Hawaii Experimental Tropical Forest 2007 – 2009 Annual Report

Prepared by the USDA Forest Service
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Acknowledgements

The establishment and administration of the Hawaii Experimental Tropical Forest (HETF) has been successful due to the work of many individuals. We would like to recognize and thank Deanna Stouder and Paul Conry for their leadership roles and Ann Bartuska and Boone Kaufman for their vision and hard work in making the HETF a reality.

The USDA Forest Service would like to also thank the State of Hawaii including the Division of Forestry and Wildlife and the Board of Land and Natural Resources for their cooperation and efforts for the establishment and administration of the HETF. In particular we would like to thank the following State staff 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, Ron Canarella, Michael Constantinides, Mike Donoho, Betsy Gagne, Lisa Hadway, Roger Imoto, Lyman Perry, Hans Sin, and Charlene Unoki. We would also like to thank the Natural Area Reserve System Commission and the Puu Waawaa Advisory Council for their cooperation and respective roles in facilitating the overlay of the HETF on lands overseen by their jurisdiction.

Mahalo to Colleen Cole, Bob Masuda, and Elliot 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: Jerry Carlson, Tom Cole, Susan Cordell, Melissa Dean, Marti Dodds, Christian Giardina, Christine Hansen, Pamela Holton, Julie Laufman, Franny Kinslow, Casey Matsunaga, Veronica Moreland, William Nielson, Cheyenne Perry, Paul Scowcroft, John Slown, Randy Shrank, Hao Tran, Tom Schmidt, Larry Rabin, and Molly Murphy.

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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

HETF - Hawaii Experimental Tropical Forest

HIPPNET – Hawaii Permanent Plot Network

LAU - Laupahoehoe Unit of the Hawaii Experimental Tropical Forest

NAR - Natural Area Reserve

PWW - Puu Waawaa Unit of the Hawaii Experimental Tropical Forest

USDA - United States Department of Agriculture

Hawaii Experimental Tropical Forest (HETF) Summary

Timeline of HETF Events

- **October 1992:** The Hawaii Tropical Forest Recovery Act was signed into law by President George H. Bush. The law recognized the importance of Hawaii's tropical forests and authorized the establishment of an Experimental Forest in Hawaii, the Virgin Islands, and Puerto Rico, the only remaining U.S. territories/state without an Experimental Forest designation. The United States Department of Agriculture (USDA) Experimental Forests and Range network dates back over one hundred years. Other Experimental Forests have had the opportunity to conduct long term landscape scale research for the last eighty years. Scientists now have the opportunity to research forest dynamics, response stressors, and to understand the impacts of climate change in Hawaii.
- **February 2006**: The Hawaii Department of Land and Natural Resources (DLNR) Land Board recommended to the Governor to establish an Experimental Forest on existing State Lands in Puu Waawaa (encompassing State Parks, Forest Reserve and Wildlife Sanctuary land designations) and in the Natural Area Reserve (NAR) and a portion of the Hilo Forest Reserve in Laupahoehoe. The lands are managed by the DLNR and administered by the DLNR Division of Forestry and Wildlife (DOFAW).
- **December 2006:** The DLNR Land Board approves a Cooperative Agreement between the USDA Forest Service and the DLNR to manage the HETF (Appendix A). The parties involved agreed to be committed to working together on consulting, reaching agreements on coordinating research, management, outreach, access and education.
- **January 2007:** The DLNR grants a use permit to the USDA Forest Service for the HETF for purposes of research, education, demonstration, and related purposes (Appendix B).

HETF Mission

The Mission of the HETF 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 best be accomplished by: 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 by providing education and demonstration opportunities for those interested in tropical forest studies and management.

Major Research Topics

Based upon the unique attributes, threats, and management needs that exist in Hawaii, the USDA Forest Service and the DLNR have cooperatively identified critical research needs that we believe the HETF and its underlying purpose as an Experimental Forest are especially suited to support. Among these critical needs are understanding:

1. **The structure and function of tropical wet and dry forest watersheds and their component parts.** This emphasis area focuses on how tropical forest ecosystems function. Research should strive to gain a better understanding of the physical, chemical, and biological processes at all relevant geographic and time scales.

2. **The structure and function of freshwater and near shore marine ecosystems in tropical landscapes and the connectivity between terrestrial and marine environments.**
3. **Invasive alien species.** One of the greatest threats to biodiversity worldwide is habitat destruction and alteration by non-native and invasive species. In Hawaii, tropical forests are currently disappearing due to an influx of introduced species that harm natives and alter ecosystems. Research should seek to understand how invasive species affect community and ecosystem structure and function, and how their effects and spread can be minimized.
4. **Methods/tools for restoration of tropical forest ecosystems.** Hawaiian forests have been subject to a large number of human-induced changes over the last 250 years including the introduction and spread of non-native species, ranching, agriculture, and extractive industries such as logging. As a result, native tropical forest ecosystems are currently degraded and many species that were once common are now rare or threatened with extinction. A critical need for land managers involves understanding the most effective and cost-efficient methods for restoring degraded habitats and landscapes. The HETF provides ample opportunities for investigating the effectiveness of different restoration methods in different kinds of plant communities that are found within the HETF.
5. **Impact of global climate change on tropical ecosystems.** Global climate change is expected to change the distribution and abundance of species by altering community structure and composition, changing range distributions and altering phenology, and impacting the extent and availability of habitat suitable for species. Most work has emphasized the effects of climate change on habitats in northern latitudes, but there is a critical need to understand how climate change will influence tropical forests.
6. **Native Hawaiian/traditional resource management techniques.** There is a need to provide opportunities for investigation of traditional land management practices originally used by native Hawaiians (Polynesians). The HETF has the capacity to accommodate some experimentation of customary traditional uses and learn how the forest ecosystem responds to these methods of management.
7. **Specialty wildland management topics.** There are some special or unique land and resource management activities that require additional research or demonstration to hone management techniques and inform future decision-making. Some examples that could be accommodated in the HETF include:
    - Impacts of fire on native ecosystem structure and function
    - Reintroduction of threatened and endangered species
    - Introduction of bio-control agents for invasive species control

HETF Units Summary

Laupahoehoe Wet Forest

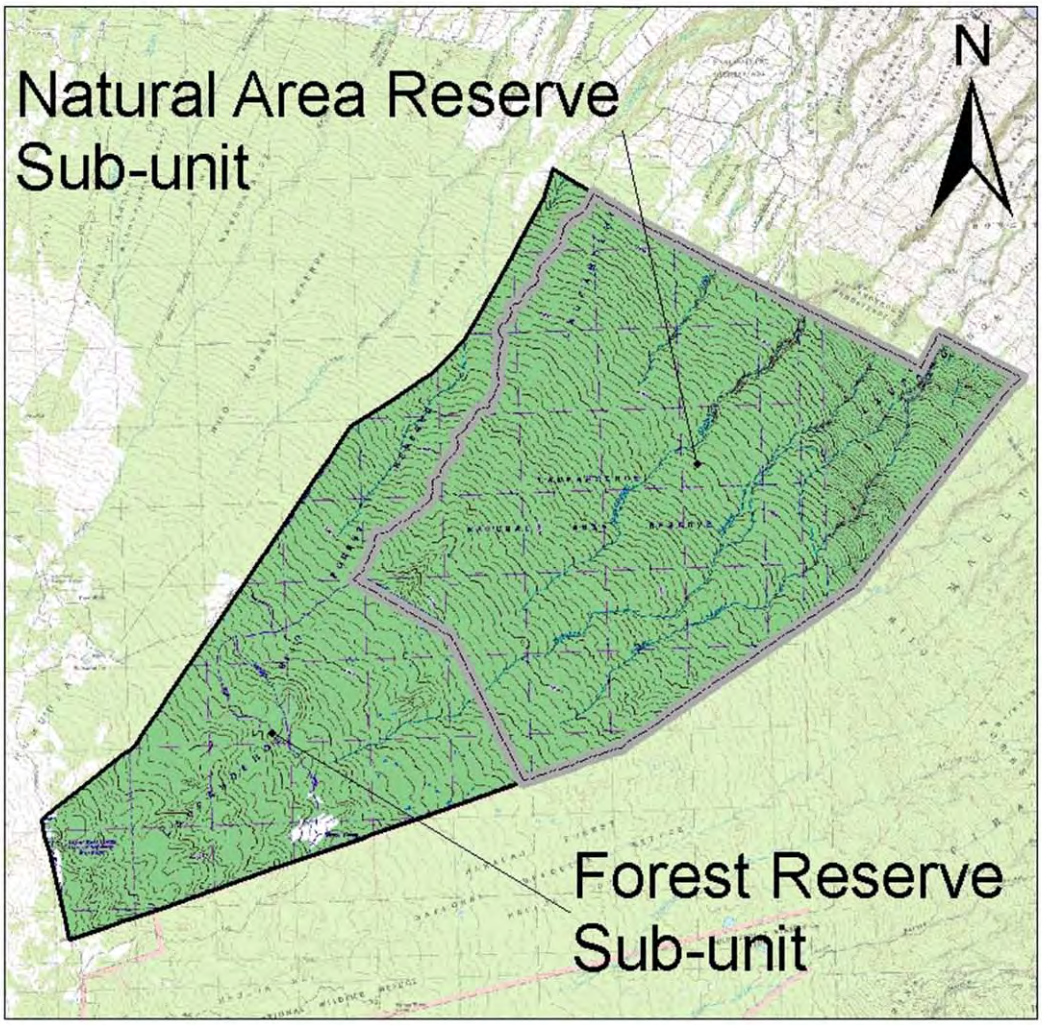
The Laupahoehoe Experimental Forest Unit is located on the windward side of the island of Hawaii on the slopes of the Mauna Kea volcano (Figure 1). The Unit incorporates 4,449 acres (1,800 ha) of land designated as Forest Reserve and 7,894 acres (3,195 ha) of land designated as Natural Area Reserve (NAR). The lands are managed by the Hawaii Department of Land and Natural Resources (DLNR) and administered by the DLNR Division of Forestry and Wildlife (DOFAW). The 12,343 total acres (approximately 5,000 ha) contains magnificent examples of tropical rain forest and is the habitat of numerous endangered plant[1] and animal species[2]. A total of 234 vascular plants (native and non-native) have been identified. Among them, 12 are considered rare (known from fewer than 20 locations worldwide or less than 3,000 individuals). Twenty-two bird species (native and non-native) have been observed, including four Federally-listed endangered bird species.

The Laupahoehoe Unit contains native-dominated forested landscapes from lowland forest at 2,300 feet (700 m) above sea level extending through four life zones (subtropical basal wet forest, subtropical lower montane moist forest, subtropical lower montane wet forest, and subtropical montane wet forest) to almost 6,200 feet (1,890 m) in elevation. Average annual rainfall of the Unit ranges from 135 inches (3,428 mm) at lower elevations to 69 inches (1,752 mm) at higher elevations. It is part of the largest remaining native dominated forest in Hawaii. Forests are largely dominated by ohia (*Metrosideros polymorpha*) and koa (*Acacia koa*), the two most widespread tree species in native forest remaining in Hawaii. In addition, the landscape includes plantations dominated by tropical ash (*Fraxinus uhdei*) and eucalyptus (*Eucalyptus* spp.), degraded pastures, abandoned sugarcane fields, and sites dominated by invasive non-native plants and animals. Invasive non-native flora include strawberry guava, clidemia and other melastomes, vines, and grasses, while invasive non-native fauna include pigs, rats, various birds (terrestrial) and fish, shrimp, and caddisflies (aquatic). Seven headwater streams originate in the Unit and provide excellent opportunities to conduct hydrologic and aquatic ecology studies. Streams in the site include two first order tributaries of Kaawalii Stream, Laupahoehoe Stream, Kilau Stream, Kiwilahiahi Stream, Haakoa Stream, and Pahale Stream. Three distinct and continuous soil substrates of differing ages occur along broad elevational ranges.

Photo courtesy of Molly Murphy

Elevations below this Unit are privately owned and adjacent lands at upper elevations are administered by Department of Hawaiian Homelands and the DOFAW. Locating an Experimental Forest within this existing framework provides researchers with a globally unique opportunity to study environmental gradients from the upper limits of agriculture at lower elevations through eight life zones terminating at the alpine life zone at almost 13,996 feet (4,267 m) in elevation.

[1&2]:http://hawaii.gov/dlnr/dofaw/nars/reserves/big-island/laupahoehoemp.PDF



Map produced by
Cheyenne Perry
January 2011

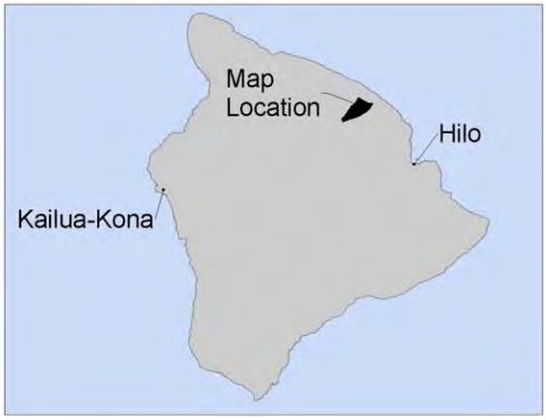


Figure 1. Map of the Laupahoehoe Unit of the HETF.

Puu Waawaa Dry Forest

The Puu Waawaa Experimental Forest Unit is located on the North Kona coast on the Island of Hawaii (Figure 2). This 38,885 acre (15,743 ha) Unit lies on the northern flank of Hualalai volcano, extending from sea level to within 1 mile (1.6 km) of the mountain summit. The Unit incorporates a number of land designations within DLNR. Approximately 31,475 acres (12,743 ha) are designated as Forest Reserve and together with the 3,806 acre (1,542 ha) Forest Bird Sanctuary, are managed through DOFAW. The remaining 3,530 acres (1,430 ha) are managed by the DLNR Division of State Parks. In addition there are approximately 74 acres (30 ha) of private in holdings within the HETF boundaries.

The landscape consists of exotic-dominated grasslands, and tropical dry and moist forests. Tropical dry forests are considered among the most endangered forest types in the world, and in Hawaii the few remaining remnants are severely threatened by wildfire, invasive plant species, and ungulate browsing. With the exception of Puu Waawaa, there are no tropical dry forests represented on any Experimental Forest in the US and very few across the world, even although historically they were among the most widespread of tropical ecosystems.

A Biological Assessment* completed in 2003 listed 189 native vascular plants, 36 land snails (2 introduced), 264 native arthropods, 35 cave arthropods, 104 non-native arthropods, 15 native birds, and 38 non-native bird species. At least 40 rare plant taxa have been reported from the area. Of these, 17 are Federally-listed endangered species. Also listed are 11 endangered bird species and one insect. Botanical surveys reveal that a great number of plants have been extirpated at Puu Waawaa in recent years.

The watershed or ahupuaa has an elevational range from sea level to 6,400 feet (1,951 m). It covers the gradient of the major dry and mesic forest types in Hawaii including five life zones: subtropical basal thorn woodland, subtropical basal dry forest, subtropical lower montane moist forest, subtropical lower montane thorne steppe, and subtropical montane steppe. It contains examples of highly degraded as well as intact native forests. Much of the mesic forests at the upper elevations are dominated by the ecologically and economically important koa. Annual rainfall ranges from an average of 11 inches (279 mm) on the coast to about 49 inches (1,250 mm) at the highest elevations. An infrastructure that includes roads, houses, and water exists on the Unit. Because the forests extend from almost 6,500 feet (2,000 m) to sea level, there is great potential to do watershed level studies that link forests to marine environments.

