

2020 HETF Annual Report

USDA Forest Service

Pacific Southwest Research Station
Institute of Pacific Islands Forestry
60 Nowelo Street
Hilo, HI 96720
(808) 854-2604

www.thehetf.us

Prepared by: Tabetha Block

TABLE OF CONTENTS

ACKNOWLEDGEMENTS 2
Introduction 3
Administration 5
- HETF Support Staff 5
- Permitting 5
- Community Advisory Councils 6
- State Managed Research Activities 6

Facilities 7
- Laupāhoehoe 7
- Puʻuwaʻawaʻa 7

Research summary 8
Kahikina Learning Center (KLC) 10
- ʻŌhiʻa Common Garden 10

2020 Education, Outreach and Access Activity Summary 11
- Hawaii Youth Conservation Corps (YCC) 11
- Conservation Leadership Development Program (CLDP) 11
- Blue Waters Exchange Program 11
- Ulu Lehulehu & Akaka Foundation for Tropical Forests Partnership 12
  - Teaching Change 12
  - Ōhiʻa Disease Resistance Program (ODRP) 13
  - Puʻuwaʻawaʻa Community-Based Subsistence Forest Area (P-CBSFA) 13
- HETF Webinar Series 14
- Laupāhoehoe Unit 14
- Puʻuwaʻawaʻa Unit 14
- Kahikina Learning Center (KLC) 15

Climate Data Summary 16
- Laupāhoehoe 16
- Puʻuwaʻawaʻa 17
  - Māmalahoa 17
  - Forest Bird Sanctuary 18

HETF Related Citations 19

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 2020 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, Lisa Shizuma, Dave Smith, Kanalu Sproat, and Dean Takebayashi.

Special thanks to the additional USDA Forest Service employees who have worked to support the HETF's success in their respective capacities in 2020 including: Richard Barhydt, Andrew Bouchard, Jodi Chew, Tom Cole, Susan Cordell, Christian Giardina, Kainana Francisco, Robert Hegemann, Valerie Hipkins, James Hokoana, Frank McArthur, Jon Mitsuda, Damon Romero, Jim Snow, Frank Stefaniak, and Sylvia Qi.

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

We would like to acknowledge the lands on which the Hawaii Experimental Tropical Forest is established, lands that are sacred to Kānaka Maoli, the Native Hawaiian people. The HETF encompasses the ahupua‘a of Pu‘uwa‘awa‘a in the moku of North Kona and a section of the ahupua‘a of Laupāhoehoe in the moku of North Hilo. The HETF is dedicated to providing landscapes, facilities, and data/information to support research and education activities; as well as caring for Hawai‘i’s biocultural landscapes and communities. This land acknowledgement welcomes everyone who gathers here.

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/).

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.

Our 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.

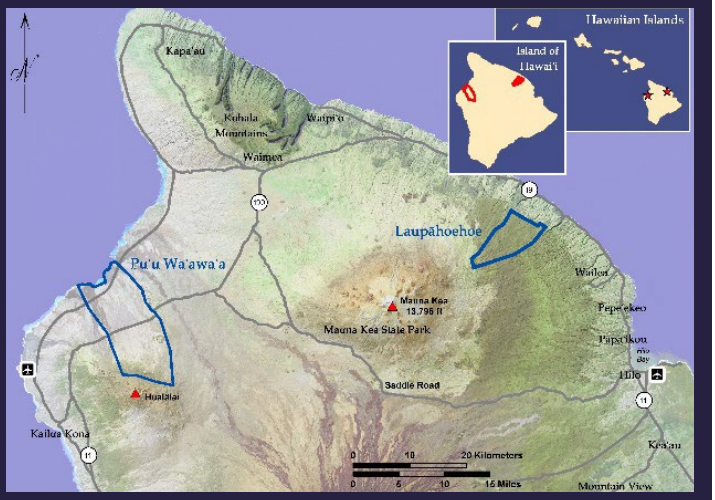


Figure 1: Map of Hawai'i Island highlighting the Pu'uwa'awa'a and Laupāhoehoe Units of the HETF.

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 www.thehetf.us.

ADMINISTRATION

Per the HETF Cooperative Agreement, "owing to the many values and benefits that arise from research, education and demonstration on the HETF and elsewhere, the Parties (the USFS and the State of 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.

HETF Support Staff	
USFS	
Dr. Susan Cordell	USFS-HETF Line Officer & Science Lead
Dr. Christian Giardina	USFS-HETF Education Lead
Jon Mitsuda	USFS-HETF Facilities Manager
Tabetha Block	HETF Resource Associate
DOFAW	
Steve Bergfeld	Hawai'i Island DOFAW Branch Manager
Nick Agorastos	Hawai'i Island Natural Area Reserves Program Manager
Jay Hatayama	Hawai'i Island Forestry Program Manager
Ian Cole	East Hawai'i Island Wildlife Biologist
Kanalu Sproat	West Hawai'i Island Wildlife Biologist
Dr. Elliott Parsons	Pu'uwa'awa'a Coordinator
Dean Takebayashi	State Parks Hawai'i Island District Superintendent

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.

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

HETF support facilities are located in both units. For the Laupāhoehoe Unit, the Kahikina Learning Center sits within the town of Laupāhoehoe but outside the forest boundary. The Pu‘uwa‘awa‘a facilities are owned and operated by the Hawai‘i State Division of Forestry and Wildlife (DOFAW), and may available upon request by HETF permit holders. Due to the unforeseen impacts of the COVID-19 global pandemic, planned improvements to the facilities, as well as planning for partnerships to help oversee facilities has been slowed for most of 2020.

