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Revitalizing Action on the 2017-2027 Hawai'i Interagency Biosecurity Plan. Chelsea Arnott, *Hawai'i Invasive Species Council*

In 2017, the Hawai'i Department of Agriculture launched the 2017-2027 Hawai'i Interagency Biosecurity Plan (HIBP), a multi-sector analysis of biosecurity and invasive species program needs throughout the State. The HIBP approaches the concept of biosecurity from a comprehensive perspective that includes 147 action items that, if implemented, addresses pre-border, border, and post-border needs to mitigate costs associated with invasive species. As of January 2023:

- 68% of the action items have been initiated;
- 39% have been "completed" or are "ongoing in perpetuity;"
- 29% have been initiated, however many are not progressing; and
- 32% of the actions have not been initiated or require re-evaluation.

The HIBP is now halfway through its 10-year timeline and there is an opportunity to reassess the plan to ensure the best and appropriate steps are being taken to move actions forward. This reassessment includes changes to funding or policy needs and coordinating efforts amongst all partners, policymakers, and the public. Updating the plan will result in a shared path forward where individual agency actions contribute to an overarching strategy that provides stability over time and allows policymakers to develop and prioritize related legislation.

HPWRA Turns 25: A quarter century of Weed Risk Assessment in Hawai'i. Chuck Chimera, *Hawai'i Invasive Species Council*

In 1994, Australian scientists developed and tested a predictive tool used to assess the potential for plants to become invasive in their introduced range. In 1998, this Australian weed risk assessment system, along with models developed for temperate North America and South Africa, were evaluated for their predictive ability in the Hawaiian Islands. The Australian model proved most accurate and was modified for further use and evaluation in Hawaii and other Pacific islands. Originally developed as an academic tool, the Hawaii-Pacific Weed Risk Assessment system (HPWRA) gradually became adopted by members of the horticultural industry, government agencies, and invasive species organizations as an effective way to identify and discourage introduction or use of high risk (likely invasive) non-native plants and promote the use of low risk (likely non-invasive plants). Twenty-five years, and 2300+ weed risk assessments later, the HPWRA is now incorporated as a program within the Hawaii Invasive Species Council and continues to be used as a non-regulatory prevention component of the state's biosecurity strategy. Here I provide an overview of this history, and the various applications of the HPWRA, discuss the strengths and weaknesses of the system, and prospects for the program going forward.

Priority Invasive Species for Prevention and Containment. Helen R. Sofaer[1] and Leyla Kaufman[2]. *[1]U.S. Geological Survey, Pacific Island Ecosystems Research Center, [2]Hawai'i Invasive Species Council*
The strategy in support of the Hawai'i Interagency Biosecurity Plan calls for collaboratively generating two non-regulatory species lists to guide invasion prevention. The Prevention Priority List includes species that are not currently established anywhere within the state of Hawai'i, but which have high risk of introduction, establishment, and negative impacts. These species are priorities for actions to prevent their introduction to the state. The Limited Distribution List includes invasive species that are currently established within the state, but are not established on one or more major islands. These species are priorities for inter-island containment, to prevent spread to currently uninvaded islands. The Prevention and Early Detection and Rapid Response Working Group of the Hawai'i Invasive Species Council and the Coordinating Group on Alien Pest Species has worked with patterns to produce updated versions of both the prevention and limited distribution lists. The updated lists incorporate information on invasion pathways, providing a link to preventative actions. Here, we introduce the Prevention Priority and Limited Distribution lists and highlight some harmful invasive species whose impacts can be prevented or contained.