Photo courtesy of Chris Nishioka

*:http://www.state.hi.us/dlnr/dofaw/pubs/PWW_biol_assessment.pdf

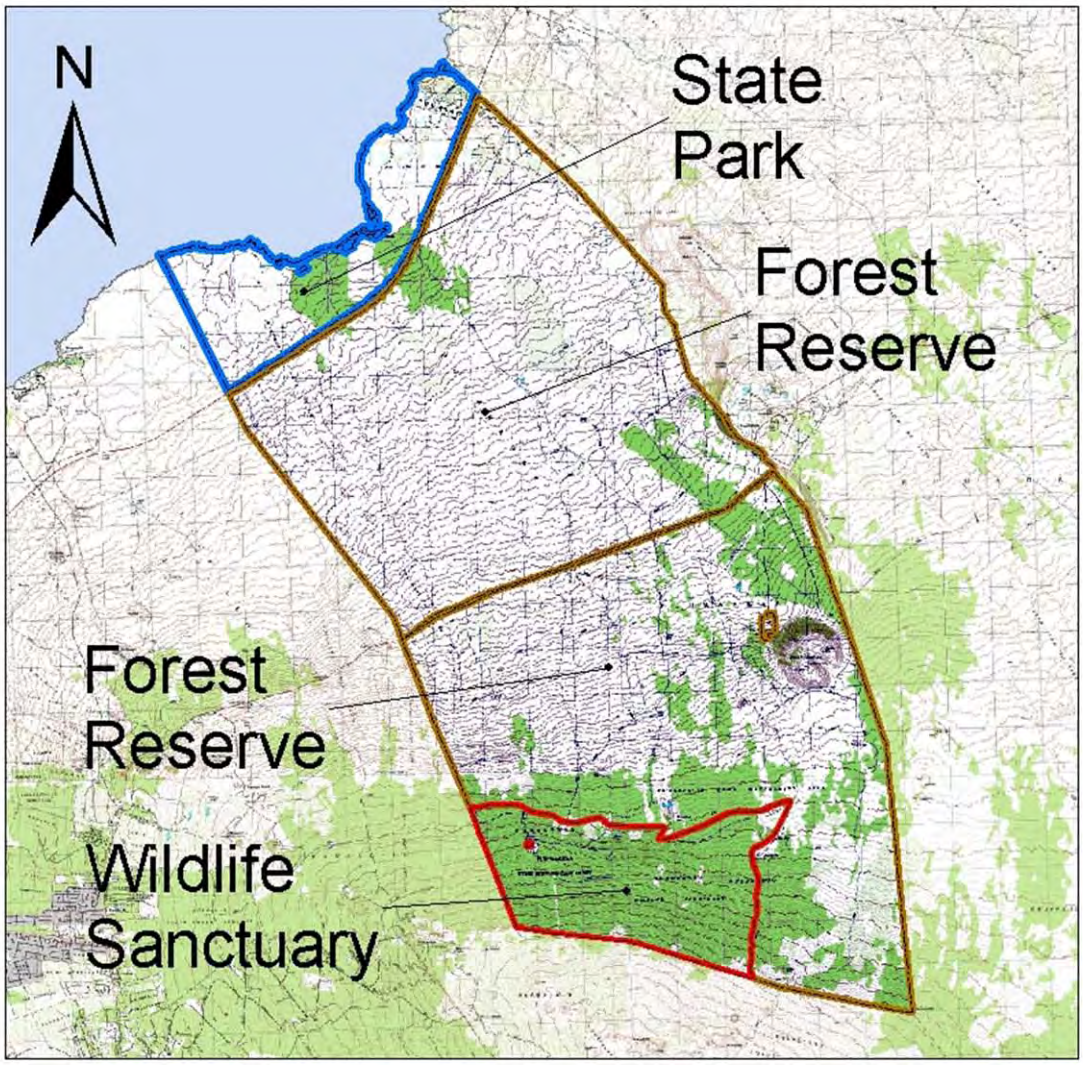


Figure 2. Map of the Puu Waawaa Unit of the HETF.

2007 Research

Research Summary

Four research permit applications were submitted and approved in 2007. Three projects were initiated (all new projects). Details concerning the uninitiated/unfinished projects are given below. One* of the three projects occurred within both HETF Units (*although the HIPPNET permit included both Units, no work was initiated in Puu Waawaa). Results were disseminated in journals including *Biological Journal of the Linnean Society*, and *Ecosytems* (see section 'HETF Related Citations' of this report).

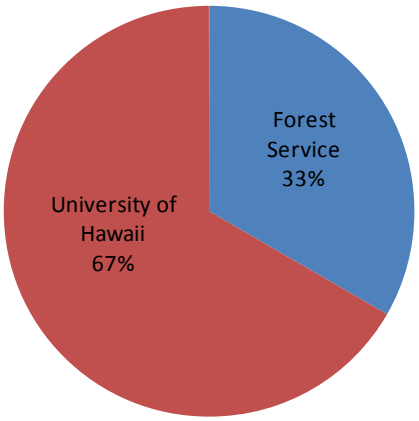


Figure 3. Affiliation of the three research projects initiated in 2007.

Uninitiated/Unfinished Research Projects

- Dr. Sun Park was approved to work in Laupahoehoe NAR/Forest Reserve and Puu Waawaa for the project "An assessment of tropical ecosystem dynamics in response to climate variability using long-term satellite data records". He did not obtain his permit from the DOWFA office rendering it invalid.
- The HIPPNET permit included research in both HETF Units as noted in the Research Detail section; however no work was initiated within the Puu Waawaa Unit and was not noted as occurring in more than one Unit in the Research Summary above. The work effort to set up the plots was focused in the Laupahoehoe Unit.

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. The Laupahoehoe Unit is detailed by Sub-Unit, as the Natural Area Reserve had different annual reporting requirements than the Forest Reserve at the time of this report. All annual reports that were received by the time of this document's publication are noted in the detail and provided in the section 'Annual Reports Received' of this document. Acronyms used in this section include: LAU=Laupahoehoe, NAR=Natural Area Reserve, FR=Forest Reserve and PWW=Puu Waawaa.

Laupahoehoe-Forest Reserve Sub-Unit (2007)

Principle Investigator: Cordell, Susan et al.	**Permit Duration:** Jun 2007-Jun 2008
New Permit ☒ **Renewal** ☐ **Permanent (contingent upon approval)** ☒ **No Valid Permit** ☐	
Project Location(s): LAU-NAR ☒ LAU-FR ☒ PWW ☒ **Note**: *No research was conducted in PWW*	
Research Title: Hawaii Permanent Plot Network (HIPPNET)	
Affiliation: UH-Hilo, UH-Manoa, USDA Forest Service IPIF, Hawaii Community College	
PI Contact Info: (808)933-8121; scordell01@fs.fed.us	
Dates of Anticipated Results: Summer 2008	**Citation Submitted:** Yes ☐ No ☒
Annual Report Received: Yes ☐ No ☐ Not Required ☒	

Principle Investigator: Kapono, Mark	**Permit Duration:** Dec 2007-Dec 2008
New Permit ☒ **Renewal** ☐ **Permanent (contingent upon approval)** ☐ **No Valid Permit** ☐	
Project Location(s): LAU-NAR ☐ LAU-FR ☒ PWW ☒	
Research Title: Comparative nutritive values of traditional and exotic foraging substrates for upper elevation forest birds.	
Affiliation: UH-Hilo	
PI Contact Info: (808)778-3395; mkapono@hawaii.edu	
Dates of Anticipated Results: December 2008	**Citation Submitted:** Yes ☐ No ☒
Annual Report Received: Yes ☐ No ☐ Not Required ☒	

Laupahoehoe-Forest Reserve Sub-Unit (2007) continued

Principle Investigator: Miura, Tomoaki	**Permit Duration:** Oct 2007-Sept 2008
New Permit ☒ **Renewal** ☐ **Permanent (contingent upon approval)** ☐ **No Valid Permit** ☐	
Project Location(s): LAU-NAR ☒ LAU-FR ☒ PWW ☐	
Research Title: An assessment of Hawaiian tropical ecosystem dynamics in response to climate variability using long-term satellite data records.	
Affiliation: UH-Manoa, UH-Hilo	
PI Contact Info: (808)956-7333; tomoakim@hawaii.edu	
Dates of Anticipated Results: Summer 2008	**Citation Submitted:** Yes ☐ No ☒
Annual Report Received: Yes ☐ No ☐ Not Required ☒	

Laupahoehoe-Natural Area Reserve Sub-Unit (2007)

Principle Investigator: Cordell, Susan et al.	**Permit Duration:** Jun 2007-May 2008
New Permit ☒ **Renewal** ☐ **Permanent (contingent upon approval)** ☒ **No Valid Permit** ☐	
Project Location(s): LAU-NAR ☒ LAU-FR ☒ PWW ☒ **Note**: *No research was conducted in PWW*	
Research Title: Hawaii Permanent Plot Network (HIPPNET)	
Affiliation: UH-Hilo, UH-Manoa, USDA Forest Service IPIF, Hawaii Community College	
PI Contact Info: (808)933-8121; scordell01@fs.fed.us	
Dates of Anticipated Results: Summer 2008	**Citation Submitted:** Yes ☐ No ☒
Annual Report Received: Yes ☐ No ☒ Not Required ☐	

Principle Investigator: Miura, Tomoaki	**Permit Duration:** Oct 2007-Sept 2008
New Permit ☒ **Renewal** ☐ **Permanent (contingent upon approval)** ☐ **No Valid Permit** ☐	
Project Location(s): LAU-NAR ☒ LAU-FR ☒ PWW ☐	
Research Title: An assessment of Hawaiian tropical ecosystem dynamics in response to climate variability using long-term satellite data records.	
Affiliation: UH-Manoa, UH-Hilo	
PI Contact Info: (808)956-7333; tomoakim@hawaii.edu	
Dates of Anticipated Results: Summer 2008	**Citation Submitted:** Yes ☐ No ☒
Annual Report Received: Yes ☐ No ☒ Not Required ☐	

Puu Waawaa Unit (2007)

Principle Investigator: Cordell, Susan et al.	**Permit Duration:** May 2007-Apr 2008
New Permit ☒ **Renewal** ☐ **Permanent (contingent upon approval)** ☒ **No Valid Permit** ☐	
Project Location(s): LAU-NAR ☒ LAU-FR ☒ PWW ☒ **Note**: *No research was conducted in PWW*	
Research Title: Hawaii Permanent Plot Network (HIPPNET)	
Affiliation: UH-Hilo, UH-Manoa, USDA Forest Service IPIF, Hawaii Community College	
PI Contact Info: (808)933-8121; scordell01@fs.fed.us	
Dates of Anticipated Results: Summer 2008	**Citation Submitted:** Yes ☐ No ☒
Annual Report Received: Yes ☐ No ☐ Not Required ☒ **Note**: *No research was conducted in PWW*	

Principle Investigator: Kapono, Mark	**Permit Duration:** Dec 2007-Dec 2008
New Permit ☒ **Renewal** ☐ **Permanent (contingent upon approval)** ☐ **No Valid Permit** ☐	
Project Location(s): LAU-NAR ☐ LAU-FR ☒ PWW ☒	
Research Title: Comparative nutritive values of traditional and exotic foraging substrates for upper elevation forest birds.	
Affiliation: UH-Hilo	
PI Contact Info: (808)778-3395; mkapono@hawaii.edu	
Dates of Anticipated Results: 2009	**Citation Submitted:** Yes ☐ No ☒
Annual Report Received: Yes ☐ No ☐ Not Required ☒	

2007 Access, Outreach, and Education

2007 Access, Outreach and Education Summary

Laupahoehoe Unit

Nine participants on one trip visited the Laupahoehoe Unit in 2007. Coleen Cole took the American Association of University women on a natural history trip.

Puu Waawaa Unit

No data were available for 2007 access, outreach and education at Puu Waawaa.

2008 Research

Research Summary

Sixteen research permit applications were submitted and approved in 2008. Thirteen research projects were initiated (twelve new and one permit lapse during which research still occurred). Details concerning the uninitiated/unfinished projects are given below. There was a break in the HIPPNET HETF permit from May 2008 to January 2009 after the initial permit expired during which time research activity continued. However the Forest Service Permit to Use State Lands (Appendix B) was in effect for this project. (This project is included in the affiliation data and research detail; however the renewal did not occur until January 2009.) One* of the thirteen projects were located in both HETF Units (*although the HIPPNET permit included both Units, no work was initiated in Puu Waawaa).

The initiated research projects covered a wide span ranging from: sprouting vs. seeding in wet, mesic, and dry forests, climate change, and studies on endemic birds and bats. HETF related journal articles were published in *Oecologi, Proceedings of National Academy of Sciences, Oikos* and other journals (see section 'HETF Related Citations' of this report).

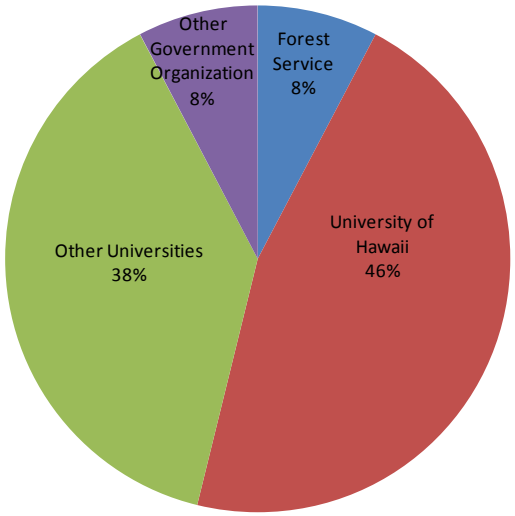


Figure 4. Affiliation of the thirteen research projects initiated in 2008.

Uninitiated/Unfinished Research Projects

- Dr. James Leary was approved to conduct research in Puu Waawaa for the project "Development of best management practices for control of Madagascar Fireweed in Hawaii". He was unable to complete his research due to fire in the area prompting the closures of Puu Waawaa. His permit was granted a one year extension. However more fires that year made it impossible to conduct or finish his work.

- Dr. Robert Peck was approved to conduct research in the Laupahoehoe Unit (Forest Reserve and NAR). His project was entitled “Identifying impacts of parasitoid wasps on *Lepidoptera* communities in a Hawaiian wet forest”. He was unable to start his research due to a loss of funding.
- Dr. Marc Kramer was approved to conduct research in the Laupahoehoe Forest Reserve for the project entitled “Pedogenic and climatic thresholds in carbon stabilization”. He did not obtain his permit from the DOFAW office rendering it invalid.
- Dr. Jonathan Eldon was approved to conduct research in Puu Waawaa for the project entitled “Collection of *Drosophila sproati* from Puu Waawaa at elevations of 4000-5500'”. He was unable to find any specimens and therefore unable to complete his research.
- The HIPPNET permit included research in both HETF Units as noted in the Research Detail section; however no work was initiated within the Puu Waawaa Unit and was not noted as occurring in more than one Unit in the Research Summary above. The work effort to set up the plots was focused in the Laupahoehoe Unit.

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. The Laupahoehoe Unit is detailed by Sub-Unit, as the Natural Area Reserve had different annual reporting requirements than the Forest Reserve at the time of this report. All annual reports that were received by the time of this document's publication are noted in the detail and provided in the section 'Annual Reports Received' of this document. Acronyms used in this section include: LAU=Laupahoehoe, NAR=Natural Area Reserve, FR=Forest Reserve and PWW=Puu Waawaa.

Laupahoehoe-Forest Reserve Sub-Unit (2008)

Principle Investigator: Bonaccorso, Frank	**Permit Duration:** Nov 2008-Nov 2009
New Permit ☒ **Renewal** ☐ **Permanent (contingent upon approval)** ☐ **No Valid Permit** ☐	
Project Location(s): LAU-NAR ☒ LAU-FR ☒ PWW ☐	
Research Title: Passive study of vocalizations of Hawaiian hoary bat for evaluation of conservation status.	
Affiliation: USGS - PIERC	
PI Contact Info: (808)985-6126	
Dates of Anticipated Results: September 2009	**Citation Submitted:** Yes ☐ No ☒
Annual Report Received: Yes ☒ No ☐ Not Required ☒	
Note: Permit was issued from NARS office in Honolulu - no HETF application done.	

Principle Investigator: Broadbent, Eben	**Permit Duration:** Feb 2008-Feb 2009
New Permit ☒ **Renewal** ☐ **Permanent** ☐ **No Valid Permit** ☐	
Project Location(s): LAU-NAR ☒ LAU-FR ☒ PWW ☐	
Research Title: Forest architecture, Carbon dynamics, and climate change interactions: linking field and remote sensing along temporal and spatial gradients.	
Affiliation: Stanford University, Carnegie Institute of Washington	
PI Contact Info: Cell (605)704-2065; eben@stanford.edu	
Dates of Anticipated Results: September 2011	**Citation Submitted:** Yes ☐ No ☒
Annual Report Received: Yes ☒ No ☐ Not Required ☒	

Laupahoehoe-Forest Reserve Sub-Unit (2008) continued

Principle Investigator: Busby, Posy	**Permit Duration:** Jan 2008-Dec 2008
New Permit ☒ **Renewal** ☐ **Permanent (contingent upon approval)** ☐ **No Valid Permit** ☐	
Project Location(s): LAU-NAR ☐ LAU-FR ☒ PWW ☒	
Research Title: Sprouting vs. seeding in Hawaiian wet, mesic, and dry forests.	
Affiliation: Stanford University	
PI Contact Info: (503)381-4168; busby@stanford.edu	
Dates of Anticipated Results: August 2008	**Citation Submitted:** Yes ☒ No ☐
Annual Report Received: Yes ☐ No ☐ Not Required ☒	

Principle Investigator: Cordell, Susan et al.	**Permit Duration:** Lapse from May 2008 to Jan 2009
New Permit ☐ **Renewal** ☐ **Permanent (contingent upon approval)** ☒ **No Valid Permit** ☒	
Project Location(s): LAU-NAR ☒ LAU-FR ☒ PWW ☒ N**ote**: *No research was conducted in PWW*	
Research Title: Hawaii Permanent Plot Network (HIPPNET)	
Affiliation: UCLA, UH-Hilo, USDA Forest Service IPIF, RCUH, UH-Manoa	
PI Contact Info: (808)933-8121; scordell01@fs.fed.us	
Dates of Anticipated Results: Summer 2008	**Citation Submitted:** Yes ☐ No ☒
Annual Report Received: Yes ☐ No ☐ Not Required ☒	
Note: Note: FS Permit to Use lands in effect during HETF permit lapse.	

