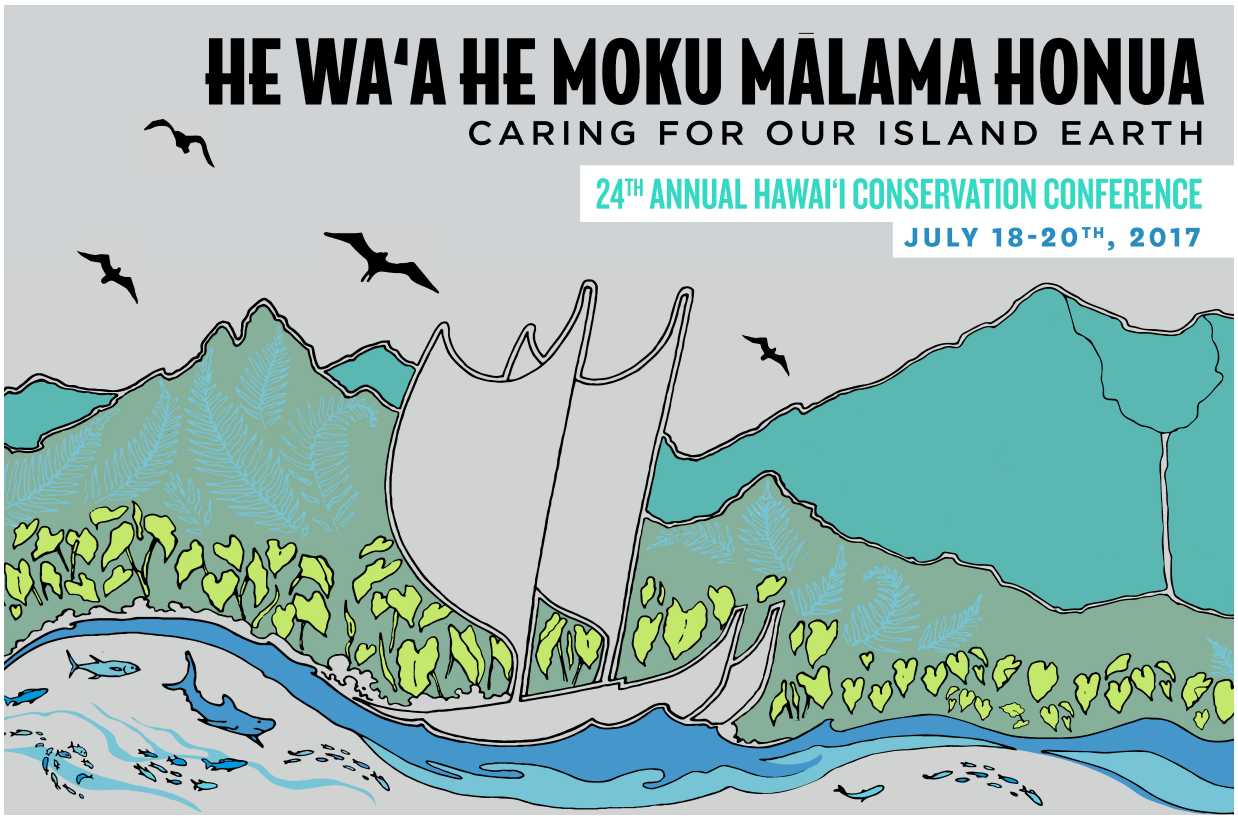

2017 HAWAI'I CONSERVATION CONFERENCE

ABSTRACT BOOK

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Tuesday, July 18th, 2017

CONCURRENT SESSION 1

1-1

Creative Engagement: Designing effective community outreach programs using social science– an introduction to community-based social marketing

Franny Kinslow Brewer[1], Liz Foote[2], Evelyn Wight[3], Kristin Maize[3] *[1]Big Island Invasive Species Committee (UH/PCSU), Hilo, USA, [2]Project S.E.A.-Link, Lahaina, USA, [3]The Nature Conservancy, Hawaii, USA*

Traditional outreach programs often focus on providing knowledge to the public, in the hope that increased knowledge will lead to changes in behavior. However, decades of research has shown that knowledge is only a weak predictor of behavior change. What's missing? We will look at practices from developing research in behavior change science to discover what works. We will discuss community-based social marketing (CBSM), an approach that uses theories and practices from social science, including sociology, conservation psychology, and behavioral economics, to encourage and facilitate the adoption of conservation friendly and sustainable behaviors. Explore some of the strategies used in successful social marketing, as well as the theory behind them. Learn how to identify the barriers to action as well as the benefits that will encourage your target community to engage sustainable behavior. Find out how you can use effective narrative structure and creative communication approaches to “tell your story” and “sell” sustainability. Participants are encouraged to bring information about planned or active outreach efforts for analysis and discussion.

1-2

Maximizing the connections between a community in a hybrid forest: Building off an assessment of contemporary relationships with forest plants

Kawika Winter[1,2], Tamara Ticktin[3] *[1]National Tropical Botanical Garden, Kalaheo, HI, USA, [2]University of Hawai`i at Mānoa, Natural Resource and Environmental Management, Honolulu, HI, USA, [3]University of Hawai`i at Mānoa, Dept. of Botany, Honolulu, HI, USA*

Several forest restoration projects around Hawai`i have elected to build off of the many connections between Hawaiian culture and native plants as a means to encourage community engagement in and support for conservation efforts. One challenge is that such projects are often informed by research that is more than a century old, and therefore they do not always build off of contemporary relationships that are immediately relevant in the 21st Century. As a means to inform the species selection for a restoration project in the forest (*wao lā`au*) adjacent to a native Hawaiian community (*wao kānaka*), focus groups and the methods associated with quantum ethnobotany were used to determine which native species are the most relevant in the contemporary context, and which others had the deepest ancestral connections in hibernating traditions which

contemporary Hawaiians could rebuild relationships to. The result will be a restoration project that not only restores native ecological health and function, but also one that maximizes the potential connections to the Hawaiian community.

1-3

Restoring to the Future: Aiming for Resilience in Light of Economic, Cultural, and Ecological Tradeoffs in Limahuli Valley, Kaua'i

Kimberly Burnett[1], Kawika Winter[2,3], Cheryl Scarton[3], Leah Bremer[4,5], Christopher Wada[1], Lisa Mandle[5], Natalie Kurashima[6], Shimona Quazi[4], Kim Falinski[7], Tamara Ticktin[0] *[1]University of Hawai`i Economic Research Organization, University of Hawai'i at Mānoa, Honolulu, HI, USA, [2]Limahuli Garden and Preserve, National Tropical Botanical Garden, Ha`ena, HI, USA, [3]Department of Natural Resources and Environmental Management, University of Hawai'i at Mānoa, Honolulu, HI, USA, [4]Department of Botany, University of Hawai'i at Mānoa, Honolulu, HI, USA, [5]Natural Capital Project, International, USA, [6]Kamehameha Schools, Honolulu, HI, USA, [7]The Nature Conservancy Hawai`i, Honolulu, HI, USA*

Resource managers and conservation professionals are increasingly faced with restoration choices that will result in various ecological, environmental, and cultural benefits and consequences. The objective of this project is to explicitly consider a number of current and proposed restoration scenarios designed by managers at the National Tropical Botanical Garden's (NTBG) Limahuli Preserve on the island of Kaua'i, Hawai'i; and to assess outcomes in terms of ground-water recharge, sediment, cultural value, and various ecological measures including native species' ability to persist, number of native species, ability to support wildlife, and functional diversity. Working directly with managers at Limahuli, we develop long-term management scenarios based on current and proposed restoration practices. When potential ecological, resilience, and cultural benefits of various restoration portfolios were weighed against the management costs associated with acheiving these states, we find that the hybrid restoration scenario maximizes potential measured benefits at a relatively moderate total cost. A major contribution of this work is the development of a "Quantum Co-evolution Unit" (QCU) scoring process to quantify cultural values of each restoration scenario.

1-4

Tracing Social-Ecological Relationships

Cheryl Geslani Scarton[1], Kawika Winter[1,2], Kimberly Burnett[3] *[1]Department of Natural Resources and Environmental Management, University of Hawai'i at Mānoa, Honolulu, HI, USA, [2]Limahuli Garden and Preserve, National Tropical Botanical Garden, Ha`ena, HI, USA, [3]University of Hawai'i Economic Research Organization, University of Hawai'i at Mānoa, Honolulu, HI, USA*

This research considers Hā'ena, Kaua'i as a social ecological system. Established frameworks based on the work of Elinor Ostrom are operationalized to describe change over time and discover social-ecological relationships and regime shifts. This system

was chosen because the coastal and cultural resources are being co-managed by the government and resource users. After overcoming early challenges they are creating adaptive management for common pool resources. A broad documentation review was conducted to create a timeline that was dissected using three different methodologies. Information from the timeline analysis was translated into time series data that was regressed against other social and ecological quantitative time series variables. Results show Hurricane Iniki may have had a negative influence on coastal salinity, and positive influence on groundwater levels. Groundwater level is negatively related to well chlorides, which points to impending saltwater intrusion of the well. Correlations found from multiple regression analysis offer future management considerations. Identifying fresh water management areas within the system will prioritize and motivate policy. Regime shifts coincided with the introduction of new actors. Identifying actors over time highlights who has the most experience and knowledge with the system, while defining the actor groups that need to be included during rule creation and future care-taking.

1-5

Ridge-to-reef management to foster coral reef resilience: An assessment of two ahupua`a at opposite ends of the main Hawaiian islands

Jade Delevaux[1], Robert Whittier[2], Kostantinos Stamoulis[3,4], Leah Bremer[14], Alan Friedlander[4,6], Stacy Jupiter[7], Whitney Goodell[4], Jonatha Giddens[4], Chad Wiggins[8], Eric Conklin[8], Robert Toonen[9], Kimberly Burnett[10], Kawika Winter[11], Natalie Kurashima[12], Tamara Tiktin[13] *[1]NREM Department, University of Hawai'i at Mānoa, Honolulu, HI, USA, [2]Hawaii Department of Health, Honolulu, HI, USA, [3]Curtin University, Perth, Australia, [4]Fisheries Ecology Research Lab, Honolulu, HI, USA, [5]Natural Capital Project, Stanford University, Palo alto, USA, [6]National Geography Society, Washington, DC, USA, [7]Wildlife Conservation Society, Suva, Fiji, [8]The Nature Conservancy, Hawaii Marine Program, Honolulu, HI, USA, [9]Department of Biology, University of Hawai'i, Honolulu, HI, USA, [10]University of Hawaii Economic Research Organization, University of Hawai'i, Honolulu, HI, USA, [11]Limahuli National Tropical Botanical Garden, Hanalei, USA, [12]Kamehameha Schools Natural and Cultural Resources, Kailua-Kona, USA, [13]Department of Botany, University of Hawai'i, Honolulu, HI, USA, [14]University of Hawaii at Manoa, Honolulu, HI, USA*

The Hawaiian Cultural Renaissance is rooted in the recognition of declining biocultural resources and has brought the ahupua'a into the contemporary ecosystem-based management framework. Several communities around Hawai'i seek to re-acknowledge the important links between land and sea to protect their land and freshwater, and to restore abundant reef fisheries. This study focused on two ahupua'a, at opposite ends of the main Hawaiian Islands, and thus captures a wide spectrum of environmental drivers governing coral reefs. Both communities have place-based, co-management designations: Hā'ena (north shore, Kaua'i Island) is a Community-based Subsistence Fishing Area, and Ka'ūpūlehu (leeward coast, Hawai'i Island) recently initiated a 10-year rest period on fishing. In order to provide management recommendations for maintaining system resilience through future environmental change, we modeled impacts to coral reefs and associated fish populations of the natural and anthropogenic disturbances unique to each place. We coupled simulated changes in nutrient discharge from groundwater with coral reef predictive modeling to evaluate the effects of different coastal development and climate change scenarios on coral reefs and fisheries. Our

results suggest that sheltered, dry Ka‘ūpūlehu is more susceptible to land use and climate change. In contrast, Hā'ena benefits from dilution and mixing due to higher wave power and freshwater discharge. However, reef fisheries in both study sites become vulnerable to the impact of land-based nutrients when models incorporate climate change. This study shows that ridge-to-reef management aimed at improving water quality and protecting important habitats can promote coral reef resilience in the face of climate change.

