HETF 2019 ANNUAL REPORT

USDA FOREST SERVICE

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Acknowledgements

The establishment and administration of the Hawai'i Experimental Tropical Forest (HETF) has been successful due to the support and hard work of many individuals. The U.S. Department of Agriculture, Forest Service (USFS) would like to thank the State of Hawai'i including the Board of Land and Natural Resources, the Division of Forestry and Wildlife and State Parks for their cooperation in the administration of the HETF. In particular we would like to thank the following State staff in 2019 for their efforts to reach agreements, provide valuable feedback, and help move forward the processes needed to effectively administer the HETF's mission: Edith Adkins, Nick Agorastos, Steve Bergfeld, Ian Cole, Charmian Dang, Tom DeMent, Jay Hatayama, Cynthia King, Elliott Parsons, Lyman Perry, Tanya Rubenstein, Lisa Shizuma, Kanalu Sproat, and Dean Takebayashi.

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Additionally, we acknowledge the Laupāhoehoe and Pu'uwa'awa'a Advisory Council members for their important role in the guidance of HETF activities.

Introduction The Hawai'i Experimental

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



Figure 1: Map of Hawai'i Island highlighting the Pu'uwa'awa'a and Laupāhoehoe Units of the HETF.

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

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

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

The report information herein is focused on the research and education activities that took place within the HETF in 2019. Activity data from the previous four years is included in graphical data where relevant. Additional information regarding the HETF's history, future plans and annual reports as well as other resource documents can be found online at <u>www.hetf.us</u>.

Administration Per the HETF

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

Permitting

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

Community Advisory Councils

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

Support USFS Staff

USFS-HETF Line Officer & Science Lead – Dr. Susan Cordell USFS-HETF Education Lead -Dr. Christian Giardina USFS-HETF Facilities Manager - Jon Mitsuda HETF Resource Associate - Tabetha Block

DOFAW Staff

Hawai'i Island DOFAW Branch Manager - **Steve Bergfeld** Hawai'i Island Natural Area Reserves Program Manager - Nick Agorastos Hawai'i Island Forestry Program Manager - **Jay Hatayama** East Hawai'i Island Wildlife Biologist - **Joey Mello** West Hawai'i Island Wildlife Biologist - **Kanalu Sproat** Pu'uwa'awa'a Coordinator - Dr. Elliott Parsons State Parks Hawai'i Island District Superintendent -**Dean Takebayashi**

State Managed Research Activities

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

http://hawaii.gov/dlnr/reports-to-the-legislature.

Facilities

Laupāhoehoe

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

The Kahikina Learning Center (KLC) is an invaluable asset to efforts seeking to engage the public about the importance of our unique Hawaiian forests. Currently, however, the KLC is underutilized because of complex administrative rules, and limited staffing. To better realize our vision for the center we have organized a partnership with several non-profit and government organizations including the Partners in Development Foundation (PIDF), the Malama 'Āina Foundation, the Akaka Foundation and the Department of Land and Natural Resources to help manage and provide oversight of the facility through an agreement. Specifically, Partners in Development Foundation will help manage and provide oversight of the facility. A Memorandum of Undersatnding to support and assist in ensuring successful, responsible, and culturally appropriate stewardship of the upland forests and to provide the youth of Hawai'i with knowledge of the importance of forest resources in our island community through the experience of Hawaiian cultural values and practices with hands-on learning was signed by all

parties in 2019. Co-management of the KLC is expected to occur in 2020.

Pu'uwa'awa'a

In 2019 the infrastructure focus in Pu'uwa'awa'a is on rehabilitating existing infrastructure (Meeting and Lake houses), owned and operated by the Hawai'i State Division of Forestry and Wildlife (DOFAW). Rehabilitation of these existing facilities will greatly benefit all members of the HETF community, providing upgraded, safe, and more useable bunkhouse and meeting facilities.

Conceptual rehabilitation design was completed in September 2018, with a multi-disciplinary group of USFS and DOFAW staff providing input to a USFScontracted architectural and engineering (A&E) firm. Completion of the final design improvements package was completed in 2019. Subsequently, award of the construction contract is planned for September 2020. Construction activities should be complete by mid-2021.