Principle Investigator: Gaudioso, Jacqueline	**Permit Duration:** Feb 2008-Feb 2009
New Permit ☒ **Renewal** ☐ **Permanent (contingent upon approval)** ☐ **No Valid Permit** ☐	
Project Location(s): LAU-NAR ☐ LAU-FR ☒ PWW ☐	
Research Title: Objective quantification of plumage coloration of a Hawaiian honeycreeper (*Hemignathus virens*) along environmental gradiations of biogeography: does variation exist between sub-populations?	
Affiliation: UH-Hilo, USGS	
PI Contact Info: (203)457-0161; jgaudioso@gmail.com	
Dates of Anticipated Results: December 2009	**Citation Submitted:** Yes ☒ No ☐
Annual Report Received: Yes ☒ No ☐ Not Required ☒	

Laupahoehoe-Forest Reserve Sub-Unit (2008) continued

Principle Investigator: Vitousek, Peter	**Permit Duration:** May 2008-May 2009
New Permit ☒ **Renewal** ☐ **Permanent (contingent upon approval)** ☐ **No Valid Permit** ☐	
Project Location(s): LAU-NAR ☒ LAU-FR ☒ PWW ☐	
Research Title: Sources and fates of nutrients on a substrate age gradient across the Hawaiian archipelago and their consequences for forest dynamics.	
Affiliation: Stanford University	
PI Contact Info: (605)814-6812; vitousek@stanford.edu	
Dates of Anticipated Results: 1995	**Citation Submitted:** Yes ☒ No ☐
Annual Report Received: Yes ☒ No ☐ Not Required ☒	

Laupahoehoe-Natural Area Reserve Sub-Unit (2008)

Principle Investigator: Bonaccorso, Frank	**Permit Duration:** Nov 2008-Nov 2009
New Permit ☒ **Renewal** ☐ **Permanent (contingent upon approval)** ☐ **No Valid Permit** ☐	
Project Location(s): LAU-NAR ☒ LAU-FR ☒ PWW ☐	
Research Title: Passive study of vocalizations of Hawaiian hoary bat for evaluation of conservation status.	
Affiliation: USGS - PIERC	
PI Contact Info: (808)985-6126	
Dates of Anticipated Results: September 2009	**Citation Submitted:** Yes ☐ No ☒
Annual Report Received: Yes ☒ No ☐ Not Required ☐	
Note: Note: Permit was issued from NARS office in Honolulu - no HETF application done.	

Principle Investigator: Broadbent, Eben	**Permit Duration:** Jan 2008-Jan 2009
New Permit ☒ **Renewal** ☐ **Permanent** ☐ **No Valid Permit** ☐	
Project Location(s): LAU-NAR ☒ LAU-FR ☒ PWW ☐	
Research Title: Forest architecture, Carbon dynamics, and climate change interactions: linking field and remote sensing along temporal and spatial gradients.	
Affiliation: Stanford University, Carnegie Institute of Washington	
PI Contact Info: Cell (605)704-2065 ; eben@stanford.edu	
Dates of Anticipated Results: September 2011	**Citation Submitted:** Yes ☐ No ☒
Annual Report Received: Yes ☒ No ☐ Not Required ☐	

Principle Investigator: Cordell, Susan et al.	**Permit Duration:** Lapse from May 2008 to Jan 2009
New Permit ☐ **Renewal** ☐ **Permanent (contingent upon approval)** ☒ **No Valid Permit** ☒	
Project Location(s): LAU-NAR ☒ LAU-FR ☒ PWW ☒ N**ote**: *No research was conducted in PWW*	
Research Title: Hawaii Permanent Plot Network (HIPPNET)	
Affiliation: UCLA, UH-Hilo, USDA Forest Service IPIF, RCUH, UH-Manoa	
PI Contact Info: (808)933-8121; Scordell01@fs.fed.us	
Dates of Anticipated Results: Summer 2008	**Citation Submitted:** Yes ☐ No ☒
Annual Report Received: Yes ☐ No ☒ Not Required ☐	
Note: Note: FS Permit to Use lands in effect during HETF permit lapse.	

Laupahoehoe-Natural Area Reserve Sub-Unit (2008) continued

Principle Investigator: O'Grady, Patrick	**Permit Duration:** Oct 2008-Oct 2009
New Permit ☒ **Renewal** ☐ **Permanent (contingent upon approval)** ☐ **No Valid Permit** ☐	
Project Location(s): LAU-NAR ☒ LAU-FR ☐ PWW ☐	
Research Title: Study of the molecular evolution of arthropods - phylogenetic study.	
Affiliation: University of California, Berkley	
PI Contact Info: (510)642-0662; ogrady@nature.berkley.edu	
Dates of Anticipated Results: NA	**Citation Submitted:** Yes ☐ No ☒
Annual Report Received: Yes ☐ No ☐ Not Required ☐ **- UNKOWN** see note below	
Note: Permit issued through NARS office in Honolulu- no HETF application completed.	

Principle Investigator: Vitousek, Peter	**Permit Duration:** May 2008-May 2009
New Permit ☒ **Renewal** ☐ **Permanent (contingent upon approval)** ☐ **No Valid Permit** ☐	
Project Location(s): LAU-NAR ☒ LAU-FR ☒ PWW ☐	
Research Title: Sources and fates of nutrients on a substrate age gradient across the Hawaiian archipelago and their consequences for forest dynamics.	
Affiliation: Stanford University	
PI Contact Info: (605)814-6812; vitousek@stanford.edu	
Dates of Anticipated Results: 1995	**Citation Submitted:** Yes ☒ No ☐
Annual Report Received: Yes ☒ No ☐ Not Required ☐	

Principle Investigator: Yeung, Norine	**Permit Duration:** Oct 2008-Oct 2009
New Permit ☒ **Renewal** ☐ **Permanent (contingent upon approval)** ☐ **No Valid Permit** ☐	
Project Location(s): LAU-NAR ☒ LAU-FR ☐ PWW ☐	
Research Title: Study of alien snails, survey of native snails.	
Affiliation: UH-Manoa	
PI Contact Info: (808)956-4909; nyeung@hawaii.edu	
Dates of Anticipated Results: TBA	**Citation Submitted:** Yes ☐ No ☒
Annual Report Received: Yes ☐ No ☒ Not Required ☐	

Puu Waawaa Unit (2008)

Principle Investigator: Busby, Posy	**Permit Duration:** Jan 2008-Dec 2008
New Permit ☒ **Renewal** ☐ **Permanent (contingent upon approval)** ☐ **No Valid Permit** ☐	
Project Location(s): LAU-NAR ☐ LAU-FR ☒ PWW ☒	
Research Title: Sprouting vs. seeding in Hawaiian wet, mesic, and dry forests.	
Affiliation: Stanford University	
PI Contact Info: (503)381-4168; busby@stanford.edu	
Dates of Anticipated Results: August 2008	**Citation Submitted:** Yes ☒ No ☐
Annual Report Received: Yes ☐ No ☐ Not Required ☒	

Principle Investigator: Cavaleri, Molly	**Permit Duration:** Apr 2008-Apr 2009
New Permit ☒ **Renewal** ☐ **Permanent (contingent upon approval)** ☐ **No Valid Permit:** ☐	
Project Location(s): LAU-NAR ☐ LAU-FR ☐ PWW ☒	
Research Title: EPSCoR Terrestrial Ecohydrology Project	
Affiliation: UCLA, USDA Forest Service IPIF, UH-Hilo	
PI Contact Info: (970)215-4817; mollycavaleri@gmail.com	
Dates of Anticipated Results: March 2011	**Citation Submitted:** Yes ☐ No ☒
Annual Report Received: Yes ☐ No ☐ Not Required ☒	

Principle Investigator: Cordell, Susan et al	**Permit Duration:** Lapse from May 2008 to Jan 2009
New Permit ☐ **Renewal** ☒ **Permanent (contingent upon approval)** ☒ **No Valid Permit** ☐	
Project Location(s): LAU-NAR ☒ LAU-FR ☒ PWW ☒ **Note**: *No research was conducted in PWW*	
Research Title: Hawaii Permanent Plot Network (HIPPNET)	
Affiliation: UCLA, UH-Hilo, USDA Forest Service IPIF, RCUH, UH-Manoa	
PI Contact Info: (808)933-8121; scordell01@fs.fed.us	
Dates of Anticipated Results: Summer 2008	**Citation Submitted:** Yes ☐ No ☒
Annual Report Received: Yes ☐ No ☐ Not Required ☒	
Note: FS Permit to Use lands in effect during HETF permit lapse.	

Puu Waawaa Unit (2008) continued

Principle Investigator: Juvik, James	**Permit Duration:** Mar 2008-Mar 2009
New Permit ☒ **Renewal** ☐ **Permanent (contingent upon approval)** ☐ **No Valid Permit** ☐	
Project Location(s): LAU-NAR ☐ LAU-FR ☐ PWW ☒	
Research Title: Climate-hydrologic monitoring on the north slope of Hualalai.	
Affiliation: UH-Hilo	
PI Contact Info: (808)959-5744; jjuvik@hawaii.edu	
Dates of Anticipated Results: December 2010	**Citation Submitted:** Yes ☐ No ☒
Annual Report Received: Yes ☐ No ☐ Not Required ☒	

Principle Investigator: Kaufman, Leyla et al	**Permit Duration:** Oct 2008-Oct 2009
New Permit ☒ **Renewal** ☐ **Permanent (contingent upon approval)** ☐ **No Valid Permit** ☐	
Project Location(s): LAU-NAR ☐ LAU-FR ☐ PWW ☒	
Research Title: Study of infestation of and biocontrol on *Erythrina sandwichensis.*	
Affiliation: UH-Manoa, Hawaii Department of Agriculture	
PI Contact Info: (808)973-9526; julianaA.Yalemar@hawaii.gov	
Dates of Anticipated Results: December 2011	**Citation Submitted:** Yes ☐ No ☒
Annual Report Received: Yes ☐ No ☐ Not Required ☒	

Principle Investigator: Miura, Tomoaki	**Permit Duration:** May 2008-May 2009
New Permit ☒ **Renewal** ☐ **Permanent (contingent upon approval)** ☐ **No Valid Permit** ☐	
Project Location(s): LAU-NAR ☐ LAU-FR ☐ PWW ☒	
Research Title: An assessment of Hawaiian tropical ecosystem dynamics in response to climate variability using long-term satellite data records.	
Affiliation: UH-Manoa	
PI Contact Info: (808)956-7333; tomoakim@hawaii.edu	
Dates of Anticipated Results: Summer 2009	**Citation Submitted:** Yes ☐ No ☒
Annual Report Received: Yes ☐ No ☐ Not Required ☒	

Puu Waawaa Unit (2008) continued

Principle Investigator: Thorne, Mark	**Permit Duration:** May 2008-May 2009
New Permit ☒ **Renewal** ☐ **Permanent (contingent upon approval)** ☐ **No Valid Permit** ☐	
Project Location(s): LAU-NAR ☐ LAU-FR ☐ PWW ☒	
Research Title: Development of best management practices for control of Madagascar Fireweed in Hawaii.	
Affiliation: UH-Manoa	
PI Contact Info: 67-5189 Kamanalu Road, Kamuela, HI 96743	
Dates of Anticipated Results: November 2009	**Citation Submitted:** Yes ☐ No ☒
Annual Report Received: Yes ☐ No ☐ Not Required ☒	

2008 Access, Outreach, and Education

2008 Access, Outreach and Education Summary

Laupahoehoe Unit

Seventy-six participants on eleven trips visited the Laupahoehoe Unit in 2008. The trips included service learning, the forest as a living class room, local outreach, and tours by the USDA Forest Service. The Director for the Smithsonian Center for Tropical Forest Science visited the HIPPNET site during this year. Engineers and program managers for the National Ecological Observatory Network (NEON) project and the Pacific Southwest Research Station advisory council both did site visits.

Puu Waawaa Unit

Eight hundred and fifty-four participants on thirty-one trips visited Puu Waawaa for education, hiking, camping, and service learning.

2008 Access, Outreach, and Education Detail

Laupahoehoe Unit

Organization	Event	Contact	Date	Group #
Oahu Sierra Club	service trip	Colleen Cole	2/16	12
Forest Service visitors (J. Sedell)	visit & tour	Boone Kauffman	2/27	3
UH Manoa (Tom Giambelluca)	visit & tour	Christian Giardina	4/11	4
Brian Kloeppel	visit & tour	Susan Cordell	5/27	3
UHH Geography Dept.	geography class	Dr. James Juvik	8/5	14
Oahu Sierra Club	service trip	Colleen Cole	8/30	13
Outreach- Local hunter Paul Diaz	hike & discussion of issues	Cheyenne Perry	10/1	3
PSW Advisory Council	visit & tour	Boone Kauffman	11/22	6
Engineers for NEON	visit & tour	Colleen Cole/Susan Cordell	12/9	10
CTFS Director visit	HIPPNET site visit	Christian Giardina	12/13	5
Outreach - Laupahoehoe school principal & science teacher	visit & tour of facilities site	Cheyenne Perry	12/23	3

Puu Waawaa Unit

Organization	Event	Contact	Date	Group #
Kanu o ka Aina	Aha Aina	Ku'ulei Keakealani	1/12	71
Kona SWCD	Field Trip	Bob Nelson	2/9	32
BSA Troop 79	Campout	Bruce Soto	2/23	23
Nahele Dry Forest Symposium	Field Trip	Kathy Frost	2/24	41
Digital Science Solutions	Overnight, meeting	Alan Nakagawa	2/28	14
Wilderness Inquiry	Hike Ohia Trail	Bill Simpson	3/11	24
Wilderness Inquiry	Cone Trail	Bill Simpson	3/18	22
Wilderness Inquiry	Ohia Trail	Bill Simpson	3/25	26
Parker School	Overnight, hike, service	Shelley	4/10	10
CNA Forest Fire Assoc	Field Trip	Miles Nakahara	4/17	44
Kamehameha School	Overnight, hike, service	Merle Samura	5/5-5/9	97
BSA Troop 29	Overnight, service	Geoffrey Whitener	5/16	26
BSA Troop 37	Service	Dwayne Keanaaina	5/24	22
Carleton University	Site Visit	Brian Cousens	5/9	32
W. HI Explorations Academy	Overnight/service	Ben Duke	5/31-6/2	27
Grand Valley State U.	Site Visit	Steve Maddox	6/13	33
Holualoa Elem Summer School	Overnight	Tamar Atsumi	6/20	15
Youth Conservation Corps	Week-long	John Leong	6/23-6/27	13
Youth Conservation Corps	Week-long	John Leong	6/30-7/3	13
Youth Conservation Corps	Week-long	John Leong	7/7- 7/11	13
Jr. Forest Team/Alu Like	Day trip	Kathy Rodriguez	7/15	15
BSA Troop 79	Camping, hike, service	Bruce Soto	7/25-7/27	25
UHH Geography	Campout, field school	Jim Juvik	8/10-8/15	15
TREE	Cone Trip, service project	Steve Coffee	9/29	18
TREE	Cone Trip and service	Steve Coffee	10/17	16
UHH -West	Hawaiian Trail Culture Class	Kalani Flores	10/18	21
TREE	Cone trip and history lecture	Steve Coffee	10/31	23
County/B-WET Program	GIS Day @ Old Airport	Elizabeth Pickett	11/14	60
Waimea Middle School	Hike and talk	Lily Edmonds	11/15	22
HPA Upper School	Hoolaulea	Mary-Alice Nogues	11/21	29
TREE	Cone Trip and service	Steve Coffee	11/24	12

2009 Research

Research Summary

Eighteen research permit applications were submitted and approved in 2009. Seventeen projects were initiated (six renewals and eleven new). Details concerning the uninitiated/unfinished projects are given below. One* of the seventeen projects were located within both HETF Units (*although the HIPPNET permit included both Units, no work was initiated in Puu Waawaa). HETF related journal articles were published in *Biotropica*, *Ecosystems*, *Functional Ecology* and more (see section 'HETF Related Citations' of this report).

Two long term projects were started this year. Dr. Flint Hughes started a long term landscape scale study on community composition, forest, structure, diversity, biomass and carbon mass. Also, Dr. Creighton Litton and Dr. Christian Giardina began their long term project to understand the impacts of rising temperature on carbon input, allocation and loss in Laupahoehoe. One ongoing long term project was incorporated into the HETF permit system. Dr. Peter Vitousek has studied the substrate age gradients in Laupahoehoe to understand the sources and fates of nutrients in the soil since 1991. His work is expected to continue until 2015. Also, the HIPPNET project in Laupahoehoe, which began in 2007, passed a significant milestone by completing their first plant census. 16,000 individual plants were tagged, identified, mapped and measured.

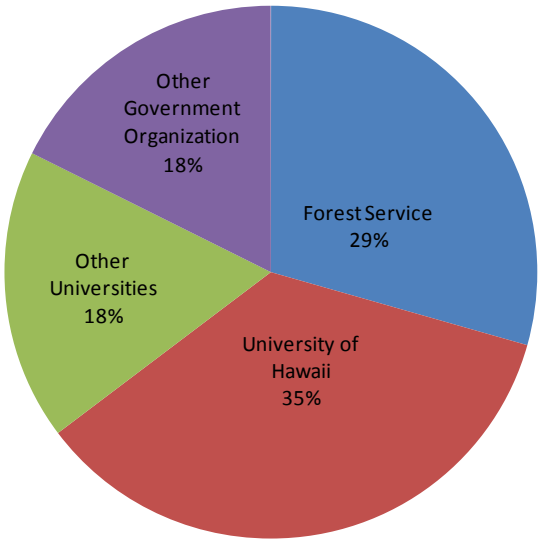


Figure 5. Affiliation of the seventeen research projects initiated in 2009.