1-6

Pilina – Mālama – ‘Āina Momona: A Community-driven Monitoring Program to understand health and well-being of people and place

Emily Cadiz[1], Mehana Vaughan[1,2], Pelika Andrade[2,3], Kawika Winter[4,1], Alan Friedlander[5] *[1]Dept. of Natural Resource and Environmental Management, University of Hawai`i at Manoa, Honolulu, HI, USA, [2]UH Sea Grant & Hui Aina Momona, Honolulu, HI, USA, [3]Na Maka o Papahanaumokuakea, Hilo, HI, USA, [4]Limahuli Garden and Preserve, National Tropical Botanical Garden, Ha`ena, HI, USA, [5]Fisheries Ecology Lad, University of Hawai`i at Manoa, Honolulu, HI, USA*

Indigenous communities in Hawai‘i and around the world assess health and well-being holistically because they view people, place, and resources as interconnected. Yet current centralized management systems openly rely upon monitoring tools that look narrowly at selected resources without connecting these observations across ecosystems and to human well-being. In Hawai‘i, there is a growing shift towards community-based management of fisheries based on traditional ecological knowledge. However communities are struggling to balance their own ways of understanding resource health with standards of scientific rigor, and the monitoring expectations of Hawai‘i’s Department of Land and Natural Resources (DLNR). Lack of monitoring approaches that integrate indigenous and western knowledge systems for understanding resource health is a critical gap hindering community management across the Pacific. The purpose of this project was to establish a place-based, community-driven monitoring program for Hā‘ena, Kaua‘i to support the community’s goals towards being self-reliant stewards of their place. I used a Community Based Participatory Research approach and mixed methods including mapping, focus groups, ‘ōpihi monitoring, gonad collection, and seasonal observations to address three research questions. The results of this project offer a model process to understand ecosystem health that values relationships, and different knowledge systems, while building community capacity and empowerment for ‘āina momona.

1-7

Cohort senescence and shifting distribution patters of Kukui (*Aleurites moluccana*): Mapping the transition between agroforestry and naturalization

Kawika Winter[1,2], Ben Nyberg[1] *[1]Limahuli Garden and Preserve, National Tropical Botanical Garden, Ha`ena, HI, USA, [2]Dept. of Natural Resource and Environmental Management, University of Hawai`i at Manoa, Honolulu, HI, USA*

Kukui (*Aleurites moluccana*) is not classified as a native tree, yet has been a part of Hawaiian forests for more than a millennium, and has deep connections to native Hawaiian culture. It is also the State Tree, and one of the few trees in Hawaiian forests that are readily recognizable to the general public. It, therefore, has a perceived positive value by large swaths of the broader community in Hawai`i. There is, however, debate within the conservation community about whether the presence of Kukui in Hawaiian forests are remnants of the ancient agroforestry footprint, or a process of naturalization which leads some to classify it as an invasive species. This contentious perspective has left some conservation professional unsure of how to treat Kukui in forest restoration projects and habitat protection areas. As a means to inform conservation initiatives in the ahupua`a of Hā`ena (Kaua`i) aerial photographs were compared between 1964 and 2016. An analysis of the differences in the distribution pattern of Kukui between the two images suggests a cohort senescence of ancient agroforestry plantings coupled with an expanding footprint in the 20th century that is the result of the process of naturalization, and a shrinking footprint of naturalization succumbing to other invasive trees. The results provide useful information for conservation initiatives which attempt to balance the need to honor the ancient Hawaiian agroforestry footprint with the need to restore habitat for native plants.

1-8

Where Are They Now? Keeping Track of Hawai‘i’s Invasive Plants and New Introductions

Jacob Gross, Alison Ainsworth *NPS Inventory & Monitoring, Hawaii National Park, Hawaii, USA*

Many Pacific Island vegetation communities are changing rapidly in response to invasive plants and plant diseases. Long-term vegetation monitoring provides valuable reference conditions to quantify the dynamic nature of these events and support effective management actions. The Pacific Island Inventory and Monitoring (I&M) program conducts long-term, standardized monitoring across entire vegetation communities within national parks with repeated monitoring at five year intervals. Non-native plant records from the first cycle (2010-2015) of monitoring at Hawai‘i Volcanoes (HAVO) and Haleakalā (HALE) national parks were summarized by measurements of richness, frequency, and cover.

Non-native plant species were documented within Metrosideros polymorpha dominated wet forests and high elevation (>1800m) subalpine shrubland plant communities. Unsurprisingly, non-native species varied spatially across each plant community and were best summarized by contiguous regions within parks. Maps of species presence and cover were created for all currently managed species and new potential threats. Non-native plants within HALE's wet forest decreased in cover with increased elevation, presumably due to an advancing invasion front from adjacent lowland pasturelands and gardens. Two of the most frequent HALE wet forest invasives, Clidemia hirta and Hedychium gardnerianum, were only detected as incipient populations 20 years ago. Similarly, at HAVO we documented five new park species and one new island species, Dicanthium annulatum (Poaceae). Early detection of new invaders and new expansions within natural areas is critical information for prioritization of management efforts.

Importantly, I&M collaborates closely with park resource managers, including frequently employing park staff, to ensure rapid exchange of information.

1-9

The Bedrocks of Botany: Using Herbaria to Inform Early Detection and Prioritization of Invasive Plants in Hawai‘i

Kelsey Brock *Kauai Invasive Species Committee, Kapa'a, HI, USA*

Invasive plant managers in Hawai‘i strive toward a future where new arrivals are quickly identified and removed, small existing populations are eradicated, and the spread of non-eradicable populations throughout the archipelago are halted. Although the threat of invasive plants is a global issue, the alien flora of Hawai‘i present unique problems associated with its diversity and variable distribution amongst the islands. Thus, a comprehensive understanding of Hawai‘i's flora is necessary to elevate management decisions regarding species control prioritization from a species-specific approach to a holistic and long term strategy. Pairing current management approaches with information from herbaria is an important first step toward this goal. These collections are not only crucial for identification purposes, but recent digitization efforts have greatly increased the accessibility of highly valuable data. Demonstrating a strategy used by the Kaua‘i Invasive Species Committee (KISC), I summarize taxonomic, ecological and geospatial data from herbaria and outline its uses for minimizing uncertainty when prioritizing species for control. This includes planning early detection surveys, detecting historic locations, as well as assessing feasibility of control and ecosystem risk. I propose that increased collaboration between invasive plant managers and herbaria will increase early detection and eradication success of invasive plants. This partnership will provide the foundation for an evidence-based and taxonomically rigorous information source that will help tackle the unpredictable invasive species challenges to which Hawai‘i is well accustomed.

1-10

Proving Utility of an Innovative Technology through Action Research in Invasive Plant Species Management

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Miconia (*Miconia calvescens* DC) was introduced to East Maui as a single horticultural specimen circa 1970. Management commenced two decades later with a 25-year history that continues today. In 2012, Herbicide Ballistic Technology (HBT) was introduced as a novel treatment platform on manned helicopter surveillance missions; virtually doubling operational efficiency by combining intelligence gathering activities with concurrent target elimination. To date, over 100 HBT missions have been conducted, approaching 500 hours of operational flight time, treating over 20,000 high-value incipient targets, protecting over 18,000 ha of the East Maui Watershed (EMW). These robust operations

data allow us to explore performance analytics in a real management setting, e.g., search efficiency, herbicide use rate, etc., which can be further monetized to determine variable costs of an operation. With basic GIS, we have also determined the dispersal kernel of miconia in the EMW, spreading out to 1644 m from the maternal source, creating an impact area approaching 850 ha. Our future goal is to use these new model parameters for optimizing containment and asset protection strategies with most effective impact reduction and highest return on future cost avoidance. To conclude, the aerial deployment of HBT is proving to be an efficient management system reducing further impact to these fragile ecosystems. The successful adoption of this new technology was achieved through a spontaneous form of participatory action research where scientists and practitioners shared in the responsibilities of research and management towards evolving solutions in sustainable invasive species management.

1-11

Living Shorelines of Change in Hawaiian Estuaries

Kimberly Peyton[1], Troy Sakihara[2] *[1]DLNR DAR, Honolulu, Hawaii, USA, [2]DLNR DAR, Hilo, Hawaii, USA*

Mangrove forests, the ecosystem that typifies estuaries located between 25°N and 25°S, did not naturally establish in Hawaii. Rather than waterborne propagules of mangroves reaching Hawaii, shorelines of estuaries were almost certainly dominated by sedges that arrived via migratory birds. In one of the first efforts to engineer estuarine shorelines in the Hawaii Islands, Red mangrove Rhizophora mangle was introduced. Left unchecked this ecosystem engineer has aggressively altered calm water habitats in estuaries. And mangroves are not the sole invasive plant crowding the shorelines of estuaries; there are also introduced grasses, such as California grass Urochloa mutica. These invasive plants have been so successful for so long that there are no extant reference sites that we can study or even enjoy a sedge marsh view. On the plus side there is rapidly growing concern by community groups, fishing clubs, land owners, scientists, engineers and managers to take action to restore these habitats by removing invasive plants and replanting native species. Interestingly, this attention towards ecological restoration in estuaries is not coming from typical sources, such as government mandates or actions generated by environmental permitting. We find ourselves at a crossroads regarding what to do about these estuarine invaders. Is it worthwhile to remove these plant invaders? What native species could replace the invasives? What are the costs and benefits to an estuary if the status quo of invasion is allowed to continue? What are the costs and benefits of actions taken to historically reconstruct estuarine shorelines and return sedge marshes?

1-12

Albizia Biological Control - the First Steps

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Maluku, Indonesia,[4]National Agricultural Quarantine Inspection Authority, Port Moresby, Papua New Guinea,[5]Universitas Gadjah Mada, Yogyakarta, Indonesia

Research for the biological control of albizia (*Falcataria moluccana* [Fabaceae]) has been initiated with a series of exploratory survey expeditions in the native range of this invasive tree. Together with local collaborators in Indonesia and Papua New Guinea we have sampled trees in the forests throughout the region where Hawaii's albizia trees originated. The scarcity of this tree in its homeland and the large variety of insect herbivores and diseases collected from them suggests that albizia is a strong candidate for biological control. Specialist natural enemies greatly reduce canopy density in the native range by causing galls on leaves, defoliation, and mining of small branches, which could potentially decrease the danger of wind damage to these giant trees and their brittle branches in Hawai'i. Experiments conducted at two Indonesian universities have tested the attack rate and impact of insect herbivores on young albizia trees. Numerous insects readily attack saplings which limits seedling establishment, tree growth and population expansion. Additional experiments have started to screen the *Uromycladium* gall rust fungus on albizia and a suite of native Hawaiian and economically important relatives. So far only albzia appears to be susceptible to this fungal infection. The results of our surveys and field experiments will allow us to choose the best potential candidates for the classical biological control of albizia. Future tests will examine the potential risk that specialist albizia insects and diseases may pose to our native koa trees (*Acacia koa*) and other close relatives to this high priority target.

1-13

Impacts of Non-native Ungulate Removal on Fuel Loading and Wildfire in Insular Terrestrial Ecosystems

Timothy Zhu[1], Creighton Litton[1], Christian Giardina[2] *[1]University of Hawaii-Manoa, Honolulu, USA,[2]Institute of Pacific Islands Forestry, Hilo, USA*

The interactions of wildfire, non-native invasions, and climate present significant threats to native species and ecosystems in Hawai'i and globally. In Hawai'i, wildfires have increased in scope and intensity from historic conditions due to human ignitions, abundant fuels associated with non-native grasses, and changing climate. For wildfire management, this presents many challenges which are exacerbated by the uncertainties of novel fuel types that occur with the invasion of non-native grasses, and the removal of non-native ungulates that at least partially control fuel loads. Although non-native ungulate removal is a general prerequisite for the effective conservation and restoration of native ecosystems in Hawai'i, it is largely unknown how their removal impacts the drivers of wildfire. This study asks whether non-native ungulate removal increases fuel loads, and whether potential increases in fuel loads vary as a function of mean annual precipitation (MAP). We hypothesized that ungulate exclusion would increase fuel loads at intermediate MAPs, but have no impact at low or high MAPs. We used standard fuel transects and sampling to quantify fuel loads inside and outside of 12 non-native ungulate exclosures located across a 2,700 mm MAP gradient on the island of Hawai'i. Results demonstrate that fine fuel loads and heights, primary drivers of wildfire, were higher with ungulate exclusion. However, we found little support for our original hypothesis that this would only be true for intermediate MAPS, as increased fuel loads

with ungulate exclusion increased with MAP. This research informs management attempting to balance wildfire and conservation/restoration across tropical landscapes.

