2008. Remote sensing of native and invasive species in Hawaiian forests. Remote Sensing of the Environment 112:1912-1926

Asner GP, Knapp DE, Kennedy-Bowdoin T, Jones MO, Martin RE, Boardman J, Hughes RF. 2008. Invasive species detection in Hawaiian Rainforests using in flight fusion of airborne imaging spectroscopy and LiDAR.

Hughes, Richard Flint - FIA Inventory of Hawaii's Forests.

Submitted: February 2012

Project Location(s): Laupahoehoe Forest Reserve and NAR; Puu Waawaa Forest Reserve and Wildlife Sanctuary
HETF Annual Report for Project Period: 01/2011-01/2012

Status Update *(including any significant findings)***:**
Approximately 98% of the inventory plots have been successfully installed and measured over the course of last year. Only a handful remain to be done.

Timeline *(including overall expected completion date)*:
We expect to be completed with this work well before June 2012.

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)*:
Yes many noteworthy observations will be forthcoming once we begin analysis of the FIA plot data that is currently being pre-processed in Portland by the analysts in the PNW Portland office (USFS).

Challenges *(encountered while working in the HETF)*:
The most challenging aspect involved getting to some of the very remote parts of the wet and dry units of the HETF.

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

Hughes RF, Asner GP, Uowolo A, Mascaro J. 2011. Determining forest carbon across the Hawaiian Islands: Use of FIA plots and LiDAR. Paper, Society of American Foresters Convention in Honolulu, HI (11/06/11).

Tango LKK, Franklin H, Hiraoka K, Murphy M, Hughes RF. 2011. Forest Inventory & Analysis: Witnessing forest change. Paper, Hawai'i Conservation Conference in Honolulu, HI (08/03/11).

Hughes RF, Asner GP, Uowolo A, Mascaro J. 2011. Determining forest carbon across the Hawaiian Islands: Use of FIA plots and remote sensing (LiDAR) approaches. Paper, Hawai'i Conservation Conference in Honolulu, HI (08/03/11).

Franklin H, Tango LKK, Hiraoka K. Murphy M, Hughes RF. 2011. Forest Inventory & Analysis: Witnessing forest change. Paper, Hawai'i Ecosystems Meeting, in Hilo, HI (06/30/11).

Hughes, R F and colleagues - Quantifying nitrogen dynamics and magnitude of water loss from Kiawe forests in North Kona - Kiholo Bay.

Submitted: May 2012

Project Location(s): Puu Waawaa State Park (Kiholo)
HETF Annual Report for Project Period: 04/2011-04/2012

Status Update *(including any significant findings)*:
Many aspects of the project have been initiated and are now ongoing or completed. The Prosopis pallida individuals were instrumented with their respective sapflow probes and monitored on an ongoing basis for the past 21 months. This work is providing real time water fluxes for individual stems that is being scaled up to the tree and stand scale. This scaling up process has been accomplished by linking velocity measures of water transport through sap wood of instrumented trees with relationships of sapwood area to stem diameter determined from cross sections of sampled P. pallida stems of both upland and lowland study sites. Stand level stem density and basal diameter measures have been completed and stand-level estimates of biomass are still being developed. Bi-monthly leaf area index measures of upland and lowland stands began in May 2011, but were ceased in July 2011 due to difficulties in obtaining accurate measurements at the sparsely wooded upper site. Quarterly measurements of P. pallida physiology and water use, begun in December 2010 are continuing, along with constant rainfall, humidity and temperature monitoring at all sites. Water stress is measured quarterly using water potential and photosynthetic efficiency, while water use efficiency is estimated using delta 13C of leaf tissue. Relative contributions of groundwater and rainfall to P. pallida trees are being assessed using quarterly analysis of stem sap, groundwater and shallow soil water delta 18O, and delta 18O of individual rainfall events (since May 2011). Nutrient status of P. pallida is being assessed using quarterly measurement of %N, %P and delta 15N of leaf tissue. Three measurement periods of soil nitrogen dynamics (i.e., net N-mineralization) are now completed at both upland and lowland sites, these include a one month heavy rainfall simulation, in which we adding di-ionized water to the N-min tubes. This simulation was necessary due to the low rainfall levels in winter 2011/2012. Two further 3-month insitu incubations and one 1-month heavy rainfall simulation remain to be completed at each of the 5 forest plots located at both upland and coastal sites. We have also now completed 8 of the 12 monthly collection of litter from litter traps placed within each plot at each study site. In addition we have measured the stand-level biomass and set up litter collecting stations around the one and only P. pallida-dominated pond that is located in the Kiholo Bay area and that is included in our larger study of the influence of vegetation type on anchialine ponds chemistry and biology. Litter collections and water collections at this pond are underway; Litter collections will continue until November 2012 and litter collections will continue until March 2013.

Timeline *(including overall expected completion date)*:
Sapflow and weather station data collection is due to be completed in March 2013, along with litter collections around the single anchialine pond study site at Kiholo. Nitrogen mineralization core work, and litter collections will be completed by September 2012, and the final quarterly sampling of Kiawe physiological parameters (water potential, stem sap and leaf tissue chemistry), shallow soil, rainfall and groundwater isotope chemistry, will also be in September 2012.

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

We propose to investigate the possibility of deducing decadal trends of groundwater availability and nitrogen dynamics in Kiawe through examination of tree ring oxygen, hydrogen and nitrogen stable isotope ratios. In particular, this promises to be an elegant method of examining changes in drawdown of aquifer water near the shoreline by Kiawe trees, and trends in nitrogen flow to groundwater over the last 150 years. This will require cutting of several tree cookies at the upland and lowland sites.

Noteworthy Observations *(including the presence of T&E species, new observances of invasive species, and/or human activity or disturbances in the area)*:
Abundance of feral cats and goats. Better management of people. Incredibly dry year - winter in particular was virtually precipitaion free. Bow hunters seen in late April 2012 at the upper Kiholo carpark.

Challenges *(encountered while working in the HETF)*:
We had a slightly worrying sighting of crossbow hunters entering the park at the upper Kiholo carpark last week. We will wear high visibility vests to work in the park in the future.