Research Summary

Seventeen research applications were submitted and approved in 2019. All projects were initiated (ten renewals and seven new). HETF related journal articles were published in the Journal of Ecology; Global Ecology and Biogeography; Functional Ecology; Biodiversity Data Journal; and Ecosystems. A list of publications submitted with annual reports is included at the end of this report. Selected 2019 research projects are highlighted below.

 Hawaiian Hoary Bat Conservation Biology: A three year field study has been initiated to advance understanding of key aspects of the endangered Öpe'ape'a (Hawaiian hoary bat; Lasiurus cinereus semotus) ecology and population biology listed as priority research goals for the State of Hawai'i's Endangered Species Recovery Committee (ESRC) and the USFWS 1998 Recovery Plan for the Öpe'ape'a. The study will provide information to help managers make decisions assisting the recovery of Öpe'ape'a and for improved selection and design of bat restoration-mitigation areas. The study results will improve understanding of the roosting habitat needs and key host plant species for the insects that are the diet of



Ōpe'ape'a (Hawaiian hoary bat; Lasiurus cinereus semotus) in hand.

this insectivorous, tree-roosting bat. Tissue samples collected from captured bats will be used for studies to improve understanding of genetic variation and population structure of the Ōpe'ape'a. During the first year of field work in the Laupāhoehoe Unit of the HETF, 15 Ōpe'ape'a were captured, of which 5 were lactating females. Radio-tagged bats were tracked to roost trees in a variety of tree species and forest types in the vicinity of the HETF. Aerial insect sampling to initiate diet studies was conducted during 6 nights.

Evaluating koa as a restoration tool In Hawai'i: Acacia koa is often planted in restoration because it grows relatively quickly and is easy to propagate. However, Koa can have the unanticipated effect of facilitating exotic grass growth under its canopy. This likely occurs because Koa fixes nitrogen leading to higher levels of soil nitrogen, and its canopy allows relatively high amounts of light to pass through, both of which benefit grass growth. Researchers asked the question: How do these Koa-soil-grass interactions vary across gradients of climate and Koa density? Cool temperatures and/or low precipitation could slow rates of decomposition and nutrient cycling and could diminish Koa's facilitative effects. High

densities of Koa may also limit pasture grasses by shading. Researchers then selected sites spanning dry to mesic forest across the island of Hawai'i. At Pu'uwa'awa'a, they established two sets of plots: one in the drier region and one in the wetter region of the Forest Bird Sanctuary. In general, grass was still present even under the highest stem densities of Koa. Less light reached the forest floor and more leaf litter fell with more Koa stems. Decomposition rates of Koa leaf litter tended to be faster where there were more Koa stems suggesting that the layer of leaf litter persists for a shorter time period than in plots with fewer Koa stems.



Clarice Esch, Ph.D. candidate at Michigan State University, measuring grass biomass by clipping grass plots under Koa stands.

Potential changes in evapotranspiration in Hawaiian forests caused by climate change and invasive species: In December 2019, data was successfully collected from plots in Laupāhoehoe, along with forest inventory measurements, such as canopy cover and species composition, using a LiDAR instrument to produce 3-dimensional imagery of the forest plots. The data is currently being analyzed to find differences in forest structure between heavily invaded forest dominated by strawberry guava and native forest dominated by 'Ōhi'a. Once analysis is completed, researchers will be able to infer how invasive species can influence forest evapotranspiration in addition to soil infiltration.



A member of the research team posing with an 'Ōhi'a tree in Laupāhoehoe forest plots

Research projects can be restricted to specific State land designations or occur within multiple State land designations. Five of the 17 projects initiated in 2019 were located in the Laupāhoehoe Unit, eight occurred within the Pu'uwa'awa'a Unit, and four research projects were conducted in both Units (Table 1). Figure 2 shows the percentage of 2019 HETF research projects grouped by State land designation. In Pu'uwa'awa'a research permitting for the HETF is limited to land activities. Research activities that take place in water including the tide line are under the jurisdiction of the DLNR-Division of Aquatic Resources. Figure 3 shows research affiliation for projects within the HETF over a five-year period 2015-2019.

