Abstract Book for Kūlia i ka huliau — Striving for change by Abstract ID

3

Discussion from Hawai'i's Largest Public facilities - Surviving during this time of COVID-19.

Allen Tom[1], Andrew Rossiter[2], Tapani Vouri[3], Melanie Ide[4]

[1]NOAA, Kihei, Hawaii. [2]Waikiki Aquarium, Honolulu, Hawaii. [3]Maui Ocean Center, Maaleaa, Hawaii. [4]Bishop Museum, Honolulu, Hawaii

Track

V. New Technologies in Conservation Research and Management

Abstract

Directors from the Waikiki Aquarium (Dr. Andrew Rossiter), Maui Ocean Center (Tapani Vouri) and the Bishop Museum (Melanie Ide) will discuss their programs public conservation programs and what the future holds for these institutions both during and after COVID-19. Panelists will discuss: How these institutions survived during COVID-19, what they will be doing in the future to ensure their survival and how they promote and support conservation efforts in Hawai'i. HCC is an excellent opportunity to showcase how Hawaii's largest aquaria and museums play a huge role in building awareness of the public in our biocultural diversity both locally and globally, and how the vicarious experience of biodiversity that is otherwise rarely or never seen by the normal person can be appreciated, documented, and researched, so we know the biology, ecology and conservation needs of our native biocultural diversity. Questions about how did COVID-19 affect these amazing institutions and how has COVID-19 forced an internal examination and different ways of working in terms of all of the in-house work that often falls to the side against fieldwork, and how it strengthened the data systems as well as our virtual expression of biodiversity work when physical viewing became hampered. Has this opened doors to global virtual visitation and appreciation of the resource otherwise tucked in the middle of the Pacific Ocean? Audience will be engaged virtually via poll questions and audience questions via the chat box. All questions will be saved and forwarded to the speakers.

Agenda & Additional Required Information for Forums, Workshops, and Trainings

Hosted by Allen Tom (superintendent of the Hawaiian Islands Humpback Whale National Marine Sanctuary) we have memoranda of agreements with all three of these entities. Agenda - Introductions and why we are here - Allen

Tapani - Maui Ocean center, programs they are doing now due to COVID, and what conservation efforts they are working on (reef restoration, water quality montioring)

Andy Rossiter (Waikiki Aquarium) - will discuss the same

Melanie Ide - same, with expanded discussion on their in-house efforts to conservation of Native Hawaiian biota, research and artifacts.

Q and A once all speakers are done via chat box. Questions not answered due to time constraints will be saved and forwarded to the speakers.

4

Historical and Modern Ecology of Kukui (*Aleurites moluccanus*): Implications for the Hawaiian Footprint and Ancient Management Zones

Noa Lincoln[1], Qian Zhang[2], Qi Chen[2]

[1]University of Hawai'i at Mānoa, Hilo, HI. [2]University of Hawai'i at Mānoa, Honolulu, HI

Track

I. Cultural Values and Practice in Conservation

Abstract

Kukui (candlenut; *Aleurites moluccanus*) is a Polynesian introduced tree crop and the designated state tree of Hawai'i. Kukui was an important element to indigenous Hawaiian agroforestry and retained some of its importance throughout Hawai'i's history. We examined the historical ecology and trends of kukui, including a review of the ethnobotany. Remote imagery was analyzed to map the current distribution and cover of kukui canopy on the five largest Hawaiian Islands, and historical aerial images were used to assess the change in kukui cover over time. Kukui was a major component of ancient land management, existing in virtually all agro-ecological strategies utilized by Native Hawaiians and the dominant species in serval extensive systems. Kukui is still widespread through the state, being a significant component in many novel low-land mesic and wet forests. However, kukui is declining and across the five islands surveyed has lost an average of ~58% of total canopy cover over the last 70 years. Spatial trends suggest that kukui likely did not spread much following the large-scale shifts in Hawaiian socio-ecosystems that accompanied the arrival of colonial powers and we suggest that the footprint of kukui in Hawai'i closely approximates the extent of indigenous agroforestry and forest alteration. This study informs conservation in Hawai'i by (1) documenting the trajectory of a major component of Hawai'i's lowland novel forests and (2) better understanding the extent and form of traditional Hawaiian land-management at the landscape scale.

6

Waihona Online Repository: Sharing Resources to Build the Next Generation of Aloha 'Āina Leaders

Kanoe Wilson

Kamehameha Schools, Kea‘au, HI

Track

V. New Technologies in Conservation Research and Management

Abstract

Kanaeokana, the Kula Hawaii Network is a membership based organization that includes Hawaiian Focused Charter Schools, Hawaiian Language Immersion Program schools, and over 60 other Hawaiian education organizations including ‘Āina-based organizations. Established in 2016, Kanaeokana is providing new opportunities for Hawaiian culture based educators to raise their voices to advocate for things that are important: Hawaiian language renormalization, teacher recruitment and retention, ‘āina-based/place-based learning, culturally innovative learning solutions, and curriculum resources development and dissemination using a cloud based repository called Waihona.

Kanaeokana Network has been working diligently to find innovative ways to support our communities during this time of travel bans, quarantines, school shutdowns and new teaching paradigms. We are pleased to offer up the Waihona online repository to our community of lāhui educators as one of many tools to empower educators and learners. Our team has been working around the clock to bring this online open source learning platform where people across the pae ‘aina can share ideas to support and elevate ‘Ike Hawai‘i and ‘Ōlelo Hawai’i in relevant ways to help build the next generation of Aloha ‘Āina leaders.

Join us in this interactive session where we share the mo‘olelo of Kanaeokana and the development of Waihona, how this supports ‘āina-based education and has the application to connect classroom teachers with ‘āina-based educators and vice versa, we will take you on a virtual huaka‘i of Waihona and share the vast resources that colleagues around the world are sharing.

Agenda & Additional Required Information for Forums, Workshops, and Trainings

Agenda & list of speakers (if accepted, your abstract will be scheduled in session between 1 to 2 hours in duration)

1. Ho‘olauna Introduction
2. Presentation
    1. Mo‘olelo of Kanaeokana & Waihona
3. Virtual Huaka‘i
    1. Interactive session
        1. Register to be a User on Waihona
        2. Access Resources

    2. Audience Poll
4. Talk Story
5. Q&A
6. Mahalo & Closing

- Description of innovative audience engagement techniques

Including some “funfication” (gamification) with the audience to keep them engaged. It will include answering questions in the chat, contributing to a wordle, and a virtual huakaʻi to have them register onto the site.

- Explanation of goals and target audience

Goals or outcomes of the presentation:

By the end of the presentation audience can….

1. know what is the Waihona.
2. Be able to access resources on the Waihona.
3. Learn how to contribute and share resources on the Waihona
4. Contribute to a growing community of educators to elevate ʻāina-based/place-based/ecological knowledge

7

The Kona Airport Malama 'Āina Mural

Calley O'Neill

The Rama Tree, Kamuela, Hawai'i. Hawai'i State Foundation on Culture and the Arts, Honolulu, Hawai'i

Track

III. Global and Regional Change & Challenges

Abstract

E Ola ka Honua! O Wau ka Honua! Long Live the Earth! I Am the Earth!

An Aloha ʻĀina Mural for Hawaiʻi and the World, Calley O’Neill

Ellison Onizuka Kona International Airport at Keahole

What you call resources, we call relatives. Nainoa Thompson

Commissioned by Hawai'i State Foundation on Culture and the Arts

Guided by highly esteemed kupuna of the land who will appear in the mural in monumental scale. History: In October 2018, Waimea conservation and cultural artist Calley O'Neill unanimously won an international competition with entries from 300 applicants to create this permanent cultural conservation mural.

The Artist: O'Neill is a highly respected muralist who has created significant public murals on Oahu, Maui, and Hawai'i. Chosen as the featured artist for the IUCN World Conservation Congress 2016, she is well known for her groundbreaking collaboration with abstract painter Rama the Elephant. Calley earned a BFA Summa cum laude, Pratt Institute, NY, and an MA in Social Ecology, Goddard College, Vt.

Mural Size and Media: 12' by 300'- 8 walls 12' by 40', mixed media mineral paint and stained glass mosaic.

Dedication: This mural is dedicated to the Hawaiian kupuna and Indigenous leaders worldwide who carry the wisdom we need now to preserve and restore nature for all the children of all species for all time.

Purpose: The *Kupuna* express a vital message at the heart of the Hawaiian culture to inspire all who see it to love and care for their own special place on Earth.

8

Contactless Connecting: How We Brought Invasive Species Outreach Online

Kaili Kosaka, Koki Atcheson

CRB Response, Honolulu, HI

Track

II. Capacity in Conservation

Abstract

The success of past Coconut Rhinoceros Beetle (CRB) Response outreach activities has relied on in-person events and interactions. What happens when a global pandemic turns the world on its head, significantly limiting in-person communication? The CRB Response, along with countless other organizations, faced this challenge in 2020. Creating an online presence is a daunting task, and with so many options out there, it's hard to imagine where to begin. Careful consideration and planning helped us to bring our outreach capabilities online. Starting from scratch, we developed a plan and timeline. We utilized business marketing principles of branding to guide the development of our website, social media accounts, and print materials. Next, we engaged stakeholders to determine decision making power and studied which metrics to track to indicate success. Bringing it all together, we developed a website as the backbone to support our outreach efforts.

By creating an online presence, we've reached more than 500 unique website users in the first three months, maintained a social media engagement rate 100 times greater than the industry benchmark, and continued to engage with our community without having to leave the office.

Our hope in laying out our strategy and considerations is to help others bolster their online presence. With no end in sight to COVID-19, creating an online presence has been vital to keeping us connected to the communities we serve. We hope this poster can serve as a guide for other organizations working to build their online brand.

9

Impaired Germination in Hawaiian Coastal Plants with Increasing Salinity: Implications for Management in the Face of Climate Change

Seana Walsh[1,2], Dustin Wolkis[1,2], Raffaela Abbriano[1,2], Kasey Barton[2]

[1]National Tropical Botanical Garden, Kalāheo, Hawai‘i. [2]University of Hawai‘i at Mānoa, Honolulu, Hawai‘i

Track

III. Global and Regional Change & Challenges

Abstract

Many coastal plant species have adaptations that enable them to exist in higher saline conditions. However, rising sea levels, increased frequency and intensity of storm surges, and increased drought due to climate change are anticipated to increase the level of salinity to which coastal plants are exposed. Although some species may be able to tolerate these changes, salinity tolerance is highly variable across species and ontogenetic stage.

Coastal ecosystems are critical for the welfare of our islands, providing sustenance, stabilizing shorelines, and promoting economic and cultural well-being. Understanding how increased salinity will

affect Hawaiian coastal plants is important to better predict the range of impacts that climate change will have.

To improve our understanding of coastal plant species tolerance to projected increases in salinity exposure, we tested the effect of salinity (0, 10, 20, and 35 ppt total salinity of unfiltered/untreated seawater) at the early ontogenetic stage of seed germination. We included 18 native and 3 non-native species in our study.

We found increasing salinity decreased germination and mean time to germination. Seeds of most species germinated up to the 20 ppt salinity treatment. Only a few species germinated in the 35 ppt salinity treatment. Most species, including *Brighamia insignis*, were able to recover (rinsed and sowed seeds in freshwater) from the 20 ppt or 35 ppt treatment.

Our results identify the most tolerant and vulnerable species to salinity increases, enabling conservation practitioners to make well-informed management decisions for restoration projects in our Hawaiian coastal ecosystems.

10

Using Stakeholder Objectives to Inform Fire Resource Management in Waiʻanae Hawaiʻi

Rachael Cleveland

University of Hawaiʻi at Mānoa, Honolulu, HI

Track

IV. Putting Research into Management Practice

Abstract

Fire frequency is increasing in Hawaiʻi, threatening biodiversity conservation efforts throughout the state. However, little is known about fire's impact on the ecosystem services, or benefits to people, provided by these affected environments. Because humans and biodiversity are reliant on ecosystems and the various services they provide, it is important to understand how ecosystem services are affected by fire and fire management decisions. Previous research in Hawaiʻi has studied outcomes from land management on fire behavior and ecosystem services, but not how fire management objectives and choices directly impact ecosystem service delivery, nor has this research been integrated into structured decision making (SDM), a process that facilitates decision-making by managers. Stakeholders from the Wai'anae Community Fire Group were interviewed to determine which fire management objectives and ecosystem services were important to them when considering wildfire management in the Wai'anae watershed on O'ahu, Hawaiʻi. Ecosystem service models were then developed through Fuzzy Cognitive Mapping using expert knowledge and integrated into the SDM process to determine how different fire

management actions would impact these identified stakeholder objectives. I found that stakeholder objectives and values had a significant impact on which management actions were selected through the SDM process. This research advances our ability to predict ecosystem service outcomes from alternative fire management strategies and our understanding of how stakeholder values impact fire management decision making. Moreover, understanding these impacts allows fire managers to make better, more efficient decisions, protecting and prioritizing the ecosystem services and conservation outcomes stakeholders value.

11

Biocontrol of Strawberry Guava in Mākaha Valley, O`ahu: Progress to Date

Nancy Matsumoto

Honolulu Board of Water Supply, Honolulu, Hawaii

Track

IV. Putting Research into Management Practice

Abstract

The Honolulu Board of Water Supply (BWS) Watershed Program works to ensure an adequate supply of fresh water for current and future generations, by protecting the ability of O`ahu's watersheds to capture and store rainfall in the aquifers below. This ability is critical, as rainfall is the sole natural source of fresh water supply for the island. One of the methods BWS employs to protect the watersheds is to reduce the spread of invasive plant species which are considered to be high water users, taking up rainfall that would otherwise be percolating into the ground and recharging the water supply aquifers. Strawberry guava (*Psidium cattleianum*) is considered to be one of the most destructive, water-intensive invasive plant species in Hawai`i. Accordingly, BWS established two 20-foot by 20-foot pilot test plots for the biocontrol (scale insect) *Tectococus ovatus* on watershed land invaded by strawberry guava in Mākaha Valley. Since inoculating the test plots, field surveys have confirmed the biocontrol has spread successfully throughout and well beyond the boundaries of the plots into the invaded forest, to an estimated total extent of 52,163 square feet. Future work includes ongoing monitoring and additional test plots.

12

"Decentralized" Imagery Analysis on the ArcGIS Online Platform

Dylan Davis

Ko'olau Mountains Watershed Partnership, Pearl City, HI

Track

V. New Technologies in Conservation Research and Management

Abstract

This is a "how-to" demonstration of the creation and utilization of an online webmap for imagery analysis and data creation simultaneously from multiple remote locations using the ArcGIS Online (AGOL) platform.

Rates of analysis and data production must increase to capitalize on the increasing volume of products developed through improving remote sensing technologies. Development of webservices, such as AGOL, and data hosting allows several people to perform analysis from various locations all at once. The method documented in this presentation requires orthrectified imagery to analyze, either ArcMap or ArcPro, a single AGOL enabled license, and a cursory familiarity with ArcPro and AGOL's web map viewer. The result is an interactive map, available online through a web browser, with which multiple users, all at the same time, can view imagery and create GIS vector data from them, without need for installation of any ESRI software or local storage of data.

Remote analysis with this method engaged 9 people for over 400 hours during the initial state-wide stay-at-home order of 2020, resulting in nearly 8,000 discrete weed points created across 7,000 acres of remote, mountainous terrain in the Ko'olau mountain range of O'ahu. This has allowed for far more comprehensive population mapping of high-priority invasive weed targets, namely *Angiopteris evecta* and *Falcataria moluccana*. The same method can be adapted to a wide-variety of objectives, such as mapping land features, native species (morphology dependent), or updating large-scale infrastructure (e.g. fence) location data.

14

Regeneration of ʻIliahi: Hemiparasitic Relationships in Hawaiian Tropical Dry Forests

Emily Thyroff[1,2], Travis Idol[1,2], Douglass Jacobs[3,4]

[1]University of Hawaiʻi at Mānoa, Department of Natural Resources and Environmental Management, Honolulu, HI. [2]Tropical Hardwood Tree Improvement and Regeneration Center, Honolulu, HI. [3]Purdue University, Department of Forestry and Natural Resources, West Lafayette, IN. [4]Tropical Hardwood Tree Improvement and Regeneration Center, West Lafayette, IN

Track

IV. Putting Research into Management Practice

Abstract

Santalum sandalwood species, including the endemic Hawaiian species known as ʻiliahi, are ecologically distinct as evergreen, hemiparasitic trees. Being hemiparasitic means ʻiliahi can photosynthesize yet require suitable hosts for resource acquisition and long-term survival. Reforestation and sustainable forestry of ʻiliahi at degraded tropical dry forest sites, therefore, also require supporting host plant communities. Planting ʻiliahi among established hosts may increase the probability of making early, and abundant, hemiparasitic connections, but this must be balanced with competition for limiting resources. Our project aims to improve the survival and establishment of planted ʻiliahi seedlings by better understanding regeneration and establishment tradeoffs between *S. paniculatum* and *Acacia koa* (koa), a commonly planted native species at reforestation and restoration sites. In 2010, koa seedlings were planted in a 0.81-ha fenced plot. Patchy survival over ten years resulted in varying gap sizes, creating a matrix of micro-environments into which 10-month-old seedlings of ʻiliahi were planted using a completely randomized experimental design. Morphological and physiological measures are being taken to identify parasitic connections and understand drivers of ʻiliahi establishment. First-year results will be presented. We hypothesize that there is an optimal range of overstory gap sizes that balances competition for resources and abundant root networks for ʻiliahi to establish hemiparasitic root connections. Results will contribute to better understanding ʻiliahi establishment within gaps of established hosts and help improve silvicultural efforts to restore functionally compatible and abundant forests.

15

Investigating Origins of the Nuisance Alga Chondria tumulosa from Manawai (Pearl and Hermes Atoll) in the Papahānaumokuākea Marine National Monument

James Fumo, Alison Sherwood, Monica Paiano

University of Hawaiʻi at Mānoa, Honolulu, HI

Track

III. Global and Regional Change & Challenges

Abstract

The nuisance alga *Chondria tumulosa* appeared suddenly in 2016 and spread rapidly across Manawai (Pearl and Hermes Atoll) in Papahānaumokuākea Marine National Monument by 2019. The alga grows in mats up to 18 cm thick, can grow up to depths of 19 meters, smothering corals and occupying considerable benthic cover. As the name “nuisance” implies, it is unknown whether this species is invasive or simply a native cryptic species that is blooming due to a change in environmental or ecological conditions. The morphology of this species, as well as its molecular signature, do not match any other currently described species of *Chondria, inspiring the description of the species as Chondria tumulosa in 2020.* In 2021, we are embarking on a project that seeks to gather specimens of *Chondria* from across the Pacific basin and from other tropical and warm temperate areas to determine the origin and nature of *Chondria tumulosa* as well as to assign a status of nuisance or invasive. We will also assess its biogeography and phylogeography, and undertake a much-needed

systematic revision of the tribe Chondrieae. In order to accomplish this, we are collaborating with researchers around the world to sample the specimens housed in their herbarium collections for DNA analysis and morphological characteristics. As this project is ongoing throughout the calendar year of 2021, and potentially beyond, we will provide an update regarding the samples we have received, extracted, and assessed morphologically and will present preliminary results.

16

Changes in Hawai‘i ‘Ākepa Densities at Hakalau Forest National Wildlife Refuge: Application of Density Surface Models

Richard J Camp[1,2], David L Miller[2], Len Thomas[2], Stephen T Buckland[2], Steve J Kendall[3]

[1]USGS-PIERC, Hawai‘i National Park, HI. [2]University of St Andrews, St Andrews, Scotland. [3]USFWS, Hilo, HI

Track

IV. Putting Research into Management Practice

Abstract

Precise measures of population abundance and trend are needed for species management; these are most difficult to obtain for rare and rapidly changing populations. We applied smoother-based modeling methods that included spatially- and temporally-referenced covariates to produce more precise density estimates than are available from standard design-based methods such as point-transect distance sampling. We used a generalized additive model, with the annual effective area surveyed per point as an offset, to model the spatial and temporal patterns of Hawai‘i ‘Ākepa (*Loxops coccineus*) densities to produce density surface maps for a 31-year time series at Hakalau Forest National Wildlife Refuge, Hawai‘i Island. In addition to predicting annual spatio-temporal density surfaces from the generalized additive model, we incorporated detection probability uncertainty using an approach that does not assume independence of the model components to estimate annual abundances. We observed a 37% decrease in model-based density estimate confidence interval widths compared to the uncertainty derived from the design-based method. Integrating detection function modeling with spatio-temporal modeling exploits survey data more efficiently by producing finer-grained abundance estimates than are possible with design-based methods as well as producing more precise abundance estimates. Moreover, the method also produces maps of bird density changes across space and time allowing managers to evaluate management actions, which benefits conservation planning through improved management efficiency and reducing costs by applying management actions to priority areas. Prioritized and efficient management will become more important as traditional approaches to conserving and managing species inadequately account for rapidly changing, uncertain environments.

17

Repurposed Seedbank Data Reveals Variation In Germination Success Between Generalized Provisional Seed Zones Informing Conservation Planning For ʻŌhiʻa On Kauaʻi

Dustin Wolkis[1], Seana Walsh[1], Christopher Barnes[2], Elizabeth Stacy[3], Nina Rønsted[1]

[1]National Tropical Botanical Garden, Kalaheo, Hawaiʻi. [2]University of Copenhagen, Copenhagen, Denmark. [3]University of Nevada, Las Vegas, Nevada

Track

IV. Putting Research into Management Practice

Abstract

Climate can play a critical role in plant physiological processes, and while investigations often focus on later life stages, climate can also influence seed development and germination, which in turn can affect community dynamics. Linking seed germination information with environmental variables and locality may help understanding plant community structure and how that may change along an environmental gradient or in response to climate change. Native Hawaiian *Metrosideros* (Myrtaceae; ʻōhiʻa) is a hyperdiverse species complex dominating Hawaiʻi's wet and mesic forests and serves as the most bioculturally important native plant in Hawaiʻi. In response to Rapid ʻŌhiʻa Death, a major threat to native forests caused by introduced fungal pathogens, state-wide seed collections of ʻōhiʻa have increased as one management strategy to safeguard the species. We used initial seed germination data from recent collections stored in National Tropical Botanical Garden's Seed Bank to explore if seed germinability is correlated with seed zones and environmental variables. We included seed germinability data of the most widespread and common taxon, *M. polymorpha* var. *glaberrima,* from 85 collection sites across Kauaʻi. Linear models of the proportion of seed germinated, seed zones, and environmental data calculated from the Online Climate Atlas of Hawaiʻi revealed that only seed zones were significantly correlated with the proportion germinated. Our results suggest that such seed zones based on elevation, rainfall, and other geographic landscape features may be better tools for planning conservation collections and restoration projects than individual bioclimatic factors or locality alone.

18

Assessing Extinction Risk, Conservation Reliance, and Downlisting Potential of Two Endangered Hawaiian Waterbirds

Charles van Rees[1,2], Chris Elphick[3], J. Michael Reed[4]

[1]River Basin Center and Odum School of Ecology, University of Georgia, Athens, GA. [2]Livable Hawaiʻi Kai Hui, Honolulu, HI. [3]University of Connecticut, Storrs, CT. [4]Tufts University, Medford, MA

Track

IV. Putting Research into Management Practice

Abstract

The ae‘o (Hawaiian stilt *Himantopus mexicanus knudseni*) and the ‘alae ke‘o ke‘o (Hawaiian coot *Fulica alai*) are endangered waterbirds endemic to Hawai‘i. Both have shown impressive population recoveries since listing under the Endangered Species Act (ESA) and the establishment of protected, managed refuges. Both species are generally assumed to be conservation reliant, meaning that they could not maintain viable populations without continued management. Nonetheless, the ae‘o is currently being considered for downlisting under the ESA. To test whether either of these species meets downlisting criteria, we investigated their population persistence, resilience, and functional carrying capacity using stochastic, individual-based population models and Bayesian state-space time series analysis. For both species, we found a low probability of extinction (0% and 11% for stilts and coots respectively) by the year 2100, but also that range-wide carrying capacity is very likely below the minimum population size for downlisting (97% and 94% probability, respectively). Despite low probability of extinction under present conditions, sensitivity analysis showed that small changes in vital rates like nest failure rate or juvenile mortality could dramatically increase extinction risk for both species. Such changes are well within the realm of possibility if management is ceased in key waterbird breeding areas. Our various findings strongly support the notion that these two endemic waterbird species are conservation reliant and not candidates for downlisting under the ESA.

19

Characterizing Mauka to Makai Connections for Aquatic Conservation on Maui

Ella Wilmot[1], Jesse Wong[2], Yinphan Tsang[1], Abigail Lynch[3], Dana Infante[4], Hannah Clilverd[5]

[1]University of Hawai‘i at Mānoa, Honolulu, HI. [2]USGS, Reston, VA. [3]USGS National Climate Adaptation Science Center, Reston, VA. [4]Michigan State University, East Lansing. [5]UK Centre for Ecology and Hydrology, Edinburgh

Track

IV. Putting Research into Management Practice

Abstract

The connection from mauka to makai – or commonly referred to as ridge-to-reef – is essential for sustaining life, especially in Hawai‘i, where land and sea are in close proximity. These interconnected environments provide various natural and social resources, and support cultural practices and recreational usages. To guide comprehensive aquatic resource management, accounting for the resources and connections among these environments is critical. The objective of this study was to identify spatial linkages in landscapes that promote multiple and diverse uses, following the ridge-to-reef concept, at an island-wide scale. We used diverse data, including estuaries locations, indicators of freshwater input from streams, nearshore fish biomass, fishpond locations, agricultural land in watersheds, coral cover, beach recreation use, and future climate projections scenarios (RCP 8.5), to

examine the spatial linkages from land to sea. We also included human use data in the analyses because incorporating Native Hawaiian cultural values within resource management has been proven to be engaging, well-received by local communities, and effective to achieve sustainable usage of resources. With Zonation Conservation Planning Software, we identified areas of high conservation prioritization to help inform aquatic resources management. We used Maui as the pilot study island and the results displayed that areas of high conservation prioritization include many minimally-disturbed streams in east Maui and the coastal zones of diverse coral reefs. With this information, managers can incorporate the results to understand the natural and social influences on habitat condition and other values in these areas, and strategically plan future management and conservation actions.

20

The National Ecological Observatory Network: Ground Beetle (Coleoptera: Carabidae) Abundance and Diversity in Pu`u Maka`ala, Hawai`i Island

Sam Preer, Michael Long

National Ecological Observatory Network (NEON), Hilo, HI

Track

II. Capacity in Conservation

Abstract

The National Ecological Observatory Network (NEON) is a continental-scale interdisciplinary observation facility designed to collect 30 years of open-access data to better understand how ecosystems are changing. Data are collected from 81 diverse field sites across the United States, including Pu`u Maka`ala (PUUM) Natural Area Reserve on Hawai`i Island. Across NEON, Carabidae are sampled as indicators of changing ecosystems due to their presence in many habitats, well-defined species richness gradients, sensitivity to disturbance, and influence on trophic structure. In Hawai`i, Carabidae are relatively understudied and repeated annual sampling for abundance and species diversity will provide insight into potential changes in Hawaiian ecosystems. Bi-weekly sampling from April to October started in 2019 and collections were from 3 pitfall traps in each of 10 plots distributed throughout PUUM. Preliminary results showed 1432 carabids in 2019 (15 species in 3 genera) and 422 carabids in COVID-abridged 2020 (13 species in 3 genera, including 2 newly collected species). Additionally, in 2020, there was a 24% increase in the proportion of non-native *Trechus obtusus*, which could signal declining native Carabidae. Future annual collections can provide better perspective of changes in beetle abundance and diversity over time. Specimens are archived at Bernice Pauahi Bishop Museum in Honolulu, Hawai`i and are available for public review and analysis. Carabidae sampling is one example of NEON terrestrial, aquatic, and atmospheric data streams freely available (data.neonscience.org) for monitoring environmental change by researchers, educators, and students, and to inform land management and policy decisions.

21

Plant Naturalization Trends Reflect Socio-economic History and Show a High Likelihood of Inter-island Spread in Hawai‘i

Kelsey Brock, Curtis Daehler

University of Hawai‘i - Mānoa, Honolulu, Hawaii

Track

III. Global and Regional Change & Challenges

Abstract

Effective biosecurity strategies for archipelagos depend on knowing the rate at which non-native species naturalize and spread between islands as well as their mode of introduction. However, these factors often vary with socio-economic changes such as GDP growth or the rise of certain industries, and thus, naturalizations must be analyzed over time to ensure that the types of species/pathways perceived as most important are not outdated. We compared naturalization rates with socio-economic trends in Hawai‘i alongside data on the origin, native climate type, and likely introduction pathway for all non-native plants. We found that naturalizations have increased linearly during the past century without any sign of plateauing. However, accounting for different pathways of introduction revealed notable fluctuations in naturalization trends, with ornamentals increasing recently while agriculture-related naturalizations have decreased. These changes mirror a socio-economic shift from agriculture to tourism after the mid-20th century. We further revealed that the average naturalized species spreads at a rate of 1.86 islands per decade, eventually occupying most islands, and the spread rate has increased since Hawai‘i’s economic shift. Our findings highlight the extraordinary diversity of Hawai‘i’s non-native flora, which originates from a variety of climates, continents, and taxonomic groups. Many naturalized species have native ranges that include temperate climates, which is important because these climates typically co-occur with remnant patches of native-dominated ecosystems, suggesting that these critical habitats are vulnerable to invasion. Management implications for Hawai‘i will be discussed in addition to findings that are applicable to other invader-rich regions.

22

Monitoring and Identifying Predators of Kamehameha Butterflies Using Continuous Video Technology

Jana Maravi[1,2], Will Haines[2,3], Cynthia King[2]

[1]Kupu Conservation Leadership Development Program, Honolulu, HI. [2]Department of Land and Natural Resources, Division of Forestry and Wildlife, Honolulu, HI. [3]University of Hawaii, Center for Conservation Research and Training, Honolulu, HI

Track

V. New Technologies in Conservation Research and Management

Abstract

The Hawai‘i state insect, the Kamehameha butterfly (Nymphalidae: *Vanessa tameamea*), is one of two native butterflies (pulelehua) endemic to the Hawaiian islands. Population declines observed over recent decades have led to the extirpation of the species from many parts of its range. The Hawai‘i Invertebrate Program attempted to reintroduce the butterflies from 2017-2019 in the southern Ko‘olau range where host plants such as māmaki (*Pipturus albidus*) are abundant. Unfortunately, no caterpillars survived beyond the first generation due to unknown predators, possibly birds or ants. Reintroduction efforts were halted and a focus was placed on identifying the primary predators in 2020 and 2021. Because predators could be nocturnal or diurnal and vertebrate or invertebrate, we required a portable, multi-camera, continuous video monitoring system with macro and nighttime infrared capabilities. Caterpillars were deployed and individually monitored on trees with and without cameras three times per week within the Mānoa Cliff Restoration Area. Similar disappearance rates were found on camera and off camera. The warbling white eye (*Zosterops japonicus*) accounted for 92% of predation events recorded. No ant predation events were recorded. Our results suggest that cameras can be used successfully for invertebrate monitoring in the field and that the warbling white eye (WAWE) is the primary predator of Kamehameha butterfly caterpillars in the Mānoa Cliff Restoration Area. Further camera studies are recommended at additional sites in order to determine if the primary predators are consistent across the butterfly’s range. Continued refinement of the camera setup is also recommended due technical limitations.

23

Coral Feeding Preference of the Cushion Star (*Culcita novaeguinea*e)

Daniela Escontrela

University of Hawai‘i at Mānoa, School of Life Sciences, Honolulu, Hawai‘i

Track

IV. Putting Research into Management Practice

Abstract

As reefs face mounting threats, controlling local stressors, such as excess coral predation, will be key for managing for resilience. The cushion star (*Culcita novaeguineae*), a coral predator, has undergone an explosion in abundance since 1986 off the south shore of Waikīkī, O‘ahu. Understanding which coral species are preferred by these predators is an important first step in planning management strategies. I have deployed cages on our study reef where I starve individual cushion stars for a week and then place fragments of two species of coral with the star for another week. At the end of the trial, I rank corals based on consumption preference. While most such food choice experiments have been conducted in labs, this novel approach in the field allows cushion stars to be exposed to all their normal predatory cues. Cushion stars have shown an overwhelming preference for *Pocillopora meandrina* followed by *Montipora patula* and *Montipora capitata. Porites lobata* was consumed in only a single trial and *Fungia*

scutaria has been avoided completely. These prey choice experiments will determine whether the stars have a preference hierarchy among coral species, which would indicate whether, given the demise of preferred species, they may switch to less desired species. Additionally, findings from this research will inform future experiments which will try to determine the effects of cushion star predation on coral mortality and coral community composition. Should cushion stars be having an effect at their naturally occurring densities, management practices, such as star removals, will need to be enacted.

24

Quantifying Impacts of Terrigenous Sediment on Coral Reef Health and Morphology Using Remote Sensing and Machine Learning

Logan Ellis[1], Richard Gill[1], Walter Ritte[2]

[1]Brigham Young University, Provo, Utah. [2]ʻĀina Momona, Hoʻolehua, Hawaii

Track

V. New Technologies in Conservation Research and Management

Abstract

Erosion, with associated sedimentation of reefs and loss of habitat for marine and coastal species, is one of the most pressing environmental challenges in Hawaii. Identifying hotspots of soil erosion guides management on land, but limited work has been done connecting land cover to coral reef health and morphology. Current reef survey methods overgeneralize the spatial variation of benthic cover and sediment deposition. We propose a novel approach to improve accuracy by connecting sedimentation source to sink using Unmanned Aerial Vehicles (UAVs), Unmanned Surface Vehicles (USVs), local knowledge, and machine learning. UAVs can capture images to create 3-D orthomosaics of the terrestrial system while USVs can be used to create 3-D coral reef models. Models are classified using machine learning to quantify vegetation across the system. Community knowledge is used to refine the classified models, providing land managers with geographic information system (GIS) layers that specify areas of high concern for conservation. This technique can provide information on spatial patterns of erosion hotspots, benthic cover types, reef morphologies, reef health, water temperatures, and water turbidity. These data are critical for management decisions. We showcase a test of this approach at the Kaʻamola ahupuaʻa on Molokaʻi where local insights and imagery are used to improve conservation planning. Here we present the terrestrial image acquisition and analysis with marine data acquisition to be performed in Summer 2021. This approach is widely applicable across Hawaii and the Pacific and will lead to better management of watershed-coral reef ecosystems.

25

E Hānai ʻAi Ma Ka Muliwai: Assessing the Diets of Forage Fish in Hawaiʻi Estuaries Using DNA Metabarcoding

Nākoa Goo

University of Hawai‘i at Mānoa, Honolulu, HI

Track

IV. Putting Research into Management Practice

Abstract

Native forage fish species that inhabit estuary ecosystems have been harvested for centuries in Hawai‘i as a bait and food resource. These species fulfill a critical ecological role by providing a pathway for energy to flow from lower levels of the food web to higher trophic levels. Following nearly a century of commercial exploitation and habitat degradation, the conservation status of these species remains uncertain due to a variety of threats, including impacts associated with climate change and introduced species. Observed declines in populations of native forage fish made by local fishermen have ignited an urgent call to action in communities where these species once provided an important subsistence fishing resource for generations. This presentation will highlight ongoing research to assess the dietary composition of native forage fishes including nehu (*Encrasicholina purpurea*), ‘iao (*Atherinomorus insularum*) and piha (*Spratelloides delicatulus*) using DNA metabarcoding. Genetic sequence data obtained from the gastrointestinal tracts of fishes will be analyzed to compare the diets of native forage fish to the introduced goldspot herring (*Herklotsichthys quadrimaculatus*), and determine whether native species are being impacted via competitive interactions, or predation. This project aims to address threats to native biodiversity by investigating causes of decline in forage fish populations, and providing an improved understanding of food web dynamics in estuaries throughout Hawai‘i. Outcomes from this research will inform the co-development of management recommendations through collaboration with communities and resource managers to support the replenishment of native forage fish populations, and restore abundance to estuaries throughout Hawai‘i.

26

Investigating the Relative Pollutant Removal Efficiencies of Biochar, Mulch, Coconut Coir, and Native Soils of Hawaii within Stormwater BMPs

Amanda Cording[1], Joana Castillo[2], Roger Babcock[1]

[1]University of Hawaii WRRC, Honolulu, Hawaii. [2]University of Hawaii, Civil and Environmental Engineering Graduate Program, Honolulu, HI

Track

IV. Putting Research into Management Practice

Abstract

The City and County of Honolulu stormwater rules require that new and re-development projects greater than 1-acre implement Green Stormwater Infrastructure (GSI) techniques for stormwater retention and treatment. Although these practices are now widely established in other parts of the U.S., dissolved nutrients, heavy metals, and bacteria removal remain highly variable and heavily influenced by the engineered soil media characteristics and the presence or absence of an internal water storage zone. Given the unique characteristics of the heavily weathered tropical soils of Hawaii, data from the continental U.S. or other non-tropical climatic regions are not likely to predict the performance of GIS systems in Hawaii.

Using locally available materials (soil, compost, mulch, coconut coir, biochar, cinder, and stone), this study investigated the relative removal of soluble and insoluble nutrients, total suspended solids, dissolved heavy metals, and bacteria (i.e., Escherichia coli and Total coliforms) within bioretention and infiltration trench mesocosms. Nine soil blends were dosed with synthetic stormwater and effluent was compared after 4 increasing saturation durations (free drain, 24 hours, 6 days, and 15 days retention time).

Results generally indicate that dissolved nutrients, many heavy metals, total suspended solids, and bacteria decreased with increasing saturation condition, although the results varied by soil blend, with increasing organic matter (e.g., wood chip mulch and low nutrient biochar) enhancing nitrate and bacteria removal, respectively. Infiltration trenches were found to have a negligible effect on pollutant removal.

27

Results of five years of translocation of Hawaiian petrels and Newell's shearwaters at Kilauea Point National Wildlife Refuge, Kauai

Lindsay Young[1], Andre Raine[2], Robert Kohley[1], Heather Tonneson[3], Hannah Nevins[4], Scott Hall[5], Leilani Fowlke[1], Daniela Casilla[1], Eric VanderWerf[1]

[1]Pacific Rim Conservation, Honolulu, HI. [2]Kauai Endangered Seabird Recovery Project, Hanapepe, HI. [3]US Fish and Wildlife Service, Kilauea, HI. [4]American Bird Conservancy, The Plains, VA. [5]National Fish and Wildlife Foundation, Washington, DC

Track

IV. Putting Research into Management Practice

Abstract

Newell's Shearwater (NESH) and Hawaiian Petrels (HAPE) are both listed as Threatened and Endangered under the US Endangered Species Act and are declining due to habitat degradation, predation by introduced predators and collisions with power lines and structures caused by light attraction. Translocation to protected sites with social attraction was proposed in the 2015 Action Plan and 1983

recovery plan. In 2012, funding became available to begin preparing for translocations to Kīlauea Point National Wildlife Refuge, home to one of the largest seabird colonies in the main Hawaiian Islands. A predator proof fence was completed in September 2014 and all non-native mammals were removed from the 7-acre fenced area by January 2015. In August 2015 habitat restoration began and 75 artificial burrows were installed. From 2015-2020 110 HAPE and 87 NESH that had not emerged from their montane burrows were removed by hand and transported via helicopter to the refuge and were hand-fed a fish, oil, Pedialyte and squid mixture until they fledged. A total of 106 HAPE (96%) and 87 NESH (100%) fledged from the site. To date, five translocated HAPE have returned to the site as adults and are expected to begin breeding in 2021. Once complete, this project is expected to result in a new, secured and accessible breeding population of both species that will be crucial along with other protected and managed colonies in helping to prevent the extinction of this species and restoring a missing component of the coastal ecosystem in Hawaii.

28

From Colony to Fallout: Spatial Distribution of ʻUaʻu kani Fledglings Reveal Risks Posed by Artificial Lights Within and Among Islands

Brooke Friswold[1], Jessica Idle[1], Jennifer Learned[2], Jay Penniman[2], Tiana Bolosan[3], Lindsay Young[4], Melissa Price[1]

[1]University of Hawaiʻi at Mānoa, Honolulu, HI. [2]Maui Nui Seabird Recovery Project, Makawao, HI. [3]Hawaiʻi Department of Land and Natural Resources, Honolulu, HI. [4]Pacific Rim Conservation, Honolulu, HI

Track

III. Global and Regional Change & Challenges

Abstract

Seabirds are at a heightened risk of population declines via attraction to, and disorientation by artificial light, resulting in the grounding of individuals ("fallout"). Wedge-tailed Shearwaters (*Ardenna pacifica,* ʻuaʻu kani), an abundant native Hawaiian seabird, experience elevated fallout in the Hawaiian Islands, particularly among fledgling juveniles. To spatially examine fallout, a banding study was conducted on Oʻahu at multiple colonies prior to fledging. Fallout birds with identification bands indicated distances between fallout locations and nesting colonies. Additionally, fallout location radiance, elevation, and distance from fallout location to coastline and roads were analyzed. Fallout data from Maui was obtained and analyzed for comparison. Our results demonstrated surprisingly varied bicoastal fallout, with distances between nesting colonies and fallout locations on Oʻahu ($\bar{x}$ = 24.71 km) greater than Maui ($\bar{x}$ = 8.39 km). On Oʻahu, no fledglings came from the nearest colony to their fallout location. Additionally, a Principal Component Analysis identified fallout location radiance and proximity to nesting colony, (although greater than expected), as the most influential variables in fallout location, with the other variables still exerting influence. Light pollution played a stronger role in fallout at greater distances than expected, with a bird from an Oʻahu nesting colony recovered on Maui at a high radiance location. Overall. we suggest that all artificial lights in the Hawaiian archipelago pose

some fallout risk to seabirds, including those 100+ km away from their nesting colony. Collaborative, large-scale light management for fledging seasons is critical to the recovery of Pacific Island seabird populations.

29

Efficacy and Efficiency of DOC-200 Versus Tomahawk Traps for Controlling Small Indian Mongoose (*Herpestus javanicus*) in Wetland Wildlife Sanctuaries

Lisa Roerk[1,2], Lindsey Nietmann[1], Aaron Works[1]

[1]Department of Land and Natural Resources Division of Forestry and Wildlife, Honolulu, HI. [2]Kupu, Honolulu, HI

Track

III. Global and Regional Change & Challenges

Abstract

The introduction of the small Indian mongoose (Herpestus javanicus) devastated native fauna in Hawai‘i, especially ground-nesting endangered waterbirds. Predator trapping is a vital wildlife management practice for Hawai‘i’s wetlands, since endangered waterbirds are considered ‘conservation-reliant’. This study examines how efficiency and efficacy of trapping can be improved by comparing DOC-200 kill traps to Tomahawk live traps, while observing mongoose behavior around traps. Twenty-five trap pairs will be deployed at Kawainui Marsh State Wildlife Sanctuary on O‘ahu from February to May of 2021, followed by analysis and results by June. Total mongoose catch per trap type will be analyzed using a paired samples test. To compare efficiency (i.e. cost per mongoose) between traps, a subset of the trap checks will be timed for baiting and checking, euthanasia costs will also be factored in. Randomly selected trap pairs will be monitored using a trail camera with infrared triggering. Videos will be analyzed for any qualitative preference mongoose may have for either trap (i.e. visiting versus entering trap) as well as any adjustments that can be made to improve each trap following the study. Trap comparison research can improve our trapping regimen and can be utilized and implemented for other study areas that employ predator control methods for mammals. Results of a more efficient and effective trap can greatly reduce costs and increase success rate for agencies that deploy these traps. Reducing mongoose population prevents the depredation of native species, transfer of diseases, and increases the abundance of prey species.

30

Applications of Drone Data for Science, Conservation and Education: Examples from Hawai'i and Antarctica

Derek Ford

University of Hawaii at Manoa, Honolulu, HI. Island UAV LLC, Waipahu, HI

Track

V. New Technologies in Conservation Research and Management

Abstract

This poster presents three case studies which demonstrate a variety of drone data analysis techniques for science, conservation and educational purposes. Firstly is a study on tree species mapping in the Pupukea forest reserve using drone data and deep learning. In this study three classification algorithms were tested for identifying five dominant plant species or family of species. Highest overall accuracy of 71% was achieved, and African Tulip was identified with 95% accuracy. This study is presented as an example of how accurately and to what level of detail tree species can be affordably mapped within a dense mixed forest setting in Hawai'i. Secondly is an analysis of land cover and surface temperature in Antarctic moss banks using visible light, near-infrared (NIR) and thermal-infrared (TIR) data collected from a multi-sensor drone. It was found that vegetated surfaces get warmer than non-vegetated surfaces under sunny conditions. This study showcases two drone data analysis techniques in particular: the use of normalized difference vegetation index (NDVI) for vegetation mapping, and modeling solar radiation from the drone-derived DEM. This study also demonstrates the versatility of drones and miniaturized sensors. Thirdly is an educational exercise involving school campus surface hydrology mapping conducted by high school students using drone data and ArcGIS. Within this exercise students learned how to use a drone-derived digital elevation model (DEM) to create surface flow accumulation models and identify important areas on campus for water retention features. This case study demonstrates the educational potential of drones for science and conservation.

31

Olonā in Moloka'i traditions

Russell Kallstrom

The Nature Conservancy, Kualapuu, Hawaii

Track

VI. Place-based Conservation

Abstract

A brief look at olonā (*Touchardia latifolia*), its traditions and importance in ancient times with respect to Moloka'i. Tags: olonā, place names, 'ōlelo no'eau, wao lā'au, hālau, Moloka'i

32

Seeds From Herbarium Collections as a Last Conservation Resort for Resurrecting Extinct or Critically Endangered Kaua‘i Plants

Kelli Jones, Dustin Wolkis, Nina Rønsted

National Tropical Botanical Garden, Kalāheo, HI

Track

III. Global and Regional Change & Challenges

Abstract

Herbarium seeds have been suggested as a last option for resurrecting extinct plants. While living collections and seed banks provide ideal storage and source material for propagation, not all extinct or near-extinct taxa are represented in such collections. Herbarium collections may also offer broader/unique/lost genetic/locality representation. We examined specimens from the herbarium of the National Tropical Botanical Garden (NTBG) representing species from the Plant Extinction Prevention Program (PEPP) list of Kaua‘i taxa (taxa with less than 50 individuals left in the wild). We examined a total of 1250 specimens. Of these, 137 specimens had at least 5 mature seeds allowing a sampling maximum of 20% for propagation. To test for germinability, seeds were rehydrated, sanitized, sown on blotter paper and exposed to a 12/12 hour lighting regime at 25/15 C° thermoperiod for 90 days. None of the seeds germinated and all were transferred for further propagation in the NTBG nursery. The NTBG herbarium included 37 of 81 Kaua‘i PEPP taxa (46%). Of these, six taxa (23%) were not conserved in the NTBG Seed Bank. Seeds were only found on 11% of the specimens suggesting that herbarium specimens typically represent flowering or sterile stages. While the high representation of Kaua‘i PEPP taxa in the herbarium supports the idea that herbaria can be a last option for resurrecting extinct plants, none of the seeds germinated. We recommend that efforts continue to conserve rare and endangered plant taxa in living collections and seed banks with optimal storage conditions.

33

Exploring Microbial Indicators of Coastal Ecosystem Health Across a Gradient of Human Development in Tutuila, American Samoa

Becca Lensing[1], Ashley Nalani Olguin[1], Veronica Gibson[2], Christopher Shuler[3,4], Daniel Amato[2,4], Lydia Baker[5], Craig Nelson[6,7], Henrietta Dulai[3,4], Celia Smith[1,2], Rosanna Alegado[6,7]

[1]Marine Biology Graduate Program, University of Hawai‘i at Mānoa, Honolulu, HI. [2]School of Life Sciences, University of Hawai‘i at Mānoa, Honolulu, HI. [3]Department of Earth Sciences, University of Hawai‘i at Mānoa, Honolulu, HI. [4]Water Resources Research Center, University of Hawai‘i at Mānoa, Honolulu, HI. [5]Cornell University, Ithaca, NY. [6]Department of Oceanography, University of Hawai‘i at Mānoa, Honolulu, HI. [7]Daniel K. Inouye Center for Microbial Oceanography: Research and Education, University of Hawai‘i at Mānoa, Honolulu, HI

Track

V. New Technologies in Conservation Research and Management

Abstract

On Pacific islands, subsistence agriculture and fishing remain essential for sustaining Indigenous populations, yet intensified agriculture and increased wastewater impacts have significantly altered the state of coastal ecosystems. Concomitant shifts in coastal microbial assemblages can alter nutrient cycling and create human health issues. Moreover, having informative microbial datasets available could support management decisions, but are often absent or rely on a single indicator species. Our primary objective was to apply water quality monitoring tools developed and implemented in the Hawaiian Islands to augment ongoing water quality monitoring on Tutuila, American Samoa, specifically identifying microbial indicators of ecosystem health in areas vulnerable to water quality degradation. We genetically surveyed microbial assemblages from coastal water, biofilms, and two coral species from four watersheds on Tutuila, across a gradient of development levels. Sample type efficiency and bias in environmental monitoring were evaluated and identified critical links between coastal water quality and microbial assemblages among development levels. Microbial indicators of development level were identified in all sample types. Results showed higher than expected nitrogen levels at a semi-pristine site, possibly representing a critical hot spot for anthropogenic change, and all sample types differentiated between development levels but with varying patterns and clarity. This work supports existing monitoring and assessment projects to integrate a diverse array of biological and physical datasets into a decision-making framework. This multi-dimensional study has enabled a better understanding of commensurate responses in coastal microbial assemblages that will inform future methodologies and aid resource managers in on-going monitoring of coastal ecosystems.

