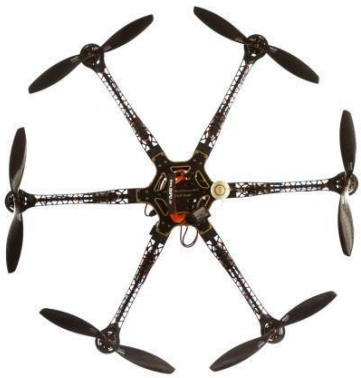
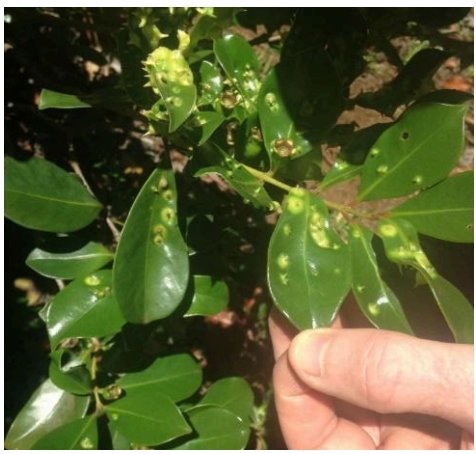
The 5th Annual Oahu Natural Areas Restoration and Weed Management Forum

March 22, 2018, 08:00 a.m. – 04:00 p.m.
Aloha Stadium, Honolulu, HI





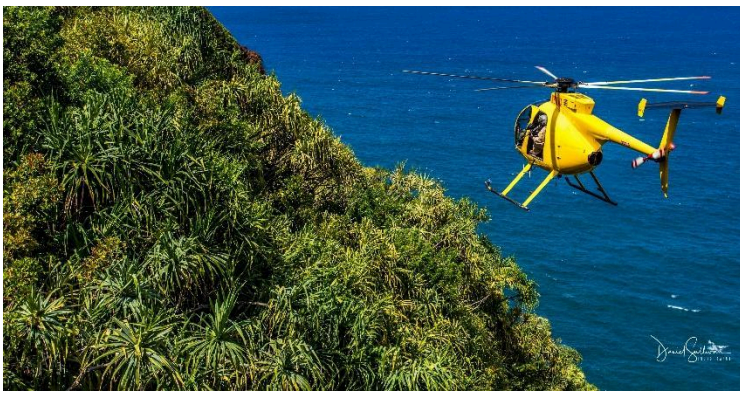
Presented by:
Division of Forestry and Wildlife (DOFAW/DLNR)
Hawaii Agriculture Research Center (HARC)
Koolau Mountain Watershed Partnership (KMWP)
Natural Resources and Environmental Management (NREM)
Oahu Army Natural Resources Program (OANRP)
Oahu Invasive Species Committee (OISC)
ʻŌhulehule Forest Conservancy, LLC (OHU)
Waimea Valley, Hi`ipaka LLC. (WMV)

AGENDA

0730	**Welcome and Sign in**	
0800	Introduction	*Weed Spreadsheet Updates*
0830*	Dudley et al.	*Eco-regional Koa*
0855	Fujikawa et al.	*Remote Sensing UAV*
0920	Lewis et al.	*Kipapa Burn Response*
0945	Leary et al.	*Accelerating Koa*
1010	**Coffee Break**	
1020	Pool	*Waimea Valley Updates*
1045	Zweng	*Restoration in Waikane*
1110	Masters	*Time Budget*
1135	Marsh	*Restoration Weed Control*
1200	**Lunch**	
1300	Brosius et al.	*Tectococcus Release*
1330**	Breakout	*Monitoring*
1420	Breakout	*Native Plant Restoration*
1530	**Closing and Acknowledgements**	

* *10-min presentations +15-min discussion*

** *25-min group discussion +20-min summary*



Applied Genetic Conservation of Hawaiian *Acacia koa*: An Eco-Regional Approach

Nick Dudley[1], Tyler Jones[1], Robert James[2], Richard Sniezko[3], Jessica Wright[4], Christina Liang[5], Paul F. Gugger[6], Phil Cannon[7], Amanda Hardman[8]*