Year	Laupāhoehoe Unit Only	Pu'uwa'awa'a Unit Only	Both HETF Units	Total # of Projects Initiated
2019	5 (29%)	8 (47%)	4 (24%)	17
2018	5 (36%)	6 (43%)	3 (21%)	14
2017	6 (32%)	6 (36%)	6 (32%)	18
2016	5 (28%)	9 (50%)	4 (22%)	18
2015	7 (31%)	13 (58%)	3 (11%)	23
Total	28	42	20	90

Table 1: Total number of research projects initiated in the HETF per year and grouped by Unit from 2015-2019.



Figure 2: Percentage of HETF research projects grouped by State land designation in 2019. (NAR=Natural Area reserve, FR=Forest Reserve, FBS=Forest Bird Sanctuary)



Figure 3: Affiliation for research projects initiated and ongoing within the HETF from 2015-2019.

Kahikina Learning Center (KLC)

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

'Ōhi'a Common Garden

The 'Ōhi'a Common Garden was established in the summer of 2014 in conjunction with the education and outreach program Ulu Lehulehu (The Million 'Ōhi'a Initiative) whose mission is to connect Hawai'i's youth to 'ōhi'a trees. The common garden serves multiple purposes including community engagement and research platform as well as reforestation of degraded lands at the Center. The garden is home to over 800 native 'ōhi'a trees.

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

which supports both the research and education efforts of the 'ōhi'a common garden.





Before and after of an 'Õhi'a sapling having been weeded as part of regular maintenance of the 'Õhi'a Common Garden.



2019 Education, Outreach and Access Activity Summary

This section highlights various non-research program activities, as well as specific Unit education, outreach, and access details that occurred within the HETF in 2019.

Hawaii Youth Conservation Corps (YCC)

Youth Conservation Corps programs in Hawai'i are administered by Kupu, a nonprofit community organization (www.kupuhawaii.org). HETF participates in three Kupu/ AmeriCorps Youth Conservation Corps (YCC) programs: The HYCC Summer Program is a 7-week summer team experience designed for young adults (ages 17-20). Team members complete hands-on fieldwork at various worksites. The Conservation Leadership **Development Program (CLDP) Summer experience** provides a more in-depth individual 8-week summer experience at a single worksite that best matches the individual's interests. The CLDP, Year Long program offers an intensive entry-level 11-month experience where members assist with projects that equip them with job skills and leadership growth opportunities to move ahead in their career. In addition to gaining valuable insight in the conservation field, members also receive a living allowance and an AmeriCorps education award for their time.

2019 was the eighth year the HETF supported HYCC Summer teams. HYCC Summer program members gained introductory experience in all aspects of natural resource management. These teams supported work within the Pu'uwa'awa'a HETF, from mauka to makai (mountain to the sea) in the ahupua'a of Pu'uwa'awa'a (traditional land division). Activities focused on establishing an outdoor classroom area in the Kīpuka 'Owē'owē unit (clearing the understory vegetation, leveling the ground, building a wall around the learning area, building benches); fixing and re-routing trails in that unit; hand clearing non-native vegetation and cleaning the surrounding outdoor areas of the new education and outreach office; weeding outplanting areas in the Hau'āina unit; and conducting maintenance on fire breaks and large, public trails through weed whacking and hand removal of non-native vegetation. These teams also had the opportunity to work with USFS partner organizations on their sites, including The Nature Conservancy at Kīholo in Kona, Aloha Kuamo'o 'Āina in Kona, and Nā Mamo O Kāwā in Ka'ū. One team also participated in the 2019 Native Youth Community Adaptation Leadership Congress in West Virginia.

2019 was the fifth year the HETF HYCC Summer team attended the Native Youth Community Adaptation and Leadership Congress (NYCALC) in Shepherdstown, West Virginia. This is a week-long conference that discusses the effects of climate change on tribal communities. The conference was attended by Alaska Native, American Indian, and Native Hawaiian high school students representing tribes from across the nation. The 2019 USFS team members included: Naehu Leialoha, Kaden Kort, Chris Knell, Joshlyn Pohai Rodrigues and Destiny Ishii (pictured below). Attendance to the conference is sponsored by the USFS.