34

Initial Success of Reintroduction Efforts for the Orangeblack Hawaiian Damselfly (*Megalagrion xanthomelas*) on O‘ahu

Matthew Sandrich[1,2], William Haines[1,2], Katrina Scheiner[1,2], Kelli Konicek[1,2], Momi Pearlman[1,2], Karl Magnacca[3], Kapua Kawelo[4], Cynthia King[1]

[1]Department of Land and Natural Resources, Division of Forestry and Wildlife, Honolulu, HI. [2]University of Hawaii, Center for Conservation Research and Training, Honolulu, HI. [3]University of Hawaii, Office of the Vice President for Research and Innovation, Honolulu, Hawaii. [4]United States Army Garrison, Hawaii, Honolulu, HI

Track

III. Global and Regional Change & Challenges

Abstract

The orangeblack Hawaiian damselfly (*Megalagrion xanthomelas*) is an endangered, endemic Hawaiian damselfly (pinapinao) with small populations on Oʻahu, Molokaʻi, Maui, and Hawaiʻi Island. Nonnative fish are a primary cause of decline of this species. On Oʻahu, there is a single known wild population at the Tripler Army Medical Center. In 2018, the Hawaiʻi Invertebrate Program (HIP) began a captive rearing and reintroduction program for *M. xanthomelas*. Reintroductions of captive-reared naiads were attempted at both Lyon Arboretum and Waiʻanae Kai Forest Reserve in 2019 but were ultimately unsuccessful. In June 2020, HIP and the Army's Natural Resources Program began weekly *M. xanthomelas* releases at Dillingham Military Reservation (DMR). The selected site, a 420 m stretch of a spring-fed, fish-free stream, was the target of an unsuccessful attempt to translocate wild-caught damselflies in 1999. As of February 2021, over 3,000 captive-reared adult damselflies, marked with individual ID numbers for tracking, have been released at DMR. Weekly monitoring of the stream revealed continual use by released damselflies, including mating and egg-laying. In November 2020, wild-born, adult *M. xanthomelas* were observed at the stream, marking the first documented wild-born generation of *M. xanthomelas* after a reintroduction attempt. Damselflies from the wild generation were captured and marked with unique ID numbers, and new wild-born individuals continue to emerge weekly. The completion of a wild generation represents an exciting milestone in preventing extinction of *M. xanthomelas*, but continued monitoring is needed to assess the long term establishment of this new wild population.

35

Cultivating Conservation Connection in an Age of Disconnection: A Kauaʻi Middle School's Student Run Native Plant Garden

Breghan Klein

Division of Forestry and Wildlife - Kauaʻi Branch, Līhuʻe, HI

Track

II. Capacity in Conservation

Abstract

Transformation in the way that conservation is practiced begins with teaching environmental management to the greatest stewards of natural spaces, children. Fostering a connection with the environment creates impactful change in the conservation field for Hawaiʻi's youth because it prioritizes hands on learning rather than being stuck at a desk. The future of conservation relies on the upcoming generation with the students of Chiefess Kamakahelei Middle School being a prime example. The Kauaʻi Division of Forestry and Wildlife has partnered with Chiefess Kamakahelei Middle School to dedicate a plot of land to native plants for environmental education and to teach cultural traditions in the era of COVID where students lack community engagement and opportunity. Children's education has been uprooted, and this partnership is a way to combat against the isolation that COVID has caused. To create a successful connection with the environment, students spend weekly class sessions outside weeding, watering plants, identifying indigenous versus endemic plants, and finishing assignments focused on understanding why native plants are so important to Hawaiʻi's culture. Successful results are produced on a weekly basis at Chiefess Kamakahelei Middle School as students get to spend time outside

connecting to one another and to the land instead of staring at a screen inside of a classroom. This presentation exhibits how digging into soil, touching native plants like ōhiʻa, aʻaliʻi, maile, etc., and how working as a community in the outdoors can inspire Hawaiʻi's youth to create a lasting connection to the ʻāina.

36

An Overview of Rapid ʻŌhiʻa Death Entomology Research and the Use of Chemical Ecology for ʻŌhiʻa Stewardship

Kylle Roy[1,2], Matthew Ginzel[3], Robert Peck[4], Ellen Dunkle[4], Dan Mikros[4]

[1]USGS PIERC, Hawaii National Park, Hawaii. [2]Purdue University, Lafayette, Indiana. [3]Purdue Univesity, Lafayette, Indiana. [4]Hawaii Cooperative Studies Unit, Hilo, HI

Track

IV. Putting Research into Management Practice

Abstract

The spread of Rapid ʻŌhiʻa Death (ROD), an emerging and deadly disease caused by the fungal pathogens *Ceratocystis lukuohia* and *Ceratocystis huliohia,* has been linked to ambrosia beetles (Coleoptera: Curculionidae), particularly those of the Xyleborini tribe. These fungal pathogens are decimating the ecologically- and culturally- foundational tree, ʻōhiʻa (*Metrosideros polymorpha*) in Hawaiʻi, and it has been estimated that ROD has killed at least one million ʻōhiʻa trees. There is a critical need to develop ambrosia beetle management strategies to mitigate the spread of ROD. Developing effective management plans for ambrosia beetles can be applied to forest and agricultural systems throughout Hawai'i and beyond as these beetles are pests of forests and agricultural systems around the world. Understanding the chemical ecology of the disease could lead to early detection and semiochemical-based management tools to manipulate populations to protect high-value tree stands and individual ʻōhiʻa. This presentation will provide an overview of the past ROD entomology research regarding the role ambrosia beetles play in ROD dissemination, decontamination techniques, and the future use of semiochemicals for beetle management.

37

Rapid ʻŌhiʻa Death: What we have learned from over five years of intensive research and the future of ʻōhiʻa stewardship

Kylle Roy[1,2], Flint Hughes[3]

[1]USGS-PIERC, Hawaii National Park, Hawaii. [2]Purdue University, Lafayette, Indiana. [3]Institute for Pacific Islands Forestry, Pacific Southwest Research Station, USDA Forest Service, Hilo, Hawaii

Track

IV. Putting Research into Management Practice

Abstract

Rapid ʻŌhiʻa Death (ROD) has killed over 1 million ʻōhiʻa (*Metrosideros polymorpha*) trees since first reported from the Puna District of Hawaiʻi Island in 2010. ʻŌhiʻa are ubiquitously important to both the Hawaiian landscape and Hawaiian culture, therefore this new threat triggered a rapid response of research and adaptive management. Multiple agencies have come together to save the invaluable trees, generously supported by numerous state and government agencies. After over five years of intensive research, we have made great strides in understanding the disease and may be at a turning point to *kūlia i ka hulia*, and collectively focus our efforts on ʻōhiʻa stewardship. This symposium will focus on the research and lessons learned since the discovery of the disease, with an emphasis on the understanding of the vectors of the pathogens and how we will take this knowledge and apply it towards ʻōhiʻa stewardship. Topics will include the role of ambrosia beetles and ungulates in the spread of ROD, and the movement of fungal inoculum in soil, wind, and water pathways. The symposium will finish with a panel discussion by the presenters regarding the outlook of ʻōhiʻa longevity.

Agenda & Additional Required Information for Forums, Workshops, and Trainings

The goal of this symposia is to be reflective on the past Rapid ʻŌhiʻa Death research and identify the needs for future ʻōhiʻa stewardship.

Schedule of Confirmed Presenters:

1. Title: Ambrosia beetles (Coleoptera: Scolytinae) as casual vectors of Rapid Ohia Death

Presenter: Ellen Dunkle

Affiliation: Hawaiʻi Cooperative Studies Unit

2. Title: The ʻŌhiʻa Disease Resistance Program: Building the foundation of a resistance program to return ʻōhiʻa to our ROD-impacted spaces

Presenter: Blaine Luiz ʻŌhiʻa Disease Resistance Program Coordinator

Affiliation: Akaka Foundation for Tropical Forests

3. Title: How long does ʻōhiʻa infected with Rapid ʻŌhiʻa Death (ROD) remain a source of infectious inoculum?"

Presenter: Robert W. Peck

Affiliation: Hawaiʻi Cooperative Studies Unit

4. Title: Rapid ʻŌhiʻa Death: Stand-scale patterns, dynamics, impacts, and prospects for management.

Presenter: Flint Hughes

Affiliation: Institute for Pacific Islands Forestry, Pacific Southwest Research Station, USDA Forest Service.

5. Title: Optimization of soil viability testing techniques for *Ceratocystis lukuohia*

Presenter: Gabriela Benito

Affiliation: Pacific Cooperative Studies Unit and USDA Forest Service IPIF

6. Title: An overview of Rapid ʻŌhiʻa Death entomology research and the use of chemical ecology for ʻōhiʻa stewardship

Presenter: Kylle Roy

Affiliation: USGS-PIERC and Purdue University

7. Title: Genetic fingerprinting traces the introduction and movement of *Ceratocystis lukuohia* on Hawai'i and Kaua'i Islands

Presenter: Thomas Harrington

Affiliation: Iowa State University

8. Title: Kauai's ROD Response: Adaptive Strategies and Innovative Management

Presenters: Brenna Fowler + Kalli Harshman

Affiliation: KISC + DOFAW

9. Title: Disease Threats and Management to Trees in Hawaiʻi: A Mix of Old and New

Presenter: Marc Hughes

Affiliation: Paciffic Cooperative Studies Unit and USDA Forest Service IPIF

10. Title: ʻŌhiʻa regeneration following mass defoliation due to *Austropuccinia psidii* in the northern Koʻolau, O'ahu

Presenter: Will Weaver

Affiliation: Natural Resource Manager at Ko'olau Mountains Watershed Partnership

11. Title: Expanding ROD monitoring efforts via high-resolution satellite imagery

Presenter: Ryan Perroy

Affiliation: Spatial Data Analysis and Visualization University of Hawai'i at Hilo

12. Statewide Rapid ʻŌhiʻa Death Surveillance and Monitoring 2020 Summary

Presenter: Brian Tucker, Robert D. Hauff, and William T. Stormont

Affiliation: Pacific Cooperative Studies Unit

13. Title: Don't Do That!: Using social psychology to create an effective message for encouraging use of a boot brush station

Presenter: Franny Brewer

Affiliation: Big Island Invasive Species Committee

14. Title: Using high-resolution imagery to quantify differences in Rapid ʻŌhiʻa Death mortality associated with ungulate presence or absence on Hawaiʻi Island

Presenter: Ryan Perroy

Affiliation: Big Island Invasive Species Committee

20 minute panel discussion

38

New County Legislation Expands the Capacity for the Preservation and Restoration of Native Forest Habitats on the Island of Hawai‘i

Sebastian Ma‘a[1], Rebecca Ostertag[1], Susan Cordell[2], Leslie Cole-Brooks[3], Lisa Miura[4], Keita Jo[4]

[1]University of Hawai‘i at Hilo, Hilo, HI. [2]Institute of Pacific Islands Forestry, Hilo, HI. [3]Leslie Cole-Brooks LLC, Pāpa‘aloa, HI. [4]County of Hawai‘i Real Property Tax Division, Hilo, HI

Track

II. Capacity in Conservation

Abstract

The County of Hawai‘i Real Property Tax Division native forest dedication program has been expanded to provide private landowners with reduced property tax rates for dedicating their land to native forest. Native Forest Bill 178 made significant amendments to many aspects of the existing law including expanded options for native forest categories and changes to the financial and procedural requirements for native forest dedications. Ordinance number 20-60 establishes a dedication process for forest preservation and restoration for private landowners who dedicate a minimum of 2.75 acres of contiguous native forest habitat. To support this legislation, a team from UH Hilo, USDA Forest Service, and an environmental lawyer created new resources to outline descriptions of each program, how to apply, and provide tools to maximize the success of the individuals participating in this community-based native forest restoration program. Examples include a native, non-native/non-invasive plant species list and an accompanying plant nursery list, a management plan template that allows landowners to develop management plans without the help of a certified natural resource management professional, and an evaluation checklist that the County will use to evaluate management plans. This legislation, which is the first of its kind in the State, not only facilitates community-based native forest preservation and restoration projects but, also carries substantial ecologic, cultural, and economic implications as it increases habitat connectivity of native forests throughout the County of Hawai‘i while ensuring the continuation of ecosystem services that support our existence here in the middle of the Pacific.

39

Automating Coral Species Segmentation and Classification from High-Resolution Coral Reef Imagery

Sofia Ferreira[1], John Burns[1], Peter Sadowski[2]

[1]University of Hawaii at Hilo, Hilo, HI. [2]University of Hawaii at Manoa, Honolulu, HI

Track

V. New Technologies in Conservation Research and Management

Abstract

Coral reefs are exceptionally productive and valuable ecosystems. They support high levels of marine biodiversity and provide critical resources for human livelihood and well-being. Unfortunately, these environments are rapidly degrading worldwide and thus the availability of ecosystem services is in decline. Scientists have recently been using Structure-from-motion (SfM) photogrammetry to produce high-resolution 3D reconstructions of coral reef habitats. The models contain valuable data that allow scientists to better understand the ecology and biology of these highly complex ecosystems. Community composition data, for example, is currently obtained by manually annotating every colony on digital orthomosaics. While this approach produces useful ecological data, it is a substantially time-consuming process given a single plot may contain anywhere from hundreds to thousands of individual coral colonies. Considering the rapid ecosystem decline, innovative advancements are needed to automate and expedite this process. The objective of this project is to develop a reproducible machine learning (ML) workflow to automate the segmentation and classification of coral colonies from reef imagery. We used manually annotated and validated data as a training dataset for object detection models in order to determine which ML techniques are most accurate and efficient for this particular task. By expediting these repeatable and time-consuming tasks, we can create an automated data processing pipeline to be used for large-scale reef monitoring. Monitoring reef habitats at a larger spatial scale using 3D SfM along with ML techniques can greatly optimize coral reef research and aid in developing strategic conservation plans.

40

Teens Creating Conservation Innovations: Students Share Their Hawai‘i Youth Sustainability Challenge Projects

Elia Herman[1], Natalie McKinney[2], Lindsay Todd[1], Paahana Kincaid[1]

[1]Kupu, Honolulu, HI. [2]Kokua Hawaii Foundation, Haleiwa, HI

Track

II. Capacity in Conservation

Abstract

The Hawai‘i Youth Sustainability Challenge, a program of Kupu and Kokua Hawai‘i Foundation, helps students develop innovative solutions to conservation challenges identified in their schools and communities. New to the program this year are “community partnership challenges” in which organizations from across the state identified the top problems they confront that would benefit from creative solutions developed by students. The 2020-2021 cohort comprises 18 project teams, four of which are addressing community partner challenges. These teams are composed of 37 student leads in grades 9-12 from across Hawai‘i. Student projects include: investigating water quality issues, innovating new technologies, designing sustainable products, reducing waste, addressing food insecurity, conserving native plants and forests, and much more. Teams are awarded up to $1000 and projects are conducted throughout Spring 2021 with the support of mentors. For the first time, students are also receiving training on a range of topics including action planning, entrepreneurship, and strategic communications to support project work and build personal toolkits to help them now and in the future. During this forum we will share the successes and challenges of the new program components, and five exemplary project teams will present their work and engage in meaningful exchange with the audience on the opportunities and challenges they encountered as young people building a more sustainable Hawai‘i. The forum also provides an opportunity for intergenerational learning, and will help aspiring students build a network they can draw from moving forward.

Agenda & Additional Required Information for Forums, Workshops, and Trainings

AGENDA

1. Overview of Hawaii Youth Sustainability Challenge (including deep dive into new program pieces) by Kupu and KHF staff, including 1 min video (8 min)
2. Student Presentations (5 presentations x 5 min = 25 min)
3. Facilitated Q & A for all presenters (20 min)
4. Program Discussion/Crowdsource to identify Community Partner Challenges and new partnerships for students for HYSC 2022 (7 min)

Presenters

- Elia Herman, Senior Program Manager, Kupu
- Natalie McKinney, Executive Director, Kokua Hawaii Foundation
- 5 student project teams (presenting teams will be selected in May/June 2021 at the completion of the program and upon submission of their final reports)

Goals and Target Audience: The goal of the forum is to provide a space to inspire the audience (by giving them the chance to hear about the students' passion and innovative work) and empower the students (by giving them the opportunity to share their work in a formal setting in front of respected professionals). Furthermore, the goal is for both professionals and students to exchange ideas to help improve each other's work and for the students to make connections they can draw on in the future. The target audience is resource managers and practitioners, as well as formal and non-formal educators.

41

Policy Analysis of Sustainable Agricultural Water Management and Agri Food System in Hawai'i

Rupananda Widanage, Catherine Chan, Kirsten Oleson, Yin-Phang Tsang

University of hawai'i, Honolulu, Hawai'i

Track

VI. Place-based Conservation

Abstract

The objectives of this paper are to conduct a policy analysis of water diversion between increasing local food production and the conservation of wetland ecosystem services and to provide necessary information for decision makers to design policy strategies for sustainable agricultural water management and agri-food system in Hawai'i. Hawai'i Department of Agriculture (HDOA), Board of Water Supply (BWS), Honolulu, and civil society are interested in improving economic and ecological gains in agricultural water use in Hawai'i. Hawai'i state has been implementing policies and programs for improving food self-sufficiency. This creates an additional potential demand for agricultural water use. Similarly, wetland provides foraging and breeding services for water bird population. Thus, hydrological conditions in wetland play a significant role in water bird conservation. Hence, there is a competition for water between local food production and the conservation of water bird population. This competition creates trade-off in water diversion. The current agricultural water pricing policy is consistent with neither economic efficiency nor ecological sustainability. This paper employs a rational policy analysis model to identify policy strategies for agricultural water management and sustainable agri-food system in Hawai'i. The findings of the policy analysis emphasize the combinations of market-based approach, ecosystem-based management, and climate smart agricultural practices for maximizing economic and ecological gains in agricultural water use. Hence, this analysis provides a rationale for appropriate government intervention to reallocate water resources to achieve socially desirable goals other than economic efficiency such as fair distribution of water and wetland conservation.

42

Mapping Coconut Palm Dominance on 270 Remote Pacific Islands using Very High Resolution Satellite Imagery

Michael Burnett[1], Rory French[2], Timothy White[3], Zheng Yan[3], Nick Holmes[4], Alexander Wegmann[5]

[1]The Nature Conservancy, Kamuela, HI. [2]UC Berkeley, Berkeley, CA. [3]Stanford University, Stanford, CA. [4]The Nature Conservancy, San Francisco, CA. [5]The Nature Conservancy, Honolulu, HI

Track

V. New Technologies in Conservation Research and Management

Abstract

Remote atolls and coral islands in the Pacific are home to ecosystems of remarkable diversity and productivity, where seabirds supply nutrients from the open ocean to support tropical forests and thriving reefs. But these connections between the pelagic, terrestrial, and coastal realms are also hotspots of anthropogenic change: evidence suggests that the widespread conversion of native broadleaf forests to monocultures of coconut palm (*Cocos nucifera*)—the most important tree for islanders' livelihoods—reduces the available nesting area for seabirds, thus limiting nutrient inputs and altering food webs. We set out to create the first Pacific-wide assessment of coconut dominance on low coral islands, which has only recently been made possible by the availability of high-resolution satellite imagery. We acquired 490 cropped WorldView-2 images covering nearly every remote low island in the Pacific (270 islands with 2,418 sq. km of land area) at 50 cm resolution and generated 8 gray-level co-occurrence matrix (GLCM) textural features from every image. Our classification system uses a "random forest" machine learning algorithm and geometric lighting corrections; in trials, a classification of Palmyra Atoll in the Northern Line Islands achieved 97% accuracy in distinguishing between coconut palms, native broadleaf trees, shrubs, and non-vegetated land. In addition to quantifying the dominance of coconut across the Pacific, we will publish georeferenced forest maps of all 270 islands in the study.

43

Scent Detection Dogs Sniff for Yellow Crazy Ants at Johnston Atoll National Wildlife Refuge

Aisha Rickli-Rahman[1], Kyoko Johnson[2], Sheldon Plentovich[3], Michelle Reynolds[2], Beth Flint[1], Kate Toniolo[1], Kendra Maty[4], Keely Hassett[5]

[1]U.S. Fish and Wildlife Service Pacific Islands Refuges and Monuments Office, Honolulu, Hawaii. [2]Country Canine LLC, Waialua, Hawaii. [3]U.S. Fish and Wildlife Service Pacific Islands Fish and Wildlife Office,

Honolulu, Hawaii. [4]U.S. Fish and Wildlife Service Realty Mapping and Survey Branch, Portland, Oregon. [5]U.S. Fish and Wildlife Service Interior Region 12 Invasive Species Strike Team, Kahuku, Hawaii

Track

III. Global and Regional Change & Challenges

Abstract

Yellow crazy ants, *Anoplolepis gracilipes* (YCA), an invasive species harmful to components of island ecosystems including breeding seabirds, were discovered in 2010 at Johnston Atoll National Wildlife Refuge, part of Pacific Remote Islands Marine National Monument. Since discovery, 20 crews have deployed to work towards eradicating YCA by applying formicides. Biologists doing visual searches last detected YCA in December 2017. We trained then deployed two Hawaii-based scent detection dogs to Johnston for two weeks in December 2020 to locate YCA, which may still be present at low densities. We used mapping-grade GPS devices with ≤ 5m accuracy to map survey tracks of canine-handler teams. We quantified search effort by estimating detection distances for each dog using YCA odor training aids hidden during operational YCA surveillance to document search coverage by canine-handler teams. We surveyed 177 km over 53 ha of treatment area, in approximately 84 hrs. Solo and his human team tracked an average of 6.7 km/day (range=2.4-10.4km/day; n=24); Guinness and his human team averaged 7.0 km/day (range=2.8-8.9km/day; n=21). Average YCA detection distance (using training aids) was 6.4 m (range=2.1-14.8m; n=22). Dogs surveyed priority areas 1-3 times, where YCA were most recently detected. Seventy-three percent (53 of 72 hectares) of the treatment area (buffered infestation area), was successfully surveyed. No YCA were detected over the 14-day period. Field biologists will continue surveillance and response until June 2021. Employing detection canines combined with hand-searching and other survey techniques at Johnston Atoll cumulatively help to evaluate the goal of YCA eradication.

44

Responding to the Climate Crisis in Hawai‘i: Recent Experience with Landscape Scale Conservation

Wendy Miles[1,2], Susanne Moser[3], Deanna Spooner[4]

[1]U.S. Fish & Wildlife Service, Honolulu, HI. [2]East-West Center, Honolulu, HI. [3]Susanne Moser Research & Consulting, Hadley, MA. [4]U.S. Fish & Wildlife Service (retired), Roseburg, OR

Track

II. Capacity in Conservation

Abstract

An important shift occurred in Hawai‘i during the first two decades of the 21st century, as climate change was increasingly discussed, understood, and incorporated into the management of natural and

biocultural resources. This presentation reflects on this recent history, and our collective process of kūlia i ka huliau (striving for change) in the face of the growing climate crisis. Based on a survey and semi-structured interviews with representatives from across Hawai‘i’s government agencies (county, state, and federal), Native Hawaiian and non-governmental organizations, large-scale private land management entities, and academic institutions, we examine the journey to mainstreaming climate science into natural and biocultural resource management in Hawai‘i during the decade from 2009 to 2018. We revisit challenges that have been overcome before exploring the most daunting adaptation barriers ahead—ranked and described by natural and biocultural resource managers in Hawai‘i. The presentation points to important gaps that need to be filled in the future and offers recommendations shared by representatives from Hawai‘i’s conservation community. Based on lessons learned to-date, they help managers of natural and biocultural resources along on the next leg of this transformational journey towards environmental and community resilience.

45

Evaluating 50 years of ‘Ae‘o (Hawaiian Stilt) Reproductive Success

Jessica Idle[1], Kristen Harmon[1], J. Michael Reed[2], Melissa Price[1]

[1]University of Hawaii at Manoa, Honolulu, HI. [2]Tufts University, Medford, MA

Track

IV. Putting Research into Management Practice

Abstract

‘Ae‘o (Hawaiian Stilt; *Himantopus mexicanus knudensi*) are one of four remaining species of endangered native waterbirds in Hawai‘i. The ‘ae‘o population is under assessment for potential down-listing from ‘endangered’ to ‘threatened’. An evaluation of ‘ae‘o reproductive success is necessary to improve population assessments for this subspecies. In this study, we conducted a temporal assessment of ‘ae‘o reproductive success using present-day field observations and historical data. Present-day reproductive success metrics were collected for ‘ae‘o nesting in wetlands on O‘ahu from 2018-2020. We elicited historical data from past published literature and unpublished reports spanning the last 50 years. We first summarized the methods by which reproductive data were collected and calculated across the literature. We then used raw reproductive values from our field observations and the literature to construct linear regression models that assess changes in each reproductive success metric over time across nesting sites. We identified several reproductive success metrics that have been calculated or extracted including effort, clutch size, hatching success, hatch rate, fledging success, recruitment, and overall reproductive success. Reproductive metrics stayed relatively stable over time; however, recruitment and overall reproductive success, representing the production of individuals that reach the flight stage, have not improved over time, suggesting a need for additional and innovative conservation actions. Differences in methods for data collection and reproductive success metric calculations were substantial across sites and over time, suggesting the need to establish standardized methodologies across the state to allow for improved population assessments.

46

Landscape Prioritization for Climate-Resilient Rare Species Conservation in Maui Nui

Lucas Berio Fortini[1], Christina R. Leopold[2], J. Scott Fretz[3], Fred Amidon[4], Matthew Keir[5], Lauren Weisenberger[6], Fern Duvall[7], Henry Oppenheimer[8], James Jacobi[9], Jonathan Price[10], Loyal Mehrhoff[11], Stephen E. Miller[12], Robert D. Sutter[13]

[1]Pacific Island Ecosystems Research Center, U.S. Geological Survey, Honolulu, HI. [2]Hawai'i Cooperative Studies Unit, University of Hawai'i at Hilo, Hilo, HI. [3]State of Hawai'i, Division of Forestry and Wildlife, Kahului, HI. [4]Pacific Islands Fish and Wildlife Office, U.S. Fish & Wildlife Service, Honolulu, HI. [5]State of Hawai'i, Division of Forestry and Wildlife, Honolulu, HI. [6]U.S. Fish & Wildlife Service Pacific Region, Honolulu, HI. [7]State of Hawai'i, Division of Forestry and Wildlife, Kahului, Maui. [8]Plant Extinction Prevention Program, University of Hawai'i, PCSU, Kahului, HI. [9]Pacific Island Ecosystems Research Center, U.S. Geological Survey, Volcano, HI. [10]University of Hawai'i, Hilo, Hilo, HI. [11]Retired, U.S. Fish and Wildlife Service, Hawai'i, Honolulu, HI. [12]Pacific Islands Fish and Wildlife Office, U.S. Fish and Wildlife Service, Honolulu, HI. [13]Enduring Conservation Outcomes, Honolulu, HI

Track

IV. Putting Research into Management Practice

Abstract

Identifying priority areas for conservation can help allocate limited resources towards the effective recovery of Hawaiian plant species at risk of extinction. However, this not only requires considering the distribution of existing endangered populations and broader available habitat for individual species, but how these species distributions overlap with those from other endangered plant species. Additionally, consideration of other factors such as changing climatic conditions, the distribution of invasive species, co-occurrence of other important taxa (e.g. forest bird distributions), and differences in cost and access of areas may make resulting plans more or less implementable by conservation practitioners.

In partnership with state, federal and private land managers and species experts, we co-developed an optimization framework that integrates the factors above to help prioritize landscape conservation efforts for rare plants in Maui Nui. Using East Maui as a focus area, we used current and historical plant population data, and predictive habitat suitability models from multiple target species to identify potential recovery areas across 36 endangered species. Multiple landscape configurations met recovery targets across all species, allowing managers and experts to select configurations based on tradeoffs across multiple criteria such as climate resilience, accessibility, and habitat quality. The resulting outputs identify both the overall landscape footprint needed to collectively meet recovery goals and to prioritize areas for individual species management. Our approach provides a transparent, adaptable method inclusive of management needs and realities, that further demonstrates that co-production of knowledge between researchers and management can lead to optimized conservation plans.

47

Research Update on Biological and Chemical Control of Coconut Rhinoceros Beetle in Hawaii

Zhiqiang Cheng, Mason Russo

University of Hawaii at Manoa, Honolulu, HI

Track

IV. Putting Research into Management Practice

Abstract

Coconut rhinoceros beetle (CRB) is a large scarab beetle native to Southeast Asia and a severe pest of palms, most notably coconut palm and oil palm, but potentially also some native Hawaiian palm species. CRB adults damage palms, particularly younger ones, by boring into the center of the crown, where they injure the young, growing tissues and feed on the sap. In Hawaii, CRB was first confirmed on Oahu in December 2013. This presentation reports our ongoing research on biological and chemical control of CRB. For biological control of CRB, we have collected over 60 entomopathogenic fungal strains and over 20 entomopathogenic nematode strains from various sites on Oahu. Based on our lab assays, we identified 6 *Metarhizium* strains that caused > 70% mortality of CRB larvae. A small-scale field trial with 3 most effective *Metarhizium* strains resulted in 40% mortality of CRB larvae in field conditions. Based on our recent chemical control lab assays, we identified that dinotefuran and abamectin were very effective against CRB adults, with 100% beetles negatively affected by dinotefuran within 4 hours (mortality or paralysis), and 100% beetles negatively affected by abamectin within 24 hours (mortality or paralysis). Based on these lab assay results and our previous CRB research, we are currently conducting 2 field trials with 70 coconut palms using dinotefuran, abamectin, imidacloprid, and acephate, delivered via trunk injection. Most up-to-date research results will be presented at the 2021 HCC. The end product of this research is an IPM program protecting palms from CRB in Hawaii.

48

Defining Timelines for Spore-to-Sporophyte Growth in Hawaiian Native Ferns to Advise Conservation Management Planning

Charlet Hotchkiss, Mike Demotta, Rhian Campbell, Kevin Houck

National Tropical Botanical Garden, Lawaii, Hawaii

Track

IV. Putting Research into Management Practice

Abstract

Often overlooked in habitat restoration projects in the Hawaiian islands, ferns comprise over one quarter of the native flora. Their function in the ecosystem is not fully appreciated, nor is their biocultural importance, and they are not readily available to most organizations and restoration planners. In the National Tropical Botanical Garden's (NTBG's) Fern Lab, however, successful native fern propagation and development of standard operating procedures (SOPs) is bringing ferns back into the forefront of restoration project planning. In this study we begin to describe timelines for native fern propagation, from spore to sporophyte, and document windows for when gametophyte trays are at their most productive stage. Using seven native species (Doryopteris decora, Asplenium adiantum-nigrum, Dryopteris fuscoatra, Sadleria cyatheoides, Cibotium glaucum, Marattia douglasii, and Doryopteris angelica), spores were sown using our NTBG SOPs and the length of time was recorded until each sporophyte was ready to transplant; the experiment ended at 391 days. The results, although varying greatly by species, emphasize that growing ferns from spores is a lengthy process, and planning ahead for numbers is vital in restoration planning and conservation management. The small amount of data collected so far indicates that most fern sowings need to be done two years or more before planned outplantings. By repeating this experiment with the same species we can begin to define average sporophyte growth times; knowing timelines for growth from spore can enable planners to include more native ferns in restoration outplantings.

49

Implementing Aloha ʻAina in Ahupuaʻa Restoration

Leihiwahiwa Ritte[1], Lana Corpuz[2], Amber Kukuileiwilimomi Afelin[2], Kalaniua Ritte[2], Jane Au[2,3], Walter Ritte[2]

[1]Maui Community College/Molokai Education Center, Kaunakakai, HI. [2]ʻĀina Momona, Kaunakakai, HI. [3]University of Hawaii, Honolulu, Hawaii

Track

I. Cultural Values and Practice in Conservation

Abstract

ʻĀina Momona's goals are centered on restoring the Kaʻamola ahupuaʻa through community-led restoration efforts that prioritize capacity building for our people, Hawaiian values, and aloha ʻāina stewardship. This approach is central to our work on the land, in the sea, and within our wider programs. It is our aim to cultivate a communal practice of aloha ʻāina throughout the islands, to bring greater justice to our land and communities.

To continue our community education and outreach in light of the pandemic, we have established an on-site school to educate a new generation of students in aloha ʻāina practices. Students learn to garden and prepare the foods they grow and are mentored by cultural practitioners and environmental experts.

Our Aloha ʻĀina Fellows Program has supported 46 young leaders on Molokaʻi over the past three years. Fellows have hosted meetings for environmental cleanups, conducted integral civic engagements, and have networked with leading experts in archeology, permaculture and traditional food systems. In particular, fellows have focused on restoring cultural resources and native species while actively conserving landscapes throughout Molokaʻi. They have conducted community-led conservation efforts from Kapukahehu to Hālawa, preserving koʻa, loko iʻa, and loʻi, while removing invasive species, combating erosion, and restoring ancestral management practices. Recently fellows have focused on restoring land and food systems at Keawanui. Thus far, the team has successfully cleared five acres of invasive species and have planted over one hundred ʻulu trees and over eight hundred kalo in their place.

50

Using Spatial Conservation Prioritization to Recover Climate Resilient Habitat for Rare Species While Protecting Subsistence and Recreational Hunting Opportunities

Christina R. Leopold[1], Lucas Berio Fortini[2], Jonathan Sprague[3], Rachel Sprague[3], Steven C. Hess[4]

[1]Hawaiʻi Cooperative Studies Unit, University of Hawaiʻi at Hilo, Hilo, HI. [2]Pacific Island Ecosystems Research Center, U.S. Geological Survey, Honolulu, HI. [3]Pūlama Lānaʻi, Lānaʻi City, HI. [4]U.S. Department of Agriculture, Animal and Plant Health Inspection Service, Wildlife Services, National Wildlife Services, Hilo, HI

Track

IV. Putting Research into Management Practice

Abstract

Conservation and recovery of rare species is not the only focus of most natural resource managers and must be considered with other, sometimes conflicting, land-use objectives. Here we use the island of Lānaʻi as a case study to examine whether a spatial conservation prioritization approach can inform rare plant recovery planning while maintaining subsistence and recreational hunting opportunities. We also evaluated whether a proposed 8,100 ha conservation area on the windward coast of Lānaʻi would provide sufficient habitat to meet rare species recovery goals.

Based on expert input, we developed a list of rare species for recovery planning, and the area required to meet recovery goals. We met with natural resource managers to identify land-use constraints and understand priorities for preserving hunting areas on Lānaʻi. We included current and future predicted species range data to build climate resiliency into plant recovery targets and included ungulate habitat suitability models to weight hunting areas towards optimal habitat. Using a spatial conservation prioritization framework, where algorithms are used to meet conservation goals using the fewest resources, we evaluated tradeoffs between improving reserve contiguity, native vegetation protection,

and maximizing hunting opportunities. Results show that the proposed 8,100 ha conservation area meets nearly all rare plant recovery requirements and conserves a large portion of existing native vegetation, while numerous areas with high-quality game mammal habitat are retained for subsistence and recreational hunting opportunities. Our results also help identify specific areas critical to meeting conservation and hunting goals. This study demonstrates a practical, transparent approach to balancing natural resource objectives for multiple land-uses.

51

Conservation Connections: Explore Your Possible Pathways - Nāhululeihiwakuipapa Networking Session

Sean Marrs[1], Linnea Heu[2], Keʻala Alama[3], Paʻahana Kincaid[4], Daniel Pâté[5], Tara Meggett[6]

[1]The Nature Conservancy - Hawaiʻi, Honolulu, Hawaiʻi. [2]Nāhululeihiwakuipapa Subcommittee - Hawaiʻi Conservation Alliance, Honolulu, Hawaiʻi. [3]Kūlia Support Project - University of Hawai'i at Mānoa, Honolulu, Hawaiʻi. [4]Kupu, Honolulu, Hawaiʻi. [5]Center on Disability Studies - University of Hawai'i at Mānoa, Honolulu, Hawaiʻi. [6]Hawaiʻi Conservation Alliance & Foundation, Honolulu, Hawaiʻi

Track

II. Capacity in Conservation

Abstract

Join the HCA Nāhululeihiwakuipapa Subcommittee during this networking session to meet with professionals from across the Hawaiian Islands! This includes fellow students and emerging professionals, as well as established professionals who we all look up to! This is an opportunity for you to make connections and cultivate relationships to enhance your career in conservation. Meet professionals who have similar interests and can share their advice to give you guidance on your career path. No one career path is the same, but that's why it's so important to talk story with folks from across the Hawaiian Islands to discover the right path for you. Please fill out this RSVP (https://forms.gle/cQBqJr2g2JiVDMgs6) to indicate you will be attending.

52

Evaluating Phytoremediation of Lead-Contaminated Soils in Loʻi Agriculture

Ryan Ueunten

University of Hawai'i at Mānoa, Honolulu, HI

Track

IV. Putting Research into Management Practice

Abstract

Traditional irrigated pondfields, known as lo'i agriculture, are an important component to the biocultural landscape of Hawai'i. Cultivation of lo'i agriculture not only produces the ancestral food kalo (*Colocasia esculenta*), but also provides key habitat for native waterbirds, insects, fishes and plants. Furthermore, perpetuation of lo'i agriculture strengthens fundamental relationships to place, culture, and community. As lo'i agriculture continues to expand today, soil lead (Pb) contamination from anthropogenic sources (e.g., illegal dumping, runoff from busy roadways) poses a serious hazard to the many farmers and families restoring this important practice. While phytoremediation (i.e., growing plants to remove contaminants from the soil) is often implemented to address soil contamination, no study has yet to test if phytoremediation is effective in lo'i systems. Thus, this study investigated if certain plants are more effective at reducing Pb found in lo'i soils. After *in situ* growth in Pb-contaminated lo'i plots, the native wetland plant 'ae'ae had a significantly higher Pb concentration ($P < 0.001$, Tukey HSD test) and Pb uptake ($P < 0.001$, Tukey HSD test) than any other plant. Based on the total mass of Pb in lo'i plots, however, an estimated 100-1000 years of 'ae'ae growth would be needed to reduce soil Pb concentrations to a safe level (0-75 mg/kg Pb). In conclusion, implementing 'ae'ae plants alone would not be enough to remediate Pb-contaminated lo'i soils. Future efforts will need to consider additional methods of soil remediation in order to support the perpetuation of lo'i agriculture.

53

Individual and Seasonal Variation in the Movement Behavior of two Tropical Nectarivorous Birds on the Island of Hawai'i

Jennifer Smetzer[1], Kristina Paxton[1], Eben Paxton[2]

[1]Hawaii Cooperative Studies Unit, Hilo, HI. [2]USGS Pacific Island Ecosystems Research Center, Hilo, HI

Track

V. New Technologies in Conservation Research and Management

Abstract

Nectarivorous birds exemplify the diversity of movement behavior in the tropics, due to high variability in food and competition. However, movement behavior of these small-bodied organisms remains poorly studied. We used an automated VHF radio telemetry network to track the movement of two nectarivorous Hawaiian honeycreepers, the ʻapapane (*Himatione sanguinea*) and ʻiʻiwi (*Drepanis coccinea*) over multiple years. We tracked 57 birds from high-elevation breeding populations, and documented sedentary, central-place-foraging, commuting and nomadic movement behaviors in both species. We observed a high degree of variability in movement behavior between birds, and individuals tracked multiple years switched strategies. The timing of the different movement syndromes corresponded well with regional bloom patterns of ʻōhiʻa, their primary nectar source. However, different movement behaviors were simultaneously used across the population, indicating that

unstudied factors also likely shape movement behavior. Many individuals made long forays (>24h) from their central area, but birds otherwise exhibited loyalty to a core site, even in the non-breeding period. This finding is notable because year-round loyalty to high-elevation roosting sites minimizes exposure to avian malaria, an introduced disease limited to lower elevations. Both species expanded their range of movement in the non-breeding period but exhibited little seasonal changes in elevation (< 200 m), adding to the growing evidence that the selection pressure of avian malaria may be dampening elevational movements. Our findings demonstrate the power of automated telemetry to investigate complex fine-scale movement behaviors in rugged tropical environments and reveal a system in which birds can flexibly respond to environmental change.

54

Nest Site Characteristics of Pueo (Asio flammeus sandwichensis) on Oʻahu

Olivia Wang, Chad Wilhite, Julen Torrens-Baile, Kaleiheana-a-Pōhaku Stormcrow, Marie-Sophie Garcia-Heras, Melissa Price

University of Hawaiʻi at Mānoa, Honolulu, HI

Track

IV. Putting Research into Management Practice

Abstract

The Hawaiian Short-eared Owl (*Asio flammeus sandwichensis*), or pueo, is the only endemic raptor species known to breed across all the main Hawaiian Islands. As a species of ecological and cultural importance, understanding the habitat characteristics pueo use for nesting is necessary to inform conservation, especially on Oʻahu where they are state-listed as endangered. In this study we assessed nest-site characteristics of 8 pueo nests found during the 2020 and 2021 breeding seasons at two sites at the Lualualei Navel Annex in Waiʻanae, and the Nuʻupia Ponds at Marine Corps Base Hawaii—Kaneohe Bay, Oʻahu. We collected nest-site characteristics including the percent cover, maximum vegetation height, and visual obstruction reading (VOR) at nest sites and at four randomly selected points within 100 meters. Seven nests were found in managed non-native grassland (dominant plant species: buffelgrass (*Cenchrus ciliaris*)) and one was found in a wetland (dominant plant species: pickleweed (*Batis maritima*)). Vegetation height at the nests ranged from 0.43 to 0.55 meters tall, and percent cover ranged from 65% to 98%. A logistic regression model using site characteristics as covariates was used to identify site characteristics that best predict the probability of use as a nest site. We found that pueo preferred to nest in sites with taller and denser vegetation than expected if nests were randomly placed throughout the habitat. This study is an important step in understanding

vegetation characteristics that can be promoted through conservation actions to maximize pueo occupancy and nesting success in Hawai‘i.

55

Pūpūkahi i Holomua: Environmental, Social and Cultural Impacts of Unique Collaboration of Seven Community-Based Nonprofits During COVID19

Ekolu Lindsey

Maui Cultural Lands, Lahaina, HI. Maui Nui Marine Resource Council, Kahului, HI

Track

I. Cultural Values and Practice in Conservation

Abstract

Pūpūkahi i Holomua (“unite in order to progress”) encourages working together cooperatively. Yet community nonprofits are often so challenged with daily operations that collaborations with other nonprofits are infrequent. As COVID-19 challenged “normal” life, seven nonprofits on Maui and Molokai worked cooperatively with Maui Nui Marine Resource Council (MNMRC) to pursue significant funding through Maui County’s MauiCARES program. Each nonprofit had a project site of environmental and cultural significance (including lo’i, fishponds and historical sites). Shared objectives included stewardship of cultural landscapes, protection of natural resources including coral reefs, and support of local biocultural diversity. The funding allowed the hiring of 73 unemployed/underemployed residents to work at seven sites. Workers participated in resource management and cultural restoration, and were trained in traditional Hawaiian ecological knowledge, values and practices, plus applicable technology. Despite the physically challenging work, employees reported deep satisfaction in reconnecting to the ‘aina and sharing traditional knowledge. The short timeframe associated with the Federal funding caused stress for the County, MNMRC and the partner nonprofits and limited what could be accomplished, but the workers’ efforts rapidly accelerated progress at each site. Professionally created videos, presentations and outreach funded by this program raised local awareness of each partner nonprofit. With a showing of one of the videos (“Kipuku Olowalu”) and information on the accomplishments, benefits and broader environmental, cultural and social impacts of this collaborative effort, this presentation provides a blueprint for local resource managers to utilize collaboration to extend the impacts of their future projects.

56

Wetland Connectivity by Hawaiian Waterbirds in a Developed Landscape

Kristina Paxton[1], Martha Kawasaki[2], Marcos Gorresen[1], Jared Underwood[3], Charles van Rees[4]

[1]Hawaii Cooperative Studies Unit, University of Hawaii Hilo, Hilo, HI. [2]University of Hawaii Hilo, Hilo, HI. [3]US Fish and Wildlife Service, Honolulu, HI. [4]Tufts University, Medford, Massachusetts

Track

V. New Technologies in Conservation Research and Management

Abstract

O‘ahu Island has lost over 60% of its historic wetlands, with only small and isolated wetlands remaining within a largely developed landscape. Pearl Harbor on O‘ahu is a largely urban landscape supporting some of the most important wetlands for endangered Hawaiian waterbirds, including ‘Alae ‘ula (Hawaiian Gallinule; *Gallinula galeata sandvicensis*), ‘Alae ke‘oke‘o (Hawaiian Coot; *Fulica alai*), and Ae‘o (Hawaiian Stilt; *Himantopus mexicanus knudseni*). We used automated radio tracking towers to document movement behavior of the three endangered waterbirds among five wetlands within Pearl Harbor and to detect long-distance movements to north and east O‘ahu. Movement patterns differed markedly between the three species. Of 13 ‘Alae ‘ula tracked for 16-391 days, none were detected moving between monitored wetlands. Of 13 ‘Alae ke‘oke‘o tracked from 26-554 days, 4 (31%) were detected moving to another wetland. In contrast, we detected a high degree of movement between wetlands for Ae‘o, with 70% of the 44 individuals tracked for a period of 27-749 days detected in 2 to 6 different wetlands. Despite the high level of movement, Ae‘o showed strong fidelity to specific wetlands, and movement between wetlands were non-random. The high degree of movements connects wetlands, highlighting the importance of each wetland as well as the network of wetlands. Given that these wetlands are managed by different entities, coordinated management for the conservation of waterbirds on a regional level may be the most successful strategy to maintain healthy populations.

57

Investigating the Role of the Gut Microbiome in Susceptibility to Avian Malaria in Hawaiian Honeycreepers

Amanda Navine[1,2], Kristina Paxton[3], Eben Paxton[4], Patrick Hart[1], Jeffrey Foster[5], Nancy McInerney[2], Robert Fleischer[2], Elin Videvall[2,6]

[1]University of Hawai‘i at Hilo, Hilo, HI. [2]Center for Conservation Genomics, Smithsonian Conservation Biology Institute, Washington, DC. [3]Hawai‘i Cooperative Studies Unit, University of Hawai‘i at Hilo, Hilo, HI. [4]U.S. Geological Survey, Pacific Island Ecosystems Research Center, Hawai'i Volcanoes National Park, HI. [5]Pathogen and Microbiome Institute, Northern Arizona University, Flagstaff, AZ. [6]Department of Ecology and Evolutionary Biology, Brown University, Providence, RI

Track

V. New Technologies in Conservation Research and Management

Abstract

Elevated extinction rates among Hawaiian honeycreepers (subfamily Drepanidinae) due to mosquito-vectored avian malaria (Plasmodium relictum) showcase how introduced diseases can devastate naïve ecosystems. Most honeycreeper species persist in high-elevation refugia from disease, where lower temperature limits development of both mosquitoes and malaria parasites. However, as climate change raises global temperatures there is a risk that P. relictum may move up in elevation and cause a rapid loss of these avian refugia. ʻAmakihi (genus Chlorodrepanis) are the only honeycreepers that remain at high densities in low-elevation areas where malaria prevalence is high. We hypothesize that ʻamakihi persistence in these disease hotspots may be partially due to increased immunity to P. relictum conferred by their gut microbiota. To test this, we collected cloacal swabs and blood from wild Hawaiʻi ʻAmakihi (C. virens, n = 185) and malaria resistant Warbling White-eyes (Zosterops japonicus, n = 179), at 16 sites of variable elevation (50-1750m) and malaria prevalence (20.0-67.3%) across the island of Hawaiʻi. We used 16S ribosomal RNA gene sequencing to characterize the gut microbiome and qPCR to quantify P. relictum parasitemia intensity for each bird. Using an established bioinformatics pipeline and PERMANOVA model we assessed the relationship between microbiome composition and P. relictum infection and determined which bacterial taxa are associated with lower parasitemia intensity. Elucidating if microbial species are associated with increased protection against avian malaria in ʻamakihi is an essential first step in understanding host-microbiota-disease dynamics in this system and ultimately determining if probiotic based conservation strategies could mitigate honeycreeper decline.

