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Hawaii Experimental Tropical Forest

2011 Annual Report



Photos courtesy of Faith Inman-Nara

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List of Acronyms

DLNR - Hawaii Division 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 RTC - Research Technical Committee for the Hawaii Experimental Tropical Forest 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 Deanna Stouder, Alex Friend, Pat Manley and Paul Conry for their leadership and support in 2011. 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 2011 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, Michael Constantinides, Lisa Hadway, Roger Imoto, Kevin Moore, Lyman Perry, Hans Sin, and Charlene Unoki. 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 2011 including: Hao Tran, Jerry Carlson, Tom Cole, Susan Cordell, Christian Giardina, Julie Laufman, Veronica Moreland, William Nielson, Paul Scowcroft, John Slown, Randy Shrank, Wendy Powell and Tabetha Block. Mahalo also to Bob Masuda and Marti Dodds who continue to support HETF operations and growth through their respective contributions. 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, and the Puu Waawaa Dry Forest, totaling 38,885 acres (Figure 1). The HETF overlays existing State of Hawaii, Department of Land and Natural Resources (DLNR) managed lands and includes 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/).

The HETF's mission is to provide landscapes, facilities, and data/information for those wishing to conduct research and education activities contributing to a better understanding of the biological diversity and functioning of tropical forests and riparian ecosystems and their 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 2011 including annual reports received from researchers. Activity data from previous years is included in graphical data where relevant. Also included is information related to HETF administration including concerns, comments, and challenges that took place relating to operations. Additional information regarding the HETF's history, future plans and the 2007-2009 and 2010 Annual Report 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 Natural Area Reserve Hawaii Island Manager, the Forest Reserve Hawaii Island 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.



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

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 will begin to outline overall and site specific goals and priorities for research, education, and demonstration within the HETF boundaries. As these plans progress they will be included in future annual reports. For the Laupahoehoe Unit, the USFS has secured funding for a Management Plan and associated Environmental Assessment. The DOFAW-NARS Project Coordinator will be writing the management plan and is expected to start in mid-2012. Advisory councils, partners and stakeholders will be included in all planning activities.

2011 Research Summary

Twelve research permit applications were submitted and approved in 2011. All 12 were initiated (eight renewals and four new). See Appendix A for detailed information regarding research projects. A few of the 2011 research projects are highlighted here.

- Kiawe, nitrogen and water Dr. Flint Hughes, USFS, Dr. Becky Ostertag and Dr. Bruce Dudley, University of Hawaii-Hilo, and Dr. Thomas Giambelluca and Dr. Yoshiyuki Miyazawa, University of Hawaii-Manoa are conducting a project called "Quantifying the dynamics and magnitude of water loss from Kiawe forests in North Kona Kiholo Bay". Kiawe trees (*Prospois pallida*), a common sight in Hawaii are native to South America and are particularly at home in the dry, young soils on leeward coasts. Able to generate their own nitrogen, they have particularly deep roots and water retention capabilities which enable their growth in these harsh environments. However, their removal of scarce water resources and addition of nitrogen to soils may be altering leeward ecosystems, to the disadvantage of native plant and animal communities. To date the team's research has shown nitrogen content in leeward soils to be controlled by the presence and density of Kiawe trees, with larger and more dense stands exhibiting much higher rates of productivity and evolution of biologically active nitrogen, and that these rates are in turn determined by their access to groundwater resources near the coastal zone.
- Ohia rust disease surveys Aileen Yeh is monitoring several sites on Hawaii Island including the Laupahoehoe Unit under a DOFAW contract for a project titled "Forest Disease Monitoring for Rust Disease affecting Ohia Lehua". Rust disease caused by *Puccinia psidii* is affecting ohia lehua, a foundation species on the Big Island. Seedlings and mature trees are monitored in both new and previously established plots; presence and absence of disease is recorded as well as the level of damage. Samples of rust found on ohia, guava, strawberry guava or other myrtacae in the plot, are sent to the University of Hawaii-Manoa for analysis. Following visits will determine whether effects are worsening and impacting seedling and coppice growth. This study is consistent with the objectives of the NARS by monitoring the health of the forest as well as the impact of *Puccinia psidii* and possibly other pathogens on Hawaii's native forests.
- Cave mapping Doug Medville, in his ongoing research of lava tubes, has surveyed over 80 individual caves with a combined survey length of 33.6 miles (177,572 feet). He intends to describe and document significant resources within and around the caves, including biological features (roots, flora growing in cave entrances and skylights, slimes and cave life) geological resources (flow linings, lava stalactites and lava balls) and cultural features (constructed walls, gourd cradles and stepping stone trails). Tubes are entered and surveyed with great care as to maintain their undisturbed condition. The use of laser distance measuring tools reduces the amount of foot traffic within the caves. Any cultural features discovered within the lava tubes are recorded and reported directly to the State Historic Preservation Division in an effort to preserve them.
- Tropical forest comparisons Patterns of species richness, diversity, density, basal area, biomass, and size class distributions are being compared among Hawaiian forests and across a global network of tropical Forest Dynamics Plots (FDP) by a research team consisting of Dr. Susan Cordell and Dr. Christian Giardina, USFS, Dr. Becky Ostertag, University of Hawaii-Hilo, and Dr. Lawren Sack, University of California-Los Angeles. Results from the 1st census show that while the Hawaii Forest Dynamics Plots (HIPPNET, http://www.hippnet.hawaii.edu/) were floristically distinct, they were not as different in stem densities. The Montane Wet Forest (Laupahoehoe) had greater species richness than the Lowland Dry Forest (Palamanui) (21 versus 15, respectively), and 7.8 to 8.5-fold higher basal area and biomass. The Hawaiian FDPs support the lowest species richness in the global Center

for Tropical Forest Science Network (<u>http://www.ctfs.si.edu/</u>), and just 6-21% of the species richness observed in the most comparable island FDPs. By contrast, the Laupahoehoe plot was within the range of other tropical FDPs in measures of stand structure including stem density, basal area, and size class distributions. A new HIPPNET site is being installed in the Puu Waawaa Forest Bird Sanctuary this year.

Forest Inventory and Analysis Program (FIA) in Hawaii - FIA is a nationwide USFS program aimed at collecting, analyzing, and reporting information on the status and trends of America's forests. With the support and coordination of numerous entities in Hawaii, Hawaii's FIA program collects additional information on the presence of invasive plants and other disturbances such as feral pigs to provide a baseline assessment of the current state of forests all over Hawaii. In 2011, the FIA team installed 35 out of 47 plots in the Puu Waawaa Unit and 24 out of 30 plots in the Laupahoehoe Unit. These plots represent a portion of the approximately 600-700 plots proposed for all of Hawaii. Plots will be re-measured every 10 years to provide insights into changes in forest extent, composition, structure, and disturbances.

HETF-related journal articles were published in *Frontiers in Ecology and Evolution, Ecosystems, Soil Biology* as well as in several books. 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. Five of the 12 projects initiated in 2011 were located in the Laupahoehoe Unit, five occurred within the Puu Waawaa Unit, and two research projects were conducted in both Units (Table 1). Figure 2 shows the percentage of 2011 HETF research projects grouped by State land designation. Figure 3 shows research affiliation for projects within the HETF from 2007-2011.

Year	Laupahoehoe Unit Only	Puu Waawaa Unit Only	Both HETF Units	Total # of Projects Initiated
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
2007	1 (33%)	0	2 (67%)	3
Total	30	25	8	63

Table 1: Total number of research projects initiated in the HETF per year and grouped by Unit from 2007-2011.



Figure 2: Percentage of HETF research projects grouped by State land designation in 2011. (NAR=Natural Area reserve, FR=Forest Reserve, FBS=Forest Bird Sanctuary, and Park=State Park Reserve)



Figure 3: Affiliation for research projects initiated and ongoing within the HETF from 2007-2011.