Laupāhoehoe

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, Akaka Foundation for Tropical Forests will help manage and provide oversight of the facility. A Memorandum of Understanding 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

The focus on rehabilitating the existing State infrastructure (Meeting and Lake houses) owned and operated by the Hawai‘i State Division of Forestry and Wildlife (DOFAW) in Pu‘uwa‘awa‘a, has been halted. The eventual rehabilitation of these existing facilities will greatly benefit all members of the HETF community, by providing an 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 USFS-contracted architectural and engineering (A&E) firm. Completion of the final design improvements package was completed in 2019. Subsequently, construction contract was awarded in September 2020. Original plans were scaled down to include renovations to the Meeting House only, and DOFAW and USFS began working on 1) a lease to USFS of the buildings so USFS could invest funds in their repair, 2) an Operations Plan to guide use of the buildings, and 3) a fee-structure for building use for non USFS/DOFAW users once construction is complete. Construction activities are planned to be complete by fall of 2021.

RESEARCH SUMMARY

Research projects can be restricted to specific State land designations or occur within multiple State land designations. Seven of the 19 projects initiated in 2020 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 1 shows research affiliation for projects within the HETF over a five-year period 2016-2020. Figure 2 shows the percentage of 2020 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 up to the high tide line are under the jurisdiction of the DLNR-Division of Aquatic Resources.

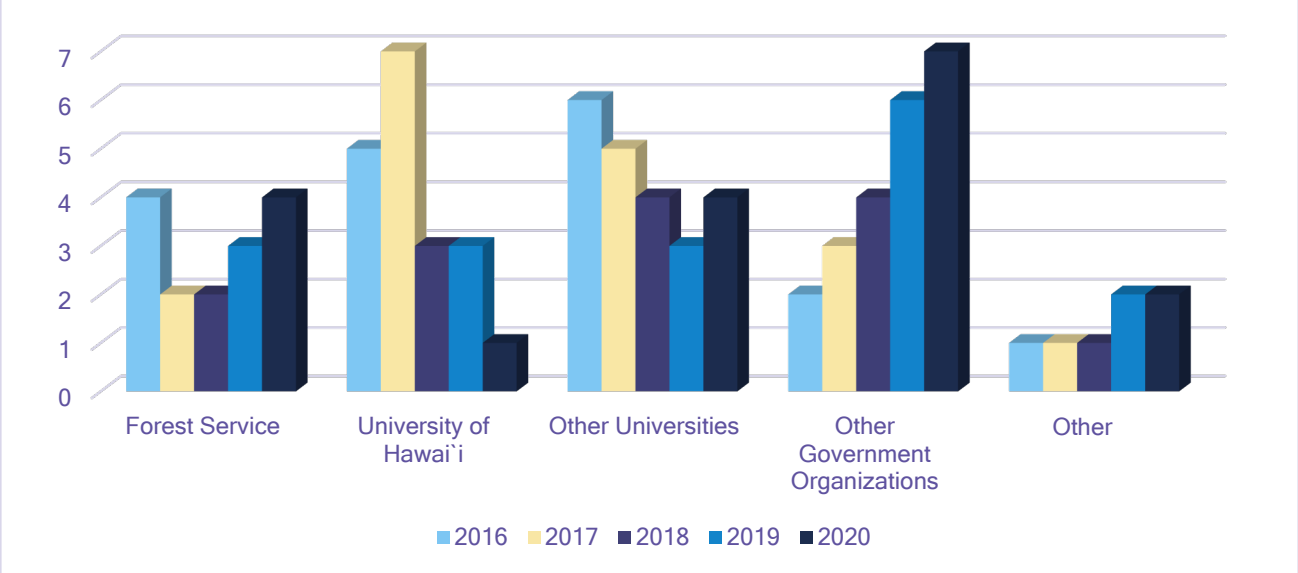


Figure 2: Affiliation for research projects initiated and ongoing within the HETF from 2016-2020.

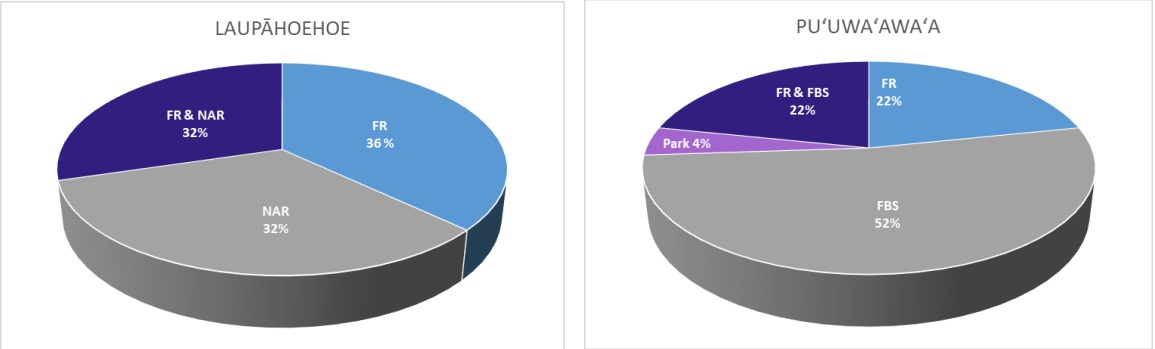


Figure 3: Percentage of HETF research projects grouped by State land designation in 2020. (NAR=Natural Area Reserve, FR=Forest Reserve, FBS=Forest Bird Sanctuary)

Nineteen research applications were submitted and approved in 2020. All projects were initiated (sixteen renewals and three new). HETF related journal articles were published in Ecosystems, Geochimica et Cosmochimica Acta, Frontiers in Plant Science, and Ecology and Evolution. A list of publications submitted with annual reports is included at the end of this report.

Table 1: Total number of research projects initiated in the HETF per year and grouped by Unit from 2016-2020.