58

Reef communities persist under future ocean acidification and warming

Chris Jury[1], Keisha Bahr[2], Evan Barba[1], Russel Brainard[3], Annick Cros[4], Kerri Dobson[5], Andrew Graham[1], Rowan McLachlan[5], Craig Nelson[6], James Price[5], Mariana Rocha de Souza[1], Leah Shizuru[1], Celia Smith[7,8], Wesley Sparagoh[6], Cheryl Squair[7], Molly Timmers[9,10], Tiana Tran[11], Jan Vicente[1], Maryann Webb[1], Nicole Yamase[8], Andrea Grottoli[5], Rob Toonen[1]

[1]Hawai'i Institute of Marine Biology, Kaneohe, HI. [2]Department of Life Sciences, Texas A&M University – Corpus Christi,, Corpus Christi, TX. [3]Red Sea Research Center, King Abdullah University of Science and Technology, Thuwal, Saudi Arabia. [4]Woods Hole Oceanographic Institution, Woods Hole, MA. [5]School of Earth Sciences, The Ohio State University, Colombus, OH. [6]Daniel K. Inouye Center for Microbial Oceanography: Research and Education, Department of Oceanography and Sea Grant College Program, School of Ocean and Earth Science and Technology, University of Hawaiʻi at Mānoa, Honolulu, HI. [7]School of Life Sciences, College of Natural Sciences, University of Hawaiʻi at Mānoa, Honolulu, HI. [8]Marine Biology Graduate Program, College of Natural Sciences and School of Ocean and Earth Science and Technology, University of Hawaiʻi at Mānoa, Honolulu, HI. [9]Pacific Islands Fisheries Science Center, National Oceanic and Atmospheric Administration, Honolulu, HI. [10]Joint Institute for Marine and Atmospheric Research, University of Hawaiʻi at Mānoa, Honolulu, HI. [11]School of Ocean and Earth Science and Technology, University of Hawaiʻi at Mānoa, Honolulu, HI

Track

III. Global and Regional Change & Challenges

Abstract

Coral reefs are among the most sensitive ecosystems affected by ocean acidification and warming, and reefs are predicted to shift from net accreting calcifier-dominated systems to net eroding algal-dominated systems over the coming decades. Here we present the longest and most holistic experimental study to date examining the responses of entire mesocosm coral reef communities to acidification (-0.2 pH units), warming (+2 °C), and combined (-0.2 pH, +2 °C) treatments. We show that under future ocean conditions, net calcification rates declined yet remained positive, corals showed reduced abundance but were not extirpated, and community composition shifted while species richness was maintained. Our results suggest that under future ocean acidification and warming, coral reefs may persist in a degraded yet partially functional state rather than collapse, but that both local and global mitigation efforts are required to maintain reef function.

60

Believing in a Future History for Hale'iwa

Sean Connelly

AFTER OCEANIC, HONOLULU, HI. Department of Architecture at the Massachusetts Institute of Technology, Cambridge, MA

Track

III. Global and Regional Change & Challenges

Abstract

When most people think about Haleʻiwa (North Shore), the first image is of shaved ice, not the native Hawaiian fishpond Loko Ea within Oʻahu's third-largest wetland, ʻUkoʻa. Even locals from Oʻahu are unfamiliar with this great yet forgotten resource, once a royal fishpond. The problem of our generational amnesia has to do with the century's long history of regional US infrastructure projects that physically obscured the ʻUkoʻa-Lokoea Fishpond Complex from plain sight, which has been shrinking as a result of the physical change the infrastructure brought. Surveying the (1) construction of the railroad; (2) the destruction of the mauka wetland to make Kawailoa Landfill; (3) the Army Corps dredging of Anahulu River to make Haleʻiwa Harbor; (4) the construction of Haleʻiwa Bypass—this presentation shares a visual mapping summarizing a year's long project in applied research in landscape architecture commissioned by the Malama Loko Ea Foundation to analyze the past history of physical changes to the 'Uko'a-Lokoea Fishpond Complex to better understand the strategic process for its future regional recovery. Through an original analysis of historic aerial photographs and maps focused on the period of time from 1898 to 1998, this presentation will summarize the results of the analysis. The goal of the presentation is to raise awareness of the forgotten history of infrastructure projects in Haleʻiwa, and to

help provide a framework for the audience to ask, what else about Hawai‘i must we remember not to forget?

61

Natural History and Biogeography of Hawaiian Mushrooms

Jeffery Stallman[1], Kyra Robinson[2]

[1]Purdue University, West Lafayette, IN. [2]University of Hawai‘i at Hilo, Hilo, HI

Track

II. Capacity in Conservation

Abstract

The Hawaiian Islands have been an important location for studies of evolution and biogeography due to their isolation and known geological history. While some groups—such as birds and flowering plants—have received extensive biogeography and natural history study for over a century, mushrooms (Agaricomycotina) have received comparatively less attention until the last several decades. From the early 1990s to 2007, knowledge of the mushrooms occurring in the Hawaiian Islands grew from less than 100 species to over 600, but analyses of their ecologies and biogeographies are lacking. Therefore, we compiled an updated list of c. 650 mushrooms occurring in Hawai‘i with associated ecological data and provide the first large-scale summary of Hawaiian macrofungal biogeography and natural history. While knowledge of the biodiversity of Hawaiian mushrooms and tropical fungi in general is still very incomplete, this initial assessment provides a descriptive overview of island occurrence, habitat, and phenology that can potentially be used to inform conservationists. Only six mushrooms in Hawai‘i have been evaluated by the IUCN, but four were found to be threatened: one endangered and three vulnerable. The list and associated metadata are publicly available, and contributions from community scientists and natural resource workers—in particular those who visit remote or inaccessible areas—are encouraged. We hope this initial assessment will stimulate further research into the taxonomy, biogeography, natural history, and conservation concern of Hawaiian macrofungi, and provide a baseline for further studies among both professional mycologists and amateur naturalists.

62

An Assessment of Lethal Trap Efficacy at Haleakalā National Park

Erika Kekiwi, Kayla Purdy

Haleakalā National Park, Kula, HI

Track

IV. Putting Research into Management Practice

Abstract

Control of non-native predators is vital for managing resources at Haleakalā National Park and has been ongoing since the 1970s. A 2016 evaluation of the trapping program suggested incorporating lethal traps to improve predator capture. This project assessed three lethal traps for performance and efficacy: Goodnature® A24, DOC 250 (Department of Conservation), and Belisle 220 Super X body grip traps.

The use of exclusionary box designs and careful trap placement were evaluated to determine if these features would prevent the capture of non-target species. Using wildlife game cameras, interactions with lethal traps of target and non-target species were examined. Non-target species were not observed interacting with lethal traps in a harmful manner.

Capture rates from lethal and live traps were compared in similar areas. Of captures from Goodnature traps, 99% were rats, and 1% were mongooses. Of DOC 250 captures, 71% were mongooses, 25% were rats, and 4% were cats. Body grip traps did not capture any animals during the evaluation period but captured one mongoose during the efficacy period. Goodnature traps had the highest capture rate for rats, followed by DOC 250 and cage traps. For mongooses, DOC 250 had the highest capture rates followed by cage traps.

Staff noted that although lethal traps require considerable labor for initial setup, lethal traps required less labor to monitor than live traps and were advantageous in remote areas. This suggests that incorporating lethal traps would greatly benefit predator control at Haleakalā National Park.

63

Ambrosia Beetles (Coleoptera: Scolytinae) as Potential Vectors of Rapid ʻŌhiʻa Death

Ellen Dunkle[1], Dan Mikros[1], Kylle Roy[2], Robert Peck[1], Carter Atkinson[2]

[1]Hawai'i Cooperative Studies Unit, Hilo, HI. [2]United State Geological Survey, Volcano National Park, HI

Track

IV. Putting Research into Management Practice

Abstract

The vascular disease Rapid ʻŌhiʻa Death (ROD), caused by the fungal pathogens *Ceratocystis lukuohia* and *Ceratocystis huliohia,* is threatening the persistence of ʻōhiʻa lehua forests (*Metrosideros polymorpha*) across Hawai'i. Because ʻōhiʻa provides vital habitat for many plant and animal species, understanding how ROD spreads is critical for disease management. Ambrosia beetles (Coleoptera: Scolytinae) create brood galleries within ROD-infected ʻōhiʻa and expel frass that can contain viable ROD inoculum. However, it is unknown if these beetles can directly transmit the fungi between infected and uninfected trees. To test if beetles carry *Ceratocystis* on their bodies, we screened field-caught *Xyleborinus saxesenii, Xyleborus affinis,* and *Xyleborus ferrugineus* for *Ceratocystis* using a water aeration technique, confirming *Ceratocystis* DNA via quantitative Polymerase Chain Reaction (qPCR). Next, we exposed beetles to live *C. lukuohia* and *C. huliohia* cultures, allowed them to bore into healthy ʻōhiʻa seedlings and monitored the seedlings for symptoms of ROD. Results revealed a maximum *Ceratocystis* detection rate of 4% on *X. saxesenii*, 2% on *X. ferrugineus* and 25% on *X. affinis* caught in ROD-infested forests. Furthermore, about two-thirds of all seedlings were inoculated with ROD by beetles that bored into the plants. We conclude that ambrosia beetles are capable of mechanical transmission of *C. lukuohia* and *C. huliohia* and may be important vectors for natural spread of the disease. These findings further our understanding of the pathosystem of these virulent fungi and can help guide management strategies aimed to maintain the ʻōhiʻa-prominent landscapes of Hawai'i.

64

Machine vision tools for delimiting distribution of coconut rhinoceros beetle on the island of Oahu

Mohsen Paryavi, Daniel Jenkins, Michael Melzer, Reza Ghorbani, Il-Yong Chun, Yao Zheng

University of Hawaii, Honolulu, HI

Track

V. New Technologies in Conservation Research and Management

Abstract

An incipient population of Coconut Rhinoceros Beetle (CRB; *Oryctes rhinoceros*) on the island of Oahu was discovered in late 2013, posing a major threat to iconic palm trees on the island and a stepping stone for movement to the other Hawaiian Islands and US Mainland. Surveillance and physical trapping of CRB in remote, undeveloped areas is a critical part of the program for containment and eradication efforts, but monitoring these traps is labor and resource intensive. We are developing machine vision tools for automated detection of CRB in surveillance systems embedded in remotely distributed traps, as well as for detection of characteristic CRB damage to palm trees in aerial imagery. Communication of trap images to a domain and inferencing on the cloud using effective ConvNets like MobileNet with Transfer learning for beetle detection is highly accurate (99%) but bandwidth-intensive. Alternatively, an inference can be made locally on limited microcontroller memory using TensorFlow Lite, where inference results are communicated through low data rate radio transmission, however, with less accuracy (80 to 90%) in the current prototypes. We are planning to implement the latter approach on distributed wireless networks to automate CRB trap surveillance and analysis in remote areas.

65

Communicating Principles of Conservation Biology Using European Mythology

Brian Bowen

Hawai'i Institute of Marine Biology, Kaneohe, Hawai'i

Track

I. Cultural Values and Practice in Conservation

Abstract

Mythology has been called a window to the subconscious, and a window to the universe. Hence the stories and images conjured by our ancestors provide an intuitively appealing platform to communicate aspects of the natural world. The scientific field of conservation biology is dominated by three specialties: phylogenetics, ecology, and evolution. Under this triad, phylogenetics is oriented towards the *past* history of biodiversity, conserving the divergent branches in the tree of life. The ecological component is rooted in the *present*, maintaining the contemporary life support systems for biodiversity. Evolutionary conservation is concerned with preserving the raw materials for generating *future* biodiversity. This concept of interlocking past, present, and future biodiversity is expressed in the Orlog worldview of Norse culture. In this framework, all biodiversity dwells in the tree of life, Yggdrasil, which is guarded by 3 sisters: Urd, Verdandi, and Skuld. The 3 sisters nurture the tree and protect it from dragons that seek to destroy the domain of life. They are personifications of the past, present, and future, or "was, being, and shall be" that correspond to the scientific disciplines of phylogenetics, ecology, and evolution. This simple and attractive metaphor demonstrates the cooperating scientific fields that seek to protect biodiversity.

67

Conserving Endangered Endemic Trees of Kaua'i: From Collection to Outplanting

Matthew Kahokuloa, Jr., Nina Rønsted, Rhian Campbell, Uma Nagendra

National Tropical Botanical Garden, Kalaheo, Hawai'i

Track

II. Capacity in Conservation

Abstract

The island of Kaua'i hosts unique native and endemic flora; however, ongoing habitat alteration and invasive species pose major threats to the environment, and many rare species have been reduced to only a few individuals left in the wild. This three-year project led by the National Tropical Botanical

Garden (NTBG) aims to restore populations of eleven endemic tree species (*Charpentiera densiflora, Cyanea hardyi, Cyanea kuhihewa, Gardenia remyi, Hibiscus kokio subsp. saintjohnianus, Hibiscus waimeae subsp. hannerae, Ochrosia kauaiensis, Polyscias racemosa, Pritchardia limahuliensis, Pritchardia perlmanii, Trematolobelia kauaiensis*) to Limahuli valley where they were found historically, but have since either gone extinct or are near extinction. Restoration work on this scale involves the collaborative capacity of many different NTBG staff members. Field botanists source and collect wild seeds, which are sent to seed bank and nursery personnel for preservation and propagation. Once new plants are ready, outplanting and monitoring work is done in Limahuli Preserve in relatively pristine areas where weed and pest control is ongoing. All work is planned to optimize the genetic diversity of target taxa as well as to maintain a healthy ecosystem. Through these collaborative efforts, conservation collections for seven of the eleven target species have increased significantly, replenishing and expanding seed bank collections. Two hundred individual plants have also been outplanted; this meets goals set for four of the eleven plants and significantly increases their populations in the valley, demonstrating a confident step towards the restoration of diversity within a native Hawaiian ecosystem.

68

Comparing movement behavior of Hawaiian forest birds in fragmented and continuous habitat

Eben Paxton[1], Kristina Paxton[2], Jennifer Smetzer[2], Patrick Hart[3]

[1]USGS Pacific Island Ecosystems Research Center, Hawaii National Park, HI. [2]Hawaii Cooperative Studies Unit, Hilo, HI. [3]University of Hawaii, Hilo, HI

Track

IV. Putting Research into Management Practice

Abstract

Accelerating rates of habitat loss and fragmentation of forest ecosystems poses a threat to the long-term population viability of Hawaiian forest birds. There is substantial evidence that forest fragmentation has a negative effect on species persistence and richness. However, how birds adapt their behavior to acquire resources in response to landscape changes is a critical step in determining how populations may be able to persist in fragmented landscapes. We compared space use and movement patterns of four endemic Hawaiian forest birds that differ in their foraging guilds within a fragmented and continuous landscape on the island of Hawai‘i. We found that both core area and home range sizes of Hawaiian forest birds were 3- to 12-fold larger in a continuous landscape compared to a fragmented landscape, suggesting that fragmentation restricts the movements of all four species. Fine-scale movement patterns revealed that birds in the fragmented landscape returned more frequently to the same location and stayed longer in an area around a particular location compared to the movements of birds in the continuous landscape. There was little difference in fine-scale movement patterns among the four species in the continuous landscape. In contrast, movement patterns in the fragmented landscape differed among the four species when the species occupied forest habitats and the

surrounding matrix habitats, suggesting species specific responses to the heterogenous landscape. Understanding the mechanisms and underlying processes of how species respond to landscape changes is a critical step in developing effective management strategies for species persistence in fragmented landscapes.

69

Teaching Change: Improving environmental and climate literacy through a biocultural framework for Hawai‘i Island youth

Blaire Langston[1], Maa Greenhill[2]

[1]RCUH, Hilo, Hawai‘i. [2]Akaka Foundation for Tropical Forests, Hilo, Hawai‘i

Track

II. Capacity in Conservation

Abstract

Teaching Change is an educational partnership between the University of Hawai‘i at Mānoa, the United States Forest Service, and the Akaka Foundation for Tropical Forests. Our goal is to improve local students’ knowledge of environmental phenomena by utilizing local conservation areas as outdoor classrooms for place-based education and biocultural connections. Students participate in hands-on projects that support current conservation efforts and engage in biocultural activities that foster a connection to place through Hawai‘i life-way perspectives. We present the results of a study that evaluates the effectiveness of our program’s pedagogy by examining the influence of field courses on environmental literacy, climate literacy, and confidence in pursuit of conservation careers for local elementary to high school students. Through the administration of course assessments before and after student participation in 111 Teaching Change field courses over a seven year time period, we found significant positive effects across all three areas. Specifically, we found that elementary students' environmental literacy increased by an average of 33%, middle and high school by 25%, climate increased by literacy by 27%, and confidence in pursuit of conservation careers increased by 10% (paired sample t-tests, $p < .001$). These results indicate that Teaching Change’s place-based pedagogy is highly effective in improving student knowledge and confidence across a range of environmental topics. As island ecosystems continue to face a wide range of challenges it is imperative to educate students about these issues from a young age to inspire the next generation of environmental stewards and leaders.

70

How to Access and Use the National Ecological Observatory Network’s Open Access Ecological Database in Hawai‘i and Nationally

Michael Long[1], Donal O‘Leary[1], Blaire Langston[2]

[1]Battelle/NEON, Boulder, Colorado. [2]Akaka Foundation for Tropical Forests, Hilo, Hawai‘i

Track

V. New Technologies in Conservation Research and Management

Abstract

The National Ecological Observatory Network (NEON) is a continental-scale facility that collects long-term, open access, ecological data to better understand ecosystem processes across the United States. NEON will provide 30 years of data from 81 ecologically diverse terrestrial and aquatic field sites via standardized collection methods designed to support research studies at varying spatial and temporal scales. NEON data cover a range of subject areas within ecology, including organismal observations, biogeochemistry, aerial lidar, hyperspectral imagery, and micrometeorology. All samples and data collected by NEON are publicly available and can be accessed digitally through the NEON website. Locally, NEON's field site at Pu‘u Maka‘ala Natural Area Reserve on Hawai‘i Island began collecting ecological data on a Hawaiian montane wet forest in 2018. Data from this site are being used as part of the curriculum at Teaching Change, an educational partnership led by the University of Hawai‘i, for Hawai‘i Island schools.

We invite you to our two-hour workshop to learn more about NEON, the field site in Hawai‘i, and how to access and work with NEON data. During this hands-on workshop we provide an introduction to discovering, accessing and preparing a variety of NEON data for your research or teaching, primarily using R. If you are a researcher interested in local ecological, phenological, and aerial data, or an educator looking to incorporate locally sourced data into your lesson plans, this workshop will provide you with practical applications on how to get started with NEON data.

Agenda & Additional Required Information for Forums, Workshops, and Trainings

Agenda

<u>15 Minutes</u>

- Introduction to NEON and Teaching Change
    - What/who is the National Ecological Observatory Network (NEON)?
    - Pu‘u Maka‘ala and its significance
    - How Teaching Change incorporated NEON data into local educational programs

<u>30 Minutes</u>

- Introduction to NEON Data & Resources
    - What types of data does NEON collect?
    - Why is this data significant or relevant for local educators and researchers?
    - How is this data being applied?
    - NEON Resources: Data Tutorials, Code Hub, quick overview of Teaching Modules

5 Minutes Break

60 Minutes

- Working with NEON data
    - NEON Data Portal Overview [20 minutes]
    - Download and Explore NEON Data in R using the NEON Utilities package [40 minutes]

10 Minutes

- Final Q&A
- Post-workshop evaluation
- Post-workshop evaluation

List of speakers

- Michael Long, Field Operations Manager, Battelle, National Ecological Observatory Network
- Donal O'Leary, Data Science Educator, Battelle, National Ecological Observatory Network
- Blaire J. Langston, Project Manager at the Akaka Foundation for Tropical Forests

Description of innovative audience engagement techniques

This workshop will feature multiple engagement techniques with each designed to stimulate a new aspect of the participant's imagination. Workshop presenters will use presentations, youtube videos, web pages (including the NEON data portal), live coding exercises, and a short Q&A section to deliver information that spans the breadth of the NEON program and Teaching Change initiative. The live coding and Q&A sections are designed to be interactive and conversational while staying focused on developing participant skills and addressing their concerns. Participants will need to bring their computer, have R and RStudio installed along with a working knowledge of how to use RStudio (we will not be leading a lesson in how to use RStudio). Instructions on how to download R and RStudio along with the specific packages we will be using will be sent out prior to the workshop.

Explanation of goals and target audience

Our goal is to inform the Hawai'i conservation community of the benefits of the NEON program, globally and locally. This workshop will be most useful for people who are interested in working with open access data sets on Hawai'i Island, people who are interested in climate data at Pu'u Maka'ala Natural Area Reserve, or accessing large sets of ecological data around the United States. This workshop can benefit researchers, educators, and students to support research projects and educational activities. We would like our participants to walk away with increased awareness of NEON data as an open access resource, and an introductory level of information and skills needed to access and work with the data. Finally, we aim to inspire the Hawai'i conservation community to use the free resource for educational and/or research purposes at their own institutions.

71

Factors affecting outbreak dynamics and the response of koa to defoliation by the koa moth

Paul Banko[1], Robert Peck[2], Stephanie Yelenik[1]

[1]US Geological Survey, Pacific Island Ecosystems Research Center, Hawai'i National Park, Hawai'i.
[2]University of Hawai'i at Hilo, Hawai'i Cooperative Studies Unit, Hawai'i National Park, Hawai'i

Track

III. Global and Regional Change & Challenges

Abstract

We investigated the dynamics of the 2013–2014 koa moth (*Scotorythra paludicola*) outbreak on Hawai'i Island. At Hakalau Forest NWR, we evaluated predictions from the resource concentration hypothesis (RCH) that dense stands of koa (*Acacia koa*) planted for reforestation would suffer greater defoliation than would mixed stands of koa and 'ōhi'a (*Metrosideros polymorpha*). We also assessed 1) effects of habitat type, tree size, and defoliation severity on rates of koa survival and refoliation, 2) effects of caterpillar herbivory and tree size on leaf type during refoliation, and 3) redistribution patterns of caterpillar frass-derived nutrients to soil and understory vegetation. Contrary to RCH, caterpillar biomass and defoliation severity were relatively high in mixed koa- 'ōhi'a stands. Mortality was comparatively high for heavily defoliated small koa. Refoliation occurred quickly for lightly defoliated small koa, but we observed the opposite trend for large trees. Small koa initially refoliated with true leaves, the foliage type generally avoided by caterpillars compared to phyllodes. Nitrogen from caterpillar frass was redistributed to the soil and was taken up primarily by alien grasses instead of native shrubs. The single outbreak at Hakalau contrasts with the three cycles of defoliation-refoliation observed at lower, warmer elevations, potentially due to faster rates of refoliation and caterpillar development and sparser grass cover. Formerly defoliated stands recovered, suggesting resilience in both planted and natural forests, but tree density and diversity, tree size, grass cover, and elevation affected the dynamics of the outbreak in sometimes unexpected ways.

72

An Approach to Assessing Place Attachment Towards Improving Place-Based Biological Conservation and Environmental Planning Efforts.

Dimuthu Jayakody[1,2], Vanessa Adams[1], Libby Lester[1,3], Gretta Pecl[1,2]

[1]University of Tasmania, Tasmania, Australia. [2]Centre for Marine Socioecology, Tasmania, Australia. [3]Institute for Social Change, Tasmania, Australia

Track

IV. Putting Research into Management Practice

Abstract

Place attachment, which is broadly defined as the cognitive or emotional bonds formed between person and place, is increasingly recognized as a key to understanding human-environmental interactions, particularly in the context of changing environments such as with climate change. Map-based measures of place attachment offer an easy to implement way of accessing individual place attachment values to inform environmental decision making.

We developed a Public Participatory Geographic Information System (PPGIS) platform, that enables comprehensive assessment of place attachment through spatial identification of place-based values. This platform is based on methodologies utilized globally across different cultures and ecosystems and use landscape values as a proxy measure for place attachment. The Landscape Values Mapping Platform (LVMP) is a flexible tool that enables the use of prescribed values or can be customized to fit the local sociocultural or ecological contexts.

This platform is presented and its value for informing environmental planning and conservation is demonstrated through a case study conducted along the East Coast of Tasmania, Australia. We present the platform's ability to collect place values specific to the coastal zone, which includes terrestrial, coastal and marine values; the type of data that can be collected, including spatial and quantitative data on the strength of place attachment; and the key outputs that can be produced including value hotspot maps and climate risk maps. This talk will demonstrate the use and capabilities of the LVMP and how it can be adapted to optimize place-based biodiversity conservation and environmental planning in Hawai'i.

73

Mapping the Distribution of the Invasive Rosy Wolfsnail, the *Euglandina rosea* Species Complex, in Hawai‘i

Taylor Maruno[1,2], Jaynee Kim[1], Norine Yeung[1], Yinphan Tsang[2], Kenneth Hayes[3]

[1]Bishop Museum, Malacology, Honolulu, Hawaii. [2]Natural Resources and Environmental Management, University of Hawai‘i at Mānoa, Honolulu, Hawaii. [3]Bishop Museum, Pacific Center for Molecular Biodiversity, Honolulu, Hawaii

Track

III. Global and Regional Change & Challenges

Abstract

The *Euglandina rosea* species complex comprises several invasive, carnivorous land snails introduced from Florida to Hawai‘i as failed biocontrol for the Giant African Snail (*Lissachatina fulica*). These invasive snails have been implicated in the extinction of numerous Pacific Island land snails, and continue to threaten Hawai‘i’s imperiled native snail fauna, which is renowned for its diversity and endemism. In Hawai‘i, recent studies confirmed the presence of three distinct clades, each probably representing a separate species, within the *E. rosea* complex. Little is known however, about their ecology and spread, or if any disparities exist between their ranges. To assess the distribution of the *E. rosea* complex across the main Hawaiian Islands, we used specimen collections from extensive surveys and developed maps using qGIS with post-2000 locational records of all three clades from the Bishop Museum Malacology Collection and their partners. Results indicate clade 1 has the greatest distribution, found on Kaua‘i, O‘ahu, Maui, Lana‘i, and Hawai‘i. Clade 2 was found on the same islands, except Lana‘i, while clade 3 was found only on Maui. Clades 1 and 2 have similar elevational ranges, but are sympatric in only three locations. Understanding the distribution of the *E. rosea* complex and clarifying differences between the three lineages provides important data for evaluating the species’ ecological requirements and identifying native snail populations that may be negatively impacted. The first step in combating *E. rosea* is knowing where they are. This study will help implement effective, island-specific land snail management approaches within the coming years.

74

Shining a Light on ‘O‘opu: A Year in Review of the Hā‘ena ‘O‘opu Restoration Project

Puakea Mo'okini-Oliveira[1], Uma Nagendra[1], Kawika Winter[1,2]

[1]Limahuli Garden and Preserve, National Tropical Botanical Garden, Hā‘ena, Hawai'i. [2]He'eia National Estuarine Research Reserve, He'eia, Hawai'i

Track

IV. Putting Research into Management Practice

Abstract

The Hā‘ena ‘O‘opu Restoration Project highlights the capacity for multi-level approaches to monitor indicator species while contributing to the overall health and biodiversity of surrounding habitat. The study site is located within the near-pristine perennial stream in Limahuli valley, in Hā‘ena, Halele‘a, Kaua‘i. This stream provides habitat for all five endemic species of ‘o‘opu

(family Gobiidae and Eleotridae) and other native aquatic invertebrates, although not at the historic levels of abundance observed by Hā‘ena’s kūpuna. Motivation for this work includes revitalizing Indigenous Resource Management strategies to maximize species abundance and system resilience. By increasing canopy light levels within a riparian corridor, the project intends to promote a regime shift from a diatom-dominated to a chlorophyte-dominated aquatic environment.

From September 2019 - February 2020, a 1,500 foot longitudinal light gap was created over the riparian corridor through selective removal of invasive canopy trees. Over 3,300 native individuals of suitable vegetation have been outplanted to date. Species were selected because of their fast-growing, hardy characteristics that add to overall stabilization during extreme conditions (i.e., flash flooding). Restoration, maintenance, and biological monitoring are ongoing. Monitoring includes an underwater visual census, canopy openness and bank vegetation changes. Preliminary analysis suggests species diversity of aquatic animals (Shannon’s Diversity Index) has remained the same overtime in both control and restoration reaches, although species composition has fluctuated. In addition to the project's main goals, experience working on this project underlines the need for a long-term freshwater management network.

75

Willingness to Pay for Biodiversity Protection: Evidence from Waikamoi Preserve, Maui

Alison Cohan[1], Sonja Kolstoe[2,3], Brian Vander Naald[4]

[1]The Nature Conservancy of Hawaii, Maui terrestrial program, Makawao, Hawaii. [2]United States Forest Service, Pacific Northwest Research Station, Corvallis, OR. [3]Salisbury University, Department of Economics & Finance, Salisbury, MD. [4]Drake University, Department of Economics & Finance, Des Moines, IA

Track

III. Global and Regional Change & Challenges

Abstract

The Nature Conservancy's (TNC) 9000-acre Waikamoi Preserve in Maui is the largest private nature preserve in Hawai'i. It is home to 10 species of native birds, 6 of which are threatened or endangered. Visitors most commonly go to see Hawai'i's rare and endemic forest bird species, including the ‘ākohekohe, kiwikiu, i‘iwi, and ‘alauahio. TNC is responsible for protecting Waikamoi's fragile ecosystems, including limiting access to mitigate invasive species introduction. Currently TNC offers one free monthly guided hike that is open to the public. However, there is great public demand to access Waikamoi to see birds. To determine how people might respond to the implementation of a fee-based

hiking program by TNC, we used a discrete choice experiment to collect preference data from over 1000 respondents using a Qualtrics national sample in summer 2020. We collected data on donations to an Invasive Species Rapid Response Fund, implementing a fee for the existing general hike so it can be self-sustaining and offered more frequently, as well as a fee-based birding hike. We will discuss two distinct conclusions. The first is that people are willing to pay for expanded access to the Preserve, including a smaller birding-focused hike. Second, respondents are willing to pay a positive amount to mitigate risks to Waikamoi posed by invasive species and climate change. The second conclusion extends beyond the value people are willing to pay to go on the hike and reveals the value of TNC's efforts to protect the species that inhabit Waikamoi Preserve.

76

Testing Scalable Revegetation Strategies in the Arid Pelekane Watershed (West Hawai'i Island)

Michael Burnett[1], Julia Rose[1], Kim Falinski[2], Willie Rice[3], Carolyn Stewart[4], Christopher Balzotti[5], Shalan Crysdale[5]

[1]The Nature Conservancy, Kamuela, HI. [2]The Nature Conservancy, Honolulu, HI. [3]Forest Solutions, Inc., Kamuela, HI. [4]Marine and Coastal Solutions International, Inc., Kamuela, HI. [5]The Nature Conservancy, Nā'ālehu, HI

Track

IV. Putting Research into Management Practice

Abstract

The Pelekane watershed in West Hawai'i features one of the driest landscapes in the state, with low elevations receiving less than 7 inches of rainfall annually. These areas, which consist primarily of exotic, fire-adapted grasses and scattered native species, serve as rangeland for 500 head of cattle rotationally grazing in six ~1,000-acre paddocks. Excessive grazing pressure, primarily from a large population of feral goats, and wildfires have created hundreds of acres of exposed soil that erodes from the hillslopes during intense winter storms. When these sediments discharge into Pelekane Bay, they create vast sediment plumes detrimental to water quality and marine ecosystems along the coastline.

In addition to directly managing feral goats and wildfires in Pelekane's lower reaches, our partnership of landowners and resource managers aims to mitigate these erosion problems through targeted dryland revegetation in the watershed's most degraded areas. We implemented a fenced experimental trial in the watershed to determine the most scalable and effective strategies to restore vegetative cover and reduce erosion in the absence of ungulates. The 3-acre randomized experimental design represents nine treatments including scattering of different seed mixtures, seedling outplanting, topographic enhancements, hydromulching, and irrigated/unirrigated control plots. Treatments were initiated in March 2021. Monitoring vegetative cover and survival over a one-year study period will allow us to track

the potential of each treatment for scalable ecosystem recovery in Pelekane. Mapping of erosive areas in partnership with USGS and NOAA will support the expansion of these treatments to broader regions in the future.

77

Illuminating the Mosses and Liverworts of Limahuli Valley, Kaua‘i

Kassandra Jensen[1], Tim Flynn[2], Uma Nagendra[3]

[1]KUPU Americorps/ National Tropical Botanical Garden Limahuli Garden and Preserve, Ha‘ena, HI. [2]National Tropical Botanical Garden, Kalaheo, HI. [3]National Tropical Botanical Garden, Ha‘ena, HI

Track

IV. Putting Research into Management Practice

Abstract

Bryophytes (mosses, liverworts, and hornworts) are often overlooked but essential in Hawaiian ecosystems. Bryophytes are key in nutrient cycling, moisture retention, bioindication of pollution, and plant germination. They also help prevent soil erosion and flooding, which are common occurrences on Kaua‘i. Despite their ecosystem importance, there are few resources pertaining to the Hawaiian bryoflora. Those that are available are difficult to access and often contain jargon and concepts a novice bryologist may not yet understand. Adding to those resources and increasing their availability can help conservationists more fully understand and utilize the benefits of bryophytes in conservation projects.

This project aims to collect and identify bryophytes in Limahuli Valley on Kaua‘i with the goal of creating a field guide. Collections are made in multiple habitats in order to discern which bryophytes are fundamental in each: riparian, invasive Schefflera actinophylla-dominated, or Aleurites moluccana-dominated. Specimens are taken within a ten-by-ten meter section of each habitat and stored as herbarium collections at the National Tropical Botanical Garden (NTBG) herbarium. Currently, 15 species have been identified across 7 sites. By July 2021, specimens will be collected, identified, and preserved from 9 locations within Limahuli Valley. Photos and information of each genus and species will be formatted into a PDF file. A field guide to the bryophytes in Limahuli Valley can be used as a resource for other bryologists and help begin the much needed conversation about the potential benefits of bryophytes in conservation.

78

Micro-scale Habitat Use of Humpback Whales off West Maui, Hawai‘i, Revealed Through Acoustic and Visual Monitoring

Anke Kügler[1], Marc Lammers[2], Adam Pack[3], Eden Zang[2]

[1]University of Hawai'i at Mānoa, Honolulu, HI. [2]Hawaiian Islands Humpback Whale National Marine Sanctuary, Kīhei, HI. [3]University of Hawai'i at Hilo, Hilo, HI

Track

IV. Putting Research into Management Practice

Abstract

North Pacific humpback whales (*Megaptera novaeangliae*) have been studied for decades, yet much is still unknown about the whales' micro-scale habitat use in the Main Hawaiian Islands, their principal breeding and calving ground. There, mature males produce an elaborate acoustic display known as "song" in an asynchronous chorus, which, between December and April, becomes the dominant source of low-frequency (0-1.5 kHz) energy in the marine soundscape. This chorus has a strong correlation with whale numbers, including non-singing whales, and can therefore be used as a proxy for relative abundance. We collected data using passive acoustic monitoring with multiple shallow and deep autonomous bottom-moored recorders distributed throughout the survey area off West Maui over four consecutive breeding seasons (2017-2020). Concurrent visual observations were conducted from a land station one to three times a week throughout each season, recording the number, social composition, and locations of whales in the same area. Our results show that whales appear to variably cluster in space and time at various scales (diurnal to throughout the season), indicating that distribution of whales is not uniform or haphazard off Maui. Understanding how a species utilizes its environment and how that use varies is crucial for successful management of that species. This current study helps to understand how humpback whale habitat use off Maui may interfere with overlapping human commercial and recreational activities, potentially impeding social and acoustic behaviors. Our analysis is ongoing to identify social and/or environmental factors driving the observed spatial and temporal patterns.

79

How Long Does ʻŌhiʻa Infected With Rapid ʻŌhiʻa Death (ROD) Remain a Source of Infectious Inoculum?

Robert Peck[1], Dan Mikros[1], Ellen Dunkle[1], Josie Tupu[1], Kylle Roy[2], Carter Atkinson[2], Flint Hughes[3], Ryan Perroy[4]

[1]Hawaii Cooperative Studies Unit, University of Hawaii-Hilo, Hawaii National Park, Hawaii. [2]USGS Pacific Island Ecosystems Research Center, Hawaii National Park, Hawaii. [3]USDA Forest Service Institute for Pacific Islands Forestry, Hilo, Hawaii. [4]University of Hawaii-Hilo, Hilo, Hawaii

Track

IV. Putting Research into Management Practice

Abstract

Rapid ʻŌhiʻa Death (ROD) is a fatal fungal disease that is threatening the health of ʻōhiʻa forests across the Main Hawaiian Islands. Dying and dead ʻōhiʻa infected with ROD-causing *Ceratocystis lukuohia* and *C. huliohia* fungi are a source of infectious inoculum as long as the fungi remain viable in the tree and there is a mechanism by which the fungi can escape the vascular tissue of the tree. Viable fungal propagules embedded in frass particles extruded by wood-boring ambrosia beetles is the primary way that *Ceratocystis* enters the extra-arboreal environment. Understanding how long infected wood remains a threat to further spreading ROD is important to mitigating and managing the disease. The objectives of this study were to identify how long ambrosia beetles produce frass and *Ceratocystis* remains viable in ʻōhiʻa killed by ROD. We assessed standing trees that were killed by ROD during 2017–2019 across Hawaiʻi Island for beetle activity and for the presence of viable *Ceratocystis*. Beetle activity was identified by the occurrence of fresh frass on the bark and fungal viability was determined by screening tree tissue samples for live fungi. We found frass on trees that had been dead for more than three years, although beetle activity decreased considerably over time. Similarly, *Ceratocystis* was cultured from ʻōhiʻa killed during each year sampled. Together, these results suggest that dead ʻōhiʻa may remain a source of infectious inoculum for several years after a tree succumbs to the disease, potentially influencing how these trees are managed.

80

Arthropod-Based Biosecurity Assessment of Wake Atoll

Robert Peck

Hawaii Cooperative Studies Unit, University of Hawaii-Hilo, Hawaii National Park, Hawaii

Track

IV. Putting Research into Management Practice

Abstract

Wake Atoll, located about 3700 km west of Honolulu, Hawaiʻi, protects important habitat for several species of nesting seabirds and migratory shorebirds. The three islands that comprise the atoll are managed by the Department of Defense, and biosecurity is an important issue for military operations and for protection of wildlife habitat. The aims of this study were to provide a more complete understanding of the terrestrial arthropod fauna of Wake and to identify arthropod species that may pose a biosecurity risk to both military objectives and ecosystem health. To meet these objectives, a suite of standard entomological techniques was deployed across the atoll during 23 May–6 June 2019. More than 170 species or morpho-species from within at least 29 orders were identified during the survey. Hymenoptera (ants, bees and wasps) were most diverse (37 species), followed by Coleoptera (beetles; 31 species), Diptera (flies; 26 species), and Araneae (spiders; 15 species). As many as 156 of these species were documented on Wake for the first time. The survey identified fourteen species that pose moderate to high levels of concern to Wake. Of particular concern were yellow crazy ants (*Anoplolepis gracilipes*) and the urbicola soft scale (*Pulvinaria urbicola*), species which may impact nesting seabirds and the health of *Pisonia grandis* stands, respectively. Strategic management actions

may be effective at mitigating the impact of these species. Importantly, we failed to detect several arthropod species that pose a significant biosecurity threat to Wake Atoll and other islands in the Pacific Basin.

81

Mild events, mild effects? A nuanced picture of coral and fish community changes during a bleaching event

Zoe Denckla[1,2], Devynn Wulstein[2,1], Shreya Yadav[2,1], Elizabeth Madin[2,1], Joshua Madin[2,1]

[1]University of Hawai'i at Mānoa, Honolulu, Hawai'i. [2]Hawai'i Institute of Marine Biology, Kāne'ohe, Hawai'i

Track

III. Global and Regional Change & Challenges

Abstract

The Hawaiian Archipelago is home to many endemic fish species that inhabit and specialize in coral reef environments. Utilizing location specific data is essential to understanding the relationship between fish and coral, while furthering our ability to protect them against climate change threats. Kāne'ohe Bay, located on the east side of O'ahu, contains a hardy reef ecosystem that is often exposed to environmental extremes. In 2019, water temperatures were predicted to significantly increase causing corals in Hawai'i to bleach. While water temperature reached high levels they declined in time for most corals to survive. This event gave us an opportunity to investigate how mild events affect ecosystem level changes. Here we present data on coral and fish community change that reveals the sublethal community responses to bleaching. At three patch reefs for three time points across the bleaching event (September-November), images and videos were collected. The videos were analyzed for fish behavior and abundance. These datasets allowed us to measure changes in coral community structure, coral health (i.e., bleaching indices), habitat complexity and the associated fish community. Our results shed light on the complex relationship between coral and fish present in Kāne'ohe Bay, so future precautions can be taken to ensure the persistence of this vital ecosystem. Furthermore, the results add to the larger understanding of how reef communities change during anthropogenic-induced stress events.

82

Effective Hawaiian Forest Conservation and Invasive Plants: Evidence for the Role of Management from the Forest Inventory and Analysis Program

Kevin Potter[1], Susan Cordell[2], Christian Giardina[2], R. Flint Hughes[2], Amy Koch[3], Olaf Kuegler[4], Emma Yuen[5]

[1]North Carolina State University, Raleigh, North Carolina. [2]Institute of Pacific Islands Forestry, United States Department of Agriculture, Forest Service, Hilo, Hawaii. [3]Pacific Islands Area, United States Department of Agriculture, Natural Resources Conservation Service, Hilo, Hawaii. [4]Forest Inventory and Analysis Program, United States Department of Agriculture, Forest Service, Portland, Oregon. [5]Native Ecosystems Protection and Management Program, Hawaii Division of Forestry and Wildlife, Honolulu, Hawaii

Track

III. Global and Regional Change & Challenges

Abstract

Hawai‘i is a global hotspot of species invasion, with non-natives severely threatening the biodiversity of its forests. We used 2010-2015 USDA Forest Service data from the Forest Inventory and Analysis (FIA) Program – a statewide network of 238 standardized plots spanning diverse ownership and management strategies – to quantify the presence of non-native plants across Hawaiian forests and to assess relationships among invasion, management and environmental characteristics. Statewide, 29 percent of large forest trees, 63 percent of small trees and 66 percent of tree seedlings were non-native. Overall, 39 percent of forest area was dominated by non-native trees. Lowland tropical rainforests, moist forests, and dry forests were significantly more invaded by trees and shrubs than montane rainforests. Altogether, these findings provide a rather bleak outlook for Hawai‘i’s native forests, but there are important positive findings. Forests on public lands, in conservation reserves, or in fenced and ungulate-free areas were significantly less invaded by non-native trees and shrubs (but not forbs and grasses) than those in other ownership or management types. Mixed-effects models revealed that forests with higher native tree richness and at higher elevations were less invaded by non-native trees. These results suggest that management may effectively conserve Hawaiian forests in the face of invasion by trees and shrubs (but not forbs and grasses). However, core conservation areas are often located in high-quality forest, so observed patterns may reflect differences in starting conditions. Data from the ongoing re-inventory of the FIA plots should help clarify these relationships.

83

Using UAS and ArcGIS to Create a Vegetation and Land Cover Map of Kēālia Pond National Wildlife Refuge

Elyse Sachs, Rachel Rounds, Suzanne Conlon, Ka‘ua‘oa Fraiola

U.S. Fish and Wildlife Service, Honolulu, Hawai‘i

Track

V. New Technologies in Conservation Research and Management

Abstract

Keālia Pond National Wildlife Refuge was established in 1992 to preserve, restore, and manage essential habitat for two endangered Hawaiian waterbirds: the aeʻo (Hawaiian stilt; Himantopus mexicanus knudseni) and ʻalae keʻokeʻo (Hawaiian coot; Fulica alai). The Refuge is an important foraging and nesting area for endangered wetland birds, and it supports hundreds of migratory shorebirds and waterfowl during winter months. In 2016, the Refuge was awarded a grant to establish long-lasting protections for endangered waterbirds, including fencing, ungulate removal, and invasive plant control. We used unmanned aircraft systems (UAS) imagery and ArcGIS software to map the vegetation of Keālia Pond National Wildlife Refuge to support the invasive plant removal portion of the grant. Imagery was collected using a Rico GRII camera mounted to a quad copter (3DR Solo) UAS. A preliminary classification was completed using Trimble eCognition software, followed by hand digitization in ArcGIS Pro to create a fine-scale vegetation map. The resulting map delineates invasive and native species distribution, serves as a baseline inventory of vegetation composition and land cover at the Refuge prior to fence completion and ungulate removal, and will guide future habitat restoration. We hope the map will provide a baseline tool for the tracking of management actions on the Refuge, particularly as vegetation changes due to ungulate removal, changes in the hydrologic regimes, restoration actions, and projected climate change. Restoration efforts should focus on restoring nonnative-dominated wetland habitats to native wetland species that support endangered waterbirds.

84

ʻŌhiʻa regeneration following mass defoliation in the northern Koʻolau

Wiliwili Weaver

Ko'olau Mountains Watershed Partnership, Pearl City, Hawaii

Track

V. New Technologies in Conservation Research and Management

Abstract

ʻŌhiʻa are the most important native tree species, representing more than 50% of all forests in Hawaiʻi. ʻŌhiʻa forests serve as critical habitat for a host of rare native species and perform a vital role in aquifer recharge. In 2016, managers across Oʻahu observed a land-scape scale defoliation event of Metrosideros polymorpha var. glaberrima and Metrosideros tremuloides across the Koʻolau mountain range. ʻŌhiʻa wood samples were collected and returned with negative results for Rapid ʻŌhiʻa Death (ROD). An aerial survey was conducted in February 2017, and defoliating ʻōhiʻa were observed at an upper elevation band across much of the central Koʻolau range. Further investigation confirmed the presence of ʻōhiʻa rust (Austropuccina psidii) on leaf samples. It was determined that the rust was likely the cause of the massive defoliation in conjunction with abnormally hot and wet late Summer seasons in 2015 and 2016. ʻŌhiʻa rust has been in Hawaiʻi since 2005, but this type of severe impact on ʻōhiʻa had yet not been observed. Genetic testing was conducted and confirmed that the samples of A. psidii had not mutated into a new strain of rust. Ongoing monitoring in the northern Koʻolau shows resilience and

mass refoliation of greater than 50% of the affected ‘ōhi‘a. A. psidii continues to be present but in low abundance.

85

A Trial Habitat Enhancement for ‘Alae ‘ula (*Hawaiian gallinule*) at Keawāwa Wetland on O‘ahu

Charles B. van Rees[1,2], Lukanicole C. Zavas[3,4], Annie Miller[5]

[1]River Basin Center and Odum School of Ecology, University of Georgia, Athens, GA. [2]Livable Hawai'i Kai Hui, Honolulu, HI. [3]Wildlife Ecology Lab, University of Hawaii at Manoa, Honolulu, HI. [4]Livable Hawaii Kai Hui, Honolulu, HI. [5]California Academy of Sciences, San Francisco, CA

Track

IV. Putting Research into Management Practice

Abstract

We present unpublished work from two undergraduate research projects investigating habitat correlates of the abundance and occupancy of ‘Alae ‘ula (Hawaiian gallinule, Gallinula galeata sandvicensis) in wetland impoundments on O‘ahu. This information is crucial for habitat restoration and enhancement of this habitat-limited, endangered waterbird. We conducted playback surveys for ‘alae ‘ula at 86 ponds across 15 wetland locations O‘ahu and collected diverse habitat information including water depth transects, seed head density, habitat cover and configuration of cover types. Spatial data analysis indicated that edge length or interspersion among habitat types like open areas, emergent vegetation, and open water had a statistically significant, positive relationship with ‘Alae ‘ula abundance and occupancy. Taking this empirical information into account, we have initiated habitat enhancement at Keawāwa wetland, a privately-owned freshwater marsh stewarded by the Livable Hawaii Kai Hui (LHKH). Habitat enhancement was accomplished in two phases, first we used heavy machinery to remove dense bulrush creating open water sections. Second, community groups assisted in planting the bank with native wetland flora, creating floating islands composed of ‘ae‘ae (Bakopa monnieri*)* and emergent sedges (Cyperus spp*.,* e.g. Mākalo, ‘Ahuawa), and maintaining exposed mudflats interspersed with kalo *(*Colocasia esculenta*).*

Preliminary results suggest that the resident ‘alae ‘ula population is responding positively to the enhancement, with higher densities of individuals reported in restored sections of marsh. Results from this study will provide conservation evidence and an empirical test of observed trends that managers can use to improve habitat for this rare and important endemic subspecies.