Exploring the climate change-invasive species nexus with Pacific RISCC. Elliott Parsons[1], Chelsea Arnott[2], Laura Brewington[3], Jeff Burgett[4], Glenn Dulla[5], Bradley Eichelberger[6], Jacques Idechong[7], Gerson Jackson[8], Kennedy Kaneko[9], Heather Kerkering[10], Christy Martin[11], Roland Quitugua[12], Denis (DJ) Sene Jr[13].*[1] Pacific Regional Invasive Species and Climate Change Management Network, [2] Hawai'i Department of Land and Natural Resources, Division of Forestry & Wildlife, [3] Pacific Regional Integrated Sciences and Assessments Program/Arizona State University Global Institute of Sustainability and Innovation /East West Center, [4] U.S. Fish & Wildlife Service, Science Applications, [5] University of Guam, Western Pacific Tropical Research Center, [6] Commonwealth of the Northern Mariana Islands Division of Fish and Wildlife, Department of Lands & Natural Resources, [7] Palau Community College Cooperative Research and Extension Program, [8] Office of the President of the Federated States of Micronesia, [9] Secretariat of the Pacific Regional Environment Programme, Northern Pacific Sub-Regional Office Majuro, Republic of the Marshall Islands, [10] U.S. Geological Survey, Pacific Island Climate Adaptation Science Center, [11] Coordinating Group on Alien Pest Species, [12] University of Guam, Cooperative Extension Services, [13] American Samoa Community College, Agriculture, Community, and Natural Resources Division*

Communities across the Pacific are threatened by the impacts of invasive species and climate change. Invasive species have had devastating impacts on Pacific Island biodiversity, ecosystem services, food, infrastructure, and public health. Meanwhile, climate change is expected to worsen droughts and wildfires, increase storm severity, and raise the sea level, all of which exacerbate invasive species issues and increase management challenges. To increase the effectiveness of invasive species management in the face of climate change, the Pacific Regional Invasive Species and Climate Change (RISCC) Management Network was established in 2020 to serve as a boundary spanning organization working at the interface between science producers and invasive species practitioners. Pacific RISCC has grown into a multi-partner collaboration across Hawai'i, U.S. Pacific Territories and the U.S. Affiliated Pacific Islands. Goals include the

synthesis and translation of relevant science, co-production of actionable research and usable products, and the facilitation of dialogue between researchers, resource managers, and community members. In this presentation we will highlight our recent accomplishments, current directions, and discuss the state of the science at the nexus of climate change and invasive species in the Pacific.

A step forward: Predicting the abundance of *Culex quinquefasciatus* in Hawai‘i to inform Management. Adam Vorsino, Lisa Cali Crampton, Hanna Mounce and Stephanie Mladinich, *United States Fish and Wildlife Services*

Hawai‘i’s native forest avifauna are experiencing drastic declines due to climate change induced increases in temperature encroaching on their upper elevation montane rainforest refugia. These refugia from avian malaria infection are receding, with increasing temperatures leading to greater densities of its primary vector, the southern house mosquito (*Culex quinquefasciatus*)(Cq). Federal, State and Non-Governmental entities are supporting the development and application of next-generation tools, such as the Incompatible Insect Technique (IIT), to control *Cq* and help maintain these refugia. Understanding tool efficacy in relation to application across the landscape in relation to low *Cq* densities *in silica* is the first step in prioritizing and enhancing tool utility. Here we present three main objectives associated with this process using >9k data points collected from remote landscapes on three islands (Kauai, Maui, Hawai‘i) that represent >230k trap hours. The first objective is to understand and standardize mosquito trap type efficacy in relation to these remote landscapes. The second is to project these zero-inflated collections across the landscape to obtain *Cq* population estimates at targeted locations. The third is to estimate IIT tool efficacy in relation to variations in release methodology. The estimates presented here have already been used to enhance mosquito collections and identify target sites.

Distribution and abundance of wild ungulates in Hawaii highlights their diverse impact. Derek Risch and Melissa Price, *Department of Natural Resources and Environment Management, UH Mānoa.*

Invasive ungulates disproportionately impact island ecosystems globally and have been shown to have considerable economic impacts to agriculture, native ecosystems, and urban environments. However, many ungulates are also considered valuable game species for recreational hunting, food provisioning, and in some cases (e.g. feral pigs) have known cultural associations. To address both the economic concerns caused by ungulate damage and the value placed on these species by recreational and cultural practitioners, billions of dollars are spent annually in the United States to manage invasive ungulates. Nowhere in the United States are these issues more present than in Hawai‘i, where invasive ungulates from all over the world have become established with each island providing a unique assemblage of ungulate species. Numerous studies have addressed the impacts of invasive ungulates on natural areas, but few have identified the extent of their distribution, areas where they are most abundant, and key environmental drivers that influence both of these factors. A better understanding of the distribution and abundance of ungulate species across the Hawaiian Islands will aid in both conservation decision making and game management for recreational hunting. In this study, we present a culmination of four years of extensive ungulate surveys across O‘ahu, Maui, and

Kaua‘i and present species distribution models for four invasive ungulates; feral pigs (*Sus scrofa*), feral goats (*Capra hircus*), Axis deer (*Axis axis*), and Black-tailed deer (*Odocoileus hemionus*). We identify key drivers of these species' distribution and examine the differences in these species' relative abundance and distribution on each island.