Year	Laupāhoehoe Unit Only	Pu'uwa'awa'a Unit Only	Both HETF Units	Total # of Projects Initiated
2020	7 (37%)	8 (42%)	4 (21%)	19
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
Total	**28**	**37**	**21**	**86**

KAHIKINA LEARNING CENTER (KLC)

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 in tropical forestry, conservation biology, and natural resources research and management.



ʻŌhiʻa Common Garden

The ʻŌhiʻa Common Garden was established in the summer of 2014 as a University of Tennessee led study of the effects of fragmentation on ʻōhiʻa genetics. In conjunction with the education and outreach program Ulu Lehulehu (The Million ʻŌhiʻa Initiative), whose mission is to connect Hawaiʻi's youth to ʻōhiʻa trees, the common garden became a hub for biocultural outreach and education activities, and so serving multiple purposes including community engagement, research and practical reforestation of degraded lands at the Center. The garden is home to over 800 native ʻōhiʻa trees.

The ʻŌhiʻa Common Garden will help answer important science questions about how long-term forest fragmentation (>100 years) affects ʻōhiʻa genetics, and in turn how genetics controls growth rates and survivorship. The trees were all created from cuttings taken from ʻōhiʻa that occur in the center and edge of forest kīpuka, or forest fragments created by lava flows, as well as from ʻōhiʻa trees colonizing the lava matrix between kīpuka. The team selected these trees because they noticed that there were differences in trees between these sites and hypothesizing that these differences were genetically determined. Over 1000 ʻōhiʻa from these different locations were propagated and studied for two years in a greenhouse prior to outplanting at the KLC. The team found that location of the mother trees strongly affected genetics. Trees from kīpuka centers grew faster and taller than edge trees or matrix trees even though all the trees were grown in a common environment (same soils and greenhouse). Researchers are now studying how these differences persist in the field as the trees grow and mature. The common garden also allows participants to learn about ʻōhiʻa biology and ecology as well as this biocultural keystone species' importance to the health of the forest. Participants support service learning projects caring for the ʻōhiʻa (weed/grass control), which supports research and education efforts of the ʻōhiʻa common garden.

2020 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 2020. Due to the unforeseen impacts of the COVID-19 global pandemic and a statewide stay at home order issued by Governor David Ige, followed by strict proclamations restricting social gatherings, no activities took place within the HETF after March 25, 2020.

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 two Kupu/ AmeriCorps Youth Conservation Corps (YCC) programs: The Hawaii Youth Conservation Corps (HYCC) Summer Program is a 7-week summer team experience designed for young adults (ages 17-20) and the Conservation Leadership Development Program (CLDP) yearlong program offers an intensive entry-level 11-month experience where members (ages 18+) 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. The HETF did not participate in the HYCC program in 2020 due to the pandemic.

Conservation Leadership Development Program (CLDP)

The HETF hosted one CLDP Kupu member from January to December 2020. This members responsibilities included: coordinating partnership opportunities associated with the HETF, including with Division of Forestry and Wildlife, University of Hawaii, Akaka Foundation for Tropical Forests, Kupu, and local non-profits, while also supporting the planning of events geared to development of a partnership-focused plan to effectively co-manage research, outreach and education opportunities at the HETF; ongoing research projects in the Laupāhoehoe and Pu'uwa'awa'a HETF Units; engaging with HETF advisory councils, and outreach with the public, as well as occasionally assisting partners with their education and outreach programming.

Blue Waters Exchange Program (BWE)

In 2020, The Blue Water Exchange Program (https://www.bluewaterexchange.org/) moved to a virtual platform. It became a 6-month Capstone experience, with intention of travel to Hawaii and California, but due to COVID all travel was cancelled. The 2020 program ran from June 2020 to November 2020. Participants connected via zoom classrooms once a month to hear from guest speakers and discuss conservation topics.

Guest speakers included Jeff Marsolais of the USDA Forest Service, Herman Filmore of the Lake Tahoe Washoe Tribe, Hugh Safford of the UDSA Forest Service, and Cheyenne Perry of Mauna Kea Watershed Alliance.

Topics included connection to place and past, indigenous perspectives, current environmental issues, politics, advocacy, and community engagement. The 2020 BWE team included: Carson Alexander (CA), Cindy Among-Serrao (HI), Cooper Solomon (CA), Daniel Rosales (CA), Josephine Tupu (HI), Kaile Luga (HI), Kawika Cardus (HI), Melissa Gomez (CA), and Montserrat Valencia (CA).

The BWE creates an opportunity for individuals to work in new landscapes, meet and learn from different cultures, and gain exposure to conservation careers and expand thinking by having deep dialogue about our community's most pressing issues as seen through different perspectives.

Akaka Foundation for Tropical Forests Partnership

Ulu Lehulehu

The USFS and HETF continued a robust partnership with the Akqkq Foundation for Tropical Forests in 2020, collaborating on several projects of the Ulu Lehulehu program including: Teaching Change, ʻŌhiʻa Disease Resistance Program, the Puʻuwaʻawaʻa Community-Based Subsistence Forest Area, and the Indigenous Drought Knowledge Synthesis. In 2020, the Akaka Foundation for Tropical Forests ʻohana grew to include five full-time staff, five part-time employees and three part-time interns who support these various programs.

Ulu Lehulehu was conceived in 2012 by James Akau, who combined the root words ULU, meaning to grow, spread, and protect, and LEHULEHU, meaning numerous, innumerable, and a multitude. Collaboratively led by the HETF/USFS and the Akaka Foundation of Tropical Forests (https://akakaforests.org/projects/ululehulehu), this project supports a thriving partnership with AmeriCorps, Kupu, and Laupāhoehoe Community Public Charter School (LCPCS). Focused on teaching students about the importance of intimately knowing native species, student participants engage Indigenous Hawaiʻi lifeways to help reconnect with and better understand their places. The Ulu Lehulehu program bridges multiple knowledge systems and engages community to develop and strengthen people's relationships with their places through: 1) youth education, 2) community outreach, 3) native forest restoration, and 4) urban forestry.