86

Developing an Alternative, Lab-Based Diet for Hawaiian Ground Snails – Food Preference Research and Nutrient Analyses

Lilly Thomey[1,2], David Sischo[1]

[1]Hawai'i's DLNR – Division of Forestry and Wildlife, Snail Extinction Prevention Program, Honolulu, Hawai'i. [2]Kupu Conservation Leadership Development Program, AmeriCorps Service Member, Honolulu, Hawai'i

Track

IV. Putting Research into Management Practice

Abstract

Many rare and endangered species rely on captive propagation to prevent extinction. Understanding an organism's natural diet and associated foraging behavior is critical to diet replication in a lab environment. Terrestrial snail species of the Hawaiian Islands face many threats, including invasive predators, habitat loss, and climate change. *Ex situ* captive rearing programs, like Hawai'i's Snail Extinction Prevention Program (SEPP), are essential for keeping these native snail species from the brink of extinction. Amastridae is an endemic family of imperiled ground and semi-arboreal snail species that feed on decaying leaves of native plants including, but not limited to, māmaki (*Pipturus albidus*), ūpuhe (*Urera glabra*), and ʻieʻie (*Freycinetia arborea*). Currently, rearing amastrid species is restricted to the islands due to their reliance on wild-collected native plant material for food. The objective of this research is to develop an alternative, lab-based diet that will meet the nutritional needs of amastrid species. We performed buffet style feeding trials with *Amastra intermedia* individuals to quantify the type and proportion of preferred food items. Next, we sent preferred food material off for nutrient analyses. Using the results of the nutrient analyses, we identified commercially available ingredients to compose alternative manufactured diets. Results of our feeding trials and nutrient analyses will be presented, as well as suggestions for future diet research. An effective manufactured diet for Amastridae would enable the expansion of captive rearing efforts to participating partners outside of the state, significantly increasing the potential for conservation.

87

Fish Assemblage Structure Before and After a Marine Heatwave in West Hawai'i

Amy Olsen[1], Shawn Larson[1], Jacqueline Padilla-Gamiño[2], Terrie Klinger[2]

[1]Seattle Aquarium, Seattle, Washington. [2]University of Washington, Seattle, Washington

Track

III. Global and Regional Change & Challenges

Abstract

Coral reefs are subject to human-induced disturbances such as marine heatwaves. Thermal stress can negatively affect corals and the associated marine organisms that use these areas as critical habitat. In this study we examined coral reef resilience after a marine heatwave by looking at changes in fish assemblages (relative abundance of functional groups). We analyzed 11 years of subtidal survey data from an ongoing reef monitoring program along three areas in West Hawai'i, capturing a marine heatwave event in 2014-2016. Fish assemblages were divided into seven functional groups: predators, secondary consumers, planktivores, corallivores and three herbivores: scrapers, grazers and browsers. Our study revealed three key findings. First, we show that regardless of location and differences in management strategy, all fish assemblages became more similar (i.e., more homogeneous) after a major marine heatwave. Second, we found that few species seem to be driving most of the change in fish communities across locations. Third, following the marine heatwave, total fish abundance increased in the areas with fewer fishing regulations, Mahukona and Puakō, and appeared to remain relatively stable in Kona, a protected Marine Life Conservation District. Understanding how marine heatwaves impact coral reef communities can guide decision-making for effective coastal management, especially with 30x30 initiatives in mind. Continued long term monitoring is necessary to evaluate disturbance impacts on the coral reef ecosystem as climate change continues into the future.

88

Post-release Monitoring of *Mompha trithalama* and *Carposina bullata*, Two Biological Control Agents Released in Hawai‘i to Control *Clidemia hirta*

Ellyn Bitume, Rosalie Nelson, Tracy Johnson

United States Forest Service, Hilo, HI

Track

IV. Putting Research into Management Practice

Abstract

Classical biological control involves the introduction of natural enemies (agents) from the native range of an invasive plant (target) into the invaded range. To be successful, biocontrol agents must establish in the invaded range and significantly impact the growth or reproduction of the target weed. Post-release monitoring is necessary to evaluate biocontrol impacts on targets such as *Clidemia hirta* (Koster's curse), an invasive weed in many tropical areas including Hawai‘i. Between 1953 and 1995, several agents were released in Hawaii to control *C. hirta*. Here, we look at establishment and impact of two fruit-feeding moths, *Mompha trithalama* and *Carposina bullata*, across three elevational transects on Hawaii Island. We found that *M. trithalama* populations were high at low and intermediate elevations (500-2000 ft) and very low at upper elevations (2500-3000 ft). Upper elevation populations varied seasonally, increasing in December. We also found a general trend for fruit size to decrease with elevation. *Carposina bullata*, previously thought to have failed to establish following release in the 1990s, was found at just one site in July 2020, but by December was found at several sites in all three transects. Our results show that *M. trithalama* is widely established on Hawai‘i, affecting a large proportion of *C. hirta* fruit, and that *C. bullata* is well established although less common. Further research will quantify the impact of these biocontrol agents on *C. hirta* seed production.

89

Exploration of Potential Biological Control Agents for Albizia *(Falcataria moluccana)* in its Native Range

Ellyn Bitume[1], Purnama Hidayat[2], Audrey Leatemia[3], Tracy Johnson[1]

[1]United States Forest Service, Hilo, HI. [2]Institut Pertanian Bogor, Bogor, Indonesia. [3]Pattimura University, Ambon, Indonesia

Track

IV. Putting Research into Management Practice

Abstract

Classical biological control refers to the intentional introduction of a natural enemy from the native range of an invasive species into the presumably enemy-free space of the invaded range. The objective of biocontrol is for introduced agents to establish permanently and provide long-term suppression of an invasive species and the restoration of ecological balance. The island of Hawai'i is negatively impacted by an invasive tree native to Indonesia, albizia *Falcataria moluccana*, which destroys native landscapes and threatens Hawai'i businesses and homes with many millions of dollars in damage. We have completed exploratory surveys in Indonesia searching for specialist natural enemies of this invasive tree that will eventually undergo extensive host specificity and impact testing prior to release in Hawai'i. Two high priority candidates for further study include gall forming eriophyid mites and a stem boring weevil. Also among early prospects is a rust fungus (*Uromycladium falcatarium*) that galls new growth and is a major problem for albizia plantations in the Philippines and Indonesia. Here we discuss the biological control process, describe the potential agents, and discuss the next steps in our international collaboration with researchers in Indonesia to find and evaluate appropriate natural enemies of albizia.

90

Stable Nitrogen Isotopes and Tissue Nitrogen of Shallow-Water and Mesophotic Hawaiian Limu Differ between the Main and Northwestern Hawaiian Islands

Nicholas Strait, Heather Spalding

College of Charleston, Charleston, SC

Track

IV. Putting Research into Management Practice

Abstract

The Hawaiian Archipelago has a high abundance and diversity of limu, or macroalgae. These photosynthetic organisms occur from the intertidal to mesophotic (40 – 150+ m) depths and absorb nutrients within the water column. This study's goal was to improve our understanding of nutrient dynamics within shallow reefs and Mesophotic Coral Ecosystems (MCEs), using macroalgal tissue stable isotopes ($\delta^{15}N$) and percent nitrogen (%N). We collected 813 Chlorophyta, Rhodophyta, and Phaeophyceae samples from 13 islands/atolls within the Hawaiian Archipelago at depths ranging from 0 to 117 m. Within the Main Hawaiian Islands (MHI), mesophotic $\delta^{15}N$ was significantly higher and shallow water %N was significantly higher. However, within the Northwestern Hawaiian Islands (NWHI), significant differences in $\delta^{15}N$ and %N were not found. Regionally, MHI macroalgae had $\delta^{15}N$ and %N values suggesting the presence of anthropogenic N within both habitats. In comparison, the protected NWHI had natural signatures of $\delta^{15}N$ and %N. The data suggest that nearshore anthropogenically-derived nutrients are detectable from shallow to mesophotic depths within the MHI, while nutrient upwelling may be enhancing shallow and mesophotic productivity within the NWHI. Understanding the sources of nitrogen, both natural and anthropogenic, within these ecosystems plays an important role in management and protection. Managing nearshore anthropogenic nitrogen sources may be useful in combating invasive macroalgae at a regional scale, while protecting natural sources could help maintain ecosystem health and diversity.

91

Disease Threats and Management of Trees in Hawai‘i: A Mix of Old and New

Marc Hughes[1,2], Flint `Hughes[2]

[1]University of Hawaii-Pacific Studies Cooperative Unit, Hilo, HI. [2]USDA Forest Service-Institute of Pacific Islands Forestry, Hilo, HI

Track

IV. Putting Research into Management Practice

Abstract

Since the first documented cases of forest and tree diseases in Hawai‘i nearly a century ago, scientists and land managers have been dealing with the negative impacts of plant pathogens. The consequences of these diseases upon Hawaiian forests span from minor importance to severe with widespread and devastating impacts to whole forest stands. Here we detail a compilation of a few examples of well-known and new disease phenomena to native and exotic hardwood trees across Hawai‘i and discuss their potential causal agents, ecological impacts, and management implications. Two newly recognized tree and forest health issues include an undescribed stem and trunk disease of `ōhi`a (*Metrosideros polymorpha*) occurring predominantly in the urban landscape and a canopy dieback and defoliation of the highly invasive and widespread strawberry guava tree (*Psidium cattleianum*) that is affecting large acreages across multiple islands across the state. For well-established diseases, we highlight

management strategies informed by forest pathology research, including the development of koa (*Acacia koa*) and `ōhi`a disease resistance via tree breeding and screening programs to the pathogens *Fusarium oxysporum* f. sp. *koae* and *Ceratocystis lukuohia*, respectively. Regulatory efforts to halt the importation of live plants in the same family as `ōhi`a (Myrtaceae) to prevent novel introductions of the `ōhi`a rust pathogen (*Austropuccinia psidii*) and phytosanitary treatments of `ōhi`a wood are discussed to highlight the continuing effort to improve the state's biosecurity.

92

Using Exclusion Cage to Protect Newly Outplanted Hawaiian Corals from Corallivorous Fishes

Arielle Pollock[1,2], Christina Jayne[1]

[1]Division of Aquatic Resources, Hawai'i Coral Restoration Nursery, Honolulu, Hawai'i. [2]Kupu, Conservation Leadership Development Program, Honolulu, Hawai'i

Track

IV. Putting Research into Management Practice

Abstract

Working to restore damaged Hawaiian coral reefs, our land-based coral nursery fast-grows native Hawaiian corals onto large concrete pyramid modules to outplant onto degraded reef areas. These outplants are most vulnerable to corallivorous fish predation immediately following outplanting because they are a new element in the environment that draws predator attention. To address this concern, a cage, designed to surround the modules, was temporarily outplanted with a coral module to protect it from predation. To our knowledge, fish exclusion cages have not been previously used for outplants of nursery-grown corals in Hawai'i. The cage enclosed one of two newly outplanted 20-centimeter coral modules at a test site on O'ahu. It was deployed for three weeks during which the cage was cleaned weekly. At the end of this period, the cage and its method of attachment were fully removed from the site. During the time the cage was in use, no fish bites were observed on the protected coral. After cage removal, the coral outplant did experience some fish predation, but to a lesser extent than observed on the coral module of the same species, outplanted at the same time without a cage. This indicates that using a temporary cage to provide an adjustment period for corallivorous fishes decreases predation on newly outplanted coral modules. This cage design and deployment method can be easily modified to fit coral outplants of different species, sizes, and shapes to increase survivorship of nursery grown coral modules.

93

Investigating the Spatial Patterning of Coral Relatedness Across an Urban Reef Environment

Lupita Ruiz-Jones[1], Carlo Caruso[2], Mariana Rocha De Souza[2]

[1]Chaminade University of Honolulu, Honolulu, HI. [2]Hawaii Institute of Marine Biology, Kaneohe, HI

Track

V. New Technologies in Conservation Research and Management

Abstract

Kaneohe Bay is Hawaii's largest bay and home to several of the most abundant reef-building coral species found across the Main Hawaiian Islands. The bay has historically been heavily impacted by anthropogenic sources, such as dredging, input of sewage, and invasive algae. In contemporary times, the bay is regularly frequented by fishers and tourists. Kaneohe Bay is also a spatially heterogenous mosaic, making it an ideal place to examine the association between genotypic diversity, phenotypic variation, and environment across space. During the recent global bleaching event variation in individual response was observed within species and adjacent colonies. Despite these various stressors, coral abundance in the bay remains relatively high compared to nearby reefs, especially on the south shore. These spatially heterogenous mosaics might be useful sources of corals for restoration. Data on genotype uniqueness when selecting reef restoration stock helps to preserve genetic diversity. In our study we seek to gain insight into how environmental conditions influence population structure and persistence of specific genotypes of *Montipora capitata,* a potential restoration species. Using temperature loggers, sedimentation traps, and water flow meters, we characterized 30 sites and systematically sampled 600 colonies across the bay. With reduced representation genome sequencing we are investigating relatedness. We are developing a seascape map with genetic, phenotypic, and environmental information that can assist in understanding the relationship between the three.

94

A moment of clarity: modeling the ecosystem dynamics that influence water clarity in a Hawaiian *Chara*-dominated system

Cassandra Evanchuk, Heather Spalding

College of Charleston, Charleston, SC

Track

IV. Putting Research into Management Practice

Abstract

Chara (‘onohi‘awa, or stonewort), is a genus of slightly calcified, native green limu, or algae, found in freshwater to brackish environments. In high abundance, *Chara* can maintain a clear water state via mechanisms such as nutrient bioremediation, allelopathy, and/or by limiting sediment resuspension. Holistic ecosystem modeling is used to quantify the composition, interaction, and dynamics in a specific ecosystem, and may be a useful tool to model which factors and mechanisms are most influential in maintaining water clarity in a *Chara*-dominated system. The Wai Kai Lagoon in ‘Ewa, Oʻahu is a man-made, 21.8 hectare brackish (7.5-8 ppt) body of water with an average depth of 6 m. *Chara* naturally colonized the Lagoon and currently has ~90% coverage of the Lagoon bottom. Since 2014, monthly data on water quality parameters, water column irradiance, phytoplankton, and *Chara* abundance, canopy height, and coloration (an in-situ proxy of growth stage) have been collected at 12 sites within the Lagoon. Statistical models (linear models, variation partitioning, and a path-diagram) were used to determine which abiotic and biotic factors were most significant in influencing water clarity. *Chara* coloration was the most significant factor determining the seasonality of *Chara*, with a co-dependency between nutrients and *Chara* explaining water clarity. This study suggests that *Chara* may be used as a bioremediation tool and provides baseline ecological information for *Chara* populations in a subtropical environment. These results will be used to inform holistic management practices and future monitoring in both man-made and naturally formed water bodies.

95

The Hawai‘i Conservation Alliance Effective Conservation Program and Status of Conservation Report

James Jacobi[1], Sam ‘Ohu Gon[1,2], Allen Allison[3], Dan Polhemus[4], Emma Yuen[5], Kawika Winter[6]

[1]U.S. Geological Survey, Pacific Island Ecosystems Research Center, Hawai‘i National Park, HI. [2]The Nature Conservancy of Hawai‘i, Honolulu, HI. [3]B.P Bishop Museum, Honolulu, HI. [4]U.S. Fish and Wildlife Services, Honolulu, HI. [5]Hawai‘i DLNR, Div. of Forestry and Wildlife, Honolulu, HI. [6]Hawai‘i Institute of Marine Biology, Honolulu, HI

Track

III. Global and Regional Change & Challenges

Abstract

The Hawai’i Conservation Alliance (Alliance) is a collaboration of conservation leaders representing government, cultural, educational, and non-profit organizations from across the state. The Alliance’s Effective Conservation subcommittee has compiled geospatial and tabular data that allow us to evaluate our collective status and progress in conservation of Hawai‘i`s very unique terrestrial and near-shore marine biodiversity resources. This information is being used to compile a Hawai‘i Status of Conservation Report which will be periodically updated to track progress to more effective conservation throughout the state. This status assessment will also be used to identify additional priority areas and issues needing further emphasis to meet critical conservation goals. In this forum the members of the panel will first present a brief overview of the conservation data that has been compiled and discuss how this information has been used to produce the Status of Conservation Report. During the second

half of the session the panel will ask for input from the audience focused on a series of questions addressing: 1) the contents and conclusions of the current report, 2) what additional information should be included in the next iteration of the report, and 3) how we can use this information at the statewide-scale to improve our effectiveness with conserving Hawai'i's biodiversity resources. This forum connects directly to the 2021 Conference theme that focuses on how we live and interact with our environment.

Agenda & Additional Required Information for Forums, Workshops, and Trainings

This forum will start with short presentations from members of a panel who will present a brief overview of the conservation data that has been compiled and discuss how this information has been used to produce the Status of Conservation Report. During the second half of the session the panel will ask for input from the audience focused on a series of questions addressing : 1) the contents and conclusions of the current report, 2) what additional information should be included in the next iteration of the report, and 3) how we can use this information at the statewide-scale to improve our effectiveness with conserving Hawai'i's biodiversity resources. During the audience interaction session we also plan to poll the audience to get input on the importance of selected conservation issues.

96

Coqui Frog (*Eleutherodactylus coqui*) Eradication Efforts Transformed through Partnerships Between Resource Managers and the Community

Susan Frett[1], Adam Radford[1], Adam Knox[1], Abraham Vantze[1], Elizabeth Speith[1,2], Carl Schwarz[1]

[1]Maui Invasive Species Committee, Pā'ia, HI. [2]Hawai'i Invasive Species Council, Honolulu, HI

Track

II. Capacity in Conservation

Abstract

Maui residents are coming together to bring back their quiet nights, protect their property values, and defend native species from invasive coqui frogs. Left unchecked coqui multiply rapidly, reaching population densities two to four times higher than in their native range. Their prolific reproduction makes coqui a threat to native and endemic biodiversity. They are voracious consumers of insects and increase the fertility of soil giving an advantage to invasive plants. They also have a profound effect on human well-being with their loud, disturbing calls that have been measured at 80-90 decibels.

Empowered by support from the Community Coqui Control Program at the Maui Invasive Species Committee (MISC), neighbors are joining forces to control coqui in their backyards. The partnership between MISC and residents developed as managers recognized the lack of capacity for field crews to address the entire infestation in and around Māliko Gulch on Maui. The infestation covers hundreds of acres across residential and wilderness settings. Affected residents are leading eradication efforts in

their neighborhoods while MISC staff are working in difficult to reach gulches and other high priority areas.

Utilizing a Community-Based Social Marketing approach, MISC provides guidance, organizational and logistical support, training, equipment, and supplies for residents to control coqui while community members provide boots on the ground. By collaborating with communities, work towards eradicating coqui has been transformed into a more sustainable, effective program. This presentation highlights preliminary results and lessons learned from the first two years of the program.

97

Genetic Fingerprinting Traces the Introduction and Movement of *Ceratocystis lukuohia* on Hawai'i and Kaua'i Islands

Thomas Harrington[1], Chase Mayers[1], Kyung Seok Kim[1], Jenna Vickery[1], Marnie Rechtzigel[1], Eva Brill[2], Lisa Keith[3]

[1]Iowa State University, Ames, Iowa. [2]University of Hawaii, Hilo, Hawaii. [3]USDA-Pacific Basin Agricultural Research Center, Hilo, Hawaii

Track

IV. Putting Research into Management Practice

Abstract

The primary cause of Rapid 'Ōhi'a Death, *Ceratocystis lukuohia*, is not likely native to Hawai'i, is primarily windborne and infects wounds. Disease management could be improved with better understanding of where the epidemic began and how it has spread across Hawai'i Island and to Kaua'i. We developed 21 highly-variable DNA markers from *C. lukuohia* genomes to trace the accumulation of mutations in more than 250 isolates. Only one genotype (unique combination of markers) was widespread across Hawai'i Island, and other isolates were closely related, suggesting a single introduction. The greatest genetic diversity (most accumulated mutations) was found in the Puna/Hilo area, where the first mortality was noted in 2010. In other regions, clusters of wind-exposed trees often show synchronous mortality, apparently years after a major storm event. Isolates from each cluster were very closely related to each other, suggesting the inoculum came from one or a few trees. Less genetic variation was found on Kaua'i, where there was a widespread genotype closely related to Hawai'i isolates, suggesting a single introduction from Hawai'i. Most of the genetic variation on Kaua'i was found in the southeast, where the pathogen may have gone undetected for years. Recent mortality in northern Kaua'i appears clustered and wind-associated, and isolates from within these clusters were nearly identical to each other and likely originated from southeast Kaua'i. These results point to the challenge of detecting and limiting sources of windborne inoculum.

98

Strawberry Guava Control

Don Bryan

Hawaii Forest Industry Association, Papaaloa, Hawaii

Track

IV. Putting Research into Management Practice

Abstract

Strawberry guava (*Psidium Cattleianum*) currently covers 600,000 acres on Hawaii Island. Native plant biodiversity, economic, recreation, and cultural opportunities have been lost on these lands. Hawaii Forest Industry Association (HFIA) is developing an economically feasible program for landowners to control and/or remove the Strawberry guava on at least 80% of the land it currently inhabits by 2040. Project planning has been completed. Methods which we believe to be both efficacious and economically practical have been developed. Testing has begun. Further trials are scheduled for 2021 and 2022. In 2023, HFIA will begin demonstrations of the methods at operational scale for forestland owners.

The methods to be utilized are: Biocontrol, Clear Clusters, and Mechanical Removal. Biocontrol utilizes *Tectococcus ovatus* insects. The insects suppress guava vigor by 80%, rendering it non-competitive with native vegetation. The Clear Clusters method mechanically removes biologically weakened guava clusters in mosaic patterns intermixed with indigenous forest, and replaces them with indigenous forest plants. Mechanical Removal will be utilized where Strawberry guava has completely overtaken an area. Process and outcomes will be consistent with appropriate conservation standards, landowner's objectives, and zoning.

Program planning has received the support of various agencies. DOFAW is providing GIS data. USFS is supporting with entomology and biocontrol advice. USGS is supplying vegetation type maps. UH Hilo provides technical forestry information and advice. Volcano Helicopters has provided helicopter time for initial distribution trials. Glenwood Ranch has offered suitable land for insect gall production. Foresters at HFIA manage economic feasibility.

99

Expanding Conservation in Hawai‘i from Local-scale Actions to Statewide-scale Success: How Can We Get From Here to There?

James Jacobi[1], J. Michael Scott[2], Scott Fretz[3], Sam ‘Ohu Gon[4], Melissa Price[5], David Sischo[6], Lindsay Young[7]

[1]U.S. Geological Survey, Pacific Island Ecosystems Research Center, Hawai‘i National Park, HI. [2]U.S. Geological Survey (retired), Moscow, ID. [3]Hawai‘i DLNR, Div. of Forestry and Wildlife, Wailuku, HI. [4]The Nature Conservancy of Hawai‘i, Honolulu, HI. [5]University of Hawai‘i at Manoa, Honolulu, HI. [6]Hawai‘i DLNR, Div. of Forestry and Wildlife, Honolulu, HI. [7]Pacific Rim Conservation, Honolulu, HI

Track

IV. Putting Research into Management Practice

Abstract

The unique biodiversity of the Hawaiian archipelago has long been the focus of evolutionary and ecological research, as well as concerted efforts to conserve these important native species and ecosystems. Major factors driving species and habitat declines include direct alteration or destruction of habitats combined with impacts from a non-native invasive species, now compounded with climate change. Conservation efforts to reverse these effects have ranged from micro-scale efforts to protect individual nesting birds or extremely rare plants and tree snails, to eliminating populations of introduced ungulates from large management units. Despite these heroic and challenging efforts, we continue to see significant declines or loss of native species and habitats, coupled with an expansion of distribution and abundance of invasive species, and continued increase in the introduction numbers of non-native species. While current conservation efforts in Hawai‘i are critically important, we currently lack the funding and support to pursue many critical conservation actions at a scale that will not only prevent extinctions, but allow for species and ecosystem recovery. This forum builds on discussions from the preceding session that describes the Hawai‘i Conservation Alliance’s Status of Conservation Report and addresses the Conference theme “transforming how we do conservation”. Following brief opening statements by panelists representing wide conservation expertise, we will engage with the audience and challenge ourselves collectively to think beyond current conservation perspectives and comfort zones to identify new ideas on how to develop and implement strategies to effectively stabilize and restore Hawai‘i’s biodiversity.

Agenda & Additional Required Information for Forums, Workshops, and Trainings

Panel members:

- Jim Jacobi (moderator)
- Mike Scott
- Scott Fretz
- Sam Gon
- Melissa Price
- Dave Sischo
- Lindsay Young

Following brief opening statements by our panelists who represent wide conservation expertise, we will engage with the audience and challenge ourselves collectively to think beyond our current conservation perspectives and comfort zones to identify new ideas on how to develop and implement strategies to effectively stabilize and restore Hawai‘i’s biodiversity. A series of questions will be posed to both the

panel members and audience to initiate and stimulate an interactive discussion on how to move forward with conservation actions.

1) What are the limitations to large-scale conservation?

2) How can we move from managing conservation reliant species to self-sustaining populations in viable ecosystems?

3) What bridges can be built among different conservation programs to enhance our effectiveness?

4) What new tools or approaches can we use to enhance our conservation effectiveness?

5) How can we generate better understanding and support for conservation from the public?

6) How do we incorporate projected climate change into our conservation strategies.

7) What is our vision of when we will have achieved effective conservation?

We plan to also poll the audience to assess priorities for selected conservation needs and actions.

100

Wake Atoll Vegetation Survey – Collecting Data to Inform Biosecurity Planning

James Jacobi

U.S. Geological Survey, Pacific Island Ecosystems Research Center, Hawai'i National Park, HI

Track

IV. Putting Research into Management Practice

Abstract

Wake is one of the most isolated atolls in the Pacific and its location has limited the number of plants that could colonize its 7 km^2 land surface naturally. While just 21 species of vascular plants are considered native to Wake, many others have been purposely or accidentally introduced by humans. Although most non-native plants are cultivated only in gardens or yards, others have become naturalized. A field survey was conducted on Wake in 2019 to assess the status of plant species and communities found there and to provide information for incorporating into a biosecurity plan for this atoll. During the survey 153 plant species were recorded: 20 native and 133 introduced. Most plants recorded during the survey were found on Wake Islet (151), with fewer on Peale (56) and Wilkes (34) Islets. Of the 51 introduced species that were established outside cultivation, 26 are considered invasive. Some plants in cultivation are also potentially invasive in similar habitats elsewhere. Without active management many invasive species already established or cultivated on Wake Atoll may spread more widely and increase impacts on the native ecosystems. Additionally, there are many other highly invasive species that could become established on Wake if they are purposely or accidentally

transported there in the future. This information connects to the Conference theme "Transforming how we do conservation" and may help managers identify and implement biosecurity measures and conservation actions to manage Wake Atoll, as well as in Hawai'i and other island ecosystems throughout the Pacific.

101

Characterizing Pseudocryptic Diversity in Hawaiian Mesophotic Red Blades of the Genus *Croisettea*

Feresa Cabrera[1], John Huisman[2], Heather Spalding[3], Randall Kosaki[4], Celia Smith[1], Alison Sherwood[1]

[1]University of Hawai'i at Mānoa, Honolulu, Hawai'i. [2]Department of Biodiversity, Conservation and Attractions, Kensington, Western Australia. [3]College of Charleston, Charleston, South Carolina. [4]NOAA Papahānaumokuākea Marine National Monument, Honolulu, Hawai'i

Track

V. New Technologies in Conservation Research and Management

Abstract

Recent investigations into the species diversity of blade or foliose forms of red algae in Hawai'i have revealed several pseudocryptic species, highlighting the need for a more thorough taxonomic assessment of these algae. Expanded to lobed red blades preliminarily identified as belonging to the genus *Croisettea* M.J.Wynne were studied morphologically using light microscopy and with molecular analyses using COI-5P (mitochondrial) and *rbc*L (plastidial) markers. *Croisettea* currently includes three species: *C. requienii* (J.Agardh) Kützing (the generitype), *C. australis* (Womersley & R.E.Norris) G.W.Saunders, and *C. tasmanica* (Harvey) G.W.Saunders. The genus has a wide and disjunct distribution in the North Atlantic, Pacific, and Indian Ocean. Four new mesophotic Hawaiian *Croisettea* species are described based on our combined molecular and morphological analyses. Each taxon was resolved as a unique genetic lineage with varying distance between relatives. Gross morphology alone was an inadequate discriminator, but the incorporation of distribution patterns and depth ranges facilitated the species identifications. The discovery of these four novel mesophotic species highlights the increasing awareness of pseudocryptic diversity among red blades, and indicates that Hawaiian mesophotic reefs still have a high level of undescribed algal biodiversity. The significance of this discovery inspired cultural naming collaborations that referenced ma uka to ma kai connections and kupuna who contributed to the discovery and conservation efforts of the Hawaiian biota. This study contributes to a more integrative view of the expanded red blades providing opportunities to gain new insights into fundamental ecological dynamics and enhance the success of conservation strategies in the marine tropics.

102

The ʻŌhiʻa Disease Resistance Program: Building the Foundation of a Resistance Program to Return ʻŌhiʻa to Our ROD-Impacted Spaces

Blaine Luiz

Akaka Foundation for Tropical Forests, Hilo, HI

Track

V. New Technologies in Conservation Research and Management

Abstract

Naturally occurring host resistance can be an effective tool for combatting the devastating effects of nonnative pathogens. In the ʻōhiʻa (*Metrosideros polymorpha*) - Rapid ʻŌhiʻa Death (ROD) pathosystem, evidence from previous disease screening experiments suggests that resistance to *Ceratocystis lukuohia* may be present in some Hawaiʻi Island varieties of ʻōhiʻa. However, producing resistance that is durable in the landscape requires expanding screenings and implementing long-term, rigorous verification of greenhouse experiments. The ʻŌhiʻa Disease Resistance Program (ODRP) was established in 2018 to fill this need by laying the foundation for a large-scale resistance program. The framework for this program will be discussed in this presentation, covering the steps the program plans to take to achieve ROD-resistant ʻōhiʻa, including: *i*) evaluating and operationalizing methods for greenhouse-based production and screening of plants; *ii*) greenhouse screening of seedlings and rooted cuttings sampled from native *Metrosideros* throughout Hawaiʻi; *iii*) establishing field trials to validate results from greenhouse assays; *iv*) understanding environmental and genetic drivers of resistance to characterize the durability of resistance to ROD; *v*) developing remote sensing and molecular methods to rapidly detect ROD-resistant individuals; and *vi*) conducting breeding to improve the level and durability of ROD resistance. Currently, the program is in the process of growing ʻōhiʻa for testing, but will begin screening on the earliest collections in 2021. Ultimately, the ODRP seeks to produce ROD-resistant material to facilitate the restoration of ROD-impacted spaces across Hawaiʻi.

103

Evidence for Expanded Waterbird Habitat During the Hawaiian Era

Kristen Harmon[1], Kawika Winter[1,2], Melissa Price[1]

[1]University of Hawaiʻi at Mānoa, Honolulu, HI. [2]Hawaiʻi Institute of Marine Biology, Heʻeia, HI

Track

I. Cultural Values and Practice in Conservation

Abstract

Studies of biodiversity loss often imply that species extinctions have occurred linearly over time, which perpetuates the assumption that humans are intrinsically bad for nature. This has led to the "fortress conservation" mentality that is used in conservation today, whereby humans are separated from nature. However, global mass extinctions in the Anthropocene began at the onset of the 19th century, and in many regions, mass species extinctions were largely caused by introduced species or technological advancements in hunting associated with 19th century European settlement. While species extinctions did occur after the initial settlement of Indigenous Peoples, evidence suggests that these extinctions cannot be directly attributable to failures of Indigenous Resource Management (IRM). To the contrary, there are indications that IRM expanded some habitats and benefited many endemic species. For example, some studies suggest that Hawaiians were responsible for mass avifauna extinctions. However, the development of Hawaiian agro-ecosystems (loʻi) greatly expanded wetland habitat, and thus likely benefited native waterbird populations. In this study we use existing data to build the first empirical case for the expansion of waterbird habitat following Polynesian arrival to Hawaiʻi and the decline in waterbird habitat following 1778. Our findings further corroborate previous research that suggests contemporary IRM may help to recover Hawaiʻi's endangered waterbirds. Moving forward, we encourage people to avoid statements that imply major species declines occurred as a result of Polynesian arrival and use more specific language that correctly attributes declines to a complex suite of novel threats introduced in the islands following 1778.

104

Horizon Scan of Invasion Risk Posed by Vertebrates in Trade: What Species Might Be a Threat in the Pacific?

Helen Sofaer[1], Wesley Daniel[2], Brett DeGregorio[3], Peder Engelstad[4,5], Richard Erickson[6], Jonathan Freedman[7,2], Catherine Jarnevich[4], Deah Lieurance[8], Justin Procopio[7,2]

[1]U.S. Geological Survey, Hawaii National Park, HI. [2]U.S. Geological Survey, Gainesville, FL. [3]U.S. Geological Survey, Fayetteville, AR. [4]U.S. Geological Survey, Fort Collins, CO. [5]Colorado State University, Fort Collins, CO. [6]U.S. Geological Survey, La Crosse, WI. [7]Cherokee Nation Strategic Solutions, Gainesville, FL. [8]University of Florida, Gainesville, FL

Track

III. Global and Regional Change & Challenges

Abstract

International trade is a major source of invasive species. Identifying potentially invasive species prior to their establishment can inform policy and guide response planning. For vertebrates, the pet trade represents a pathway of arrival, and species can become established after intentional release or escape from confinement. We are conducting a global horizon scan of vertebrate species in trade to identify the species most likely to become problematic invaders in the U.S. Using lists of imported birds, fishes, reptiles, amphibians, and mammals from government and industry, we calculated climatic similarity

between each species' global locations and U.S. states and territories, and compiled information on prior invasion history. This information feeds into an assessment led by taxonomic experts for each species group. We calculated the climatic similarity at a regional level, including for Hawai'i and Pacific Island territories, allowing us to identify species posing regional risk and evaluate overlap in potentially problematic species among regions. In addition, analyses of the climatic similarity, propagule pressure (i.e., the number of introduced individuals), and invasion history of already established species allow for quantitative testing and validation of our approach.

105

Insights into the Movement Ecology of Pueo (Hawaiian Short-eared Owl; *Asio flammeus sandwichensis*) on the Island of O'ahu

Marie-Sophie Garcia-Heras[1], Chad J. Wilhite[1], Olivia Wang[1], Kaleiheana-a-Pōhaku Stormcrow[1], Melissa R. Price[2]

[1]University of Hawaii at Manoa, Honolulu, HI. [2]University of Hawaii, Honolulu, HI

Track

V. New Technologies in Conservation Research and Management

Abstract

Short-eared Owls (SEOW) are one of the most widespread raptor species in the world, present in almost all continents. Known to be extremely vagrant and to show little site-fidelity, the bulk of the research thus far has been documented in temperate and continental regions from Eurasia and North America, yet relatively little is known from SEOW movements from islands in tropical/sub-tropical climates. In Hawai'i, the pueo (Hawaiian Short-eared Owl; *Asio flammeus sandwichensis*), is an endemic subspecies that is native to and thought to reside on all the main Hawaiian Islands. Currently state-listed as endangered on O'ahu, there has been increasing concerns for pueo and its suspected population decline. This medium sized ground-nesting raptor has however remained understudied, and in fact, very little is still known about its general ecology. In 2019, our team launched the first study looking at pueo movement ecology, on the island of O'ahu, during which two adults were tagged with Very High Frequency (VHF) devices. In 2021, we extended our knowledge by tagging additional birds with GPS-VHF devices. On average, pueo were monitored for about one to two consecutive months. Movement patterns and individual habitat use via home range analyses were conducted, giving critical information of how pueo interact with their surrounding landscape during the breeding season. This novel study represents a major step towards a better understanding of pueo movement ecology, and contributes to providing the knowledge needed to incorporate movements into conservation management planning.

106

Exploring the effect of elevated nutrients on the growth rate of Hawaiian *Porites* species used for coral restoration.

Adam Desjardins[1,2], Christina Jayne[2]

[1]Kupu, Conservation Leadership Development Program, Honolulu, HI. [2]Division of Aquatic Resources, Hawai'i Coral Restoration Nursery, Honolulu, HI

Track

IV. Putting Research into Management Practice

Abstract

Hawaiian corals are some of the slowest growing in the world, leaving Hawaiian reefs vulnerable to anthropogenic disturbance events, for which natural recovery is miniscule. Our land-based coral nursery uses established aquarium techniques to produce and outplant large, massive-form Hawaiian coral colonies from small original source corals in a fraction of the time it would take naturally. For decades, elevated nutrient levels in coral aquaria were believed to be detrimental for coral growth, but recent research indicates slightly elevated nitrate levels may induce rapid growth in both soft and stony corals. A previous coral nursery experiment found the addition of a mysis shrimp pellet food produced the fastest growth for three Hawaiian Porites species. However, due to the large pellet size, it was theorized the pellets were not consumed by the coral and slowly released nutrients (Nitrate and Phosphate) in the treatment aquaria, which may have fueled coral growth. Therefore, we conducted an experiment to study Porites growth under elevated nutrient regimes. Three Porites species were grown under three treatment conditions: low nutrient, high nutrient, and fed mysis shrimp pellets. We observed unexpected results, as control fragments had the most growth, while no substantial difference in growth was observed between treatment tanks. However, the control fragments bleached and some lost tissue while the nutrient treatments appeared healthier with darker-colored tissue and extended polyps. This study suggests a small dosage of nutrients to Porites corals may not increase growth rate, but can be important for maintaining health long-term in aquaria.

107

Wake Atoll Reptile Survey with Implications for Biosecurity Actions in the Pacific

Stacie Hathaway[1], Adam Backlin[2], Cynthia Hitchcock[3], Robert Fisher[1]

[1]U.S. Geological Survey, San Diego, CA. [2]U.S. Geological Survey, Santa Ana, CA. [3]U.S. Geological Survey, Ventura, CA

Track

VI. Place-based Conservation

Abstract

Wake Atoll is one of the most isolated islands in the Pacific. We conducted field surveys to determine current status of plant, arthropod and reptile communities on Wake as part of assessing biosecurity practices to evaluate where they could be strengthened. Reptiles have been observed during various

expeditions with specimens vouchered beginning in 1871. The reptile community had never been formally surveyed, therefore filling gaps in knowledge regarding biodiversity was another objective of our expedition. We conducted rapid assessment surveys to update the species list, determine presence, status and distribution of historically known species, and to determine presence of new potentially invasive reptile or other invasive species with potential to negatively impact species native to Wake, human inhabitants or mission critical elements of the military installation. Using sticky traps and visual encounter surveys we detected four of eight previously documented reptile species. We consider two to be native, one as possibly native, and one invasive with potential threat to native species. One invasive snake documented recently is not a known threat. One rare potentially native and one invasive lizard were not detected. One nonnative snake was removed in 1948. We detected no previously unreported reptile species. We developed a species guide including invasive reptile and amphibian species that could become established on Wake if accidentally transported there in the future. Continuing to develop and enforce robust biosecurity protocols may prevent future invasions. This information may help managers implement biosecurity for Wake, Hawai'i and other island ecosystems throughout the Pacific.

108

Towards a Systematic Revision of the Hawaiian Achatinellidae, a Highly Threatened Land Snail Family

Norine Yeung[1,2], Ellen Strong[3], John Slapcinsky[4], Kenneth Hayes[5,2]

[1]Bishop Museum - Malacology, Honolulu, HI. [2]University of Hawaii - Pacific Biosciences Research Center, Honolulu, HI. [3]Smithsonian National Museum of Natural History, Washington, DC. [4]Florida Museum of Natural History, Gainesville, FL. [5]Bishop Museum - Pacific Center for Molecular Biodiversity, Honolulu, HI

Track

IV. Putting Research into Management Practice

Abstract

Effective conservation is predicated on comprehensive, accurate, and evolutionarily informative systematics, which is lacking for most Pacific Island land snails. The iconic and threatened Achatinellidae are the second most diverse, in number of species, of the thirteen Hawaiian land snail families, but the current taxonomic assessment for the Achatinellidae is outdated and only one subfamily, the Achatinellinae, has been assessed within a modern molecular framework. To guide a systematic revision of the family, we used an integrative taxonomic approach incorporating shell morphology, anatomy, biogeography, original descriptions, and mitochondrial and nuclear DNA sequences from historic and contemporary specimens of all Hawaiian achatinellid genera excluding only the monotypic *Gulickia*, which is likely extinct. While subfamilies are strongly supported and clearly differentiated using conchological and anatomic data, their component genera are not, especially in the larger bodied Auriculellinae and Achatinellinae. Phylogenetic analyses support family and subfamily monophyly, but current generic assignments within the Achatinellinae are polyphyletic. Herein we present the

provisional updated taxonomic framework and a broader understanding of Hawaiian achatinellid relationships and biogeography to better inform conservation of the remaining species and update management plans to protect them more effectively. With a clear list of accurately identified species occurring on managed lands, and an understanding of their biology, evolution, and ecology, all of which are predicated on accurate taxonomy, resource managers will be able to effectively put into practice science-based, data driven management actions that are just not possible without accurate taxonomy.

109

Staphylococcus aureus: An Indicator Organism Showing the Challenge of Increasing Species Biodiversity in the Human-Impacted Kailua, O ʻahu, Ahupuaʻa

Sherine Boomla

University of Hawaii, Manoa Campus, Honolulu, HI

Track

IV. Putting Research into Management Practice

Abstract

The Kailua, Oʻahu, ahupuaʻa is an important watershed and Bay providing habitat for native and migratory birds, fish, and humans. Spanning from the Koʻolau summit, across Kawainui Marsh (Hawaii's largest wetland) and Kailua, and draining into Kailua Bay, the ahupuaʻa crosses diverse terrain and elevation. With increasing population, watershed habitat has been lost and altered as more urban and agricultural structures including golf courses, cemeteries, landfills, and a quarry, negatively affect the watershed ecosystem health. Moreover, the bacterial pathogen *Staphylococcus aureus* has been found in the ahupuaʻa's coastal and stream waters and causes serious, hard-to-treat human skin infections. Past studies speculate that *S. aureus*in coastal waters probably comes from the watershed adjacent land cover, but specific sources are unknown. Healthy watershed ecosytems have a variety of microbial and other species and are not dominated by one or a few pathogens. This study's purpose was to discover if *S. aureus* was present in the ahupuaʻa's stream and coastal waters and to examine possible correlations between anthropogenic land use and watershed ecosystem health through using *S. aureus* as an indicator organism. Characterisitc of the urban stream syndrome, increased *S. aureus* was found at sites close to urban and agricultural structures. Study results will show possible correlations between water physico-chemical, nutrient, and land cover factors and *S. aureus*abundance. Best management practices need to reduce urban and agricultural pollutants and restore habitat to increase native species biodiversity and ecological health.

110

When are alien species good or bad for native plants? Assessing positive and negative effects of interactions with alien species

Alex Loomis

Duke University, Durham, NC

Track

IV. Putting Research into Management Practice

Abstract

Invasive species can simultaneously have negative and positive effects on native species. Effects of alien species on natives can be direct (e.g., through consumption or competition for abiotic resources) or indirect (e.g., supporting populations of pollinators or making natives less apparent to herbivores or pollinators). Indirect effects could be mediated through interactions with other invasive or other native species. Furthermore, abiotic conditions could modify these indirect and direct effects, changing their magnitudes—including within individual populations as abiotic conditions change seasonally and over different years.

Hawaii's diverse but highly invaded terrestrial ecosystems provide excellent opportunities for understanding how native and alien species interact and understanding these relationships is critical for the planning and implementation of conservation of native plants. This study examines the impact of interactions with non-native species in a population of the endemic *Schiedea globosa* that experiences a cooler, wet winter and a hotter, dry summer. I used a demographic approach, conducting bi-annual censuses, to evaluate positive or negative effects of species interactions on individual vital rates. Alien neighbor removal, mollusk suppression, and supplemental watering experiments were implemented to increase the variation of interactions with alien species. Examining the demography of this species across the two seasons allows for analysis of whether the relationship with non-native species is constant across vastly different abiotic conditions or changes between seasons, indicating a potential trade-off between negative and positive interactions with potential implications for the net-effect of non-native species on population growth.

111

Abundance estimates for the mosquito vector of avian malaria: Preliminary results from a recent mark-release-recapture experiment.

Dennis LaPointe, Matthew Mueller, Jared Nishimoto

U.S. Geological Survey, Pacific Island Ecosystems Research Center, Hawaii National Park, HI

Track

V. New Technologies in Conservation Research and Management

Abstract

Introduced avian malaria remains the main obstacle to recovery of endemic Hawaiian forest bird populations. The vector*, Culex quinquefasciatus*, has become increasingly widespread in native forests following local climate change and control of vector numbers has become a conservation priority. As efforts to develop landscape-scale mosquito control move forward and mosquito monitoring increases across the islands, accurate estimates of mosquito abundance remain difficult to obtain due to low capture rates and the high variability of trapping success. To estimate the density of mosquitoes in a Hawaiian forest, we conducted a small-scale, mark-release-recapture trial with *C. quinquefasciatus* testing the fluorescent dye rhodamine B for marking both male and female mosquitoes. In November 2020, we released 5,353 lab-reared female and 3,604 lab-reared male mosquitoes marked with rhodamine B and an additional 490 wild-captured female mosquitoes marked with a distinct fluorescent dust into a mixed, tropical ash/ohia rainforest. Trapping effort was evenly divided among three trap types (BG Sentinel, CDC light traps and CDC gravid traps) that were distributed over a 1 km radius circular plot. Over the course of nine days, we captured 314 *C. quinquefasciatus* of which 17 were rhodamine B-marked female mosquitoes (recapture rate 0.3 %) and 3 were fluorescent dust-marked mosquitoes (recapture rate 0.6%) in 518 trap-nights of effort. No marked male mosquitoes were captured. Low recapture rates may have been due to heavy rains during the recapture period and the unreliability of rhodamine B detection. We expect recapture numbers to increase with fluorescent microscopy detection techniques.

112

Mamalu Poepoe: Enhancing Hawai'i's Biosecurity Through Increased Invasive Species Surveillance at Airports

Leya Kaufman

University of Hawaii Pacific Cooperative Studies Unit, Honolulu, Hawaii. Hawaii Invasive Species Council, Honolullu, Hawaii

Track

II. Capacity in Conservation

Abstract

Invasive species cause severe effects in Hawaii's economy as well as in its fragile and unique ecosystem. Mamalu Poepoe is a pilot program funded by the Department of Transportation (DOT) for a five-year period, and aims at enhancing surveillance of selected invasive species at airport facilities statewide. The program brings together different State agencies in Hawai'i, such as DOT, Department of Health (DOH), Department of Agriculture (DOA), Department of Land and Natural Resources (DLNR), and the University of Hawai'i. The program also partners with Invasive Species Committees (ISCs) statewide and the Hawai'i Ant Lab (HAL) to conduct the mornitoring activities. Selected target invasive species include the Coconut

Rhinoceros Beetle (*Oryctes rhinoceros*), Africanized Honeybees (*Apis mellifera scutellata)*, mosquitoes and ants. Target species were selected due to the threat they present, they can be easily missed during inspections, as well as the ability to set up feasible and time efficient monitoring protocols.

The main goals of the program are to (a) foster cooperation, coordination and communication among partner agencies regarding invasive species surveillance at airport facilities in Hawai'i; (b) improve the state's capability to prevent invasive species introductions through systematic monitoring efforts; and (c) increase security of Hawaii's people, natural resources, food supply and economy through an interagency monitoring program of incipient pests at major airports. This presentation will provide information about the current program progress, future efforts, and how this program fits in the overall Hawaii Interagency Biosecurity Plan.

113

New Breeding Population of ʻUaʻu (Pterodroma sandwichensis) in the Maunaloa Forest Reserve

Naomi Himley[1], Bret Mossman[2], Alex Wang[3]

[1]Americorp-Kupu, Hilo, HI. [2]Pacific Cooperative Studies Unit, Hilo, HI. [3]Hawaii Island Natural Area Reserve Program (DOFAW), Hilo, HI

Track

IV. Putting Research into Management Practice

Abstract

ʻUaʻu on Hawaiʻi Island are limited to a few remote populations on Maunaloa, Kohala, and Maunakea. This species is endangered and continues to decline due to various anthropogenic threats. Within Hawaiʻi Volcanoes National Park, a 600-acre cat proof fence was constructed to protect an established breeding colony in 2012. Since then additional populations have been identified and are being monitored. In 2016 the Hawaiʻi Island Natural Area Reserve Program and the Wildlife Department of the Hawaiʻi Division of Forestry and Wildlife began monitoring seabird activity within the Maunaloa Forest Reserve. Remote audio recorders were deployed from 2017-2020 to locate vocalization "hotspots" of nocturnal seabirds. Both ʻuaʻu and ʻakēʻakē (*Oceanodroma castro*) were detected including ground-based calls. Then human observers used Forward looking infrared (FLIR) and night vision to observe nocturnal seabird activity around likely nesting locations and count the number of birds in the area. In summer of 2020, the first ʻuaʻu burrow was discovered and using a remote camera the chick was observed successfully fledging in November of the same year. A second burrow was discovered that December indicating a possible colony in the monitored area. This project provides important insights and techniques for managers to deploy to locate additional endangered seabird resources in remote areas. Additionally, identifying and protecting the locations that host these populations is critical to the preservation of this once abundant natural and cultural resource.