Bibliography of Publications *(Publications should include work that was done in the HETF, including gray literature, conference presentations/posters, etc.)*:
No publications to list at present.

Relevant Presentations:

Bruce Dudley, RF Hughes, R Ostertag, Y Miyazawa, TW Giambelluca , Groundwater availability alters soil nitrogen inputs in a leeward stand of Kiawe (Prosopis pallida). Weed Science Society of America meeting, Kona, 2012.

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

Submitted: May 2012

Project Location(s): Laupahoehoe Forest Reserve
HETF Annual Report for Project Period: 06/2011 - 06/2012

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 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)*:
Two modifications to our research in the HETF are being proposed for the coming year, and are outlined in detail in our permit renewal application. First, we will be conducting a litter decomposition study to examine how decomposition of ohia litter responds to temperature. Second, we will be initiating a long-term soil carbon formation and decomposition experiment to better understand: (1) belowground responses to nutrient supply; and (2) impacts of temperature on the formation and decomposition of carbon in soil, which is the largest and most important carbon pool in terrestrial ecosystems.

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 of research other than the typical vandalism that occurs in our plots (markers and equipment moved and destroyed).

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.)*:

Publications (Reverse Chronological Order)

Litton, C.M., Giardina, C.P., Albano, J.K., Long, M.S., Asner, G.P. 2011. The magnitude and variability of soil-surface CO2 efflux increase with temperature in Hawaiian tropical montane wet forests. Soil Biology & Biochemistry 43:2315-2323.

Mascaro, J., Litton, C.M., Hughes, R.F., Uowolo, A., Schnitzer, S.A. 2011. Minimizing bias in biomass allometry: Model selection and log-transformation of data. Biotropica 43:649-653.

McKinley, D.C., M. G. Ryan, R.A. Birdsey, M.E. Harmon, R. B. Jackson, C. P. Giardina, R. A. Houghton, L. S. Heath, B. C. Murray, J. F. Morrison, D. E. Pataki, K. E. Skog. On forests and carbon storage in the United States: a synthesis of current knowledge. Ecological Applications: In Press.

Giardina, C. 2011. Carbon dynamics: processes, pools and fluxes, and regional differences. A Carbon Management Short Course for Land Managers. (http://www.fs.fed.us/ccrc/).

Ryan, M. G., M. E. Harmon, R. A. Birdsey, C. Giardina, L. S. Heath, R. A. Houghton, R. B. Jackson, D. C. McKinley, J. F. Morrison, B. C. Murray, D. E. Pataki, K. E. Skog. 2010. A Synthesis of the Science on Forests and Carbon for US Forests. Issues in Ecology, Report Number 13.

Giardina, C. 2008. Forests. Encyclopedia of Global Warming and Climate Change. Sage Publications, Inc, 1552 p. (Invited; Refereed).

Giardina, C. 2008. Gross Primary Production. Encyclopedia of Global Warming and Climate Change. Sage Publications, Inc, 1552 p. (Invited; Refereed).

Giardina, C. 2008. Soil Organic Carbon. Encyclopedia of Global Warming and Climate Change. Sage Publications, Inc, 1552 p. (Invited; Refereed).

Litton, C.M., Giardina, C.P., 2008. Below-ground carbon flux and partitioning: Global patterns and response to temperature. Functional Ecology 22, 941-954.

Litton, C.M., Kauffman, J.B., 2008. Allometric models for predicting aboveground biomass in two widespread woody plants in Hawaii. Biotropica 40, 313-320.

Presentations (Reverse Chronological Order)

Giardina, C.P., Litton, C.M. and Crow, S.E. 2011. Response of total belowground carbon flux and soil organic carbon storage to increasing mean annual temperature in Hawaiian tropical montane wet forest. American Geophysical Union Annual Meeting, San Francisco, CA

Giardina, C. 2011. Overview of Research being conducted in the Laupahoehoe unit of the Hawaii Experimental Tropical Forest. Quarterly Meeting of the Laupahoehoe Advisory Council, Laupahoehoe, HI.

Giardina, C. 2011. Carbon dynamics: processes, pools and fluxes, and regional differences. USFS Workshop on Forest and Grassland Carbon in North America: a Carbon Management Short Course for Land Managers. Slade, Kentucky.

Iwashita, D., Litton, C.M., and Giardina C. 2011. Does temperature impact coarse woody debris and dead tree fern biomass in Hawaiian tropical montane wet forests? Ecological Society of America Annual Meeting, Austin, TX

Iwashita, D., Litton, C.M., and Giardina C. 2011. Role of coarse woody debris and dead tree ferns in Hawaiian tropical montane wet forests. Hawai'i Conservation Conference, Honolulu, HI

Iwashita, D., Litton, C.M., and Giardina C. 2011. Temperature impacts on native plant diversity and regeneration in Hawaiian tropical montane wet forests. College of Tropical Agriculture and Human Resources Student Symposium, University of Hawaii at Manoa, HI

Litton, C.M. and Giardina, C.P. 2011. The magnitude and variability of soil-surface CO2 efflux increase with mean annual temperature in Hawaiian tropical montane wet forest. American Geophysical Union Annual Meeting, San Francisco, CA

Litton, C.M., Giardina, C. and Crow, S.E. 2011. Soil carbon storage does not vary with temperature along a 5.2°C mean annual temperature gradient in Hawaiian tropical montane wet forests. Ecological Society of America Annual Meeting, Austin, TX

Litton, C.M. and Giardina, C. 2011. Increased carbon flux to belowground drives increased soil respiration with rising mean annual temperature. Hawaii Ecosystems Meeting, Hilo, HI

Freeman, K.R., Litton, C.M. and Giardina, C. 2010. Litterfall and soil respiration across a 5°C MAT gradient in Hawaiian Wet Forest. Hawaii Ecosystems Annual Meeting, Hilo, HI

Giardina, C. 2010. Model systems for ecological research: some new ones for Hawaii researchers. University of Hawaii at Hilo – the Tropical Conservation Biology and Environmental Science Lecture Series, Hilo, HI.

Giardina, C. 2010. Next generation model systems in Hawaii for asking ecological and socio-ecological questions. University of Hawaii at Manoa – Botany Department Lecture Series, Honolulu, HI.