1-14

The Mālama Honua Worldwide Voyage's Promise to Pae‘ Aina o Hawai‘i

Eric Co[1,2], Eva Schemmel[3], Manuel Mejia[4,1], Jean Tanimoto[5], Elia Herman[6], Kevin Chang[7], Elizabeth Fischer[7] *[1]Polynesian Voyaging Society, Honolulu, HI, USA, [2]Harold KL Castle Foundation, Kailua, HI, USA, [3]Conservation International, Honolulu, HI, USA, [4]The Nature Conservancy, Honolulu, HI, USA, [5]NOAA Office for Coastal Management, Honolulu, HI, USA, [6]Department of Land and Natural Resources, Honolulu, HI, USA, [7]Kuaaina Ulu Auamo, Kaneohe, HI, USA, [8]U.S. Department of Transportation Federal Highway Administration, Honolulu, HI, USA*

Since embarking on the Mālama Honua Worldwide Voyage in May 2014, Hōkūle‘a, Hawai‘i‘s iconic sailing vessel, has sailed more than 26,000 nautical miles and made stops in 14 countries and 70 ports, weaving a “Lei of Hope” around the world. The voyage seeks to engage all of Island Earth - practicing how to live sustainably while sharing Polynesian culture, learning from the past and from each other, creating global relationships, and discovering the wonders of this precious place we call home. Along the way, Hōkūle‘a‘s crew and partners have spread the message of Mālama Honua (or taking care of Island Earth) by promoting sustainability and environmental consciousness, as well as exchanging ideas with the countries the canoe has visited. The canoe will return to Hawai‘i on June 17th, 2017.

Consequently, the natural questions arise: During a worldwide voyage with worldwide implications, what will be done to improve Hawai‘i? How will the Hawai‘i that the canoe comes home to, be different from the Hawai‘i it left behind four years prior? In response to these questions, a number of marine resource management organizations, spanning the federal, state, local government and private sectors gathered and penned the Promise to the Pae‘Āina. Today, more than 60 organizations and 150+ individuals have committed to this unique collective impact initiative and are taking action. The significance of these actions is that, like Hōkūle‘a, they serve as a platform that brings us together, as a canoe that propels us to work toward shared destinations.

CONCURRENT SESSION 2

2-1

Kai Kuleana Kākou - working together to care for land and sea in West Hawai‘i

Charles Young[1], Hannah Springer[2], Kaimi Kaupiko[3], Malia Kipapa[4], Kuulei Keakealani[5], Diane Kanealii[7], Jeff Coakley[8], Reggie Lee[9], Pii Laeha[10], Chad Wiggins[11], Lani Watson[12] *[1]KUPA, Hookena, South Kona, USA, [2]Ka‘ūpūlehu Marine Life Advisory Committee, Kaupulehu, North Kona, USA, [3]Paa Pono Milolii, Milolii, South Kona, USA, [4]West Hawai‘i Fishery Council, Pahoehoe, North Kona, USA, [5]Hui Aloha Kiholo, Kiholo, North Kona, USA, [6]Kailapa Community Association, Kailapa, South Kohala, USA,*

[7]Maikaʻi Ka Makani O Kohala, Inc., Kauhola, North Kohala, USA, [8]Kohanaiki, Kohanaiki, North Kona, USA, [9]Kalahuipuaʻa, Kalahuipuaa, South Kohala, USA, [10]TNC, West Hawaii, USA, [11]NOAA, Habitat Blueprint, Uzbekistan

Coastal communities with deep ties to lands and waters have been caretakers of their home for hundreds of years. With and without outside support, they continue to fulfill the kuleana to mālama ʻāina. Today, coastal community leaders from West Hawaiʻi are working together to help each other succeed by learning, teaching, sharing, returning to traditional practice, and trying new actions. Throughout failure and success, they are steadfast in their efforts, and inclusive in sharing what they have learned. From watershed stabilization to wastewater upgrades to rest periods for reef fish to fishpond rehabilitation and more, the collective knowledge of the Kai Kuleana Network is vast and growing. Join representatives as they share their story and contribute what you know to move forward together.

2-2

Hawaii's Interagency Biosecurity Plan 2017-2027: Pivoting from Planning to Implementation

Joshua Atwood *Hawaii Invasive Species Council, Honolulu, HI, USA*

The Hawaiʻi Interagency Biosecurity Plan was developed by a broad coalition of stakeholders working to identify a 10-year path to better protect Hawaii's agriculture, natural resources, economy, and the health and lifestyle of Hawaiʻi's people. The planning process, led by the Hawaiʻi Department of Agriculture and Department of Land and Natural Resources, takes a comprehensive, interagency look at our current biosecurity system across pre-border, border, and post-border functions. The resulting plan is a systems analysis that highlights areas where new policies, processes, capacity, and infrastructure can be implemented to better mitigate risks and impacts associated with invasive species. This talk reviews the key recommendations that came out of the planning process and then pivots to discussing implementation. As Hawaiʻi embarks on the 10-year path detailed by the Biosecurity Plan, this talk will review several initiatives that are already underway as part of the first year of implementation, including the development of electronic manifesting technology, new concepts in inspection processes, and restored capacity for addressing human health risks associated with invasive species. This talk will also touch on more challenging aspects of implementing the Biosecurity Plan that are anticipated for implementation later in the 10-year timeline, such as developing dedicated emergency response funding for invasive species and long-term investments in increased capacity for diagnostics, detection, rapid response, and control. This talk is intended as a Year 1 baseline for implementation of the Hawaiʻi Interagency Biosecurity Plan, with future presentations detailing progress and challenges in approaching the plan's 10-year vision.

2-3

What Biosecurity Risk Assessment Tools are Being Considered for Aquatic Invasive Stowaways in Ballast Tanks and Attached to Ship Hulls?

Brett Higgins[1,2], Julie Kuo[1] *[1]Department of Land and Natural Resources (Division of Aquatic Resources), Honolulu, HI, USA, [2]KUPU, Honolulu, HI, USA, [3]AmeriCorps, USA, USA, [4]HISC, Hawaii, USA, [5]USFWS, USA, USA, [6]PCSU, Honolulu, HI, USA*

Hawai`i has the worst aquatic invasive species (AIS) problem among the Pacific Regional states, including Alaska, Washington, Oregon, and California. The top two vectors of AIS transfer into Hawai`i are through the maritime industry via unmanaged ballast water discharge and the attachment of organisms to ship hulls (also known as vessel biofouling). Residents of Hawai`i depend on the commercial shipping industry to bring over 80% of their consumable goods. As a result, nearly 1000 visits to Hawai`i commercial harbors occur annually by shipping vessels. Approximately three quarters of vessel arrivals are international, where the last port-of-call spanned more than 350 locations around the world. Each vessel that arrives from overseas carries the potential for transferring AIS. As a result, the Hawai`i Department of Land and Natural Resources (Division of Aquatic Resources) is considering various vessel biosecurity risk assessment tools for addressing the top two vectors of AIS transfer. This presentation provides an overview of the ballast water and biofouling risk assessment tools being considered as a line of pre-border and border defense against potential AIS introductions. These tools will be used to inform vessel risk management decisions, minimize AIS transfer, and subsequently contribute to the preservation of Hawai`i's aquatic resources.

2-4

Vessel Biofouling: International Ocean Law and Hawai'i's Fight Against Aquatic Invasive Species

Andrew Porter *Coordinating Group on Alien Pest Species, Honolulu, HI, USA*

Aquatic invasive species (AIS) destabalize the ecological framework on which native species depend and negativly impact the economic and recreational capacity of nearshore waters. In developing regulations, it is imperative to understand that a preventative approach to AIS introductions is far more cost-effective than reactive measures to manage alien species once introduced. Due to the very nature of shipping, AIS introdcutions from the shipping industry are a global problem requiring a global solution. This presentation will outline the prevention of AIS transfer through the regulation of vessel biofouling under international ocean law. It will also provide an overview of the current regulatory regime affecting vessels entering Hawai'i's waterways and the permitting system for hull husbandry in Hawai'i harbors. The presentation will conclude with a summary of regulatory challenges and solutions aimed at addressing the transfer of AIS via vessel biofouling on a regional, national, and global level.

2-5

E-manifesting and Inspection Facilities: Increasing Efficiency Through Risk-Based Inspections

Jonathan Ho *Hawaii Department of Agriculture Plant Quarantine Branch, Honolulu,*

Hawaii, USA

The Hawaii Department of Agriculture Plant Quarantine Branch (PQB) is developing a modern E-manifest system to allow shippers and importers to electronically submit relevant commodity information prior to arrival in Hawaii. This system, in conjunction with inspection facilities, will allow the PQB to utilize risk-based inspections and prioritize a limited workforce. This talk will provide an overview of how the E-manifest system and inspection facilities work within the scope of the Hawaii Interagency Biosecurity Plan, and how the implementation of an E-manifest system and utilizing inspection facilities will increase PQB inspector efficiency and increase detection and prevention efforts at ports of entry throughout the State.

2-6

Researching the Efficacy and Efficiency of a Low-cost and Lay-tech, Small Unmanned Aerial System for Detecting Multiple Invasive Species Targets

Timo Sullivan[1,2] *[1]BIISC, Hilo, HI, USA, [2]UH Hilo, TCBES, Hilo, HI, USA*

Detection of invasive species is the first step in effectively managing their presence. However, given the remote or inaccessible areas of the Hawaiian Islands, and the high-cost of traditional aerial surveillance, many landscapes remain unsurveyed for invasive species. In order to address this detection gap, Big Island Invasive Species Committee (BIISC) has purchased and modified a consumer, small unmanned aerial system (sUAS) in order to research the cost, efficacy, and practicality of detecting invasive species from low-altitude, high-resolution aerial imagery. Because conservation agencies throughout Hawai`i deal with a large catalog of invasive species with limited budgets and expertise, our sUAS is designed to be broad-use, low-cost (<$3000), and lay-person friendly. Collected imagery is in the form of GoPro® video and subsequent imagery proccesing, classification, and geo-rectification are only marginally required. With this system BIISC has completed over 100 hours of flight time and 500 acres of surveillance, resulting in 2,000+ individual plants and 11 invasive species being successfully detected. Our findings regarding the cost and efficacy of sUAS surveillance compared to other traditional methods suggest that at times a sUAS can more accurately and efficiently detect invasive species. Our talk will focus on our system, methods, results, conclusions, permissions, and dissemination in respect to this low-cost, lay-tech sUAS research.

2-7

Integrating global and regional species distribution models to improve biosecurity and invasive species management in Hawai‘i

Lauren Kaiser[1], Lucas Fortini[2,3], Jim Jacobi[2], Adam Vorsino[4] *[1]HCSU, Hilo, HI, USA, [2]USGS Pacific Island Ecosystems Research Center, Honolulu, HI, USA, [3]Pacific Islands Climate Change Cooperative, Honolulu, HI, USA, [4]US FWS, Strategic Habitat Conservation Division, Pacific Islands Office, Honolulu, HI, USA*

In Hawai‘i, invasive plants can be detrimental to native ecosystems and lead to the degradation of endemic environments. Invasive plants threaten the components and processes of these native ecosystems that are home to an abundance of species found nowhere else in the world. Species Distribution Models (SDMs) can be used to forecast current locations and potential distributions of invasive species to help prioritize conservation management practices. The utility of SDMs as a tool for predicting the impact of invasive species has been hindered in the past by certain data and model based limitations. We used a combination of regional and global data along with local expert knowledge to overcome such limitations by improving the estimates of potential distribution and impacts of several invasive plant species of concern in Hawai‘i. By using species habitat suitability scores from global models to weight the regional models, more robust species distributions projections for multiple invasive species in Hawai‘i can be modeled under current and future climate scenarios. This work builds on our understanding of native-dominated ecosystems and associated threats from the combination of introduced plant species and ongoing climatic changes to better prioritize management efforts. This framework can also be applied to other species, including those not yet present in Hawai‘i, to aide in preventative conservation planning and ensuring greater biosecurity.