114

Contributions to the U.S. Navy Joint Region Marianas Biosecurity Program

Kenneth Puliafico[1], Jill Krumlauf[1], Stephen Mosher[2], Marc Hall[2], Tom Mathies[3]

[1]Center for Environmental Management of Military Lands, Asan, Guam. [2]US Navy, Naval Facilities Engineering Systems Command Marianas, Santa Rita, Guam. [3]Center for Environmental Management of Military Lands, Fort Collins, Colorado

Track

III. Global and Regional Change & Challenges

Abstract

The overall goal of the U.S. Navy Joint Region Marianas (JRM) Biosecurity Program is to reduce the risk of introduction and spread of invasive species through the Department of Defense (DoD) transportation network. Under the direction of the Naval Facilities Engineering Systems Command - Marianas (NAVFAC-MAR), the Center for Environmental Management of Military Lands (CEMML) implements a number of tasks supporting the JRM Biosecurity Program. Tasks focus on finding, monitoring and mitigating terrestrial invasive species on DoD properties and military leased lands across Guam and the Commonwealth of the Northern Mariana Islands (CNMI) in keeping with the Mariana Islands Training and Testing Biological Opinion issued to the U.S. Navy by the U.S. Fish and Wildlife Service. CEMML's contributions include, but are not limited to: 1) conduct biosecurity Quality Control/Quality Assurance inspections of all military cargo and vehicles including incoming, outgoing, and inter-island movement associated with training exercises both on Guam and in the CNMI to ensure cleanliness standards are maintained according the Armed Forces Pest Management Board, Technical Guide 31, 2) Conduct Early Detection Surveys for invasive species at over 160 sites within the military transportation network on Guam and Tinian, 3) conduct surveys and management for little fire ant (LFA) and coconut rhinoceros beetle (CRB) around military transportation hubs and in training areas to prevent further spread of these invasives, and 4) implement lethal control measures for the brown treesnake (BTS) on Naval Base Guam to protect endangered species and reduce risk of BTS entering the transportation network.

115

Developing a Baseline of Phytoplankton Biomass and Diversity across the He'eia Estuary to Open Ocean Continuum

Sarah Tucker[1,2], Kelle Freel[1], A. Hi'ilei Kawelo[3], Keli'i Kotubetey[3], Kawika Winter[1,2], Yoshimi Rii[1,2], Michael Rappé[1]

[1]Hawai'i Institute of Marine Biology, Kāne'ohe, HI. [2]He'eia National Estuarine Research Reserve, Kāne'ohe, HI. [3]Paepae o He'eia, Kāne'ohe, HI

Track

IV. Putting Research into Management Practice

Abstract

Understanding the potential impacts that climate change may have on healthy and productive aquatic food webs is a major challenge for resource managers. Climbing ocean temperatures are increasing the stratification of the open oceans, which restricts the delivery of nutrients to phytoplankton at the ocean's surface. Because phytoplankton rely on these nutrients in order to conduct photosynthesis, increased ocean stratification has led to annual declines in global phytoplankton primary productivity and biomass, and declines in productivity and biomass are expected to amplify across the trophic food web. Adjacent to one of the world's most oligotrophic oceanic environments (the North Pacific Subtropical Gyre), the He'eia National Estuarine Research Reserve (NERR) may be particularly vulnerable to food-web shifts and productivity declines due to increased ocean stratification via global climate change. With Indigenous aquaculture resource management partners, we utilize time-series sampling to examine phytoplankton assemblages forming the base of the aquatic food web and to inform ongoing biocultural restoration projects that aim to maximize herbivorous fish productivity through the aquatic food web. Data collected from a monthly time-series that samples stations spanning Kāne'ohe Bay and the adjoining offshore environment, including sites within the He'eia NERR, provide a baseline of oceanographic measurements, phytoplankton biomass and diversity, and bacterial community composition for comparisons across space and time. These results inform the He'eia community of the current biogeochemical drivers of phytoplankton assemblages within the He'eia NERR and the potential impacts that intensifying ocean stratification may have on phytoplankton productivity and subsequently on total biological productivity.

116

Molokai GO Limu Hui: An Ahupua'a-Based Approach to Managing *Gracilaria salicornia* on Molokai

A. Kukuileiwilimomi Afelin[1,2], Christopher O'Brien[3], Davidette Pa-Kala[4], Kilia Purdy-Avelino[5], Walter Ritte[2], Clayton Ching[6], Matt Yamashita[7], Josiah Ching[8]

[1]Sustainable Molokai, Kaunakakai, HI. [2]'Āina Momona, Kaunakakai, HI. [3]Sustainable Molokai, Kaunakaki, HI. [4]Kamiloloa-One Ali'i Homestead Association, Kaunakakai, HI. [5]Ola Moloka'i Home School, Kaunakakai, HI. [6]Hallelujah Hou Fishing, Kaunakakai, HI. [7]Quazifilms Media, Kaunakakai, HI. [8]Molokai GO Limu Hui, Kaunakakai, HI

Track

VI. Place-based Conservation

Abstract

Molokai GO Limu Hui (MGOLH) is a community-led, research-backed conservation project building capacity for place-based community management of Gracilaria salicornia, commonly known as Gorilla Ogo (GO). Molokai's population, largely concentrated along the South Shore, has seen the largest fringing reef in the United States become infested with GO, damaging a vital food resource for many Molokai residents, who rely on subsistence food gathering from our coastal waters.

MGOLH unites organizations, agencies, and individuals to coordinate and implement best practices for removing GO. At the landscape level, our geographic focus spans Molokai's South Shore, but our impact is maximized by engaging in place-based conservation within each ahupua'a. This place-based connectedness facilitates a deep understanding of stewardship. MGOLH provides research-backed knowledge to implement best practices for conservation management in each ahupua'a and encourages the use of kilo to build upon these practices.

Best practices were established by consulting academic limu (seaweed) experts and limu practitioners alike and conducting a feasibility study to determine how to adapt these practices locally. Monitoring protocols were implemented to track changes in biodiversity as a result of clean ups. These experiences and collaboration with the Department of Aquatic Resources informed our development of community training materials. The interdisciplinary background of our hui has enabled us to build strong networks with other organizations. These relationships have led us to begin conducting cleanups and training with the Kamiloloa and One Ali'i Homestead Association, which will also serve as the site for native limu outplanting later this year.

Agenda & Additional Required Information for Forums, Workshops, and Trainings

List of Speakers: A. Kukuileiwilimomi Afelin, Davidette "Hala" Pa-Kala, Kilia Avelino-Purdy, Christopher O'Brien, Walter Ritte, Jeaninne Rossa, Clay Ching, Josiah Ching, Matt Yamashita

Agenda: Opening poll: how many of you (audience) utilize the ocean as a primary food source? (2 minutes), Introductions (5 minutes), Presentation: the MLH was formed in response to the GO invasion (15 minutes), connecting tradition and modern science (10 minutes): what limu did you grow up eating? Where did you notice that it grows? How can you differentiate that limu from another limu? Example with samples suspended in water. Introduction of best practices and monitoring protocol development (10 minutes), Ahupua'a based conservation: how and why we defined these parameters, Kamiloloa example (10 minutes), Question and answer (7 minutes)

Innovative techniques: polls, engaging our senses and Hawaiian language to ID limu in the field exercise, chatbox use, breakout rooms to discuss our relationship to limu and its habitats as we remember them growing up (facilitating intergenerational knowledge example)

117

On the Back of an Albatross: Characterizing Hawaiian Albatross Encounters with Fishing Vessels Using Radar Detecting Biologging Devices

Rachael Orben[1], Leigh Torres[1], Lesley Thorne[2], Melinda Conners[2], David Kroodsma[3], Henri Weimerskirch[4], Scott Shaffer[5]

[1]Oregon State University, Newport, OR. [2]Stony Brook University, Stony Brook, NY. [3]Global Fishing Watch, Washington, DC. [4]CNRS, Villiers en Bois, France. [5]San Jose State University, San Jose, CA

Track

V. New Technologies in Conservation Research and Management

Abstract

Understanding what drives the interactions between albatross and fisheries operations can offer resource managers new perspectives on strategies to reduce negative encounters, thereby promoting ocean management and albatross conservation. Albatross populations worldwide have been severely impacted by mortalities from long-line fisheries interactions where birds consume bait, become hooked, and then drown. Although albatross can be attracted to fishing vessels, simple overlap between albatross and fisheries distributions does not specifically equate to negative interactions for all individuals. Thus, an individual-based perspective can offer insights into the conditions under which albatross approach fishing vessels, and hence reveal intrinsic bird characteristics and/or situational behavior that can be applied in a management context. This approach is particularly relevant for the large populations of black-footed and Laysan albatross breeding within the Papahānaumokuākea Marine National Monument. Bycatch of black-footed albatross by US fishing fleets in both Alaska and Hawai'i has increased in recent years, but it is unknown to what extent bycatch by the international fleets is impacting these populations. Here we present a pilot study in which we deployed novel biologging devices containing GPS and vessel radar detecting sensors on Laysan and black-footed albatrosses nesting at Midway Atoll in January 2019. Additionally, we used the Global Fishing Watch dataset to identify fishing vessels fishing in the high-seas around the monument. Tags detected three vessel encounters and captured associated fine-scale behavior. Our results lay the foundation for applying this approach to disentangle drivers of fine-scale albatross-fisheries interactions on the high-seas.

118

Cross-Border Collaboration in North Kona: Working Together to Protect the ʻĀina and the ʻOhana from Wildfire

Kara Vega[1], Elliott Parsons[2], Edith Adkins[1], Nani Baretto[3], Carson Magoon[3], Elizabeth Pickett[3]

[1]Pacific Cooperative Studies Unit, Hilo, HI. [2]Divisions of Forestry and Wildlife, Hilo, HI. [3]Hawaii Wildfire Management Organization, Waimea, HI

Track

II. Capacity in Conservation

Abstract

One of the largest remaining stands of tropical dry forest in Hawai‘i is found at Pu‘uwa‘awa‘a State Forest Reserve bordered by the communities of Pu‘uanahulu and Pu‘uwa‘awa‘a in North Kona. Home to numerous endangered species, restoration projects are underway to protect biodiversity and encourage resilience against many threats including wildfire. Community members here have a deep appreciation for this ‘āina (land) and include ‘ohanas (families) with historical homesteads and subdivision residents, grazing permittees, ranch owners, and forest managers, but highly flammable invasive plants combined with nearby human activity means high wildfire risk. Thousands of acres have burned in recent years and large fires could irreparably damage the biodiversity of this region. Due to an increase in the number and severity of wildfires, the communities of Pu‘uanahulu and Pu‘uwa‘awa‘a, Hawai‘i Wildfire Management Organization, the Nāpu‘u Conservation Project, and the Division of Forestry and Wildlife have worked together since 2019 to change their approach to wildfire issues in this area. Accomplishments include eight community-driven hazardous fuels removal projects with nearly three acres of vegetation along the Pu’uanahulu fire break cleared, more than 8220 pounds of fire fuels removed, and three truckloads of wood chips generated from non-native species for recycling. These coordinated efforts across boundaries of private and public lands have created awareness and have built a proactive community planning and participating in projects that help protect the ‘āina and ‘ohanas, native biodiversity as well as biocultural and human resources, from wildfire.

119

Rapid Ohia Death: Stand-scale patterns, dynamics, impacts, and prospects for management

Flint Hughes

Institute for Pacific Islands Forestry, Pacific Southwest Research Station, USDA Forest Service, Hilo, Hawaii

Track

IV. Putting Research into Management Practice

Abstract

‘Ōhi‘a (*Metrosideros polymorpha*) accounts for 50% of all trees on Hawai'i Island. Rapid ‘Ōhi‘a Death (ROD) caused by the primary fungal pathogen, *Ceratocystis lukuohia* threatens Hawai‘i's ‘Ōhi‘a forests statewide and has caused stand-level mortality across approximately 140,000 hectares of ‘Ōhi‘a forest

on Hawai‘i Island. Here we present results of research to determine the manifestation of *Ceratocystis*-induced Rapid ‘Ōhi‘a Death (i.e., ROD) – its distribution, patterns, and impacts - across Hawai‘i Island. We established 250 ROD monitoring plots to characterize forest stands in which ROD is occurring and to determine ‘Ōhi‘a annual mortality rates within those forests. Where *C. lukuohia*-infected trees were detected, ‘Ōhi‘a annual mortality rates averaged 9%. Results indicated that younger, smaller stature ‘Ōhi‘a stands exhibited lower annual rates of mortality (i.e., 4 to 5%) compared to older, larger stature ‘Ōhi‘a stands (i.e., 12 to 13%). Mortality rates were also lower in young ‘Ōhi‘a stands growing on historic (i.e., < 200 years in age) lava flows compared to rates on older flows. Mortality rates decreased with increasing elevation and increased with increasing mean annual temperature (MAT). Annual mortality rates also increased with increasing mean annual precipitation (MAP). ‘Ōhi‘a seedling recruitment was rare or absent within most plots measured; ‘Ōhi‘a seedlings were completely absent from 182 inventory plots, or 80% of all plots. Plots containing ‘Ōhi‘a seedlings almost exclusively were found in upper elevations of ‘Ōhi‘a forest range and were absent from lower elevation plots where non-native invasive species dominated. Research results from will help inform additional critically needed ROD management efforts.

120

Preliminary Assessments of Coral Health Response to Annual Bleaching Events Informs Future Monitoring in Leeward Maui, Hawai‘i

Tiara Stark[1], Roxie Sylva[2], Alana Yurkanin[2], Emily Fielding[2], Allison Cleghorn[2], Jillian Wirt[2]

[1]The Nature Conservancy, Marine Program (Maui, HI), Makawao, Hawai‘i. [2]The Nature Conservancy, Marine Program (Maui, HI), Makawao, Hawai'i

Track

VI. Place-based Conservation

Abstract

Healthy coral reef ecosystems are ecologically, culturally, and economically vital to the livelihood of people of Hawai‘i. As critical habitats threatened by chronic local anthropogenic stressors and repeated coral bleaching events induced by climate change, a greater understanding of the impacts of periodic heat stress and bleaching on coral health and resiliency across the islands are needed to inform effective site-specific management decisions. In this study, 40 coral colonies (*Porites lobata*, *Montipora patula*, *Montipora capitata*) from four sites across leeward Maui were monitored from 2017-2020 to examine the severity of bleaching and mortality during warm water events, and to understand how species- and site-specific factors may impact a coral’s ability to resist and recover. Numerous statistical analyses in RStudio v.1.2.5042 were used to explore the relative importance of species and site characteristics (sea surface temperature, nutrients, turbidity) hypothesized to influence coral resiliency, as indicated by coral health parameters (bleaching susceptibility, mortality). Statistical analyses and anecdotal evidence suggest monitored *P. lobata* colonies and colonies located at sites with better water quality and more herbivores are more resilient to bleaching and mortality, findings further supported by previous

research. Using lessons learned, we outline recommendations for expansion of monitoring efforts to increase statistical power to better assess relationships between coral health and coastal stressors. We hope our takeaways and findings inform others interested in establishing coral reef monitoring programs and contribute to a deeper understanding of coral reef status across sites to better inform management and policy in Maui and Hawai'i.

121

Establishing native trees on difficult terrain with unmanned aerial vehicles and seed enablement technology: Trial results from the Big Island

matthew aghai, Tiffani Manteuffel-Ross, Olivia Moskowitz

DroneSeed Co, Seattle, WA

Track

V. New Technologies in Conservation Research and Management

Abstract

DroneSeed is a startup developing software, hardware, and infrastructure for land surveying, and aerial seed deployment in forests, rangelands and other ecosystems. Wildfire, among other ecosystem disturbances, including intensive agro-silvo-pastoral use, are adding to the global reforestation deficit, thus requiring novel and scalable solutions to assist conventional nursery and planting systems. Constraints to revegetation include accessibility to remote areas, difficulty distributing seed precisely at scale, establishing seedlings from seed because of biotic and abiotic conditions (e.g. invasive species, seed predation, and moisture availability), associated costs (such as labor), and lagging production timelines. DroneSeed is currently paid per acre to survey land and distribute seed that's been manufactured into a vessel to improve in situ seed viability. The vessels contain proprietary ingredients such as sustainably sourced fibrous substrates and strategic amendments to protect seed, retain moisture, and promote germination.

The presentation will provide an overview of the company's technology and innovations to revegetation processes and highlight the research and development supporting our data-driven approach. We will present the first year results of a seeding trial conducted with native Hawaiian species including Acacia koa, Dodonaea viscosa, and Santalum ellipticum, on the Big Island. The trial explores strategies for difficult, often lava dominated terrain at elevations exceeding 4000ft, where access and edaphic conditions are not suitable for conventional seedling planting. Our trial demonstrated successful

application of the seed enablement technology in achieving established seedlings. We will share next steps and how our approach can assist with restoration and larger forest conservation efforts.

122

Assessing modifications to Goodnature™ A24 rat traps in Hawai´i to reduce non-target mortality while maintaining or improving trap efficacy

Lisa "Cali" Crampton[1], Mari Reeves[2], Tyler Bogardus[3], Erica Gallerani[4], Justin Hite[1], Tyler Winter[1], Aaron Shields[5]

[1]Kauai Forest Bird Recovery Project, Hanapepe, HI. [2]US Fish and Wildlife Service, Honolulu, HI. [3]Army Natural Resources Program, Honolulu, HI. [4]UCLA, Los Angeles, CA. [5]USDA, Fort Collins, CO

Track

III. Global and Regional Change & Challenges

Abstract

On Pacific islands, introduced rats (*Rattus* spp.) are drivers of extinction of endemic species. Recently, managers in Hawai´i have relied on the self-resetting Goodnature™ A24 trap for rat control, but these can incur non-target mortality. We field tested several trap modifications that might deter bird entry (lure type, lure flavor, blockers, and trap height) and assessed rat kill rates using both digital counters and counts of carcasses. Trials were conducted at two sites with a history of rat control on Kaua´i, Hawai´i, and two sites with no recent rat control on Oahu, Hawai´i in 2019 and 2020. At both Kaua´i sites, kill rates were more strongly affected by space and time variables than any experimental treatment. On Oahu, site and treatment both affected kill rates. These observations will inform reconfiguration of trap grids and better allocation of staff and hardware resources. On Kauai, there was no effect of trap height on kill rates. Both plastic blockers and cinnamon lure designed to deter birds slightly depressed kill rates vs unobstructed traps and chocolate lure; automatic lure pumps had similar kill rates as static lure. On Oahu, traps with metal mesh blockers had lower kill rates compared to traps with plastic blockers. We concluded that all lure (except cinnamon), height, and blocker (except metal mesh) options would likely provide similar rat control, so the critical question becomes which modifications best deter birds. Future deployments will focus more on the timing and landscape position of traps to maximize kill rates.

123

Shifting the Balance in Lowland Mesic Forests

Michael Ross, Joseph Williams-Solomon

Kapiolani Community College, Honolulu, Hawai'i

Track

IV. Putting Research into Management Practice

Abstract

The Wailupe Valley Restoration project is an on-going collaborative effort between Kapiʻolani Community College (KCC) and the State of Hawaiʻi, Division of Forestry and Wildlife (DOFAW), to help restore a 5-hectare fenced exclosure in Wailupe Valley, Oʻahu. The fenced exclosure was built by DOFAW in 2014 to remove herbivore ingress, primarily feral pigs, and to protect habitat for the endangered ʻElepaio (*Chasiempis ibidis*), which is an endemic bird that nests in the area. During the first phase of the project, vegetation monitoring and invasive species removal efforts were employed, and regeneration of native seedlings was shown to occur. However, despite the natural regeneration of native seedlings, the overall native plant species diversity is still quite low at the site. Therefore, in the second phase of the project efforts are being focused on outplanting of native dry and mesic forest plant species. The site has the potential to serve as an important refugia for many rare or endangered native plants from the southern Koʻolau Mountains. Some of the native plant species being outplanted include, *Antidesma platyphyllum* (hame), *Chrysodracon halapepe* (halapepe), *Ochrosia compta* (hōlei), *Pittosporum glabrum* (hōʻawa), *Pneumatopteris hudsoniana* (laukahi), and *Rauvolfia sandwicensis* (hao).

Agenda & Additional Required Information for Forums, Workshops, and Trainings

- Agenda; present our ongoing forest restoration project poster to audience. Speaker is Joseph Williams-Solomon.

- Pictures of the project will give the audience a better idea/understanding of the project.

- Our goal is to spread awareness to the audience about the issue of invasive flora and fauna in Hawaiʻi. Target audience is people in Hawaiʻi and abroad.

124

Restored waterbird habitat within cultural Hawaiian landscapes through Indigenous Resource Management.

Alishia Orloff[1], Kealoha Freidenburg[1], Yoshimi Rii[2,3], Kawika Winter[2,4], Kānekoa Shultz[5]

[1]Yale School of the Environment, New Haven, Connecticut. [2]Heʻeia National Estuarine Research Reserve, Kaneohe, Hawaiʻi. [3]Hawaiʻi Institute of Marine Biology, Kaneohe, Hawaiʻi. [4]Hawaiʻi Institute of Marian Biology, Kaneohe, Hawaiʻi. [5]KākoʻoʻŌiwi, Kaneohe, Hawaiʻi

Track

IV. Putting Research into Management Practice

Abstract

Indigenous Resource Management (IRM) serves as a robust model for sustainable ecosystem management and restoration. Through agro-ecological practices, Indigenous peoples of Hawai‘i have developed comprehensively complex strategies and traditions for maintaining the resilience of wetland ecosystems. Traditional practices such as agro-ecological systems involving kalo (taro) have been exercised in Hawaiian wetlands for centuries particularly because of its capacity to optimize multiple wetland ecosystem services. While often underestimated, these adaptive strategies are crucial in local bird conservation and water management efforts especially under current environmental pressures. Three management sites were surveyed in the He‘eia National Estuarine Research Reserve to understand the relationships between management and habitat structure, water quality, as well as waterbird utilization. Radial surveys (15 m) were conducted at 30 randomly selected point locations at two IRM sites, a hybrid managed wetland site, and an unmanaged control site. Our GLM models suggest that the management of certain vegetative communities is an indicator of canopy cover across the reserve. These management practices shape the habitat conducive to certain waterbird species. Explanatory factors of bird detections used in these analyses reveal that IRM sites are positively associated with waterbird detections and specifically more of the endangered species. Individual bird species were associated with unique structural predictors. This data provides insights to habitat structure and function for the conservation of waterbirds that are maintained by IRM. Recovery efforts of these species and integration of adaptive management perpetuate avenues for conservation and cultural revitalization.

125

Identifying Social Tipping Points: A Case Study in Hawai‘i

Lansing Perng[1,2], Kirsten Oleson[2], Mariska Weijerman[1], Kirsten Leong[1]

[1]National Oceanic and Atmospheric Administration, Honlulu, HI. [2]University of Hawaii at Manoa, Honolulu, HI

Track

IV. Putting Research into Management Practice

Abstract

Management agencies have recently adopted an Ecosystem Based Management approach to manage marine resources and human resource users as an integrated system. Humans are dependent on ecological goods and services (e.g. seafood, recreation, marine-related revenue) and also alter ecosystem state through resource use and conservation. Environmental and human-induced stressors can push ecosystems from a high-functioning state past a threshold into a new, often undesirable state (e.g. coral-macroalgal regime shifts). Ecological regime shifts are well-studied, but potentially associated social shifts are unexplored. Undesirable shifts lead to low resource provisioning and compromise the ability of coastal communities to meet societal objectives (e.g. food provisioning, revenue). Identifying

social thresholds that have been crossed offers vital information on causes of undesirable shifts, allowing resource managers to better conserve natural systems and sustain high resource provision. In our case study, we used social indicators (e.g. tourism GDP, employment) to identify social thresholds in Hawai'i. Generalized Additive Models (GAMs) identified nonlinear trends in several social indicators, indicating the existence of thresholds and, thus, regime shifts. Identified thresholds were linked to regulatory and environmental changes. For example, changes in tourism GDP and marine sector employment coincided with the Great Recession. This direct linkage of social thresholds to observed changes in social condition demonstrates the utility of GAMs to pinpoint significant shifts in the achievement of social objectives. Threshold identification can inform conservation interventions to prevent unfavorable shifts in resource provision, thus building beneficial relationships between ecosystems and the people that depend on them.

126

What, where, and how many? Improving our understanding of invasive ungulates in Hawai'i

Derek Risch[1], Jason Omick[2], Shaya Honarvar[1], Jason Misaki[2], Shane De Mattos[3], Lance De Silva[3], Lindsey Ibara[4], Melissa Price[1]

[1]University of Hawai'i Mānoa, Honolulu, Hawai'i. [2]Division of Forestry and Wildlife, Honolulu, Hawai'i. [3]Division of Forestry and Wildlife, Kahului, Hawai'i. [4]Division of Forestry and Wildlife, Lihue, Hawai'i

Track

IV. Putting Research into Management Practice

Abstract

Invasive ungulates disproportionately impact island ecosystems globally and have been shown to have considerable economic impacts on agriculture, native ecosystems, and urban environments. However, many ungulates are also considered valuable game species for recreational hunting, food provisioning, and in some cases have known cultural value. To address both the conservation 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 ungulates. Nowhere in the United States are these issues more apparent than in Hawai'i, where invasive ungulates were introduced from all over the world, providing a unique assemblage of ungulate species on each island. 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. In this study, we present a culmination of six 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 species distribution and examine the differences in relative abundance and distribution among islands. We hope to help transform our understanding of the

distribution and abundance of ungulate species across the Hawaiian Islands to aid in conservation decision making, agricultural land management, and game management for recreational hunting.

127

Pacific Island Land Snail Biodiversity Repository (PILSBRy) Portal

Chandra Earl[1], Norine Yeung[1], Kenneth Hayes[1,2]

[1]Charles Montague Cooke, Jr. Malacology Center, Bishop Museum, Honolulu, HI. [2]Pacific Center for Molecular Biodiversity, Bishop Museum, Honolulu, HI

Track

III. Global and Regional Change & Challenges

Abstract

Pacific Islands land snails (PILS) are among the most imperiled animals existing today. Containing more than 6,000 species, this extraordinarily diverse fauna mostly comprises narrow-range, single island endemics threatened by habitat destruction and invasive species. Due to these threats, PILS account for nearly half of all documented animal extinctions since the 1500s. Unfortunately, a lack of research and easily available data, such as species names, collection dates and locations has limited the development of PILS knowledge needed for conservation efforts. Much of this information can be obtained from specimens and associated data housed in museum collections. In 2019 a coalition of six museums holding the majority of PILS information in the United States was established to make the data more widely accessible for research, education, and conservation. Consequently, the Pacific Island Land Snail Biodiversity Repository (PILSBRy) web portal was developed, mobilizing these valuable digital resources for use by researchers, organizations and citizen scientists. Data for 3,681,279 specimens across 375,951 collecting events have been made publicly available, significantly contributing to biodiversity and systematic assessments. A comprehensive taxonomic authority file and a Pacific Island wide gazetteer are in development and will facilitate synthesis of data from across all collections. Images of type material and other associated metadata will also be linked to specimen records. This quick sharing of accurate, reliable data is necessary if we are to make effective decisions regarding PILS conservation and understand the evolution of this group across the Pacific Islands.

128

"*Ka Wai Ola*"- Water is Life: A Virtual Platform for Engaging People in Tropical Island Ecosystems.

Derek Esibill[1,2], Lisa Hinano Rey[1,3]

[1]Pacific American Foundation, Kaneohe, HI. [2]University of Hawaii, Manoa, HI. [3]University of Hawaii Windward Community College, Kaneohe, HI

Track

V. New Technologies in Conservation Research and Management

Abstract

All of us live at some point in a watershed and are all impacted by changes in those watersheds. As tropical watershed hydrology is highly variable in response to seasonality, changes in land use, and climate, it is difficult to quantify and document those changes. Hawaiian Fishponds, situated at the intersection of the watershed drainage and ocean, offer a unique opportunity to study water dynamics. With the advent of in situ data streaming and logging water quality and quantity sensors, the observation of patterns, cycles, and relationships between water quality parameters becomes possible. When these sensors are placed in a Hawaiian Fishpond, remote study of these dynamics real-time is timely and critical. Furthermore, the ability to observe these patterns remotely through a place-based interactive platform can make communication of this data more digestible, especially to broad audiences. COVID-19 pandemic has created barriers preventing student groups from interacting with watersheds and gaining hands-on experience in-person from previous curricula. Prior student projects has provided historical and abundant water quality data to managers and researchers, now being incorporated in the 360º interactive platform affords students the ability to interact with and develop connection to place remotely. By embedding sensor data streams and logs, students are now able to connect data to place for a deeper understanding in a geospatial context. This platform has demonstrated effectiveness in student learning regarding ecosystem hydrology. Likewise, it has spawned the development of new educational curricula and the ability to ask new research questions regarding the aforementioned relationships.

129

Integrated Pest Management of Coconut Rhinoceros Beetles in Support of Regional Biosecurity

Maranda Keller[1], Jessica DeBlieck[1], Stephen Mosher[2], Marc Hall[2], Tom Mathies[3], Kenneth Puliafico[1]

[1]Center for Environmental Management of Military Lands, Asan, Guam. [2]US Navy, Naval Facilities Engineering Systems Command Marianas, Santa Rita, Guam. [3]Center for Environmental Management of Military Lands, Fort Collins, Colorado

Track

III. Global and Regional Change & Challenges

Abstract

Coconut rhinoceros beetle (CRB; *Oryctes rhinoceros*), a destructive invasive species that has caused considerable damage to palm species across the Pacific, was first detected on Guam in 2007. Identifying

effective measures to reduce its impact on biocultural resources and preventing future invasions requires an examination of integrated pest management (IPM) techniques. To date, a variety of IPM techniques for CRB management have been deployed on the island of Guam; however, a data-driven assessment of the efficacy and synergism of these techniques is lacking. To address this knowledge gap, we analyzed data from CRB monitoring/interdiction traps and CRB breeding site surveys across military lands on Guam. A network of 287 CRB pheromone traps around military transport networks were monitored bi-weekly for 8 months, allowing for a long-term assessment of beetle abundance and examination of temporal variations in capture rates and sex ratios. Additionally, surveys of CRB breeding site locations were carried out twice-annually to support removal of dead palms and green waste sites. CRB density and breeding site density across the study areas were examined with spatial interpolation to identify CRB hotspots and to extract relationships between the two variables. Preliminary data indicates a positive correlation between CRB density and breeding site density and highlights CRB hotspots along forest margins. As the project continues, we seek to better understand relationships between breeding site removal, palm damage, and beetle abundance for the ultimate purpose of reducing beetle numbers at critical points in the military transportation network to reduce regional biosecurity risks.

130

Kauai's ROD Response: Adaptive Strategies and Innovative Management

Brenna Fowler[1], Kalli Harshman[2]

[1]Kauaʻi Invasive Species Committee, Pacific Cooperative Studies Unit - University of Hawaiʻi, Kapa'a, HI.
[2]Kauaʻi Division of Forestry and Wildlife, State of Hawaii, Lihue, HI

Track

IV. Putting Research into Management Practice

Abstract

ʻŌhiʻa (Metrosideros polymorpha) is the keystone species of Hawaiʻi's native forests: pioneer after fresh lava flows; provider of biodiverse ecosystems for hundreds of endemic species; supplier of fresh water to the archipelago's watersheds. Since the first detection of Rapid ʻŌhiʻa Death (ROD) in 2018, the Kauaʻi ROD Rapid Response Team has detected 237 trees infected by either Ceratocystis lukuohia (destroyer of ʻōhiʻa) or Ceratocystis huliohia (disruptor of ʻōhiʻa) and multiple with coinfections.

For the first time, in late 2020, the deadly fungal pathogen C. lukuohia was discovered in three distinct areas in Kōkeʻe, one of Kauaʻi's highest priority upper-elevation, native-dominant forests, creating a greater urgency in response. Kauaʻi resource managers and Hawaiʻi Island science teams collaborated to develop novel site-specific management and monitoring actions. The innovative solutions include tarping felled trees, focusing on minimizing the dispersal of inoculum; evaluating ambrosia beetle mitigation techniques to reduce release of fungus-contaminated frass; and ongoing aerial monitoring of the site using drones--small Unmanned Aircraft Systems (sUAS).

Incorporating drone monitoring has added a comprehensive layer in ROD management across Hawaii. Island-wide monitoring plots and reconnaissance missions have been established, capturing high quality aerial imagery. This continually aids on-the-ground logistics for reaching targets and identifying and prioritizing suspects remotely. The sUAS program introduced a tool to guide management actions with greater surveillance, while capturing geotemporal data in ROD affected areas for future analysis.

The applied management and direct scientific research propel the ROD response on Kaua'i to new levels of collaborative thinking, problem-solving, and community resilience.

131

Application of Strawberry Guava Biocontrol in Hawai`i

Tracy Johnson, Nancy Chaney

USDA Forest Service, Volcano, HI

Track

IV. Putting Research into Management Practice

Abstract

As we approach one decade since the release of a natural enemy for biocontrol of strawberry guava (*Psidium cattleianum*), evidence mounts for substantial future benefits from biocontrol. The Brazilian leaf galling insect *Tectococcus ovatus* suppresses growth, leaf cover and fruiting of strawberry guava after a period of several years of sustained galling. Populations of the insect can persist and grow in all habitats invaded by strawberry guava. Natural spread of the biocontrol appears to occur at a rate of tens of meters per year. Meanwhile however, guava populations continue to expand exponentially in Hawaiian forests. To achieve widespread suppression of strawberry guava across forested landscapes within the next two decades, broad-scale artificial dispersal of *Tectococcus* to remote forest sites is needed. A variety of methods for distributing the insect to canopy trees have been tested, and new techniques of aerial application are under development.

132

Developing a Climate Change Refugia Suitability Model for Hawaii's Critical Habitats

Kai Mottley

Kauai High School, Lihue, Hawaii

Track

V. New Technologies in Conservation Research and Management

Abstract

A predictive model using Geographic Information Systems (GIS) was developed to (1) determine the impact of sea level rise on Hawaii's biodiversity, (2) model future "refugia" or protected areas suitable for the relocation of endangered species vulnerable to sea level rise, and (3) also measure the "cost" (in terms of species loss) of delayed conservation action to establish refugia. This project is a continuation of the research presented at the Hawaii Conservation Conference last year. The model has been expanded with additional spatial data, more variables (such as elevation and moisture data), and also includes five (4) sea level rise scenarios. Also new is the inclusion of an analysis to determine species loss due to delayed action.

133

Database Conversion from Microsoft Access to Web-based Geodatabase with Mobile Field Data Collection Applications

Kerri Fay[1], Alison Cohan[1], Jennifer Laws[2]

[1]The Nature Conservancy, Makawao, Hawaii. [2]Esri Professional Services, Redlands, California

Track

V. New Technologies in Conservation Research and Management

Abstract

Many resource managers collect location-based data that can later be used to inform reports and research. Microsoft Access was the default application due to compatibility with ESRI mapping products, but within the past five to six years Microsoft has been threatening to stop supporting Access. The Nature Conservancy of Hawaii's Maui terrestrial program decided to move to a web-based platform design in ArcGIS Online and use smart devices for field-based data collection. The creation of web-maps, feature layers, forms, web-applications, and dashboards form the structure of the platform. Field data collection with ArcGIS Collector and Survey 123 via Trimble TDC 600's is synced to ArcGIS Online upon return to the office where the data is integrated into the platform. The data is translated to dashboards or pulled into ArcGIS Pro and used for reporting purposes. Originally TNC hoped to migrate 30 years of ungulate data into the new platform but decided emphasis should be on current demands. Minor hiccups and steep learning curves must be worked through when switching platforms. We will share lessons learned from this project that others can apply when attempting to modernize field data collection and geodatabase platforms. Ultimately, we plan to share this platform with other projects and management organizations that collect similar field data, which will enable collating data at a larger scale to inform management decisions across the landscape.

134

The Kaliʻuokapaʻakai Collective Report: Re-envisioning Wahi Kūpuna Stewardship in Hawaiʻi

Kelley Uyeoka[1], Kekuewa Kikiloi[1,2], Dominique Cordy[3]

[1]Huliauapaʻa, Hakalau, HI. [2]University of Hawaiʻi, Mānoa, Honolulu, HI. [3]Kaliʻuokapaʻakai Collective, Hakalau, HI

Track

I. Cultural Values and Practice in Conservation

Abstract

Cultural Resource Management (CRM) in Hawaiʻi has historically been a contentious field, and a core issue is that Native Hawaiians have a limited role in determining the fate of their own ancestral heritage. In order to build a system that truly protects wahi kūpuna and empowers community-led stewardship, we need to re-conceptualize CRM by exploring culturally grounded and meaningful preservation practices where the integrity of the cultural and environmental health of a place and its people are interconnected. We must increase the opportunities and abilities of Hawaiians to re-vitalize relationships with wahi kūpuna through direct management of policy, resources, and practices. And all those that care for our wahi kūpuna must come together as a collective to elevate our kuleana and integrate more of a holistic worldview into Wahi Kūpuna Stewardship for the betterment of all in Hawaiʻi.

The Kaliʻuokapaʻakai Collective (KC) is a community of practice of advocates in Wahi Kūpuna Stewardship that was created from the need to organize our shared ideas, resources, and strategies to build capacity and take collective action in safeguarding Hawaiʻi's wahi kūpuna. In March 2021 the KC released a first of its kind report focusing on 4 priority areas identified by the Collective:

1- Building Community Capacity

2- Knowledge Cultivation and Stewardship

3- Restoring Wahi Kūpuna

4- Mālama Iwi Kūpuna

This report serves as a guiding document to steer the KC along a new path. It also aims to bring awareness to specific issues and highlight ways that individuals, organizations, professionals, and others can take action towards greater stewardship of our wahi kūpuna.

135

Putting Out The Fire: Aerial Control of Little Fire Ants On Maui, 2021 Update

Brooke Mahnken[1], Adam Knox[1], Adam Radford[1], Michelle Montgomery[2], David Duffy[3]

[1]Maui Invasive Species Committee, Makawao, HI. [2]Hawaii Ant Lab, Hilo, HI. [3]University of Hawaii, Honolulu, HI

Track

III. Global and Regional Change & Challenges

Abstract

Since 2019 the Maui Invasive Species Committee has continued aerial control of little fire ants (Wasmannia auropunctata) in Nāhiku Maui using a gel bait matrix containing s-methoprene (brand name Altosid). The treatments have been done by helicopter and are the main thrust of an effort to reduce little fire ant (LFA) density and population spread with the goal of eventual eradication at the site. A custom-made, externally mounted tank and sprayer system designed for use with a MD 500 helicopter was utilized to administer the aerial treatments.

In this presentation methodology, operational components, and results of nearly two years of little fire ant aerial control efforts on Maui are discussed. Though still ongoing, both the infested area and population density has decreased, and progress continues to inform a roadmap for other similar eradication efforts where LFA persists in difficult to access areas.

136

Assessing the Risk of the Protozoan Parasite *Toxoplasma gondii* in Human-Natural Marine Systems in Hawai‘i

Ashley Nalani Olguin, Roise Alegado

University of Hawaii at Manoa, Honolulu, HI

Track

IV. Putting Research into Management Practice

Abstract

Toxoplasmosis is a food and waterborne disease caused by the parasite *Toxoplasma gondii* and is estimated to infect ~40 million people nationwide. The CDC has encouraged disease prevention through management of feline populations as cats are the definitive host for *T. gondii* and oocysts released into the environment in feces are infectious. *T. gondii* transmission to marine mammals and fish species correlate with runoff from urban areas and fecal loading from feral cat populations into streams are suspected as a plausible transport mechanism. Recent studies suggest that fish sold for human consumption may be another route for *T. gondii* transmission. This novel route further motivates the need to characterize the prevalence of toxoplasmosis in freshwater and marine environments. However, direct assessment of community risk is ineffective as *T. gondii* oocysts are refractory to molecular isolation. We are focusing our investigations on the He'eia watershed as *T. gondii* was identified from cat feces within the He'eia Boat Harbor/State Park in 2020. Here we aim to: 1) estimate cat colony populations on a watershed scale, 2) develop bacterial indicators of cat fecal contamination as a proxy for toxoplasmosis risk, and 3) measure cat fecal contamination levels in the He'eia watershed from ridge to reef in water and nearshore fish species. Our studies will assist in identifying priority areas for cat population control, clarifying the health risk from contaminated water and fish sources statewide. These studies also have implications for management of Hawaiian monk seals, which have experienced population decline due to *T. gondii* infection.

137

DNA Metabarcoding Identifies Diet Composition of Introduced Rodents on O'ahu, Hawai'i

Sara Gabrielson[1], Rebecca Mau[1], Donald R. Drake[2], Jinelle Sperry[3,4], Jeffrey Foster[1]

[1]Northern Arizona University, Flagstaff, AZ. [2]University of Hawai'i at Mānoa, Honolulu, HI. [3]University of Illinois Urbana-Champaign, Champaign, IL. [4]U.S. Army Corps of Engineers, Washington, DC

Track

V. New Technologies in Conservation Research and Management

Abstract

Rodents are some of the most ubiquitous and successful invasive species globally, and are particularly destructive on islands. Three rodent species, black rat, *Rattus rattus*; Pacific rat, *R. exulans*; and house mouse *Mus musculus*, are abundant throughout forested ecosystems on O'ahu. They depredate a wide variety of plants and animals due to their omnivorous diets. Invasive rodent diets have been studied through captive-feeding trials, visual stomach contents identification, and stable isotope analysis. While each method has inherent biases, thus far, none have been able to identify natural diet diversity at a fine taxonomic scale. This limits our understanding of rodent effects on the communities they invade. DNA metabarcoding analyses can provide a description of invasive rodent diets at fine taxonomic levels

and allow comparison of natural diets across rodent species and site. Rodents were trapped across 7 forest communities on Oʻahu from November 2014 through November 2016, and 531 fecal samples were collected from the traps. Samples were extracted and sequenced using metabarcoding to identify plant and arthropod species in the samples. A broad range of native and non-native plants and arthropods were identified, with significant diet differences among rodent species and sites. Plant species richness was higher in house mouse diets than in black rats, while no richness difference was found in Pacific rat compared to either black rat or house mouse. Detailed diet composition analyses provide a more complete understanding of the roles of rodents in Hawaiian forests and can clarify potential indirect effects of rodent control efforts.

138

From diesel to DNA: Developing tools for coconut rhinoceros beetle management on Oʻahu

Nelson Masang, Shizu Watanabe, Brandi Adams, Alejandro Olmedo-Velarde, Tomie Vowell, Alexandra Kong, Michael Melzer

University of Hawaii, Honolulu, HI

Track

V. New Technologies in Conservation Research and Management

Abstract

The coconut rhinoceros beetle (CRB; *Oryctes rhinoceros*) is a large scarab beetle and major pest of oil and coconut palms in the Pacific. CRB was first detected on Oʻahu in 2013, triggering research efforts to develop tools for management and eradication. As part of this effort, we have explored disparate strategies ranging from a diesel-powered mobile vacuum steam unit (MVSU) for sanitizing CRB-infested materials, to the use of synthetic DNA in an RNA interference (RNAi) approach. To develop the MVSU approach, the minimum lethal temperature required to kill all CRB life stages (egg to adult) following a 5 min exposure was determined in the laboratory. Using this temperature, 56^{o}C, a protocol for processing CRB-infested green waste was established using the MVSU. Using this protocol, approximately 2.3 cubic meters of material can be sanitized per hour. Further optimization of this protocol to increase throughput is continuing. To develop an RNAi approach, we generated transcriptome data from 1st instar CRB to identify potential target genes, then created double-stranded RNA (dsRNA) from synthetic DNA constructs for 24 of these genes. Injection of dsRNA derived from five of these DNA constructs resulted in high mortality for all CRB life stages. We are currently evaluating various substrates to stabilize these dsRNAs in the environment and facilitate their delivery across the CRB gut lumen. Importantly, these tools have the potential to be used in management and eradication efforts targeting other invasive species in Hawaii.

139

Optimization of Soil Viability Testing for *Ceratocystis lukuohia*

Gabriela Benito[1,2], Marc Hughes[3,2], R.Flint Hughes[2], Lisa Keith[4], Bruce Mackey[5]

[1]Pacific Cooperative Studies Unit- University of Hawaii at Manoa, Honolulu, HI. [2]United States Department of Agriculture-Forest Service- Institute of Pacific Islands Forestry, Hilo, HI. [3]Pacific Cooperative Studies Unit, Honolulu, HI. [4]United States Department of Agriculture- Agricultural Research Station-Daniel K. Inouye U.S. Pacific Basin Agricultural Research Center, Hilo, HI. [5]United States Department of Agriculture- Agricultural Research Service, Western Regional Research Center, Albany, CA

Track

V. New Technologies in Conservation Research and Management

Abstract

Metrosideros polymorpha (ʻŌhiʻa) is Hawaiʻi's keystone native tree, providing habitat and resources for multitudes of native flora and fauna; its forests are integral to maintaining Hawaiʻi's healthy watersheds. In 2014 a new fungal pathogen, *Ceratocystis lukuohia,* was discovered in Hawaiʻi and identified as causing rapid tree wilt of ʻŌhiʻa trees, ultimately resulting in their death. This disease is locally referred to as Rapid ʻŌhiʻa Death (ROD). Previous field soil baiting attempts for the selective isolation of *Ceratocystis lukuohia* have been problematic, producing mixed results due to rapid degradation of carrot baits by non-target contaminants (e.g., bacteria and non-*Ceratocystis* fungi). We developed new methods to optimize detection of viable *Ceratocystis lukuohia* in field soils that included adding antibiotics to carrot baits, air drying soils to reduce soil moisture, and mechanical separation by soil particulate size. Results showed that application of streptomycin and ampicillin antibiotics effectively delayed carrot degradation throughout the 30-day observation period. Air drying soils for approximately 25 hours further reduced carrot bait degradation, presumably through elimination of anaerobic soil bacteria populations. Lastly, mechanical sieving partitioned soils into aggregate sizes that expressed varying levels of viability; 2000-micron and 500-micron soil aggregate sizes proved best for detection of viable *C. lukuohia*. Results confirmed that, in combination, these methods effectively detect viable *Ceratocystis* inoculum in soils, adding an important new diagnostic tool to combat *Ceratocystis* spread. We plan to use these techniques to confidently test for presence of viable *Ceratocystis* inoculum in soils of high priority ROD management areas.

140

Revised Policy Recommendations for Hawaiian Monk Seal Conservation and Toxoplasmosis Management

Vaibhavi Dwivedi

University of Hawaii at Manoa, Honolulu, Hawaii

Track

IV. Putting Research into Management Practice

Abstract

The spread of *Toxoplasmosis* (toxo) from the feces of feral cats is a leading cause of endangered Hawaiian monk seal mortality. To date, 13 monk seals out of a population of approximately 300 individuals have died from toxo in the last two decades. Given the ecological and cultural significance of these endangered marine mammals, it is crucial to curb the spread of toxo effectively and aid conservation efforts. With an estimated feral cat population of over 300,000 living on Oʻahu alone, the severity of this deadly infection spreading within the Hawaiian monk seal population is high. To better manage the growing cat population, it is imperative that a uniform definition of a feral cat be implemented by the State of Hawaiʻi. Doing so will help standardize the development and execution of management policies across the state. This paper analyzed feral cat definitions used in Hawaiʻi and compared their implications on management policies with other states within the United States, New Zealand, and Australia. Legislative recommendations for defining feral cats and implementing policies in Hawaiʻi are included as the basis of effective management policies. If enacted in Hawaiʻi, a uniform feral cat definition has the potential to set a strong precedent for other island states to incorporate in their conservation strategies. As a secondary output, a user-friendly website was created to increase the outreach and support the long-term goals of this research.