2011 Education, Service, and Other (Access, etc.) Summary

Laupahoehoe Unit

One hundred and seventeen participants on six trips visited the Laupahoehoe Unit in 2011 (Table 2). A breakdown of trip totals, affiliation and type from 2007-2011 is detailed in Figure 4. Noelani Puniwai of the University of Hawaii at Hilo's Pacific Internship Programs for Exploring Science (PIPES) took a group of student interns into the Unit to discuss the effects of strawberry guava on native forests, the change of water availability with climate change, and ecosystem services. The USFS sponsored an activity through the Starts with a Seed Initiative-More Kids in the Woods Program. This trip involved students from Honokaa High School's Forestry class, focusing on forest ecosystems services, native and non-native plants, and science careers. The Hawaii Forest Industry Association also toured the Unit, discussing the need for Experimental Forests, the relationship between the HETF and the local community, and forest management issues.

Organization	Activity	Contact	Date	Group Size
Hawaii Forest Industry Association	Education	Simmons, Peter	1/29/2011	25
USFS	Education	Giardina, Christian	5/26/2011	7
USFS	Education	Dean, Mel	10/21/2011	2
USFS	Education	Dean, Mel	10/31/2011	2
USFS	Education	Akau, James	12/1	36
PIPES	Service/ Education	Puniwai, Noelani	6/1-2/11	45

Table 2: Information relating to education/service/other trips taken in the HETF Laupahoehoe Unit in 2011.





Puu Waawaa Unit

Three hundred and five participants on 16 trips visited the Puu Waawaa Unit in 2011 (Table 3). A further breakdown of trip total, affiliation and type from 2007-2011 is detailed in Figure 5. Steve Mattox of the Department of Geology at Grand Valley State University, Michigan, took two trips into the Unit in 2011. The first trip included geology students and professors and the second trip included high school Earth Science teachers. Both groups visited the quarry and focused on volcanic eruptions and materials. The Kona Historical Society conducted a jeep tour of Puu Waawaa, discussing the cultural history and geography of the area. Imi Pono no ka Aina, the Three Mountain Alliance Environmental Education Program, utilized Puu Waawaa as part of their summer enrichment program. A total of thirty-four students, grades 6 - 12, learned about the history of the area as well as participated in a service project with the Puu Waawaa Coordinator.

Organization	Activity	Contact	Date	Group Size
Hartwick College	Education	Griffing, David	1/19/2011	21
UHH-CCECS	Education	Aue, Asa	2/12/2011	12
USFS	Other	Carlson, Jerry	2/28-3/9 2011	5
E Mau Na Ala Hele	Service	Schaefer, Barbara	3/20/2011	20
UH-Manoa	Education	Sinton, John	3/21/2011	16
DOE-West Hawaii	Education	Nakagawa, Alan	3/25-26/2011	19
Kona Historical Society	Education	Navas, Pixie	4/23/2011	40
UH-Hilo	Service	Kryss, Caitlin	5/21/2011	10
lmi Pono no ka Aina	Education/Service	Camara, Lahela	6/21-22/2011	17
lmi Pono no ka Aina	Education/Service	Camara, Lahela	7/19-20/2011	17
Grand Valley State University	Education	Mattox, Steve	7/17/2011	20
UH-Hilo	Education	Juvik, Jim	8/6-9/2011	16
Grand Valley State University	Education	Mattox, Steve	8/8/2011	30
University of Florida/Amer. Soc. for Horticultural Science	Education	Stamps, Robert	9/27/2011	26
The Wildlife Society	Education	Polhemus, John	11/6/2011	25
USFS	Education	Dean, Mel	11/7/2011	11

Table 3: Information relating to education/service/other trips taken in the HETF Puu Waawaa Unit in 2011.



Figure 5: Total, affiliation and type of education/service/other trips taken in the HETF Puu Waawaa Unit, 2007-2011.

2011 HETF Concerns, Comments, and Challenges

Reported in 2011:

- There were concerns with researchers bringing dogs into the HETF.
 - Conditions were added to the permit stating that no dogs are permitted to travel with permittee while conducting research within the HETF with the exception of leashed service animals.
- How do the new Wildlife Administration rules apply to the existing USFS permit to use State lands?
- For scientists conducting research across the island, having to complete an HETF permit adds another agency level and therefore increases the permit application workload.
- Issues of vandalism and high human traffic at Kiholo State Park Reserve resulted in permittee needing to create a theft-resistant containment system to secure valuable equipment (i.e. solar panels and electrical components used to power sapflow units and climate sensors).
 - This has become less of a concern since the implementation of the Kiholo State Park Reserve Master Plan, limiting camping and vehicular traffic along the coastal areas.

Prior HETF Concerns, Comments, and Challenges still ongoing:

- o A Management Plan is needed for the Laupahoehoe Unit in order to guide decision making.
 - Work is scheduled to begin on this Plan in early 2012.

Prior HETF Concerns, Comments and Challenges that were addressed in 2011:

- No system is in place for the USFS to know if permits were signed and if the permittee had picked up the permit from DOFAW.
 - The HETF Administrator now inquires regularly with the Hilo DOFAW office staff regarding permit status.
- Clarity is needed on how management and monitoring actions by the State could be reported to the USDA Forest Service for overall HETF tracking.
 - Information regarding management and monitoring actions are available via annual Division reports to the BLNR and NARS Commission.
- Criteria are needed to determine when a project is considered research versus a State management activity. State management activities do not require an HETF permit. Example activities include: Naio thrip and gall wasp monitoring.
 - If the project is managed by a State employee no research permit is needed. If a project is contracted out with no immediate State employee supervision, the contractor is required to complete a permit.

2011 Annual Reports Received

Annual reports received from researchers are listed alphabetically below. 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. Content and header differences between reports are due to annual report template changes. All information submitted in these annual reports, are included as is. We do not remove any diacritical marks, correct punctuation, capitalization or grammatical errors.

Bonaccorso, Frank - Hawaiian hoary bat habitat occupancy, reproduction, and diet.

Submitted: November 2011

Project Location(s): Laupahoehoe Forest Reserve & NAR

HETF Annual Report for Project Period: 11/2010-11/2011

Status Update:

USGS Hawaiian Hoary Bat Project has now monitored ultrasonic bat calls for 5 years. The cumulative data indicates that this endangered bat occupied the Laupahoehoe NAR throughout the annual cycle each year. High levels of bat activity as inferred from occupancy analysis occurred from April through November of each year (See Figure 2 attached). Bat occupancy was low to moderate from December through March. Feeding activity to some extent occurred throughout the year as determined by "feeding buzz" calls. We anecdotally have observed "fall swarming" in which large numbers of reproductively active adult males and females gather in this NAR Unit during September and October presumably for mating purposes. The collection of fecal samples from bats and light trapping of insects was concluded in late 2010 and this data will be part of a food habits manuscript on hoary bats currently in review by the journal Pacific Science and in a Master's Thesis at the University of Hawaii at Hilo being written by Christopher Todd. Moths and beetles formed the bulk of the diet for hoary bats at Laupahoehoe NAR. A map of our study locations, records of bats captured, banded, and released, and summary of seasonal bat occupancy over 5 years are attached in Tables 1-3 and Figures 1-2.

Table 1. Geo-coordinates of the six and three ultrasonic acoustic recording arrays within Laupahoehoe NAR, deployed during surveys from October 2010 – 2011.

Six Sta	tion Arra	y (2010)	Three S	tation Ar	ray (2011)
Station	Easting	Northing	Station	Easting	Northing
1b	260083	2205461	1A	260083	2205461
2b	260359	2205848			
3b	260633	2206122	2A	260732	2206304
4b	260766	2206538			
5b	260824	2206972	3A	260980	2207303
6b	261033	2207346			

Table 2. Sampling details and results for seven acoustic surveys of bat activity conducted within the Laupahoehoe NAR from October 2010 to 2011.