Non- native freshwater snail diversity in the Hawaiian Islands. Hayes, KA[1,2], Kim, JR[1], Yeung, NW[1]. *[1]Charles Montague Cooke, Jr. Malacology Center, [2]Pacific Center for Molecular Biodiversity, Bishop Museum.*

Among the most impactful threats to natural resources, agriculture, human health, and biodiversity are non-native species. Knowing which species are present and where they occur provides conservation and resource managers with critical data for evaluating impacts, prioritizing control and mitigation activities and developing management policies. Currently, there are at least 75 established non-native, non-marine mollusc species in Hawai‘i, 17 of which are freshwater taxa belonging to six families (Ampullariidae, Cochliopidae, Lymnaeidae, Physidae, Planorbidae, Thiaridae). These include some cryptic species complexes within the *Thiaridae, Planorbidae,* and *Lymnaeidae* and several unidentified species (e.g. *Tryonia* sp., *Physa/Physella* sp.). Several well-established and widespread species are known agricultural pests (e.g., *Pomacea canaliculata*) and vectors of zoonotic diseases (*Melanoides tuberculata*). Surveys across the main islands, carried out in the previous decade, have recorded four newly established invasive freshwater molluscs on a single island, so far. Effective biosecurity policies and actions require accurate identification and an understanding of the potential impacts of introduced species, and ongoing surveys ensure early detection that are critical to control and eradication. Without continued and consistent survey efforts, and the support from agencies charged with managing resources, many more species will continue to establish and spread, threatening native ecosystems, agricultural resources, and public health.

Invasive non-marine snails in Hawai‘i: Species updates and pathways of spread. Yeung, NW[1], Kim, JR[1], Hayes, KA[2]. *[1]Charles Montague Cooke, Jr. Malacology Center, [2]Pacific Center for Molecular Biodiversity, Bishop Museum*

Invasive terrestrial (including freshwater) snails are a threat to natural resources, agriculture and human health and up-to-date surveys of introduced species are crucial for biosecurity plans as they provide data for identification, establishment and spread. Knowing which species are present, and where they occur aids conservation and invasive species managers to determine threat levels and prioritize control measures. Many snail pests have been and continue to be introduced to the Hawaiian Islands by the agricultural and horticultural trade and are spread within and among islands rapidly. In 2008, 38 non-native terrestrial species were reported as established in Hawaii and in 2018, 52 species were reported as established; an additional 14 species in a decade. Currently, with additional surveys and help from genetic analyses, there are 75 established non-natives species with several cryptic species complexes and unknown species. Early detection of recent introductions is critical for effective eradication before they spread, which is why continued surveys are needed to strengthen biosecurity and to develop preventive measures aimed at reducing the potential impacts of invasive species.

Yellow Crazy Ant Control at Endangered Snail Enclosures. Kevin Armstrong and Kaia Kong, *Army Natural Resources Program on O'ahu*
Yellow crazy ants, *Anoplolepis gracilipes,* rank amongst the most infamous invasive species. Their ability to transform ecosystems stems from their aggressive behavior, ability to form supercolonies, and their breadth of resource use. Yellow crazy ants (YCA) have been documented on numerous islands throughout the pacific, causing devastating impacts to a wide range of animals. On johnston atoll, YCA were a major threat to seabirds as YCA swarmed nesting habitat, mutilating chicks and threatening nestling bird survival by attacking birds with formic acid spray. It took the dedication and talent of the Crazy Ant Strike Team 10 years to declare the species eradicated from the island. The major breakthrough in control came from the use of hydrogels saturated with dinotefuran, something not currently allowed in Hawai'i. A yellow crazy ant infestation is having devastating impacts on arthropod diversity in Kahanahāiki. Soil-dwelling arthropod abundance within the population's boundary is close to zero. The use of Maxforce Complete, the only useful, state approved insecticide, is having promising results, with an 85% reduction in the YCA population but will not be sufficient for long-term control on its own. ANRPO is eager to partner with researchers to pursue new treatment options for YCA in sensitive forest habitat.