2-8

Responding Hard and Fast On Soft Money, Or, How Stable Relationships Killed the Drama and 10,000 Invasive Plants

Springer Kaye[1], Flint Hughes[2] *[1]Big Island Invasive Species Committee, Pacific Cooperative Studies Unit, University of Hawaii, Manoa, Hilo, HI, USA, [2]Institute for Pacific Islands Forestry, USDA Forest Service, Hilo, HI, USA*

Strong, stable funding for post-border management of invasive species is critical to ensure that new and sparsely established pest species do not create permanent, costly impacts to agriculture and conservation areas. Early Detection and Rapid Response capacity in Hawaii is largely tax-payer funded, and affected similarly and simultaneously at the local, state, and federal level by strong shifts in the US economy, such as the 2007 economic recession. During the past five years, for example, the Hawaii Invasive Species Council has received relatively strong and consistent funding, when compared to the previous five years (though at no point have funds been sufficient to meet statewide need). Ten years ago, the Big Island Invasive Species Committee adopted an Early Detection and Rapid Response (EDRR) approach to invasive species management, closing the chapter on Operation Miconia in favor of stopping "the next miconia." Six target species were selected to demonstrate the potential for eradicating species established, at varying degrees of severity, on the island of Hawaii. In this presentation, we will examine progress made toward eradication of each species between 2008 and 2012, during the recession, and 2013-present. We discuss effective methods for systematic eradication of species, and other factors contributing to the economic recovery of ISC programs. An encouraging picture emerges, for those optimistic about Hawaii's economic future and the adoption of the Hawaii Interagency Biosecurity Plan.

2-11

Skewed Sex Ratios in a Critically Endangered Forest Bird on Kaua'i

Justin Hite[1], Lisa Crampton[1], Bryce Masuda[2] *[1]Kauai Forest Bird Recovery Project, Hanapepe, HI, United States Minor Outlying Islands, [2]San Diego Zoo Global, San Diego, CA, United States Minor Outlying Islands*

'Akikiki (*Oreomystis bairdi*) have suffered dramatic declines in recent decades, from several thousand to fewer than 500 birds, yet causes of this decline have remained a mystery. Specifically, is the decline uniform among all ages and sexes? From detailed observations of wild 'Akikiki (studied as we monitored nests for egg collection) and the developing flock of captive birds, we can now confidently age wild unbanded birds to hatch year (HY), second year (SY), and after second year (ASY). In 2015 and 2016, we were able to age both adults of 49 breeding pairs. Both adults were ASY in 60% of pairs, compared to 32% with an ASY male and SY female. Both birds were SY in only 6% of pairs, and there were no cases of an SY male with an ASY female. In total there were 19 SY females in the breeding population, compared to 3 SY males (a six-fold difference). Using plumage we also documented turnover of territories between 2015 and 2016. The number of territories in our study area dropped from 36 to 25. Based on plumage, we estimate that half the remaining territories include at least one new bird, typically the female. These observations suggest that mortality is higher for females than males, which will likely dramatically limit population growth, although reproductive success appeared high. Causes of possible higher female mortality are not understood, but may include increased rat predation or incidence of mosquito-borne diseases, because only females incubate eggs. Both threats must be addressed immediately.

2-12

***In Situ* and *Ex Situ* Conservation of Two Critically Endangered Forest Bird Species through Conservation Partnerships**

Michelle Clark[1], Lisa Crampton[2], Bryce Masuda[3], Justin Hite[2], Lucas Behnke[4], Katie Ersbak[5], John Vetter[1], Melissa Fisher[4] *[1]Pacific Islands Fish and Wildlife Office, Kapaa, Hawaii, USA, [2]Kauai Forest Bird Recovery Project, Hanaepepe, Hawaii, USA, [3]San Diego Zoo Global, Volcano, Hawaii, USA, [4]The Nature Conservancy, Lihue, Hawaii, USA, [5]Division of Forestry and Wildlife, State of Hawaii, Department of Land and Natural Resources, Honolulu, Hawaii, USA*

'Akikiki (*Oreomystis bairdi*) populations have declined by over 80 percent in the last two to three decades and the species' range has contracted from 21,745 ac. in 1973 to less than 6,178 ac. today. 'Akikiki now number an estimated 468 individuals. Akeke'e (*Loxops caeruleirostris)* populations have also undergone a dramatic decline over the past two decades and currently the species has a population estimated at 950 birds with its range contracting from 31,382 ac. to less than 12,355 ac. over the past decade (Paxton et al. 2016). Both species could go extinct within the next five to ten years. A Structured Decision Making workshop was conducted by the Kaua'i Forest Bird Recovery Working Group in 2013 to prioritize actions to prevent extinction. The highest ranking priority actions involved conducting a combination of management activities

including *ex situ*, collecting eggs for conservation breeding and future releases, and *in situ*, habitat protection, predator control and mosquito abatement strategies**.** The Kaua'i Forest Bird Recovery Project, Hawai'i Division of Forestry and Wildlife, San Diego Zoo Global, Pacific Islands Fish and Wildlife Office, The Nature Conservancy, Kaua'i Watershed Alliance, American Bird Conservancy and Pacific Cooperative Studies Unit have come together to implement many of the recommended actions, such as establishing captive populations, habitat management and predator control. To address the threat of mosquito born avian diseases, preliminary studies have been conducted to identify source populations and treat larval breeding sites. Future studies are geared towards controlling mosquitoes across the landscape.

2-13

Changes in Hawaiian Bird and Plant Communities across 40 Years

Kevin Brinck[1], Marcos Gorresen[1], Rick Camp[2], Paul Berkowitz[1], Jackie Gaudioso-Levita[3], Jim Jacobi[2] *[1]University of Hawaii at Hilo, Hilo, Hawaii, USA, [2]U.S. Geological Survey, Volcano, Hawaii, USA, [3]Hawaii State Division of Forestry and Wildlife, Hilo, Hawaii, USA*

Beginning in 1977 the Hawaii Forest Bird Survey (HFBS) collected measurements of the bird and plant communities on all the main Hawaiian islands except Oahu (Scott et al. 1996). In 2015 we-resurveyed the original HFBS transects in a single tract of native forest on windward Hawaii Island. We replicated the original techniques to produce measurements that could be directly compared across the decades. Considerable changes occurred in the bird and plant communities. Native bird abundance decreased and two species are no longer found at lower elevations, while naturalized birds increased in both abundance and number of species in the same region. The richness of endemic and indigenous plant species decreased dramatically in the low and middle elevations below an invasive weed front. The structure of the forest showed evidence of changes in dominant and sub-dominant tree canopy cover, shrub and herbaceous cover, and tree canopy height.

Land use, invasive species, and climate change are strong drivers affecting the composition of native bird and plant communities. Monitoring those changes are a valuable tool in prioritizing and evaluating conservation targets and techniques. The original Hawaii Forest Bird surveys provide a baseline for measuring those changes across the state and over the past four decades.

2-14

Securing the Future: How We Founded Conservation Breeding Populations of Two Critically Endangered Endemic Passerines from Kaua'i

Lisa Crampton[1,4], Justin Hite[1,4], Bryce Masuda[2], Michelle Clark[3], John Vetter[3] *[1]DOFAW-Kauai Forest Bird Recovery Project, Hanapepe, HI, USA, [2]San Diego Zoo Global, San Diego, CA, USA, [3]USFWS-Pacific Islands Fish and Wildlife Office, Honolulu, HI, USA, [4]University of Hawaii Manoa-PCSU, Honolulu, HI, USA*

Alarming population trends of two endangered endemic honeycreepers on Kaua'i, ‘Akikiki (Oreomystis bairdi) and ‘Akeke'e (Loxops caeruleirostris), have necessitated immediate action. Surveys in 2012 found only 468 ‘Akikiki (95%CI: 231-916) and 945 Akeke'e (95%CI: 460-1,547) individuals, down 71% and 48% respectively since 1981, with steeper declines and range contractions since 2000. Now restricted to the Alaka'i Plateau (>1000m ASL), these species face numerous threats: habitat loss, hurricanes, invasive plants and animals, and introduced mosquito-borne diseases. In 2013, experts deemed the foundation of conservation breeding populations, along with in situ threat management, necessary to safeguard against the imminent extinction of these species. Thus in 2015, we began egg collections to initiate conservation breeding populations; collections continued in 2016 and 2017 with a goal of 60 founders per species. Egg collection involves finding nests, monitoring until eggs are 10-14 days old, accessing eggs via a ladder suspended by ropes, placing them in a temporary incubator, and flying them to an on-island rearing facility. Chicks are moved to permanent facilities within two weeks. To date, we have found 78 ‘Akikiki and 9 ‘Akeke'e nests and collected 45 ‘Akikiki eggs from 29 nests and 10 ‘Akeke'e eggs from four nests, from which 33 ‘Akikiki and seven ‘Akeke'e hatched. Currently, 26 ‘Akikiki and three ‘Akeke'e reside in facilities. Egg collections have little effect on wild populations because many pairs renest and fledge chicks from a second nest. We discuss differences between ‘Akikiki and ‘Akeke'e results and plans to build a robust ‘Akeke'e conservation breeding flock.

2-15

Movement and Sexual Dimorphism of the Endangered Hawaiian Coot (*Fulica alai*) on Oahu

Randi Riggs *USFWS, Kahuku, HI, USA*

The Hawaiian Coot is one of only six native waterbird species remaining in Hawaii. Most of its population is on Kauai and Oahu. Oahu also has the most wetland loss and fragmentation. This study aimed to determine if the species exhibits sexual dimorphism, if shield size exhibits seasonal variation, and if morphometrics could predict sex accurately, as an alternative to molecular sexing. It also sought to determine if wetland loss prevents movement and how common intraisland and interisland movements are. Sixty coots were captured from five Oahu wetlands, tagged with neck collars, and morphometric measurements and blood samples were taken. Resight data were collected from November 2011 to December 2013. The sex ratio was male biased. No morphological character tested differed significantly between the sexes when assessed independently. However, stepwise binary logistic regression indicated tarsus length, bill height, tail length, and wing length in combination differed between the sexes. Shield size of males exhibited a significant declining trend over the year, being larger in males during the pre-breeding and breeding season and smaller during the post-breeding season. Female shield size did not vary among seasons. The accuracy of predicting sex based on morphometrics was insufficient to substitute for molecular sexing. Habitat fragmentation did not preclude movement, intraisland movement was common and channels between islands did not impede interisland movement. Movement was not associated with sex or wing morphometrics. Analysis of resight histories indicated encounter probability was lower during the pre-breeding and early breeding seasons than the late and post-breeding seasons.

2-16

The Spatial Distribution of Wēkiu Bugs (*Nysius wekiuicola)* Within a Cinder Cone on Maunakea Volcano, Hawai‘i

Jessica Kirkpatrick, Jesse Eiben *University of Hawai‘i at Hilo, Hilo, HI, USA*

The Hawaiian endemic wēkiu bug (*Nysius wekiuicola)* is a unique flightless insect that inhabits the tephra cinder cones above ~3,500 m elevation on the summit of the Maunakea volcano. These insects persist on cinder cones due to the cinder substrate characteristics that allow the bugs to survive the extreme daily variations in temperature and humidity. Astronomical observatory facilities have been constructed predominantly on these cinder cones and overlap with wēkiu bug habitat. Observatories will be decommissioned in upcoming years, and the decommissioning process requires a habitat restoration plan for arthropod communities. Baseline information on species habitat use through time is necessary for a successful habitat restoration plan. Our study assessed the spatial arrangement of wēkiu bugs within a cinder cone from June 2016 thru June 2017 to identify annual habitat use. Forty random points were selected within a cinder cone, and baited pitfall traps were placed at trap locations 6 times throughout the sample period. In 2016, wēkiu bug captures were almost exclusive to the Northern slope of the cinder cone. However, in January 2017 just after a large snow event, we captured 528 wēkiu bugs on the South slope alone. These results suggest the wēkiu bug requires the entire cinder cone habitat throughout the year, and the differing cardinal direction aspects appear to serve as an important habitat refuge from snow events. Habitat restoration efforts should focus on continuous cinder cone habitat for long-term survival of the wēkiu bug, rather than specific aspects of the cinder cone.

2-17

Ka‘ika‘i Iwikuamo‘o - Nāhululeihiwakuipapa Leadership Styles & Pathways Workshop

Sean Marrs[1], Kehau Springer[2], Mahealani Bambico[3], Linnea Heu[1], Kaimana Bacarse[5], Justyn Ah Chong[6], Pelika Andrade[7], Kamala Anthony[8], Brenda Asuncion[9], Keola Chan[10], Alex Connelly[9], Bryson Hoe[6], Kim Morishige[11], No‘eau Peralta[12], Miki‘ala Pescaia[13], Mana Purdy[14] *[1]The Nature Conservancy, Hawaii, USA, [2]Conservation International, Hawaii, USA, [3]Hawaii Conservation Alliance, Hawaii, USA, [4]UH Hilo, Hilo, USA, [5]Kamehameha Schools, Hawaii, USA, [6]‘Oiwi TV, Hawaii, USA, [7]Sea Grant, Hawaii, USA, [8]Honokea Loko I‘a, Hawaii, USA, [9]Kua‘aina Ulu Auamo, Hawaii, USA, [10]‘Aka Kane, Hawaii, USA, [11]UH Mānoa, Hawaii, USA, [12]Hui Mālama ke Ala Ūlili, Hawaii, USA, [13]Kalaupapa National Historical Park, Hawaii, USA, [14]Queen Lili‘uokalani Trust, Hawaii, USA*

Ka‘ika‘i means to lead, support, lift up, or raise. Iwikuamo‘o is one of four starlines used by navigators to lead them to their destinations; it also means “backbone”, and is a metaphor for a genealogical line. With these two terms as inspiration, the Nāhululeihiwakuipapa Next Gen Subcommittee welcomes participants who want to explore leadership skills, styles and pathways to leadership.