Bat Monitoring Result	ts		Raw Totals (All Bat Stations)			Adjusted (Per Night Per Bat Station)			
Survey Dates	Stations	Nights	Nights	Active Nights	Passes	Pulses	Active Nights*	Passes*	Pulses*
10/15/10 - 10/22/10	6	7	42	42	22,200	113,136	1.00	528.57	2693.70
12/29/10 - 1/5/11	3	7	21	7	327	1,325	0.33	15.57	63.10
3/1/11 - 3/8/11	2	7	14	0	0	0	0.00	0.00	0.00
5/3/11 - 5/10/11	3	7	21	13	555	2,300	0.62	26.43	109.52
7/6/11 - 7/13/11	3	7	21	20	1607	8,208	0.95	76.52	390.86
8/17/11 - 8/24/11	3	7	21	21	2,433	10,366	1.00	115.86	493.62
9/26/11 - 10/4/11	3	8	24	22	1,933	9,107	0.92	80.54	379.46
	Totals		164	125	29,055	144,442			

Table 3. Banding Records of Bat Capture and Release at Laupahoehoe NAR in 2010-2011. The asterisk next to Numberand Band represents a recaptured individual.

Number	Date	Time	Sex	Age	Band LeftWing/RightWing	Forearm (cm)	Weight (g)	Reproductive Condition
2225	5-Oct-10	18:57	F	ADULT	Orange/Purple	48.8	17.5	Non-reproductive
2226	5-Oct-10	19:37	Μ	ADULT	Orange/Orange	47	13.4	Testes descended
311	8-May-11	19:36	F	ADULT	Orange/White	51.36	18.25	Non-reproductive
411*	2-Sep-11	19:12	F	ADULT	Orange*/Yellow	50.01	21.5	Post-lactating
511	2-Sep-11	19:36	Μ	ADULT	Orange/OrangeYellow	47	14	Non-reproductive
611	6-Sep-11	19:12	Μ	JUV	Orange/RedWhite	48.2	13.75	Non-reproductive
711	6-Sep-11	19:20	F	SUBA	Orange/GreenYellow	49	15.5	Non-reproductive
811	6-Sep-11	21:10	Μ	ADULT	Orange/RedYellow	47.5	15	Non-reproductive
911	9-Oct-11	18:45	F	ADULT	Orange/LightBlueYellow	50.9	17.5	Non-reproductive



Figure 1. Point locations of bat acoustic monitoring stations and mist-net capture sites used along Blair Road in Laupahoehoe NAR.



Figure 2. Average detectability by month of Hawaiian hoary bat activity within Laupahoehoe NAR based on all surveys conducted from 2007 to 2011. Bars represent an index of confirmed bat vocalizations in which 1.0 represents all microphones recording bat calls every night of a survey period and 0 represents no detections during a survey.

Timeline (including overall expected completion date):

We have completed all acoustic monitoring, insect light trapping, food habits, and reproductive monitoring research. No further research to be conducted on this project.

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):

The Laupahoehoe NAR Unit is a major refuge for the endangered Hawaiian Hoary Bat (*Lasiurus cinereus semotus*). These bats forage, roost, and apparently reproduce there.

Challenges (encountered while working in the HETF):

No significant challenges have been encountered.

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

<u>Presentations</u>: Ecology, Diet, and Altitudinal Migration in Hawaii's Only Native Terrestrial Mammal: The Hawaiian Hoary Bat. Oral Presentation by Frank Bonaccorso at the The Wildlife Society's 2011 Annual Conference, Kona, Hawaii.

Publications:

The Food Habits of the Hawaiian Hoary Bat (Lasiurus cinereus semotus), F. Bonaccorso, R. Bernard, C. Todd, C. Pinzari, and T. Zinn, in review, Pacific Science.

Bradford, Mark - Do expected evolutionary trade-offs in enzyme activities manifest at the

level of microbial community function?

Submitted: November 2011

Project Location(s): Laupahoehoe Forest Reserve

HETF Annual Report for Project Period: 11/2010-11/2011

Status Update:

Findings from this project will not be available until near the end of the work, because they rely on integrating measures of microbial function with composition, and the compositional work is most robust when all samples are analyzed simultaneously. What has been achieved is 2 annual samplings, across 2 sites at 11 locations (therefore 22 research sites), spanning arctic to tropical climates. Microbial functional measures are complete and will be analyzed when the compositional data are available.

Timeline (including overall expected completion date):

Final of three samplings scheduled for spring/ summer 2012. Analyses are then expected complete by 31st January 2013.

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):

See "status update"

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.):

None yet

Broadbent, Eben - Influence of Forest Architecture on Carbon Assimilation along an

Elevation Gradient in Hawaii: Linking Field Measurements, Airborne LiDAR and Modeling.

Submitted: April 2011

Annual Report Period: April 15th 2010 – April 15th 2011

Research progress update:

Research field data collection is near completion. I will continue collecting field data until May 15th, 2011. If all goes according to schedule I will be removing my field research equipment in June, 2011.

Significant findings:

Data collection is ongoing and no significant findings have been found as analysis has not yet occurred.

Changes in methodology:

Methodology continues as is described in my permit research proposal.

Timeline, including overall expected completion date:

Field data collection will be completed for the most part in May or June, 2011. The modeling portion of the project will be completed in June, 2011. I expect to have a peer-reviewed article from this research ready for submission by September, 2011.

Presence of T&E, invasive species, or human activities:

Abundant invasive species, including Guava and Ginger, have been seen throughout all areas of the lower elevation study sites – as described and GPS points provided in the research proposal. Significant human activities have not been observed with the exception of some camping gear left in the forest and one encounter with a pack of 6 wild dogs.

Publications, including peer-reviewed or gray literature, posters and presentations:

No new publications or presentations related to this project have occurred since April 2010.

Any challenges met while working in the HETF:

The situation with the keys and multiple remains an inconvenience. I would recommend that researchers get their own copy of keys to use during the duration of their project, rather than being required to check out and return them constantly to the Hilo DOFAW office.

Cordell, Susan and colleagues - Hawai'i Permanent Plot Network - Laupahoehoe Unit.

Submitted: May 2011

Research progress update and significant findings:

Our long-term goal in the Hawai'i Permanent Plot Network (HIPPNET) is to establish several large-scale, permanent 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 Laupāhoehoe plot represents montane wet forest. Our initial census was completed in 2009, and in the fall of 2010, we recensused about 10% of the plot area. In the original census, there were 21 species found and 15 families represented in the 4-ha plot. In the forest, 68% of stems were trees, 5% were shrubs, and 28% were tree ferns, accounting for 54.1%, 0.2% and 45.7% of the basal area respectively. Total basal area was 67.3m^2 /ha (of which 30.6 m²/ha was from tree ferns) and stem density was 3078 stems/ha. Very large trees (> 60 cm DBH) made up the greatest proportion of the biomass. An interesting feature of the species is that 31% of all stems were growing on a substrate other than the soil, attesting to the importance of tree ferns and logs as regeneration substrates. Only a few non-native stems qualified for DBH measurements (> 5 cm); F. uhdei averaged 32.3 cm (n = 1) and P. cattleianum averaged 6.2 cm (n = 1). After measurement, nonnative trees were cut and treated with herbicide. In the 2010 recensus, the diameter growth rates of canopy dominants Acacia koa and Metrosideros polymorpha were 0.71 cm yr⁻¹ (SD=0.61, n=49) and 0.11 cm yr^{-1} (SD=0.29, n=232), respectively. The mean diameter growth rate for all species was 0.10 cm yr^{-1} (SD=0.18, n=1546). Both A. koa (n=50) and M. polymorpha (n=238) experienced mortality of ~1.0% yr⁻¹ with mortality of other species ranging between 0.6-5.1% yr⁻¹. Recruitment was limited to a total of 16 stems of 7 different species. Hawaiian forests appear to have low growth rates, high mortality for some species, and overall low recruitment, making them particularly susceptible to non-native invasions and changes in climate.

We plan to do a full re-census every year and a partial re-measurement annually. The long-term nature of these data will serve as an important baseline to understand how Hawaiian forests function and to understand the effects of climate change and invasive species.