The Teaching Change Partnership

Based out of Hilo, Hawaiʻi, Teaching Change aims to inspire local youth to be environmental stewards and to pursue post-secondary education and follow careers in Hawaiʻi in natural resource management. Teaching Change is co-led by the USDA Forest Service, University of Hawaiʻi at Mānoa, and the Akaka Foundation for Tropical Forests, and partners with Hakalau Forest National Wildlife Refuge, Center for Getting Things Started, and the HETF. In 2020 we began offering virtual huakaʻi, and adapted our field courses to support the learning objectives of our various STEM-based education programs. We reached 68 students and seven teachers through our online programs. This includes a two-week hybrid online/in-person summer course for Kohala Middle School. This program focused on improving environmental literacy and career-connected learning in students through a series of presentations on various environmental science topics and introducing students virtually to local conservation professionals. We also had the opportunity to provide two socially distanced field courses with students to learn about native flora and fauna and connect with nature. In 2020, Teaching Change also launched the first half of two, one-year long programs: the NEON program run in collaboration with Hilo

High School, and a Professional Development Pathways Program developed for Kea‘au High School. These programs also focus on biocultural learning and career connected learning, but dive deeper into topics through a year-long format.

Ōhi‘a Disease Resistance Program (ODRP)

The ‘Ōhi'a Disease Resistance Program (ODRP) was established in 2018 to identify ROD-resistant ‘ōhi‘a with the goal of producing disease-resistant plants for restoration of native forests, landscaping, and the perpetuation of ‘ōhi‘a in our biocultural landscapes. In 2020 we continued to support the ‘Ōhi‘a Disease Resistance Program (ODRP), hiring Blaine Luiz full-time in April 2020 to serve as the Program Coordinator. With financial support from USDA Forest Service and the Hawai‘i Community Foundation, Foundation and USFS staff and interns helped to lead this research and development effort including landscape sampling designs, collection of ‘ōhi‘a cuttings and seed, phenology measurements and greenhouse care from preparing fresh cuttings from ‘ōhi‘a trees to be rooted to preparing older plants for screening.

Pu‘uwa‘awa‘a Community-Based Subsistence Forest Area (P-CBSFA)

The Pu‘uwa‘awa‘a Community-Based Subsistence Forest Area (P-CBSFA) is an 84 acre project area on the Pu‘uwa‘awa‘a cinder cone that is the site of collaborative, multi-generational, multi-ethnic, and multi-talented community-based restoration. The PCBSFA, committed to perpetuating practices of aloha ‘āina at Pu‘uwa‘awa‘a, is a growing partnership of multi-generational community leaders, nonprofit organizations, and agencies working to transform 84-acres of pastureland into native dryland and mixed-mesic forest in Pu‘uwa‘awa‘a, foster biocultural education for K-12 students, and enhance community wellbeing. The PCBSFA represents an extension of community-based subsistence fishing areas from the marine realm to the terrestrial realm, and so may come to represent a model for how to collaboratively develop and implement community-based natural resource management. The PCBSFA Hui Nui, or working group, made significant progress in the development of a community-based Stewardship Plan. Hawai‘i Game Management LLC completed fencing of the 84-acre project area in June, 2020 and installed four gates to ensure ease of access for the community. The Hui Nui contracted *Geometrician Associates* to create a web application which features a searchable interactive map that details resources and history of the Pu‘uwa‘awa‘a. Maps were divided into “story maps” with a lot of narrative and the working maps, each with its own URL. Application users can easily switch back and forth between them.

Working maps are found here:
https://cardnotec.maps.arcgis.com/apps/webappviewer/index.html?id=e43bf8791f254a66ac3df211290bf245

Narratives can be found here:
https://cardnotec.maps.arcgis.com/apps/MapJournal/index.html?appid=a42147c236a143cca4ae7a6c2b68bbc3#

HETF Webinar Series

The HETF webinar series was developed in 2020 during the pandemic as a way for researchers to fulfill a permit condition, requiring HETF researchers to "give back to the community". Moving to a virtual platform allowed for a broader number of participants to attend. In 2020, the HETF hosted six webinars:

June 2020	**Community-Managed Forests in Hawai'i**	By: Rebekah Ohara (Purdue University, Forestry and Natural Resources Department and Akaka Foundation for Tropical Forests)
July 2020	**Bio-cultural approach to place-based conservation at Pu'uwa'awa'a**	By: Liana Macdonald-Kainoa (DLNR-DOFAW)
Aug 2020	**Establishment and parasitism of a biological control agent**	By: Dr. Ellyn Bitume (USFS)
Sept 2020	**Researching 'Ōpe'ape'a (Hawaiian hoary bat) A Focus on the Laupāhoehoe Area**	By: Julia Hoeh (USGS)
Oct 2020	**Examining spatiotemporal variation in climate on forest growth and mortality**	By: Dr. Ian Ware (USFS)
Nov 2020	**Effect of geologic evolution of Hawai'i on formation of new spider species**	By: Dr. Darko Cotoras (California Academy of Sciences)

HETF webinars can be viewed here:
https://www.youtube.com/channel/UCMJhMJYQbDb0rZ211V_7l1A/featured

Laupāhoehoe Unit

There were no visits to the Laupāhoehoe Unit in 2020.