[1]Hawaii Agriculture Research Center, Kunia, HI, [2]Plant Disease Consulting Northwest, Vancouver, WA, [3]United States Department of Agriculture Forest Service, Dorena Genetic Resource Center, OR, [4]United States Department of Agriculture Forest Service, Pacific Southwest Research Station, Davis, CA, [5]United States Department of Agriculture Forest Service, Pacific Southwest Research Station, Hilo, HI, [6]University of Maryland Center for Environmental Science, Appalachian Laboratory, Frostburg, MD, [7]United States Department of Agriculture Forest Service, Forest Health Protection, Vallejo, CA, [8]Division of Forestry and Wildlife, Department of Land and Natural Resources, Pearl City HI

Koa (Acacia koa A.Gray) is a valuable tree species economically, ecologically, and culturally in Hawaii. A vascular wilt disease of Acacia koa (koa) caused by the fungal pathogen Fusarium oxysporum f. sp. koae (FOXY) causes high rates of mortality in field plantings and threatens native koa forests in Hawaii. Producing seeds with genetic resistance to FOXY is vital to successful koa reforestation and restoration. The Hawaii Agriculture Research Center (HARC), with both public and private partners, operates a tree improvement program to develop koa wilt resistant populations in Hawaii. The population genetics of koa are poorly understood across the broad range of habits that koa occupies and seed zones have not been sufficiently established. Thus, HARC estimates seed zones based on biogeographic variables and has selected wilt resistant koa populations for six ecological regions (eco-regions) in Hawaii. This conservative approach, based on planting locally sourced germplasm, is often a requirement of many restoration programs in the state. We further consider population genomic (single-nucleotide polymorphism) data in relation to the proposed eco-regions. Preliminary analyses suggest genetic differences among and within islands that are broadly consistent with eco-regions, but also suggest additional population differences that should be considered in genetic conservation of koa.

Remote sensing of invasive plants with unmanned aerial vehicles (UAV) and open-source computer vision software

Jean Fujikawa, Derek Ford, and Solomon Champion
Oahu Invasive Species Committee, Kailua, HI

Advances in technology, increasing amounts of imagery available, and the enthusiasm of two of our field crew led us to experiment with both drone surveys and computer-aided object detection for invasive species management in this past year. We experimented with a DJI Mavic Pro, DJI GO 4 flight software, and DroneDeploy for flight planning and processing orthomosaics. UAVs were most useful for miconia (*Miconia calvescens*) surveys on uluhe ridges where survey quality seemed equivalent to ground or aerial surveys and in residential areas. UAVs were also useful in locating the specific location of dead ʻōhiʻa trees when sampling for Rapid ʻŌhiʻa Death. We used OpenCV for computer-aided object detection and experimented primarily with fountain grass (*Cenchrus setaceus*) classifiers, but also tried classifiers for miconia. We created Python programs to identify some of our target species in single images, in a batch of images, and in videos. Future research would involve making the video review more automated,and collecting imagery specific to our target species as well as the image collection method to created better classifiers.

Native Forest Restoration in the Kipapa Burn Response Area: Management Update

Jordan Lewis, Dylan Davis, Will Weaver
Koolua Mountain Watershed Partnership, Honolulu, HI

In January 2015, a forest wildfire burned 180 acres of koa/ʻōhiʻa lowland mesic forest located between 1,000 ft. and 1,500 ft. elevation along the lower western boundary of the Oahu Forest National Wildlife Refuge. Within a year of the fire, a suite of woody weeds invaded the site or resprouted from burned stumps, including: albizia (*Falcataria mollucana*), broomsedge (*Andropogon* virginicus), paperbark tree (*Melaleuca quinquenervia*), gunpowder tree (*Trema orientalis*), shoebutton ardisia (*Ardisia elliptica*) and white moho (*Heliocarpus popayanensis*). KMWP received funding from the DOI Burned Area Emergency Rehabilitation (BAER) program for initial control work and weed mapping of the burned area [referred to as the Kīpapa Burn Response (KBR) area] during 2015. KMWP mapped

the affected area, identified invasive targets, designated subunits for management purposes, developed a management plan, and initiated invasive grass and woody target weed control to facilitate recruitment of native vegetation throughout the target area. Monitoring in the unit indicates that native vegetation is responding positively to continued weed control actions with further management needed. Paperbark (*Melaleuca quinquenervia*) was designated a high priority target weed for the KBR area during FY17 due to its aggressive domination of landscapes affected by fire and its ability to outcompete native vegetation with allelopathy exhibited by leaf litter. Control was ramped up in 2017 and treatment method trials are underway in 2018.