2019 Native Youth Community Adaptation and Leadership Congress (NYCALC) in Shepherdstown, WV.

Blue Waters Exchange Program

A six-week collaborative youth work exchange (ages 18-26) program for ten youth between the Lake Tahoe Basin in the high Sierras of California and Nevada and the beautiful Hawaiian Islands in the Pacific.

Lake Tahoe and Hawaii communities cultivate local youth by providing volunteer and work opportunities on public lands. Through programs like Lake Tahoe's Generation Green and Hawaii's Na Leo's (NLOH) programs, students connect to their environments while developing the skills, knowledge, and passion to be leaders in their communities and stewards of the land. The Blue Waters Work Exchange Program will create opportunities for alumni of these programs to focus on careers in wildland fire and natural resource management through an intensive work, job skills training and development program that incorporates leadership and cultural exchange. The combination of hard work and personal development provides opportunities to develop future environmental leaders.

Exchanges between the Hawaii and Lake Tahoe facilitated through the Blue Waters programs bridge the geographic and cultural space between these two environmentally dynamic and different places. Work and educational exchanges are invaluable to local and global communities alike because youth have the opportunity to broaden their horizons beyond the waters where they grew up.

2019 was the second year the USFS/HETF partnered with the Blue Waters Exchange Program. The group spent nine days on Hawaii Island submersed in an assortment of hands-on experiences ranging from mauka to makai. The 2019 participants included: Erika Kekiwi, Pualani Mautatia, Christine Flauta, Hayden Atkins and Keely Hassett (from Hawaii); Elisa Escobar, Alondra Gomez, Christian Garcia, Allen Collier and Ariana Torres (from Lake Tahoe).

Ulu Lehulehu - The Million 'Ōhi'a Initiative

Ulu Lehulehu was conceived in 2012. The root words are, ULU, meaning to grow, spread, protect and LEHULEHU, meaning numerous, innumerable, a multitude. This program is a partnership between the HETF/USFS, Akaka Foundation of Tropical Forests

(<u>https://akakaforests.org/projects/ululehulehu</u>), AmeriCorps, Kupu, and Laupāhoehoe Community Public Charter School (LCPCS).

Ulu Lehulehu's initiative inspires the next generation of conservationists by working with Hawai'i communities to develop and strengthen relationships with and create vibrant landscapes abundant in 'ōhi'a. The programs K-12 education work involves bringing the forest into the school classroom, and taking students into the outdoor classroom to learn about native forest ecosystems and watersheds, the importance of knowing your landscapes intimately, and engaging in indigenous Hawai'i lifeways to help kids reconnect with and better understand their places. Ulu Lehulehu bridges science, culture, and community to develop and strengthen people's relationships with and create vibrant landscapes abundant in 'ohi'a through four integrative approaches of youth education, community outreach, native forest restoration, and urban forestry.

During the 2018-2019 academic school year Ulu Lehulehu provided hands-on, in-classroom and outdoor learning opportunities for the LCPCS 9th grade science class to engage with 'ohi'a, our landscapes and resources, and the stories of our places. Program staff visited the students five times in the classroom, and then led an overnight, twoday huaka'i (field trip) to visit and learn about places in the ahupua'a (traditional mountain to the sea land division) of their school and town. The spring semester was wrapped up back at the school with a reflection of the time spent with the program, and a giveback project to the school (building a planter around one of the school's 'ohi'a trees). Ulu Lehulehu's education efforts help to shape the next generation of responsible, engaged, aware, and motivated stewards involved in the conservation and protection of the natural and cultural resources of Hawai'i.

Laupāhoehoe Unit

Two participants on 1 trip visited the Laupāhoehoe Unit in 2019.

 USFS and Mauna Kea Watershed Alliance staff visited the Laupāhoehoe Unit of the HETF to scoping the area along Blair Road for potential summer environmental education activities - in particular for visits with Blue Waters Exchange Program and Mauna Kea Watershed Alliance teacher training workshops and potential future huaka'i.

Pu'uwa'awa'a Unit

Seven hundred and seventy four participants on 27 trips visited the Pu'uwa'awa'a Unit in 2019. The high number of participants, compared to the Laupāhoehoe Unit, who are able to visit, work, and learn in Pu'uwa'awa'a is in a large part due to the presence and availability of onsite DOFAW staff that lead, participate in, and facilitate these activities. The existing road and facility infrastructure in Pu'uwa'awa'a Forest Reserve also play an important role in making these trips possible. The continued presence and availability of onsite staff is necessary for Pu'uwa'awa'a to be able to continue to support this level of public interaction. A further breakdown of participants in the HETF from 2015-2019 is detailed in Figure 4. A few of the 2019 HETF education trips to Pu'uwa'awa'a are detailed here.