Giardina, C. 2010. Where are we and where are we going? Future experiments for understanding soil carbon decomposition responses to climate change. Soil Carbon Processes Workshop, Golden, CO.

Iwashita, D., Litton, C.M., and Giardina C. 2010. Impact of mean annual temperature on native wet forest structure and biodiversity in Hawai'i. Tester Symposium, University of Hawaii at Manoa, HI

Iwashita, D., Litton, C.M., and Giardina C. 2010. Impact of mean annual temperature on native wet forest structure and biodiversity in Hawai'i. College of Tropical Agriculture and Human Resources Student Symposium, University of Hawaii at Manoa, HI
Iwashita, D., Litton, C.M., and Giardina C. 2010. Temperature impacts on native wet forest structure and biodiversity in Hawai'i. Hawai'i Conservation Conference, Honolulu, HI
Iwashita, D., Litton, C.M., and Giardina C. 2010. Biodiversity, coarse woody debris, and seedling establishment across a 5°C mean annual temperature gradient in Hawaiian wet forests. Hawaii Ecosystems Annual Meeting, Hilo, HI

Litton, C.M. and Giardina, C. 2010. Carbon input and partitioning across a 5°C mean annual temperature gradient in Hawaiian wet tropical forests. Ecological Society of America Annual Meeting, Pittsburgh, PA

Litton, C.M. 2010. Carbon input and partitioning along a 5°C mean annual temperature gradient in Hawaiian wet tropical forests. University of Hawaii at Manoa, Department of Geography, Departmental Seminar Series, Honolulu, HI

Litton, C.M. and Giardina, C. 2010. Carbon partitioning across a 5°C mean annual temperature gradient in Hawaiian wet tropical forests. Hawaii Ecosystems Meeting, Hilo, HI

Giardina, C. 2009. Methods for examining soil carbon decomposition to climate change: strengths and weaknesses. International Soil Organic Matter Workshop, Colorado Springs, CO.

Litton, C.M. and Giardina, C.P. 2009. Carbon input and partitioning across a 5°C mean annual temperature gradient in Hawaiian wet tropical forests. American Geophysical Union Annual Meeting, San Francisco, CA

Litton, C.M., Sandquist, D.R. and Cordell, S. 2009. Impacts of nonnative grass invasion and precipitation variability on carbon partitioning in a Hawaiian tropical dry forest. Ecological Society of America Annual Meeting, Albuquerque, NM

Litton, C.M. and Giardina, C.P. 2009. Impact of MAT on ecosystem carbon storage, flux and partitioning in native Hawaiian wet forests. Hawaii Ecosystems Meeting, Hilo, HI

Litton, C.M. and Giardina, C.P. 2008. Belowground carbon flux and partitioning: Global patterns and response to temperature. American Geophysical Union Annual Meeting, San Francisco, CA

Litton, C.M. and Giardina, C.P. 2008. Impacts of climate change on terrestrial carbon cycling: Infrastructure and research in the Hawaii Experimental Tropical Forest, Laupahoehoe. Hawaii Ecosystems Meeting, Hilo, HI

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

Submitted: September 2012

Project Location(s): Puu Waawaa Forest Reserve and Forest Bird Sanctuary
HETF Annual Report for Project Period: 01/2012-12/2012

Status Update (including any significant findings)**:**
In 2012, surveys were conducted in 7 caves having a combined length of 20,775 feet (3.93 miles). The caves are in three general areas in accordance with the permit.

1. Mauka subunit, HETF. This area, extending from the vicinity of Pu`u Iki mauka to the makai boundary of the Sanctuary subunit, contains a very high concentration of cave entrances and voluminous lava tube caves in a 3000-5000 year old flow. Survey work continued in the largest of these caves; Hapu`u Cave, containing nearly 15,000 feet of passages and extending over a vertical range of 750 feet. In 2012, 10,293 feet of passages were surveyed in this cave with it continuing makai and also mauka. The mauka end of the cave passes beneath the boundary fence at the lower end of the Wildlife Sanctuary and continues mauka toward other caves that have been surveyed. Hapu`u Cave contains numerous fossil bird bones, some of which have been previously identified by ornithologists. Surveys were also conducted in two nearby caves: Delissea Cave and Pig Fence Cave with 3,122 feet of passages surveyed in these adjacent caves. Although both of these caves pass beneath the Wildlife Sanctury fence and indeed, join on the mauka side of this fence, the passage in Delissea Cave does not contain fencing to prevent pigs from crossing into the Wildlife Sanctuary from below. In addition to the surveys, project team members accompanied Dr. Helen James to one of the caves on the Wildlife Preserve in March 2012 to provide support as part of a documentary being produced that describes her ornithology findings in one of the caves that we had previously surveyed (Display Cave/Upper Owl Cave).
2. Makai Subunit, HETF. Access is via the Old Kiholo Road on the makai side of Rt. 190. Survey work took place in three caves about 2 miles below Rt. 190. Surveys were completed in two of these and continue in the third. In Aluminum Ladder Cave, a survey reached the makai end of the cave in a lava seal; total passage length is 5,774 feet and work in this cave is complete. A lateral fire road extending west from the Old Kiholo Road crosses a 3000-5000 year old flow about a mile to the west; this flow contains numerous large volume caves extending mauka-makai. One of these; Fire Road Cave #10, was surveyed to a makai end, just above the Fire Road. Mauka, this cave ends at the lower end of a 400 foot long trench with a continuation (Stone Step Cave) at the mauka end of the trench. Stone steps just inside one of the entrances to this cave were the only evidence of previous use of this cave; no cultural materials were observed further in the cave. In 2012, 1,931 feet of passages were surveyed in a single visit with the cave continuing.
3. Pu`u Anahulu flow. A 3,000-5,000 year old flow extends for five miles from the makai side of Rt. 190 to Rt. 19. The flow is bounded by the 1859 flow on the west and the Puu Anahulu Cooperative Game Management Area on the east. Surveys were conducted in two shallow complex braided caves on the west side of the flow 2 with 3,640 feet of passage surveyed. Neither cave contained cultural materials.