What else is in here? Exploring a large geospatial ant sampling dataset for trends and insights. Brooke Mahnken, *Maui Invasive Species Committee*

Efficacy of Organic herbicides on Devil weed, *Chromolaena odorata*. Chelsea Tamayo[1], Melissa Valdez[2], Michelle Akamine[1]. *[1]Office of the Vice President for Research and Innovation, Army Natural Resources Program on O'ahu. [2]United States Fish and Wildlife Service*

Due to the highly invasive and ecosystem altering characteristics associated with *Chromolaena odorata*, it is a priority for containment and control by the Army Natural Resources Program on Oahu (ANRPO). Use of conventional herbicides, such as those with the active ingredient glyphosate, have effectively resulted in plant mortality. However, public concern over use of conventional herbicides prompted investigation into alternative products to control *C. odorata*. Herbicide efficacy was assessed using the highest recommended concentration of five contact, non-selective, broad-spectrum natural herbicides (Avenger®, BurnOut®, Scythe®, Vinagreen and Weed Zap®). Multiple size classes of plants were tested, with herbicide treatments occurring progressively if proven to be successful at the previous size class, starting from small (2-15 cm in height), to medium (15-40 cm), and large (40-75 cm). Three products (Avenger®, Vinagreen, and Weed Zap®) were ineffective (mortality < 50%) on small plants and were not tested further. Burnout® was effective (mortality > 50%) on small plants but not medium plants. Scythe® produced the best control for small and medium-sized plants but was ineffective in controlling large plants. No natural herbicides were identified at successfully controlling *C. odorata* in this experiment and conventional herbicides are still preferred by ANRPO. However, some managers who are unwilling to use conventional herbicides may find products like Burnout® or Scythe® useful to treat small to medium sized plants, although repeat treatment applications are likely necessary. Additionally, safety considerations to the applicator need to be evaluated. Scythe® has a product label with the signal word "Warning" and states that the product is harmful if

inhaled and causes skin irritations. Vinagreen, the least effective product, has a "Danger" label stating irreversible eye damage and harm if absorbed or swallowed.

Poorly studied and misidentified non-insect invertebrate pests in Hawai'i. Hayes, KA[1,2], Kim, JR[1], Maruno, TMB[1], Yeung, NW[1]. *[1]Charles Montague Cooke, Jr. Malacology Center, [2]Pacific Center for Molecular Biodiversity, Bishop Museum*

Hawai'i, despite being only about 0.2% of the land mass of the continental United States, is home to nearly half of all endangered species on the U.S. Endangered Species list. This result, in part, is caused by the impact of non-native species introduced to the islands, which threaten native biodiversity, ecosystem functions, agricultural biosecurity, human health, and commerce. It is estimated that each week, nearly twenty novel plant and animal species are introduced and established in Hawai'i, many going unnoticed until they become major pests. The most notable among these introduced animals include taxa that are the least well studied, making them even more difficult to detect and identify within a timeframe that allows their control. These include gastropods (snails and slugs), annelids (earthworms and leeches), and platyhelminths (flatworms). All these major taxa include species that are known agricultural pests, carriers of zoonotic diseases, and likely to become invasive once established. Here we review some of the known pests from these poorly studied groups that have become established in the islands, and discuss results from updated surveys and taxonomic studies aimed at clarifying the identities and impacts of these species.