Uninitiated/Unfinished Research Projects

- Dr. Fred Stone was approved to conduct research in Puu Waawaa for the project entitled "(HI Barcoding Project) Determine Caconemobious cricket species, ranges, and estimated abundance using DNA testing and morphological measurements." He was unable to find any subjects therefore unable to complete his research.
- The HIPPNET permit included research in both HETF Units as noted in the Research Detail section; however no work was initiated within the Puu Waawaa Unit and was not noted as occurring in more than one Unit in the Research Summary above. The work effort to set up the plots was focused in the Laupahoehoe Unit.

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. The Laupahoehoe Unit is detailed by Sub-Unit, as the Natural Area Reserve had different annual reporting requirements than the Forest Reserve at the time of this report. All annual reports that were received by the time of this document's publication are noted in the detail and provided in the section 'Annual Reports Received' of this document. Acronyms used in this section include: LAU=Laupahoehoe, NAR=Natural Area Reserve, FR=Forest Reserve and PWW=Puu Waawaa.

Laupahoehoe-Forest Reserve Sub-Unit (2009)

Principle Investigator: Bonaccorso, Frank	**Permit Duration:** Nov 2009-Nov 2010
New Permit ☐ **Renewal** ☒ **Permanent (contingent upon approval)** ☐ **No Valid Permit** ☐	
Project Location(s): LAU-NAR ☒ LAU-FR ☒ PWW ☐	
Research Title: Passive study of vocalizations of Hawaiian hoary bat for evaluation of conservation status.	
Affiliation: USGS - PIERC	
PI Contact Info: (808)985-6126	
Dates of Anticipated Results: September 2009	**Citation Submitted:** Yes ☐ No ☒
Annual Report Received: Yes ☒ No ☐ Not Required ☒	

Principle Investigator: Broadbent, Eben	**Permit Duration:** Apr 2009-Apr 2010
New Permit ☐ **Renewal** ☒ **Permanent** ☐ **No Valid Permit** ☐	
Project Location(s): LAU-NAR ☒ LAU-FR ☒ PWW ☐	
Research Title: Forest architecture, Carbon dynamics, and climate change interactions: linking field and remote sensing along temporal and spatial gradients.	
Affiliation: Stanford University, Carnegie Institute of Washington	
PI Contact Info: Cell (605)704-2065; eben@stanford.edu	
Dates of Anticipated Results: September 2011	**Citation Submitted:** Yes ☐ No ☒
Annual Report Received: Yes ☒ No ☐ Not Required ☒	

Laupahoehoe-Forest Reserve Sub-Unit (2009) continued

Principle Investigator: Cordell, Susan et al	**Permit Duration:** Jan 2009-Jan 2010
New Permit ☐ **Renewal** ☒ **Permanent (contingent upon approval)** ☒ **No Valid Permit** ☐	
Project Location(s): LAU-NAR ☒ LAU-FR ☒ PWW ☒ N**ote**: *No research was conducted in PWW*	
Research Title: Hawaii Permanent Plot Network (HIPPNET)	
Affiliation: UCLA, UH-Hilo, USDA Forest Service IPIF, RCUH, UH-Manoa	
PI Contact Info: (808)933-8121; scordell01@fs.fed.us	
Dates of Anticipated Results: Summer 2008	**Citation Submitted:** Yes ☐ No ☒
Annual Report Received: Yes ☒ No ☐ Not Required ☒	

Principle Investigator: Friday, JB	**Permit Duration:** Sep 2009-Sep 2010
New Permit ☒ **Renewal** ☐ **Permanent (contingent upon approval)** ☐ **No Valid Permit** ☐	
Project Location(s): LAU-NAR ☐ LAU-FR ☒ PWW ☐	
Research Title: Developing productivity models and silvicultural guidelines for growing and managing the native Hawaiian hardwood *Acacia koa.*	
Affiliation: UH Manoa College of Tropical Agriculture and Human Resources, Cooperative Extension Office	
PI Contact Info: (808)981-8266; jbfriday@hawaii.edu	
Dates of Anticipated Results: 2008	**Citation Submitted:** Yes ☒ No ☐
Annual Report Received: Yes ☐ No ☐ Not Required ☒	

Principle Investigator: Giardina, Christian	**Permit Duration:** Jun 2009-Jun 2010
New Permit ☒ **Renewal** ☐ **Permanent (contingent upon approval)** ☐ **No Valid Permit** ☐	
Project Location(s): LAU-NAR ☒ LAU-FR ☒ PWW ☐	
Research Title: Examining the impacts of strawberry guava on native biodiversity in Hawaiian forests.	
Affiliation: USDA Forest Service IPIF	
PI Contact Info: (808)933-8121 ext 119; cgiardina@fs.fed.us	
Dates of Anticipated Results: TBA	**Citation Submitted:** Yes ☐ No ☒
Annual Report Received: Yes ☐ No ☐ Not Required ☒	

Laupahoehoe-Forest Reserve Sub-Unit (2009) continued

Principle Investigator: Giardina C. and Litton C.	**Permit Duration:** Jan 2009-Jan 2010
New Permit ☒ **Renewal** ☐ **Permanent (contingent upon approval)** ☒ **No Valid Permit** ☐	
Project Location(s): LAU-NAR ☒ LAU-FR ☒ PWW ☐	
Research Title: Experimental Test of the impacts of rising temp on C input, allocation, and loss in model forests.	
Affiliation: USDA Forest Service IPIF, UH-Manoa	
PI Contact Info: (808)933-8121 ext 119; cgiardina@fs.fed.us, (808) 956-6004; litton@hawaii.edu	
Dates of Anticipated Results: 2010	**Citation Submitted:** Yes ☐ No ☒
Annual Report Received: Yes ☐ No ☐ Not Required ☒	

Principle Investigator: Goodenough, D.G.	**Permit Duration:** Oct 2009-Dec 2009
New Permit ☒ **Renewal** ☐ **Permanent (contingent upon approval)** ☐ **No Valid Permit** ☐	
Project Location(s): LAU-NAR ☐ LAU-FR ☒ PWW ☐	
Research Title: Douglas-site multi-scale and platform calibration for USAF ARTEMIS mission	
Affiliation: Canadian Forest Service Natural Resources	
PI Contact Info: David.Goodenough@NRcan.gc.ca	
Dates of Anticipated Results: TBA	**Citation Submitted:** Yes ☐ No ☒
Annual Report Received: Yes ☐ No ☐ Not Required ☒	

Principle Investigator: Hughes, Flint	**Permit Duration:** Jan 2009-Jan 2010
New Permit ☒ **Renewal** ☐ **Permanent (contingent upon approval)** ☒ **No Valid Permit** ☐	
Project Location(s): LAU-NAR ☒ LAU-FR ☒ PWW ☐	
Research Title: Assessing forest structure, community composition, diversity, carbon mass, and biomass on a landscape scale in HETF.	
Affiliation: USDA Forest Service IPIF, Carnegie Institute of Washington	
PI Contact Info: fhuges@fs.fed.us	
Dates of Anticipated Results: December 2008	**Citation Submitted:** Yes ☒ No ☐
Annual Report Received: Yes ☐ No ☐ Not Required ☒	

Laupahoehoe-Forest Reserve Sub-Unit (2009) continued

Principle Investigator: Magnacca, Karl	**Permit Duration:** Jul 2009-Jul 2010
New Permit ☒ **Renewal** ☐ **Permanent (contingent upon approval)** ☐ **No Valid Permit** ☐	
Project Location(s): LAU-NAR ☒ LAU-FR ☒ PWW ☒	
Research Title: Moore Foundation Hawaiian Barcoding Project	
Affiliation: University of Hawaii at Hilo	
PI Contact Info: (808)756-4631	
Dates of Anticipated Results: TBA	**Citation Submitted:** Yes ☐ No ☒
Annual Report Received: Yes ☐ No ☐ Not Required ☒	

Principle Investigator: USDA NRCS	**Permit Duration:** Sep 2009-Sep 2010
New Permit ☒ **Renewal** ☐ **Permanent (contingent upon approval)** ☐ **No Valid Permit** ☐	
Project Location(s): LAU-NAR ☒ LAU-FR ☒ PWW ☐	
Research Title: Soil Survey	
Affiliation: USDA NRCS	
PI Contact Info: (808)933-6997; amy.saunders@hi.usda.gov	
Dates of Anticipated Results: TBA	**Citation Submitted:** Yes ☐ No ☒
Annual Report Received: Yes ☐ No ☐ Not Required ☒	

Principle Investigator: Vitousek, Peter	**Permit Duration:** Jun 2009-Jun 2010
New Permit ☐ **Renewal** ☒ **Permanent (contingent upon approval)** ☒ **No Valid Permit** ☐	
Project Location(s): LAU-NAR ☒ LAU-FR ☒ PWW ☐	
Research Title: Sources and fates of nutrients on a substrate age gradient across the Hawaiian archipelago and their consequences for forest dynamics.	
Affiliation: Stanford University	
PI Contact Info: (605)814-6812; vitousek@stanford.edu	
Dates of Anticipated Results: 1995	**Citation Submitted:** Yes ☒ No ☐
Annual Report Received: Yes ☐ No ☐ Not Required ☒	

Laupahoehoe-Natural Area Reserve Sub-Unit (2009)

Principle Investigator: Bonaccorso, Frank	**Permit Duration:** Nov 2009-Nov 2010
New Permit ☐ **Renewal** ☒ **Permanent (contingent upon approval)** ☐ **No Valid Permit** ☐	
Project Location(s): LAU-NAR ☒ LAU-FR ☒ PWW ☐	
Research Title: Passive study of vocalizations of Hawaiian hoary bat for evaluation of conservation status.	
Affiliation: USGS - PIERC	
PI Contact Info: (808)985-6126	
Dates of Anticipated Results: September 2009	**Citation Submitted:** Yes ☐ No ☒
Annual Report Received: Yes ☒ No ☐ Not Required ☐	

Principle Investigator: Broadbent, Eben	**Permit Duration:** Apr 2009-Apr 2010
New Permit ☐ **Renewal** ☒ **Permanent** ☐ **No Valid Permit** ☐	
Project Location(s): LAU-NAR ☒ LAU-FR ☒ PWW ☐	
Research Title: Forest architecture, Carbon dynamics, and climate change interactions: linking field and remote sensing along temporal and spatial gradients.	
Affiliation: Stanford University, Carnegie Institute of Washington	
PI Contact Info: Cell (605)704-2065; eben@stanford.edu	
Dates of Anticipated Results: Sep 2011	**Citation Submitted:** Yes ☐ No ☒
Annual Report Received: Yes ☒ No ☐ Not Applicable ☐	
Note: Permit lapse for four months; application got lost in the system; no fieldwork during the lapse	

Principle Investigator: Cordell, Susan et al	**Permit Duration:** Jan 2009-Jan 2010
New Permit ☐ **Renewal** ☒ **Permanent (contingent upon approval)** ☒ **No Valid Permit** ☐	
Project Location(s): LAU-NAR ☒ LAU-FR ☒ PWW ☒ **Note**: *No research was conducted in PWW*	
Research Title: Hawaii Permanent Plot Network (HIPPNET)	
Affiliation: UCLA, UH-Hilo, USDA Forest Service IPIF, RCUH, UH-Manoa	
PI Contact Info: (808)933-8121; scordell01@fs.fed.us	
Dates of Anticipated Results: Summer 2008	**Citation Submitted:** Yes ☐ No ☒
Annual Report Received: Yes ☒ No ☐ Not Required ☐	

Laupahoehoe-Natural Area Reserve Sub-Unit (2009) continued

Principle Investigator: Giardina, Christian	**Permit Duration:** Jun 2009-Jun 2010
New Permit ☒ **Renewal** ☐ **Permanent (contingent upon approval)** ☐ **No Valid Permit** ☐	
Project Location(s): LAU-NAR ☒ LAU-FR ☒ PWW ☐	
Research Title: Examining the impacts of strawberry guava on Native biodiversity in Hawaiian forest.	
Affiliation: USDA Forest Service IPIF	
PI Contact Info: (808)933-8121 ext 119; cgiardina@fs.fed.us	
Dates of Anticipated Results: TBA	**Citation Submitted:** Yes ☐ No ☒
Annual Report Received: Yes ☐ No ☒ Not Required ☐	

Principle Investigator: Giardina C. and Litton C.	**Permit Duration:** Jan 2009-Jan 2010
New Permit ☒ **Renewal** ☐ **Permanent (contingent upon approval)** ☒ **No Valid Permit** ☐	
Project Location(s): LAU-NAR ☒ LAU-FR ☒ PWW ☐	
Research Title: Experimental Test of the impacts of rising temp on C input, allocation, and loss in model forests.	
Affiliation: USDA Forest Service IPIF, UH-Manoa	
PI Contact Info: (808)933-8121 ext 119; cgiardina@fs.fed.us, (808) 956-6004; litton@hawaii.edu	
Dates of Anticipated Results: 2010	**Citation Submitted:** Yes ☐ No ☒
Annual Report Received: Yes ☐ No ☒ Not Required ☐	

Principle Investigator: Hughes, Flint	**Permit Duration:** Jan 2009-Jan 2010
New Permit ☒ **Renewal** ☐ **Permanent (contingent upon approval)** ☒ **No Valid Permit** ☐	
Project Location(s): LAU-NAR ☒ LAU-FR ☒ PWW ☐	
Research Title: Assessing forest structure, community composition, diversity, carbon mass, and biomass on a landscape scale in HETF.	
Affiliation: USDA Forest Service IPIF, Carnegie Institute of Washington	
PI Contact Info: fhuges@fs.fed.us	
Dates of Anticipated Results: December 2008	**Citation Submitted:** Yes ☒ No ☐
Annual Report Received: Yes ☐ No ☒ Not Required ☐	

Laupahoehoe-Natural Area Reserve Sub-Unit (2009) continued

Principle Investigator: Magnacca, Karl	**Permit Duration:** Jun 2009-Jun 2010
New Permit ☒ **Renewal** ☐ **Permanent (contingent upon approval)** ☐ **No Valid Permit** ☐	
Project Location(s): LAU-NAR ☒ LAU-FR ☒ PWW ☒	
Research Title: Moore Foundation Hawaiian Barcoding Project	
Affiliation: University of Hawaii at Hilo	
PI Contact Info: (808)756-4631	
Dates of Anticipated Results: TBA	**Citation Submitted:** Yes ☐ No ☒
Annual Report Received: Yes ☐ No ☒ Not Required ☐	

Principle Investigator: USDA NRCS	**Permit Duration:** Sep 2009-Sep 2010
New Permit ☒ **Renewal** ☐ **Permanent (contingent upon approval)** ☐ **No Valid Permit** ☐	
Project Location(s): LAU-NAR ☒ LAU-FR ☒ PWW ☐	
Research Title: Soil Survey	
Affiliation: USDA NRCS	
PI Contact Info: (808)933-6997; amy.saunders@hi.usda.gov	
Dates of Anticipated Results: TBA	**Citation Submitted:** Yes ☐ No ☒
Annual Report Received: Yes ☐ No ☒ Not Required ☐	

Principle Investigator: Vitousek, Peter	**Permit Duration:** Jun 2009-Jun 2010
New Permit ☐ **Renewal** ☒ **Permanent (contingent upon approval)** ☐ **No Valid Permit** ☐	
Project Location(s): LAU-NAR ☒ LAU-FR ☒ PWW ☐	
Research Title: Sources and fates of nutrients on a substrate age gradient across the Hawaiian archipelago and their consequences for forest dynamics.	
Affiliation: Stanford University	
PI Contact Info: (605)814-6812; vitousek@stanford.edu	
Dates of Anticipated Results: June 2010	**Citation Submitted:** Yes ☒ No ☐
Annual Report Received: Yes ☒ No ☐ Not Required ☐	

Puu Waawaa Unit (2009)

Principle Investigator: Cordell, Susan et al	**Permit Duration:** Jan 2009-Jan 2010
New Permit ☐ **Renewal** ☒ **Permanent (contingent upon approval)** ☒ **No Valid Permit** ☐	
Project Location(s): LAU-NAR ☒ LAU-FR ☒ PWW ☒ **Note**: *No research was conducted in PWW*	
Research Title: Hawaii Permanent Plot Network (HIPPNET)	
Affiliation: UCLA, UH-Hilo, USDA Forest Service IPIF, RCUH, UH-Manoa	
PI Contact Info: (808)933-8121; scordell01@fs.fed.us	
Dates of Anticipated Results: Summer 2008	**Citation Submitted:** Yes ☐ No ☒
Annual Report Received: Yes ☐ No ☐ Not Required ☒	