As many emerging professionals continue on their career path, defining one's style of leadership is necessary in building personal capacity. There are numerous types of leadership and the pathways to become a leader are different; each person's experience is unique. Similar to voyaging on a wa'a, leadership needs to come in various forms for the wa'a to function efficiently and allow the crew to thrive.

Our workshop will begin with a hands-on activity exploring the significance of 'aha and how this traditional practice intertwines with leadership. The hands-on activity will continue throughout the workshop to incorporate into the 'aha the 'ike (knowledge) being shared and gained. A panel of seasoned and emerging leaders will discuss their leadership styles and share their personal journeys. Panelists will then lead breakout groups and facilitate discussion surrounding leadership perspectives and methodology. The group will reconvene to close the workshop with overarching insights and themes on leadership. Join us for a dynamic and interactive discussion about navigating leadership pathways in Hawai'i.

2-18

Building capacity and collaboration to implement the Hawai'i Strategy for Plant Conservation

Matthew Keir[1], Lauren Weisenberger[2] *[1]Laukahi: The Hawaii Plant Conservation Network, Honolulu, Hawaii, USA, [2]U.S. Fish and Wildlife Service, Honolulu, Hawaii, USA*

The plants of the Hawaiian Islands comprise one of the most unique and rare floras in the world, with over half of all species at risk of extinction. Decades of diligent work has secured thousands of acres of habitat, mitigated the impact of invasive species, and secured collections of several hundred rare plants at botanical gardens and seed banks. With the number of rare species increasing, and half the flora endemic to just one of the main islands, it is increasingly imperative that we collaborate, communicate, and demonstrate progress towards common goals to local and international conservation agencies, funders, and government. The Hawai'i Strategy for Plant Conservation (HSPC) was developed with input from over fifteen local conservation entities to address these needs. It is aligned with the Global Strategy for Plant Conservation to promote progress towards protecting global biodiversity. The HSPC called for establishing Laukahi: The Hawai'i Plant Conservation Network, a voluntary alliance of agencies and public and private organizations to implement the HSPC. Laukahi promotes standard metrics to monitor collective progress toward Hawai'i's conservation goals, builds capacity of infrastructure and personnel by engaging new partners, encourages increased research on Hawai'i's native plants that advance conservation efforts, engages with national and global efforts to raise Hawai'i's profile in global biodiversity conservation, and facilitates collective planning and shared goal-setting for securing and protecting ex situ collections and in situ habitat.

2-19

***Hibiscus waimeae* subsp. *hannerae*: A Case Study on Implementing the Hawai'i Strategy for Plant Conservation**

Seana Walsh *National Tropical Botanical Garden, Kalaheo, HI, USA*

Urgency to protect our native flora is apparent. A large network of gardens, seed banks and nurseries in state, federal and private organizations (Laukahi: The Hawai‘i Plant Conservation Network) is working to implement the Hawai‘i Strategy for Plant Conservation (HSPC), which was modeled after the Global Strategy for Plant Conservation, and introduced in 2014. The HSPC created benchmark goals to protect native plant species of conservation importance, by first reaching complete *ex situ* genetic representation for each target species. One target is the Critically Endangered Kaua‘i endemic taxon, *Hibiscus waimeae* subsp. *hannerae*. Almost all remaining individuals in Hanakāpī‘ai Valley (36 individuals), Pohakuao Valley (6 individuals), and Lower Limahuli Valley (23 individuals), have been tagged with a unique ID, mapped, and DNA, seed and cutting collections made. Leveraging strength of the HSPC, genetic research is being done in collaboration with Chicago Botanic Garden. This molecular study is allowing examination of the genetic diversity of this taxon that remains, which will inform how to best manage *ex situ* collections and eventual outplantings in the wild. With less than 200 individuals remaining, maintaining robust *ex situ* conservation collections that adequately capture remaining genetic diversity will help to ensure success in future population augmentations and reintroductions into protected and managed habitat. The work being done can serve as a model for effective coordination and implementation of plant conservation strategies for other species of conservation importance in Hawai‘i.

2-21

TEMPORAL VARIATION IN MOVEMENT PATTERNS WITHIN THE SEED DISPERSAL COMMUNITY ON OAHU; IMPLICATIONS FOR CONSERVATION

Rebecca Wilcox, Corey Tarwater *University of Wyoming, Laramie, USA*

Invasive species are of conservation concern on islands across the Pacific, however their impact on ecological processes, such as seed dispersal, is often unclear. Seed dispersal is a critical ecosystem process for maintaining the integrity, diversity and structure of native ecosystems. Understanding the movements of invasive dispersers is a key aspect of assessing their impact on seed dispersal, however we often take a static view of movement and ignore how temporal variation in movement might alter seed dispersal. This is particularly important in novel ecosystems where plants and their invasive dispersers have not evolved together and a decoupling between plant phenology and long distance dispersal events may occur. Here we examine temporal variation in movement of the three key vertebrate dispersers on Oahu, where all native frugivores have gone extinct. Our study species range in body size, gape size, diet preference, and density. Interspecific and intraspecific variation in their distances traveled and foraging behaviors may impact what seeds are dispersed and how far they are dispersed. We examined variation in disperser movement using radio-telemetry and found that the distances that individuals moved per hour varied between the wet and the dry seasons and by bird species. This suggests that plant species that fruit and are consumed by specific dispersers during the dry season will potentially be moved greater distances than other plant species. Our work here indicates that understanding temporal variation in invasive disperser movement is critical for understanding the impact specific

invasive dispersers have on native plant communities.

2-22

Rates and Patterns of Natural Regeneration of Dryland Forest Species in Ka‘ūpūlehu Forest Preserve.

Reko Libby[1], Tamara Ticktin[1], Yvonne Carter[2], Keoki Carter[2], Wilds Brawner[2], Lehua Alapai[2], Kekaulike Springer[2] *[1]University of Hawaii at Manoa, Honolulu, Hawaii, USA, [2]Kamehameha Schools, Kailua Kona, Hawaii, USA*

Dryland forests are severely threatened in Hawai‘i, largely because of habitat destruction, fire, drought, ungulate grazing, and invasive plant competition. Although restoration efforts of threatened and endangered species (T&E species) have been taking place for more than 15 years in some locations, there is little quantitative information on if and how natural regeneration of these species are occurring. We assessed rates and patterns of natural regeneration for seven T&E species in the fenced 76 acre Ka‘ūpūlehu Forest Preserve, Hawai‘i Island, where fire and invasive plants/ungulates have been controlled. Working along with managers, we monitored all natural regeneration of the seven species annually over 3 years, recording growth, survival, and presence/absence of flowering and fruiting. We took hemispheric photos to assess canopy cover, measured water potential with a Pressure Chamber instrument, and visually estimated degree of insect herbivory as factors that contribute to natural regeneration. A total of 279 new recruits recovered over a 3-year period. Some species, including kauila (Colubrina oppositifolia), ko'o ko'o lau (Bidens menziesii and B. micrantha), and ma'o hau hele (Hibiscus brackenridgei) showed consistent and high levels of recruitment and subsequent seedling survival. Uhiuhi (Mezoneuron kavaiensis) on the other hand produced many seedlings but few survived up to sapling stage due to intense insect herbivory. Kauila, ko'o ko'o lau, ko'o loa 'ula (Abutilon menziesii), and Bonamia menziesii had the highest percentage of seedlings that flowered. Our results help highlight threats to endangered species and sheds some light on understanding the demography of Hawaiian dryland ecosystems regeneration.

2-23

Impacts of Introduced Leaf-Galling Insects on Reproduction and Seedling Survival of *Myoporum sandwicense*, a Native Hawaiian Tree

Corie Yanger, Rebecca Ostertag *University of Hawai‘i at Hilo, Hilo, HI, USA*

On Hawai‘i Island, an introduced leaf-galling thrips species (*Klambothrips myopori*) has infested populations of naio (*Myoporum sandwicense*), an abundant native tree, causing widespread dieback. The extent to which infestation affects naio reproduction has been unknown. Within two recently invaded naio populations, one mesic and one dry, I counted flowers and fruits and assessed gall damage and foliage dieback for trees with different levels of initial gall damage monthly for one year. At these same sites, I

recorded gall damage, foliage dieback and height for naio seedlings. Naio reproduction decreased for trees with moderate and high initial gall damage regardless of site. Reproduction also declined drastically for trees with zero to low initial gall damage at the dry site. Results from analyses indicated that tree foliage dieback, branch foliage dieback, and branch death were the most significant variables explaining naio reproductive decline over time. Damage increased for trees with zero to low initial gall damage at the mesic site, while gall damage remained extremely low for trees with zero to low initial gall damage at the dry site. Damage and dieback increased for trees with moderate initial gall damage at both sites. Seedling survival was 34% at the mesic site and 88% at the dry site, but did not appear to be strongly related to thrips damage. These results indicate that introduced thrips have a notable negative impact on naio reproduction and that additional factors are influencing naio reproduction. This study suggests that without management action, naio populations will likely decline.

2-25

Plant conservation from a microbial perspective: Foliar microbiome transplants confer disease resistance and survival to a critically-endangered Hawaiian endemic

Geoffrey Zahn, Anthony Amend *University of Hawaii at Manoa, Honolulu, HI, USA*

Inside the roots and leaves of every plant ever studied, there are dozens or even hundreds of different species of fungi (the plant microbiome), many of which have been shown to fight off infection from pathogens. This fact has been exploited successfully in agricultural systems, where much care is often given towards managing plant microbiomes for productivity, but there has been very little effort to incorporate foliar microbiomes into plant conservation efforts. Phyllostegia kaalaensis is a critically endangered Hawaiian endemic mint that has been extirpated from the wild and is known to suffer from pathogen mortality. Greenhouse populations are dependent on regular fungicidal applications that cannot be maintained for remote out-planted populations, which quickly perish. We conducted an experiment to test total foliar microbiome transplants from wild relatives onto P. kaalaensis in an attempt to mitigate disease. Individuals receiving applications of a simple leaf slurry showed decreased disease, to which we partially attribute an increase in a beneficial fungal partner. Treated plants have since been moved to a native habitat and, as of this writing, remain disease-free, representing the only exant wild population of this species. Plant conservation efforts should strive to include foliar microbes as part of comprehensive management plans.

2-26

Artificial Coral Heads for Reef Resilience: Shelter Availability and Reef Context Determine Colonization Rates

Mark Hixon, Eric Dilley, Erik Brush, Ryan Jones *University of Hawaii at Manoa, Honolulu, HI, USA*

Herbivores are crucial for the resilience of reef-building corals by keeping macroalgae in

check, yet are terribly overfished on the main Hawaiian Islands, especially O‘ahu. One means of enhancing the local abundance of herbivorous fishes and urchins on degraded reefs is to deploy artificial coral heads that provide ample shelter and settlement surfaces. A pilot experiment on the south shore of O‘ahu is using cubic-meter concrete modules to cross-factor shelter availability (zero vs. many holes) with fishing intensity (low at Hanauma Bay vs. high off Waikiki). Preliminary results within months of deployment test three hypotheses regarding colonization rates: (1) Modules with many holes will be colonized by fishes and urchins more rapidly than those without holes: corroborated. (2) Because fish and urchin density is greater at Hanauma Bay, modules there will be colonized more rapidly than off Waikiki: falsified. (3) Because there is little natural shelter available off Waikiki, modules there will be colonized more rapidly than in Hanauma Bay: corroborated. Long-term predictions are that, at least at low fishing intensities, modules with many holes will support many herbivores and thus ample corals, whereas modules with no holes will support few herbivores and become dominated by macroalgae.