Pu'uwa'awa'a Unit

One hundred and eighteen participants on 4 trips visited the Pu'uwa'awa'a Unit in 2020 prior to the shutdown due to the global pandemic. 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 2016-2020 is detailed in Figure 3. The 2020 HETF education trips to Pu'uwa'awa'a included South Dakota School, Cub Scouts, the Sierra Club and UH Hilo.

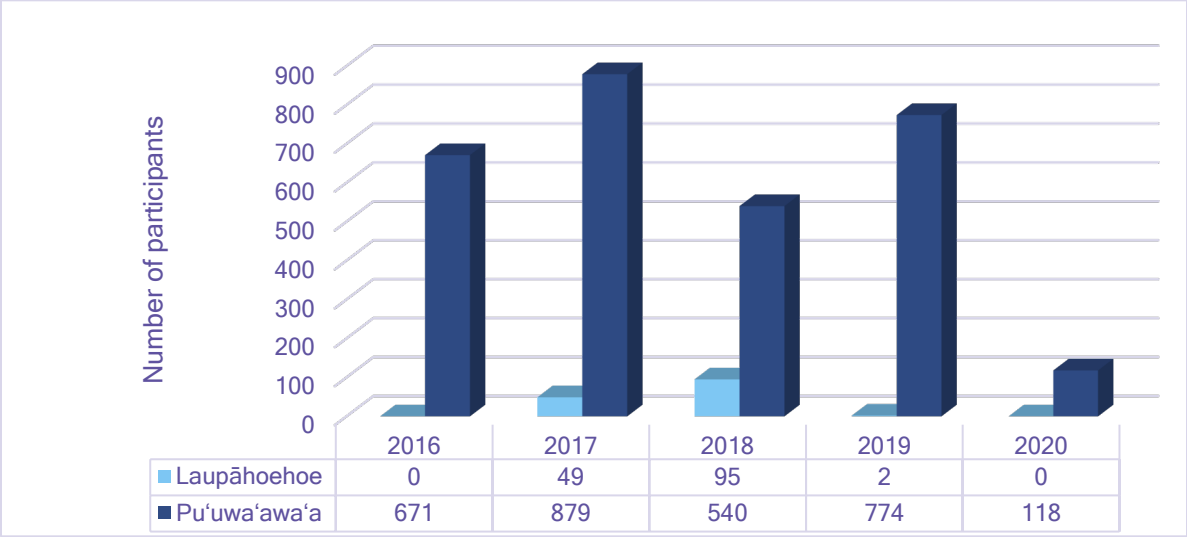


Figure 4: Number of participants to visit the HETF from 2016-2020

Kahikina Learning Center (KLC)

Twenty-five participants visited the Kahikina Learning Center (KLC) on a variety of trips. The 2020 activities included, overnight use by USGS-PIERC Avian Malaria Genomic Research Project members, day use by USFS, and land use by Kupu and the Laupāhoehoe Community Emergency Response Team (CERT).

Organization/Project	Participant Age	Activity Description	Dates	# of People
Facility Use - Day				
USFS/IPIF	Adult	Team retreat to discuss the HIPPNET Project	3/10/2020	6
Facility Use - Overnight				
USFS/IPIF	Adult	Bram Gunther - NYC Parks (retired)	1/19-2/1/2020	1
USGS-PIERC/Avian Malaria Genomic Research Project	Adult	Research group conducting avian malaria research activities within the Laupāhoehoe HETF Unit. The field crew is based out of Hawaii Volcanoes Nation Park and will be conducting research activities in the early morning and into the afternoon. Lodging at the ʻŌhiʻa House will allow for easy access to field research sites.	2/18-2/21/2020	4
Land Use				
Kupu	Adult	Hawaii Island January CLDP cohort service project at Kupuaʻe - learning about the area, moʻolelo, mālama ʻāina, weeding and caring for the common garden.	1/22/2020	12
Laupāhoehoe Community Emergency Response Team (CERT)	Adult	Use of driveway and parking lot for ham radio practice.	3/8/2020	2

CLIMATE DATA SUMMARY

Monitoring the climate of the HETF units and being able to relate the climate and any climate change to the ecology of the HETF is a major goal of the experimental forest. This section contains available summary data for the HETF climate stations located within the Forest Reserve in Laupāhoehoe, Māmalahoa and the Forest Bird Sanctuary in Pu'uwa'awa'a and associated with the Hawai'i Permanent Plot Network (HIPPNET), http://www.hippnet.hawaii.edu/.

Laupāhoehoe

Mean annual rainfall, temperature, and relative humidity at Laupāhoehoe, 2016 – 2020 (standard errors in parenthesis).

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

YEAR	Rainfall (mm)	Temperature (C°)	Relative Humidity (%)
2020	4003	16.2 (±0.4)	85.3 (±1.3)
2019	3010	16.7 (±0.6)	84.9 (±1.0)
2018	5250	16.7 (±0.4)	87.3 (±1.0)
2017	4261	16.5 (±0.4)	88.1 (±1.6)
2016	4613	16.1 (±0.3)	90.3 (±1.2)
Mean	4227 (±397)	16.4 (±0.1)	87.2 (±1.0)

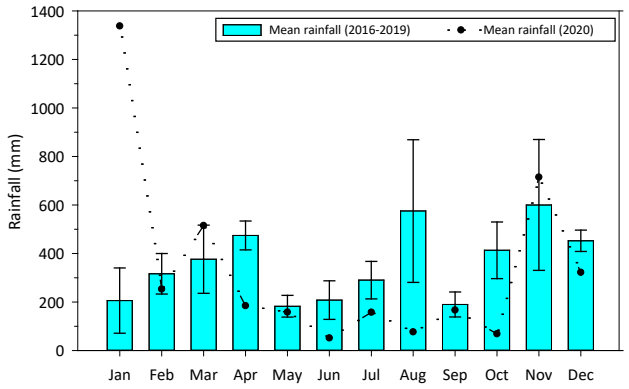


Figure 5: Mean rainfall for 2016-2019 compared to 2020 in Laupāhoehoe.