Principle Investigator: Cordell, Susan	**Permit Duration:** Jun 2009-Jun 2010
New Permit ☒ **Renewal** ☐ **Permanent (contingent upon approval)** ☐ **No Valid Permit** ☐	
Project Location(s): LAU-NAR ☐ LAU-FR ☐ PWW ☒	
Research Title: The potential for restoration to break the grass/fire cycle in dryland ecosystems in Hawaii.	
Affiliation: USDA Forest Service IPIF	
PI Contact Info: (808)933-8121 ext 128; scordell01@fs.fed.us	
Dates of Anticipated Results: TBA	**Citation Submitted:** Yes ☐ No ☒
Annual Report Received: Yes ☐ No ☐ Not Required ☒	

Principle Investigator: Hart, Patrick	**Permit Duration:** Aug 2009-Jul 2010
New Permit ☒ **Renewal** ☐ **Permanent (contingent upon approval)** ☐ **No Valid Permit** ☐	
Project Location(s): LAU-NAR ☐ LAU-FR ☐ PWW ☒	
Research Title: Age and dynamics of Hawaiian trees.	
Affiliation: University of Hawaii at Hilo	
PI Contact Info: pjhart@hawaii.edu	
Dates of Anticipated Results: 2010	**Citation Submitted:** Yes ☐ No ☒
Annual Report Received: Yes ☐ No ☐ Not Required ☒	

Puu Waawaa Unit (2009) continued

Principle Investigator: Juvik, James	**Permit Duration:** Mar 2009-Mar 2010
New Permit ☐ **Renewal** ☒ **Permanent (contingent upon approval)** ☐ **No Valid Permit** ☐	
Project Location(s): LAU-NAR ☐ LAU-FR ☐ PWW ☒	
Research Title: Climate-hydrologic monitoring on the north slope of Hualalai.	
Affiliation: UH-Hilo	
PI Contact Info: (808)959-5744; jjuvik@hawaii.edu	
Dates of Anticipated Results: December 2010	**Citation Submitted:** Yes ☐ No ☒
Annual Report Received: Yes ☐ No ☐ Not Required ☒	

Principle Investigator: Kaughman, Leyla	**Permit Duration:** Oct 2009-Oct 2010
New Permit ☐ **Renewal** ☒ **Permanent (contingent upon approval)** ☐ **No Valid Permit** ☐	
Project Location(s): LAU-NAR ☐ LAU-FR ☐ PWW ☒	
Research Title: Study of infestation of and biocontrol on *Erythrina sandwichensis.*	
Affiliation: UH-Manoa, Hawaii Department of Agriculture	
PI Contact Info: (808)973-9526; julianaA.Yalemar@hawaii.gov	
Dates of Anticipated Results: December 2011	**Citation Submitted:** Yes ☐ No ☒
Annual Report Received: Yes ☐ No ☐ Not Required ☒	

Principle Investigator: Lapoint, Richard	**Permit Duration:** Aug 2009-Aug 2010
New Permit ☒ **Renewal** ☐ **Permanent (contingent upon approval)** ☐ **No Valid Permit** ☐	
Project Location(s): LAU-NAR ☐ LAU-FR ☐ PWW ☒	
Research Title: Evolution of Hawaiian Diptera.	
Affiliation: University of California at Berkeley	
PI Contact Info: (603)969-1166; rlapoint@nature.berkeley.edu	
Dates of Anticipated Results: TBA	**Citation Submitted:** Yes ☐ No ☒
Annual Report Received: Yes ☐ No ☐ Not Required ☒	

Puu Waawaa Unit (2009) continued

Principle Investigator: Magnacca, Karl	**Permit Duration:** Jun 2009-Jun 2010
New Permit ☒ **Renewal** ☐ **Permanent (contingent upon approval)** ☐ **No Valid Permit** ☐	
Project Location(s): LAU-NAR ☒ LAU-FR ☒ PWW ☒	
Research Title: Moore Foundation Hawaiian Barcoding Project	
Affiliation: University of Hawaii at Hilo	
PI Contact Info: (808)756-4631	
Dates of Anticipated Results: TBA	**Citation Submitted:** Yes ☐ No ☒
Annual Report Received: Yes ☐ No ☐ Not Required ☒	

Principle Investigator: Torres-Santana, Christian	**Permit Duration:** May 2009-May 2010
New Permit ☒ **Renewal** ☐ **Permanent (contingent upon approval)** ☐ **No Valid Permit** ☐	
Project Location(s): LAU-NAR ☐ LAU-FR ☐ PWW ☒	
Research Title: Pollination ecology and breeding systems of the endangered *Kadua coriacea* (Rubiaceae).	
Affiliation: University of Hawaii at Manoa	
PI Contact Info: (808)956-6738; cwts@hawaii.edu	
Dates of Anticipated Results: November 2009	**Citation Submitted:** Yes ☐ No ☒
Annual Report Received: Yes ☒ No ☐ Not Required ☐	

2009 Access, Outreach, and Education

2009 Access, Outreach, and Education Summary

Laupahoehoe Unit

Eighty-seven participants on seven trips visited the Laupahoehoe Unit in 2009. Colleen Cole of the NAR System took thirty people to the Laupahoehoe Unit for education. The USDA Forest Service held a tree climbing training class for employees. Cheyenne Perry of the USDA Forest Service took fourteen students from DeSales University to Laupahoehoe in January for a Field Biology Class. He was sent reports from the students who attended the class. The students were given/taught: "wonderful explanations of the tropical wet forest", some history of Hilo, invasive species, history and impacts of cattle in Hawaii, the importance of Hawaiian hardwood trees, and identification of native birds and plants.

Puu Waawaa Unit

Six hundred and ninety-eight participants on thirty-four trips visited Puu Waawaa in 2009. The Boy Scouts and the Hawaii Youth Conservation Corp did service learning trips. Both groups helped with invasive species removal and native species out-planting. Many people contributed time and effort on Puu Waawaa volunteer days. Non-local universities also visited including: De Sales University, Pacific University and Hartwick College and they studied geology and dryland forest ecosystems.

2009 Access, Outreach, and Education Detail

Laupahoehoe Unit

Organization	Event	Contact	Date	Group #
DeSales University	Education	Cheyenne Perry	1/5	15
NARS/FS	Education	Cheyenne Perry	2/9	11
FS	Education	Cheyenne Perry	2/15	19
UH CCES OLLI program	Education	Colleen Cole	3/14	10
FS/CAO techs (tree-climbing cert)	Tree climbing training	Christian Giardina	3/15-3/18	6
Teacher's workshop focus on NARS	Education	Colleen Cole	3/23	20
DOFAW admin staff	Service Trip - Admin Day	Colleen Cole	5/19	6

Puu Waawaa Unit

Organization	Event	Contact	Date	Group #
Hawaii Audubon Society	Christmas Bird Count	Donoho/Maile Melrose	1/5	13
DeSales university	Geology, dryland forest study	Donoho/Joe Colosi	1/8	18
Pacific University	Dryland Ecosystem Study	Donoho/Rich Van Buskirk	1/16	16
Hartwick College	Geology	Donoho/David Griffing	1/21	21
West Hawaii Today	Feature article	Donoho/Carolyn Lucas	1/28	2
PWW Volunteer Day	Service learning/outreach	Donoho	2/8	32
Dry Forest symposium	Planting techniques	Donoho/Bill Garnett	2/26	44
PWW Volunteer Day	Service learning	Donoho	3/7	38
Parker School	Service learning	Donoho/Shelley Kaiyala	3/23	9
Digital Science Camp	Service learning/lectures	Alan Nakagawa	3/27-3/29	17
Ka Imi Pono	Service Learning	Mililani Browning	3/30	11
PWW Volunteer Day	Service learning	Donoho	4/5	38
Parker School	Service learning	Donoho/Shelley Kaiyala	4/9	10
Innovation Charter School	Service learning	Donoho/Kevin Miller	4/13	22
STARS home school network	Service learning	Donoho/Phil Stroud	4/14	7
Puu Anahulu Ohana	Family field visit	Kuʻulei Keakealani	4/18	40
PWW Volunteer Day	Service learning	Donoho	5/2	20
PWW Volunteer Day	Service learning	Donoho	6/7	44
HCC Indigenous Land Mgmt	Ed tour	Donoho/Kuʻulei Keakealani	6/13	14
HYCC-VISTA Crew	Service learning/internship	Donoho	6/22	6
HYCC	Service learning/internship	Donoho	6/29-7/2	10
PWW Volunteer Day	Service learning	Donoho	7/5	34
HYCC	Service learning	Agorastos	7/6-7/10	11
HYCC	Service learning	Donoho	7/13-7/17	10
TNC, KSBE staff	Field trip	Donoho, Giffin	7/21	18
Ka Imi Pono	Service learning	Mililani Browning	7/21-7/23	17
STARS home school network	Service learning	Stroud	8/5	16
UHH	Service learning	Donho, Juvik	8/10-8/13	22
BSA Troop 79	Service learning	Donoho, Kaniho	8/28-8/29	14
PWW Volunteer Day	Service learning	Donoho	9/5	22
Na Kahumoku	Service learning	Donoho, Bartlett	9/15	15
PWW Volunteer Day	Service learning/planting	Donoho	9/17	70
STARS home school network	Service learning	Stroud	11/6	8
PWW Volunteer Day	Service learning	Donoho	11/13	9

HETF Concerns, Comments, and Challenges

Concerns, comments, and challenges the HETF encountered from 2007 to 2009 are captured below as both a record and as a guide for improvement.

- There were complaints from forest users (non-researchers) concerning PVC, equipment, and rebar in the forest. They were concerned about safety issues and no public notice that these materials and equipment would be placed in the forest.
- There were complaints from permit applicants that their applications were misplaced within the application system. One researcher offered the following suggestion:
  - "Use an electronic submission / tracking system like is used for article submission to a peer-reviewed journal".
- USDA Forest Service (FS) research projects were not tracked until it became protocol in November 2008 for FS researchers to complete HETF permit applications. While the FS Permit to Use State Lands permits (with conditions) FS research projects in the HETF, it was agreed by both the State and the FS that the easiest way to track FS research is for researchers to complete an HETF permit.
- No system in place to remind permit holders that their permit would expire, increasing the likelihood that ongoing project permits would lapse.
- No system in place for the USDA Forest Service to know if and when permits were signed by the DOFAW Branch Manager and if the permittee had picked up the permit (permits not obtained are invalid).
- Few annual reports and publication citations were received from researchers.
- Potential lack of communication from some researchers regarding where and when their project results were given in talks or published and whether proper acknowledgement was given to the HETF, DOFAW and the USDA Forest Service.
- No clear valid permit dates indicated on permits.
- Not all permit holders readily provided up to date lists of people and vehicles traveling into the Laupahoehoe Unit of the HETF which is necessary in order for the USDA Forest Service to update the authorized persons list as required by the Right of Entry agreement with Kamehameha Schools.
- A systematic close out plan is needed to ascertain that no equipment, markers, or trash are left in the HETF after project completion.
- Some research projects in the Laupahoehoe NAR were not initially captured due to confusion on which entity (Honolulu NAR System or HETF) should handle and approve permits.
- Clarity is needed on how management and monitoring actions by the State could be reported to the USDA Forest Service for overall HETF tracking.
- A Natural Resources Management Plan is needed for the Laupahoehoe Unit in order to guide decision making.
- An advisory council for the Laupahoehoe Unit is needed to fulfill the requirements of the Cooperative Agreement and to make recommendations for the Natural Resources Management Plan.
- Full time staff is needed to help manage the permit system, track decisions and policies instituted by the HETF Planning Group, and ensure the completion of the legal requirements per the Cooperative Agreement with the State.

Metadata

- Permits that were valid for more than one year were treated as renewals for the following years after the initial application for the purposes of this document. NAR permits are only valid for one year.
- The data used for the research affiliation figures includes only the affiliation of the Primary Investigator.
- Annual reports were required only on permits issued for research projects located in the NAR for the timeframe of this annual report. Whether or not an annual report was required and received is relevant to the 'Research Detail' Unit or Sub-Unit section in which the information is located. For example a project that spans PWW and LAU-NAR may indicate no annual report was required in PWW, but that a report was or was not received for the portion of the work in the LAU-NAR.
- Uninitiated/unfinished research is not included in the information outlined within the 'Research Detail' section, 'Research Summary' section or 'Research Affiliation' figures.
- If a project was permitted for more than one HETF Unit, but no research occurred in one of the Units, all permitted locations were included in the 'Research Detail' section with a note indicating in which Unit the work was not completed.

Annual Reports Received

Annual reports received from researchers are listed below alphabetically.

Bonaccorso, Frank

1 of 2 - Submittal Date: September 2009

Acoustic surveys on bat vocalizations have been conducted by the USGS Hoary Bat Project since January 2007. Microphones were deployed along Blair Road periodically for one-week sampling periods and results are summarized in the Figure 1.

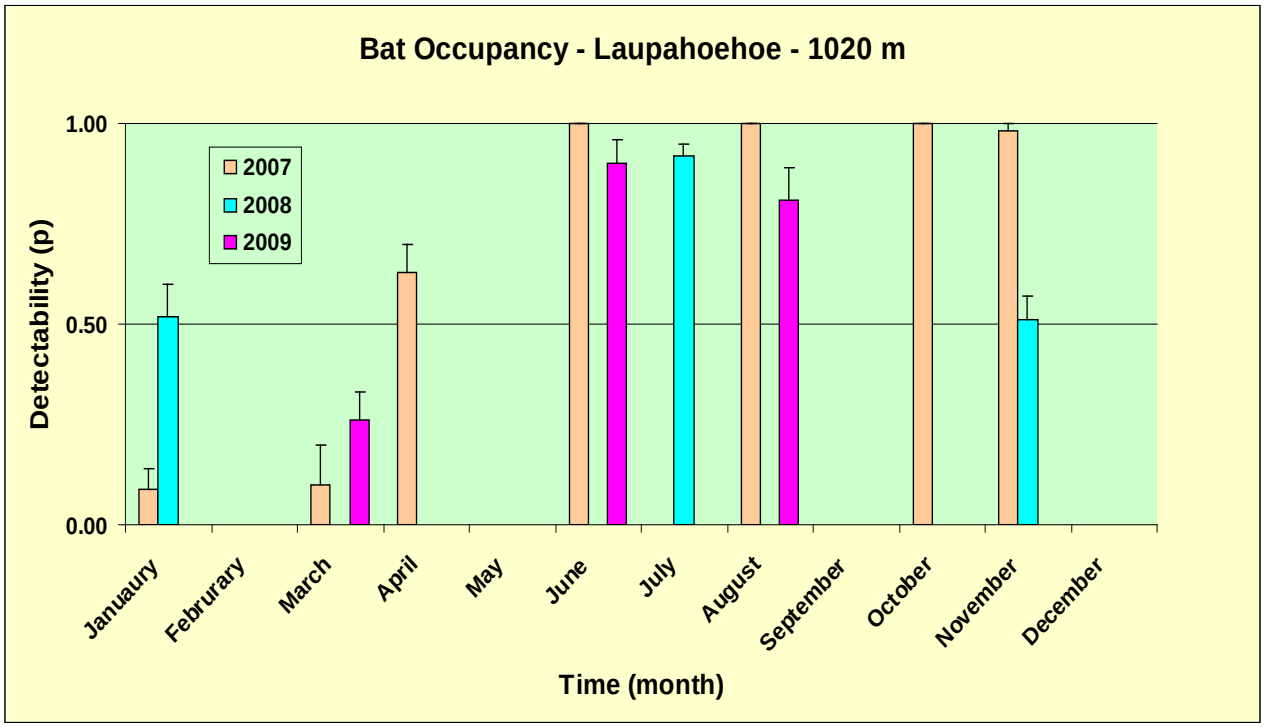


Figure 1. Detectability of bats at Laupahoehoe. Detectability = 1.0 indicates that all microphones recorded bat calls each night of deployment over one week.

Laupahoehoe has the highest rate of bat detectability among over 20 geographic sites sampled by our USGS team throughout the island of Hawai'i. Although bat activity was detected in every period sampling at Laupahoehoe from 2007 through September 2009, there is a seasonal nature to bat activity as measured by detectability. Note on the graph that the highest levels of detectability occur between June and November each year. The lowest levels of bat occupancy generally are from January through March.

Laupahoehoe is especially important as a foraging and roosting habitat for bats during the summer reproductive period and during the fall bat fledging period.

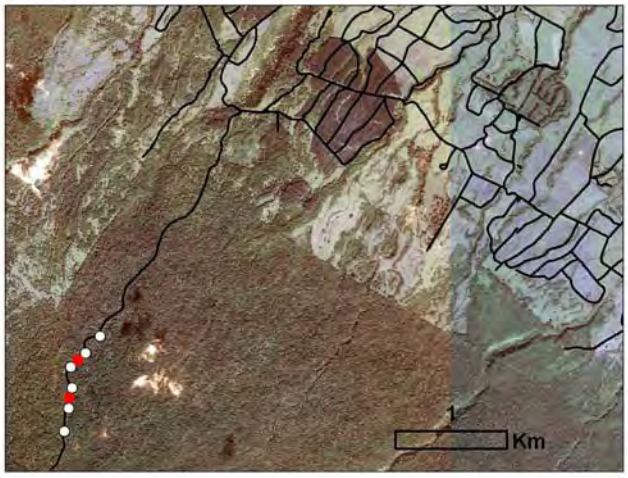
The USGS Hoary Bat Project has been tasked by the USFWS and the Hawai'i DLNR to gather survey and research information critical to the USFWS Recovery Plan for the Hawaiian Hoary Bat to include a 5-year study of population trend, reproduction, and geographic distribution. The Hoary Bat Project will enter its fourth year of this survey in the 2010 calendar year, and requests that our NARS/HEFT Special Use permit be renewed for another year through the end of December 2010.