Currently the climate station at Laupahoehoe 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

1. 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.

2. 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).

3. 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.

4. Nāhelehele Dry Forest Symposium, February 2011, Keauhou:

Cordell, Susan and colleagues - Hawaii Permanent Plot Network - Pu`u Wa`awa`a Unit

Mamalahoa Site.

Submitted: October 2011

Project Location(s): Pu'u Wa'awa'a Forest Reserve

HETF Annual Report for Project Period: 11/2010-10/2011

Status Update:

Our long-term goal in the Hawai'i Permanent Plot Network (HIPPNET) is to establish several large-scale, permanent 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 (<u>www.ctfs.si.edu</u>). The 1ha by 1ha 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):

The plot size was expanded from 60m x 60m to 1 ha by 1 ha because the original plot only encompassed 40 trees - not enough information to get relevant forest dynamics.

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, 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.

2. 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).

3. 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.

5. 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.

6. 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.

7. 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.

8. 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.

9. 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.

Friday, JB - Productivity of second-growth Koa forests.

Submitted: June 2011

Project Location(s): Laupahoehoe Forest Reserve

HETF Annual Report for Project Period: 07/2010-06/2011

Status Update:

We are measuring dbh's of all Koa trees in four 20 x 20 m plots. We assume these plots were regenerated after the logging in the 1970s and are thus about 35 years old now. Quadratic mean dbh continues to increase in all plots. The more densely stocked plots (densities of 400 and 475 stems/ha) have shown some density-dependant mortality, while the less densely stocked plots have the same density (250 and 275 stems/ha) as when we started measuring in 2006. Self-thinning has not progressed enough to show any evident trajectory. Basal areas range from approx. 30 m2/ha to 60 m2/ha. The latter is the highest basal area we have measured in the state, indicating the high productivity of the site. For three of the four plots basal area continues to increase, while for one, mortality has offset diameter growth leading to no increase in basal area.

Timeline (including overall expected completion date):

We have been measuring these four plots for six years now and amassing valuable data on long-term growth of the Koa forest. We would like to continue to have access to the site in the future. Our next round of measurements will include upper diameters, which will allow us to estimate potential timber production of the site.

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):

Challenges (encountered while working in the HETF):

No problems. The road is much improved.

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

Friday, J. B. In press. Long-term field research for forest and ecosystem restoration in Hawai'i. In: Irland, L. C., ed. Long Term Forest Research Vol. II. GISF Research Paper 000. Yale School of Forestry and Environmental Studies, New Haven, CT.

Friday, JB. 2009. Carbon Sequestration Possibilities in Koa Forest Restoration. Presentation at the Hawai'i Conservation Conference

Meason, DF. 2009. The phosphorus cycle, labile nutrients, and soil water dynamics of Acacia koa forests: Effects of soil development and silviculture. PhD dissertation, UH Manoa CTAHR Department of Natural Resources and Environmental Management, Honolulu, HI.

Hughes, R. Flint and colleagues - Quantifying dynamics and magnitude of water loss from

Kiawe forests in North Kona - Kiholo Bay.

Submitted: August 2011

Project Location(s): Pu'u Wa'awa'a State Parks Sub-Unit

HETF Annual Report for Project Period: 06/2010-06/2011

Status Update:

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 9 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 in the process of being developed. Bi-monthly leaf area index measures of upland and lowland stands began in May 2011. 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 delta¹³C 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 delta¹⁸O, and delta¹⁸O of individual rainfall events (since May 2011). Nutrient status of P. pallida is being assessed using guarterly measurement of %N, %P and delta¹⁵N of leaf tissue. Measurement of soil nitrogen dynamics (i.e., net N-mineralization) is now begun at both upland and lowland sites. These measures will consist of four, 1-month insitu incubations with each of the 5 forest plots located at both upland and coastal sites. Additionally we have begun measurement of litterfall via monthly collection of litter from litter traps placed within each plot at each study site. These collections will continue for one continuous year. 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.

Timeline (including overall expected completion date):

Experiments will continue through 2012 and into 2013.

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

None of note to report at this time.

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

No T&E species were encountered during fieldwork conducted up to present. No new observances of invasive species were made up to present. Significant human activity has been regularly observed in or adjacent to study plots, particularly those located in the near shore environments on the southern portion of the state park (i.e, just up behind the beach). Such activity includes defecation, and some disturbance of research implements (i.e. litter traps) has also been observed. Large numbers (> 100) of people have been documented camping along the beach on some occasions and for long periods of time in some cases. Additional human disturbance included the theft of the solar panel and inverter system that powered the sapflow and climate system at the upland sites near the entrance to Kiholo and Queen Kahumanu Highway.

Challenges (encountered while working in the HETF):

The high human traffic, impacts along coastal areas in particular (see above). Creating a theft-resistant containment system to secure valuable and attractive equipment such as solar panels and electrical components used to power sapflow units and climate sensors at upland site near the highway.

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:

Dudley B, Hughes RF, Ostertag R, Cordell S. 2011. Groundwater availability alters soil nitrogen inputs in a leeward stand of Kiawe (Prosopis pallida). Paper, Hawai'i Ecosystems Meeting, Hilo, HI (06/30/11). Also presented at the Hawaii Conservation Conference, Honolulu, HI (08/03/11)

Nelson-Kaula K, Hughes RF, Ostertag R. 2011. Determining the influence of kiawe and milo on nutrient loads of anchialine ponds. Paper, Hawaii Ecosystems Meeting, Hilo, HI (06/30/11).

Nelson-Kaula K, Hughes RF, Ostertag R. 2011. Influences of kiawe and milo on nutrient loads in anchialine ponds. Paper, Queen Lili'uokalani Children's Center, Kona, HI. (06/28/11). Also presented at Water Resources Meeting, Hilo, HI (03/21/11)

Litton, Creighton and Christian Giardina - Experimental Test of the impacts of rising temp on C input, allocation, and loss in model forests.

Submitted: May 2011

Research Progress and significant findings:

Recent cross-site global syntheses have provided important insights into the impacts of rising temperature on C cycling in forest ecosystems. Raich *et al.* (2006) examined a global dataset of tropical wet forests and found that: (*i*) component C fluxes, and presumably GPP, increase with temperature; (*ii*) total ecosystem C storage does not vary with temperature; and (*iii*) a shift in ecosystem C storage from soil to aboveground wood occurs as temperature increases. Litton and Giardina (2008) used a global forest database to examine how belowground C flux and partitioning responds to MAT. They found that: (*i*) GPP and component belowground C fluxes increase with MAT; (*ii*) the fraction of belowground C flux that is production (vs. respiration) increases with MAT and centers around 0.50 between 5 and 30°C MAT; and (*iii*) partitioning of C to belowground increases with MAT for temperate and tropical ecosystems. Of particular importance to the research being done here is this last finding, which Litton and Giardina (2008) hypothesized was the result of

a shift in limiting resources from aboveground (light, temperature) to belowground (H₂O and nutrients) as MAT increases globally.