2-27

Monitoring human behavior and perceptions in Hawaii through NOAA's National Coral Reef Monitoring Program (NCRMP)

Arielle Levine[1,2], Peter Edwards[1], Matt Gorstein[3], Jarrod Loerzel[3] *[1]NOAA Coral Reef Conservation Program, Silver Spring, MD, USA, [2]San Diego State University, San Diego, CA, USA, [3]NOAA NCCOS, Charleston, SC, USA*

NOAA's Coral Reef Conservation Program is involved in a new effort to incorporate social and economic monitoring into the National Coral Reef Monitoring Program (NCRMP). The socioeconomic monitoring component includes gathering information on population change, use of coral reef resources, and knowledge, attitudes, and perceptions of coral reef resources and management. The overall goal of the socioeconomic monitoring component is to track relevant information regarding each jurisdiction's social and economic structure in order to investigate both the impacts of society on coral reefs, and the contributions of healthy corals to nearby communities.

A phone survey of 2,240 adult residents of the Main Hawaiian Islands was completed in 2015. This presentation will highlight summary findings from the survey, including topics such as: resident participation in coral reef-related activities (e.g. fishing, diving, swimming, snorkeling...), residents' knowledge of threats to coral reefs, local perceptions of marine resource condition, support for coral reef management strategies, and understandings of community involvement in coral reef management. Results are currently being incorporated into the NCRMP report card for Hawaii and are available for local researchers and managers to better inform local management planning.

2-28

Using Proteomics and Genetics to Understand Local Acclimatization and Adaptation of Corals

Kaho Tisthammer *Kewalo Marine Lab, University of Hawaii at Manoa, Honolulu, HI, USA*

Corals in nearshore environments are increasingly facing reduced water quality, such as high sedimentation, pollutant and eutrophication. However, some individual corals thrive despite the prolonged exposure to these environmental stressors, suggesting that these individuals are acclimatized and/or adapted to withstand such stressors. Using genetics, population structure was analyzed for the lobe coral *Porites lobata* from Maunalua Bay (Oahu), West Maui, and Palau. The coral populations from the areas with high anthropogenic influences and more pristine offshore sites were compared. The results revealed strong genetic differentiation between the two, indicating that selection (adaptation) is driving the genetic partitioning. Using proteomics, which provides the expressions of over 1000 proteins, the molecular physiological responses of these corals were investigated to understand the mechanisms behind such adaptation. The analysis results suggest inherent differences in metabolic state of the two coral populations. Genetics can provide much information on the state of local populations. For example, understanding small-scale genetic diversity can provide adaptive capacity for a local stressor. Proteomics can reveal the mechanisms of stress resilience of adapted or acclimatized corals. Both will be critical for predicting the effects of climate and environmental changes on coral populations, and establish their effective conservation strategy.

2-29

Appropriate Spatial Scales to Survey Coral Reefs for Conservation and Management

Robert Schroeder, Gerry Davis *NOAA Fisheries, Pacific Islands Regional Office, Habitat Conservation Division, Honolulu, HI, USA*

Effective management of coral reefs depends on understanding ecosystem dynamics at the appropriate scale relative to anthropogenic impacts. Knowledge of the primary spatial extent of major stressors/impacts can help determine the most effective survey design/methods for assessment of biological components. Broad-scale surveys (island to basin) help provide a wide characterization of resources and inform on the general status and long-term trends of reef conditions. The major manageable threats that stress reefs operate primarily at local scales (e.g., watershed, bay), including land-based sources of pollution, military activities, and near-shore fishing impacts. Threats from climate impacts can act at multiple scales and are highly variable. Site-based local surveys, spatially scaled to the geographic extent of the primary impact zone, are needed to inform conservation recommendations and corrective management actions/adaptations. For coral reef managers to maximize success, sites with the greatest risk potential should be prioritized, within a given jurisdiction, and the management question(s) should be explicitly defined, with the most appropriate methods to provide the desired outcome. Factors that need to be fully integrated into implementation planning include: site accessibility, scope and scale of data needs, ecological indicator thresholds, habitat complexity, compliance requirements, compensatory mitigation, and meaningful measures of success. Related considerations include funding availability, human resource capacity, and timeline requirements. With limited resources, ecological surveys to inform efforts that directly halt and reverse coral

reef decline should be prioritized over documenting status and trends.

2-30

Resilience and Recovery of Mounding *Porites* Species Following the 2015 Bleaching Event on Leeward Maui, HI

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Coral reefs worldwide are threatened by thermally induced bleaching events. In 2015, the National Oceanic and Atmospheric Administration declared the third global bleaching event during which Hawaiian coral reefs were severely impacted. To understand how reefs around leeward Maui responded to this bleaching event, large, composite 100m^2 photomosaic images of reefs were analyzed from 2014 to present. Three major reefs were examined across a gradient of herbivorous fish biomass and freshwater input. Mounding *Porites* coral colonies were outlined and individually numbered in each photomosaic in order to compare colony size class distribution before and after the 2015 bleaching event. We found that the population of mounding *Porites* shifted towards small colony predominance on these reefs, as larger colonies of *Porites* experienced greater partial or total tissue mortality after bleaching. Due to differences in the changes between sites, this study suggests that anthropogenic stressors impact coral resilience during bleaching events. These data may be used to help guide coral reef management strategies in Maui moving forward. In addition, the photomosaics present an important new tool for monitoring and managing coral reef ecosystems.

2-31

2015 Coral Bleaching Event on the Coral Reefs of Kaloko-Honokōhau National Historical Park in Hawai‘i

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We report findings on the 2015 coral bleaching event for reefs within Kaloko-Honokōhau National Historical Park located in North Kona, Hawai‘i Island. Since 2007, the National Park Service (NPS) Pacific Island Inventory and Monitoring Network (PACN) has annually monitored the Park’s marine resources. This monitoring includes collecting benthic photoquadrats along thirty, 25-m transects that are subject to standardized image analysis. We analyzed a subset of 15 fixed transects (n=389 photoquadrats) to determine the severity of bleaching on each transect and the prevalence of bleached corals identified to species. Bleaching severity was assigned by estimating the percentage of coral colonies within each photoquadrat that were bleached into one of five categories (0%, 1-25%, 26-50%, 51-75%, 76-100% bleached). In October 2015,

bleached coral colonies were observed on all 30 transects. Of the 15 transects analyzed to date, the majority of photoquadrats contained severely bleached colonies (76-100% range) except for one transect in the 51-75% range. Seventy-seven percent of the analyzed coral points (n=4193) were bleached for 2015. Focusing on the dominant coral species in the park, bleaching was observed in 99% of *Pocillipora meandrina*, 77% of *Porites lobata*, and 75% of *P. compressa*. Analyses of 2016 benthic monitoring is now underway; post-bleaching response and recovery will continue to be monitored to better understand the resiliency of the Park's marine ecosystem and inform management actions.

2-32

Monitoring Individual Coral Colonies through Repeated Bleaching Events at Molokini and Olowalu, Maui

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Hawai'i's coral reefs suffered widespread bleaching events in 2014 and 2015. Coral colony monitoring, originally set up in 2013 at Molokini in response to a coral disease outbreak and bleaching event, was expanded within the reef at Molokini and also to Olowalu to capture the response of corals to these consecutive warm water events. Coral colonies were tagged based on disease and/or bleaching occurrence. This type of colony specific evaluation of coral response to repetitive bleaching events presented a new opportunity to gain a better understanding of the resilience of Hawaiian coral species to disease and bleaching. Summaries were compiled of mean partial mortality data for all colonies by genera and year (i.e. 2013, 2014, 2015). For both sites, the 2015 bleaching event resulted in a higher percentage of mortality per observed colony. The majority of the affected colonies experienced tissue loss in excess of 50% of their surface area. Exposed coral skeletons were quickly overgrown with thick mats of turf algae, which will likely reduce future coral growth and lead to increased erosion on the reef. Some color morphs were more resistant to bleaching, suggesting that there may be intraspecific differences in zooxanthellae clades. Monitoring of individual colonies can easily be done by citizen scientists and the Eyes of the Reef Network has developed an "Adopt a Coral" program to facilitate this. Findings from our study may help to predict future impacts to Maui's coral reefs allowing for better management in light of increasing stressors from global climate change.

2-33

Effects of the 2015 Mass Coral Bleaching Event on the Reefs of West Hawai'i

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For the first time in Hawai‘i's history, the state experienced back-to-back mass coral bleaching with extensive bleaching in both 2014 and 2015 accompanying prolonged thermal stress. The 2015 event was particularly severe, with widespread bleaching observed on almost all of the Main Hawaiian Islands. NOAA's Coral Reef Watch program data showed that in 2015 the western side of Hawai'i Island experienced over 18 consecutive weeks of thermal stress, the highest levels observed in the state. In October 2015, scientists from The Nature Conservancy, NOAA's Coral Reef Ecosystem Program, and Hawai‘i's Division of Aquatic Resources conducted field surveys to assess bleaching in North Kona and South Kohala. The team surveyed more than 14,000 coral colonies across 40 sites, assessing the incidence (proportion of coral colonies that bleached) and severity of bleaching of each colony. Bleaching incidence did not vary significantly with depth, but 68.41% of shallow corals and 59.96% of deep corals were partially or fully bleached. Bleaching was more extensive in South Kohala compared to North Kona. Preliminary results suggest that some South Kohala reefs experienced 55-99% coral mortality due to bleaching in 2015, and 39 of the 40 sites were revisited in October 2016 to estimate overall loss of coral cover. By examining spatial patterns in bleaching and recovery, we can gain insight into which species and regions are especially susceptible or tolerant and improve our capacity to manage Hawai‘i's reefs in the face of increasing bleaching frequency and severity.

2-34

Harnessing a Multi-tracer Approach to Map Non-Point Source Sewage Pollution and its Impacts on South Kohala Reefs.

Courtney Couch[1], Tracy Wiegner[2], Leilani Abaya[2], Rebecca Most[3], Steven Colbert[2], Kristina Remple[4], Kaile‘a Carlson[5], Lindsey Kramer[6], Chad Wiggins[3], Craig Nelson[4], Eric Conklin[3], James Beets[2] *[1]Hawai‘i Institute of Marine Biology, Kaneohe, HI, USA, [2]Marine Science Department, University of Hawai‘i at Hilo, Hilo, HI, USA, [3]The Nature Conservancy, Honolulu, HI, USA, [4]Center for Microbial Oceanography: Research and Education, Department of Oceanography and UH Sea Grant, University of Hawai`i at Manoa, Honolulu, HI, USA, [5]Kaloko-Honokohau National Historic Park, Kailua-Kona, HI, USA, [6]Research Corporation of the University of Hawaii, Kailua-Kona, HI, USA*

Increasing human populations in Hawaii’s coastal regions combined with ineffective land use practices have resulted in deteriorated water quality and impaired reef health statewide. Land-based pollution is of particular concern in Puakō, Hawai‘i Island due to evidence of sewage pollution, and a 50% decline in coral cover during the last 40 years. However, detecting non-point source pollution from cesspools is challenging and its link to coral health is unclear. We used a combination of dye tracer releases, measurements of sewage indicators (fecal indicator bacteria (FIB), nutrient concentrations, $\delta^{15}N$ in macroalgae), and mapping tools to identify sewage pollution hotspots in Puakō. We also conducted coral health assessments to test the link between coral health and environmental metrics. Fluorescein dye injected into cesspools was detected at the shoreline in as little as nine hours. Shoreline nutrient concentrations were two times higher than those in upland groundwater. Nutrient concentrations and FIB abundance were highly spatially variable, but were elevated in shoreline areas and

declined reefward, confirming the presence of land-based inputs. $\delta^{15}N$ macroalgal values and presence of human-specific gut bacteria confirmed the presence of chronic sewage and when combining all variables, we identified 2 sewage 'hot spots'. Nutrient concentration was the strongest environmental predictor of coral health, with higher prevalence and severity of growth anomalies in regions with elevated nitrate concentrations. Our study provides an important management tool for understanding the extent of sewage pollution in Hawaii's nearshore waters and provides a baseline to gauge the efficacy of sewage treatment remediation.

2-35

What does success look like? Developing a monitoring plan for wastewater upgrades at Puako, South Kohala using the open standards.

Chad Wiggins *The Nature Conservancy, Waimea, Hawaii, USA*

Pollution caused by widespread use of outdated wastewater treatment technology, including coastal cesspools, represents a challenge for coastal communities, ocean users, and natural resource managers in Hawai'i. Through the Clean Water for Reefs project, the community of Puakō are being guided through a process to help them decide which wastewater treatment solution they want to implement to solve their sewage pollution problem. In 2016, researchers, regulators, agency officials, engineers, cultural practitioners, volunteer coordinators, and educators cooperatively developed a monitoring plan designed to demonstrate the impact of four possible treatment upgrade scenarios that could be selected by the Puakō community to either reduce or eliminate cesspools and septic systems in Puakō, Hawai'i Island.This plan builds upon research that demonstrated a direct connection between toilets and coastal waters, elevated pathogens along the shoreline, and correlated groundwater inputs to coral disease. Social, economic, and ecological indicators were selected based on expected outcomes associated with each of the four treatment upgrade scenarios, each representing a different level of treatment and implementation timeline. The results from this effort will inform communities, researchers and resource managers about the benefits associated with upgrading sewage treatment technology and this plan can be used as a template for other sites. We will discuss the process of developing this plan, research methodologies selected and expected outcomes.