Timeline (including overall expected completion date)**:**

January 2013-December 2013; actual completion date is open ended; depending on the needs of the HETF.

Changes to Methodology (or other aspects of the project)**:**
No changes were made to the methodology used to locate, document, and survey the caves or to that used to produce cave maps and overlays. If HETF uses GIS tools, then the cave entrance locations and map outlines can be used as layers on ArcView.

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 see any threatened or endangered species in the lava tubes but did observe, as expected for the area, fossil bird bones and in places, slimes on the passage walls, indicative of microbial activity. Cave slimes in other Hawai`i lava tubes have been sampled and their DNA sequenced by Dr. Diana Northup at the University of New Mexico. This is a possible future activity, subject to issuance of a collecting permit (not requested at this time).

Challenges (encountered while working in the HETF)**:**
Routine natural challenges encountered include accessing the cave entrances, avoiding native vegetation when traversing the flows, not disturbing bird bones and other features in the caves while surveying, and working within constraints imposed by poor weather, property closures due to fire danger and drought, and other HETF constraints on access.

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 conducted is on the documentation of the extent and contents of the caves on Pu`u Wa`awa`a through the completion of cartographic surveys, topographic map and air photo overlays, additions to a spreadsheet of cave names, locations, and features, and written descriptions of the caves surveyed. This information is provided to the HETF and DOFAW on a periodic basis.

Stone, Fred D. - Barcoding on Hawai'i Island: Caconemobius Project.

Submitted: May 2012

Project Location(s): Puu Waawaa Forest Reserve
HETF Annual Report for Project Period: 01/2009--12/2009

Status Update (including any significant findings):
Eight bait traps containing shrimp paste bait and propylene glycol preservative were placed in a lava tube in Pu'u Wa'a Wa'a (3600 feet elevation, N. 95 deg. 45.07', W 155 deg. 51.3') with the purpose of collecting Caconemobius crickets. The traps were left for six days, from 07/17/2009 to 07/23/2009. No crickets were collected, but many other inverterbrates were collected. These included: 1 snail, 1 spider, 7 amphipods, 27 millipedes, about 20 collembola, 30-40 diptera (plus several larvae and pupae), 3 coleoptera (Staphylinidae, cave adapted), 3 aphids, 1 hymenoptera, 2 lepidoptera. All specimens were preserved in 95% etoh, and were given to Dr. Jon Giffen to add to the invertebrate collection from Pu'u Wa'a Wa'a.
Although no Caconemobius crickets were collected, poor health prevented further collection trips.

Timeline (including overall expected completion date):
If the applicant is able to continue this research in the future, a new application will be submitted.

Changes to Methodology (or other aspects of the project):
The method was successful in capturing a significant cross section of the invertebrates, and would be used in the event that future research is proposed.

Noteworthy Observations (including the presence of T&E species, new observances of invasive species, and/or human activity or disturbances in the area):
The cave adapted Staphylinid beetle is a significant finding. No evidence of human disturbance to the cave was observed.

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

Bibliography of Publications (Publications should include work that was done in the HETF, including gray literature, conference presentations/posters, etc.):
Since no Caconemobius crickets were collected, they could not be included in the research.

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

Submitted: January 2012

Project Location(s): Laupahoehoe Forest Reserve
HETF Annual Report for Project Period: 11/2010 – 10/2011

Status Update *(including any significant findings)*:
We report progress for ongoing studies of the structure and biogeochemistry of Hawaiian forests, which our group has been working on at Laupahoehoe since 1990. In the past year, we have published an analysis of the canopy structure and turnover of the Laupahoehoe forest, making use of two LiDAR overflights by the Carnegie Airborne Observatory in 2007 and 2009. From this highly detailed information, we were able to evaluate the rate of treefall gap formation (for tree and branchfalls of different sizes) across the whole Laupahoehoe landscape. This information was published in the journal ECOSYSTEMS and a pdf will be forwarded with this report.
‘ In addition, we have continued to use a site within the Laupahoehoe forest as an important point on an age gradient across the Hawaiian Islands, with all sites at similar elevation and rainfall but varying in soil age from ~ 300 years near Volcanoes National Park to ~ 4.1 million years near Kokee, Kauai. Our site at Laupahoehoe is at 1200 m, west of Blair Road, between the road and the Waipunalei boundary.
Laupahoehoe is the largest-stature and highest-nutrient forest along the gradient, and so it gives us a clear idea of what is possible given those conditions of elevation and rainfall. In the past year we have continued work in this area in several dimensions – including detailed characterizations of soils and the movement of dissolved organic matter through soils (Kramer et al in press), of the relative importance of nutrients, plant tissue chemistry, and soil biota in controlling decomposition and nutrient turnover (Cleveland et al submitted, and manuscript in preparation), and of methods for characterizing the nature and properties of plant chemistry, and its influence on soils (Stewart et al. in press). As these make their way into publication, I will send them to HETF.

Timeline *(including overall expected completion date)***:**
We plan to continue to work in Laupahoehoe as a part of the age gradient across the islands in the coming year; I anticipate that I will work in the core site on our gradient this summer. The work in Laupahoehoe is long-term (since 1990) and ongoing.

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)***:**
In winter 11, I found mesh spread on the forest floor in our core site - as if someone were trying to collect a lot of litter fast for a dec omposition experiment. Clearly abandoned.

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.)***:**

Benner, J., P.M. Vitousek, and R. Ostertag. 2010. Nutrient cycling in tropical montane cloud forest. p 90-100. In Bruijnzeel, L.A., J. Juvik, and F. Scatena (eds.), Tropical Montane Cloud Forests. Cambridge University Press

Kellner, J. R., G. P. Asner, P. M. Vitousek, M. A. Tweiten, S. Hotchkiss, O. A. Chadwick. 2011. Dependence of forest structure and dynamics on substrate age and ecosystem development. Ecosystems DOI: 10.1007/s10021-011-9472-4.