Utilizing the AT220 Automatic self-resetting trap as another tool in small vertebrate control. Troy Levinson, *Oahu Army Natural Resource Program*

Introduced, invasive small vertebrates such as house mice (*Mus musculus*), rats (*Rattus* spp.), small Indian mongoose (*Herpestes auropunctatus)*, and cats (*Felis catus*) have wreaked havoc on native species across the planet, especially across the Hawaiian Island archipelago. Island flora and fauna communities are at particular risk from these introductions, and many endangered species in Hawai'i continue to face the challenges posed by this suite of invasive mammals. Conservation managers have utilized a variety of tools to control some of these invasive mammals, including various types of single-set rodent traps, body-grip traps, toxicants, and the recent development of self-resetting traps such as the Goodnature A24 rat trap. A new self-resetting trap called the "AT-220 Possum and Rat Trap" has been manufactured by NZ Auto Traps and put to use in conservation projects in New Zealand with encouraging results.
The Army Natural Resources Program on O'ahu began field testing AT-220 units in management units in the Wai'anae range over the past year to look at the feasibility and effectiveness of using this new tool to bolster small vertebrate control to protect endangered taxa from a range of invasive species. Our experience with the initial testing of these traps can be informative to other managers across Hawai'i who are looking to expand their pest control programs, as well as provide insight to the positive impacts and potential downsides of using the AT-220 on their respective projects. Field testing and data collection will continue during the rest of 2023, and into 2024.

Haumana Speak for ʻŌhiʻa Lehua and Manu of the Forest- Engaging Students to Participate in Hawaiʻi's Legislature to Advocate for Native Species Conservation. Kailee Lefebvre[1], Ambyr Miyake[2], and Lukanicole Zavas[3], *[1]Coordinating Group on Alien Pest Species, [2]College of Tropical Agriculture and Human Resources, University of Hawaiʻi at Mānoa, [3]American Bird Conservancy Hawaiʻi Program*

Participating in the State legislature can be daunting, confusing, and seem out of reach, especially for youth and particularly, those in underserved communities. This presentation will provide details on a state-wide project to engage haumana (students) grades K-12 in two legislative efforts that would support native species conservation in Hawaiʻi. The Coordinating Group on Alien Pest Species (CGAPS) and partners worked to engage students in two real-life experiences advocating for a bill to designate ʻōhiʻa lehua (*Metrosideros polymorpha)* the State endemic tree in 2022, and a resolution to designate a Hawaiian Honeycreeper Celebration Day in 2023. The objectives of this project were twofold; to raise awareness about the importance, threats, and conservation efforts of these native species, and engage students in the legislative process. Classroom lessons focused on these species and civics were conducted ahead of each legislative session, and together these students reached out to 25 legislators, conducted community outreach, and submitted over 3,225 pieces of testimony during the 2022 and 2023 legislative sessions. Both the bill and resolution were unanimously passed by the legislature and the bill was signed into law. Surveys showed that students had a positive experience, learned a lot about the native species, and said they are likely to participate in the legislative process in the future. Teachers found it highly valuable and said they would participate in a similar project in the future. This talk will review the project methods, outcomes, and other data, and can serve as a template for future engagement efforts.

Current status and future directions of the Coconut Rhinoceros Beetle Response in Hawaiʻi. Arisa Barcinas, *CRB Response Team*

The Coconut Rhinoceros Beetle (*Oryctes rhinoceros*) was discovered on Oʻahu in 2013. This launched an emergency Coconut Rhinoceros Beetle Response in 2014. Since the first detection of CRB on Oahu, populations of the beetle have increased in size and spread geographically. Oahu is now considered infested with CRB, shifting response efforts from eradication into containment, control and long-term management. This work includes activities focused around ports of exit off Oʻahu and working with businesses that prepare potential CRB host material for export off Oʻahu. CRB was also detected on Kauaʻi in May 2023, which is the first CRB detection on a neighboring island. Response efforts on Kauaʻi have since shifted from prevention to eradication. Increased surveying, outreach and treatments are ongoing. Prevention of CRB to other neighboring Hawaiian Islands remains a top priority of the response. Early detection and rapid response tools are an essential part of these response activities.

Motivating the public to prevent Coconut Rhinoceros Beetle on O‘ahu. Tina Lau[1] and Bonnie McCann[2].[1]*Oahu Master Gardener Program Coordinator,* [2]*Master Gardener Emeritus*

The invasive Coconut Rhinoceros Beetle (CRB) is established on O‘ahu and its population extent continues to expand. Master Gardeners conduct public outreach about horticulturally related topics, including composting workshops with CRB information. Based on public demand, composting workshops use this engaging high demand topic to also inform the public about CBR threats and how to prevent its spread on the island. Master Gardeners and the CRB team present information at the Urban Garden Center (UGC) public events in a coordinated education campaign. Post-workshop surveys show that workshops allowing people to apply prevention techniques can be effective motivators. Expansion of educational efforts on social media and with store owners will be the next step to further outreach efforts by the Master Gardener Program.