2-36

Understanding Sustainable Capacity Development and Roles and Responsibility of Advanced Wastewater Treatment Systems at Rural Community Level

Mahana Gomes *Hawaii Rural Water Association, Kamuela, HI, USA*

The sustainabilty of a wastewater treatment facility (existing or future) relies on the understanding of its capacity needs and roles related to such. The Clean Water for Reefs Puako project is a case study of how the three capacity areas and ten keys of Susatainable and Effective Utility Management has guided a rural community in decision making steps of managing their local waste.

Approaching the project with the goal of sustainability in Finance, Management and Technical Capacity, and through a series of trainings and continued communication, awareness and willingness, the Puako project has experienced a rapid pace of forward movement. The Hawai'i Rural Water Association will share some of the highlights of their role in supporting the project.

2-37

Clean Water for Reefs Puakō: A Case-Study Using a Multi-Disciplinary Approach in Guiding Community Decision Making Through a Collaborative Network

Erica Perez *Coral Reef Alliance, Keaau, HI, USA*

Puakō is a rural community that lies in South Kohala and comprises of 231 developed and 37 un-developed Tax Map Key lots. Residents are a diverse mix of permanent homeowners, part-time homeowners, renters, and visitors. Puakō's shoreline is polluted by sewage coming from cesspools, septic tanks and faulty aerobic treatment units that are directly connected to the groundwater. Concerned homeowners approached Coral Reef Alliance (CORAL) to help them identify and facilitate implementation of a solution to address wastewater pollution. The Clean Water for Reefs Puakō project, established and led by CORAL, is solving this problem through a thorough community engagement process and collaboration across a suite of experts. In this talk we will review steps taken to inform community decision-making through recommendations provided by an advisory committee that comprises of community representatives and experts in regulation, research construction, civil engineering and marine conservation. This committee guides: a) water quality research that demonstrates the nature and cause of the pollution; b) investigation and analyses to identify engineering solutions that fit community needs and the local environment; c) presentation of findings to the community; and d) the community decision-making process. We will present lessons learned through engagement and the importance of providing support to local regulatory bodies about wastewater impacts, engineering and implementation of solutions.

CONCURRENT SESSION 3

3-1

Engaging the Sacred - a Hawai‘i Framework and Bio-cultural Curriculum for Transforming Conservationists and Conservation in Hawai‘i

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Today, natural resource professionals in Hawai‘i recognize that effectiveness of and

personal satisfaction from resource management can be enhanced by integrating multiple knowledge systems into all aspects of the management process. Hawai‘i lifeways, sometimes expressed as Hawaiian culture, teaches us that we are kin with our environment, just as we are kin with our siblings, parents, and grandparents. By learning a little more about Hawai‘i lifeways (language, story, ritual, music, hula or dance, poetry, chant, wahipana or pulsing places, family life, the arts, and many other aspects) we learn more about how to express aloha (love, affection, care) for the potential of our island home. Hālau ‘Ōhi‘a Hawai‘i Stewardship Training is a professional development program for stewards of the Hawai‘i landscape, and was created with the goals of: 1) fostering a working knowledge of Native Hawaiian perspectives on resources and resource management; 2) gaining skills founded in Hawai‘i lifeways to enhance how we engage with our ‘āina (landscape) community and our kanaka (human) community; and 3) strengthening relationships among members of the natural resources and conservation community. The program asks learners to grow personally, become younger siblings to the world around us, then think about our conservation jobs from a transformed understanding of who we are and what our role is in maintaining this older sibling. In this forum, Hālau ‘Ōhi‘a members will demonstrate elements of the course and invite audience participation, and share experiences of how this course has influenced their work in conservation, and personal lives more broadly.

3-2

INTEGRATED LANDSCAPE INDICATORS TO EVALUATE THE CONDITION OF "RIDGE TO REEF" SYSTEMS AND PRIORITIZE HAWAIIAN WATERSHEDS FOR RESTORATION

Erik Franklin, Iain Caldwell, Ku'ulei Rodgers *Hawaii Institute of Marine Biology, University of Hawaii, Kaneohe, HI, USA*

The ahupua'a concept, a linkage between the condition of watersheds and adjacent nearshore coral reef communities is an assumed paradigm in the concept of integrated coastal management. We present quantitative evidence for this "ridge to reef" relationship on a large-scale comparing the Hawai'i Watershed Health Index (HI-WHI) and Reef Health Index (HI-RHI). A significant positive relationship is shown between the health of watersheds and adjacent reef environments when all sites and depths are considered. This relationship is strongest for shallow sites facing in a southerly direction, but diminishes for north facing coasts exposed to persistent high surf that increase local wave driven currents and flush watershed-derived materials away from nearshore waters. Candidate metrics for assessing reef condition were tested against independent measures of human disturbance to define biocriteria. Prioritization of watersheds and coastal waters are being developed for protection and restoration in Hawai'i. This study facilitates an understanding of the interaction between ecological processes, spatial patterns, and human activity which can be applied to improve regional-scale conservation and resource management.

3-3

Mapping supply and demand of coral reef ecosystem services to inform a spatial

approach to management

Mary Donovan, Kirsten Oleson, Joey Lecky *University of Hawaii Manoa, Honolulu, HI, USA*

To operationalize ecosystem goods and services and make the concept relevant for decision-making, the process that leads from ecosystem structure and functioning to human wellbeing needs to be unpacked. This includes multiple steps, such as quantifying 1) ecological capacity for supplying goods and services, 2) pressures affecting capacity, 3) demand for services, and 4) actual flow. We mapped the theoretical ecological capacity of coral reefs across the Hawaiian Islands of Maui, Molokaʻi, and Lānaʻi for producing goods and services (e.g., coral reef health, fisheries, cultural resources, and recreation), using using spatial predictive models and ecological production functions. To understand the relationship between capacity and actual flow, we overlaid maps of human use with predicted capacity. We found some areas with low potential capacity have high demand, and vice versa. Likewise, areas with high demand also corresponded to areas with high pressures. In particular, we highlight areas with high potential capacity, but also high demand and high pressure, which represent locations where management actions are needed to avoid comprising ecosystem service supply. Thus, by spatially linking capacity, use, and pressures, management actions can be spatially prioritized such that goals can be tailored to particular processes the lead from ecosystems to human wellbeing. Therefore, the framework we developed offers a novel, social-ecological approach to spatially quantifying ecosystems services for decision-making.

3-4

HIReefSim: a novel modeling tool for ridge-to-reef management of Hawaiʻi's watersheds

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Coral reefs provide critical ecosystem goods and services, but are seriously threatened by environmental and anthropogenic pressures. Ecosystem models can be used to simulate the impacts of local-scale versus global-scale stresses and the effects of management and climate change scenarios on ecosystem goods and services. When ecosystem model output is translated using ecological production functions (EPFs), the outcomes are more tangible and relevant to scientists and decision-makers. We adapted an existing regional-scale model for Maui Nui, Hawaiʻi and applied three EPFs to quantify changes in key ecosystem goods and services over time. We evaluated EPFs under alternative management actions and future climate predictions. Losses of corals were more stymied under high effort sediment mitigation scenarios, but the effects of these management strategies were largely lost when climate change pressures were introduced. This work provides insight into the relative influence of land-based versus marine stresses and local versus global pressures as drivers of reef health.

3-5

Defining Social and Ecological Interactions in West Hawai'i Using Participatory Conceptual Ecosystem Modeling

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The marine ecosystem along the West coast of Hawai'i Island faces numerous threats that compromise the region's ability to deliver socially valuable ecosystem services. The ecological and socio-economic importance of the region prompted the National Oceanic and Atmospheric Administration to initiate an Integrated Ecosystem Assessment (IEA), a program focused on conducting scientific research to support Ecosystem Based Management in West Hawai'i. Initial IEA phases involve identifying socio-economic and ecological relationships. During 2014-2016, we held participatory workshops and surveys involving resource managers, scientists, and community members to gather expert and place-based knowledge. Using this information, we developed Conceptual Ecosystem Models (CEMs) guided by the Driver-Pressure-State-Impact-Response framework that quantify the strength of complex socio-economic and ecological pathways acting upon ecosystem components. We found that many of the strongest pressures acting upon the ecosystem are locally manageable, such as fishing and habitat destruction. Our results also underline corals as highly impacted by pressures, while simultaneously holding great importance for delivery of ecosystem goods and services. Ecosystem service delivery relied on multiple ecosystem components. The most impacted services were primarily intangible benefits, such as cultural and spiritual value, along with foundational services such as biodiversity. Additionally, workshops elicited local values, fostered diverse relationships, and increased community engagement in resource management. This information was used in the West Hawai'i IEA indicator selection process, and will continue to inform subsequent IEA phases. Furthermore, results will help guide local resource managers in creating strategies that mitigate the strongest pressures to protect highly impacted ecosystem services.

3-6

He'eia NERRS: A Partnership to Study the Outcome of Large Scale Restoration of a Watershed to Traditional Hawaiian Ahupua'a Management

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On January 19th 2017 He'eia (Kāne'ohe Bay, O'ahu) became the 29th site in the National Estuarine Research Reserve System (NERRS). The NERRS program, which represents a long-term partnership between NOAA and these 29 Reserve System sites, seeks to advance the mission of stewardship, research, education, and policymaker training on estuaries throughout the nation. We will present the vision of the He'eia NERRS to perform a large scale ecological restoration of the impacted area overgrown by alien invasive species and return the system, insofar as possible, to the traditional ahupua'a strategy of land management with native and naturalized species. The 1385 acre He'eia NERRS will build on existing efforts by site partners mauka to

makai to remove alien invasive species, restore the watershed and rebuild the loʻi kalo that once dominated the landscape of Heʻeia to document the impact on the nearshore fisheries and reefs that change in land management produces. By measuring the suite of ecosystem services provided by this traditional management strategy in the course of the restoration, Heʻeia NERRS seeks to identify the best management practices that contribute to the resilience and integrity of Pacific Island estuarine ecosystems, providing more productive waters for all and enhancing food security. The ultimate goal of the site is to establish a successful ahupua'a in a modern urban setting, which will provide an example of a successful restoration of coastal resources in the face of ongoing anthropogenic impacts and a diverse suite of societal and environmental factors, rather than continued accelerated decline.

3-8

Building Capacity of American Samoan Communities to Manage Stormwater

Sabrina Woofter[1,2] *[1]Governor's Coral Reef Advisory Group, Fogotogo, American Samoa, [2]National Oceanic and Atmospheric Administration's Coral Reef Conservation Program, Washington, DC, USA, [3]Nova Southeastern University, Fort Lauderdale, FL, USA*

Polluted stormwater runoff is a leading factor reducing the quality of nearshore waters in American Samoa. Most residents and members of relevant governmental agencies lack sufficient knowledge and skills regarding these issues and their solutions. The Governor's Coral Reef Advisory Group (CRAG) aims to improve the health of the coral reef ecosystem via the implementation of stormwater best management practices (BMPs), namely rain gardens, around the territory. Efforts focus on community groups and governmental agencies in order to increase the number of residents and leaders who support and implement these conservation measures. Short workshops, demonstration rain gardens, and Samoan language brochures and installation guides have increased the capacity for school teachers, village leaders, American Samoa Community College staff, and members of the administration and ground staff of the Department of Parks and Recreation and the National Park Service to install rain gardens and make wise decisions regarding destructive development practices. As a result, eight community-based rain gardens have been installed in the territory in the last year. Government agencies have become more aware of these bioretention practices and their ecosystem services, as well as more confident in their ability to install them. These practices also offer opportunities to incorporate and be incorporated into Samoan cultural practices regarding local flora. Although CRAG will continue to provide some outreach and technical assistance regarding stormwater and BMPs, its ability to do so will lessen as positions within the organization change. This current capacity building effort ensures continuity of territorial stormwater and BMP knowledge.