Teaching Change is a program led by the University of Hawai'i at Mānoa and Akaka Foundation for Tropical Forests. This program offers select school groups to attend an overnight field trip at various conservation sites on Hawai'i island. In 2019 Teaching Change brought six school groups to Pu'uwa'awa'a, five of the groups were from Hawaii Island, while the other was from O'ahu. The trip allows participants to see different landscapes throughout the ahupua'a, including the Pu'u, Hau'āina, and Kīpuka 'owē'owē, which are all different restoration sites within Pu'uwa'awa'a. The framework includes educational activities, focused on learning about native plants, phenology, collecting data, climate change, and more! Activities include hiking the Pu'u and

learning about the ecosystem, native plants, and "kilo" or observing their surroundings. The group gives back by doing service projects which has included hand-weeding and outplanting. This HETF's partnership with Teaching Change has given students and teachers exposure to the native dryland forest and establishes within them, a connection to place, helping to develop a deeper understanding of the importance of our native ecosystems



- Girl Scout Troops from Hilo and Waikoloa visited Pu'uwa'awa'a Forest Reserve for an overnight camping trip. During their stay they gained knowledge about the dry land forest, native species, and invasive species. Discussion included conservation and the importance of native forests in Hawaii, and why we need to protect them. Educational activities such as a hula called "Kumokuhali'i" which talks about the function of the forest and how it provides us with clean water, are incorporated as well as native plant identification. To give back, the scouts outplanted 44 native species in the ground, leaving with a better understanding of conservation, cultural knowledge, and hands-on planting skills.
- 2019 Biocultural Blitz This was the third annual event that explores Hawaiian dry forest ecology as well as traditional Hawaiian cultural practices. The Institute

of Pacific Islands Forestry and Hawaii Experimental Tropical Forest in partnership with the Hawaii Division of Forestry and Wildlife, the University of Hawaii at Mānoa, Akaka Foundation for Tropical Forests and the Forest Service's National Partnership Office, hosted 250 fourthgraders for a "Bio-Cultural Blitz" at the HETF's Pu'u Wa'awa'a Dry Forest Unit. Students were traditionally welcomed by Native Hawaiian descendants of Pu'uwa'awa'a and spent the day visiting stations highlighting the biocultural significance of Hawaii's endangered dry forests, from botany and soils to wildlife and insects to cultural geography and indigenous resource management, while engaging in hands-on activities.

• The Sierra Club – O'ahu Chapter, visited Pu'uwa'awa'a for a two day service project



Members of the O'ahu Chapter of the Sierra Club

focused on native plant rescuing in the Cone unit. Day one included saving many rare and endangered species from being outcompeted by invasive weeds and grasses. On day two, they continued working in the Cone unit and outplanted many native 'a'ali'i shrubs.

'Imi Pono no ka 'āina offers students a chance to fully immerse themselves in natural area preserves around the island. Giving them a chance to visit special places, and to meet conservation professionals, and learn more about Hawaii's special landscapes. This program focuses on educational activities such as "kilo" observation, native plant identification, cloud identification, and hiking through the forest atop Pu'uwa'awa'a. This particular group helped outplant native species in the Hau'āina restoration unit, while they sang 'olelo Hawai'i songs together the whole time! Programs like this give students an indepth perspective of the work that is done within conservation, and how important it is for future generations to step into these roles. They take with them a deeper appreciation for the natural world and they know their "kuleana" or responsibility within it all.



Figure 4: Number of participants to visit the HETF from 2015-2019.

Kahikina Learning Center (KLC)

One hundred and sixty seven participants visited the Kahikina Learning Center (KLC) on a variety of trips. A few of the 2019 Center activities are detailed here.