2 of 2 - Submitted: October 2010

For the fourth consecutive year, a microphone and data logger array to record the vocalizations of Hawaiian hoary bats has been deployed along Blair Road in Laupahoehoe NAR (Fig 1. map of study area). A microphone array consists of 6 total microphone and recording units spaced at 400 meter intervals along approximately 2.5 kilometers of Blair Road in 2009/2010. The geo-coordinates of each bat microphone/recorder are found in Table 1 (*Table 1 - has been removed but is available upon request*). Under the coverage of the immediate past permit, microphone/recorders were deployed for periods of one week in December of 2009, and in February, April, June, and August of 2010. The levels of bat detectability (an index of bat habitat occupancy and flight/foraging activity) is shown in Figure 2 for the sum total of all four years of bat research at Laupahoehoe NAR.

It is notable that a consistent seasonal pattern of bat activity is indicated in Fig. 2. Bat activity is highest from June through early November in each year. There is relatively low bat activity from late November through March each year, a time that much of the bat population occupies elevations above 1500 m at other sites upslope from Laupahoehoe NAR. In April and May, bat activity begins to increase until it peaks again in the summer and early fall months to repeat the annual cycle.

Bat occupancy from June through August represents the reproductive season for adult females with birthing and lactation of dependent young bats. Young bats fledge in August. By September, a large population of receptive females and males with descended, large testis evidenced by mist-net captures (Table 2) at Laupahoehoe strongly suggest that fall mating activity is occurring at this site. It is believed that females either store sperm over winter or that a delayed implantation or embryonic development occurs over the winter but this aspect of hoary bat reproduction has not been investigated in Hawaii.



The high levels of bat detectability and the large numbers of bat calls (up to 12,000 call files) recorded in the summer-fall months, including calls with “feeding buzzes” of increased pulse repetition, also indicate that Laupahoehoe NARS is an extremely important foraging for Hawaiian hoary bats. Although our methodology does not permit a numerical estimate of the bat population, the data do indicate prolonged and intense use of the ohia-koa dominated forest by bats at Laupahoehoe for both reproduction and foraging. Laupahoehoe NAR may be considered the “jewel” in the crown of Hawaiian hoary bat habitat on the island of Hawaii.

Fig. 1 (above) Map of the 6 bat microphone/recording arrays (white dots) and two ultraviolet light traps for insect collection at Laupahoehoe NAR. Mist-netting sites are also along Blair Road with the boundaries of the microphone arrays.

Fig. 2. (next page) Hawaiian Hoary Bat detection probability from 2007 to 2010. Detection probability of 1.0 represents all microphones detecting bats every night of sampling, whereas 0 would be no detections on any microphones throughout a sample (note there never has been a 0 detection at Laupahoehoe, blank spaces in the graph represent no sampling conducted. Each sample represents 6 microphones recording for one week within the sample month. Error bars equal one standard error.

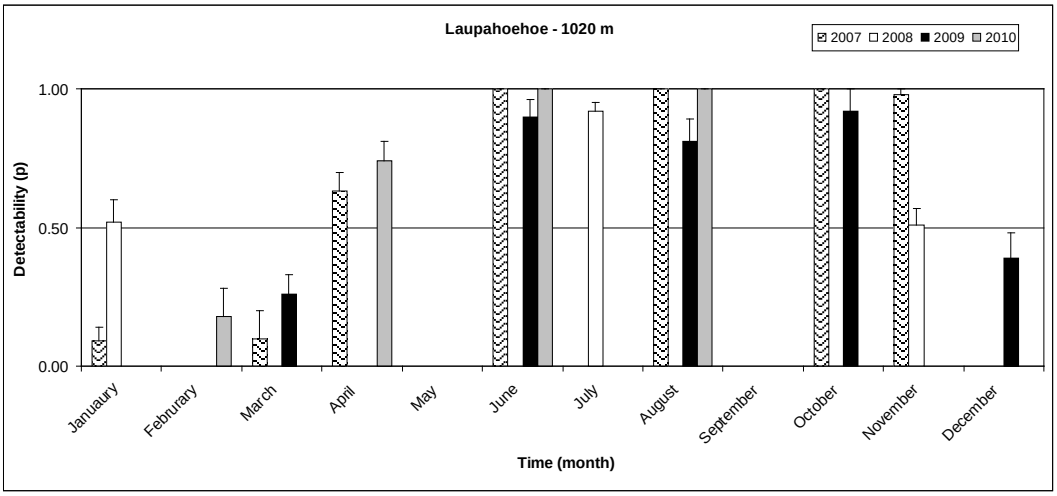


Table 2. Records of Bat Capture and Release at Laupahoehoe NAR in 2010.

Bat #	Date	Time	Sex	Age	Band	forearm	weight	reprod. Condition
810	26-Jun-10	1:20	F	ADULT	none/RedYellow	48.8	23.5	pregnant
910	1-Jul-10	21:45	F	ADULT	none/Red	50.7	19	Lactating
1010	1-Jul-10	21:45	F	ADULT	none/Purple	50.8	20.3	Post-lactating
1110	27-Aug-10	18:56	M	JUV	LightBlue/none	47.6	12	not reproductive
1210	27-Aug-10	19:23	F	ADULT	none/LightBlueWhite	50	16.75	not reproductive
1310	27-Aug-10	19:23	F	JUV	none/RedWhite	50.2	16.25	not reproductive
1410	27-Aug-10	20:48	F	ADULT	none/DarkBlueWhite	50.1	17.25	Post-lactating
1510	27-Aug-10	21:30	F	JUV	none/DarkBlue	50.5	15.5	not reproductive
1610	27-Aug-10	23:02	M	JUV	none/DarkBlueYellow	48.25	14.5	not reproductive
1710	27-Aug-10	23:37	F	ADULT	none/WhiteGreen	51.6	19.5	not reproductive
1810	27-Aug-10	23:56	M	ADULT	none/Grey	46.7	15.5	scrotal/testes descended
1910	2-Sep-10	19:09	F	ADULT	none/OrangeYellow	49.8	20.5	Post-lactating
2010	2-Sep-10	22:45	M	ADULT	none/Green	48.9	13.3	scrotal/testes descended
2110	2-Sep-10	23:05	F	ADULT	none/Orange	49.98	15.8	Post-lactating
2211	24-Sep-10	18:46	F	ADULT	none/Salmon	50.4	16	?
2212	24-Sep-10	18:40	F	ADULT	DarkBlue/none	50.5	16.75	?
2213	24-Sep-10	18:49	M	ADULT	Purple/none	50.1	15.5	scrotal/testes descended

Broadbent, Eben

1 of 2 - Submittal Date: January 2009

Schedule

Events	2007				2008				2009				2010			
	F	W	Sp	Su	F	W	Sp	Su	F	W	Sp	Su	F	W	Sp	Su
PhD																
Graduate classes																
Preliminary field work																
Set up project																
Field data collection																
Data entry and analysis																
Writing																
Defend and graduate																

F = Fall quarter: September - December
W = Winter quarter: January - March
Sp = Spring quarter: April - June
Su = Summer quarter: June - September

2 of 2 - Submittal Date: March 2010

Project and Ph.D. timeline.

Events	2007				2008				2009				2010				2011		
	W	Sp	Su	F	W	Sp	Su	F	W	Sp	Su	F	W	Sp	Su	F	W	Sp	Su
PhD																			
Graduate classes																			
Preliminary field work																			
Set up project																			
Field data collection																			
Data entry and analysis																			
Writing																			
Defend and graduate																			

W = Winter quarter: January - March
Sp = Spring quarter: April - June
Su = Summer quarter: June – September
F = Fall quarter: September - December

Cordell, Susan et al

Submittal Date: March 2010

The Hawaii Permanent Plot Network (HIPPNET) was established with the following research areas and goals in mind:

Research areas:

- Global change
- Ecohydrology
- Ecosystem services
- Remote sensing
- Restoration
- Comparative forest ecology
- Population genetics and evolutionary ecology of forest plants
- Biogeochemical processes

Goals:

- Establish 4-ha plots across natural gradients in Hawaii
- Study long-term forest dynamics
- Facilitate research
- Develop interagency and community partnerships

Locations included intact native-dominated forests with a history of ecosystem-level research. Two locations on Hawaii Island were chosen: Palamanui, a tropical lowland dry forest; and Laupahoehoe, a tropical montane rain forest. The Laupāhoehoe site is within the Hawai'i Experimental Tropical Forest. The project is a collaboration between UH, the Institute of Pacific Islands Forestry (US Forest Service), and UCLA.

During the course of this project, researchers have precisely measured 20 x 20 m grid over 4 ha. Every tree with a diameter greater than 1 cm. has been tagged, mapped, identified and measured. Both plots now have a complete first census (completed summer 2009). HIPPNET personnel have also created a web site (http://www.hippnet.hawaii.edu/) where information on access, data policies, publications, and methods can be found. Woody weed species ≥1 cm DBH within each plot were identified, mapped, measured and then removed. Woody weeds at Laupahoehoe included *Fraxinus uhdei*, *Psidium cattleianum*, and *Rubus ellipticus*.

In addition to the research conducted and enabled, there has been a large amount of training enabled by this project. A total of six technicians and plot supervisors have been trained and are passing on their knowledge to students, other researchers, and interns. The pool of interns numbers 14, with three of them being from the local area. UH Hilo student interns likewise number three, all of them from Hawaii. Hawaii Community College Forest TEAM has engaged five student employees, again all from Hawaii. There were a total of 15 UH Hilo class visits to the site.

This work has resulted in collaborations among Hawaii researchers and the Smithsonian Tropical Research Institute's Center for Tropical Forest Science (CTFS). CTFS is a network of 33 forest plots around the world (www.ctfs.si.edu). HIPPNET is now an official site of the network. The Permanent Plot Supervisor attended a workshop on database management in Panama and the HIPPNET site has been visited by the CTFS center's Director, Dr. Stuart Davies. HIPPNET personnel also attended the CTFS Workshop at the 2009 Ecological Society of America meeting.

Another meaningful collaboration has grown from this project with the Carnegie Airborne Observatory at the Carnegie Institution, Stanford University. Researchers at the CAO and from HIPPNET are working to answer research questions using remote sensing data.

Future plans include re-censusing a portion of the plot in 2010 (a complete re-census is planned in 2014) and completion of the climate tower (the tower is in place – but not fully operational). We are currently in the initial stages of measuring seedling establishment, growth and survival, seed rain, and understory light at the Laupahoehoe plot. These measurements allow us to understand tree regeneration dynamics in Hawaii. Our goal is to continue this work in 2010. Currently we are processing data from the first census which will be available in manuscript form in 2010. See attached pdf outlining our preliminary results from the first census.

Project Coordinators for HIPPNET include:

- Dr. Rebecca Ostertag, University of Hawaii-Hilo, ostertag@hawaii.edu
- Dr. Susan Cordell, IPIF-USDA Forest Service, scordell01@fs.fed.us
- Dr. Christian Giardina, IPIF-USDA Forest Service, cgiardina@fs.fed.us
- Dr. Lawren Sack, UCLA, lawrensack@ucla.edu

Former permanent Plot Supervisor Faith Inman Narahari ohia@ucla.edu, is currently a graduate student at UCLA pursuing her PhD. Her research on seed, seedling and forest dynamics will continue to be focused on the HIPPNET plots.

Gaudioso, Jacqueline

Submittal Date: June 2009, abstract to published thesis (see 'HETF Related Citations' section)

Quantification of plumage coloration of a Hawaiian honeycreeper (Hemignathus virens virens) along gradients of biogeography: Does variation exist between sub-populations on the island of Hawai'i?

by *Gaudioso, Jacqueline M.*, M.S., **University of Hawai'i at Hilo**, 2009, 81 pages; AAT 1472755

Abstract (Summary)

Plumage is a phenotypic indicator of the evolutionary past; an artifact of avian life histories and social mating systems. Until the past decade, most plumage studies assessed coloration from the subjective human-vision perspective. Plumage coloration has not been extensively studied in Hawaiian honeycreepers, and no studies have utilized objective measurement. This study is the first to investigate and document biogeographical, intraspecifc variation of plumage coloration on an island scale using spectrophotomtery. I measured the breast and rump patches of adult male and female Hawai`i `amakihi (*Hemignathus virens virens*) from twelve sites spanning six climatic categories (elevation/rain) on the island of Hawai`i. I tested Gloger's rule, a biogeographical rule that states birds are darker-pigmented in areas of higher moisture and are more carotenoid-pigmented in drier areas. I found that plumage coloration of Hawai`i `amakihi varied by elevation and rainfall on the island of Hawai`i, with mixed support for Gloger's rule. While mean brightness was higher in wetter habitats than in drier habitats, carotenoid pigmentation of males was generally higher in drier habitats. The brightest birds were found at middle elevation in wetter habitats. Sexual dichromatism was more pronounced in the breast region than the rump region, and rump dichromatism decreased as mean annual precipitation increased. The differences in plumage detected by the factor of elevation were analogous to the altitudinal genetic structure documented in `amakihi. My results suggest climate may be viewed as an ultimate factor that plays an important role in the plumage traits of `amakihi. Sex determination by field key will be improved by revisions that address variation according to locale of `amakihi capture, and will provide a more accurate estimate of breeding population size and capture sex ratio.

Torres-Santana, Christian and Clifford W. Morden

Excerpt taken from November 2009, Volume 5, Issue 11 of 'Natural Selections' (Department of Defense, Legacy Resource Management Program)

Understanding the Pollination Ecology and Breeding Systems of the Endangered Plant, *Kadua coriacea*

The endangered *Kadua coriacea* (formerly *Hedyotis coriacea*), or kio`ele, is a small, multi-branched shrub with leathery leaves and blooms white, perfect flowers. This endemic member of the coffee family (Rubiaceae) is now known only from the U.S. Army Pōhakuloa Training Area (PTA) on the island of Hawai`i, but is historically also known from the islands of Maui and O`ahu. There are only 175 wild plants left that are scattered in five subpopulations of this subtropical, montane to subalpine dry forest, a very rare ecosystem worldwide. The risk of extinction for this species is exacerbated from direct browsing by introduced feral goat and sheep. Since this species was rediscovered in PTA, only a single seedling is known to have germinated and grown naturally despite the fact that the plants are flowering and fruiting annually and that browsing ungulates have been excluded. Consequently, the PTA Natural Resource Staff are working to increase wild grown plants by reintroducing several hundred individuals in PTA, Pu`u Wa`awa`a Forest Reserve, Koai`a Tree Sanctuary, and Pu`u Huluhulu.

A coalition is conducting field studies to better understand the reproductive mechanisms and the pollination ecology *of K. coriacea* since the beginning of January 2009. This work involves many collaborators, including U.S. Army environmental personnel, the Colorado State University Center for the Environmental Management of Military Lands, Pōhakuloa Training Area Natural Resources Staff (PTA NRS), the manager of the Pu`u Wa`awa`a Forest Reserve, and the University of Hawai`i (UH) Pacific Cooperative Studies Unit. Researchers from other organizations, including Dr. Jeff Zimpfer of the U.S. Fish and Wildlife Service, Dr. Karl Magnacca from the UH-Hilo, and Dr. Caroline Gross from the University of New England (Australia), assist in the field with data collection. In addition, various students from UH-Hilo and UH-Mānoa along with community members of the island of Hawai`i are involved.

The components of the study include mostly manipulated pollination experiments, flower phenology monitoring, insect visitation observations, and other aspects of plant reproductive biology (e.g. nectar content, pollen viability). The remoteness of the field site and logistical reasons made it necessary to use circuit surveillance cameras to monitor insect visitation on flowers of *K. coriacea*. This surveillance system can record continuously for 24-hours and records the data on video for later viewing. Even though in-person observations are more reliable, the surveillance camera facilitates more hours of direct observation that may be essential to detect rare pollination events of these plants.
A summary on the findings of the study suggests that in 2009, *K. coriacea*'s flowering peak in PTA occurred from April to July, following the rainy season. However, some plants were found to be flowering earlier and/or later than the peak dates. The majority of the plants in the population are adult, indicating that most plants are capable of reproducing. The flowers of *K. coriacea* are heterostyly (having different flower morphologies, usually to promote cross pollination) and occasionally varying in flower size and color. All of the five manipulated pollination experiments resulted in a fruit set at different proportions. Therefore, the preliminary results suggest that plants may self-pollinate. Self-pollination may lead to inbreeding and possibly inbreeding depression, although the genetic fitness of the seeds and seedlings are yet to be investigated.

Observations recorded at different time intervals, suggest that a total of 10 species of insects, one spider, and one mite visited the flowers of *K. coriacea* at different times of the day. The insect groups include house flies, syrphid flies, moths, honey bees, yellow faced bees, ants, beetles, and aphids. The most common visitors, however, were the introduced honey bees and syrphid flies. Native yellow faced

bees (*Hylaeus* spp.) were also observed visiting plants on hot sunny days, mostly in the morning and midday hours. Interestingly, the native *Hylaeus* bee was observed robbing all the pollen from an untouched, open flower that subsequently did not yield any fruits.