Keywords: Hawaiian Monk Seal Conservation, Feral Cat, Endangered Species, Toxoplasmosis, Legislative Definitions

141

Drought Management Challenges, Lessons Learned, and Information Needs in Hawaiʻi

Melissa Kunz[1], Abby Frazier[2], Christian Giardina[3], Ryan Longman[2], Victoria Keener[2], Kirsten Oleson[1]

[1]University of Hawaiʻi at Mānoa, Honolulu, HI. [2]East-West Center, Honolulu, HI. [3]US Forest Service Institute of Pacific Islands Forestry, Hilo, HI

Track

III. Global and Regional Change & Challenges

Abstract

Both the frequency and severity of drought are projected to increase under future climate scenarios for Hawaiʻi, exerting greater impacts on the state's unique landscapes, ecosystems, and species. In striving to protect Hawaii's biocultural resources under changing drought regimes, land managers need more and better information to guide their resource planning and decision-making. This research sought to: 1) increase the understanding of ecological drought in Hawaiʻi; 2) document and summarize managers'

lessons learned for drought preparedness and response; and 3) identify additional resources needed to mitigate effects of drought. Semi-structured interviews were conducted with 24 natural resource managers from Federal, State, private, and partnership organizations across Hawai'i on their drought experiences and perspectives. Interview responses were analyzed by topic themes, theme frequency, and inter-theme relationships. Results show that the top drought-related management challenges are wildfire, outplanting mortality, and shifts in non-native plant and animal populations. Managers typically address drought concerns through wildfire mitigation and a variety of restoration strategies. Common practices aim to restore native ecosystems and ultimately increase drought resilience. In addition, managers want greater capacity for conservation work in general and better drought-related planning tools. Managers want climate, drought, and weather resources which are more timely, accurate, geographically-specific, and easily interpreted. Land managers most frequently discuss and interpret current drought-related information within their own organizations and with inter-agency partners. We recommend leveraging partnership organizations to support Hawai'i researchers and managers as they develop, share, and apply new drought knowledge in the face of climate change.

142

More New Biocontrol Labs to Reduce Bio-insecurity from Irrupting Pests: Citizens Building Air-Tight Case for New Air-Tight Labs

Steven Lee Montgomery

CCH, AML, Honolulu, HI

Track

II. Capacity in Conservation

Abstract

More New Biocontrol Labs to Reduce Bio-insecurity from Irrupting Pests:

Citizens Building Air-Tight Case for New Air-Tight Labs

Steven Lee Montgomery, Ph. D. Conservation Council for Hawaii

Building upon the 130 years of work by Perkins, F. Muir, Williams, Noel Krauss J. Bearbsley, R. Burkhard, Ken Teramoto Trujillo, Mary Early and M. Ramadan the science consensus is biocontrol has had many successes in Hawaii with cactus, cane pests, Koster's curse, banana poka, fire weed, spreading snakeroot, wooly whiteflies and wiliwili gall wasps. Woefully, further progress is now constrained by cramped, aged, leaking, obsolete quarantine research and propagation facilities. Citizens leading Botanical, Wildlife, Humane and Environmental Societies are becoming key proponents, joining scientists to address the public's questions on biocontrol's safety, cost-benefits and regulations. The community and NGO support for new biocontrol projects is broadening in this new era for the Nation with infrastructure upgrades a top priority. The 2004 white paper and 2016 Biosecurity Plan are guiding the strong momentum of an air-tight case for new air-tight labs on tropical isles.

Steven Lee Montgomery, Ph. D., Volunteer Board Member
Conservation Council for Hawaii
P.O. Box 2923 Honolulu, HI 96802
(808) cell 342 6244 manninga001@hawaii.rr.com

143

Plant Spacing and Plant Species Grouping Strategies in Native Hawaiian Lowland Mesic Reforestation in Highly Disturbed Areas of Waimea Valley, Oahu

Chad Middleton

Hi'ipaka, LLC, Haleiwa, HI

Track

VI. Place-based Conservation

Abstract

Hiʻipaka LLC has been successful in the first six years of the Waimea Valley Forest Stewardship Plan (FSP), completing management actions in the Wetland, Mauka, and Kalaheʻe forest management units. The primary focus is on maintaining and improving existing native forest cover and replacing current non-native forest cover with site-appropriate native species. In highly disturbed areas native trees and shrubs are in immediate competition with invasive species when planted. By grouping certain tree and shrub species together in novel spacing arrangements the manager hopes to out compete invasive while minimizing site maintenance and meeting contract spacing and species prescriptions from state and federal agencies funding parts of the project. Our video will include the reforestation sites at five, two, and one year from planting date and demonstrate the success and challenges as well as lessons learned.

144

Evidence Synthesis to Establish Water Quality Targets on Coral Reefs

Lillian Tuttle, Eileen Nalley, Alexandra Barkman, Emily Conklin, Madeline Schmidbauer, Devynn Wulstein, Megan Donahue

University of Hawaiʻi at Mānoa, Honolulu, HI

Track

III. Global and Regional Change & Challenges

Abstract

Local management action that addresses coastal pollutants can directly improve and preserve healthy ecosystem functioning of coral reefs, thus mitigating the effects of climate change. However, effective decision making for reef resilience is not easy; it relies on a complex understanding of tipping points in water quality associated with coral health and decline. In response to needs identified by reef managers from Hawai'i and the Pacific region, we conducted a set of systematic literature reviews and meta-analyses that explore the effects of marine pollutants on corals, thus identifying single and interacting thresholds for sediments, toxicants, and nutrients that enter coastal waters from various sources such as dredging, on-site waste disposal, and stormwater and agricultural runoff. The resulting dataset spans three oceans, over 140 coral species, and decades of research. Our analyses inform the no-observed and lowest-observed adverse effect levels that are used in management consultations by federal agencies in the U.S. We also adapt meta-regression techniques that estimate the magnitudes of corals' adverse responses (sublethal and lethal) to pollutants at every stage in the coral life cycle. Our results represent the best available information for decision makers to protect vulnerable reef-building corals from local stressors, especially in the absence of more location- or species-specific data. We present key recommendations for future studies that aim to define critical threshold values on reefs, based on an analysis of gaps in research-to-date. Ongoing work will continue to disentangle the additive and synergistic effects of multiple local stressors on coral reefs.

145

Return of Breeding 'Ua'u kani (Wedge-tailed Shearwater, *Ardenna pacifica*) Further Defines Success of Fallout Recovery Effort in Maui Nui

Cecelia Frisinger, Jennifer Learned, Martin Frye, Jay Penniman

Maui Nui Seabird Recovery Project, Makawao, HI

Track

IV. Putting Research into Management Practice

Abstract

Before modern-day humans, the moon and stars guided seabirds out to sea. Today, our artificial lighting and infrastructure interferes with this natural process. Seabirds will circle artificial light sources or collide with man-made structures and fall to the ground out of exhaustion or injury. This phenomenon is known as "fallout." Once grounded, seabirds are exposed to multiple fatal threats. To reduce mortalities, the Maui Nui Seabird Recovery Project (MNSRP) initiated Save Our Seabirds. This program relies on community members to notify the MNSRP of grounded seabirds. Once notified, staff respond to the call, collect the seabird, and conduct an assessment. Most birds are banded and released within 24 hours of recovery. While the immediate benefits of such efforts are clear, little is known about fallout recovery effectiveness in the long-term. For the first time, we report on the success of fallout recovery efforts for Wedge-tailed Shearwaters ('ua'u kani, *Ardenna pacifica)* in Hawai'i. We compared Maui Nui 'ua'u kani fallout data with data from our long-term mark-recapture study on 'ua'u kani colonies in Maui

Nui. From 2002 to 2015, we banded 483 hatch-year fallout birds, 19 of which were subsequently recaptured in a colony (3.93% recovery rate). From 2002 to 2020, we banded 175 after-hatch-year fallout birds, 5 of which were recaptured in a colony (2.86% recovery rate). Our findings provide leading evidence that fallout recovery is worthwhile. As light pollution continues to increase every year, all efforts to support the survival of declining seabird populations are critical.

146

The Battle with *Rubus argutus* in Hawai'i: Promising Results from Imazapyr Trials at Haleakalā National Park

Adam O'Neill[1], Stacey Torigoe[1], Woody Mallinson[1], Jeremy Gooding[2], Leila Morrison[1]

[1]Haleakalā National Park, Kula, HI. [2]National Park Service, Kula, HI

Track

IV. Putting Research into Management Practice

Abstract

Blackberry (*Rubus argutus*) has been declared a high-risk noxious weed in Hawai'i due to its potential to form dense monocultures with impenetrable brambles, outcompeting native vegetation and displacing endangered wildlife. At Haleakalā National Park, *R. argutus* is considered one of the worst invasive species in the Crater District and was targeted for herbicide trials in the 1980s. Since then, herbicide formulations of triclopyr (amine and ester) have been used for *R. argutus* treatments in basal-bark and cut-stump techniques. In four studied comparison sites throughout the Park's subalpine shrubland, triclopyr treatments resulted in an average 121% annual stem count increase over three years. The population expansion of *R. argutus* in the absence of management in these areas remains unquantified; however these treatments are clearly ineffective. Starting in 2019, imazapyr (Polaris AC) was integrated into the Park's management of blackberry with a low-volume, cut-stump technique. *R. argutus* stems were cut low to the ground and treated with a 1 ml solution of 5% Polaris AC and 1% surfactant. This precision application limits non-target injury and drastically improves treatment efficacy with an average 78% decrease in stem count after (1) year across the four areas. These results and the symptomatic remnant populations show promise of a viable option for long-term blackberry control. Expansion of treatment areas and monitoring will continue in 2021. This efficient and cost-effective treatment of *Rubus argutus* provides the potential for future eradication from particularly vulnerable areas on Haleakalā and perhaps elsewhere in Hawai'i.

147

Avian Botulism in Hawai‘i: Historical Analysis of Botulism Outbreaks and Establishment of a Botulism Working Group for Improved Wetland Management

Malia Staab[1], Kristen Harmon[1], Kawika Winter[1,2], Afsheen Siddiqi[3], Arleone Dibboe-Young[4], Melissa Price[1]

[1]University of Hawai'i, Honolulu, HI. [2]He'eia National Estuarine Research Reserve System, Honolulu, HI. [3]Hawaii Department of Land and Natural Resources, Honolulu, HI. [4]Private citizen, Kaunakakai, HI

Track

II. Capacity in Conservation

Abstract

Avian botulism is a paralytic disease that kills thousands of waterbirds globally each year. Despite annual outbreaks of avian botulism in the Hawaiian Islands, and the impacts on native and endangered waterbird species, large-scale efforts to assess and contain outbreaks are lacking at the island scale. Waterbirds disperse within and among islands to meet foraging, refugia, and nesting needs. Despite the free travel of waterbirds among wetlands throughout the state, botulism outbreaks continue to be managed as isolated events by individual wetland managers. Successful containment of avian botulism outbreak requires efficient communication within and between wetlands so managers can be aware of outbreak potential, increase monitoring and quickly remove infected carcasses. This project aimed to increase prevention and containment of avian botulism through (1) a review of historical avian botulism trends throughout the state, (2) identifying best practices for wetland management and (3) establishing a communication network among all wetland managers and owners across the state. We found that many managers faced the same issues and the increased communication about botulism allowed for best management practices for botulism and waterbird management to be shared across the state. Key threats identified during stakeholder elicitations included non-native predators, habitat loss, and concerns about climate change. Best practices for waterbird management were identified by stakeholders as predator control, regular monitoring, and habitat restoration. Using a system-wide approach for a problem often managed at a single site, this project shows how managers can use improved collaboration and communication to minimize botulism-induced mortality in waterbirds.

148

Tourism, Blockchain Technology and Waste Management: Utilization of Blockchain technology in the promotion of environmental sustainability in Hawai’i.

Constancio Paranal

University of Hawai'i at Manoa, Honolulu, Hawaii. William S. Richardson School of Law, Honolulu, Hawaii

Track

V. New Technologies in Conservation Research and Management

Abstract

As an island state, tourism is Hawai'i's major economic driver. In 2010, the 7 million tourists generated approximately 1.7 million tonnes of waste. Assuming conservative data regression, the 10.4 million tourists in 2019 generated 2.52 million tonnes of waste. Assuming 70% of the waste is generated on Oahu, the total waste generated from tourism in Ohau would amount to 4,800 tonnes per day. Meanwhile, Oahu's PVT landfill can accommodate 3,000 tonnes per day. Not counting the residents and industrial plants, it is apparent that the State of Hawai'i has a waste management problem.

With limited land and facilities coupled with increasing waste production, the uncontrolled waste management practices can be deleterious to the state's environmental and growth sustainability. The ability of the government to track waste production, distribution, and management processes would depend on a single decentralized platform that blockchain technology is able to provide.

This conceptual paper aims to discuss how blockchain technology can be utilized to address the waste management issues in Hawai'i while supporting a sustainable tourism industry. The research involves case studies on the application of Blockchain technology in Waste Management, Tourism and Hospitality Industry, and identifying success factors and challenges for industry and community adoption.

The result of this research will provide guidance on the potential of Blockchain technology in addressing Waste Management issues in Hawai'i through operational development and legislation.

149

Understanding the Conflicts of the Thirty Meter Telescope Project and Analyzing its Impact on University of Hawai'i at Hilo Students

Paige Hamada, Tobias Irish

University of Hawai'i at Hilo, Hilo, Hawai'i

Track

I. Cultural Values and Practice in Conservation

Abstract

Mauna Kea is the tallest mountain in the world and one of the most culturally significant sites in Hawai‘i. The proposal to build a thirty-meter telescope (TMT) on Mauna Kea sparked a passionate yet peaceful protest rooted in kapu aloha by kānaka maoli. This study was designed to gain insight into how students from UH-Hilo were impacted by this conflict.Twelve participants – who were students during the 2019 protest on Mauna Kea – were interviewed for thirty minutes to an hour about their experiences. The findings indicate that this conflict impacted UH-Hilo *haumāna* in both positive and negative ways. Positive impacts include feeling a sense of community with other *haumāna* and solidifying their plans to continue their journeys into higher education. Negative impacts include feelings of their cultural identities being attacked or feeling intimidated to go up to Mauna Kea. These findings highlight the amount of ‘ike the haumāna possess and provide insight into a wide variety of political, socioeconomic, and cultural perspectives on the TMT conflict. These diverse insights can help to better inform UH-Hilo programs, courses, faculty, and personnel to be more responsive to the experiences and needs of their students. This research also highlights the importance of creating more platforms and opportunities for students to express themselves and share their ‘ike and mana‘o. We believe doing so can help UHH and other institutions better serve their indigenous populations and more responsively adapt to all their student’s needs during times of conflict.

150

Future Climate Modeling For Endemic O‘ahu Tree Snail Enclosures Suggests Inter-Island Strategy Is Required

Philip Kitamura[1], Adam Vorsino[2], Lucas Fortini[3], Derek Risch[1], David Sischo[4], Michael Hadfield[5], Stephen Miller[2], Melissa Price[1]

[1]Department of Natural Resources and Environmental Management, University of Hawai‘i at Mānoa, Honolulu, HI. [2]Strategic Habitat Conservation Division, Pacific Islands Office, US Fish & Wildlife Service, Honolulu, HI. [3]Pacific Island Ecosystems Research Center, US Geological Survey, Honolulu, HI. [4]Division of Forestry and Wildlife, Department of Land and Natural Resources, Honolulu, HI. [5]Kewalo Marine Laboratory, Pacific Biosciences Research Center, University of Hawai‘i at Mānoa, Honolulu, HI

Track

III. Global and Regional Change & Challenges

Abstract

Recent, drastic population declines caused by introduced predators suggest that many Hawaiian terrestrial snails are unlikely to exist outside of predator-proof enclosures and/or captive rearing facilities by 2030. Four species in the federally-listed genus *Achatinella,* endemic to O‘ahu, are protected in enclosures, out of 10 extant species. The long-term effectiveness of current and proposed enclosures is likely to be impacted by climate change-induced species range shifts. In this study, we developed

ensemble species distribution models under present conditions and an end-of-century moderate warming scenario to identify suitable sites for enclosures, and determine the minimum number of enclosure sites needed to delist all extant species of *Achatinella*. The ensemble model consisted of Random Forest, Boosted Regression Trees, Maxent and Maxnet models combined by a weighted mean derived from each model's performance; this was further constrained using the maximum value of the four model's predictive accuracy as the minimum cut-off for the suitability index. The resulting output was filtered to identify locations with less than 30% slope, excluding areas too steep for enclosure construction. The total area with suitable enclosure conditions exceeded the extent of suitable areas on Oʻahu, suggesting that majority of the potential sites for enclosures exist outside of the historical ranges of most remaining *Achatinella* species, on other mountain ranges, or on other islands. Thus, a multi-island approach to determine optimal sites for conservation is likely necessary to achieve recovery across the genus.

151

Moʻokūʻauhau: ʻĀina Genealogy As The Foundation of Conservation Planning

Kaninau Villanueva[1], Scott Fisher[2], Rebekah Matagi Walker[3], Kekai Robinson[4], Shae Kamakaʻala[5]

[1]Hawaiʻi Land Trust, Kilauea, HI. [2]Hawaiʻi Land Trust, Wailuku, HI. [3]Hawaiʻi Land Trust, Hauʻula, HI. [4]Hālau Hanona Kūlike o Piʻilani, Wailuku, HI. [5]Hawaiʻi Land Trust, Hilo, HI

Track

I. Cultural Values and Practice in Conservation

Abstract

Each wahi (place) has its own moʻokūʻauhau or genealogy. To protect or steward any wahi in the most pono manner possible, it is incredibly helpful and arguably essential to learn and understand its moʻokūʻauhau. There are various ways to go about learning the moʻokūʻauhau of a place. Hawaiʻi Land Trust and other partners share their methods of learning the moʻokūʻauhau of the wahi they mālama, from paleoecology (study of interactions between organisms and their environments across geologic timescales), to archaeology, to historic research, to the creation of oli (chant) for that wahi that memorializes its moʻokūʻauhau.

This forum will explore through multi-island examples how learning about the distant past is used as the kahua or foundation for precise science, history, and culture-based decision-making about ʻāina protection, restoration, and management, thereby helping native ecosystems and Hawaiian cultural practices thrive amidst current and future challenges from climate, political, economic and social change.

Agenda & Additional Required Information for Forums, Workshops, and Trainings

Forum Agenda:

1) 5 minutes: Introduction of Forum goals and speakers: Laura Kaakua & Neil Hannahs

2) 25 minutes: 5-minute presentations of moʻokūʻauhau methodology and implementation of knowledge gained at each site by each presenter.

3) 20 minutes: Facilitated panel question and answer session

4) 10 minutes: Audience questions. We may also utilize a Word Cloud audience engagement technique here to ask for audience feedback in their own successful and non-successful moʻokūʻauhau methodologies.

Goals & Target Audience:

Our goal is to inspire conservationists to constantly delve deeper and expand their understanding of the history and significance of the wahi that they steward, as we have found and believe that by looking back, we can better plan for the future. Our target audience is very broad - anyone who works or volunteers in conservation or a related field.

152

Developing an Informative Hawaiian Land Snail Identification Mobile App

Kayla K. Mukai[1], Yvonne L. Chan[1], Jacqueline A.K. Okumura[1], Norine W. Yeung[2], Kenneth A. Hayes[2]

[1]'Iolani School, Honolulu, HI. [2]Bishop Museum, Honolulu, HI

Track

V. New Technologies in Conservation Research and Management

Abstract

Due to the rise of e-learning resources (e.g. mobile apps), knowledge about conservation biology can be spread and accessed anytime and anywhere. Mobile apps are commonly used and have the potential to revolutionize conservation efforts and environmental science due to their easy accessibility and ability to quickly spread knowledge. We are currently experiencing a biodiversity crisis, as many ecosystems are rapidly facing habitat destruction and species extinctions. For example, 63% of Hawaii's 754 land snail species are already extinct with 100 species estimated to face imminent extinction within the next decade. We are developing a Hawaiian land snail app to inform people about the dire situation facing these native species and provide a guide to identify invasive snails to assist in conservation efforts. This hybrid app was designed using Adobe XD, coded in HTML, CSS, and JavaScript, and uploaded to the App Store through Monaca. To assess the usefulness of this publicly available app, we developed an 18-question survey to evaluate the: 1) useability of the dichotomous key for non-native species and 2) the

users' knowledge and attitudes toward native Hawaiian land snails. Survey responses have provided positive feedback, supporting that the dichotomous key is useful and that the overall app can raise awareness about Hawaiian land snails. The next steps are to develop a native Hawaiian land snail guide and expand access to Android users. When fully developed, this e-resource can be used to educate people about Hawaii's land snails and help to conserve the remaining species.

153

How Will Climate Change Affect Residential Water Demand? Evidence from Hawai'i Microclimates

Nathan DeMaagd, Michael Roberts

University of Hawaii, Honolulu, HI

Track

VI. Place-based Conservation

Abstract

The effect that climate change will have on water resource sustainability is gaining international interest, particularly in regions where stocks are strained due to changing climate and increasing populations. Past studies focus mainly on how water availability will be affected by climate change, with little attention paid to how consumer behavior is likely to react. How a changing climate affects water demand could be equally or more important to management solutions as its influence on water supply. In this paper, we analyze the relationship between residential water use and climate on the Hawaiian island of O'ahu, and apply a variety of climate projections to estimate end-of-century water use. The island is serviced by only one water utility yet has a wide range of consumers and microclimates, which makes it an ideal location for studying these relationships. We find that climate is strongly associated with residential water use in a manner that is likely causal. If the association is causal, our mean estimates imply that residential demand may increase up to 36% island-wide by the end of the century, holding all else the same, depending on the climate model projection. Mean estimates, however, mask a large degree of uncertainty largely due to the wide range of projected climate outcomes. Strategies for offsetting the projected increase in demand are also considered, along with the study's place in broader literature examining watershed management and consumer welfare.

154

Elevational Distributions of Tardigrades on Mt. Ka'ala

Sophia R. Egger[1,2], Lydia Poisson[3], Kelli DeLeon[2], Kenneth A. Hayes[2]

[1]University of Hawaii at Manoa, Honolulu, Hawaii. [2]Bishop Museum, Honolulu, Hawaii. [3]Duke University, Durham, North Carolina

Track

VI. Place-based Conservation

Abstract

For many groups of animals, such as tardigrades, we lack information about their identities, distributions, and the role they play in ecosystem functions and services. Of the 1200 or so tardigrade species globally, only 28 are known from Hawai'i, and only three are endemic. However, this is probably an underestimation of their true diversity and endemism in the islands. To begin characterizing the tardigrades biodiversity and distributions in Hawai'i we sampled known terrestrial tardigrade habitats, moss and lichens, at seven sites along an elevational gradient on Mt. Ka'ala, O'ahu. Samples were processed and tardigrades recovered via two methods, a traditional "cherry-picking" method and a high-efficiency, centrifugation approach. Both methods recovered tardigrades at all sites, but centrifugation produced higher numbers (n=213) and greater diversity, and it was faster compared to the traditional method, which recovered only 61 specimens. The mid-elevation site was most diverse, with five genera, but low and high elevation sites had higher abundances. From the Mt. Ka'ala transect alone, we identified tardigrades belonging to *Macrobiotus, Minibiotus, Milenisium, Echiniscus, Diphascon, Ramazzotius,* and an unidentified genus, which account for 70% of the generic level diversity previously recorded across the entirety of O'ahu. Differences in elevational distribution and diversity may be related to precipitation, temperature or other factors that will be the focus of future studies. Increased knowledge of tardigrade biodiversity, and other poorly studied groups will provide the information critical for transforming how we understand and conserve biodiversity in Hawai'i.

155

Impact of Marine Debris on Whales and Dolphins in Hawai'i

Beverly Beebe

University of Hawai'i Health and Stranding Lab, Kāne'ohe, Hawaii

Track

III. Global and Regional Change & Challenges

Abstract

The University of Hawai'i Health and Stranding Lab is authorized by the National Oceanic and Atmospheric Administration (NOAA) and works with cultural practitioners to respond to strandings and collect remains of stranded Pacific whales and dolphins. At their Kāne'ohe Bay lab, whale and dolphin necropsies are done and samples, sometimes including ingested food and marine debris, are processed,

recorded, and stored. Briefly, marine debris is persistent solid material manufactured or processed and disposed of or abandoned into the ocean. A NOAA website suggested strandings are important indicators of the population health of cetaceans, apex species that can reveal ocean health. Anthropogenic impacts, like plastic ingestion and entanglement, may be evident at strandings or necropsies. The University of Hawai'i Health and Stranding Lab team is studying three short-finned pilot whales (*Globicephala macrorhynchus*), including one from the October 2017 mass stranding on Kaua'i. Each individual stranded with about 15 pounds of marine debris in their stomach, "stomach debris," which is mostly rope, netting, and plastic. Cleaning, filtering, and disentangling or separating stomach debris are labor-intensive and time-consuming processes. Each piece of debris is photographed, measured, and weighed, and other analyses may be performed. The negative effects of cetacean entanglement or debris ingestion can range from discomfort to death, and may include compromised health, gastrointestinal problems or ruptures, a false sense of being full, and starvation. Marine mammal stomach debris highlights human-caused health and conservation concerns. Findings imply that marine debris prevention and removal are important for ocean species and environmental protection.

156

Herbicide Damage to Native 'Iliahi (Santalaceae: *Santalum paniculatum*) and Considerations for Restoration and Management Planning

Asa Aue, Parker Powell, Colleen Cole

Three Mountain Alliance, Hawai`i National Park, HI

Track

IV. Putting Research into Management Practice

Abstract

Hawai`i Island is home to two species of 'Iliahi (Sandalwood), *Santalum paniculatum* and *Santalum ellipticum*, which were logged extensively in the early 19th century, leaving few remaining patches of forest dominated by these trees today. Beginning in January 2020, Three Mountain Alliance (TMA) crews began preparing 1.9 acres of *Santalum paniculatum* dominated woodland at Lupea, North Kona for restoration by spraying invasive grasses with a mixture of glyphosate (Makaze 2%) and imazapyr salt (Polaris 1%) prior to native species outplanting. By March, many 'Iliahi trees within the site had suffered what appeared to be herbicide damage. Herbicide mixes were altered, eliminating imazapyr, due to its potential to persist in soils for long periods, and affect non-target woody species. Damage increased in severity until August, when data was taken on a total of 17 trees' observed health, DBH, height, distance from herbicide application, and herbicide used. Though no results proved significant, trees in close contact to secondary treatments, those lacking imazapyr, and those considerably outside the treatment area suffered less visible damage. Although direct uptake of imazapyr is a possible cause of damage, killing surrounding grasses may also have eliminated 'Iliahi's host-species in an area where no other native vegetation is present and more immersive analysis would be needed to clarify. Currently, this situation has altered site selection and preparation techniques for restoration at this location to focus

on avoidance of existing ʻIliahi trees and alternative or grass-specific herbicide mixes. While anecdotal, it is hoped these observations can help to inform future restoration and management efforts.

157

Plants and Associated Microbial Communities Critical to Hawaiian Arboreal Snail Conservation

Wallace M. Meyer, III[1], Norine W. Yeung[2,3], André R. O. Cavalcanti[1], Edward J. Crane, III[1], Kenneth A. Hayes[4,3]

[1]Pomona College, Department of Biology, Claremont, CA. [2]Bishop Museum, Malacology, Honolulu, HI. [3]University of Hawaiʻi at Mānoa, Pacific Biosciences Research Center, Honolulu, HI. [4]Bishop Museum, Pacific Center for Molecular Biodiversity, Honolulu, HI

Track

IV. Putting Research into Management Practice

Abstract

Despite calls to protect and expand habitat for native Hawaiian snails, conservation remains hampered by a lack of foundational ecological information. For example, until recently, habitat requirements for most Hawaiian arboreal snails (e.g., what plants they require) remained unknown. We investigated native arboreal snails' plant preferences in wet montane areas (Kohala, Hawaiʻi; Mt Kaʻala, Oʻahu, and Puʻu Kukui, Maui) across the Hawaiian Archipelago, and although these studies included snails endemic to different islands, concordant preference patterns were recovered. Across islands and species, snails preferred a subset of patchily distributed understory plants (*Hydrangea arguta, Ilex* spp., and *Clermontia* spp.), and avoided the two most abundant plants at all sites studied: the dominate tree, *Metrosideros polymorpha*, and the mid-story ferns, *Cibotium* spp. Using these results as a guiding framework, we employed a metagenomic approach to test the hypothesis that epiphytic fungal and bacterial assemblages, the primary food for these snails, differed among preferred and non-preferred plant species. Analyses uncovered differences in microbial assemblages among preferred and non-preferred plant species and support the idea that protecting and restoring diverse understory plant assemblages with a focus on key plant species for snails may enhance native Hawaiian arboreal snail conservation. These data also provide opportunities for research into effective snail conservation strategies. Future research should explore if snail fitness is enhanced when feeding on preferred plants, and if certain fungi and bacteria may enhance or inhibit snail fitness. Attention to foundational ecological information may provide the vital insights required to preserve the remaining species.

158

Transforming Restoration: Hakalau in a Changing Climate

Rachel Gregg

EcoAdapt, Seattle, WA

Track

III. Global and Regional Change & Challenges

Abstract

In the Hawaiian Islands, climate change is already affecting species, habitats, and the human communities that depend on them. Managers and conservation practitioners are faced with planning actions that will play out in an evolving, unprecedented climate—an effort known as adaptation. This presentation will share the results of an effort to develop consensus-driven, climate-informed restoration activities in the Hakalau Forest National Wildlife Refuge and adjacent lands. This effort builds on the Hawaiian Islands Climate Synthesis Project, identifying how climate change may compromise current restoration efforts and how these activities can best proceed in a coordinated fashion.

The Hakalau region is an important habitat for native forest birds and plants, including several endangered species. We convened the local conservation community to share the best available science on climate change, generate strategies to respond to and recover from potential climate impacts, and facilitate conversations on how to more effectively coordinate across organizations to undertake climate-informed restoration. Partners developed adaptation options, including modifications to business-as-usual practices, new efforts in sites underserved by current restoration practices, and testing new approaches in experimental sites. The findings, including best bets for investments in restoration and additional research, are shared in the *Hakalau Region Climate-Informed Restoration Technical Resource Document*. The process used in this project may be modified for other climate adaptation planning efforts in the Hawaiian Islands and beyond.

159

Expanding Environmental Education Within Your Community

Meredith Speicher[1], Sylvia Texeira[2], Iolani Kuoha[3], Nakoa Goo[1]

[1]Hawai'i Environmental Education Alliance, Honolulu, HI. [2]Hawai'i Environmental Education Alliance, Kailua Kona, HI. [3]Hawai'i Environmental Education Alliance, Kaunakakai, HI

Track

II. Capacity in Conservation

Abstract

The Hawai‘i Environmental Education Alliance (HEEA) works with diverse groups of educators supporting conservation and natural resource management. HEEA will provide examples of what we do, what we can offer, and bright spots in environmental education over the last year. Cultivating community relationships through environmental education and stewardship helps us with larger community issues like food sustainability, clean water resources, and community resilience. We strive to bring together environmental education practitioners, conservationists, resource managers, and members of the diverse Hawai‘i Community to learn and network around the themes of resiliency, stewardship, and meaningful action. Many members of the conservation community in Hawai’i face shared challenges with developing and delivering effective Environmental Education (EE) programs. As an affiliate of the North American Association for Environmental Education (NAAEE), we will introduce participants to a broad national perspective in program evaluation and guides for excellence and equity in EE. We will also familiarize participants with various resources available through HEEA and our partners to organize future training opportunities for our Hawai‘i communities. Environmental education is part of the framework for long term stewardship and management of our natural resources. It builds the next generation of conservation professionals. We will present some inspiring case studies of environmental education, citizen science, and curriculum that showcases ways to expand conservation opportunities within our community. We welcome participants who are seeking recommendations and guidance for developing and assessing their EE programs.

160

Ka‘ao Konnections with Hālau ‘Ōhi‘a: Interpreting a Changing World to Strengthen Biocultural Connections

Kekuhi Kealiikanakaoleohaililani[1,2], Aimee Sato[1,2], Marian Chau[3,2], Hannah Azouz[4,2], Linnea Heu[1,2], Leahi Hall[5,2], Ke‘ala Ostrowski[2], Lisa Chang[2], Liana Murillo[2], Michelle Clark[2], JC Watson[2], Creighton Litton[2], Brutus La Benz[2], Lukanicole Zavas[2], Cynthia McArthur[2], Lara Reynolds[2], Marigold Zoll[2], Heather McMillen[2], Janice Jensen[2], Jolie Wanger[2]

[1]Lonoa Honua LLC, Hilo, HI. [2]Hālau ‘Ōhi‘a, Hilo, HI. [3]Kalehua Seed Conservation Consulting, Aiea, HI. [4]Ola Loa Organics, Aiea, HI. [5]Keauhou o Honuaula, Makena GBC, Honuaula, HI

Track

I. Cultural Values and Practice in Conservation

Abstract

Conservationists thrive on transformations; this theme remains at the core of restoration endeavors. Hālau ‘Ōhi‘a Hawai‘i Stewardship Training is a unique, personal and professional development program for stewards of the Hawai‘i landscape. Hālau ‘Ōhi‘a returns to the Hawai‘i Conservation Conference to host a forum, teaching ways to analyze circumstances of transformation through an Indigenous and biocultural conservation lens. We will share how Hālau ‘Ōhi‘a has adapted during the pandemic, discovering ways to create deeper connections to each other and our environment, not despite, but

through virtual engagement across the pūnaewele (worldwide web). Through continued practice of Hawai‘i lifeways, Hālau ‘Ōhi‘a learners have experienced individual and collective resilience, especially in the time of hulihia (upheaval). We will share how learners created ka‘ao (stories that cause conscious awakening) that mythologized the pandemic as an exercise to help learners reflect, process, and understand the changes and adjustments in their lives, homes, communities, and society. We learn to become the hakaka‘ao (storyteller), having the ability to write and control our own narratives. Participants will have the opportunity to interact with Hālau ‘Ōhi‘a learners in resilience building activities that engage the whole person, gaining specific Hawai‘i lifeway skills to deepen connections to our human, forest, and ocean communities as we kūlia i ka huliau. This forum’s central theme of creating ka‘ao to interpret a changing world will be explored through different forms of expression such as kuahu (shared focal point), hula (dance), and mele (poetry).

Agenda & Additional Required Information for Forums, Workshops, and Trainings

Agenda (120 minutes):

10 min: Oli Aloha

10 min: Introduction of presenters

60 min: Breakout sessions (small groups)

30 min: Full group sharing from breakout sessions

10 min: Closing remarks and protocol

Facilitator: Kekuhi Kealiikanakaoleohaililani

Speakers: Aimee Sato, Marian Chau, Hannah Azouz, Linnea Heu, Leahi Hall, Ke‘ala Ostrowski, Lisa Chang, Liana Murillo, Michelle Clark, JC Watson, Creighton Litton, Brutus La Benz, Lukanicole Zavas, Cynthia McArthur, Lara Reynolds, Marigold Zoll, Heather McMillen, Janice Jensen, Jolie Wanger

Description of innovative audience engagement techniques; Explanation of goals and target audience:

During this forum, after the initial oli aloha, the audience will be introduced to a panel of presenters with backgrounds in outreach and education, research, community engagement, natural and cultural resource management, reforestation, and watershed management. Each presenter will then lead a small group “breakout session” where audience members will be able to choose which presenter to engage with. Our goal is for each presenter to teach a particular skill that has deepened their connection to their environment, and lead a discussion on how this strengthened relationship has resulted in enhanced resilience through times of major change based on their experiences. Participants will return to the large group, where volunteers will share insights, so that all may learn from each skill. Our target

audience is anyone seeking to deepen their connections with land, ocean, and the community of living things, while interpreting a changing world through myth that causes conscious awakening.

161

Restoring Oʻahu Shoreline Habitats Using Native Oysters to Increase Biodiversity, Improve Water-Quality, and Facilitate Community Awareness of Environmental Challenges

Anne Brasher[1], Wendy Wiltse[1], Andrea Grant[1], Maria Haws[2], Daniel Wilkie[2], Marni Rem-McGeachy[2]

[1]Oʻahu Waterkeeper, Honolulu, Hawaiʻi. [2]Pacific Aquaculture and Coastal Resources Center University of Hawaiʻi, Hilo, Hawaiʻi

Track

III. Global and Regional Change & Challenges

Abstract

The health of our estuaries, and nearshore and coral reef ecosystems has been degraded by poor water-quality caused primarily by land-based sources of pollution. Oʻahu Waterkeeper conducted a six-month study designed to assess the feasibility of restoring native oysters on the island of Oʻahu. During this initial study to determine whether oysters would survive and grow, we placed 1,800 native juvenile oysters (*Dendostrea sandvicensis*) in cages at three locations: the Ala Wai Harbor, Kāneʻohe Bay, and Pearl Harbor. Six hundred of these oysters were tagged with individual numbers. Oysters are filter feeders that remove harmful pollutants from the water column, improving water-quality and clarity. In addition, the creation of oyster beds and living shorelines around the world has been shown to stabilize coastal areas, important for adapting to climate variability. Monitored weekly and measured monthly, oysters were shown to survive and grow at all three locations. Survival averaged 75% across all sites. Survival and growth was highest at Kāneʻohe Bay. Oyster growth averaged 3-9 mm in length during the study, ranging from no detectable growth to an increase of 20.4 mm. Results of this study indicate that raising oysters in these impaired waterways is feasible. We will now begin to increase oyster numbers, and start to create oyster beds, until we have a sufficient number of oysters to effectively filter pollutants. This study lays a critical foundation for the expansion of native oyster restoration efforts, in Hawaii and potentially across the Pacific.

162

Tidepooling for Solutions: Biocultural Approaches To Research and Protection of Kapoʻo (Pūpūkea Tidepools), A Unique Coastal Hawaiʻi Ecosystem under Threat

Denise Antolini[1,2], Keelan Barcina[1], Alan Friedlander[3,4], Cynthia Hunter[5], Jenny Yagodich[6], Robert Walker[7], Marvin Heskett[8]

[1]Mālama Pūpūkea-Waimea, Haleiwa, Hawaii. [2]University of Hawaii at Mānoa - William S. Richardson School of Law, Honolulu, Hawaii. [3]National Geographic Pristine Seas, Honolulu, Hawaii. [4]University of Hawaii at Mānoa, Honolulu, Hawaii. [5]University of Hawaii at Mānoa - Dept of Marine Biology, Honolulu, Hawaii. [6]Mālama Pūpukea-Waimea, Haleiwa, Hawaii. [7]Shoreline Conservation Initiative, Haleiwa, Hawaii. [8]Surfrider Foundation - Oʻahu Chapter, Honolulu, Hawaii

Track

VI. Place-based Conservation

Abstract

This Forum presents ongoing biocultural research projects at Kapoʻo, the Tidepools at Sharks Cove, part of the Pūpūkea Marine Life Conservation District (MLCD) on the North Shore of Oʻahu. Community-sponsored studies indicate that the shallow 3-acre Kapo'o Tidepools experience acute and chronic terrestrial pollution impacts from commercial development, beach parks, and high human use. Concerns include risks to human health – the area attracts hundreds of visitors a day during peak periods - and to the Tidepool's diverse fish and benthic communities.

Although under threat, spectacular Kapoʻo also functions as a protective nursery or puʻuhonua (refuge) for marine life that creates "spillover" and helps maintain the diversity and abundance of the entire MLCD. This confluence of potential threats, abundant marine life, and high community engagement makes Kapoʻo an extraordinary place for inter-disciplinary biocultural research that can lead to effective place-based management solutions.

After a virtual orientation to the vibrant beauty and marine-life secrets of Kapoʻo, the Forum panelists will share their research projects and key findings in six areas: kilo/cultural observation, marine life/fish, marine life/benthic, water quality/terrestrial pollution, groundwater discharge, and human use.

In breakout rooms of their choice, participants will take a deeper dive into the methodologies used, be invited to critique the research progress, and asked to lend their expertise to future research design and pathways. The session will reconvene with collaborative report-outs to share ideas for modifying the community research program, sparking new partnerships, and innovating solutions for the long-term protection of Kapoʻo.

Agenda & Additional Required Information for Forums, Workshops, and Trainings

:

1. Introduction/Moderator - Denise Antolini, President, Mālama Pūpūkea-Waimea (MPW) (10 min)

2. Immersive Orientation to Kapoʻo (team video) (5 min)

Speed Presentations of Research Projects and Key Findings

3. Kilo/Cultural Observation - Jenny Yagodich, Director of Education, MPW (5 min)

4. Marine life/fish - Alan Friedlander, National Geographic, Pristine Seas (5 min)

5. Marine life/benthic - Cynthia Hunter, University of Hawaii (5 min)

6. Water quality/terrestrial pollution - Marvin Heskett, Surfrider Foundation (5 min)

7. Groundwater discharge - Robert Walker, Shoreline Conservation Initiative (5 min)

8. Human use - Keelan Barcina - Marine Science Coordinator, MPW (5 min)

Deep Dive into Meth0dologies and Feedback from Participants

9. Breakout Rooms (30 minutes)

10. Reconvene - New Ideas for Research and Management Solutions (30 minutes)

11. Closing (5 min)

Audience engagement:

After the visual orientation and brief panelist presentations, in breakout rooms of their choice, participants will take a deeper dive into the methodologies used, be invited to critique the research progress, and asked to lend their expertise to future research design and pathways. The session will reconvene with collaborative report-outs to share ideas for modifying the community research program, sparking new partnerships, and innovating solutions for the long-term protection of Kapoʻo.

Goals and Target Audience:

The primary goals are to (a) obtain lay and expert feedback on the ongoing biocultural initiatives at Kapoʻo, (b) improve the future research programs, and (c) engage new partners in the inter-disciplinary research effort to more effectively manage Kapoʻo and understand its role in replenishing the MLCD.

163

Hawaiian bird community response to landscape scale biocultural restoration

Eryn Opie[1], Kawika B. Winter[1,2], Kristen C. Harmon[1], Jake M. Ferguson[3], Kanekoa Kūkea-Shultz[4,5], Yoshimi M. Rii[2,6], Hiʻilei Kawelo[7], Keliʻi Kotubetey[7], Melissa R. Price[1]

[1]Department of Natural Resources and Environmental Management, University of Hawaiʻi at Mānoa, Honolulu, HI. [2]Hawaiʻi Institute of Marine Biology, University of Hawaiʻi at Mānoa, HeNERR, Kāneʻohe, HI. [3]School of Life Sciences, University of Hawaiʻi at Mānoa, Honolulu, Hi. [4]The Nature Conservancy Hawaiʻi, Honolulu, HI. [5]Kākoʻo ʻŌiwi, Heʻeia, HI. [6]Heʻeia National Estuarine Research Reserve, Heʻeia, HI. [7]Paepae o Heʻeia, Heʻeia, HI

Track

IV. Putting Research into Management Practice

Abstract

The transformation of landscapes inherent to large-scale agri-business, forestry, engineered waterways, and urban communities has contributed to a rapid decline in species biodiversity over the last century. When ecosystems are restored into heterogeneous landscapes, avian biodiversity is expected to increase due to diversified niche space allowing more species to co-exist in the same spatial extent. In this study, we characterized the bird communities associated with degraded and restored ecosystem states in agro-ecosystems managed through Indigenous practices, to inform restoration planning. Point count surveys were conducted monthly at 29 randomly selected locations across 4 representative ecotypes within the Heʻeia National Estuarine Research Reserve. Ecological characteristics were also recorded during each survey, as restoration activities were ongoing throughout the study period. Native waterbirds and shorebirds preferentially utilized restored ecotypes, including loʻi (flooded-field taro basins), open mudflats and streams, and loko iʻa (fishponds), but were rarely observed utilizing mangrove-dominated or invasive grass-dominated wetlands. Nesting success for native waterbirds was equivalent or higher than conventionally-managed wetlands. Due to avian malaria, all forest birds at this elevation were nonnative. This research highlights the success of community driven restoration grounded in Indigenous management practices in conserving and managing endangered waterbirds and shorebirds within a biocultural framework, but also underscores the limitations of habitat restoration alone for native forest birds and seabirds, which were not observed. Integration of conventional predator control methods will be critical to maximizing avian biodiversity in spaces managed primarily through Indigenous Resource Management practices in Hawaiʻi.

164

Capturing the Effect of Black-tailed Deer (Odocoileus hemionus) on the Forest of the Alakaʻi Plateau

Nicolai Barca, Lucas Behnke

The Nature Conservancy, Lihue, HI

Track

III. Global and Regional Change & Challenges

Abstract

Consistent monitoring of Kaua‘i Watershed Alliance management efforts has revealed an apparent increase in black-tailed deer (*Odocoileus hemionus)* as they colonize the native forest of the eastern Alaka‘i Plateau. This data informed the decision to incorporate protective deer fencing into long-term protection efforts. To simultaneously capture deer impacts on vegetation and any changes which occur after deer removal, we needed to understand their diet. We documented plant species browsed by deer and conducted volumetric stomach content analysis on three deer removed from the Halehaha unit. The analysis showed apparent higher preference for the foliage of several native and non-native taxa: *Cheirodendron* spp. *(23%)*, *Sphenomeris* sp. *(11%)*, *Athurium* sp. *(10%)*, *Broussaissia* sp. *(9%)*, *Rubus argutus (5%)*, *Asplenium* spp. *(4%)*, and *Dianella* sp. *(3%)*, as well as the fruit of *Psidium cattleianum* (10%) and *Passiflora* spp. (2%). Halehaha deer density was documented at just 4 deer/mile^2 in 2017 and was reduced to ~2/mi^2 by 2019. Plant species were incorporated into preexisting vegetation monitoring transects but their total cover remained stable. Comparison to adjacent management units with seemingly more deer (14 and 25/mi^2) showed *Cheirodendron* seedlings to be 5X and 21X more abundant in Halehaha. Future surveys of adjacent units should yield more results for additional deer densities and plant communities. Information on animal density and their relationship with habitat may prove useful in managing ungulates in forests with no plans for fencing. Our methods could be easily adapted by land managers or community members to advance community co-management.

165

On the Fly: Precision Imagery Collection to Inform Best Practices for Watershed Fencing in Areas Threatened by Rapid ‘Ōhi‘a Death

Lucas Behnke

The Nature Conservancy, Lihue, HI

Track

V. New Technologies in Conservation Research and Management

Abstract

Preliminary evidence suggests that ‘ōhi‘a forest free of ungulates is more resilient to the ravages of Rapid ‘Ōhi‘a Death (*Ceratocystis* Spp.; ROD) than unprotected areas. This presents a dilemma for land managers in areas where opportunities for protective fencing of high priority for watershed and biodiversity value exist in tandem with the threat posed by ROD, either through creation of disturbance along the fencing corridor or by direct introduction. The ongoing effort by the Kaua‘i Watershed Alliance to protect an additional 2,000 acres of ‘ōhi‘a-dominated forest on the eastern Alaka‘i plateau presents an effective testing ground for both risk-minimization efforts as well as high temporal and visual

resolution monitoring of impacts to the native forest. To-date, both satellite and aircraft-based imagery collection present drawbacks in either resolution or cost-effective repetition for relatively small acreages, distributed across the landscape. By leveraging current management work, contractor oversight and additional grant support, The Nature Conservancy's staff collected baseline forest health and regular high-resolution imagery during fence construction by small unmanned aerial system (sUAS) along 5.5 miles of topographically challenging terrain. We present our analytical methods including a comparison of two cost-effective imagery collection and processing platforms, short-term results and best practices for engaging fencing contractors in the minimization of risk from ROD. It is our hope that sharing lessons learned from this new paradigm can benefit future fence projects statewide.

167

Detecting Toxoplasma gondii in the Giant African snail (Lissachatina fulica) in Oʻahu, Hawaiʻi

Olivia Stogner[1], Kenneth Hayes[2], Christopher Lepczyk[1], Sarah Zohdy[1]

[1]Auburn University, Auburn, Alabama. [2]The Bishop Museum, Honolulu, Hawaii

Track

III. Global and Regional Change & Challenges

Abstract

Toxoplasmosis is a parasitic disease to Hawaiʻi caused by the intracellular protozoan *Toxoplasma gondii* and has fatal impacts on several endangered wildlife species, such as the ʻAlalā (*Corvus hawaiiensis*) and Īlio-holo-i-ka-uaua (*Monachus schauinslandi*). Although non-native domestic cats (*Felis catus*) are the only definitive host for *T. gondii* in Hawaiʻi, it's possible for other species to ingest and carry *T. gondii* oocysts, such as marine snails, though detection of *T. gondii* oocysts in land snails has not been explored. If land snails carry *T. gondii* oocysts, this could pose a major threat to wildlife conservation, due to the high number of invasive land snails in Hawaiʻi. To determine if land snails can ingest and carry *T. gondii* oocysts, we collected fecal samples from 160 *Lissachatina fulica* from three feral cat congregation sites in Oʻahu. We extracted DNA from a portion of each sample and used nested PCR to detect presence/absence of *T. gondii* DNA, by amplifying the 529-bp repeat fragment. We will use genetic sequencing to confirm positive samples and light microscopy to examine the presence of *T. gondii* oocysts in the remaining feces of confirmed samples. Half of the samples have been screened and the remaining samples will be screened by May 2021. Sequencing of positive samples will be complete by June 2021 and microscopy by August 2021. Confirmation of *T. gondii* in land snail feces would indicate an alternative pathway for Toxoplasmosis infection in wildlife and could have important implications for conservation management and non-native species control

168

Decline of Hawaiʻi's common mesic forest trees

Tamara Ticktin[1], Zoe Hastings[1], Tressa Hoppe[1], Lisa Mandle[2]

[1]University of Hawai'i at Mānoa, Honolulu, Hawaii. [2]Natural Capital Project, Stanford, Palo Alto, California

Track

III. Global and Regional Change & Challenges

Abstract

Plant conservation efforts in Hawaiʻi have focused largely on threatened and endangered (T&E) species. Common tree species, which form the backbone of plant communities and often provide the supporting conditions for T&E species, have received much less attention. Common tree species may be affected by the same drivers of decline as T&E species, but their life-histories, including their longevity, can make decline difficult to observe, or even to detect with short-term studies. We used our 17-year demographic dataset from Mākaha, Oʻahu, combined with a series of seed predation and seedling germination experiments, to assess the long-term viability of three common mesic forest tree species: lama (*Diospyros sandwicensis*), olopua (*Nestigis sandwicensis*), and alaheʻe (*Psydrax odorata*). Using integral projection models, we show that despite ungulate control and removal of non-native plants in the overstory, all three species are slowly declining ($\lambda < 1$). Our models show that reducing seed predation increases population growth rates, but not enough to lead to population stability. Instead, seedling and sapling mortality due to competition from non-native species in the understory represents a more important bottleneck for population persistence for all three species. Conservation efforts that focus on reducing seed predation combined with consistent understory weeding appear to be necessary to ensure the long-term persistence of these pillars of the mesic forest.