In 2008, we established a model study system to test hypotheses generated from the cross-site studies described above. This work has been specifically designed to explore how tropical wet forests respond to rising MAT by quantifying ecosystem C input, C allocation (biomass, flux and partitioning), and C storage along a highly constrained 5°C MAT gradient on the Island of Hawaii (Fig. 1). To date, work has focused on quantifying patterns in C flux and partitioning, and resultant changes in ecosystem C storage (live biomass; active, slow and passive soil C fractions; and coarse woody debris), across the gradient. Nine 20x20m plots, all with similar vegetation (>85% of stand basal area in Metrosideros polymorpha), substrate type and age (~20,000 yr-old tephra-derived Typic Hydrudands) and precipitation (3,000-3,500 mm yr⁻¹) were established



Fig. 1. MAT varies from 13-18°C across the elevational gradient, while plant available water (soil VWC at 10 cm is 30-50% year-round; annual precip. of ~3-3.5 m in all plots), species composition, and substrate type and age remain constant.

across the MAT gradient using a state-of-the-science LiDAR-based approach where plots are located in areas within 10% of the maximum aboveground biomass at each target MAT (following methods in Asner *et al.* 2009). In each plot, every tree \geq 1 cm DBH was tagged, marked, and measured in the summer of 2009, and was remeasured in the summer of 2010. Climate stations were also installed across the entire gradient (air and soil temperature and soil moisture in each plot, and three comprehensive climate stations at the top, middle, and bottom of the gradient). In each plot, we are constructing annual C budgets by quantifying: (*i*) component ecosystem C storage (live above- and belowground biomass, total soil C and three soil density fractions to 1 m depth, and coarse woody debris); (*ii*) component ecosystem C fluxes (litterfall, soil-surface CO₂ efflux, above-ground NPP and R_A , TBCF, and GPP); and (*iii*) aboveground vs. belowground partitioning of GPP. To date, we have sampled most ecosystem C pools and collected 10 months of C flux data. This ongoing research demonstrates that, as hypothesized, GPP and all component C fluxes increase with MAT, with estimated rates of change in close agreement with prior global analyses (Luyssaert *et al.* 2007; Litton & Giardina 2008). However, we also originally hypothesized that partitioning to TBCF would increase with MAT, as seen in the global cross-site analysis by Litton & Giardina (2008). The opposite pattern observed to date (Fig. 2a), however, is in line with decreased partitioning to belowground as GPP increases (Fig. 2b), suggesting that belowground resource availability increases with MAT (Litton *et al.* 2007), a potentially important but untested mechanism to explain the response of C partitioning to rising temperature.



Forest ecosystems respond strongly to belowground resource availability with large shifts in C allocation (biomass, flux and partitioning) from above- to belowground when belowground resources are limiting (Litton et al. 2007). This has important implications for forest C storage, as C partitioned belowground has a greater chance of becoming stabilized as long-lived soil C (Giardina et al. 2003). Terrestrial ecosystem models have typically relied on static C partitioning schemes (Litton et al. 2007), where C partitioning is based on constant partitioning coefficients that often come from biomass distributions. However, Litton et al. (2007) demonstrated that biomass and C partitioning are poorly correlated in forest ecosystems, likely due to the large amount of relatively inactive biomass in wood, and that C partitioning varies widely across forest ecosystems which makes the use of static partitioning coefficients suspect. More recent efforts to incorporate dynamic C partitioning schemes into a modeling framework have shown the importance of getting partitioning right for estimating productivity and C storage (Friedlingstein et al. 1999; Ise et al. 2010). Friedlingstein et al. (1999) demonstrated that a dynamic scheme that varied C partitioning based on resource availability resulted in a 10% lower estimate of global biomass than the same model with a static C partitioning scheme. Ise et al. (2010) used a dynamic C partitioning scheme based on Litton et al. (2007) that varied partitioning as a function of GPP (and, presumably, resource availability) and compared it to two process-based models with static C partitioning. They found that a dynamic C partitioning scheme resulted in significantly lower estimates of global NPP (7%) and equilibrium woody biomass (14%) than the processbased models with static C partitioning schemes. It is clear from these studies that getting C partitioning right in models is important to accurately predict C cycling now, as well as in the future under global change. However, the environmental drivers of C partitioning remain largely unexplored and unexplained to date (Litton et al. 2007).

For experimental *Eucalyptus* plantations near our model gradient on the same substrate, an increase in belowground nutrient supply via fertilization resulted in an increase in GPP, as well as a shift in the partitioning of GPP from below- to aboveground (Giardina *et al.* 2003; Ryan *et al.* 2004), in line with our hypothesis that nutrient supply plays a predominant role in explaining the initial findings from the temperature gradient highlighted above. Importantly, because plant available water does not vary across

our MAT gradient (3-3.5 m of annual precipitation and no variation in soil volumetric water content along the gradient; C.M. Litton *et al.* unpub. data) water limitations to ecosystem process rates are unlikely to explain the observed patterns in C flux and partitioning in response to MAT. In addition, because partitioning of GPP to foliage is constant across a global range of forests (Litton *et al.* 2007), the observed decrease in belowground partitioning should result in increased partitioning to aboveground wood as temperature increases. Our results do indicate that as MAT increases in tropical wet forests, GPP increases, and we hypothesize that a larger fraction of GPP is being partitioned to aboveground wood as a result. Because the flux of C to belowground (TBCF) also increases with temperature, impacts of reduced partitioning of GPP to belowground on long-term C storage in soil are difficult to predict without further work.

Notably, preliminary analyses along our temperature gradient indicate that total soil C pools do not vary with MAT despite a ~25% increase in C input per 1°C MAT increase. However, surface soil C:N and the proportion of C in the light fraction of soil organic matter both increase with MAT (Fig. 3), while mean residence time (MRT) for bulk mineral soil C decreases with MAT from ~5,000 to ~2,000 years. Soil depth

appears to also be an important driver of soil C dynamics, with bulk mineral soil C MRTs increasing from ~130 years at 0-10 cm to >2,000 years at depths >50 cm. Together, these results indicate that rising temperature will shift ecosystem C storage from soil to aboveground wood, and from long-lived to short-lived soil C.

Two significant modifications have been made, or are being



proposed, to this research for the coming year. First, we have removed the original land-use change component of the research where we proposed to compare carbon cycling in intact native forest vs. degraded pasture. As such, research is confined to the original nine plots established with the prior permit. Second, all plots are currently 20x20 m, and we will expand plots to 60x60 m over the coming year.

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. No noteworthy observations or challenges were observed during the past year of research.

Magnacca, Karl - Moore Foundation Hawaiian Barcoding Project.

Submitted: December 2011

Project Location(s): Laupahoehoe Forest Reserve & NAR; Pu'u Wa'awa'a Unit Forest Reserve & Wildlife Sanctuary

HETF Annual Report for Project Period: 10/2010-10/2011

Status Update:

We collected Drosophila several times at Laupahoehoe between April and July 2011, focusing on D. sproati, D. murphyi, D. tanythrix, and D. yooni. All were relatively common there, but their abundance at baits fluctuates wildly even from one day to the next. A few smaller species of Drosophila were also collected incidentally. The only notable collection was of a female specimen believed to be D. papala, taken at 4800'. This species is a Charpentiera/Pisonia breeder, and may be either a long-distance vagrant from the Pisonia patch at 4000', or possibly an undescribed species that cannot be distinguished in females (which lack most of the species-specific characters). Puu Waawaa was not visited.

A final table with all Drosophila collections made at HETF during this project is also attached. One notable finding is that the small patch of Pisonia at about 4000 feet elevation on the forest reserve side was the most diverse site sampled. Although too small to support any picture-wing species, this disjunct grove of mesic trees has a community of smaller species not found elsewhere. Some of these are associated with Pisonia in particular (D. kambysellisi, D. nr. dissita), while others are associated with other plants but seem to be attracted to the site. This spot is worthy of greater conservation attention, especially since Pisonia is relatively rare in the Hamakua area. Several picture-wing species that breed in Charpentiera, Pisonia, and Urera were formerly known from lower elevations (~2500 ft), but this area now appears to be largely non-native, and no flies were found there.

Timeline (including overall expected completion date):

Field collections have been completed, and writeup of publications is in progress. We expect to submit manuscripts on phylogeny and conservation status in spring 2012, and the two students who conducted work there (Peltin Pelep and Tani Wright) expect to finish in spring 2013.

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):

An unknown species of Rubus was found in the forest reserve section of Laupahoehoe. It appears to occur relatively rarely as scattered individuals, but over a moderately broad area at least from 3600' to 4000' elevation. Most of the plants were small and no fertile material was found. It differs from the other species there in having only three leaflets, which are narrow and elongate, and with relatively few, smaller thorns than in R. argutus. A specimen was shown to USFS staff and other botanists, none of whom recognized it. It may be an incipient invasive species. The specimen should still be at the USFS, and a photo can be found here: http://www.flickr.com/photos/53189052@N08/4903594795

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.):

K. Magnacca and D. Price. Rapid radiation in the Hawaiian picture-wing Drosophila. Society for the Study of Evolution, July 2011, Norman, Oklahoma.