Accelerating the Restoration Trajectory of *Acacia koa*

Jeremiah R. Pinto[1], Anthony S. Davis[2], James J. K. Leary[3], Matthew M. Aghai[4]

Rocky Mountain Research Station, USDA Forest Service, Moscow, ID [1], College of Forestry, Oregon State University, Corvallis, OR [2], Department of Natural Resources & Environmental Management, University of Hawaii at Manoa, Kula, HI [3],School of Environmental and Forest Sciences, University of Washington, Seattle, WA [4]

Restoring Hawaii's native koa (*Acacia koa*, A. Gray) forests are top conservation and forestry priorities; providing critical habitat services and high-value timber products. Efforts to restore koa forests, however, are directly impeded by extensive kikuyu grass (*Pennisetum clandestinum* Hochst. ex Chiov.) swards occupying deforested montane landscapes. In separate field studies, we implemented diffrerent herbicide combination treatments for measuring grass suppression and koa seedling performance in naturalized (grass-dominated) mesic, montane sites on the Big Island and Maui. In the Maui experiment untreated plots were compared to suppression with a high-rate herbicide combination of imazapyr and glyphosate (1.7 kg a.i. ha^{-1}, respectively), administered 30 days pre-plant. Across all treatments, seedling survival was high (>95%). Grass suppression resulted in trees that were 34% taller with 66% larger root-collar diameters, 30 months after planting. Corresponding to the larger sizes, were significantly higher leaf area indices (2.6 vs. 1.8 m^2 m^{-2}), indicative of higher

photosynthetic capacity and canopy closure. Grass suppression also increased soil temperature and soil moisture in the first year, followed by a dramatic drop in soil moisture on the second year, which corresponded with an apparent log-phase growth response of koa after the first year of establishment. This is a first report of koa (a leguminous species) tolerance to a high-rate, pre-plant application of the herbicide active ingredient imazapyr. A similar experiment on the Big Island compared untreated plots against grass suppression with grass selective herbicide active ingredient fluazifop-p-butyl applied every four months for a total of five treatment applications in 20 months. We measured >70% decline in the stolon fraction after 20 months as a result of the successive applications. Furthermore, we also measured ~2-fold increase in basal diameter and canopy height of 12-month old koa saplings with the post-plant fluazifop regiment compared to the untreated control. The results of the experiments support the utility of the herbicides in grass suppression. Imazapyr and glyphosate are broad-spectrum herbicides, but are typically the most effective grass control options. There is potential for collateral injury from these herbicides if not scheduled properly in a restoration plan. Fluazifop-p-butyl is one of the few options for selective grass control in natural area restoration. It shows excellent performance as a post-plant suppression/maintenance strategy on monotypic swards of kikuyu grass positively contributes to an accelerated restoration tactic restoring koa canopy. This data was submitted in an application package by Syngenta Corp. to the Hawaii Department of Agriculture to petition for a FIFRA Sec. 24c Special Local Needs Registration for controlling invasive grass species in wildlands and restoration areas in Hawaii. The study on imazapyr and glyphosate can be referenced by searching Pinto, J. R., Davis, A. S., Leary, J. J., & Aghai, M. M. (2015). Stocktype and grass suppression accelerate the restoration trajectory of *Acacia koa* in Hawaiian montane ecosystems. *New Forests*, *46*(5-6), 855-867.