Since 2006, PTA NRS has been successfully reintroducing *K. coriacea* to Pu`u Wa`awa`a Forest Reserve. Some plants were established and set seeds, but no regeneration was observed in subsequent years. A recent discovery of 26 seedlings by PTA Horticulturist Kathy Kawakami gave us hope that the species will someday recover and finally reproduce to become bountiful.

The funding for this study was provided by the U.S. Army Garrison. Ongoing studies also include examination of the population genetics of the species to determine what genetic issues may be impacting plants in these populations. We anticipate that these efforts will assist the PTA NRS in their conservation management decision of this endangered plant species.

Vitousek, Peter and Colleagues

1 of 2 - Submittal Date: May 2009

We report progress in two areas of research – ongoing studies of the structure and biogeochemistry of Hawaiian forests, which our group has been working on at Laupahoehoe since 1990, and a new NSF funded project on forest structure and history. For the ongoing work, our major products in the past year have been 1) an analysis of forest structure and biogeochemistry in the landscape around our long-term site at Laupahoehoe (and similar sites in Volcano, Kohala, and Kokee-Kaua`i); this work is in press in Ecology (Vitousek et al.); and 2) a comparative study of forest structure at Laupahoehoe versus La Selva Biological Station, in the Atlantic lowland of Costa Rica; this work is in press in Ecology Letters (Kellner and Asner in press).

For the newer NSF-funded research, the Laupahoehoe landscape was stratified based on the Carnegie Airborne Observatory LIDAR and hyperspectral data into three distinct landscape zones between 3000 and 5000 feet elevation on the 4000-14000 years and 1400-65000 years old substrate age classes. The "Mauna kea" zone spans 3000-3800 feet and is characterized by extremely tall koa and ohia trees with a upper canopy height mode from 20 to 30 meters and a single lower canopy height mode at 7.5 meters. The "Laupahoehoe" zone spans 3800-4400 feet elevation and shows a distinctive three mode canopy height distribution with modes at 5, 11, and 19 meters. The "Montane" landscape zone spans 4400-5000 feet elevation and is characterized by patches of koa forest and extensive upper canopy dieback showing a single flat mode in canopy height from 10 to 20 meters.The correspondence between the forest structure observed in the aerial imagery and the whole plant community composition of each zone was assessed with an extensive spatially explicit ground survey. Within each landscape zone a single 980 meter long rhythmically sampled transect produced n = 180 quadrats (nested 0.25, 1, and 4 square meters in size) and copious observations at various spatial lags. Each transect is arranged from the NW to the SE across the dominant slope contour. Transects occur at ~3200, ~ 4200, and ~4500 feet elevation.

Data collection is complete on the "Mauna Kea" and "Laupahoehoe" zones. Preliminary analysis of the "Laupahoehoe" zone survey indicates that substrate type (ash or pahoehoe), surface hydrology, and wind throw gap disturbance have an influence on plant community species composition. There is also unexplained spatial autocorrelation spanning lag distances from 0 to 10 meters. This implies an important role for spatial processes like dispersal in creating community spatial mosaics or the possibility of successional dynamics following individual wind throw disturbances. The recent dynamics of the forest through time are being explored through the use of sediment cores from small areas of sediment deposition ('forest hollows'). Lead-210 chronologies of the first suite of sediment cores demonstrate some hollows are unsuitable for paleoecological analysis due to un-interpretable lead-210 profiles. However three cores, two from the "Laupahoehoe" and one from the "Montane" zones, have intact lead profiles and are being processed for pollen analysis. The spatial community analysis suggests that species of Peperomia (`ala `ala wai nui), Cibotium (hapu`u), Rubus hawaiiensis (akala), and Ilex anomala (kawa`u) all respond to windthrow disturbance and will be able to provide a temporal signature of disturbance dynamics in pollen and spore analysis.

2 of 2 - Submittal Date: March 2010

We report progress in two areas of research – ongoing studies of the structure and biogeochemistry of Hawaiian forests, which our group has been working on at Laupahoehoe since 1990, and a new NSF funded project on forest structure and history. For the ongoing work, our major products in the past year have been 1) an analysis of forest structure and biogeochemistry in the landscape around our long-

term site at Laupahoehoe (and similar sites in Volcano, Kohala, and Kokee-Kaua`i); this work is published in Ecology (Vitousek et al.) and Pacific Science; and 2) a comparative study of forest structure at Laupahoehoe versus La Selva Biological Station, in the Atlantic lowland of Costa Rica; this work is published in Ecology Letters (Kellner and Asner in press).

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We have matched that on-the-ground sampling with a continuing analysis of forest turnover in the HETF. LiDAR imagery was obtained over Laupahoehoe twice (2007 and 2009), and with careful processing it has been possible to match the images such that any change that occurred between the samples – even the fall of a canopy branch – can be detected. From this analysis we have the first data-based landscape-level analysis of forest turnover as a function of zone within Laupahoehoe, and along a developmental gradient from young forests on Kilauea through multiple zones in Laupahoehoe to the older forests of Kohala Volcano. The first product of that analysis was just submitted for publication in Ecology.

HETF Related Citations

HETF related citations submitted by researchers are given below. This list does not include all HETF related publications.

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Literature Search of Laupahoehoe and Puu Waawaa

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Appendix A – Cooperative Agreement

COOPERATIVE AGREEMENT

between the

UNITED STATES DEPARTMENT OF AGRICULTURE
FOREST SERVICE

and the

STATE OF HAWAII
BOARD OF LAND AND NATURAL RESOURCES

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

RECITALS:

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

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

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

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

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

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

I. AUTHORITIES.

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

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

II. HAWAII EXPERIMENTAL TROPICAL FORESTS.

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

1. Laupāhoehoe Experimental Forest comprising approximately 12,343 acres on the Island of Hawaii and generally depicted on the map appended hereto as Map 2.

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

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

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

1. To learn how to better restore, preserve, and sustainably manage native tropical forests, streams and entire watersheds of the Pacific, and to provide information to land managers challenged with management of these important landscapes;

2. To be a center for demonstration, education, training, and outreach on tropical forestry, conservation biology, and natural resources research and management;

3. To provide sites dedicated to long term research on tropical forestry, ecology, hydrology, conservation biology, and natural resource management; and

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

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

III. LAND USE AUTHORIZATION.

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

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

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

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

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

IV. COOPERATIVE RESEARCH AND MANAGEMENT.

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

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

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

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

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

E. To conduct global climate change research;

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

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

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

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

1. New field station facilities at Laupāhoehoe and renovation of existing structures for use as a field station at Pu'u Wa'awa'a consisting of dormitories, work areas, demonstration/education buildings, and storage facilities on experimental forest lands or other state lands encumbered under lease, license or permit.

2. Gaging stations in streams, weather stations, eddy covariance towers, and similar research structures. Gaging stations can be placed at the lower reaches of Ka'awali'i Stream, Laupāhoehoe Stream, Kilau Stream, Kiwilahiahi stream, Ha'ako'a Stream, and Pahale Stream within the Laupāhoehoe Natural Area Reserve.

3. Development and maintenance of the existing trail system and the development of a limited network of new trails to achieve access, minimize trampling damage and insure safety of users

4. Maintenance and improvement of existing roads to facilitate access and diminish ecological damage from roads in poor condition.

4

V. CONSULTATION.

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

1. Jointly develop research and management plans for the Hawaii Experimental Tropical Forests and to update these plans at least every five years;

2. Consult and reach agreement prior to implementing any written policy or plan that may affect the management of or research within the Hawaii Experimental Tropical Forests;

3. Consult and reach agreement during planning for the development of facilities or any major ground disturbing activities;

4. Consult and reach agreement before any major ground disturbing activities that may affect the conduct of research or the biological integrity of the area such as logging, scarification, chemical applications, fencing, etc.

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

VI. HAWAII EXPERIMENTAL TROPICAL FORESTS RESEARCH COMMITTEE.

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

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

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

1. The Director of the Institute of Pacific Islands Forestry in Hilo, Hawaii, or such alternative Federal official as may be named by the Station Director of the Pacific Southwest Research Station, and

2. The Hawaii Island Branch Manager of the Division of Forestry and Wildlife, or such alternative as may be named by the Board of Land and Natural Resources.

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

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

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

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

VII. AUTHORIZATION OF RESEARCH ACTIVITIES.

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

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

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

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

VIII. RESEARCH ON THE LAUPĀHOEHOE NATURAL AREA RESERVE.

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

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

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

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

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

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

X. RESEARCH RESULTS.

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

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

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

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

XI. MANAGEMENT ACTIVITIES ON HAWAII EXPERIMENTAL TROPICAL FORESTS.

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

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

C. *Public Access.*

1. If so authorized, public access will be regulated by the Board to accommodate, in a manner compatible with, ongoing research or management activities. The Board will appropriately manage public access so that threats to public safety are minimized.

2. The Board shall be primarily responsible to utilize its authorities under state law to enforce regulations and permit requirements.

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

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

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

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

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

XII. FUNDING.

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

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

XIII. LIABILITIES.

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

XIV. TERM, EVALUATION AND MODIFICATION.

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

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

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

XV. DISPUTES.

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

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

XVI. TERMINATION.

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

XVII. PRINCIPAL CONTACTS.

The principal contacts for administering this Cooperative Agreement are:

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

MAPS REMOVED - SEE MAPS IN APPENDIX B

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

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

1. Non-destructive inventory, measurements, censuses, and monitoring of trees, ferns, understory plants, birds, mammals, insects, and aquatic organisms where there is no harm to the organisms (includes both ground-based and remotely sensed measures).

2. Non-destructive inventory, measurements, and monitoring of the forest floor, dead and downed wood, and soils.

3. Non-destructive inventory, measurements, and monitoring of streams, ponds, and other aquatic ecosystems.

4. Nondestructive hydrological and geomorphic studies which do not involve the erection of structures or long term placement of equipment.

5. Research involving cutting and/or removal of exotic/nonnative vegetation that does not directly disrupt native forest species, forest composition, or forest structure (limited to test plots ≤10 acres in area).

6. Research on the use of pesticides/herbicides/prescribed fire/grazing animals to control invasive species (does not directly disrupt native forest species, composition, or structure, and limited to test plots ≤10 acres in area).

7. Erection of small protective fences and barriers ≤10 acre in area (and the removal of exotic species within such plots).

8. Construction of temporary blinds and field observation structures.

9. Soil and plant nutrient cycling research.

10. Biocontrol research to control invasive plants and animals - manipulate densities of state and federally permitted biocontrol agents through redistribution and experimental methods, including caging plants or parts of plants.

Page 1 of 2

11. Sampling air and gasses (plant and soil respiration) within the experimental forest.

12. Placement of temporary electronic devices for environmental monitoring or sampling (for periods ≤36 months).

13. Introduction and use of Carbon, Oxygen, Nitrogen and other isotopes for research.

14. Non-destructive collection of plant material (excluding all listed T&E plants), soils, and water samples for laboratory analysis.

15. Collection of plant and insect samples that are from common, exotic, and abundant taxa for laboratory, greenhouse, or herbarium sampling (excluding all listed T&E species).

16. Maintenance of a trail system for access.

STATE OF HAWAII
BOARD OF LAND AND NATURAL RESOURCES

By _____ _____
Peter T. Young Date
Chairperson

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

APPROVED AS TO FORM

_____ Date: 12/8/06
Deputy Attorney General

Appendix B - Permit to Use State Lands

LINDA LINGLE
GOVERNOR OF HAWAII

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

ROBERT K. MASUDA
DEPUTY DIRECTOR

DEAN NAKANO
ACTING DEPUTY DIRECTOR - WATER

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

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES

POST OFFICE BOX 621
HONOLULU, HAWAII 96809

PERMIT TO USE STATE LANDS

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

Definitions:

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

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

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

This Permit is subject to the following conditions:

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

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

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

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

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

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

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

4. USDA Forest Service shall insure that in the exercise of this permit to use State lands, it shall comply with all laws, statutes, ordinances, rules and regulations of the Federal, State, and county governments affecting the permit area. In addition, prior to activities in Laupāhoehoe Natural Area Reserve, USDA Forest Service shall ensure that proposed activities are to be performed in a manner which is consistent with NARS management objectives, HRS § 195-1 and in consultation with the Hawaii Island Natural Area Reserves System Area Manager to ensure that proposed activities remain consistent with NARS objectives and management actions. Prior to activities in Pu'u Wa'awa'a, USDA Forest Service shall ensure that proposed activities are to be performed in a manner consistent with the Pu'u Wa'awa'a Management Plan and in consultation with the Pu'u Wa'awa'a Coordinator.

5. In the event any unanticipated sites or remains such as bone or charcoal deposits, human burials, rock or coral alignments, pavings or walls are encountered USDA Forest Service, its contractors, and consultants shall immediately stop work and contact the State Historic Preservation Division in Kapolei at (808) 692-8015.

6. USDA Forest Service agrees to consult regularly with the State, including the appropriate DLNR land manager, on proposed and ongoing activities within the permit area, to ensure open and full communication and to minimize conflicts and maximize benefits between planned and ongoing research projects and between research projects and land management.

7. USDA Forest Service, through the Hawaii Experimental Tropical Forest Research Committee established under the Cooperative Agreement, agrees to consult regularly with the State, including:
   a. Providing a copy of the annual report submitted to Congress as required by section 607 of the International Forestry Cooperative Act of 1990, as amended by the Hawaii Tropical Forest Recovery Act;
   b. Providing an annual report on the status of approved new and ongoing research (including the primary investigator, the research topic, the location for the research, dates of field research, date of anticipated results, and contact information for the primary investigator);
   c. Providing an annual report on the number of educational tours and total number of participants; and
   d. Annually reporting on the challenges faced in the administration of the Experimental Forest.

8. The USDA Forest Service will maintain the improvements on the land that are being used by the Forest Service or its assigns. The USDA Forest Service will keep the permit area and improvements in a clean, sanitary, and orderly condition. Disturbance of native vegetation and native wildlife shall be avoided as much as possible. The USDA Forest Service will not make, permit, or suffer, any waste, strip, spoil, nuisance or unlawful, improper, or offensive use of the permit area. Precautions shall be taken to prevent introductions of plants and animals not naturally present in the permit area, including inspection and cleaning of clothing, equipment, and vehicles. At all times with respect to the permit area, USDA Forest Service will use due care for public safety and will use appropriate precautions and measures to minimize inconveniences to surrounding residents, landowners, lessees, and the public in general.

9. The State will remain primarily responsible for normal land management functions, including but not limited to control of public access, fire suppression, law enforcement, regulation of hunting and grazing activities, invasive species management, and forest disease, insect, and ungulate control. The Board will be responsible for maintenance of all improvements not used, built or placed on the land by the USDA Forest Service. The Board reserves the right for its employees, agents or representatives to enter or cross any portion of the permit area at any time.

10. Liability for any loss, damage, claim, demand, or action, caused by, arising out of or connected with the operations authorized by the Cooperative Agreement shall be governed by applicable State and Federal law. To the extent that the USDA Forest Service requires third parties, including but not limited to its contractors or consultants, to procure liability insurance or to indemnify the Forest Service, the USDA Forest Service shall also require such third parties to insure and indemnify the State.

11. This permit may be modified at any time by mutual agreement of the Director, Institute of Pacific Islands Forestry, USDA Forest Service, and the Board of Land and Natural Resources.

12. Permittee and its assigns shall not cause or permit the escape, disposal or release of any hazardous materials except as permitted by applicable federal and state law. Proposed use of hazardous materials in research activities will be disclosed to the State through the research review and approval procedures of the Hawaii Experimental Tropical Forest Research Committee and the processes for activities authorizations prescribed by the Cooperative Agreement. Permittee and its assigns shall store and use hazardous materials only as prescribed by federal law. Liability for release of a hazardous material shall be in accord with applicable Federal and state law.

    To the extent that the Permittee requires its contractors or consultants to indemnify, defend, and hold the Permittee harmless from any damages and claims resulting from the release of hazardous materials on the permit area occurring while Permittee or its contractors are in possession of the permit area, or elsewhere if caused by Permittee's contractors acting for or on Permittee's behalf, Permittee shall also require such contractors or consultants to indemnify the State. These covenants shall survive the expiration or earlier termination of this permit.

13. In the event of an alleged violation of this permit, the State will contact the Director of the Institute of Pacific Islands Forestry (or other designated official of the USDA Forest Service) with notice of such violation and a reasonable time permitted to cure the violation.

14. Disputes shall be resolved by the Station Director, Pacific Southwest Research Station, USDA Forest Service, and the Board of Land and Natural Resources. Disputes involving Laupāhoehoe Natural Area Reserve shall be taken to the Natural Area Reserve System Commission first for their recommendation to the Board of Land and Natural Resources.