K. Magnacca, K. Kaneshiro, S. Montgomery, D. Kapan, and D. Price. Conservation status of the Hawaiian picture-wing Drosophila. Pacific Branch of the Entomological Society of America meeting, March 2011, Waikoloa, Hawaii.

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

and Pu`u Anahulu.

Submitted: November 2011

Project Location(s): Pu'u Wa'awa'a Forest Reserve & Wildlife Sanctuary

HETF Annual Report for Project Period: 01/11-01/12

Status Update:

In 2011, surveys were conducted in 15 caves with a combined length of 25,001 feet (4.74 miles) surveyed. These caves were assessed for significant biological and cultural materials. Caves were surveyed in three general areas.

1. Mauka Subunit, HETF. This area, on the mauka side of Pu'u Iki, contains perhaps the greatest concentration of entrances on Pu'u Wa'awa'a. The caves are found in a thick and extensive 3,000-5,000 year old flow. The most significant of the caves surveyed is Hapu'u Cave, containing undocumented fossil bird bones and extending for a considerable distance mauka and makai. Four other caves were surveyed to the east of Hapu'u Cave: Henahena Cave 02, Henahena Cave 107 (names are those used by Mr. Jon Giffin who provided entrance locations for all of the Henahena caves), Petrel Bone Cave and Prow Cave. Henahena Cave 02 contains nearly a mile of braided passages in a shallow dendritic maze. The nearby Henahena Cave 107 is similar but shorter. Petrel Bone Cave, named for a petrel skeleton found near a skylight entrance, is just to the NE of a 300' diameter stone corral and extends mauka for over 1,000', becoming low and not followed to an end. A small cave just to the west, Prow Cave, contains prow-like lava benches at a passage junction. A survey was also conducted in Shangri La Cave, just makai of the Forest Bird Sanctuary and extending beneath it. The cave passes beneath several large skylights and, at its upper end, contains 2' long red sharks tooth stalactites.

2. Makai Subunit, HETF. Access to this area is via the Old Kiholo Road on the makai side of Rt. 190. Survey work took place in five caves. The largest, Two Owl Cave, named for two dead barn owls in an entrance, contains over 13,000 feet of braided passages with 1,100 feet added to the survey in 2011. Petrel bones and other as-yet unidentified bird bones are seen in this cave. Immediately makai and in the same flow is Aluminum Ladder Cave, named after a metal extension ladder in an entrance. In 2011, over 1/2 mile of survey was added to this cave with passages continuing makai.

A lateral fire road extends west from the Old Kiholo Road and crosses a flow containing an extensive line of caves. In February 2011, three of these caves were surveyed. Fire Road 02 Cave is on the makai side of the fire road and contains minor terracing in its entrance as well as unidentified bird bones at its upper end. Fire Road 10 Cave is 1/2 mile mauka and contains large passage going mauka, ending at the makai end of a trench. No cultural features were observed in this cave. Fire Road Cave 12 is at the trench's mauka end, was surveyed for a few hundred feet and continues mauka.

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 just above the West Hawai'i Landfill. The flow is bounded by the Pu'u Anahulu Cooperative Game Management Area on the east and the 1859 flow on the west. In 2011, surveys were conducted in three caves in this flow. These caves are part of a single system with passages terminated by trenches (collapsed passage segments).

Timeline (including overall expected completion date):

Jan 2010- Jan 2012. Actual completion date is open ended; depending on needs of the HETF.

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

No changes were made to the methodology used to identify and document entrances, survey the caves, and produce cave maps and overlays. If HETF uses GIS tools, e.g. ArcView, then maps can be produced that can be used as an ArcView layer.

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

Although we did not see any threatened or endangered species in the lava tubes surveyed, a closer look by a trained biologist (e.g. Dr. Fred Stone, specializing in native Hawaiian cave-adapted species) is desirable.

Challenges (encountered while working in the HETF):

The only challenges are natural: crossing rough lava flows, traversing the caves, carefully passing through heavily wooded areas mauka, and working within the constraints imposed by things such as poor weather and closures due to drought and fire danger.

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

No publications this year; our current focus is on production of maps of the caves surveyed and written documentation of these caves.

Pattison, Robert - Inventory of Hawaii's Forests.

Submitted: March 2011

Research progress update and significant findings:

In 2010 the US Forest Service's Pacific Northwest Research Station's (PNW) Forest Inventory and Analysis (FIA) Program initiated an inventory of the forests of Hawaii. This initial inventory had a proposed intensity of a single plot per 6,000 acres (2429 ha). A permit was submitted and received to install two plots in the Laupahoehoe Unit of the Hawaii Experimental Tropical Forests (HETF). However due to logistical difficulties none of these plots were installed in 2010. The crews attempted to visit Laupahoehoe at the end of the 2010 field season in March but strong rains prevented them from doing so. They were warned about water rapidly rising and cutting off the road into and out of the forest. As a result no plots were installed in the HETF in 2010 and consequently there are no data to report or publications to date. Two plots were recently installed in the Laupahoehoe Unit of the HETF in late March, 2011. The data from these two plots have not been processed through FIA databases and consequently are not currently available for summary. What follows is brief outline of the events that occurred since the end of the 2010 field season as they relate to work in the HETF.

After the 2010 field season was completed in March 2010, the decision was made within PNW FIA to double the intensity of plots in the state such that a single plot represents 3000 acres (1214 ha). These plots, referred to as "base grid" plots are systematically spread throughout all of the state of Hawaii. This increase in plots for Hawaii represents a substantial improvement in the utility of FIA plots to provide insights into Hawaii's forests and has been requested by state of Hawaii foresters. In 2010 funding was also provided to install approximately 30 experimental forest plots in each of the HETF Units in addition to the base grid plots. Although there are technically two different inventories occurring within the HETF, base grid and experimental plots, the data collected on all these plots are identical. In November 2010 a permit was submitted to HETF to add the experimental plots to the HETF Units. FIA consulted with Institute of Pacific Islands (IPIF) researchers and staff to make modifications to the experimental protocols so that the data collected on the HETF would be useful to IPIF researchers. For example, FIA modified protocols to increase the capacity of FIA data to "tie in" with the unique remote sensing efforts in the HETF. FIA added a list of high priority invasive species as identified by IPIF staff. FIA modified the use of monumentation (tags etc.) to ensure that plot installation complied with HETF protocols. The HETF coordinator met with FIA field crews to discuss working in the HETF. FIA field crews labeled all monumentation with "USFS FIA" and a phone number so that anyone who came across an FIA plot would know exactly who it was associated with and could contact FIA and the HETF coordinator with concerns. FIA altered its monumentation to address safety concerns. FIA crews do not use rebar and do not leave flagging in the field. FIA did not use tags on some trees where it was determined that tags could be avoided without compromising scientific integrity.

FIA accomplishments in 2010- early 2011

- Doubling of the plots across all of Hawaii
- Addition of experimental forest plots
- Hiring of a Hilo based field crew to carry out HETF work.
- Accommodating requests to sample additional Hawaii specific procedures for the both the base grid and experimental forest plots.
- Presentation of an overview of FIA procedures to the Natural Area Reserves Commission meeting on March 7, 2011 (Maui).
- Presentation of FIA at the Hawaii Conservation Conference, Honolulu August 2010.
- Installation of base grid and experimental forest plots on Hawaii Island January- March, 2011.

Throughout all stages of the process of working on the HETF, the FIA inventory has benefitted greatly from the hard work of the HETF coordinator, Melissa Dean. Ms. Dean has worked tirelessly to ensure that FIA procedures are in compliance with HETF protocols.

Questad, Erin and Susan Cordell - The potential for restoration to break the grass/fire cycle

in dryland ecosystems in Hawaii [SERDP].