Peltzer, D.A., D.A. Wardle, V.J. Allison, T.W. Baisden, R.D. Bardgett, O.A. Chadwick, L.M. Condron, R.L. Parfitt, S. Porder, S.J. Richardson, B.L. Turner, P.M. Vitousek, J. Walker, and L.R. Walker. 2010. Understanding ecosystem retrogression. Ecological Monographs 80:509–529. [doi:10.1890/09-1552.1]

Reed, S.C., Townsend, A.R., Taylor, P.G. and Cleveland, C.C. 2011. Phosphorus cycling in tropical forests growing on highly weathered soils. p. 339-369, in Bunemann, E.K. (editor), Phosphorus in Action – Biological Processes in Soil Phosphorus Cycling

Reed, S.C., P.M. Vitousek, and C.C. Cleveland. 2010. Nutrient limitation in terrestrial ecosystems: are belowground patterns consistent with those aboveground? Biogeochemistry. DOI: 10.1007/s10533-010-9522-6

Vitousek, P.M., C.M. D'Antonio, and G.P. Asner. 2011. Invasions and ecosystems: vulnerabilities and the contribution of new technologies. p. 277-288, in Richardson, D.M. (editor), Fifty Years of Invasion Ecology: The Legacy of Charles Elton. Wiley-Blackwell, Chichester.

Yeh, Aileen - Forest Disease Monitoring for Rust Disease affecting Ohia Lehua.

Submitted: February 2012

Project Location(s): Laupahoehoe Forest Reserve and NAR
Annual Report for Project Period: 04/2011 -- 4/2012

Status Update *(including any significant findings):*
Monitoring study is ongoing.

Timeline *(including overall expected completion date):*
12/31/2012

Changes to Methodology *(or other aspects of the project):*
None

Noteworthy Observations *(including the presence of T&E species, new observances of invasive species, and/or human activity or disturbances in the area):*
Incidence of Puccinia psidii (Ohia rust) was observed in the Forest more during the latter part of 2011. Incidence was also high on regrowing ohia which had been browsed by cattle in the pasture. It was not observed on any species other than Metrosideros polymorpha. No plants appeared to be killed by the rust.

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.):*
Nothing new published.

HETF Related Citations

Citations listed below have been submitted since the publication of the 2011 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.

Asner GP, Hughes RF, Mascaro J, Uowolo AL, Knapp DE, Jacobson J, Kennedy-Bowdoin T, Clark JK. 2011. High-resolution carbon mapping on the million-hectare Island of Hawai'i. Frontiers in Ecology and the Environment doi:10.1890/100179.

Asner GP, Powell GVN, Mascaro J, Knapp DE, Clark JK, Jacobson J, Kennedy-Bowdoin T, Balaji A, Paez-Acosta G, Victoria E, Secada L, Valqui M, Hughes RF. 2010. High-resolution forest carbon stocks and emissions in the Amazon.

Asner GP, Hughes RF, Varga TA, Knapp DE, Kennedy-Bowdoin T. 2009. Environmental controls over aboveground biomass throughout a tropical rain forest. Ecosystems 12:261-278.

Asner GP, Hughes RF, Vitousek PM, Knapp DE, Kennedy-Bowdoin T, Boardman J, Martin RE, Eastwood M, Green RO. 2008. Invasive plants transform the three-dimensional structure of rain forests. Proceedings of the National Academy of Science 105:4519-4523.

Asner GP, Jones MO, Martin RE, Knapp DE, Hughes RF. 2008. Remote sensing of native and invasive species in Hawaiian forests. Remote Sensing of the Environment 112:1912-1926.

Asner GP, Knapp DE, Kennedy-Bowdoin T, Jones MO, Martin RE, Boardman J, Hughes RF. 2008. Invasive species detection in Hawaiian Rainforests using in flight fusion of airborne imaging spectroscopy and LiDAR.

Litton, C.M., Giardina, C.P., Albano, J.K., Long, M.S., Asner, G.P. 2011. The magnitude and variability of soil-surface CO2 efflux increase with temperature in Hawaiian tropical montane wet forests. Soil Biology & Biochemistry 43:2315-2323.

Mascaro, J., Litton, C.M., Hughes, R.F., Uowolo, A., Schnitzer, S.A. 2011. Minimizing bias in biomass allometry: Model selection and log-transformation of data. Biotropica 43:649-653.

Peltzer, D.A., D.A. Wardle, V.J. Allison, T.W. Baisden, R.D. Bardgett, O.A. Chadwick, L.M. Condron, R.L. Parfitt, S. Porder, S.J. Richardson, B.L. Turner, P.M. Vitousek, J. Walker, and L.R. Walker. 2010. Understanding ecosystem retrogression. Ecological Monographs 80:509–529 [doi:10.1890/09-1552.1].

Thaxton, J.M., Cordell, S., Cabin, R.J., Sandquist, D.R. In press Non-native grass Pennisetum setaceum decreases water availability and seedling performance during Hawaiian dry forest restoration. Restoration Ecology. doi: 10.1111/j.1526-100X.2011.00793. (Refereed Journal Article).

Kellner, J.R. Asner, G.P., Ambagis, S., Cordell, S., Thaxton, J, Kinney, K.M., Kennedy-Bowdoin, T., Knapp, T., Questad, T. In press Potential and limitations of historical aerial photography to quantify vegetation dynamics in a tropical dry forest in Hawaii. Pacific Science. (Refereed Journal Article).

Appendix A – 2012 Research Detail

Laupahoehoe Unit

Laupahoehoe Forest Reserve Sub-Unit

Principle Investigator: Bradford, Mark	**Permit Duration:** Jan 1, 2012 to Dec 31, 2012
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: Do expected evolutionary trade-offs in enzyme activities manifest at the level of microbial community function?	
Affiliation: Yale University	
PI Contact Info: mark.bradford@yale.edu; (203) 285-4921	
Dates of Anticipated Results: Oct 2013	**Publications, etc. Received:** Yes ☐ No ☒
Annual Report Received: Yes ☒ No ☐	**New Permit** ☐ **Renewal** ☒ **Finished** ☐

Principle Investigator: Cordell, Susan	**Permit Duration:** Jun 28, 2012 to Jun 27, 2013
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 (HIPPNET LAU)	
Affiliation: USDA Forest Service	
PI Contact Info: scordell01@fs.fed.us; (808) 933-8121 ext. 128	
Dates of Anticipated Results: Indefinite	**Publications, etc. Received:** Yes ☒ No ☐
Annual Report Received: Yes ☒ No ☐	**New Permit** ☐ **Renewal** ☒ **Finished** ☐