Tools for control of adult Coconut Rhinoceros Beetle in palm trees - Aerial application to distributed IoT camera trap system. Mohsen Paryavi[1] and Daniel Jenkins[2]. [1]Department of Electrical and Computer Engineering, [2]Department of Plant and Environmental Protection Sciences, UH Mānoa

Biological invasions of the Coconut Rhinoceros Beetle (CRB; Oryctes rhinoceros) to Oahu and Kauai were discovered in 2013 and 2023 respectively. CRB poses a major threat to iconic palm trees and potential for accidental export to other Hawaiian Islands or to commercial palm plantations in California. Ongoing control efforts include sanitation / remediation of potential breeding sites in organic mulch, and pesticide application in palm trees, the primary host for adult feeding. Previously pesticides have been applied via trunk injection. As part of an integrated pest management approach with pesticide rotation, we have evaluated the efficacy of aerial application of the pesticide “Demon Max” (active ingredient / a.i. cypermethrin) directly into palm crowns as well as an alternative “organic” product “Evergreen” (a.i. pyrethroid concentrate). Moreover, we report on the deployment of autonomously powered custom electronic surveillance systems with cameras, mounted in arrays of panel traps for CRB and communicating data through a cellular network. The system enables continuous or high-frequency monitoring of traps, reducing personnel and transportation costs for manual trap checking, allowing faster response to new infestations, and a better understanding of the diurnal behavior patterns of CRB.

Improving the Integrated Pest Management of Coffee Berry Borer in Hawaiian Coffee Agroecosystems. Luis F. Aristizábal[1].[1]*Department of Plant and Environmental Protection Sciences (PEPS), UH Mānoa & Synergistic Hawaii Agriculture Council (SHAC)*

The coffee berry borer (CBB, *Hypothenemus hampei*) (Ferrari) (Coleoptera: Curculionidae) is considered the most serious invasive insect pest of coffee worldwide, causing decreases in yield and quality. Following its detection in Hawaii in 2010, state and federal agencies, NGOs, coffee farmer associations, and the coffee industry began to take steps to mitigate the impacts of this

destructive pest. Twelve years later, an integrated pest management (IPM) program for CBB was established. Here, a historical documentation of events addressing the development and implementation of this IPM program is discussed. Achievements include optimizing monitoring of CBB populations, characterizing the biology of CBB under Hawaiian agroecological conditions, optimizing the timing of *Beauveria bassiana* (an entomopathogenic fungus) sprays for more effective and economical control, and improving the efficiency of cultural control practices such as harvesting and field sanitation. Economic analyses suggest that CBB management strategies based on Hawaii-specific research have provided the greatest gains in coffee yield, price, and revenue. Although considerable effort has gone into research to support CBB IPM in Hawaii, the adoption of these strategies by coffee farmers needs to be increased. More diversified methods of outreach and education are needed to reach growers in rural, isolated areas. Future research will focus on the successful introduction and establishment of *Phymastichus coffea* La Salle (Hymenoptera: Eulophidae), an endo-parasitoid of CBB females that was recently approved for importation and release.

The Kona Research and Extension Center's Coffee Leaf Rust update. Mathew Miyahira and Andrea Kawabata. *CTAHR CE, Kona, UH*

Hawaii was one of the last remaining coffee-producing regions to farm without the presence of coffee leaf rust (*Hemileia vastatrix*) or CLR, considered the world's most devastating disease of coffee. Unfortunately, this all changed when CLR was discovered on Maui in late-October 2020. Since then, CLR has spread rapidly and has been found on all major Hawaiian Islands. Hawaii's CLR race XXIV (24) is considered prolific and aggressive. So, without early detection and proper management, growers have experienced a significant amount of defoliation, a reduction in yield, decline of tree health, and in severe cases, the death of trees. This update will provide an overview of the arrival of this devastating disease of coffee to Hawaii, the biology of this fungal pathogen, and how it affects coffee production. We will also discuss methods for its control and resources for learning more about CLR and its integrated management approach which includes sanitation and disinfestation, monitoring, fungicide applications, and improvements for plant health and resiliency. Lastly, we will provide an update on current CLR-related research and outreach including pesticide trials, tissue culture, and rust-resistant plant material projects.