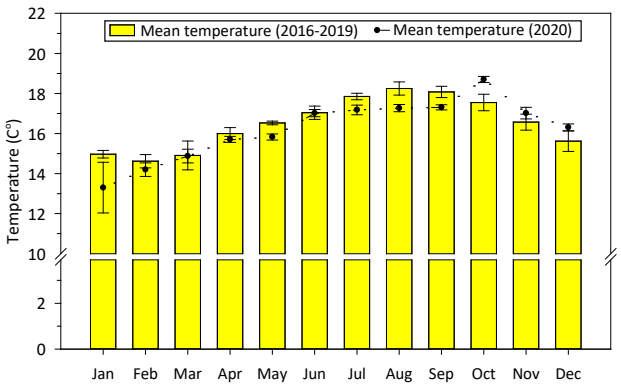


Figure 6: Mean temperature for 2016-2019 compared to 2020 in Laupāhoehoe.

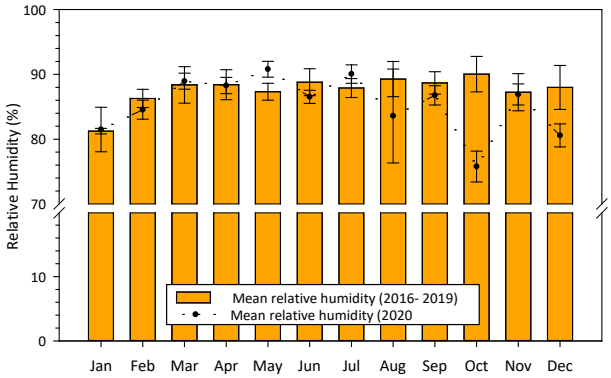


Figure 7: Mean relative humidity for 2016-2019 compared to 2020 in Laupāhoehoe.

Pu‘uwa‘awa‘a

Mean annual rainfall, temperature, and relative humidity at PWW sub-units (standard errors in parenthesis). Rainfall mean is for 2016-2020.

Māmalahoa

Table 3: Mean annual rainfall, temperature, and relative humidity at Pu‘uwa‘awa‘a, Māmalahoa climate station.

YEAR	Rainfall (mm)	Temperature (C°)	Relative Humidity (%)
2020	942	20.0 (±0.4)	81.3 (±0.6)
2019	695	20.4 (±0.5)	80.3 (±0.9)
2018	621	21.3 (±0.5)	80.1 (±1.4)
2017	288	20.6 (±0.5)	77.5 (±0.7)
2016	644	20.7 (±0.5)	78.1 (±0.9)
Mean	638 (±104)	20.6 (±0.2)	79.5 (±0.7)

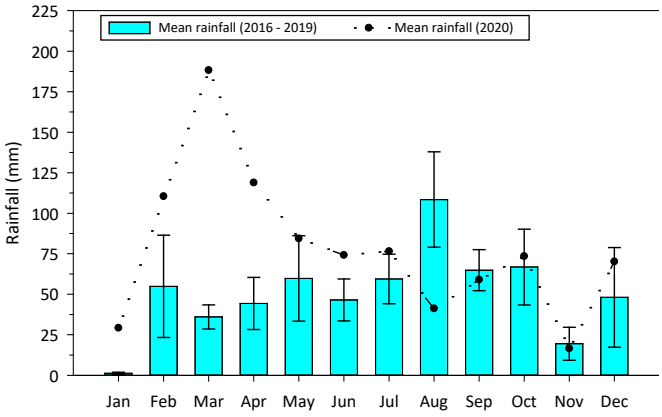


Figure 8: Mean rainfall for 2016-2019 compared to 2020 at Māmalahoa.

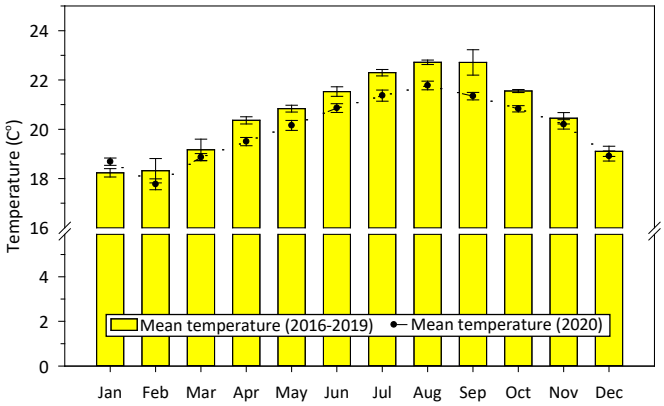


Figure 9: Mean temperature for 2016-2019 compared to 2020 at Māmalahoa.

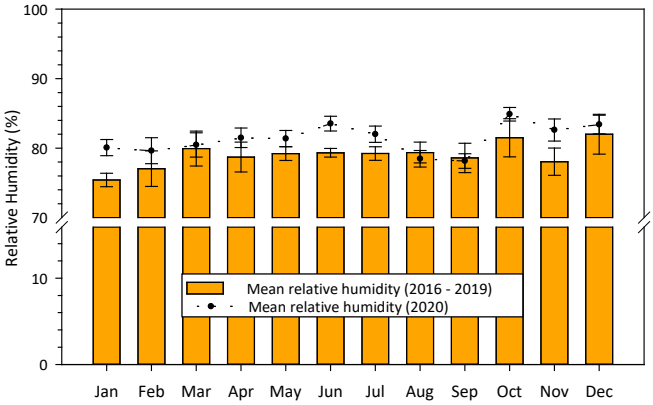


Figure 10: Mean relative humidity for 2016-2019 compared to 2020 at Māmalahoa.