Principle Investigator: Hughes, Flint	**Permit Duration:** Mar 1, 2012 to Feb 28, 2013
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: Assessing Forest Structure, community composition, diversity, carbon mass, and biomass on a landscape scale in the Hawaii Experimental Tropical Forest	
Affiliation: USDA Forest Service	
PI Contact Info: fhughes@fs.fed.us; (808) 933-8121 ext. 117	
Dates of Anticipated Results: Indefinite	**Publications, etc. Received:** Yes ☒ No ☐
Annual Report Received: Yes ☒ No ☐	**New Permit** ☐ **Renewal** ☒ **Finished** ☐

Laupahoehoe Forest Reserve Sub-Unit (continued)

Principle Investigator: Hughes, Flint	**Permit Duration:** Mar 1, 2012 to Feb 28, 2013
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: FIA Inventory of Hawaii's Forests	
Affiliation: USDA Forest Service	
PI Contact Info: fhughes@fs.fed.us; (808) 933-8121 ext. 117	
Dates of Anticipated Results: Indefinite	**Publications, etc. Received:** Yes ☐ No ☒
Annual Report Received: Yes ☒ No ☐	**New Permit** ☐ **Renewal** ☒ **Finished** ☐

Principle Investigator: Litton, Creighton et al	**Permit Duration:** Jun 28, 2012 to Jun 27, 2013
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: UH Manoa, Dept. of Natural Resources and environmental Management	
PI Contact Info: litton@hawaii.edu; (808) 956-6539	
Dates of Anticipated Results: June 2013	**Publications, etc. Received:** Yes ☒ No ☐
Annual Report Received: Yes ☒ No ☐	**New Permit** ☐ **Renewal** ☒ **Finished** ☐

Principle Investigator: Michler, Charles	**Permit Duration:** Jul 6, 2012 to Jul 5, 2013
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: Acacia Koa Genetic Improvement Program	
Affiliation: USDA Forest Service; Purdue University	
PI Contact Info: michler@purdue.edu; (765) 496-6016	
Dates of Anticipated Results: July 2013	**Publications, etc. Received:** Yes ☐ No ☒
Annual Report Received: Yes ☐ No ☒	**New Permit** ☐ **Renewal** ☐ **Finished** ☒

Laupahoehoe Forest Reserve Sub-Unit (continued)

Principle Investigator: Price, Donald	**Permit Duration:** Oct 25, 2012 to Oct 24, 2013
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: National Science Foundation - Centers for Research Excellences in Science and Technology	
Affiliation: UH Hilo – Department of Biology	
PI Contact Info: donaldp@hawaii.edu; (808) 974-7365	
Dates of Anticipated Results: Oct 2013	**Publications, etc. Received:** Yes ☐ No ☒
Annual Report Received: Yes ☐ No ☒	**New Permit** ☒ **Renewal** ☐ **Finished** ☐

Principle Investigator: Strauch, Ayron et al	**Permit Duration:** Jul 26, 2012 to Jul 25, 2013
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: Quantifying the effects of ungulate and vegetation on the hydrology of Hawaiian tropical forests	
Affiliation: UH Manoa	
PI Contact Info: astrauch@hawaii.edu; (808) 933-8121 ext. 115	
Dates of Anticipated Results: July 2020	**Publications, etc. Received:** Yes ☐ No ☒
Annual Report Received: Yes ☐ No ☒	**New Permit** ☒ **Renewal** ☐ **Finished** ☐

Principle Investigator: Vitousek, Peter	**Permit Duration:** Mar 1, 2012 to Feb 28, 2013
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) 725-1866	
Dates of Anticipated Results: 2015	**Publications, etc. Received:** Yes ☒ No ☐
Annual Report Received: Yes ☒ No ☐	**New Permit** ☐ **Renewal** ☒ **Finished** ☐

Laupahoehoe Forest Reserve Sub-Unit (continued)

Principle Investigator: Yeh, Aileen	**Permit Duration:** Apr 3, 2012 to Apr 2, 2013
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 Rust Disease affecting Ohia Lehua	
Affiliation: Contractor for DLNR/DOFAW Forest Health	
PI Contact Info: ayeh@hawaii.rr.com; (808) 936-2671	
Dates of Anticipated Results: 2013	**Publications, etc. Received:** Yes ☐ No ☒
Annual Report Received: Yes ☒ No ☐	**New Permit** ☐ **Renewal** ☒ **Finished** ☐

Laupahoehoe Natural Area Reserve Sub-Unit

Principle Investigator: Bradford, Mark	**Permit Duration:** Jan 1, 2012 to Dec 31, 2012
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: Do expected evolutionary trade-offs in enzyme activities manifest at the level of microbial community function?	
Affiliation: Yale University	
PI Contact Info: mark.bradford@yale.edu; (203) 285-4921	
Dates of Anticipated Results: Oct 2013	**Publications, etc. Received:** Yes ☐ No ☒
Annual Report Received: Yes ☒ No ☐	**New Permit** ☐ **Renewal** ☒ **Finished** ☐

Principle Investigator: Cordell, Susan	**Permit Duration:** Jun 28, 2012 to Jun 27, 2013
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 – Laupahoehoe Site	
Affiliation: USDA Forest Service	
PI Contact Info: scordell01@fs.fed.us; (808) 933-8121 ext. 128	
Dates of Anticipated Results: Indefinite	**Publications, etc. Received:** Yes ☒ No ☐
Annual Report Received: Yes ☒ No ☐	**New Permit** ☐ **Renewal** ☒ **Finished** ☐

Principle Investigator: Hughes, Flint	**Permit Duration:** Mar 1, 2012 to Feb 28, 2013
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: Assessing Forest Structure, community composition, diversity, carbon mass, and biomass on a landscape scale in the Hawaii Experimental Tropical Forest	
Affiliation: USDA Forest Service	
PI Contact Info: fhughes@fs.fed.us; (808) 933-8121 ext. 117	
Dates of Anticipated Results: Indefinite	**Publications, etc. Received:** Yes ☒ No ☐
Annual Report Received: Yes ☒ No ☐	**New Permit** ☐ **Renewal** ☒ **Finished** ☐