Research update on management of Coffee Leaf Rust in Hawaii using systemic and biological fungicides. Zhiqiang Cheng, Elizabeth Buchholz, Julia Coughlin and James Kam. *Department of Plant and Environmental Protection Sciences, UH Mānoa*

Understanding the Recent Coffee Leaf Rust Epidemic in Commercial Coffee Farms: What We Have Learned from the Last Two Coffee Seasons. Luis F. Aristizábal[1] & Melissa A. Johnson[2]. *[1]Department of Plant and Environmental Protection Sciences, UH Mānoa, [2]Daniel K. Inouye US Pacific Basin Agricultural Research Center, United States Department of Agriculture-Agricultural Research Service*

Coffee leaf rust (CLR, *Hemileia vastatrix*) is the most devastating plant pathogen affecting coffee crops worldwide. CLR was first detected on Maui and Hawaii Island in late 2020. Shortly thereafter, a monitoring program to assist growers in the early detection and management of this disease was initiated. CLR incidence and severity, as well as management practices and weather conditions were documented on commercial coffee farms across Hawaii Island in 2021 and 2022. The pattern of CLR incidence was similar across both seasons and districts. Low incidence was observed during the early coffee season (leaf flush and fruit development) followed by a rapid increase during the second half of the season (harvest and post-harvest). A positive correlation was observed between incidence and severity. High rates of defoliation and subsequent yield loss (25-75%) were observed across Kona at the end of the harvest season in 2021. In 2022, coffee farms that applied only preventive fungicides reached an average of 60% CLR infection at the end of harvest season (December). In contrast, farms that applied preventive plus translaminar fungicides had <5% CLR infection for the same period. Preliminary results from a field trial to estimate the efficacy of commercially available fungicides under Hawaii conditions will be discussed. Information obtained from these studies will be relevant to the development of a management program for CLR in Hawaii.

What we know about Rapid ʻŌhiʻa Death and how we can protect our native forests. Ambyr Miyake and J.B. Friday. *College of Tropical Agriculture and Human Resources, UH Mānoa*

Rapid ʻŌhiʻa Death (ROD) has killed over a million ohia trees on Hawaiʻi Island, is spreading on Kauaʻi, and has been found on Oʻahu. Knowledge of how the disease spreads is crucial to help managers limit the impacts of the disease. The fungi that cause ROD spread through several vectors. Ambrosia beetles emit sawdust and frass when the beetles attack infected trees. This frass can contain large amounts of fungal spores and can infect healthy trees. ʻŌhiʻa trees can only get infected if there is a wound in the bark or roots that allows the pathogen to come into contact with the sapwood.
Recent studies have shown that fenced areas that are free of ungulates have a much smaller prevalence of ROD than adjacent unfenced sites, likely because feral cattle, pigs, and goats cause injuries to ʻōhiʻa roots and stems. These studies show that the most effective landscape level tools that managers have to fight ROD is through fencing of pristine and important forest habitat. Another promising tool under development is the use of insect repellents to keep beetles from attacking infected trees and spreading frass. Researchers are also showing that there is a significant percentage of ʻōhiʻa trees that have some resistance to ROD, and selection efforts are underway to develop disease-resistant lines of ʻōhiʻa for future planting.