Table 4: Mean annual rainfall, temperature, and relative humidity at the Forest Bird Sanctuary. *Rainfall mean is for 2017-2020, 2016 is excluded due to equipment malfunction.

YEAR	Rainfall (mm)	Temperature (C°)	Relative Humidity (%)
2020	1149	14.5 (±0.3)	81.8 (±1.2)
2019	1105	14.7 (±0.6)	85.3 (±1.3)
2018	1365	15.0 (±0.3)	82.3 (±2.1)
2017	900	14.5 (±0.3)	81.5 (±2.4)
2016	699*	14.5 (±0.4)	84.6 (±2.0)
Mean	1130 (±95)	14.6 (±0.1)	83.1 (±0.8)

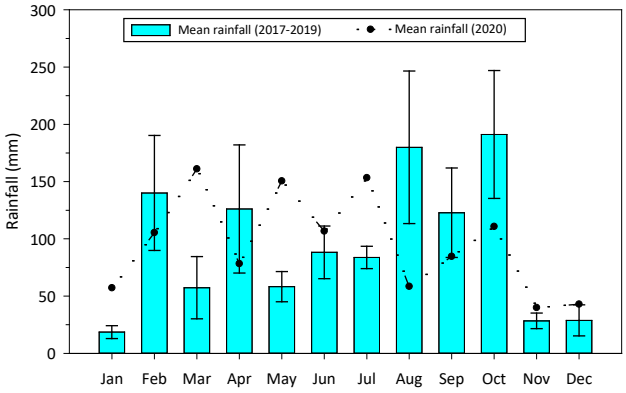


Figure 11: Mean rainfall for 2016-2019 compared to 2020 in the Forest Bird Sanctuary.

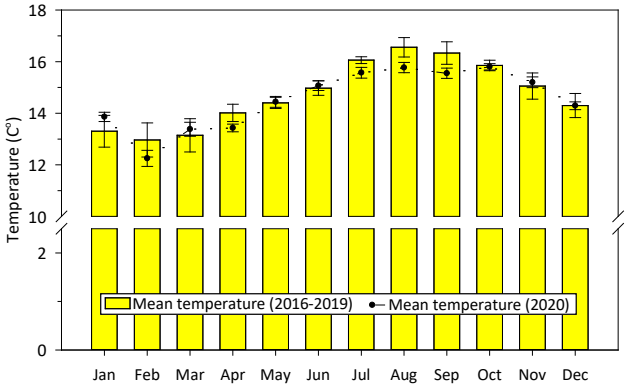


Figure 12: Mean temperature for 2016-2019 compared to 2020 in the Forest Bird Sanctuary.

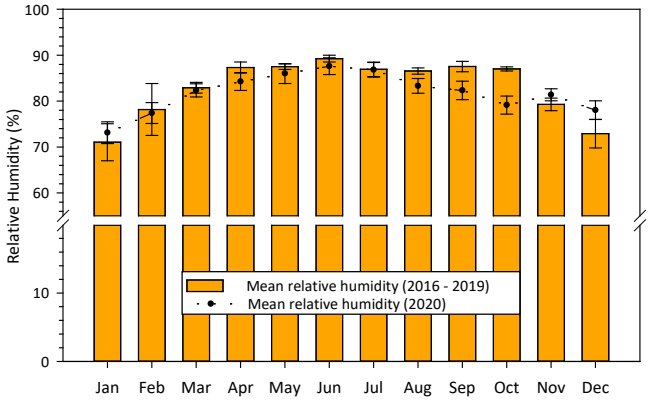
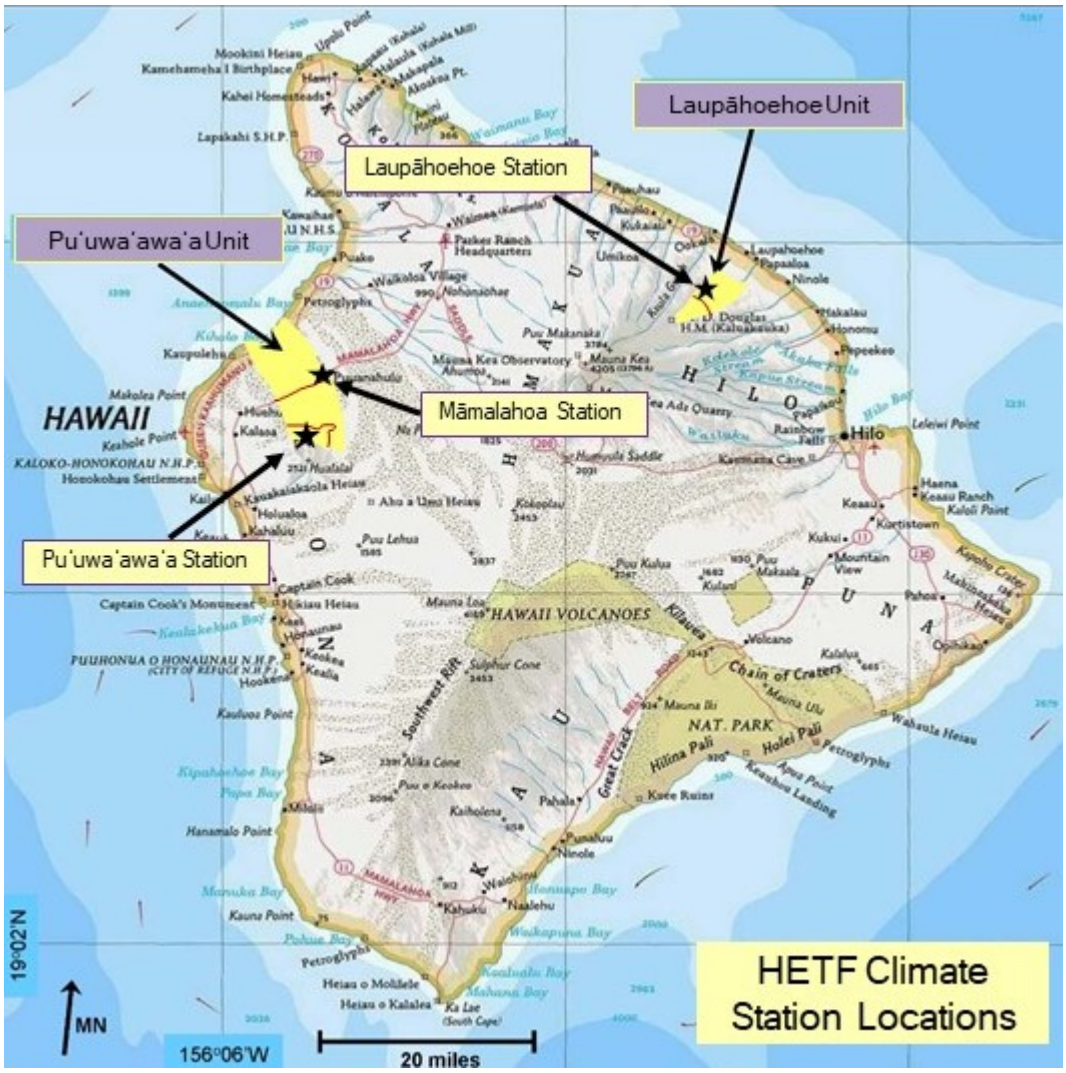