Conservation Updates from Waimea Valley

Laurent Pool
Waimea Valley / Hi`ipaka LLC, Hale`iwa HI

Since the 2008 acquisition of the 1,875-acre parcel of land on the North Shore of O`ahu, Hi`ipaka LLC has developed a functional and growing

conservation program. The program currently has 3 sites to manage. Progress updates on all 3 sites highlight challenges and successes. The Forest Stewardship Management Plan has been briefly outlined. Data is presented showing overall trends of plantings, ungulate control, volunteer involvement, and restoration efforts. Available funding sources for private landowners are also discussed. A brief guide to the "home grown" style of conservation is described and includes; native plant fruiting schedules, nursery management, site preparation, out-planting and site maintenance.

Native Hawaiian Forest Restoration at Koa Ridge, Waikāne Valley, windward Koʻolau Mountains, Oʻahu: A Progress Report

Paul L. Zweng
ʻŌhulehule Forest Conservancy, LLC

Waikāne forest restoration projects occur in mesic-to-wet, low-to-mid elevation (~400-800 ft) ridges and gullies located in the northern portions of Waikāne Valley, windward Koʻolau Mountains, Oʻahu. The native plant communities here have been largely degraded whereas more intact native plant communities still survive at higher elevations. A botanical survey conducted by Joel Lau (2012) recorded 97 native taxa including 31 trees, 19 shrubs, and 11 ground cover/herbs, 4 vines and 32 ferns/fern allies. Rare plants include haiʻwale (*Cyrtandra kaulantha* and *Cyrtandra subumbellata*). Remnant native forest on ridges and slopes are dominated by ʻōhiʻa, koa, kōpiko, ʻahakea, and lama trees. The common invasive plants occurring on ridges and upper slopes within the restoration sites include albizia, strawberry guava, shoebutton ardisia, octopus/umbrella, and white moho (trees); *Clidemia* and *Asteraceae* sp. (shrubs/ subshrubs/herbs), alien grasses such as basket grass and Hilo grass as well as alien ferns such as *Cyclosorus parasiticus*. "Search and destroy" sweeps in 2012-2017 have killed 1,552 albizia and 2,912 octopus trees, helping to mitigate their spread. Forest restoration at Koa Ridge has been conducted at ten sites, each occurring in close proximity to one or more "old growth" koa trees, using variations on the following steps: (1) Girdle/treat the largest of the strawberry guava trees as well as the numerous <1-inch wide saplings, thus removing 20-25% of the alien canopy. (2) After ~40 days, cut down and slash the girdled/treated alien trees. (3) Construct "steps" or "terraces" on the

steeper portions of ground using the harvested trunks to facilitate walking, mitigate ground disturbance/erosion, and to hold organic matter in place. (4) Out-plant ground cover plants (*e.g.,* Carex, ʻukiʻuki, *Gahnia beecheyi*, and ʻahaniu as well as palaʻā and ʻōkupukupu ferns). (5) Out-plant native shrubs (*e.g.,* ʻilima, koʻokoʻolau, naupaka kuahiwi, kokiʻo ʻula) and native tree seedlings (*e.g.,* ʻōhia, kōpiko, hōʻawa, ʻahakea, lama, and lesser number of hala pepe, hao, hōlei, and ʻohe mauka) in clusters. Anticipate koa seedlings sprouting naturally in 2-4 months after initial removal of alien trees. (6) At start of 2nd year, remove another 25-50% of the alien canopy depending on growth of the native ground cover. (7) At start of 3rd year, remove all remaining alien canopy if ground cover plants are firmly established and fully grown. (8) Weed alien grasses, ferns, shrub, and tree seedlings/sporelings on a regular basis to keep weeds under control during (3)-(7). The gradual removal of alien canopy over a 3-year period results in significantly lower weed pressure compared to single-event canopy removal. Newly sprouted shoe button ardisia and strawberry guava seedlings are common for an initial 6-9 month period, but thereafter drop significantly. Albizia and white moho sprouts are common until groundcover plants become established. Clidemia, despite being uncommon in most understories of strawberry guava thickets, begins to appear 2-4 months after initial removal of alien trees. The appearance of Asteraceae sp. weeds and grasses are common, but not abundant, and then decreases as ground cover and other native plants provide increasing amounts of shade to the site.