Laupahoehoe Natural Area Reserve Sub-Unit (continued)

Principle Investigator: Hughes, Flint	**Permit Duration:** Mar 1, 2012 to Feb 28, 2013
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: FIA Inventory of Hawaii's Forests	
Affiliation: USDA Forest Service	
PI Contact Info: fhughes@fs.fed.us; (808) 933-8121 ext. 117	
Dates of Anticipated Results: Indefinite	**Publications, etc. Received:** Yes ☐ No ☒
Annual Report Received: Yes ☒ No ☐	**New Permit** ☐ **Renewal** ☒ **Finished** ☐

Principle Investigator: Litton, Creighton et al	**Permit Duration:** Jun 28, 2012 to Jun 27, 2013
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: UH Manoa, Dept. of Natural Resources and Environmental Management	
PI Contact Info: litton@hawaii.edu; (808) 956-6539	
Dates of Anticipated Results: June 2013	**Publications, etc. Received:** Yes ☒ No ☐
Annual Report Received: Yes ☒ No ☐	**New Permit** ☐ **Renewal** ☒ **Finished** ☐

Principle Investigator: Price, Donald	**Permit Duration:** Oct 25, 2012 to Oct 24, 2013
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: National Science Foundation - Centers for Research Excellences in Science and Technology	
Affiliation: UH Hilo – Department of Biology	
PI Contact Info: donaldp@hawaii.edu; (808) 974-7365	
Dates of Anticipated Results: Oct 2013	**Publications, etc. Received:** Yes ☐ No ☒
Annual Report Received: Yes ☐ No ☒	**New Permit** ☒ **Renewal** ☐ **Finished** ☐

Laupahoehoe Natural Area Reserve Sub-Unit (continued)

Principle Investigator: Strauch, Ayron et al	**Permit Duration:** Jul 26, 2012 to Jul 25, 2013
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: Quantifying the effects of ungulate and vegetation on the hydrology of Hawaiian tropical forests	
Affiliation: UH Manoa	
PI Contact Info: astrauch@hawaii.edu; (808) 933-8121 ext. 115	
Dates of Anticipated Results: July 2020	**Publications, etc. Received:** Yes ☐ No ☒
Annual Report Received: Yes ☐ No ☒	**New Permit** ☒ **Renewal** ☐ **Finished** ☐

Principle Investigator: Yeh, Aileen	**Permit Duration:** Apr 3, 2012 to Apr 2, 2013
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 Rust Disease affecting Ohia Lehua	
Affiliation: Contractor for DLNR/DOFAW Forest Health	
PI Contact Info: ayeh@hawaii.rr.com; (808) 936-2671	
Dates of Anticipated Results: 2013	**Publications, etc. Received:** Yes ☐ No ☒
Annual Report Received: Yes ☒ No ☐	**New Permit** ☐ **Renewal** ☒ **Finished** ☐

Puu Waawaa Unit

Puu Waawaa Forest Reserve Sub-Unit

Principle Investigator: Amsili, Joseph	**Permit Duration:** Apr 23, 2012 to Apr 22, 2013
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: Soil development on the trachyte flow (100,000-105,000 years old) vs. on the Hawi flow (140,000-260.,000 years old) on Kohala Mtn. at a site with similar precipitation	
Affiliation: Cornell University, Undergraduate	
PI Contact Info: joseph.amsili@gmail.com; (607) 592-1646	
Dates of Anticipated Results: May 2012	**Publications, etc. Received:** Yes ☐ No ☒
Annual Report Received: Yes ☐ No ☒	**New Permit** ☒ **Renewal** ☐ **Finished** ☐

Principle Investigator: Cordell, Susan	**Permit Duration:** Nov 28, 2012 to Nov 27,2013
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 – Mamalahoa Site	
Affiliation: USDA Forest Service	
PI Contact Info: scordell01@fs.fed.us; (808) 933-8121 ext. 128	
Dates of Anticipated Results: Indefinite	**Publications, etc. Received:** Yes ☒ No ☐
Annual Report Received: Yes ☒ No ☐	**New Permit** ☐ **Renewal** ☒ **Finished** ☐

Principle Investigator: Cordell, Susan	**Permit Duration:** Jul 26, 2012 to Jul 25, 2013
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 Hawaii	
Affiliation: USDA Forest Service	
PI Contact Info: scordell01@fs.fed.us; (808) 933-8121 ext. 128	
Dates of Anticipated Results: 2016	**Publications, etc. Received:** Yes ☒ No ☐
Annual Report Received: Yes ☒ No ☐	**New Permit** ☐ **Renewal** ☒ **Finished** ☐

Puu Waawaa Forest Reserve Sub-Unit (continued)

Principle Investigator: Harbaugh-Reynaud, Danica	**Permit Duration:** Jan 1, 2012 to Dec 31, 2012
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: Conservation Genetics and Taxonomy of the Big Island Sandalwood, Santalum Paniculatum	
Affiliation: International Sandalwood Foundation; UC Berkeley	
PI Contact Info: danica@sandalwoodfoundation.org	
Dates of Anticipated Results: Jan 2013	**Publications, etc. Received:** Yes ☐ No ☒
Annual Report Received: Yes ☐ No ☒	**New Permit** ☒ **Renewal** ☐ **Finished** ☐

Principle Investigator: Havran, Christopher	**Permit Duration:** Apr 3, 2012 to Apr 2, 2013
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: Geographic and ecological patterns of leaf and flower morphological variation in Planchonella sandwicense	
Affiliation: Campbell University, Dept. of Biology	
PI Contact Info: havran@campbell.edu; 205 Day Dorm Rd., Buies Creek, NC. 27506	
Dates of Anticipated Results: June 2012	**Publications, etc. Received:** Yes ☐ No ☒
Annual Report Received: Yes ☐ No ☒	**New Permit** ☒ **Renewal** ☐ **Finished** ☐