169

Environmental Stewardship Groups and the Important Role They Play in Supporting Our Human Communities

Rachel Dacks[1], Heather McMillen[2], Pua Heimuli[2], Sanoe Burgess[3], Kim Kahaleua[1]

[1]University of Hawai'i at Mānoa, School of Life Sciences, Honolulu, HI. [2]Department of Land and Natural Resources, Division of Forestry and Wildlife, Honolulu, HI. [3]Alliance Commercial Finance LLC, Waipahu, HI

Track

I. Cultural Values and Practice in Conservation

Abstract

While crises are more commonly associated with negative impacts, they are essential for driving adaptation that builds resilience. There are lessons to be learned from understanding how environmental stewardship groups have adapted to the impacts of the COVID-19 pandemic. Downstream, we can learn how these adaptations have impacted these groups' volunteers. We conducted interviews with 20 O'ahu-based stewardship groups to understand the changes that have resulted from the pandemic and semi-structured surveys with 85 volunteers that engage with stewardship groups.

Groups were negatively impacted by funding losses and volunteer activity cancellations. However, there were positive impacts and outcomes related to new funding sources, increased online presence, and new and/or more apparent needs of the community. The survey results further illustrate the significant role that environmental stewardship groups play in building and maintaining community wellbeing. Over half of respondents noted that the social aspects of engaging with stewardship groups were what they have missed most during the pandemic. Further, almost half of respondents indicated that a lack of engagement with these groups during the pandemic has negatively affected their mental and/or emotional health. However, several respondents indicated that a positive impact of less engagement with stewardship groups was the increased attention to the 'āina around their own homes. Our results show how crises can lead to adaptations that increase resilience and highlight the significant role that stewardship groups play not just in caring for our environment, but also in caring for the people that make it 'āina.

170

Nā 'Ono o ka 'Āina: Biocultural Stewardship for Abundance

Pua'ala Pascua[1], Eric Co[2], Jason Jeremiah[3], Natalie Kurashima[4]

[1]Ahupua'a Accelerator Initiative, Honolulu, HI. [2]Harold K.L. Castle Foundation, Honolulu, HI. [3]Kamehameha Schools, Honolulu, HI. [4]Kamehameha Schools, Kailua Kona, HI

Track

II. Capacity in Conservation

Abstract

Adaptation and resilience are frequently described as foundational concepts in Hawai'i's conservation landscape, and many individuals continue to experience these concepts firsthand during the ongoing season of change. Relearning the strategies and practices that have long supported healthy human and ecological communities here in Hawai'i has provided an important opportunity to redefine abundance, especially at household and community scales. We invite session participants to figuratively and literally "savor the flavors" of 'āina as guest presenters from across the island chain provide a practical exploration of island sustainability by sharing biocultural stewardship practices for local abundance

together with local and cultural food preparation techniques that support continued connections to place. The session format will expand upon the virtual conference experience through hands-on demonstrations and other action-oriented modes of sharing suitable for diverse audiences. Key takeaways from the session will draw from multiple knowledge systems, including conventional conservation strategies and Indigenous and local knowledge and practice, and are expected to provide important examples of place-based adaptation strategies and community-based stewardship techniques useful to support meaningful conservation outcomes.

Agenda & Additional Required Information for Forums, Workshops, and Trainings

Agenda (2 hr session):

5 min - Welcome Remarks, Session Overview

20 min - Guest Presenter 1

*10 min - Moderated Audience Q&A

10 min - Transition and interactive polling/virtual “discussion” (e.g., via Mentimeter, Padlet, etc)

20 min - Guest Presenter 2

*10 min - Moderated Audience Q&A

10 min - Transition and interactive polling/virtual “discussion” (e.g., via Mentimeter, Padlet, etc)

20 min - Guest Presenter 3

*10 min - Moderated Audience Q&A

5 min - Closing Remarks, Exit survey

*If feasible, moderated Q&A may occur during the presentations themselves (for 30 min presentations, rather than 20min)

Innovative Engagement Techniques:

Action-oriented presentations (e.g., hands-on demonstrations)

Virtual polling/discussion tools (e.g., Mentimeter, Padlet, etc)

Goals:

1. To share and compare examples of place-based adaptation strategies and community-based stewardship techniques
2. To distill a set of key takeaways useful to support meaningful conservation outcomes
3. To provide an example of diverse modes of knowledge sharing, for instance via the action-oriented guest presentations.

Target Audience: Resource managers, researchers, community members, cultural practitioners, and others interested in

171

Assessing Population Dynamics of a Potential Nutrient Recycler in He'eia Fishpond Towards Improved Understanding of Ecosystem Health”

William Thomas[1], Rosie Alegado[2,3]

[1]Univeristy of Hawaii at Manoa - Marine Biology Graduate Program, Honolulu, HI. [2]University of Hawaii - Department of Oceanography, Honolulu, HI. [3]University of Hawai'i Sea Grant College Program, Honolulu, HI

Track

V. New Technologies in Conservation Research and Management

Abstract

A comprehensive understanding of nutrient cycling is crucial to identify linkages between microbial diversity and ecosystem resilience. However, the inability to apply cell biology tools for dissecting microorganisms at the base of the marine food web has limited the potential to address key questions about such species. For example, nanoplankton can control bacterioplankton populations and recycle limiting nutrients that are essential for a healthy coastal ecosystem. In this study, we focus on choanoflagellates, a diverse group of single-celled and colony-forming heterotrophic nanoflagellates found ubiquitously across marine and freshwater environments. The choanoflagellate Salpingoeca rosetta has been developed as a model system to study host-microbe interactions and previous genomic surveys showed the presence of significant populations of S. rosetta in Pacific subtropical estuaries. Our preliminary results show that solitary S. rosetta and a subset of colonial S. rosetta cells can be visualized with a lectin stain and enumerated using flow cytometry. Immunofluorescence staining of colonial S. rosetta protein homologs can be critical in differentiating life-history stages. Our goals are to 1) identify morphotype-specific markers from the literature that will enable robust sorting of S. rosetta colonial and single cells by flow cytometry, 2) assess seasonal abundance and variation of S. rosetta in the He‘eia

estuary, and 3) assess life-history stage frequency of environmental samples using automated methods. Results from this study can provide insight into choanoflagellate diversity, assess how seasonal environmental changes impact S. rosetta community structure, and more broadly supplement existing metrics for ecosystem resiliency.

172

Monitoring Hawaiian forest resources, health, and trends

Suzanne Owen[1], Olaf Kuegler[1], Ashley Lehman[2], R. Flint Hughes[3], Jane Terzibashian[1], Irene Sprecher[4], Tom Thompson[2], Seth Ayotte[2], Mikhail Yatskov[2], Michelle Silva[5]

[1]USDA Forest Service, Pacific Northwest Research Station; Resource Monitoring and Assessment Program, Portland, OR. [2]USDA Forest Service, Pacific Northwest Research Station; Resource Monitoring and Assessment Program, Anchorage, AK. [3]USDA Forest Service, Pacific Southwest Research Station; Institute of Pacific Islands Forestry, Hilo, HI. [4]Hawai‘i Department of Land and Natural Resources, Division of Forestry and Wildlife, Honolulu, HI. [5]Hawai‘i Conservation Alliance, Honolulu, HI

Track

III. Global and Regional Change & Challenges

Abstract

Long-term forest monitoring is vital to understand how Hawaiian forests change over time and to manage and conserve natural resources. Forest inventories are assessed approximately every 10 years in Hawai'i by the Forest Inventory and Analysis (FIA) program, Forest Service, in collaboration with state and federal partners. Statewide estimates, from inventories conducted between 2010 and 2015, included forest area, structure, species composition, carbon, invasive plant species, and pathogens and pests. An estimated 1.5 million acres of forested lands were identified, supporting many high-value resources. Hawai'i’s forests consisted of approximately 1.8 billion live trees and 112 distinct tree species. Montane rainforests were the most common forest community, accounting for 30% of Hawai'i’s forested lands. ‘Ōhi‘a lehua (*Metrosideros polymorpha*), an endemic, keystone tree species, was the most common (≥ 5 inches diameter) within Hawai'i’s forests. Strawberry guava (*Psidium cattleianum*), was the most abundant invasive tree species (≥ 1-inch diameter), which degrades Hawai'i’s native forests, and negatively impacts ecosystem function. Hawai'i’s live trees represented 51 million U.S. tons of dry mass carbon. Results from this inventory serve as a baseline for the extent and condition of ‘ōhi‘a prior to the manifestation of Rapid ‘Ōhi‘a Death (ROD), a disease that began causing widespread mortality of ‘ōhi‘a lehua trees in 2014. These data have also been used to assess damages from pigs and other invasive species over time and provides the basis for future assessments and estimates of change in forest composition, structure, and health.

173

Renewable Technology and Partnerships for Restoration and Seed Banking on Hawai‘i Island

Marian Chau[1,2], Jill Wagner[1]

[1]Terraformation, Inc., Kamuela, HI. [2]Kalehua Seed Conservation Consulting, Aiea, HI

Track

V. New Technologies in Conservation Research and Management

Abstract

Kūlia i ka huliau (striving for change) in Hawai‘i conservation must urgently address climate change. Ecosystem restoration is the best approach to both capture carbon and preserve our unique biocultural diversity. Terraformation creates renewable technology to quickly scale up reforestation, while we still have time to fight climate change. We do restoration on the ground, partnering with multiple Hawai‘i Island private landowners. At our Pacific Flight project in North Kohala, we built the world's largest off-grid 100% solar-powered desalination plant on denuded land, with only brackish water, to restore a native dry forest watershed. We are planting and monitoring 5000 native plants and will share lessons learned. One major restoration bottleneck is lack of appropriately sourced native seeds, and seed banking is a critical conservation tool to address this. Hawai‘i's seed banks excel at preserving our rarest species, but we do not bank enough seeds of less threatened species essential for restoration and disaster response. Terraformation partners with Hawai‘i Island Seed Bank (HISB) to address the bottleneck while increasing biodiversity protection via seed conservation. We built HISB a restoration seed bank: a 40' lab-in-a-container, housing all necessary equipment, and fully solar-powered. Our technology can be purchased, but we freely share blueprints, specifications, and our open-source software: a seed bank database and mobile apps for seed collecting and planting/monitoring. Anyone is welcome to adapt them, but Terraformation also hopes to collaborate directly with more Hawai‘i partners to scale up seed conservation and restoration of our precious natural resources.

175

Including cultural meanings of marine species in federal management

Kirsten Leong[1], Kalani Quiocho[2], Arielle Blacklow[3], Sheldon Rosa[4], Danika Kleiber[1], Randall Kosaki[2], Kawika Winter[5], Melissa Poe[6], Keahiahi Long[7], Noelani Puniwai[8]

[1]NOAA Pacific Islands Fisheries Science Center, Honolulu, HI. [2]NOAA Papahānaumokuākea Marine National Monument, Honolulu, HI. [3]Harvard College, Boston, MA. [4]University of Hawai‘i at Mānoa, Honolulu, HI. [5]He‘eia National Estuarine Research Reserve, He‘eia, HI. [6]Washington Sea Grant, Seattle, WA. [7]Kamakakūokalani Center for Hawaiian Studies, Honolulu, HI. [8]Kamakakūokalani Center for Hawaiian Studies, Hilo, HI

Track

I. Cultural Values and Practice in Conservation

Abstract

Widespread recognition of ecosystems as social-ecological systems has ushered in marine management frameworks that increasingly acknowledge the importance of cultural dimensions in ecosystem-based management. Offices and programs of the National Oceanic and Atmospheric Administration (including Fisheries, Sanctuaries, Estuarine Research Reserves, and Sea Grant) have begun to institutionalize cultural ecosystem services (CES) to document cultural importance. However, all of these programs have noted challenges in implementing this approach. In 2020, a group of cultural practitioners and scholars came together to advise a PIFSC Hollings/EPP Scholar pilot project focused on understanding the various cultural functions associated with marine species in the Hawaiian archipelago. While many cultural functions overlap with CES concepts, other frameworks may more effectively align ecosystem-based management with locally meaningful and culturally-relevant content. In this talk, we summarize key benefits and limitations of a CES approach. We also outline alternative frameworks for management to include cultural dimensions in planning, monitoring, and decisions. We illustrate implications of applying different frameworks to analyze a series of Hawaiian newspaper articles, Ka ʻOihana Lawaiʻa (Hawaiian Fishing Traditions). We feature approaches that triangulate multiple sources of cultural knowledge—including written texts, oral histories, ceremonies, chants, symbols, and interviews with kūpuna and other knowledge holders—to reveal aspects of intangible cultural heritage that can guide ecosystem-based management and help meet research priorities. Including a more robust focus on cultural practices and heritage not only broadens understanding of marine ecosystems and their importance to society, but also enhances science-to-management of resources in the public trust.

176

Solving Climate Change with Afforestation of Degraded Lands in Kohala, Hawai‘i

Jill Wagner, Marian Chau

Terraformation, Kamuela, HI

Track

V. New Technologies in Conservation Research and Management

Abstract

Terraformation’s “Pacific Flight” restoration project is in the North Kohala region, at 350’ elevation with low rainfall and brackish water. Dry forests historically occurred here, but degraded land, brackish water, no electricity, and high winds made the area a poor candidate for restoration. In order to make the project happen we built the world’s largest off-grid 100% solar-powered desalination plant, which can clean over 30,000 gallons a day. Our afforestation project would not have happened without fresh water. We are restoring a totally denuded landscape to a dry forest ecosystem with the foundational native tree *Acacia koaia*. We are in the process of planting 5,000 native trees and shrubs at Pacific Flight. Afforestation here is a testament to what can be accomplished on degraded lands.

Pacific Flight is committed to keeping the site forested in perpetuity, and to develop a carbon credit project from this forest. Terraformation will arrange independent verification services and provide fine-

scale plant and remote landscape monitoring technology. We have also developed new technology in the form of seed collecting apps and tree planting apps that make it easy to track and map projects. We offer these apps free and open source for anyone to use. Our mission is to solve climate change through natural carbon capture. Our approach is to develop forest technology for restoration projects in Hawaii and the rest of the world.

177

Building Undergraduate Knowledge About the Scientific Process through Our Project In Hawai'i's Intertidal (OPIHI)

Joanna Philippoff[1], Patrick Nichols[1], Florybeth F. La Valle[2,3]

[1]University of Hawaii at Manoa, Honolulu, HI. [2]Southern California Coastal Ocean Observing System & CA Sea Gran, San Diego, CA. [3]Scripps Institution of Oceanography University of California, San Diego, San Diego, CA

Track

II. Capacity in Conservation

Abstract

Our Project In Hawai'i's Intertidal (OPIHI) is an undergraduate program whose scientific purpose is to characterize the Hawaiian rocky intertidal and nearby subtidal areas to determine if and how they are changing over time. The educational purpose is to enhance scientific literacy skills while providing participants with the training needed to engage in conservation work. Hawai'i's intertidal is a culturally important ecosystem susceptible to climate change and land-use practices, but it has been historically understudied due to seasonal wave activity and a narrow tidal range. However, this area is ideal for engaging emerging scientists in research experiences because of the sampling power of trained students. The yearlong program has a nested structure that spreads mentoring responsibilities of students between project facilitators, scientific partners, and collaborating college departments. Project questions are generated and analyzed in collaboration with scientists and community groups—including those in academia, government agencies, and non-profits. Undergraduates are not only exposed to an array of mentors and career pathways, they participate in service learning, including assisting teachers and K–12 students on field trips—thus modeling the next step in the STEM pipeline. OPIHI is transitioning from a grant-funded to an institutionalized program at UHM. This presentation will share results of project assessments, which indicate participants are increasing their knowledge about Hawai'i's coastal environment and enhancing their understanding of the scientific process and scientific self-efficacy, lessons learned over six years of OPIHI undergraduates (N = 71), and next steps for the program.

178

Roost Ecology and Nocturnal Roosting Behavior of the Hawaiian hoary bat (*Lasiurus semotus*) on Hawai‘i Island

Kristina Montoya-Aiona[1], Aaron Aguirre[1], Sean Casler[1], Karen Courtot[1], Amy Durham[2], P. Marcos Gorresen[2], Julia Hoeh[1]

[1]U.S. Geological Survey, Pacific Island Ecosystems Research Center, Hawaii National Park, HI. [2]Hawai‘i Cooperative Studies Unit, University of Hawai‘i at Hilo, Hilo, HI

Track

V. New Technologies in Conservation Research and Management

Abstract

The Hawaiian hoary bat (*Lasiurus semotus*) or ‘Ōpe‘ape‘a, is a federally and state listed endangered species, and is the only extant, native terrestrial mammal in the Hawaiian archipelago. It is a solitary and foliage-roosting species that generally roosts alone or in mother-pup family groups. This research was motivated by a lack of information on roost characteristics and roosting behavior, and may provide a better understanding of the life history and ecology of this elusive species.

Hawaiian hoary bats were captured, radio-tagged, and tracked to roosting locations on Hawai‘i Island from May 2018 to February 2021. Bats were tracked to 89 roost stands and confirmed in 42 roost trees. Bats roosted in a variety of tree species and in an assortment of habitat stand types including native and non-native habitats.

Additionally, nighttime thermal video-monitoring was conducted at four separate sites in Hilo, Hawai‘i during the 2019 and 2020 reproductive seasons. More than 542 hours of video imagery was collected and analyzed during the 2019 season while analysis of the 2020 season is ongoing. Analysis of nighttime thermal video included timing of roost departure and arrival, the number and duration of bouts away from roost, and documentation of predation or disturbance. Departure from roosts ranged from 53 minutes before sunset to 20 minutes after sunset while arrival at roosts ranged from 41 minutes to 11 minutes before sunrise. While there was some evidence of rat activity near roost sites, no predation events were documented on thermal video.

179

Examining Biocontrol: Its Role and Possibilities in Hawai‘i

Tracy Johnson[1], Mark Wright[2], Darcy Oishi[3], Springer Kaye[4], Steven Montgomery[5]

[1]USDA Forest Service PSW Research Station, Volcano, HI. [2]University of Hawaii at Manoa, Honolulu, HI. [3]Hawaii Department of Agriculture, Honolulu, HI. [4]Big Island Invasive Species Committee, Hilo, HI. [5]Conservation Council for Hawaii, Honolulu, HI

Track

IV. Putting Research into Management Practice

Abstract

Managing invasive species is key to protecting Hawaii's forested watersheds, agroecosystems, and unique biodiversity, and brings substantial ecological and economic benefits. Biocontrol, the use of living organisms to suppress populations of invasive species, is a management tool with a long history of success in Hawaii and the Pacific at protecting natural systems and agricultural production. Despite this, many people still have questions as to what exactly biocontrol is, whether it's safe, how the research is conducted, how it's regulated, and what the possibilities and limits of its use are in Hawaii. This forum will host a panel of researchers, educators, outreach professionals and land management experts who will address these questions. We will define types of biocontrol, describe how it is implemented, what success looks like, and how regulations have changed over time. Focus will be given to "classical" biocontrol and the use of host specific biological control agents or "natural enemies." Audience input through polls and questions is encouraged.

Agenda & Additional Required Information for Forums, Workshops, and Trainings

Agenda (Details May Change):

- Introductions. Audience polls on understanding and interest in biocontrol, guiding topics for discussion. Animated explainer video. (5-10 mins)
- Panel discussion: Intro to biocontrol, types of biocontrol, rules/regulations. (20-25 mins)
- Audience engagement/trivia section: Can you name a biocontrol from the past? (Trivia on past biocontrols, chat engagement) (5-10 mins)
- Panel discussion: Community Engagement, Implementation, Selection of Agents. Answer 1-2 questions as needed. (20 mins)
- Audience Engagement Section: Get to know your current biocontrols. Group name pronounciation, intro biology. (5-10 mins)
- Panel discussion: What is coming up in the future? Answer 1-2 questions from chat as needed. (10-15 mins)
- Open Question and Answer Period (30 mins).

Panelists:

Tracy Johnson Research Entomologist at USDA Forest Service Pacific Southwest Research Station

Darcy Oishi Biological Control Section Chief at Hawai'i Department of Agriculture

Mark Wright Professor of Entomology and Extension Specialist at University of Hawaii at Manoa.

Springer Kaye Program Manager at Big Island Invasive Species Committee

Steven Lee Montgomery Ph. D., Beekeeper and Volunteer Board Member, Conservation Council for Hawaii UH Manoa.

Moderator:

Andy Cullison Forest Health Planner at DLNR Division of Forestry and Wildlife

Goals: Increase general understanding of biocontrol and how it can be used in a conservation setting. Help demonstrate transparency of the process, and develop a more informed and educated conservation community that can more accurately describe biocontrol to the general public.

Target Audience: Conservation community at large, but more specifically those that may be skeptical or mistrustful, those that have only an entry understanding of biocontrol, and/or those who are curious about how it is implemented and what are the potentials of its use.

180

Indigenous Influence: Utilizing Traditional Knowledge and Practices to Influence Long-Term Management Actions for Papahānaumokuākea Marine National Monument

Hoku Kaaekuahiwi Pousima[1], Kalani Quiocho[2], Brad Wong[3]

[1]NOAA Fisheries, ʻAhuimanu, HI. [2]NOAA ONMS, Hilo, HI. [3]Office of Hawaiian Affairs, Kailua, HI

Track

I. Cultural Values and Practice in Conservation

Abstract

In 2008, the Papahānaumokuākea Marine National Monument Co-Trustee management agencies jointly published a Monument Management Plan (MMP), which affirmed their strong commitment to Native Hawaiians and their culture and the foundation for conducting the appropriate management of Papahānaumokuākea's natural and cultural resources through the Native Hawaiian Community Involvement Action Plan and the Native Hawaiian Culture and History Action Plan.

As an update to these action plans and what will serve as a foundation for management planning processes to come, the Mai Ka Pō Mai Native Hawaiian Guidance Document was published this year as a coordinated effort between the Native Hawaiian community and Monument management agencies. The document provides a comprehensive framework and strategies to guide the integration of traditional Hawaiian knowledge systems, values, and practices into all areas of management. While this type of information will be used to guide the day-to-day management of Papahānaumokuākea, the long-term goal is for these knowledge systems and values to impact the mindset and values of those who are tasked with providing oversight of the Monument.

The forum will showcase five projects that demonstrate how Native Hawaiian culture and knowledge is, or can be incorporated into the conservation and management of Papahānaumokuākea. These projects have informed the development of Mai Ka Pō Mai and look at management actions on a spectrum of how we currently incorporate traditional knowledge into management actions and how we plan to continue to do so.

Agenda & Additional Required Information for Forums, Workshops, and Trainings

AGENDA

(speakers names have been italicized in text)

1. **Welina/Welcome**

- Greeting: *Hōkū Kaʻaekuahiwi Pousima*; 1 min
- Opening Protocol - Puka mai ka lā: *Kalani Quiocho*; 5 min

Moderators will conduct a cultural briefing about protocol and the mele Puka Mai Ka lā to demonstrate how PMNM has integrated Hawaiian cultural protocols into the management of the Monument and to instruct forum participants on how to act and interact during this particular protocol.

2**. Hoʻokahua/Background**

- PMNM Overview Presentation: *Hōkū Kaʻaekuahiwi Pousima, Kalani Quiocho, Brad Kaʻaleleo Wong;* 5 min

Conducted in ʻŌlelo Hawaiʻi and English

- Voices of Papahānaumokuākea Video 1: *Uncle Isaac "Paka" Harp, Athline Clark*; 9 min

Share about the genealogy of PMNM to introduce the video and the beginnings of recent NWHI protections and context for speed talks

3. **Five-Minute Speed Talks**

- Mai Ka Pō Mai Overview Presentation: *Hoku Kaʻaekuahiwi Pousima, Kalani Quiocho, Brad Kaʻaleleo Wong;* 10 min

Present MKPM framework, highlight the 4 kūkulu and hoʻukuʻi using case studies, introduce Google Jamboard, and prompt participants to contribute to the Jamboard during speed talks.

- 1st Speed talk - Utilizing Traditional Ecological Knowledge and Western Science and Research Approaches to Address Climate Change Impacts in Papahānaumokuākea: *Haunani Kāne & Amanda Boyd; 5 min*

Powerpoint presentation with narrative

- 2nd Speed talk - Cultural Dimensions and Functions of Cultural Keystone Species: *Kirsten Leong & Kawika Winter;* 5 min

Powerpoint presentation with narrative

- 3rd Speed talk - Huli ʻIa Methodology; Integrating Traditional Observation Practices Into NWHI Field Camp Training and Operations: *Pelika Andrade, Michelle Barbieri Lino, & Liz Kashinsky*; 5 min

Powerpoint presentation with narrative

- 4th Speed talk - Native Hawaiian Cultural Working Group Nomenclature; Manu and Limu: *Hōkū Pihana, Hōkū Cody, and Randy Kosaki*; 5min

Powerpoint presentation with narrative

- 5th Speed talk - PMNM Native Hawaiian Practices Permit; Protecting Place to Perpetuate Practice: *Brad Kaʻaleleo Wong & Polynesian Voyaging Society; 5 min*

Powerpoint presentation with narrative

4. **Roundtable Sessions**

- Five Roundtable Sessions: Facilitated by Hoku Kaʻaekuahiwi Pousima; 25 min
    - Hoʻomana: Utilizing Traditional Ecological Knowledge & Western Science
    - Hōʻike: Cultural Dimensions Research
    - Hoʻokuʻi: Huli ʻIa
    - Hoʻoulu: CWG Nomenclature
    - Hoʻolaha: Protecting Place to Protect Practice

Breakout rooms facilitated through Google Jamboard

Introductions to Google Jamboard

Potential Discussion Questions:

- What are the opportunities to implement Mai Ka Pō Mai for Papahānaumokuākea?
- What kinds of impacts would these opportunities have?
- What does long-term impact look like with relation to management?

5. **Roundtable Highlights & Closing Remarks**

- Voices of Papahānaumokuākea Video 2: *author*; 7 min
- Roundtable Highlights, Q&A, Closing Protocol (Mele no Papahānaumokuākea): *Hōkū Ka'aekuahiwi Pousima, Roundtable Moderators*; 30 min

Facilitated panel discussion with Roundtable moderators

Prompt participants to ask questions and continue to contribute to the Jamboard

Roundtable moderators will provide highlights from the group discussions

Description of innovative audience engagement techniques

The forum will be a structured presentation format that utilizes innovative facilitation methods such as an interactive cultural protocol, bi-lingual ʻŌlelo and English interpretation, short videos, five-minute speed talks by five presenters, five simultaneous roundtable discussions, and a facilitated panel discussion. We plan to use Google Jamboard, which is an interactive whiteboard system, to capture audience contributions during the five roundtable discussions and throughout the forum. The forum is proposed as a 2 hour time block, and includes audience participation that accounts for more than 25% of the time.

Explanation of Goals and Target Audience

The session goals are to share the Mai Ka Pō Mai Native Hawaiian Guidance Document for the management of Papahānaumokuākea Marine National Monument through case studies and to receive feedback from participants about the Mai Ka Pō Mai Native Hawaiian Guidance Document. The Mai Ka Pō Mai Guidance Document for Papahānaumokuākea was meant for managers, researchers, and other partners who help to manage and steward Papahānaumokuākea. The intended audience for the forum is anyone interested in Papahānaumokuākea. This may be Native Hawaiian community members, cultural and natural resource managers, researchers, or people who want to learn more.

181

State and Federal Management of Endangered Species in Hawai‘i; What’s Law Got to Do with It?

Maxx Phillips

Center for Biological Diversity, Honolulu, HI

Track

II. Capacity in Conservation

Abstract

We are in an era of unprecedented challenges for wildlife in Hawai‘i, with species facing relentless pressure from habitat destruction, accelerating climate change, invasive species, and numerous other stressors. Amid an extinction crisis, past administrations have moved to weaken protections of the Endangered Species Act, restricting funding, and pushing for states to take over management of endangered species. In this context, it is critical to examine how well our nation’s wildlife management systems are working to recover endangered species at the federal and state level, including addressing long-standing critiques of the Endangered Species Act. This presentation will evaluate the current status of endangered species management in Hawai‘i, looking at the interplay of management regimes, budgetary challenges, efficacy, and recommendations for improvement. At the federal level, the Endangered Species Act’s success in achieving its core purpose of preventing extinctions and recovering imperiled species will be examined. At the state level, we evaluate the state’s preparedness to manage the responsibility of recovering Hawai‘i’s imperiled species, assessing Hawai‘i’s legal and regulatory authority and use of science-based decision-making. The effectiveness of state versus federal endangered species management will be presented. Recommendation for improvements, such as increased interdisciplinary connections, appropriate funding, adherence to the precautionary principle, and ecosystem based management approaches, will be explored.

182

Expanding Rapid ‘Ōhi‘a Death Monitoring Efforts via High-Resolution Satellite Imagery

Ryan Perroy[1], Timo Sullivan[1], Eszter Collier[1], Brian Tucker[2], William Stormont[3], Dustin Swan[4]

[1]University of Hawai‘i at Hilo, Hilo, HI. [2]Pacific Cooperative Studies Unit, Hilo, HI. [3]Division of Forestry and Wildlife, Hilo, HI. [4]Big Island Invasive Species Committee, Hilo, HI

Track

V. New Technologies in Conservation Research and Management

Abstract

Aerial remote sensing has made valuable contributions to the broader effort to better understand and manage native forest impacts related to Rapid ʻŌhiʻa Death across Hawaiʻi, but limited spatial coverages (100s to 10,000s of acres) and/or lengthy or unpredictable return intervals associated with resource and technical constraints have precluded its use for systematic and regular monitoring on an island- or statewide scale. In contrast, most available satellite remote sensing platforms provide regular imagery with much greater spatial coverages (up to millions of acres) but lack the spatial resolution necessary to identify individual trees and therefore have limited utility in identifying early outbreaks in isolated ʻōhiʻa lehua (*Metrosideros polymorpha*), one example of a management need. Recently, in collaboration with federal partners and with funding from the National Geospatial Agency and National Reconnaissance Office, we have gained access to regular satellite imagery over Hawaiʻi with a spatial resolution <0.5 m, fine enough to identify individual trees. This talk will highlight examples of how we are incorporating this imagery into ongoing remote sensing efforts: greatly expanding monitoring areas, filling in time-series analysis gaps, supplementing digital mobile sketch mapping surveys, and identifying new and expanding outbreaks. Persistent cloud cover and limited imagery availability present major challenges in some locations, but we see high-resolution satellite imagery playing an important role in developing a more systematic and cost-effective statewide Rapid ʻŌhiʻa Death monitoring program.

183

Biodiversity Conservation Pilot Project

Rose-Liza Eisma-Osorio[1,2], Jonathan Liljeblad[3], David Forman[4]

[1]University of Cebu School of Law, Cebu, Philippines. [2]IUCN Academy of Environmental Law, Bethesda, Maryland. [3]Australia National University College of Law, Canberra, Australia. [4]Environmental Law Program, William S. Richardson School of Law, University of Hawai'i at Mānoa, Honolulu, HI

Track

III. Global and Regional Change & Challenges

Abstract

Students from the University of Hawaiʻi's William S. Richardson School of Law, in collaboration with students at the University of Cebu School of Law (Philippines) and undergraduate students at Australian National University (Canberra), are analyzing domestic implementation efforts under the Convention on International Trade of Endangered Species (CITES). CITES is considered one of the world's most powerful tools for biodiversity conservation, providing a framework for regulating trade in wild fauna and flora, but leaving it up to each nation to implement treaty obligations through domestic legislation. The pilot collaborative project involving UH/UC/ANU students and faculty focuses on the Philippines' implementation of CITES, specifically with regards to seahorses, sea cucumbers, pangolins, coral, and sharks. We are in the process of identifying potential gaps between the CITES framework and actual domestic law, evaluating the efficacy of implementation efforts and any resulting implications for the endangered species. If successful, we hope to expand our inquiry to Pacific Island nations (and, later,

other nations bordering the Pacific Ocean) in addition to recruiting graduate and undergraduate disciplines other than law to make this a truly interdisciplinary initiative going forward.

Agenda & Additional Required Information for Forums, Workshops, and Trainings

* Description of Pilot Project formation & methodology

* Audience participation – testing knowledge (or guesses) about international trade involving seahorses, sea cucumbers, pangolins, coral, and sharks.

* Presentation of Results as reported to the IUCN World Conservation on Environmental Law, and IUCN Academy of Environmental Law

* Reflections on the benefits of this collaborative approach by students and professors

* Audience input – seeking recommendations, if any, for necessary changes to project methodology

* Recruitment pitch for future interdisciplinary participants

* Speakers: (1) Professor Rose-Liza Eisma-Osorio, University of Cebu School of Law, Chair, IUCN Academy of Environmental Law; (2) Professor Jonathan Liljeblad (indigenous, from Myanmar – fled to Sweden in his youth), Australian National University College of Law; (3) David M. Forman, Director, Environmental Law Program, William S. Richardson School of Law, University of Hawai'i at Mānoa; (4) multiple students from UC/ANU/UH to be determined.

184

Statewide Rapid `Ohi`a Death Surveillance and Monitoring 2020 Summary

Brian Tucker[1], Rob Hauff[2]

[1]University of Hawai'i - Pacific Cooperative Studies Unit, Hilo, HI. [2]DLNR Div. of Forestry and Wildlife, Honolulu, HI

Track

II. Capacity in Conservation

Abstract

Across the state, Rapid `Ōhi`a Death (ROD) surveillance and monitoring efforts continue to be led with utilization of USDA Forest Service-developed Digital Mobile Sketch Mapping (DMSM) technology, with

trained staff using handheld tablets for digital mapping aboard helicopters. The technology allows mappers to denote points or polygons and assigns each a set of attributes for recordation. This data is then shared through ArcGIS Online for subsequent analysis and is key to ongoing early detection and rapid response effort on all islands. This presentation summarizes statewide DMSM efforts over the course of calendar 2020, by island, including hours flown, flight lines, acres covered. DMSM surveys are one method of a multi-tiered approach to statewide ROD surveillance and monitoring. This presentation includes how this relates to other aerial survey methods, such as helicopter-mounted cameras and drone surveys, and how the combination of these methods support on-the-ground management actions.

185

Nā Pana ʻĀina: Biocultural Resource Management Through Stories of Place

Pōmaikaʻi Kaniʻaupiʻo-Crozier[1], Kainoa Pestana[1], Kanoelani Steward[2], Puaʻala Pascua[3], Natalie Kurashima[4]

[1]Puʻu Kukui Watershed Partnership, Lahaina, HI. [2]Ka Malu o Kahālāwai, Lahaina, HI. [3]Ahupuaʻa Accelerator Initiative, Keaʻau, HI. [4]Kamehameha Schools, Kailua Kona, HI

Track

VI. Place-based Conservation

Abstract

I ka huliau - the changing tides experienced over the past year have highlighted the need for localized and community-based conservation solutions in Hawaiʻi given COVID-19's widespread disruptions to institutional systems of management. This time has demonstrated, perhaps more clearly than ever, that place-based knowledge and practice are critical to maintaining and supporting island conservation, biocultural resource management, and thriving human and natural systems. Increased virtual engagement has enabled us to not only talk about, but to actually show the important places and practices central to our stewardship efforts. In this forum, participants are invited to "meet" at Mauna Kahālāwai, Maui and experience the Puʻu Kukui Watershed through the eyes of two stewardship practitioners nourished by that ʻāina alongside their interns, the next generation of Maui conservation stewards. Our innovative engagement techniques will combine kūkā kamaʻilio (discussion), ʻōlelo pālua (bilingual, Hawaiian and English language), and virtual interactive software in place, as our presenters share the lands and waters that feed them together with innovative tools and approaches that enable and support improved conservation outcomes in their place. Part of the session will take place at Mauna Kahālāwai, giving the audience an unique virtual huakaʻi (trip) on ʻāina with our knowledgeable hosts Through this unique format, we aim to facilitate a meaningful virtual exchange that will identify themes and commonalities in place-based knowledge and practice on adaptation, restoration, and transformation during changing times.

Agenda & Additional Required Information for Forums, Workshops, and Trainings

Agenda:

10 min - Welcome remarks, session overview

60 min - Virtual huakaʻi and kūkā kamaʻilio between presenters at Mauna Kahālāwai, Maui, with moderated audience interaction via virtual interactive software (e.g., Mentimeter, Padlet, etc)

40 min - Moderated discussion (presenters + audience) on approaches that enable and support improved conservation outcomes in their place (using breakout group software, as feasible)

10 min - Closing remarks, exit survey

Guest Presenters:

Pōmaikaʻi Kaniʻaupiʻo-Crozier, Puʻu Kukui Watershed Partnership

Kainoa Pestana, Puʻu Kukui Watershed Partnership

Kalamaʻehu Takahashi, 2020 Puʻu Kukui Watershed Intern, UH Mānoa Graduate Student

Kainalu Steward, 2020 Puʻu Kukui Watershed Intern, UH Hilo Graduate Student

Innovative Engagement Techniques:

Virtual huakaʻi (trip) format

Virtual polling/discussion tools (e.g., Mentimeter, Padlet, etc)

Goals: To facilitate a meaningful virtual exchange that will identify themes and commonalities in place-based knowledge and practice on adaptation, restoration, and transformation during changing times.

Target Audience: Resource managers, researchers, community members, cultural practitioners, and others interested in place-based adaptation and resilience

186

Challenges and Necessary Actions for Youth Engagement in Hawaiʻi

Jessica Faith Lee

Stanford University, Palo Alto, CA. [Virtual student], Los Angeles, CA

Track

III. Global and Regional Change & Challenges

Abstract

In the midst of growing discussion and concern regarding environmental issues, the youth perspective is frequently overlooked. Like far too many youth—who stand to inherit the Earth--I have felt helpless sitting in science classes learning about climate change's horrific consequences and watching indifferent politicians on TV, while lacking the resources necessary to enact change myself. Presented with the opportunity to attend the International Union for Conservation of Nature (IUCN)'s Global Youth Summit and the IUCN World Conservation Congress (WCC) as a part of the Environmental Law Program delegation, I hope to learn from other youth and contribute to policy-based action. Approved Motion 076 acknowledges—on an international scale—the need for both youth awareness of environmental issues and their contributions in solving them. What effects does this motion bear, if any, for youth in Hawai'i? How can we ensure effective implementation of this motion's goals on a local scale? How can we increase outreach to local youth about the opportunities that do exist for them to take action? In short, how can Hawai'i youth best take advantage of this international motion to empower youth engagement and take needed action against environmental issues? I certainly do not have all the answers, but this presentation's five-minute speed talk format will provide an environment in which we can learn from each other and the unique experiences we bring to the table ... perhaps inspiring others to help brainstorm innovative solutions and ideas pertaining to youth engagement in Hawai'i.

187

Downlisting of Nēnē: The Outcome of Research Based Management

Cathleen Bailey[1], Annie Marshall[2], Paul Banko[3], Stephanie Franklin[4], Darcy Hu[5], Steve Kendall[6], Bryce Masuda[7], Raymond McGuire[8], John Medeiros[4], Kathleen Misajon[5], Joy Tamayose[1], Kim Uyehara[9], Donna Ball[6], Clay Chow[10], Charlotte Forbes-Perry[11], Thomas Kaiakakapu[10], Sierra McDaniel[11], Joey Mello[8], Jason Misaki[12], Afsheen Siddiqi[12], Kanalu Sproat[8]

[1]Haleakalā National Park, Kula, HI. [2]US Fish and Wildlife Service, Ecological Services, Honolulu, HI. [3]US Geological Survey, Pacific Island Ecosystems Research Center, Hawaii National Park, HI. [4]Hawai'i Division of Forestry and Wildlife, Kahului, HI. [5]National Park Service, Hawaii National Park, HI. [6]Hakalau Forest National Wildlife Refuge, Hilo, HI. [7]Hawai'i Endangered Bird Conservation Program, San Diego Zoo Global, Volcano, HI. [8]Hawai'i Division of Forestry and Wildlife, Hilo, HI. [9]Kaua'i National Wildlife Refuge Complex, Kīlauea, HI. [10]Hawai'i Division of Forestry and Wildlife, Lihue, HI. [11]Hawai'i Volcanoes National Park, Hawaii National Park, HI. [12]Hawai'i Division of Forestry and Wildlife, Honolulu, HI

Track

IV. Putting Research into Management Practice

Abstract

Nēnē (Hawaiian Goose, *Branta sandvicensis*), the state bird of Hawai‘i, faced imminent extinction in the 1940s. To recover the species, the Nēnē Restoration Program (NRP) was initiated in 1949 by the State of Hawai‘i and the U.S. Fish and Wildlife Service to breed and release birds through a conservation breeding program. In 1950, the global population was estimated at only 30 wild individuals. In 1967, nēnē were added to the federal Endangered Species list with approximately 240 birds on Hawai‘i Island and 39 on Maui. Birds were released through the NRP until the early 1980s. In the early 1990s, the Nene Recovery Action Group (NRAG) formed as an *ad hoc* group to discuss and implement research and practical management actions to recover nēnē in the wild. Since then, research and management actions implemented by various agencies and private organizations helped increase the population to 3,500 wild individuals on four islands in 2019. Nēnē were federally downlisted from Endangered to Threatened in December 2019 and remains Endangered by the State of Hawai‘i. Since the beginning of the NRP and the formation of the NRAG, researchers and biologists collected and analyzed data on the species that contributed to the decision to downlist the species. This included information on population status and trends, threats, releases, movement, and management actions. We present this information as well as identify future research and management necessary to ensure the continued success and survival of this iconic species.

188

Analysis of Genomic Sequence Data Reveals the Origin and Evolutionary Separation of Hawaiian Hoary Bat Populations

Corinna A. Pinzari[1], Lin Kang[2,3], Pawel Michalak[2,4], Lars S. Jermiin[5,6], Donald K. Price[7], Frank J. Bonaccorso[8]

[1]Hawai‘i Cooperative Studies Unit, University of Hawai‘i at Hilo, Hilo, Hawai‘i. [2]Edward Via College of Osteopathic Medicine, Blacksburg, Virginia. [3]Department of Biomedical Sciences and Pathobiology, Virginia-Maryland College of Veterinary Medicine, Blacksburg, Virginia. [4]Center for One Health Research, Virginia-Maryland College of Veterinary Medicine, Blacksburg, Virginia. [5]Research School of Biology, Australian National University, Acton, Australia. [6]School of Biology & Environmental Science, University College Dublin, Dublin, Ireland. [7]School of Life Sciences, University of Nevada, Las Vegas, Nevada. [8]U.S. Geological Survey, Pacific Island Ecosystems Research Center, Hawai‘i National Park, Hawai‘i

Track

V. New Technologies in Conservation Research and Management

Abstract

We examined the genetic history and population status of endemic ʻŌpeʻapeʻa, or Hawaiian hoary bat (*Lasiurus semotus*), the most isolated chiropteran species on Earth, and their relationship to North American hoary bats (*L. cinereus)* through whole-genome analysis of single-nucleotide polymorphisms (SNPs) mapped to a de novo-assembled reference genome. Profiles of genomic diversity and divergence indicate that Hawaiian hoary bats are distinct from North American hoary bats, and form a monophyletic group, indicating a single ancestral colonization event 1.34 million years ago, followed by substantial divergence between islands beginning 0.51 million years ago. Phylogenetic analysis indicates the island of Maui was central to the radiation across the archipelago, with the southward expansion to Hawaiʻi island and westward to Oʻahu and Kauaʻi islands. An evaluation of SNPs demonstrated that bat subpopulations are also genetically unique on each of the four islands sampled. Because this endangered species is of conservation concern and difficult to census, a clearer understanding of the population genetic structure and genomic diversity of ʻŌpeʻapeʻa is of timely importance to federal and state agencies tasked with balancing the demands of sustainable energy and wildlife conservation in Hawaiʻi.

189

Moving Mauka – Progress and Promise of Community-Based Subsistence Forest Areas

Rebekah Ohara[1], Katie Kamelamela[1], Kathryn Stanaway[2], Hannah Kihalani Springer[3], Ku'ulei Keakealani[4], Kauluwehi Ching[5]

[1]Akaka Foundation for Tropical Forests, Hilo, Hawai'i. [2]Department of Land and Natural Resources, Honolulu, Hawai'i. [3]Kamaʻāina of Kaʻūpūlehu, Kekaha, Kona ʻĀkau, Hawaiʻi, Kona, Hawai'i. [4]Kamaʻāina of Pu'uanahulu, Kekaha, Kona ʻĀkau, Hawaiʻi, Kona, Hawai'i. [5]uluching@gmail.com, Kona, Hawai'i

Track

I. Cultural Values and Practice in Conservation

Abstract

Community-Based Subsistence Fisheries Areas (CBSFA) have made important progress in engaging stewardship issues that affect both reef ecosystems of Hawaiʻi's near shore areas and the communities that rely on these coastal systems. In the past decade there have been important milestones achieved by Hawaiʻi's CBSFA. Since 2017, there has been a growing interest in applying the CBSFA approach to state administered lands, including the piloting of a Community Based Subsistence Forest Area model. The recently formed Puʻuwaʻawaʻa Community-Based Subsistence Forest Area (P-CBSFA) formally recognizes: "the mutual benefit to ʻāina and kānaka when kānaka gather to aloha and mālama the ʻāina; that achieving this outcome requires coordination, cooperation, and shared understanding; and that the strength of our work arises from our collective voice." Based on these starting conditions, the P-CBSFA envisions a vibrant and engaged kaiāulu applying skills,service, and aloha to maintain presence and productivity on this ʻāina aloha of Puʻuwaʻawaʻa, in cooperation with our hoaloha from public and private agencies. And so this forum will provide: (*i*) a broad overview of community-based forest stewardship examples and opportunities; (*ii*) an examination of progress and

lessons learned by the P-CBSFA; (*iii*) a detailed set of insights supporting a Community Based Subsistence Forest Area approach; and (*iv*) a participant focused discussion engaging observed and potential obstacles to the formation of new terrestrial Community Based Subsistence Forest Areas, but also their promise for addressing stewardship challenges that threaten communities and ecosystems.

Agenda & Additional Required Information for Forums, Workshops, and Trainings

Agenda & list of speakers for a *one-hour session*

Overview and introduction to Community-Based Forest Stewardship in Hawai'i. Rebekah Ohara *15 mins*

Pu'uwa'awa'a Community-Based Subsistence Forest Area – lessons learned and moving forward. Katie Kamelamela *15 mins*

Legal considerations for terrestrial CBSFAs. Kathryn Stanaway *15 mins*

Facilitated Panel – Audience engagement *15 mins*

To make the panel-audience discussion valuable, we will rely on real time polling, two carefully structured questions (obstacles and promise), ask audience to comment on speaker answers and to offer perspectives, and finally to produce a synthesis of the dialogue for the Community Subcommittee of the HCA. This forum seeks to reach the broad range of participants now attending the HCC including researchers but also resource professionals, leaders, and community members who often are most familiar with local resource condition. Our goal is to provide insights into how the CBSFA process can be applied to terrestrial environments, while identifying opportunities for collaboration or community resources and needs.