Monitoring on a Time Budget

Jenna Masters
Division of Forestry and Wildlife, Department of Land and Natural Resources, Pearl City HI

In programs with smaller staff and time constraints committing to a monitoring plan can be a daunting. Monitoring can be used evaluate program goals, management effectiveness and is often needed for reporting on grant deliverables. Finding a way to get reliable data while operating in a restricted time budget is one of the goals of this plan. NEPM wanted to assess two things; change in management areas over time and survivorship of ex-situ species in the Pahole Natural Area Reserve. One of our main challenges is to determine survivorship in species planted with fluctuating amounts of individuals. Some

species have too many to monitor every year while others have too few. To increase the sample size of plants with too few individuals our monitoring plan will span multiple years. Monitoring will continue until 2021 where we should have up to 100 individuals from each plant species. This long-term monitoring reduces monitoring time per year while providing a larger sample sizes. We will be monitoring our first cohort of plants that were introduced in 2017 this year. Photo point monitoring is used to asses change over time. Unfortunately, photos can only be representative of the areas pictured and cannot accurately assess the area as a whole. We would like to assess the difference between weed management techniques. Two common techniques include the removal of invasive by clear cutting vs. slow killing of an area. What we can determine is the amount of time and effort spent in each area and compare them to how the pictured areas have changed over time. We would like to brainstorm more ways to monitor on a time budget and think this would make a great break out topic.

Native Ecosystem Restoration as Weed Control

Taylor Marsh
Oahu Army Natural Resources Management Program, Wahiawa, HI

Although conservation agencies across the state have differing goals, one commonality exists: the need for ongoing control of invasive plants. What agencies replaced controlled weeds, or entire treated areas, with native plants via active restoration? Would this reduce the amount of weeds which occur in treatment areas over time? It is difficult to know if active restoration works, and there are a number of differing factors to consider that might make restoration efforts difficult or even unnecessary. In Hawai‘i, mostly qualitative observations about this have been made during restoration efforts, but it is nevertheless important to consider replacement strategies after the removal of weeds, as there are potentially some significant direct and indirect benefits to using the technique. At the O‘ahu Army Natural Resources Program (OANRP), efforts are currently underway to restore three alien-dominated mesic forest sites in the Wai‘anae Mountains to native-dominated understory and canopy. At these restoration sites, anecdotal information suggests that active restoration effort is effective and worthwhile, but also reveals lessons learned and associated challenges. This presentation

is intended to show restoration successes, promote discussion and, create and perpetuate momentum for more restoration projects in the future.

Early Movements of *Tectococcus ovatus*, a *Psidium cattleianum* Biocontrol, in West Maui and Oahu

Chris Brosius[1], Amanda Hardman[2], Will Weaver[3]
[1]West Maui Mountain Watershed Partnership, Lahaina, HI, [2]Division of Forestry and Wildlife, Department of Land & Natural Resources, Pearl City, HI, [3]Koolua Mountain Watershed Partnership, Honolulu, HI

Non-native, habitat modifying *Psidium cattleianum* (strawberry guava) is currently among the greatest threats to the watershed and health of native ecosystems on the Hawaiian Islands. In Hawaii, strawberry guava thrives between sea level to 4000' and satellite populations are observed at greater elevations. *P. cattleianum* was brought to Hawaii in 1825 from Brazil as an ornamental plant. It is extremely fast growing, resilient, animal and bird dispersed, monotypic, and water thirsty. An integrated management approach will be needed to control the spread given its aggressive use of habitats over challenging terrain. In West Maui, approximately 5,000 acres are already monotypic (~10% of the entire WMMWP area). Habitat modeling suggests this species has the ability to invade the entirety of the West Maui watershed if left unchecked. Almost the entire landmass on Oahu sits below 4000' and is susceptible to invasion. Strawberry guava is one of the top causes for the destruction of the native mesic forest in the Waianae range and is currently a serious threat to the upper elevations of the wetter Koolau summit watersheds. Landscape level control methods are needed to prevent further invasion. This presentation will summarize establishment efforts of the biological control agent, *Tectococcus ovatus,* on the Island of Oahu and focus on early lessons learned regarding the establishment of the biological control in West Maui. We will explore potential *T. ovatus* translocation methods to help accelerate the spread of the species and propose integrated strategies which may further future *P. cattelianum* control efforts.