Principle Investigator: Hughes, Flint	**Permit Duration:** Mar 1, 2012 to Feb 28, 2013
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: FIA Inventory of Hawaii's Forests	
Affiliation: USDA Forest Service	
PI Contact Info: fhughes@fs.fed.us; (808) 933-8121 ext. 117	
Dates of Anticipated Results: Indefinite	**Publications, etc. Received:** Yes ☐ No ☒
Annual Report Received: Yes ☒ No ☐	**New Permit** ☐ **Renewal** ☒ **Finished** ☐

Puu Waawaa Forest Reserve Sub-Unit (continued)

Principle Investigator: Medville, Doug	**Permit Duration:** Jan 1, 2012 to Dec 31, 2012
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: Hawaii Speleological Society	
PI Contact Info: medville@verizon.net; (703) 860-0134	
Dates of Anticipated Results: Jan 2014	**Publications, etc. Received:** Yes ☐ No ☒
Annual Report Received: Yes ☒ No ☐	**New Permit** ☐ **Renewal** ☒ **Finished** ☐

Principle Investigator: Price, Donald	**Permit Duration:** Oct 25, 2012 to Oct 24, 2013
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: National Science Foundation - Centers for Research Excellences in Science and Technology	
Affiliation: UH Hilo – Department of Biology	
PI Contact Info: donaldp@hawaii.edu; (808) 974-7365	
Dates of Anticipated Results: Oct 2013	**Publications, etc. Received:** Yes ☐ No ☒
Annual Report Received: Yes ☒ No ☐	**New Permit** ☒ **Renewal** ☐ **Finished** ☐

Puu Waawaa Forest Bird Sanctuary Sub-Unit

Principle Investigator: Cordell, Susan	**Permit Duration:** Jul 26, 2012 to Jul 25, 2013
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 – Forest Bird Sanctuary Site	
Affiliation: USDA Forest Service	
PI Contact Info: scordell01@fs.fed.us; (808) 933-8121 ext. 128	
Dates of Anticipated Results: Indefinite	**Publications, etc. Received:** Yes ☒ No ☐
Annual Report Received: Yes ☒ No ☐	**New Permit** ☐ **Renewal** ☒ **Finished** ☐

Principle Investigator: Hughes, Flint	**Permit Duration:** Mar 1, 2012 to Feb 28, 2013
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: FIA Inventory of Hawaii's Forests	
Affiliation: USDA Forest Service	
PI Contact Info: fhughes@fs.fed.us; (808) 933-8121 ext. 117	
Dates of Anticipated Results: Indefinite	**Publications, etc. Received:** Yes ☐ No ☒
Annual Report Received: Yes ☒ No ☐	**New Permit** ☐ **Renewal** ☒ **Finished** ☐

Principle Investigator: LaPointe, Dennis	**Permit Duration:** Oct 25, 2012 to Oct 24, 2013
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: Distribution and prevalence of knemidokoptic mange in Hawaii Amakihi on the island of Hawaii	
Affiliation: USGS – Pacific Island Ecosystems Research Center (PIERC)	
PI Contact Info: dlapointe@usgs.gov; (808) 985-6418	
Dates of Anticipated Results: Jan 2014	**Publications, etc. Received:** Yes ☐ No ☒
Annual Report Received: Yes ☐ No ☒	**New Permit** ☒ **Renewal** ☐ **Finished** ☐

Puu Waawaa Forest Bird Sanctuary Sub-Unit (continued)

Principle Investigator: Medville, Doug	**Permit Duration:** Jan 1, 2012 to Dec 31, 2012
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: Hawaii Speleological Society	
PI Contact Info: medville@verizon.net; (703) 860-0134	
Dates of Anticipated Results: Jan 2013	**Publications, etc. Received:** Yes ☐ No ☒
Annual Report Received: Yes ☒ No ☐	**New Permit** ☐ **Renewal** ☒ **Finished** ☐

Principle Investigator: Price, Donald	**Permit Duration:** Oct 25, 2012 to Oct 24, 2013
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: National Science Foundation - Centers for Research Excellences in Science and Technology	
Affiliation: UH Hilo – Department of Biology	
PI Contact Info: donaldp@hawaii.edu; (808) 974-7365	
Dates of Anticipated Results: Oct 2013	**Publications, etc. Received:** Yes ☐ No ☒
Annual Report Received: Yes ☐ No ☒	**New Permit** ☒ **Renewal** ☐ **Finished** ☐

Puu Waawaa State Park Reserve (Kiholo) Sub-Unit

Principle Investigator: Hughes, Flint	**Permit Duration:** Mar 1, 2012 to Feb 28, 2013
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: Quantifying the dynamics and magnitude of water loss from Kiawe forests in North Kona - Kiholo Bay	
Affiliation: USDA Forest Service	
PI Contact Info: fhughes@fs.fed.us; (808) 933-8121 ext. 117	
Dates of Anticipated Results: June 2013	**Publications, etc. Received:** Yes ☐ No ☒
Annual Report Received: Yes ☒ No ☐	**New Permit** ☐ **Renewal** ☒ **Finished** ☐

Principle Investigator: Hughes, Flint	**Permit Duration:** Mar 1, 2012 to Feb 28, 2013
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: FIA Inventory of Hawaii's Forests	
Affiliation: USDA Forest Service	
PI Contact Info: fhughes@fs.fed.us; (808) 933-8121 ext. 117	
Dates of Anticipated Results: Indefinite	**Publications, etc. Received:** Yes ☐ No ☒
Annual Report Received: Yes ☒ No ☐	**New Permit** ☐ **Renewal** ☒ **Finished** ☐

Appendix B – Metadata

- All information submitted by researchers, i.e. annual reports, research affiliation, title, etc., are included as is. We do not remove any diacritical marks, correct punctuation, capitalization or grammatical errors.
- Research affiliations are broken down into five groups: Forest Service, University of Hawaii (Hilo and Manoa campuses), other Universities, other Government Organizations, and Other.
- Educational permits are grouped into three categories: academic, institution and organization. Within these 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 Hoolaulea).
- All new and renewal permit applicants are required to submit an annual report.
- 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 with the exception of Fred Stone.
- FIA plots within the Puu Waawaa State Parks were not initially included in the HETF permit application.