- USGS-PIERC/Hawaiian Hoary Bat Conservation Biology research group stayed at the KLC 4 times during 2019, while conducting Hawaiian hoary bat research activities within the Laupāhoehoe unit of the HETF. The field crew is based out of Hawaii Volcanoes Nation Park and lodging at the 'Ōhi'a House allowed for easy access to field research sites.
- *Teaching Change* spent the day at Kupua'e, the 'Ōhi'a Common Garden, maintaining and learning about 'Ōhi'a.
- *Mālama 'Āina Foundation* spent the day at KLC educating students how to restore, conserve, and sustain tropical forests, as well as how to manage the biological diversity and functioning of tropical forest.
- Blue Waters Exchange the group used the facility as home base during their island wide huaka'i. During
 their stay they performed service work that contributed to the conservation of the natural forests of the
 Pacific as well as conservation efforts on HETF areas. Additionally, the group learned about the role of
 IPIF and the HETF in conservation and natural resource management and about the functions of Hawaii's
 ecosystems.



2019 Blue Waters Exchange participants visiting Hawai'i Island, with Kiholo Bay in the background.

Back row (L-R): Jeff Marsolais, Pualani Mautatia, Erika Kekiwi, Christian Garcia, Gina Carroll, Allen Collier, Alondra Gomez, Jim Oftedal and Paul Barney. Front row (L-R): Elisa Escobar, Christine Flauta, Joy Barney, Tabetha Block and Jodi Chew.

Climate Data Summary

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

Laupāhoehoe

Mean annual rainfall, temperature, and relative humidity at Laupāhoehoe, 2015 – 2019 (standard errors in parenthesis).

YEAR	Rainfall (mm)	Temperature (C°)	Relative Humidity (%)
2019	3010	16.7 (<u>+</u> 0.6)	84.9 (<u>+</u> 1.0)
2018	5267	16.7 (<u>+</u> 0.4)*	87.3 (<u>+</u> 1.0)*
2017	4261	16.5 (<u>+</u> 0.4)	88.1 (<u>+</u> 1.6)
2016	4613	16.1 (<u>+</u> 0.3)	90.3 (<u>+</u> 1.2)
2015	5067	16.7 (<u>+</u> 0.5)	89.2 (<u>+</u> 1.0)
Mean	4440 (<u>+</u> 397)	16.5 (<u>+</u> 0.2)	88.0 (<u>+</u> 0.6)

Table 2: Mean annual rainfall, temperature, and humidity at Laupāhoehoe climate station.







Figure 6: Mean temperature for 2015-2018 compared to 2019 in Laupāhoehoe.



Figure 7: Mean relative humidity for 2015-2018 compared to 2019 in Laupāhoehoe.

Pu'uwa'awa'a

Mean annual rainfall, temperature, and relative humidity at PWW (standard errors in parenthesis). Rainfall mean is for 2015-2019, excluding 2016*.

YEAR	Rainfall (mm)	Temperature (C°)	Relative Humidity (%)
2019	1105	14.7 (<u>+</u> 0.6)	85.3 (<u>+</u> 1.3)
2018	1365	14.2 (<u>+</u> 0.7)	80.6 (<u>+</u> 2.5)
2017	900	14.5 (<u>+</u> 0.3)	81.5 (<u>+</u> 2.4)
2016	699*	14.5 (<u>+</u> 0.4)	84.6 (<u>+</u> 2.0)
2015	1531	14.9 (<u>+</u> 0.5)	83.8 (<u>+</u> 2.9)
Mean	1225 (<u>+</u> 139)	14.7 (<u>+</u> 0.1)	83.5 (<u>+</u> 0.7)

Table 3: Mean annual rainfall, temperature, and relative humidity at Pu'uwa'awa'a (standard errors in parenthesis).



Figure 8: Mean temperature for 2015-2018 compared to 2019 in Laupāhoehoe.



Figure 9: Mean temperature for 2015-2018 compared to 2019 in Pu'uwa'awa'a.



Figure 10: Mean relative humidity for 2015-2018 compared to 2019 in Pu'uwa'awa'a.

HETF Related Citations

Citations listed below have been submitted since the publication of the 2018 HETF Annual Report through either project annual reports or direct submission. Only published research is listed below. Visit the HETF website http://www.hetf.us/page/publications/ for a complete list of citations received to date.

Submitted with 2019 annual reports:

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