BREAKOUT SESSIONS

. Monitoring:

A. What are people monitoring?
A. Why are people monitoring?
    1. For grant deliverables
    2. For adaptive management
B. What are some of the research questions being asked?
C. What techniques are used?
D. What are some challenges that have been found?
E. How do you determine
    1. When to stop monitoring?
    2. When to restart monitoring?
    3. The acceptable level of rigor?'
F. What technology tools are used for monitoring? (apps)

I. Common native plant use in restoration:

A. What habitat type are you working in?
A. What type of restoration is being done?
B. What are you trying to accomplish?
C. What tools are being used?
D. What are some challenges have you faced?
E. What are your next steps?

Moderator Name:

_____

Topic title:

_____

Number of people in group:

_____

Organizations in group:

_____

Please use the space below to note **highlights**, **challenges**, and **future needs**. This information will be shared at the end of the breakout session with the other groups.

Master of Science "Plan C" Program in Natural Resources & Environmental Management

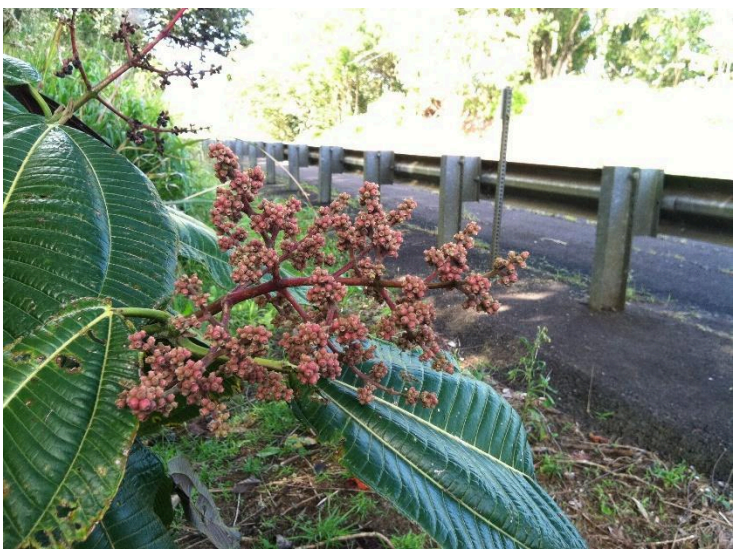
Do you have at least 5 years of professional experience in natural resource management and a BS degree? You may qualify for our Plan C MS degree program in Natural Resources and Environmental Management. Develop formal decision-making skill sets, evaluate policy & economic impacts, manage uncertainty, model dynamic systems, set priorities & implement adaptive management strategies, manage for climate change, improve stakeholder engagement. 18 credits of course work (9 core, 9 elective) may be **completed in as little as ONE YEAR** of full-time enrollment or may be taken over 2–3 years with one or two classes per semester

Application Details go to:
https://cms.ctahr.hawaii.edu/nrem/GRADUATE.aspx
or contact Graduate Chair Dr. Kirsten Oleson by email: koleson@hawaii.edu or by phone: (808) 956-7333.

Master of Science in Tropical Conservation Biology and Environmental Science

The primary purpose of the Master of Science in Tropical Conversation Biology and Environmental Science is to provide graduate training in conservation biology and environmental science to those with baccalaureate degrees and those currently working in the field. The program will utilize the extraordinary biological, physical, and cultural complexity of the island of Hawai‘i as a focus of investigation and study. The program will prepare students for technical positions and for entry into Ph.D. programs in related fields.

Application Details go to:
http://tcbes.uhh.hawaii.edu or contact Program Chair Dr. Rebecca Ostertag by email: ostertag@hawaii.edu or by phone: 808-932-7573.