Submitted: July 2011

Project Location(s): Pu'u Wa'awa'a Forest Reserve

HETF Annual Report for Project Period: 10/2010-09/2011

Status Update:

The experiment at our site is testing restoration prescriptions for lowland ohia/lama dry forest. We have been monitoring our outplants since we planted them in December of 2009. In April of 2010 outplant survival was 43%. In August 2010 survival was 36%. High outplant mortality was likely due to the abnormally dry winter in the Pacific due to the El Niño effect which put 2010 on track to be the driest year since the inception of precipitation records and likely in the past century. Despite the low survival numbers, outplanting treatments significantly increased the cover of native species. We surveyed plots again in March 2011 and recorded the height of all remaining outplants. We found that outplant survival was higher in plots under dense tree canopy, compared to plots with a degraded canopy. We found that weed removal increased outplant growth.

Due to the high mortality of outplants, we performed a supplemental planting in late March 2011. We planted an additional 20 Dodonaea viscosa plants per plot for a total of 240 plants. We are continuing to monitor the survival and growth of these plants.

We continue to take monthly measurements of soil and dead fuel moisture at our site. We have also installed weather stations to continuously monitor wind speed, temperature, rH, and precipitation. We have found that conditions vary greatly between areas with high and low tree canopy density. For example, wind speeds are much higher in open habitats compared to habitats with greater tree density.

Timeline (including overall expected completion date):

We anticipate monitoring our experiment through December 2012 in order to track the survival and growth of the outplants we planted this year.

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

We had to perform a supplemental outplanting this year because of the high mortality that occurred following the 2010 drought.

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

Since our construction of an ungulate-proof fence we have noticed regeneration of several native species that were not previously present at the site, including Nehe (Lipochaeta subcordata) and Cyperus hillebrandii. We have also observed smaller numbers of several non-native species that were not previously present. Regeneration of Ilima (Sida fallax) has increased throughout the study.

There have been several cases of goat remains being thrown into the fenced area.

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

Presentations

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)

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. (Published Abstract)

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)

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

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)

Publications:

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

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

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.

Challenges (encountered while working in the HETF):

No challenges.

HETF Related Citations

Citations listed below have been submitted since the publication of the 2010 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 (<u>http://www.hetf.us/page/major_topics/</u>) for a complete list of citations received to date.

Asner, Gregory P et al. "High-resolution carbon mapping on the million-hectare Island of Hawaii." *Frontiers in Ecology and the Environment* **9**, no. 8 (2011): 434–439. DIO: 10.1890/100179.

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

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

Meason, DF. 2009. The phosphorus cycle, labile nutrients, and soil water dynamics of Acacia koa forests: Effects of soil development and silviculture. PhD dissertation, UH Manoa CTAHR Department of Natural Resources and Environmental Management, Honolulu, HI.

Reed, S. C., A. R. Townsend, P. G. Taylor and C. C. Cleveland. "Phosphrous Cycling in Tropical Forests Growing on Highly Weathered Soil". In: Phosphrous in Action – Biological Processes in Soil Phosphrous Cycling. *Soil Biology* Volume 100, Part 3 (2011): 339-369, DOI: 10.1007/978-3-642-15271-9_14.

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

Vitousek, P.M., C.M. D'Antonio, and G.P. Asner. "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, 2011.

Appendix A - 2011 Research Detail

Projects are listed alphabetically under each Unit or Sub-Unit in which they occur. Therefore projects that took place within more than one Unit or Sub-Unit will be listed multiple times. As of November 2010 all new and renewal permit applicants were required to submit an annual report regardless of the HETF Sub-Unit. Until this time only projects taking place within the Natural Area Reserve (NAR) were required to submit annual reports within one year of project completion. The "Publications, etc. Received" question within this section relates to whether this information was provided within the submitted annual reports.

Acronyms in this section include: LAU=Laupahoehoe, NAR=Natural Area Reserve, FR=Forest Reserve, FBS=Forest Bird Sanctuary, PWW=Puu Waawaa.

Laupahoehoe Unit

Laupahoehoe Forest Reserve Sub-Unit:

Principle Investigator: Broadbent, Eben	Permit Duration: March 22, 2011 to March 21 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: Influence of Forest Architecture on G Hawaii: Linking Field Measurements, Airborne Hyper	Carbon Assimilation along an Elevational Gradient in rspectral and Waveform LiDAR and Modeling.					
Affiliation: Stanford university						
PI Contact Info: <u>eben@stanford.edu</u> ; (650) 204-1052	1					
Dates of Anticipated Results: April 2012	Publications, etc. Received: Yes 🗌 No 🔀					
Annual Report Received: Yes 🛛 No 🗌 New F	Permit					
Principle Investigator: Cordell, Susan	Permit Duration: June 16, 2011 to June 15, 2012					
New Permit 🗌 Renewal 🔀 Permanent (cont	ingent 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: <u>scordell01@fs.fed.us</u> ; (808) 933-8121 ext.128						
Dates of Anticipated Results: Indefinite	Publications, etc. Received: Yes No					
Annual Report Received: Yes 🛛 No 🗌 New Permit 🗌						

Laupahoehoe Forest Reserve Sub-Unit (continued):

Principle Investigator: Friday, JB	Permit Duration: November 17, 2011 to November 16, 2012				
New Permit 🗌 Renewal 🔀 Permanent (cont	ingent upon approval) 🗌 No Valid Permit 🗌				
Project Location(s): LAU-NAR 🗌 LAU-FR 🔀	PWW-FR PWW-FBS PWW-Park				
Research Title: Developing Productivity models and the Native Hawaiian Hardwood Acacia Koa	Silvicultural Guidelines for Growing and Managing				
Affiliation: UH Manoa College of Tropical Agriculture and Human Resources, Cooperative Extension Service					
PI Contact Info: 808-981-8266; jbfriday@hawaii.edu					
Dates of Anticipated Results: Indefinite Publications, etc. Received: Yes No					
Annual Report Received: Yes 🛛 No 🗌 New Permit 🗌					

Principle Investigator: Gillespie, Rosemary	Permit Duration: June 20, 2011 to June 19, 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: Adaptive Radiation in Hawaiian Spiders		
Affiliation: University of California, Berkeley		
PI Contact Info: gillespie@berkeley.edu; (510) 642-3445		
Dates of Anticipated Results: June 2012	Publications, etc. Received: New Permit	
Annual Report Received: Yes No New Permit No specimens found in PWW		

Principle Investigator: Hughes, Flint; Robert Pattison	Permit Duration: January 21, 2011 to January 20, 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: FIA Inventory of Hawaii's Forests		
Affiliation: USDA Forest Service and Forest Inventory and Analysis (FIA)Program		
PI Contact Info: <u>fhughes@fs.fed.us</u> ; (808) 933-8121 ext. 117		
Dates of Anticipated Results:January 2012Publications, etc. Received:New Permit		
Annual Report Received: Yes 🛛 * No 🗌 New Permit 🗌 * See metadata		

Laupahoehoe Forest Reserve Sub-Unit (continued):

Principle Investigator: Litton, Creighton et al	Permit Duration: June 16, 2011 to June 15, 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: Experimental Test of the Impacts of Rising Temperature on Carbon 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: May 2012	Publications, etc. Received: Yes 🗌 No 🔀	
Annual Report Received: Yes 🛛 No 🗌 New Permit 🗌		

Principle Investigator: Yeh, Aileen	Permit Duration: April 27, 2011 to April 26, 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: Forest Disease Monitoring for Rust Disease affecting Ohia Lehua		
Affiliation: Contractor for DOFAW/DLNR Forest Health		
PI Contact Info: ayeh@hawaii.rr.com; (808) 936-2671		
Dates of Anticipated Results: April 2012	Publications, etc. Received: New Permit	
Annual Report Received: Yes 🗌 No 🗌 New Permit 🔀		

Laupahoehoe Natural Area Reserve Sub-Unit:

Principle Investigator: Broadbent, Eben	Permit Duration: March 22, 2011 to March 21, 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: Influence of Forest Architecture on Carbon Assimilation along an Elevational Gradient in Hawaii: Linking Field Measurements, Airborne Hyperspectral and Waveform LiDAR and Modeling.		
Affiliation: Stanford University		
PI Contact Info: <u>eben@stanford.edu</u> ; (650) 204-1051		
Dates of Anticipated Results: April 2012	Publications, etc. Received: Yes 🗌 No 🔀	
Annual Report Received: Yes 🔀 No 🗌 New Permit 🗌		

Principle Investigator: Cordell, Susan	Permit Duration: June 16, 2011 to June 15, 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: Hawaii Permanent Plot Network (HIPPNET LAU)		
Affiliation: USDA Forest Service		
PI Contact Info: 808-854-2628; scordell01@fs.fed.us		
Dates of Anticipated Results: Indefinite Publications, etc. Received: Yes No		
Annual Report Received: Yes 🛛 No 🗌 New Permit 🗌		

Principle Investigator: Gillespie, Rosemary	Permit Duration: June 20, 2011 to June 19, 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: Adaptive Radiation in Hawaiian Spiders		
Affiliation: University of California, Berkeley		
PI Contact Info: gillespie@berkeley.edu; (510) 642-3445		
Dates of Anticipated Results: June 2012	Publications, etc. Received: New Permit	
Annual Report Received: Yes 🗌 No 🗌 New Permit 🔀 No specimens found in PWW		

Laupahoehoe Natural Area Reserve Sub-Unit (continued):

Principle Investigator: Hughes, Flint / Robert Pattison	Permit Duration: January 20, 2011 to January 19, 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: FIA Inventory of Hawaii's Forests		
Affiliation: USDA Forest Service and Forest Inventory and Analysis Program		
PI Contact Info: <u>fhughes@fs.fed.us</u> ; (808) 933-8121 ext. 117		
Dates of Anticipated Results: January 2012	Publications, etc. Received: New Permit	
Annual Report Received: Yes 🖾 * No 🗌 New Permit 🗌 * See metadata		

Principle Investigator: Litton, Creighton et al	Permit Duration: June 16, 2011 to June 15, 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: Experimental Test of the Impacts of Rising Temperature on Carbon 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: May 2012	Publications, etc. Received: Yes 🗌 No 🔀	
Annual Report Received: Yes 🛛 No 🗌 New Permit 🗌		

Principle Investigator: Yeh, Aileen	Permit Duration: April 27, 2011 to April 26, 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: Forest Disease Monitoring for Rust Disease affecting Ohia Lehua		
Affiliation: Contractor for DOFAW/DLNR Forest Health		
PI Contact Info: ayeh@hawaii.rr.com; (808) 936-2671		
Dates of Anticipated Results: April 2012Publications, etc. Received: New Permit		
Annual Report Received: Yes 🗌 No 🗌 New Permit 🔀		

Puu Waawaa Unit

Puu Waawaa Forest Reserve Sub-Unit:

Principle Investigator: Cordell, Susan	Permit Duration: November 16, 2011 to November 15, 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: Hawaii Permanent Plot Network (HIPPNET Mamalahoa Hwy)		
Affiliation: USDA Forest Service		
PI Contact Info: 808-854-2628; scordell01@fs.fed.us		
Dates of Anticipated Results: Indefinite	Publications, etc. Received: Yes 🛛 No 🗌	
Annual Report Received: Yes 🛛 No 🗌 New Permit 🗌		
Principle Investigator: Cordell /QuestadPermit Duration: August 22, 2011 to August 21, 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: 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; ejquestad@csupomona.edu

Dates of Anticipated Results: January 2013

Publications, etc. Received: Yes No

Principle Investigator: Gillespie, Rosemary	Permit Duration: June 20, 2011 to June 19, 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: Adaptive Radiation in Hawaiian Spiders		
Affiliation: University of California, Berkeley		
PI Contact Info: gillespie@berkeley.edu; (510) 642-3445		
Dates of Anticipated Results: June 2012	Publications, etc. Received: New Permit	
Annual Report Received: Yes No New Permit No specimens found in PWW		

Puu Waawaa Forest Reserve Sub-Unit (continued):

Principle Investigator: Hughes, Flint / Robert	Permit Duration: January 20, 2011 to January 19,	
Pattison	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: FIA Inventory of Hawaii's Forests		
Affiliation: USDA Forest Service and Forest Inventory and Analysis Program		
PI Contact Info: <u>fhughes@fs.fed.us</u> ; (808) 933-8121 ext. 117		
Dates of Anticipated Results: January 2012	Publications, etc. Received: New Permit	
Annual Report Received: Yes 🛛 * No 🗌 New Permit 🗌 *See metadata		

Principle Investigator: Medville, Doug	Permit Duration: January 20, 2011 to January 19, 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: Conduct Lava Tube Surveys and Resource Inventories at Pu'u Waa Waa and Puu Anahulu		
Affiliation: Hawaii Speleological Survey		
PI Contact Info: medville@verizon.net; (703) 860-0134		
Dates of Anticipated Results: January 2012	Publications, etc. Received: Yes 🗌 No 🔀	
Annual Report Received: Yes 🛛 No 🗌 New Permit 🗌		

Puu Waawaa Forest Bird Sanctuary Sub-Unit:

Principle Investigator: Cordell, Susan	Permit Duration: March 7, 2011 to March 6, 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: Hawaii Permanent Plot Network (HIPPNET FBS)		
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 🔀		

Principle Investigator: Hughes, Flint / Robert Pattison	Permit Duration: January 21, 2011 to January 20, 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: FIA Inventory of Hawaii's Forests		
Affiliation: USDA Forest Service and Forest Inventory and Analysis Program		
PI Contact Info: <u>fhughes@fs.fed.us</u> ; (808) 933-8121 ext. 117		
Dates of Anticipated Results: January 2012	Publications, etc. Received: Yes 🗌 No 🔀	
Annual Report Received: Yes 🛛 * No 🗌 New Permit 🗌 * See metadata		

Principle Investigator: Medville, Doug	Permit Duration: January 20, 2011 to January 19, 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: Conduct Lava Tube Surveys and Resource Inventories at Pu'u Waa Waa and Puu Anahulu		
Affiliation: Hawaii Speleological Survey		
PI Contact Info: medville@verizon.net; (703) 860-0134		
Dates of Anticipated Results: January 2012	Publications, etc. Received: Yes 🗌 No 🔀	
Annual Report Received: Yes 🛛 No 🗌 New Permit 🗌		

Puu Waawaa State Park (Kiholo) Sub-Unit:

Principle Investigator: Hughes, Flint	Permit Duration: June 20, 2011 to June 19, 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: Quantifying the dynamics and magnitude of water loss from Kiawe forests in North Kona - Kiholo Bay		
Affiliation: IPIF; PSW Research Station; USDA-Forest Service		
PI Contact Info: <u>fhughes@fs.fed.us</u> ; (808) 933-8121 ext. 117		
Dates of Anticipated Results: April 2012	Publications, etc. Received: Yes 🛛 No 🗌	
Annual Report Received: Yes 🛛 No 🗌 New Permit 🗌		

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).
- As of November 2010 all new and renewal permit applicants were required to submit an annual report regardless of the HETF Sub-Unit. Until this time only projects taking place within the Natural Area Reserve (NAR) were required to submit annual reports.
- 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. Content and header differences between reports are due to annual report template changes. All information submitted in these annual reports, are included as is. We do not remove any diacritical marks, correct punctuation, capitalization or grammatical errors.
- The Forest Inventory Analysis (FIA) project was approved for work under a permit issued in 2010. Due to weather difficulties, changes to number of plots and information protocols no work was completed on the project under this permit. The project was logged as an un-initiated project in the 2010 annual report. The project applied for another permit in 2011 and the HETF administration considers the project as 'new' given that no work was done under the 2010 permit and significant methodological changes were made between permit years. The annual report submitted for the Hughes/Pattison FIA project is reflective of the 2010 FIA permit.