Double impact of a weed biocontrol agent in Hawaii: *Secusio extensa* (Lepidoptera: Erebidae) releases for fireweed *Senecio madagascariensis* outspreads naturally to Cape ivy *Delairea odorata.* Mohsen Ramadan, Stacey Chun and Darcy Oishi. State of Hawaii Dept. of Agriculture, Division of Plant Industry, Plant Pest Control Branch

Fireweed and Cape ivy are invasive noxious weed in Hawaii that are native to South Africa. Fireweed, which is toxic to livestock, invaded the islands of Maui and Hawaii in the 1980s, and now infests an estimated 850,000 acres statewide. Cape ivy, a perennial vine that overgrows native Hawaiian forests, is also found in most coastal watersheds in Australia, California, Chile, New Zealand, and Oregon, where it has become a significant threat to riparian habitats. It smothers native vegetation, and its leaves contain toxins for birds and other wildlife. *Secusio extensa* (Butler) is a Madagascan tiger moth investigated in Hawaii for biological control of fireweed. After extensive host range studies that included 88 endemic and naturalized species, mostly were Asteraceae, it was found to reproduce on six different species of the tribe Senecioneae that are weedy. The Senecioneae contain no native species in Hawaii, and its release was approved in 2013 for biocontrol of fireweed. Fortuitous non-target impact on Cape ivy was predicted because *S. extensa* developed equally well on this plant under laboratory conditions. Shortly after its release, *S. extensa* was found to spread naturally onto Cape ivy, causing a dramatic buildup of the moth population that spread over to fireweed and Cape ivy sites. A field trial at Puu Huluhulu native tree sanctuary showed a dramatic reduction of vines in less than a year after the release of 14925 adults and larvae during 2015. Photos before and after the release were documented to show its impact. Only plants in the Senecioneae have been attacked, and the insect is spreading naturally to other islands, including Kahoolawe and Oahu. Predators and egg parasitoids have not been recorded to date, but recently the larval gregarious parasitoid, *Lespesia archippivora* (Riley) (Diptera: Tachinidae), was reported from Maui Island.

Hawai‘i Integrated Pest Management Program for Diamondback Moth: Pesticide Resistance Management. Rosemary Gutierrez, *CTAHR CE, Maui, UH.*

Diamondback moth, *Plutella xylostella* (Linnaeus) is considered the most important pest for crucifer crops. This pest is a severe problem due to its propensity to develop resistance to insecticides. A resistance management program was developed using Insecticide Resistance Action principles of limiting selection of resistance by rotating the use of insecticides with different mode of action groups. The insecticides are arranged in monthly spray windows. Resistance screenings are conducted twice a year on diamondback moth populations from the major production areas throughout the State (Oahu, Maui, and Big Island). The method used is pesticide leaf disc bioassay test for each of the different diamondback populations. These results are used to develop the upcoming insecticide spray rotation to provide growers with an insecticide rotation schedule to mitigate DBM insecticide resistance. Prior to the development of the resistance management program annual crop losses ranged from 40-60% in crucifers crops, now diamondback crop loss is less than 4%.

Recent advances in biological control. Mark G. Wright, Department of Plant and Environmental Protection Sciences, University of Hawaii at Manoa.

Biological control of invasive species has a long history in Hawaii, with many highly successful introductions of natural enemies of weeds and insects. These programs have targeted invasive species that are pests of agricultural crops, natural ecosystems and landscape plants used extensively in Hawaii. A brief overview of factors leading to successful and environmentally safe biological control will be provided. Recent work on biology and host utilization by parasitoids will be reviewed, and options for improving non-target screening discussed

Hawai‘i Invasive Pest Communication and Networking. Roshan Manandhar, CTAHR CES, Kaua‘i, UH

Hawaii, the capital of endangered species in the world, is vulnerable to species invasion thus exerts a greater impact on loss of biodiversity, natural habitats and agriculture production. A number of agencies are dedicated to working on the complex issues of invasive species. Such agencies play a role in one specific mandate such as policy making, regulation, research and/or extension. There is need of one common forum that brings all agencies together to communicate recent invasive species concerns and interlink their roles in managing them. CTAHR’s Cooperative Extension Service led the state-wide Invasive Pest Working Group, which brought key stakeholders to a collective forum to discuss current issues and provide updates on research and extension outcomes of key invasive pest initiatives. From Aug 2020 - Nov 2022, thirteen half-day webinar mini-conferences provided a platform for the IPWG members to exchange their knowledge and transfer information to a diverse group of participants. Based on feedback from a subset of participants (23% of 456), these mini-conferences were greatly impactful in learning new information and sharing them with others, thereby magnifying its effect in Hawaii and beyond. Major impacts of the mini-conferences are highlighted.