Figure 13: Mean relative humidity for 2016-2019 compared to 2020 in the Forest Bird Sanctuary.


Laupāhoehoe Unit
Laupāhoehoe Station
Pu'uwa'awa'a Unit
Māmalahoa Station
Pu'uwa'awa'a Station
HETF Climate Station Locations
HAWAII
HILO
PUNA
KAU
KONA
HAWAII VOLCANOES
NAT. PARK
Hilo
Kailua-Kona
Captain Cook
Volcano
Kilauea
Mauna Loa
Mauna Kea
Chain of Craters
Southwest Rift
Great Crack
Hilina Pali
Holei Pali
Waimea (Kamuela)
Honokohau Settlement
Kaloko-Honokohau N.H.P.
Puuhonua o Honaunau N.H.P. (City of Refuge N.H.P.)
Captain Cook's Monument
Kaupulehu
Puako
Kawaihae
Waikoloa Village
Parker Ranch Headquarters
Mauna Kea Observatory
Saddle Road
Hamakua Coast
Hilo Bay
Leleiwi Point
Kapoho Crater
Kalapana
Kalapana Black Sand Beach
Kalapana Lava Viewing Area
Kamoamoa
Kalapana Lava Flow
Kalapana Lava Flow Viewing Area
Kalapana Lava Flow Viewing Area
Kalapana Lava Flow Viewing Area

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 for a complete list of citations received to date.

Submitted with 2020 annual reports:

Bateman, J.B, P.M. Vitousek, and S. Fendorf, submitted. Climatic controls on Fe/Al solid phase dynamics and organic matter stabilization in volcanic soils. Geochimica et Cosmochimica Acta.

Duncan N. L. (+80 authors including Susan Cordell and Christian Giardina) 2019. Nitrogen-fixing trees are rare in the Asian tropics compared with the Neotropics. Journal of Ecology; 107 (6): 2598-2610 https://doi.org/10.1111/1365-2745.13199.

Giardina, C.P. Advancing Our Understanding of Woody Debris in Tropical Forests. Ecosystems 22, 1173–1175 (2019). https://doi.org/10.1007/s10021-019-00381-x

Kennedy, S.R., Prost, S., Overcast, I. *et al.* High-throughput sequencing for community analysis: the promise of DNA barcoding to uncover diversity, relatedness, abundances and interactions in spider communities. *Dev Genes Evol* 230, 185–201 (2020). https://doi.org/10.1007/s00427-020-00652-x

Litton, CM, Giardina, CP, Freeman, KR, Selmants, PC, Sparks, JP. 2020. Impact of Mean Annual Temperature on Nutrient Availability in a Tropical Montane Wet Forest. Frontiers in Plant Science https://www.frontiersin.org/articles/10.3389/fpls.2020.00784/full

Medeiros, C*; Scoffoni, C; John, G; Bartlett, M; Inman-Narahari, F; Ostertag, R; Cordell, S; Giardina, C; Sack, L. 2019. An extensive suite of functional traits distinguishes wet and dry Hawaiian forests and enables prediction of species vital rates. Functional Ecology, 33: 712-734.

Montoya-Aiona, K. M., F. A. Calderon, S. P. Casler, K. N. Courtot, P. M. Gorresen, and J. P. S. Hoeh. 2020. Hawaii Island, Hawaiian hoary bat roosting ecology and detection 2018-2019. U.S. Geological Survey data release, https://doi.org/10.5066/P9R95UYT.

Pau, S. Cordell, S. Ostertag, B. Sack, L., Inman, F. 2020. Climatic sensitivity of species' vegetative and reproductive phenology in a Hawaiian montane wet forest. Biotropica. https://doi.org/10.1111/btp.12801.

Pierre, S, Litton, CM, Giardina, CP, Sparks, JP, Fahey, TJ. 2020. Mean annual temperature influences local fine root proliferation and arbuscular mycorrhizal colonization in a tropical wet forest. Ecology and Evolution.; 00: 1–12. https://doi.org/10.1002/ece3.6561