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

STATE OF HAWAII

By _____
Chairperson of the Board of Land and Natural Resources

Approved by the Board of
Land and Natural Resources
at its meeting held on JAN 2 6 2007

USDA FOREST SERVICE

_____
James Sedell, Station Director
Pacific Southwest Research Station

APPROVED AS TO FORM:

_____
Deputy Attorney General
State of Hawaii

Dated: 1/26/07

5

Exhibit A to Permit

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

1. Operations and maintenance of buildings, dormitories, work areas, demonstration/education buildings, storage facilities, and management structures on experimental forest lands or other state lands encumbered under lease, license or permit.

2. Minor modification of existing buildings, work areas, demonstration/education facilities, and storage facilities to improve their usefulness as per the cooperative agreement, or to provide for public and worker safety.

3. Maintenance or modification of landscaping and other minor land and vegetation improvements around buildings, work areas, storage facilities on experimental forest lands to improve site use or public safety, including cutting and/or removal of vegetation, and use of pesticides and herbicides to maintain landscaping.

4. Cutting and/or removal of exotic/nonnative vegetation and animals or use of pesticides and herbicides to control or prevent the establishment or spread of invasive species.

5 Maintenance and operation of all facilities and improvements that are used by the U.S. Forest Service or its assigns, or those installed under research permits as per agreement of the Forest Service.

6. Maintenance of existing roads to facilitate access and diminish ecological damage from roads in poor condition, including the cutting or removal of roadside vegetation, and use of herbicides and pesticides in road right-of-way.

7. Maintenance of the existing trail system facilitate access, minimize trampling damage and insure safety of users, including the cutting or removal of roadside vegetation, and use of herbicides and pesticides in the trail corridor.

8. To participate in or conduct hikes, nature study, or other passive recreational activities.

9. Non-destructive inventory and monitoring of basic resources of experimental forest lands.

10. To lead site tours or provide access to school children, land managers, natural resource professionals, and the general public for forest education purposes and demonstration projects.

11. Installation and maintenance of directional and informational signs for worker, visitor, and public use and safety.

12. Monitoring of public use and environmental conditions in and around public use facilities, including placement of temporary electronic devices for environmental monitoring or sampling (for periods ≤36 months), and the sampling of air and gasses (plant and soil respiration) within the experimental forest.

13. Use of motorized or unmotorized vehicles and equipment off established roads and trails or other designated vehicle-areas for approved management and research plan activities or to respond to emergency situations.

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

14. Non-destructive inventory, measurements, censuses, and monitoring of trees, ferns, understory plants, birds, mammals, insects, and aquatic organisms where there is no harm to the organisms (includes both ground-based and remotely sensed measures).

15. Non-destructive inventory, measurements, and monitoring of the forest floor, dead and downed wood, and soils.

16. Non-destructive inventory, measurements, and monitoring of streams, ponds, and other aquatic ecosystems.

17. Nondestructive hydrological and geomorphic studies which do not involve the erection of structures or long term placement of equipment.

18. Erection of small protective fences and barriers ≤10 acre in area (and the removal of exotic species within such plots).

19. Construction of temporary blinds and field observation structures.

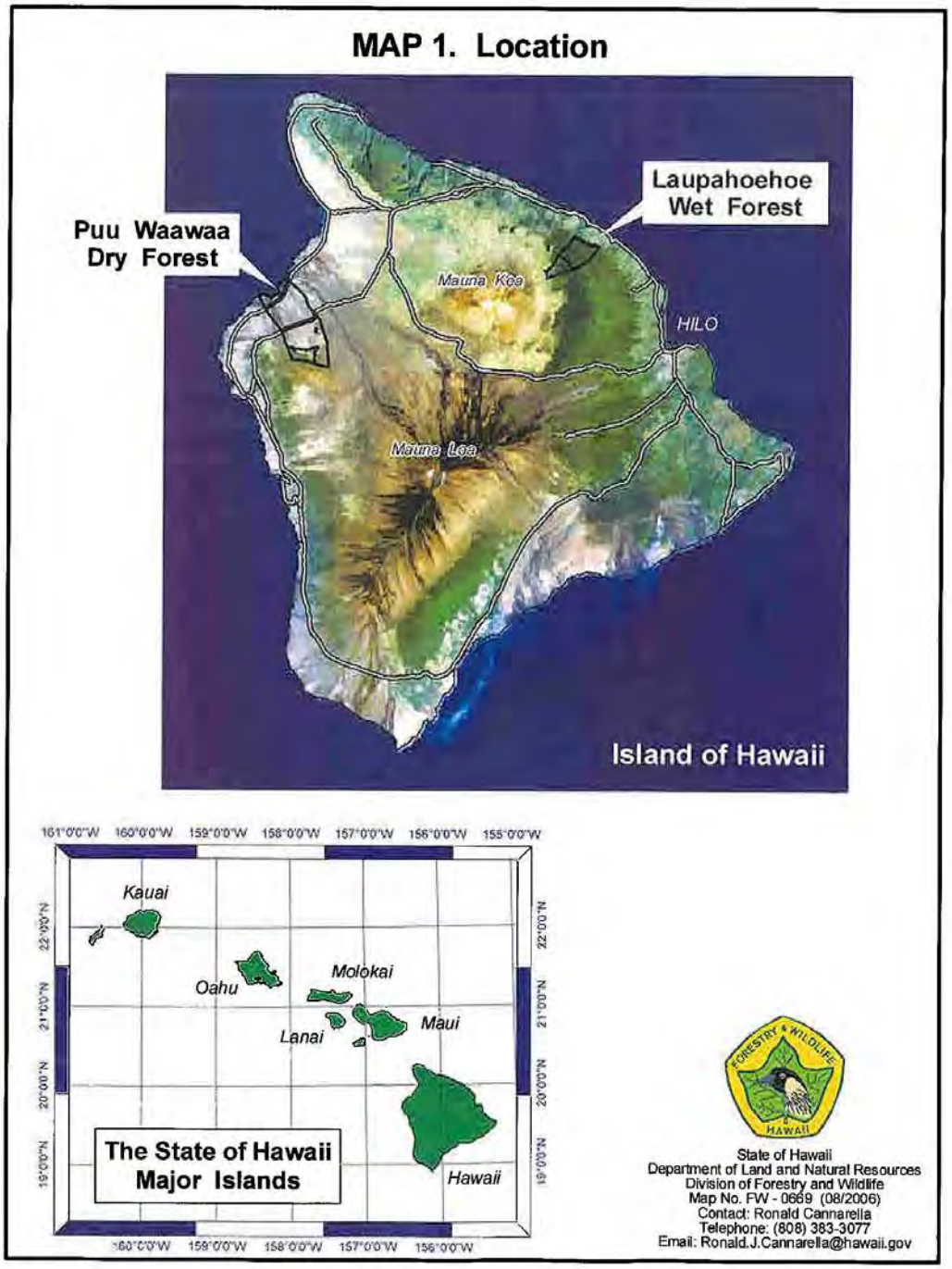
20. Soil and plant nutrient cycling research.

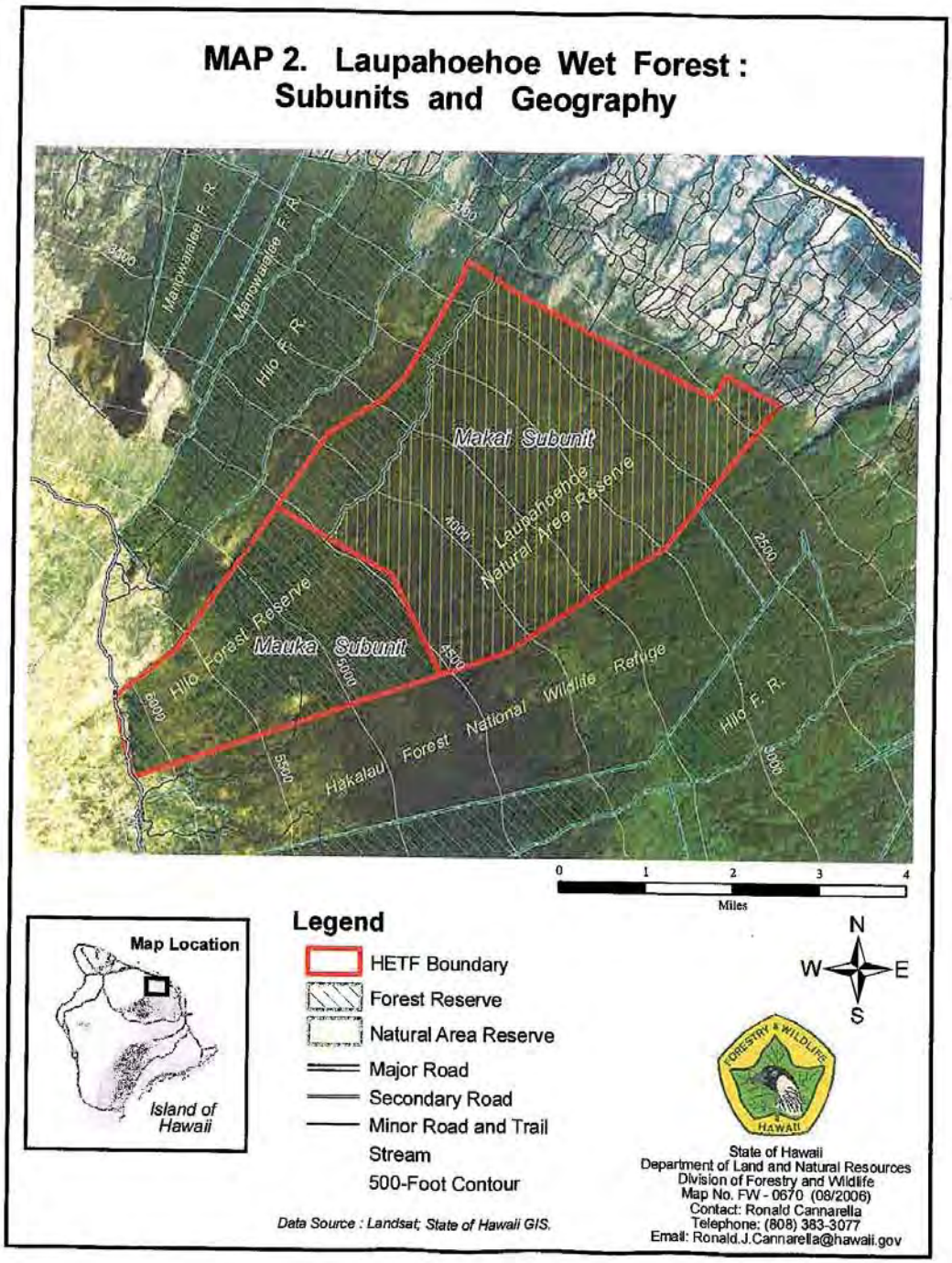
21. Biocontrol research to control invasive plants and animals - manipulate densities of state and federally permitted biocontrol agents through redistribution and experimental methods, including caging plants or parts of plants.

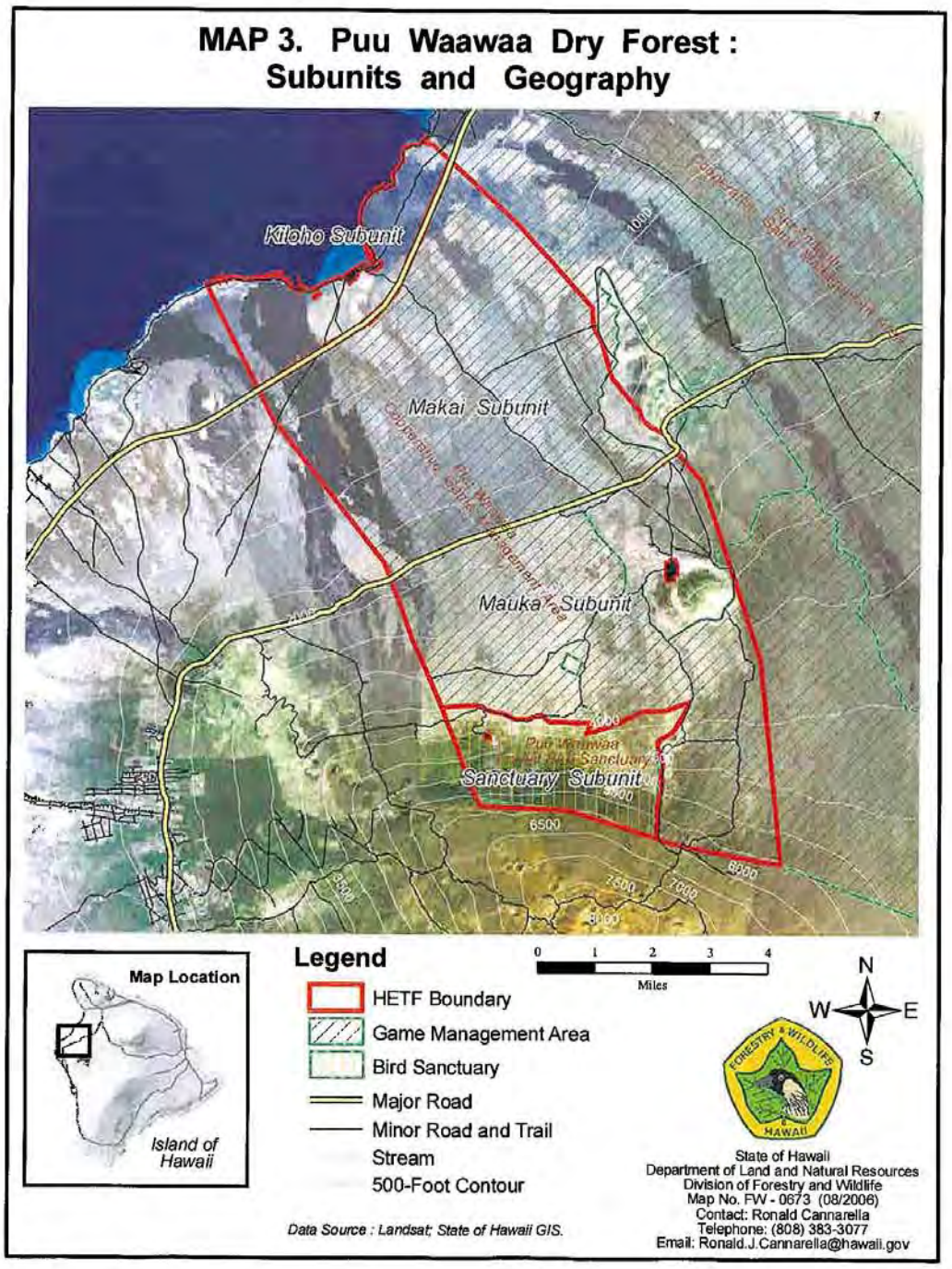
22. Introduction and use of carbon, oxygen, nitrogen and other isotopes for research.

23. Non-destructive collection of plant material (excluding all listed T&E plants), soils, and water samples for laboratory analysis.

24. Collection of plant and insect samples that are from common, exotic, and abundant taxa for laboratory, greenhouse, or herbarium sampling (excluding all listed T&E species).


MAP 1. Location
Laupahoehoe
Wet Forest
Puu Waawaa
Dry Forest
Mauna Kea
HILO
Mauna Loa
Island of Hawaii
161°0'0"W 160°0'0"W 159°0'0"W 158°0'0"W 157°0'0"W 156°0'0"W 155°0'0"W
22°0'0"N
21°0'0"N
20°0'0"N
19°0'0"N
Kauai
Oahu
Molokai
Lanai
Maui
Hawaii
The State of Hawaii
Major Islands
FORESTRY & WILDLIFE
HAWAII
State of Hawaii
Department of Land and Natural Resources
Division of Forestry and Wildlife
Map No. FW - 0669 (08/2006)
Contact: Ronald Cannarella
Telephone: (808) 383-3077
Email: Ronald.J.Cannarella@hawaii.gov


MAP 2. Laupahoehoe Wet Forest : Subunits and Geography
Mamowaiakea F. R.
Hilo F. R.
Makai Subunit
Laupahoehoe Natural Area Reserve
Hilo Forest Reserve
Mauka Subunit
Hakalau Forest National Wildlife Refuge
2500
3000
4000
4500
5000
5500
0 1 2 3 4
Miles
Map Location
Island of Hawaii
Legend
HETF Boundary
Forest Reserve
Natural Area Reserve
Major Road
Secondary Road
Minor Road and Trail
Stream
500-Foot Contour
Data Source : Landsat; State of Hawaii GIS.
N
W
E
S
FORESTRY & WILDLIFE
HAWAII
State of Hawaii
Department of Land and Natural Resources
Division of Forestry and Wildlife
Map No. FW - 0670 (08/2006)
Contact: Ronald Cannarella
Telephone: (808) 383-3077
Email: Ronald.J.Cannarella@hawaii.gov


MAP 3. Puu Waawaa Dry Forest :
Subunits and Geography
Kiloho Subunit
Makai Subunit
Mauka Subunit
Sanctuary Subunit
6500
7000
7500
8000
Map Location
Island of Hawaii
Legend
HETF Boundary
Game Management Area
Bird Sanctuary
Major Road
Minor Road and Trail
Stream
500-Foot Contour
0 1 2 3 4
Miles
N
W
E
S
Data Source : Landsat; State of Hawaii GIS.
State of Hawaii
Department of Land and Natural Resources
Division of Forestry and Wildlife
Map No. FW - 0673 (08/2006)
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