Hauʻoli Mau Loa Foundation
Graduate Assistantship Opportunities

Hauʻoli Mau Loa Foundation (*www.hauolimauloa.org*) the Department of Natural Resources and Environmental Management (NREM) at the University of Hawaiʻi at Mānoa (UHM) and and the Tropical Conservation Biology and Environmental Science (TCBES) Graduate Program at the University of Hawaiʻi at Hilo (UHH) are pleased to announce the availability of three graduate assistantships for local students dedicated to careers in natural resource management in the state of Hawaiʻi. Each assistantship comes with generous support for two years (2nd year pending satisfactory academic performance), including a Graduate Assistantship salary ($20,472/year plus fringe benefits), a full tuition remission, and $5,000 in professional development funds (books, fees, travel to local and national conferences, supplies, etc.).

The following eligibility criteria apply: (i) good academic standing (minimum GPA of 3.0 prior to and throughout the assistantship); (ii) from Hawaiʻi, as evidenced by graduating from a Hawaiʻi high school; (iii) pursuing a M.S. Plan B degree in NREM; (iv) track record of supporting Hawaiʻi's environment (e.g., internships, volunteer opportunities, etc.) and serving in a leadership capacity (academic, athletic, extracurricular, and/or professional); and (v) commitment to pursuing and attaining a long-term career in natural resource management in Hawaiʻi.

Application Details:
For applications details go to
https://cms.ctahr.hawaii.edu/nrem/GRADUATE/HML.aspx
or
http://tcbes.uhh.hawaii.edu/documents/student_info_docs/UHH-HauoliMauLoaFndtnGAshipAnnouncementTCBESforFall2018.pdf
Application deadlines is March 1, of each year for NREM and December 1 or each year for TCBES. Successful applicants are expected to be enrolled by August of each year. For more information please contact Dr. Mehana Vaughan (NREM) at (808-956-6004; mehana@hawaii.edu) or Dr. Rebecca Ostertag (TCBES) at (808-932-7573; ostertag@hawaii.edu).

Unmanned Aerial Systems Training Course

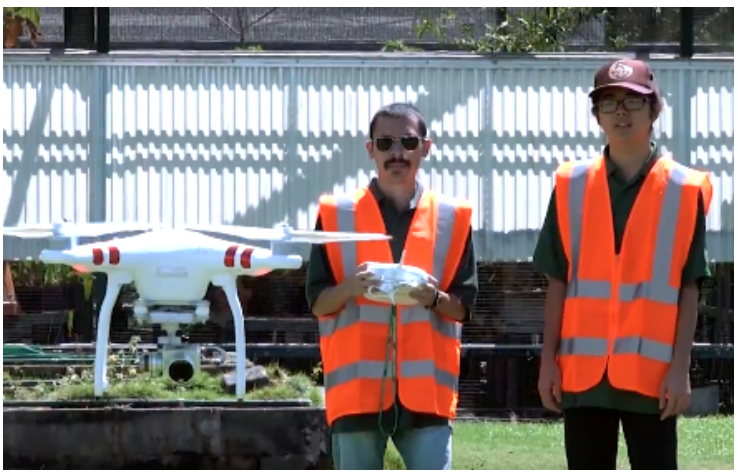
Hosted by the Aeronautical Science Program at the University of Hawai'i at Hilo

This is a four-week course on small Unmanned Aerial Systems (sUAS). This training will consist of three weeks of online lectures to prepare students to take the FAA Remote Pilot Exam and three days of flight training. Topics covered include: sUAS regulations, airspace, aviation weather, UAS performance and operation. Flight maneuvers include: pattern flying, takeoff, landing, emergency maneuvers, and autonomous operation.

Date: Summer Session I (May 21-June 15)

Cost: $695

This course will be offered through the UH Hilo College of Continuing Education and Community Service (CCECS). For more Information about how to register for this course please contact Arthur Cunningham by email: awc8@hawaii.edu or phone: 808-932-7341



This workshop is sponsored in part by The Hawaii Invasive Species Council Award POC 40466, the USDA Forest Service Special Technology Development Program Award R5-2017-01. USDA Hatch Act Formula Grant Project 1132, and USDA Renewable Resources Extension Act.

Notes:
Please share your notes, comments or questions for each of the presenters online

Notes continued:

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