190

'Ike Kūpuna o Kona (The knowledge of the elders of Kona)

Rebecca Most[1], Hannah Springer[2], Chuckie Leslie[3], Krista Johnson[4], Ku'ulei Keakealani[5], Kaimi Kaupiko[6]

[1]The Nature Conservancy, Kapaau, Hawaii. [2]Ka'ūpūlehu Marine Life Advisory Committee, Kailua-Kona, Hawaii. [3]Napoopoo fisher, Kealakekua, Hawaii. [4]Napoopoo fisher ohana, Kealakekua, Hawaii. [5]Hui Aloha Kīholo, Kamuela, Hawaii. [6]Kalanihale, Milolii, Hawaii

Track

I. Cultural Values and Practice in Conservation

Abstract

In 2013, fifteen communities in West Hawai‘i established the regional Kai Kuleana network, that aims to support one another in the perpetuation of traditional practices through active stewardship, capacity building, and place-based management that is intimately connected with the kai (sea). The traditions and values that guide these community stewardship practices include: kuleana (responsibility), lōkahi (unity), ho’omau (perpetuation), and ho’omanawanui (perseverance). These values are applied through place-based management approaches, which strengthens and builds collective momentum by integrating traditional practices and cultural values with the tools and techniques of modern resource management. This has allowed Kai Kuleana members to build support for sustainable fisheries policy, community engagement in conservation initiatives, effective collaborations and co-management with government agencies, and increased dialogue amongst members to overcome challenges together. Much of the success of this approach is perpetuated by the ‘ike (knowledge) of the kūpuna (elders) of this region, who guide stewardship initiatives while grounding activities in the concept of huliau (to think of the past). The Kai Kuleana forum will elevate the ‘ike kūpuna by engaging the audience with a knowledge sharing activity about ‘ōpelu net making. The activity will include teaching the parts of the ‘ōpelu net, and how they relate to the parts of the human body, and relationships with body part names instills the importance and function of each part of the net. This interactive forum aims to inspire and perpetuate these practices and highlight the ‘ike kūpuna that has shaped conservation initiatives through the network.

Agenda & Additional Required Information for Forums, Workshops, and Trainings

Agenda (1 hour forum):

10 min - Introduction of the Kai Kuleana network and presenters

30 min - Presentations by Kai Kuleana members (7minutes each)- share kūpuna knowledge about fishing traditions in their community

15 min - ‘Ōpelu Net Activity

5 min - Closing

191

The Laukahi Network: A Collaborative Approach to Implementing the Hawai‘i Strategy for Plant Conservation

Emily Grave

Laukahi: The Hawai‘i Plant Conservation Network, Honolulu, Hawai‘i

Track

II. Capacity in Conservation

Abstract

Goals to conserve global biodiversity are achieved when local efforts coalesce around specific measurable objectives. The Laukahi Network is implementing the Hawai‘i Strategy for Plant Conservation (HSPC) following the framework of the Global Strategy for Plant Conservation and adopting the targets most relevant to our needs.

Both Strategies set targets for *in situ* protection and *ex situ* collections. Other important metrics around cultural integration, outreach, scientific research, and workforce capacity were revised in the HSPC to follow Hawai‘i’s urgent needs around protecting native plants. Measuring how we met these targets in 2020 shows tremendous local progress compared with global and national trends. The HSPC also identified gaps where Laukahi’s partners have since expanded their research and services to fill. Following a brief introduction and update on Laukahi’s targets, the forum will feature examples of how our partners were inspired to fill those gaps, then discuss a post-2020 framework for our targets.

Laukahi is seeking community guidance on ‘cross-walking’ our targets with other successful initiatives (Aloha+ Challenge, U.N. Sustainable Development Goals, Convention on Biological Diversity). *Which these frameworks resonate most with local efforts to conserve native plants? How can we transform the inspiration that comes from setting global goals into the local capacity to reach them?*

This forum will resonate with a wide audience seeking to inspire change. If Laukahi can connect global goals for sustainability and integrating traditional knowledge into conservation practice, with local needs to restore native plants, we will obtain the collaboration and support we urgently need.

Agenda & Additional Required Information for Forums, Workshops, and Trainings

Agenda:

Emily Grave (Laukahi Network Coordinator) – 10 min

Tim Gallaher (Curator of Botany – Bernice Pauahi Bishop Museum) – 7 min

Tamara Sherrill (Executive Director – Maui Nui Botanic Garden) – 7 min

Devon Gordon (Botanical Support Technician – Lyon Arboretum) – 7 min

Abby Meyer (Executive Director – Botanic Gardens Conservation International) – 7 min

Emily Grave (Transition to discussion) – 5 min

15-17 min discussion with audience

Goals/Target audience:

Laukahi is trying to maintain support with grassroots practitioners and trying to represent the community. This conference is a good opportunity to gain some better insight, especially with everything changing so much. We want to reach out to emerging professionals and make connections for young people who are doing the work, and who are interested in understanding how they fit into the global picture. If a person is setting rat traps all day, how are they helping on a global scale? We want to connect everyday work to these larger, global frameworks while finding new, young, or emerging professionals to diversify our audience. We are trying to determine what part of these outreach messages are impactful to the young audience because we want to better serve that community.

Engagement:

Laukahi is hoping an interactive poll option will be available on the chosen platform for audience participation. We will predetermine a set of questions to 1) engage the audience, and 2) understand what is described above. Then, we will display the results live (if possible). If that is not an option, we will still ask these questions, but the audience may reply via the Q/A function or the Chat function. If live questions can be asked, we invite those as well! Following the Conference, Laukahi will post the poll results on its website.

192

A Screening System to Predict Wildfire Risk of Invasive Plants

Kevin Faccenda, Curt Daehler

University of Hawai'i, Honolulu, HI

Track

V. New Technologies in Conservation Research and Management

Abstract

In Hawai'i invasive plant fueled wildfires continue to be one of the most important issues facing managers in dry and seasonally dry areas. The plant species fueling these fires are likely to continue to change as new invasive species are transported to, and existing species are spread throughout the islands. We designed a screening system similar to weed risk assessments, but specifically assessing whether a species can increase ecosystem fire risk. We searched the scientific literature and online databases for a variety of plant traits associated with flammability for over 300 species of invasive plants and surveyed land managers across the state to obtain expert fire risk scores for 49 species which are already widely distributed. The expert scores were used to train a random forest machine learning model, and the model was then used to predict fire risk scores for other species. The model revealed four variables that can predict which species pose a higher fire risk with 90% accuracy, and low risk with 79% accuracy. We demonstrate the screening system by evaluating all species which have naturalized in Hawai'i over the past 10 years and found 8 species of concern. We will also provide a website containing our model as well as all assessments completed to date.

193

Integrating Place-Based Socio-Cultural Values into Marine Management in Hawai'i

Meghan Tait[1], Edward "Luna" Kekoa[2]

[1]University of Hawai'i at Mānoa, Honolulu, HI. [2]Department of Land and Natural Resources, Division of Aquatic Resources, Honolulu, HI

Track

IV. Putting Research into Management Practice

Abstract

Communities around the world rely on marine ecosystems for food, livelihoods, and relationships among people and places. Therefore, social connections and cultural practices are an integral part of marine management. Despite peoples' connections to marine ecosystems, social and cultural considerations are often left out of management strategies. The agency responsible for marine management in Hawai'i, the Department of Land and Natural Resources, Division of Aquatic Resources (DAR), is working towards a goal to effectively manage Hawai'i's nearshore waters with 30% established as marine management areas (MMAs) by 2030. In collaboration with DAR, this research will summarize social and cultural principles and indicators to be used in MMA planning and monitoring. Four community workshops were conducted in April and May 2021 to identify socio-cultural values by asking participants about their reciprocal relationships with nearshore areas in Hawai'i. Participants were asked to group the values they identified, forming principles upon which MMAs will be designed and evaluated. They were also be asked how the values can be measured and worked together to form indicators that will be used to monitor marine areas. Each workshop focused on a specific island (e.g. O'ahu) or set of islands (e.g. Maui Nui) in order to identify both place-based principles and indicators and those that are consistent across the main Hawaiian islands. Planning and monitoring based on communities' socio-cultural values will increase the effectiveness of management strategies, helping DAR to reach their 30x30 goal, while contributing to the wellbeing and connection of communities and ecosystems.

194

Climate Change Funding and Federal Directions Under the Biden Administration

Mari-Vaughn Johnson[1], Darcy Yogi[2], Heather Kerkering[2], Jeff Burgett[3], Laura Brewington[4], Christian Giardina[5], Caitriana Steele[6], John Marra[7]

[1]Pacific Islands Climate Adaptation Science Center, Hilo, HI. [2]Pacific Islands Climate Adaptation Science Center, Honolulu, HI. [3]U.S. Fish and Wildlife Service, Honolulu, HI. [4]NOAA Pacific Regional Sciences and Assessments, Honolulu, HI. [5]U.S. Department of Agriculture Forest Service, Hilo, HI. [6]U.S. Department of

Agriculture Southwest Climate Hub, Las Cruces, NM. [7]National Oceanic and Atmospheric Administration Regional Climate Services, Honolulu, HI

Track

III. Global and Regional Change & Challenges

Abstract

Global climate change is a driving force for accelerating land and seascape change and therefore social change. As in other regions, in Hawaii and the Pacific Region, there is a significant need for integrated planning across conservation efforts to address climate change related challenges confronting the region's unique ecosystems, rich island communities and cultures, and diverse topographies. The Biden-Harris Administration has made new strong commitments to tackle climate change in a whole-of-government effort, making it even more essential that our regional entities capitalize on this influx of monies and interest to address climate change challenges. This forum provides an interactive platform for Federal Agencies committed to science based solutions to climate change challenges to interface with stakeholders who share our concerns. There will be opportunities to learn about changes in climate change funding and direction under the current administration as well as to share outstanding needs related to climate change science. The socio-ecological diversity in our region, alongside our commitment to principles of justice, equity, diversity, and inclusion in problem solving, makes the region a representative site for other locations globally to learn from in order to work towards adaptation and resiliency in a changing climate. It is our hope this forum will also enable federal entities to demonstrate what effective interagency and community engagement around shared challenges can achieve.

Agenda & Additional Required Information for Forums, Workshops, and Trainings

Agenda & list of speakers: Would like to request for 2 hour session

Intro by Pacific Islands Climate Adaptation Science Center – Mari-Vaughn Johnson

Limit to 10 mins

Science Partners Panel

Limit to 45 mins if 1 hour and 1hr15min if 2 hours

- NOAA Pacific Regional Sciences and Assessments – Laura Brewington
- U.S. Department of Agriculture Climate Hub – Caitriana Steele
- National Oceanic and Atmospheric Administration Regional Climate Services – John Marra
- U.S. Fish and Wildlife Service Science Applications – Jeff Burgett
- U.S. Forest Service – Christian Giardina
- Pacific Islands Climate Adaptation Science Center – Mari-Vaughn Johnson

Post-panel activity - Heather Kerkering and Darcy Yogi

Limit to 15-30 mins depending on forum length

- Menti polling activity
- Panel and audience feedback for later shareable synthesis product

Description of innovative audience engagement techniques:

- Polling on conference platform throughout event - open-ended questions, ranking, agree/disagree type polls
- Ask audience to comment on panelists answers or to offer their perspectives
- Ask audience to answer questions in the chat (can be same Q posed to panel)
- Provide relevant resources throughout panel provided by panelists
- Provide synthesis type downloadable for participants to leave with

Explanation of goals and target audience:

This event is intended for: researchers, resource managers, officials, and stakeholders working on climate change impacts and adaptation for ecosystems and communities in Hawai‘i and the U.S. Affiliated Pacific Islands. The goal of this forum is to demonstrate leadership around climate change coordination in the Pacific Islands region. The intent is to convene local leaders in National climate science and adaptation efforts to bring awareness of where we are now and where we are headed in climate adaptation science and management. This would provide opportunity for audience to see where they can find and/or collaborate for research, management, or community resources and needs.

195

Resilience and vulnerability of Hawaiian cryptic reef sponges in a changing climate

Jan Vicente[1], Maryann Webb[1], Molly Timmers[2], Kathryn Van Artsdalen[3], Christopher Jury[1], Keisha Bahr[4], Robert Toonen[1]

[1]Hawaii Institute of Marine Biology, Kaneohe, HI. [2]Joint Institute for Marine and Atmospheric Research, Honolulu, HI. [3]University of California San Diego, San Diego, CA. [4]Texas A & M University, Corpus Christi, Texas

Track

III. Global and Regional Change & Challenges

Abstract

Predicting the impact of future oceanic acidification and rising temperatures on coral reef biodiversity is essential for implementing effective management strategies of vulnerable species. The cryptic fauna embedded within the reef framework is of particular importance as it harbors most of the biodiversity in coral reef communities. Sponges (Porifera) dominate in these cryptic communities, providing important nutrients which help fuel and sustain biodiversity of coral reef ecosystems. In this two-year study, we monitored settlement and survivorship of cryptic sponges in Kāne‘ohe Bay by deploying standardized

sampling units in experimental tanks, which simulated ocean acidification and ocean warming expected by the end of the century. Sampling units were recovered every two months during the two year period, resulting in over 400 sponge subsamples collected and a richness of ~100 species. The highest diversity was observed among Demosponges (70 %), followed by Calcarea (25 %) and Homoscleromorpha (5 %). Surprisingly, neither ocean warming, nor acidification affected the diversity or abundance of calcifying sponge species. Nevertheless, acidification significantly decreased diversity of non-calcifying sponges by 2.5 species. Among non-calcifying sponges, Homoscleromorpha were completely non-existent in the acidified treatment and diversity significantly decreased in the combined acidified and warming treatment. Our study highlights an unprecedented loss of undescribed sponge species due to increasing ocean acidification. Efforts to formally describe the diversity of these important, yet fragile communities are essential to better understand and predict the loss of diversity in a changing climate.

196

ʻŌpeʻapeʻa in Numbers: A Morphometric and Demographic Update From Over Two Years of Hawaiian Hoary Bat Captures

Julia Hoeh[1], Aaron Aguirre[1], Sean Casler[1], Karen Courtot[1], Kristina Montoya-Aiona[1], Corinna Pinzari[2], Marcos Gorresen[2]

[1]U.S. Geological Survey, Pacific Island Ecosystems Research Center, Volcano, HI. [2]Hawaiʻi Cooperative Studies Unit, University of Hawaiʻi at Hilo, Hilo, HI

Track

IV. Putting Research into Management Practice

Abstract

ʻŌpeʻapeʻa (Hawaiian hoary bat, *Lasiurus semotus*) is culturally and biologically important as the only native terrestrial mammal in Hawaiʻi. Much of the current morphometric and demographic information used to inform management guidance and decision-making comes from small sample sizes or is assumed similar to the related North American species (*Lasiurus cinereus*). As part of a broader on-going research effort, we captured bats on Hawaiʻi Island using mist nets year-round from May 2018–February 2021. We documented age, sex, reproductive condition, forearm length, and mass of bats captured at sites from 33–1,784 m elevation. Our efforts resulted in the capture of 112 unique individuals, with 8 individuals captured at least twice. We captured 84 males with adults weighing 13–20 g and forearm lengths of 45.8–51.1 mm. We captured 28 females with adults weighing 16–21 g and forearm lengths of 49.7–53.2 mm. Visibly pregnant females were captured during June and weighed 24–25 g. Bat captures occurred in every month of the year with more males captured in the winter months (January–March) and more females capture in summer months (June–September). Conservation work depends on fundamental knowledge (e.g. average size, timing of reproduction) to develop meaningful guidance and markers of success. This dataset provides a more comprehensive picture of ʻōpeʻapeʻa, a better

understanding of the biology of the bats, and can aid in transforming the way we do conservation by looking to our night skies to inform management practice and research efforts.

197

Pilina perspectives from Ka Loko o Kīholo

Lehua Kamaka[1], Rebecca Most[2]

[1]Hui Aloha Kīholo, Kailua-Kona, Hawaii. [2]The Nature Conservancy, Kapaau, Hawaii

Track

I. Cultural Values and Practice in Conservation

Abstract

At Ka Loko o Kīholo (North Kona, Hawai‘i Island), kia‘i loko (fishpond stewards) with The Nature Conservancy and Hui Aloha Kīholo are working together to restore fish abundance for food security and habitat health. Throughout the restoration process, the kia‘i loko have been strengthening their understanding and management by integrating techniques to kilo (observe) the i‘a (fish) that call the fishpond their home, through monthly fish surveys. Over the course of a decade of surveys together, the pilina (relationships) with each other and the fishpond have deepened by gaining perspectives about habitat health, fish behavior, and a deeper understanding of the cyclical changes in the fishpond, which has become a fundamental aspect to effective management and guiding the path forward. During the monthly kilo, surveyors record fish species abundance and biomass, to evaluate cyclical and long-term trends to assess the effectiveness of restoration efforts and develop sustainable and adaptive harvest plans. The speed talk will take you underwater with the kia‘i loko, to share the perspective they see during each kilo event, and how the traditional practice of kilo has guided to the conservation initiatives to care for this wahi pana (storied place).

198

Optimizing Reintroduction Success for Rare Endemic Plants; A Case Study of *Polyscias bisattenuata* on Kaua‘i

Julia Douglas

Botany Department, University of Hawai'i at Mānoa, Honolulu, Hawaii

Track

IV. Putting Research into Management Practice

Abstract

For the effective conservation of rare plant taxa, reintroduction initiatives and subsequent monitoring must be experimentally designed to increase both survivorship outcomes and knowledge of the focal species' biology. In Hawai'i, the urgency of optimizing reintroduction success is paramount as we face an extinction crisis of our endemic flora. *Polyscias bisattenuata* Scherff (Araliaceae) is an extremely rare tree endemic to Kaua'i, known by its Hawaiian name 'ohe mauka. The species is reduced to ~26 wild individuals, and is listed as Critically Endangered on the IUCN Red List and U.S. Endangered Species List. In a 2017 effort led by the National Tropical Botanical Garden, approximately 4,500 *P. bisattenuata* saplings were reintroduced to eleven sites across Kaua'i. The sites represented a broad spectrum of environmental variables and habitat niches. Trees were monitored in 2020 to investigate the following questions, I) What is the 2-year survivorship of reintroduced *P. bisattenuata*? II) What are the environmental drivers to reintroduction success, and what do these drivers indicate about *P. bisattenuata* habitat preferences? and III) How can future reintroduction efforts be informed by these results? Results show 648 individuals survived the initial two years after outplanting, representing a 14.3% survival rate with significant variation in survival rates across sites. Highest reintroduction success occurred at Hā'upu summit, and multiple linear repressions showed slope aspect and elevation to be significantly correlated with plant survival and vigor. This methodology contributes to the efforts to optimize reintroduction success for imperiled plant species across Hawai'i.

199

Historical Ecology of He'eia Informs Contemporary Biocultural Restoration Efforts

Matthew C.K. Kaho'ohanohano[1,2], Kawika B. Winter[3], Kanekoa Kukea-Schultz[4], Leah Bremer[5], Natalie Kurashima[6], Tamara Ticktin[1]

[1]University of Hawai'i at Mānoa Botany Department, Honolulu, HI. [2]He'eia National Estuarine Research Reserve, Kāne'ohe, HI. [3]Hawai'i Institute of Marine Biology, Kāne'ohe, HI. [4]Kāko'o 'Ōiwi, He'eia, HI. [5]University of Hawai'i Economic Research Organization, Honolulu, HI. [6]Kamehameha Schools, Kailua-Kona, HI

Track

IV. Putting Research into Management Practice

Abstract

Historical ecology is increasingly being used to inform contemporary biocultural restoration efforts. Ahupua'a (Hawaiian social-ecological communities) historically incorporated agro-ecosystems that maintained habitats for native biodiversity while increasing food production. Contemporary restoration of ahupua'a involves the revival of Indigenous Resource Management – including Indigenous agro-ecology and aquaculture – that aims to simultaneously meet both conservation and sustainable development goals. Restoration of the wao kanaka (agro-ecology zone) in the ahupua'a, He'eia, is being undertaken by multiple non-profit organizations that are community-based and Hawaiian-led. We

aimed to document the historical ecology of the He‘eia wao kanaka using a combination of hoa‘āina (land tenant) testimonies from the mid-19th century, aerial photographs from the early 20th century, and oral history interviews with kūpuna (elders). Using these primary sources, we conducted a spatial analysis of Indigenous agro-ecosystems and aquaculture systems that provides insight into the spatial extent and types of habitats that these systems provided for native species – both terrestrial and aquatic. The results of this research inform the collaborative restoration and adaptive management among the various organizations actively working in He‘eia, and that which is supported by the He‘eia National Estuarine Research Reserve.

200

Using High-resolution Imagery to Quantify Differences in Rapid ‘Ōhi‘a Death Mortality Associated with Ungulate Presence or Absence on Hawai‘i Island

Timothy Sullivan[1], Ryan Perroy[1], David Benitez[2], Flint Hughes[3], Emma Yuen[4], Brian Tucker[5]

[1]University of Hawaii, SDAV, Hilo, Hawaii. [2]National Park Service, Volcano, Hawaii. [3]Forest Service, Hilo, Hawaii. [4]DOFAW, Honolulu, Hawaii. [5]DLNR, Hilo, Hawaii

Track

V. New Technologies in Conservation Research and Management

Abstract

A priority need in managing Rapid ‘Ōhi‘a Death (ROD) is a better understanding of the variables enhancing its spread, and the development and implementation of science-based management practices to inhibit those pathways. One potentially important mechanism is the wounding of ‘Ōhi‘a trees from introduced ungulates. While individual tree wounds cannot be observed from readily available remotely sensed imagery, we have been able to quantify ROD mortality dynamics across forest stands on an individual tree basis through repeat, high-resolution aerial mapping. These efforts have included mapping differences in ‘Ōhi‘a crown mortality between fenced (ungulate-free) and unfenced (ungulate occupied) areas. From recent flights in eastern Hawai‘i Island, we noted 0.92 ‘Ōhi‘a trees per acre suspected of dying from ROD within an ungulate-present area, and only 0.008 for the directly adjacent, ungulate-free area. Another forest site to the south-west showed a similar pattern (0.98 to 0.024). To better understand these patterns on an island-wide scale, we are examining differences in ‘Ōhi‘a mortality associated with ROD for a much larger number of sites containing similarly adjacent ungulate-present and ungulate-free parcels, using multispectral satellite imagery with resolutions of <50cm. These datasets allow us to quantify the effects that ungulate presence may have on a ROD infestation's mortality level, when compared with similar and adjacent ungulate-free ROD infestations. This type of spatial documentation of the “enhancement effect” ungulates have on ROD infestations in native forest systems can potentially add another significant reason to support current and future efforts of establishing and maintaining ungulate-free areas across Hawaii.

201

Investigating Hawaiian Spinner Dolphin (*Stenella longirostris*) Habitat-Use Patterns During Restricted Commercial Boating Activities

Megan McElligott[1], Marc Lammers[1,2]

[1]Hawai'i Institute of Marine Biology, Kāne'ohe, Hawai'i. [2]Hawaiian Islands Humpback Whale National Marine Sanctuary, Kīhei, Hawai'i

Track

IV. Putting Research into Management Practice

Abstract

Hawaiian spinner dolphins (*Stenella longirostris*) frequent the Wai'anae coast off western O'ahu as part of their daily behavioral routine of foraging at night on offshore, mesopelagic prey and resting during the day in shallower, inshore waters. Spinner dolphins are an important living resource for the tourism industry, but the close proximity of dolphin resting habitats to human activities—particularly swim-with-dolphin tours—raises concern for the potential disturbance of their crucial resting behavior. In March 2020, at the onset of the COVID-19 pandemic, the Hawai'i Division of Boating and Ocean Recreation (DOBOR) restricted commercial boating operations. This provided a unique opportunity to monitor spinner dolphin habitat-use patterns during the approximately 2.5-month period of no commercial swim-with-dolphin tour activities. As part of an ongoing monitoring project, shore-based surveys were conducted at Mākua Beach, a well-studied dolphin resting bay, from June 30 - August 4 and November 22 - December 5, 2020. From 08:00 h - 14:00 h, three times weekly, vessels, human swimmers, and spinner dolphin activities were recorded based on the metrics collected by a 1995 survey effort at the same location. Results from the 2020 surveys indicated that on average, fewer spinner dolphins were present when more human swimmers were in the bay. Compared to the 1995 surveys, the average number of human swimmers was greater in 2020, and the average number of dolphins sighted was less in 2020. These results suggest that time-area closures in Mākua may be an effective management strategy to reduce human disturbance of spinner dolphins during peak resting hours.

202

A Financial Model to Encourage Private Investment in Koa Reforestation in Hawai'i

James Friday[1], Suzanne Kim[2], Irene Sprecher[3]

[1]University of Hawai'i Cooperative Extension Service, Hilo, HI. [2]Motivate Capital, San Francisco, CA. [3]Hawai'i Department of Land and Natural Resources Division of Forestry and Wildlife, Honolulu, HI

Track

IV. Putting Research into Management Practice

Abstract

Private landowners in Hawai‘i would like to reforest sub-marginal ranch lands with koa (*Acacia koa*) and ‘iliahi (sandalwood, *Santalum paniculatum*) for both economic and environmental reasons. One impediment to reforestation has been the lack of models to help landowners decide if an investment in reforestation can be profitable. We have developed a financial model for landowners to use as a decision support system. The model incorporates realistic costs for reforestation and potential income from both timber harvests and ecosystem services such as carbon sequestration and watershed protection. Information for the model was obtained from both public and private sources, including scientists, economics, landowners, and forestry consultants. The model is in a user-friendly spreadsheet-based format. Hawai‘i Island alone has tens of thousands of acres of land with potential for koa and ‘iliahi reforestation with only limited public funding. Privately funded sustainable forestry with native species would not only support the local economy but would sequester significant amounts of carbon, protect island watersheds, and provide habitat for native species.

203

Hawai‘i Forest Restoration Synthesis: Bringing Together Lessons Learned

Aurora Kagawa-Viviani[1,2], Gordon Tribble[3], Stephanie Yelenik[4], Sharon Ziegler-Chong[1], Lori Bufil[1], Thomas Giambelluca[2,5]

[1]Hawai‘i Cooperative Studies Unit, Hilo, HI. [2]Water Resources Research Center, Honolulu, HI. [3]USGS-Pacific Island Ecosystems Research Center, Volcano, HI. [4]USDA Forest Service Rocky Mountain Research Station, Reno, NV. [5]University of Hawai‘i at Mānoa Department of Geography and Environment, Honolulu, HI

Track

IV. Putting Research into Management Practice

Abstract

“Understanding Forest Restoration in Hawai‘i” is a new project partnership of the UHH Hawai‘i Cooperative Studies Unit, UHM Water Resources Research Center, and the USGS Pacific Islands Ecosystems Research Center focused on drawing together existing knowledge of native ecosystem restoration and its effects on water ecosystem services, especially hydrologic services, across the Hawaiian Islands. The project goal is to distill emergent lessons to support managers, cultural practitioners, and scientists and provide landscape-scale understanding of when, where, why, and how restoration efforts are successful. This synthesis is important given the mosaic of lands managed to maintain ecosystem and watershed function, sustain and restore native biodiversity, and protect threatened and endangered species. While some restoration efforts have been rigorously quantified and published, most work is based on experience, expert judgment, and intuition, and subsequent lessons are not widely disseminated. This project aims to support more informed and effective restoration

across Hawai‘i by 1) assembling a compendium of published and unpublished literature on restoration, 2) interviewing forest restoration practitioners themselves to identify their observations and concerns, and 3) building tools to support more effective exchange of restoration lessons given the range of environmental, managerial, and cultural contexts in which restoration is performed across the islands. We anticipate this work will improve the inclusion of local and Indigenous technical knowledge in the science and practice of ecological restoration in the islands. In this presentation, we describe our approach and preliminary findings and invite suggestions on the interviewing process and desired tools and outcomes.

204

Ho‘oulu Hou: Student Community Collaborations to Cultivate ‘Āina Momona in Hawai‘i

Mehana Vaughan[1,2], Noelani Puniwai[1,3]

[1]University of Hawai'i at Mānoa, Honolulu, HI. [2]Sea Grant, Kalihiwai, HI. [3]Kamakakūokalani Center for Hawaiian Studies, Puna, HI

Track

II. Capacity in Conservation

Abstract

Managing for abundant ‘āina and thriving communities requires training in holistic and collaborative approaches grounded in diverse ways of knowing. This forum will share student projects from The Kū‘oko‘a: Sustaining Abundant ‘Āina & Resilient Leadership initiative in an interactive format with multiple opportunities for discussion and interaction. This initiative is a collaboration of ten Native Hawaiian faculty across the University of Hawai‘i at Mānoa dedicated to enhancing community ability to care for ‘āina across the archipelago, who conduct research and teach courses related to sustainability and resilience grounded in Hawaiian knowledge. In this session, graduate and undergraduate students will share projects created in these courses, in small groups with opportunity for feedback and discussion. Projects include websites highlighting cultural and ecological resources of ahupua‘a the students come from, field classes supporting community efforts to care for significant places, and research to help in restoring bio-cultural resources across the Hawaiian islands. In addition to sharing their projects, students will reflect on their learning and how it has impacted their career paths in conservation. As collaborative and holistic efforts are becoming more widespread in natural resource and environmental policy-making processes, young people entering these fields require practical experience in applied and participatory research, community engagement, facilitation and collaboration across diverse groups. The efforts shared in this session are helping to equip a new generation of leaders, strengthen resilience of communities across the islands, build partnerships within and beyond the university, and cultivate pono decision-making regarding land and resources in Hawai‘i.

Agenda & Additional Required Information for Forums, Workshops, and Trainings

Presenters to be determined

Agenda:

Opening and welcome

Introductions

Break out groups with student presentations in small groups with rotating participants.

Return to the whole group for discussion and sharing.

Closing: Sharing of closing thoughts and take aways in chat.

Goals:

1) Share student research with individuals engaged in conservation who may find resources shared useful as well as the kind of work being done inspiring.

2) Connect those who could benefit from future student research to programs at the University.

3) Provide opportunities for all who attend to connect with one another.

Target audience is anyone interested in what young people coming into conservation fields are doing and how we can collectively enhance capacity for conservation in Hawai‘i.

205

‘Ōiwi (Hawaiian) Perspectives on Native Species and Ecosystems

Amber Nāmaka Whitehead[1], Mililani Browning[2], Sam ‘Ohu Gon III[3], Lahela Burgess Camara[4], Noah Gomes[5], Russell Kallstrom[6], Lance Mahi La Pierre[7], Rosie ‘Anolani Alegado[8], Natalie Kurashima[1], Pua‘alaikahoniho‘omau Pascua[9]

[1]Kamehameha Schools, Kailua-Kona, Hawai‘i. [2]Kamehameha Schools, Honolulu, Hawai‘i. [3]The Nature Conservancy, Honolulu, Hawai‘i. [4]Three Mountain Alliance, ‘Imi Pono No Ka ‘Āina, Hilo, Hawai‘i. [5]n/a, Hilo, Hawai‘i. [6]The Nature Conservancy, Kualapu'u, Hawai‘i. [7]Papahana Kuaola, Kāne‘ohe, Hawai‘i. [8]University of Hawai‘i at Mānoa, Honolulu, Hawai‘i. [9]Hawai‘i Conservation Alliance, Hilo, Hawai‘i

Track

I. Cultural Values and Practice in Conservation

Abstract

Hawai‘i’s people share a genealogy with the plants, animals, and landscapes of our island home. The lifeways of Kanaka ‘Ōiwi (Hawai‘i’s indigenous people) weave together science and culture, and are based in reciprocity, acknowledging that their survival is dependent upon the health of the environment

in which they live. Much of this knowledge and associated practices can still be found within the oli (chants), moʻolelo (stories, traditions), and other sources left to us by our kūpuna (ancestors), and an increasing number of Hawai'i resource stewards are reconnecting to this traditional ecological knowledge in order to improve resource management today. Presenters will share their deep knowledge on native plants, such as māmaki (*Pipturus* spp.), olonā (*Touchardia latifolia*), ʻōlapa (*Cheirodendron* spp.), and uhiūhi (*Mezoneuron kavaiense*); animals, such as native forest birds; dry forest; pōhaku (rocks), the very substrate upon which life grows; and even microbes! In hopes of encouraging others to pursue their own investigations into the species and ecosystems that give us all life, presenters will also describe how they conducted their research. A moderated discussion will provide opportunities for the audience to build on the knowledge of the presenters by sharing their own perspectives on native species and asking questions. Throughout the forum, polls and other interactive elements will be used to stimulate audience thinking, generate insights, and guide the panel discussion.

This Forum is organized by the Hawaiʻi Conservation Alliance (HCA) Cultural Subcommittee.

Agenda & Additional Required Information for Forums, Workshops, and Trainings

Presenters and Topics:

- Mililani Browning, Kamehameha Schools- Pōhaku
- Amber Nāmaka Whitehead, Kamehameha Schools- Māmaki
- Russell Kallstrom, The Nature Conservancy- Olonā
- Lahela Burgess Camara, Three Mountain Alliance, ʻImi Pono No Ka ʻĀina- ʻŌlapa
- Noah Gomes- Native Forest Birds
- Lance Mahi La Pierre, Papahana Kuaola- Uhiūhi
- Sam ʻOhu Gon III, The Nature Conservancy- Dry Forest
- Rosie ʻAnolani Alegado, University of Hawaiʻi at Mānoa- Microbes

Agenda (2 hours):

- (80 min) Individual 10 minute presentations
- (40 min) Moderated discussion

Audience Engagement:

A moderated discussion will provide opportunities for the audience to build on the knowledge of the presenters by sharing their own perspectives on native species and asking questions. Throughout the forum, polls and other interactive elements will be used to stimulate audience thinking, generate insights, and guide the panel discussion.

Goals and Target Audience:

The goals of the forum are (1) to share ʻŌiwi perspectives on native species and ecosystems and (2) to encourage other resource stewards to reconnect to traditional ecological knowledge in order to improve resource management today.

The target audience are native biodiversity stewards, managers, researchers, educators, and students.

Note:

This Forum proposal is submitted by the HCA Cultural Subcommittee.

206

Manning the Hawaiian Land Snail Conservation Lifeboats

Jan A. N. Kealoha, Kenneth A. Hayes, Norine W. Yeung

Bishop Museum, Honolulu, Hawaii

Track

II. Capacity in Conservation

Abstract

Over-collection, habitat destruction, invasive species, and climate change have dramatically reduced Hawaiian land snail diversity. The few remaining species are the last hope for restoring some of this spectacular land snail fauna. To ensure the survival of these remaining snails, we must understand their life histories and ecosystem requirements. In the 1970's, Daniel Chung noted that all Hawaiian land snails, not just the charismatic O'ahu Tree Snails, were rapidly disappearing. He began manning the conservation lifeboats of several of these species at his home before relocating them to the Bishop Museum in 2007. Since the start, he has been optimizing captive rearing techniques and training a small band of dedicated volunteers. Eleven volunteers, and a minimal part-time staff partially supported by the state's Snail Extinction Prevention Program (SEPP) now care for more than 11,400 snails from 24 species. However, captive rearing is not a long-term solution. Nearly 50 years after Daniel started his efforts, and in collaboration with SEPP, over 3,500 individuals from three *Amastra* species, believed to be extinct in the wild, have been off-loaded from their conservation lifeboats into predator-proof enclosures. This program has generated life history, taxonomic, and other data critical to ensuring the survival of the remaining snails and informing management decisions as we build the capacity to restore native ecosystems needed to sustain populations in perpetuity. Herein we present a historical overview of these efforts and review what is needed to continue building conservation capacity for the remaining land snails.

207

E Hinu Auaneʻi Nā Nuku, He Pōmaikaʻi Ko Laila: Studying the Food of Our Food, Diatoms

Aka Beebe[1], Rosie Alegado[1], Shimi Rii[2], Paepae o Heʻeia[3]

[1]University of Hawaiʻi, Honolulu, Hawaiʻi. [2]Heʻeia National Estuarine Research Reserve, Heʻeia, Hawaiʻi. [3]Paepae o Heʻeia, Heʻeia, Hawaiʻi

Track

IV. Putting Research into Management Practice

Abstract

Intentional biocultural restoration by Paepae O He‘eia, kia‘i loko (stewards) of He‘eia Fishpond (HFP), has been ongoing and improving both the skills of the kia‘i and the abundance of ‘āina since the early 2000s. Previous studies at HFP have revealed complex dynamics shown through spatial and temporal gradients in circulation, temperature, salinity, dissolved nutrients, chlorophyll and phytoplankton. Our goal is to understand the abundance and distribution patterns of diatoms, a significant component of the diet of mullet, in relation to geochemical gradients in HFP‘s aquatic environment and assess the impacts of biocultural restoration on the aquatic environment. To capture the changes over this period of time, we compared datasets from three different field sampling campaigns: (1) kuapā restoration and mangrove removal along Southern and Eastern (2008-2009), (2) repair of "ocean Break" and installation of Kaho‘okele (2014-2015), and (3) mangrove removal and kuapā and mākāhā restoration/construction in sections near He‘eia Stream (2017-2019). Although comparable environmental measurements were collected, differences in sampling location, effort and methods were a challenge for data analysis. Diatom abundances were measured from genomic DNA samples collected during 2014-2015 and 2017-2019 with qRT-PCR using diatom-specific primers. Results show diatom abundances ranged form hundreds to millions covarying with multiple environmental parameters such as salinity and silicate. The aquatic environment of HFP has become more uniform with less spatial variability and a stronger relationship between salinity and other environmental measurements.

208

Spatial Distribution of the Invasive and Native Tree Species on the University of Hawai‘i Hilo

Thathmini Kularatna

University of Hawaii Hilo, Hilo, Hawaii

Track

II. Capacity in Conservation

Abstract

This study of the spatial distribution of invasive and native tree species was conducted at the University of Hawai‘i Hilo to explore the number of these tree species, hotspot locations, and the potential distribution range within the campus. The selected invasive trees, African Tulip (*Spathodea campanulata*), Albizia (*Falcataria moluccana*), Bingabing (*Macaranga mappa*), Fiddlewood (*Citharexylum caudatum*), Gunpowder (*Trema orientalis*), Melochia (*Melochia umbellata*), and Octopus Tree (*Schefflera actinophylla*) have high Hawai‘i Pacific Weed Risk assessment values. The selected native tree species, ‘Ōhi‘a (*Metrosideros polymorpha*) and Hala (*Pandanus*

tectorius), are the remaining dominant species of the lowland wet forest. The average Nearest Neighbor analysis, hotspot (Getis-Ord Gi*), and Inverse Distance Weighted (IDW) maps were conducted using ArcGIS 10.5.1. The invasive trees (n = 1207) outnumbered the native trees (ʻŌhiʻa = 33, Hala = 20) and showed spatial clustering. Hotspot locations and the distribution of invasive trees laid in the southern direction of the campus. The coldspots also significantly important as the existing large plants are active progenitors. Human-induced activities, such as prioritized maintenance, are one proposed reason for the spatial clustering of the invasive trees. The reason for having the hotspots is the remaining forest patches across the Waiākea stream and West Kāwili Street that harbors mature invasive tree populations that actively dispersing seeds into these areas. Lastly, this study emphasized how future management activities, such as selective removal and maintenance of hotspot areas, can mitigate the further distribution of invasive tree species within the landscape.

209

Evaluating the Effects of the Rat Poison Brodifacoum on Corals

Alexandria Barkman[1], Robert Richmond[2]

[1]University of Hawaii, Honolulu, Hawaii. [2]University of Hawaii, Honolulu, HI

Track

IV. Putting Research into Management Practice

Abstract

Anticoagulant rat poisons are commonly used to eradicate invasive rat populations on priority islands that are wildlife refuges. Broadcast applications of brodifacoum bait pellets effectively eradicate invasive rat and mice populations that threaten biodiversity on islands, but can introduce brodifacoum to non-target organisms. Little is known about the effects of brodifacoum on non-target organisms, especially marine invertebrates. To test the effects of brodifacoum on corals, *Montipora capitata* gametes and larvae were exposed to brodifacoum at 0.1, 1, 100, and 1000 ppm. There was decreased fertilization success with increased concentration of brodifacoum, but larval survival did not decrease across any of the treaments. Cereal bait pellets containing brodifacoum with same formulation as those to be used in an upcoming eradication effort were used for adult exposure experiments. The coral *Porites lobata* was exposed to brodifacoum pellets for 3 days at 0.001, 0.01, and 0.1 ppm brodifacoum. There was no reduction in photosynthetic efficiency as measured by a Pulse Amplitude Modulation Fluorometer. There were signs of stress including increased mucus production at 0.01 and and 0.1ppm, but no tissue loss occurred across any of the treatments. Protein analysis indicates stress at a molecular level with enrichment of proteins involved in cellular metabolism and lipid synthesis. Results indicate that coral reproductive periods should be considered during eradication efforts to minimize effects on nearby reefs. More work needs to be done to understand how brodifacoum enters marine ecosystems, how long it persists after applications, and how it effects non-target organisms.

210

Indigenizing Circular Economy Approaches to Sustainable Development Goal 2.5

Mervyn Tano

IIIRM, Denver, Colorado

Track

VI. Place-based Conservation

Abstract

End Hunger is Sustainable Development Goal 2. To achieve SDG 2, Target 2.5, in part aims to: ". . . maintain the genetic diversity of seeds, cultivated plants and farmed and domesticated animals and their related wild species, including through soundly managed and diversified seed and plant banks at the national, regional and international levels . . ." Recently, international organizations, educational, technology, and research institutions, as well as professional associations have promoted circular economy approaches to attain the SDGs.

A circular economy is an economic system of closed loops in which raw materials, components and products lose their value as little as possible, renewable energy sources are used and systems thinking is at the core. We argue the Circular Economy paradigm, with its focus on the flow of products and materials, is inapposite when applied, not to flows but to the "stocks" such as: knowledge resources like relationships and responsibilities; building human, social, and cultural capital; and consensus building so vital to nation-building—all of which are foundational principles of indigenous definitions of sustainability.

We describe the complex web of actors implicated in achieving the ends of SDG-2.5 and suggest consensus-building and discourse guided by principles such as Kuleana (responsibility), Lokahi (unity), Aloha Aina (love and respect for the land and all that dwell on it), Kaitiakitanga (guardianship and protection), and Whakapapa (framework that links all animate and inanimate, known and unknown phenomena in the terrestrial and spiritual worlds) as the first step in indigenizing the circular economy paradigm.

211

Insights into Recruitment and Breeding Patterns Exhibited by Newell's Shearwaters Attracted to a Recently Established Nesting Colony on Maui

Gregory Spencer[1], David Ainley[2], Brad Yuen[3]

[1]H. T. Harvey & Associates, Kihei, Hawaii. [2]H. T. Harvey & Associates, Los Gatos, California. [3]H. T. Harvey & Associates, Haliimaile, Hawaii

Track

VI. Place-based Conservation

Abstract

'A'o (Newell's shearwater *Puffinus newelli)* has dramatically decreased in population size and distribution in Hawaii, and the species is listed as threatened under the US Endangered Species Act and critically endangered by the IUCN. On West Maui, where 'a'o has all but been extirpated, two ~1.8 hectare predator-resistant fences were constructed and predators were eliminated from the exclosures in 2014. Fabricated nest boxes were installed (50 each exclosure) and social attraction (recorded call playbacks and decoys) has steadily increased recruitment of breeding age 'a'o to the conservation site. Breeding effort began with egg-laying at a few nest sites in 2017-2018 and the first fledglings were produced in 2019. Nest site visitation and activities are monitored using covert infra-red game cameras to document behaviors, visitation rates, and reproductive performance. We analyzed visitation patterns exhibited by 'a'o occupying nest boxes from early April 2019, when first birds arrived, through the end of October 2019, when the last birds departed the colony, to construct a phenological timeline. Our findings reveal new insights into the processes affecting recruitment rate at a new colony and the diversity of behaviors exhibited by 'a'o during prospecting, nest site establishment, and chick provisioning. Finally, we examine the steady annual increase in nest site visitation and trend toward annual breeding success at this new colony in the context of earlier population modeling to estimate the success of this project and discuss factors affecting the efficacy of social attraction toward establishing new 'a'o nesting colonies.

212

Incorporating Detection and Occupancy Coefficients of Pacific Islands Coral Reef Fishes into Biomass Estimation Procedures Indicates Biases of Current Methodology

Bobbie Suarez[1], Timothy Grabowski[2]

[1]University of Hawaii at Hilo, Hilo, Hawaii. [2]US Geological Survey, Hawaii Fishery Cooperative Research Unit, Hilo, Hawaii

Track

IV. Putting Research into Management Practice

Abstract

Coral reef fishery management relies on visual surveys to monitor changes in population size or assemblage structure. The biomass estimates generated from underwater visual surveys make two

assumptions: reef fishes are perfectly detected, and all suitable habitat is occupied. These assumptions are unlikely to be met, and failing to account for them can result in biased biomass estimates. Our objective was to assess how accounting for imperfect detection and occupancy influence reef fish biomass estimates throughout the Pacific. To accomplish this, we generated detection and occupancy coefficients for all reef fishes appearing in the 2010-2017 monitoring data generated by the Pacific Islands Fisheries Science Centers Coral Reef Ecosystem Program. We then applied these coefficients to generate a corrected biomass estimate and compared it to each species' original biomass estimate. We applied frequentist detection and occupancy modeling to 549 species of coral reef fishes representing 55 families from 5 regions of the Pacific. The occupancy- and detection-corrected biomass estimates suggest that current methods underestimate common species biomass. However, the biomass of larger-bodied predatory fishes seems to be overestimated by current assessment methods. Herbivorous fishes did not exhibit a consistent pattern, with some species' biomass being overestimated and others underestimated. Our results represent the first effort to apply frequentist models to multiple reef fish species and estimate biomass over large regional scales. While this approach has assumptions requiring validation, it highlights several areas where current survey methods could be improved by accounting for detection and occupancy.

213

Indigenous knowledge of and biocultural relationships with pueo based on Kānaka ʻŌiwi (Native Hawaiian) perspectives can inform conservation efforts

Kaleiheana-a-Pohaku Stormcrow, Mehana Vaughan, Kamealoha Forrest, Kawika Winter, Noelani Puniwai, Melissa Price

University of Hawaiʻi at Mānoa, Honolulu, HI

Track

I. Cultural Values and Practice in Conservation

Abstract

Pueo (Hawaiian Short-eared owl; *Asio flammeus sandwichensis*) are a raptor endemic to the Hawaiian Islands. Pueo are challenging to study today due to their elusive nature and occurrence across nearly every vegetation type in Hawaiʻi. However, pueo are a cultural keystone species who are considered ʻaumākua (ancestral guardians) and hold particular value in kaʻao (legends), moʻolelo (histories), and ʻōlelo noʻeau (proverbial sayings). In this study we followed the Kua-Lako-Moʻo method in information contained in Hawaiian language newspapers of the 19th century to better understand the ecological knowledge held by kānaka ʻōiwi (Native Hawaiians) in that era, and understand their relationship with pueo. We searched *Papakilo Database* for the search terms “manu pueo” (bird pueo), “pueo akua” (god/elemental force), “pueo aumakua”, and “pueo” in conjunction with the words “nahele” (forest), “mahina” (moon), “kula” (plain) and “ālialia” (wetland) and identified a total of 1268 articles that included these terms. Preliminary review of the articles resulted in the identification of several themes and socio-ecological data types, including hoʻailona (correlations to ecological phenomena), kupua (shapeshifter), akua (god/elemental force), ʻaumākua and kinolau (physical manifestation of the divine), allegory, and natural history: physical description, and foraging and roosting behaviors/habitat. Given

scarce data about life history or historical distribution for many endangered and rare native species, collation and dissemination of this knowledge is critical to inform conservation efforts and improve strategic outcomes in an effort to return these species to abundance.

214

An Updated Invasive Species Target Selection Procedure for Hawai‘i

Springer Kaye[1,2], James Parker[1,2], Jonathan Price[3], Charles Chimera[2], Robert Parsons[1,2], Joel Brunger[1,2], Kristin Meehan[1,2]

[1]Big Island Invasive Species Committee, Hilo, HI. [2]Pacific Cooperative Studies Unit of the University of Hawaii, Honolulu, HI. [3]Department of Geography and Environmental Studies, University of Hawaii at Hilo, Hilo, HI

Track

II. Capacity in Conservation

Abstract

Island-scale eradication of newly detected invasive plants contributes to cost-effective, long-term protection of native biodiversity—when it can be accomplished. A scarcity of resources requires a triage approach that evaluates both the importance and feasibility of attempting an island-scale eradication. Risk assessment tools previously developed in Hawai‘i have primarily relied on a species’ global track record, i.e. the literature, and have contributed to at least thirty successful island-scale eradications of invasive plants. In recent years, however, high-impact pests have arrived without a history of invasion elsewhere, and sometimes without identification! Decision makers need documented, transparent selection procedures, accountability, and a sober assessment of costs—even and especially when they exceed available funding. Our new process supplements the familiar Hawai‘i Weed Risk Assessment tool with a quantitative assessment of local performance developed by the Weeds in the Early Stages of Development project of Victoria, Australia. We added a calculator to estimate the effort required to eradicate the population, and steps to consider available staff time, document the decision-making process and explicitly state the management goal. We evaluated twelve previously detected species and compared results to previous management decisions, which sometimes diverged. This technique still has limitations, and the process requires more investment at the assessment stage, but it may increase the success rate of attempted eradications while boosting transparency and accountability. Similar modifications could be made to the evaluation of other taxa, expanding the scope of risk-assessment tools that rely exclusively on the global track record.