3-9

Crabbing and Connectivity: Science for Sustainability

Kaleonani Hurley[1], Erik Franklin[1], Robert Toonen[1,2] *[1]Hawaii Institute of Marine Biology, UH Manoa, Honolulu, HI, USA, [2]SOEST, UH Manoa, Honolulu, HI, USA*

Hawaiian fishponds, or loko i‘a, are ancient aquaculture systems that are models of sustainable aquatic resource management based on long-term experience from traditional Native Hawaiian havest practices. An estimated 488 fishponds provided food security for ancient Hawai‘i, but by 1901 only 99 remained in production, and most of those were abandoned by mid century. Reclamation efforts, beginning in the 1970s, have resulted in the rejuvination of 38 actively managed fishponds across the State. Fishponds are being adapted to modern human population needs, because functional fishponds contribute to improved food security. In this study, we seek to examine culturally and economically important crab fishery species to ask two primary questions: 1) Are fishponds self-seeding or well-connected to the surrounding coastal waters, and 2) What are the traditional management practices for our species, and can those still work today? To find whether fishponds are self-seeding, we will use genetic sequence data to estimate fine-scale patterns of dispersal and exchange between fishponds, adjacent coastal waters, and nearby islands for each of these species. In order to address merging traditional and modern management practices, we investigate traditional fishing and combine it with modern collection data to propose a sustainable crab fishery model.

3-10

What's Your Punchline? How to Make Your Message Resonate with Different Audiences

Toni Parras[1], Kainoa Kaulukukui-Narikawa[1], Amy Olliffe[2] *[1]National Oceanic and Atmospheric Administration Papahānaumokuākea Marine National Monument, Honolulu, Hawaii, USA, [2]US Fish & Wildlife Service, Honolulu, Hawaii, USA*

This forum is targeted at scientists, practitioners, educators and others working in conservation and resource management and aims to improve their effectiveness in engaging with various audiences, including school and youth groups, teachers, partners, decision makers, the general public, and the media. The presenters will use interactive methods to improve message conception and delivery effectiveness. A short present¬ation followed by roundtable breakout sessions will allow participants to begin thinking about and brainstorming on how to communicate with different audiences most effectively. We will explore different mediums for communication and how to utilize them to reach different target groups. By the end of the session participants will understand how to communicate more effectively with new demographics.

The format will consist of: 1) Introductions: everyone introduces themselves in an "elevator pitch" style, saying who they are, what they do and why it's important in one minute or less. 2) A brief presentation showcasing successful examples and explaining the activity. 3) Breakout groups: each group will be given a topic (Climate Change, Marine Protected Areas, Invasive Species, Marine Debris, or other) and a target audience (4th grade students, reporter, congressman/decision maker, teacher/camp counselor, or other). Groups must figure out how they're going to communicate with them (what vehicle - press release, social media, live interaction, etc.) and what they're going to say. The use of a storybox will be introduced to assist with this task. 4) Groups report/role play back to plenary with an "elevator pitch" on their topic in a minute or less.

3-11

Follow the Smoke to Find the Fire: *Spatially Quantifying and Categorizing Statewide Vegetation Shifts and Trends.*

Matthew Lucas, Clay Trauernicht, Kim Carlson *University of Hawaii at Manoa, Honolulu, USA*

Widespread land use change across Hawaii have resulted in large scale vegetation shifts occurring within months to decades. However, much of these vegetation changes are anecdotal or only studied at a single locale, with little data on extent or rate of change. Therefore managers and decision makers lack complete information on changing land cover with which to assess, plan, and prioritize actions. To improve assessments of statewide vegetation change, this project developed annual, high resolution maps of forest, grassland and bare earth percent cover from 1999 to 2016. Vegetation cover was quantified using archived LANDSAT imagery and a custom remote-sensing algorithm developed in the Google Earth Engine platform. These annual maps enabled the detection of gradual (trend based) and rapid (event based) vegetation shifts statewide. To understand the mechanisms and outcomes of land cover change, we also attributed local ecological verification from land managers for areas with significant cover change. This combination of quantitative remote sensing and qualitative confirmation of ecological processes identifies a several drivers and patterns of land cover change in Hawaii. Findings included: (i) 10 years of fire driven forest cover lost, (ii) grass colonization in abandoned agriculture and lava flows, (iii) invasive woody species expansion in vacant pasture, (iv) forest loss from rural development and, (v) native forest regeneration due to intensive restoration efforts. This work is intended to help understand the direct land cover impacts from land use changes, thus allowing researchers, managers and decision makers to evaluate management actions and their landscape scale consequences.

3-12

Forecasting climate and land use/cover change impacts on freshwater ecosystem services in Maui through integration of hydrological and participatory models

Hla Htun, Christopher Lepczyk, Steven Gray, Kirsten Oleson, Yin-Phan Tsang *UH Manoa, Honolulu, HI, USA*

Climate and land use/cover changes are expected to have significant impacts on freshwater resources. We hypothesize that ecosystem services-based integrated modeling, which translates biophysical outcomes into benefits for humans, will increase the adaptive capacity of decision-makers. Adapting to future hydrological conditions requires decision-makers to identify actions that will maintain, or minimize, the loss of valuable ecosystem goods and services. To test our hypothesis, we evaluated local stakeholders' perceptions and values of freshwater, the difference in perceptions between stakeholder groups (i.e., conservationists, agriculturalists, cultural practitioners, and water resources managers), and the impact of climate change and policy on the stakeholders. The integrated approach involved three major steps: modeling freshwater

quality and quantity changes using a hydrological model, SWAT; describing relationships between watershed dynamics and stakeholder values using a participatory model, Mental Modeler; and informing management strategies. Accordingly, we predicted changes and interviewed twenty-seven stakeholders in windward watersheds (Wahikuli, Honokōwai, Kahana, Honokahua and Honolua), and in a leeward watershed (ʻĪao) in Maui. Model results indicated all the stakeholders had very similar perceptions on impacts of climate change, native and alien species, sediment and nutrients on freshwater quantity and quality. However, conservationists believed that stream diversions were a total negative impact, while agriculturalists perceived them as partially helpful irrigation structures. Lastly, both agriculturalists and cultural practitioners stressed freshwater was a lifeline for their operations, practices, and values. Finally, our approach would enhance managers' understanding of the potential impacts that environmental change and management/policy could have on ecosystem goods and services stakeholders value.

3-13

A Data Driven Approach To Measuring Conservation Impact With Web and Mobile Tools

Sam Aruch *Natural Resource Data Solutions, Haiku, Hawaii, USA*

One of the biggest challenges towards implementing and measuring effective conservation across social and political boundaries is communicating the impact and needs of on-the-ground work to stakeholders. This disconnect is driven by the inability to collect and report accurate and relevant data. After over 16 years of experience performing fieldwork and building databases for conservation practitioners throughout Hawai'i, Natural Resource Data Solutions has developed nrds.io, a web and mobile platform to help conservation managers, measure, map, and share their impact. The platform provides an end to end solution to get data out of the field and into the hands of decision makers in near realtime. We will discuss the inspiration behind the project, our approach, successes, challenges, and future needs. We will talk about how the tool can be used by community groups, non-profits, government, and private conservation managers to collaborate, measure impact, and track effective conservation.

3-14

A Multi-Sensor Approach to Vegetation Mapping and Monitoring in a Hawaiian Mesic Forest

Will Weaver, Tomoaki Miura *UH Manoa, Honolulu, HI, USA*

Monitoring the response of Hawaiian forests to management efforts and tracking how vegetation changes over time is a key component of conservation and restoration efforts. Traditional "on-the-ground" vegetation monitoring techniques are time consuming and costly, and can vary in accuracy and consistency. Recent advances in remote sensing technology hold potential for providing an accurate and timely assessment of vegetation at a set point in time. Several new very high resolution (VHR) platforms have emerged that can differentiate individual tree crowns and, thus, have the potential to

change the paradigm of vegetation monitoring and its efficacy. The primary objective was to determine the utility of VHR platforms for vegetation mapping and monitoring in Hawaiian forests. An effective synthesis of the VHR platforms was found to implement classification on satellite imagery where Gigapan, and UAS were used to validate classification results. The costs associated with the implementation of remote sensing based monitoring were determined as compared to ground monitoring methods conducted in the same target area.

3-15

Stewardship Mapping and Assessment Project (STEW-MAP), a Tool to Understand and Support Environmental Stewardship

Heather McMillen[1], Lindsay Campbell[1], Erika Svendsen[1], Christian Giardina[2] *[1]USDA Forest Service, New York City Urban Field Station, New York, NY, USA, [2]USDA Forest Service, Institute of Pacific Islands Forestry, Hilo, HI, USA*

The successful management of urban natural resources relies on collaborative approaches with environmental stewardship organizations. A strong understanding of who these groups are, how they interact, and where they work can enhance collaboration among stewardship groups and between community and agency efforts. The Stewardship Mapping and Assessment Project (STEW-MAP) is a Forest Service research program that addresses the questions: Which environmental stewardship groups are working across urban landscapes? Where, why, how, and to what effect? STEW-MAP uses surveys and other methods to identify organizational characteristics, geographic area (enabling spatial analysis), and relationships with other civic, private, and governmental organizations (enabling social network analysis). Since it was initiated in New York City, the tool has been applied in six more U.S. cities and is underway in other cities around the globe including a pilot program on Hawai‘i Island with plans to expand to O‘ahu. Through building on existing tools and resources such as HCA’s Conservation Connections, STEW-MAP databases and interactive maps can enable the public, municipal agencies, and nonprofits to visualize where and how environmental stewardship groups are working across the landscape. Custom downloads of STEW-MAP data can be used by local government and community organizations to support policymaking and natural resource management. Network analyses of these groups can show the connections among groups and identify groups that are key in distributing information and resources within the network. Analysis of where stewardship is or is not taking place highlights opportunities or issues to address in meeting local conservation goals.

3-16

Mug Shots: Using Photo Matching Software to Keep Track of Hawai`i`s Imperiled Tree Snails

Jenny Prior, David Sischo, Kupa`a Hee *DLNR/DOFAW, Honolulu, HI, USA*

The endangered kāhuli, genus *Achatinella*, is a nocturnal tree snail that inhabits only

remnants of its former habitat on O`ahu. Current protection and restoration practices are difficult to evaluate for success in part because of the challenges of determining accurate snail population sizes before and after management actions. The Snail Extinction Prevention Program has adopted photo-feature-matching software for use with O`ahu's tree snails. We have also updated traditional mark-recapture techniques by eliminating the need to handle and physically mark individuals, thereby reducing snail stress and increasing staff efficiency. Combined with a shorter mark-recpature sampling schedule this new technology has allowed us to reliably estimate population size in a fraction of the time of traditional mark-recapture studies. At our initial study site we have have calculated our detection probability at 20% and are now better positioned to detect changes in population size and also to determine if management actions we have undertaken are being reflected in higher snail numbers. This photo matching technology holds promise for use with other rare taxa (fish, marine invertebrates, large mammals) when individuals are cryptic, nocturnal, or rare, or when reducing risks associated with handling is imperative.

3-17

Traditional Management of Marine Protected Areas of American Samoa

Maria Mauga Vaofanua[1], Christina Mataafa Samau[1] *[1]Department of Marine & Wildlife Resources, Pago Pago, American Samoa, [2]Department of Marine & Wildlife Resources, Pago Pago, American Samoa*

Effective communication, traditional involvement, and permission from the village council are key factors in establishing a Community-based Fishery Management Area. Department of Marine and Wildlife Resources (DMWR) use a bottom up approach when engaging the communities to ensure village involvement. Traditional Chiefs or Family Matai make up the village council and it is they who either accept or deny the program. An initial meeting between DMWR and the village chiefs is set to introduce the Marine Protected Areas program, its purpose as well as the process. Once accepted, meetings with three target groups (chiefs, untitled men, women) in the village is scheduled to identify and discuss, importance, resource uses, and problems with their reefs and possible solutions to these problems. In addition, causes and effects to problems identified to assist in the development of a Village Management Plan. Outreach efforts focus on church and village groups to get an understanding of how different groups utilize their marine resources and educate them on the benefits of establishing a Marine Protected Area (MPA). Village council can develop additional laws in conjunction with existing American Samoa Laws to help regulate the use of the MPA. These regulations will be enforced by individuals identified by the village council with the assistance of the DMWR Enforcement Division.

3-18

Mapping Human Impacts to Coral Reefs with Unmanned Aerial Vehicles

Robert O'Conner *NOAA Fisheries, Honolulu, HI, USA*

Low-cost unmanned aerial systems have been underutilized in mapping damage to coral reefs due to recreational boating activities. The need for fast and accurate mapping is important when making sense of situations where coral reefs require emergency restoration and damage assessments.

With coral reefs under increasing stress from global climate change and other anthropogenic factors, the need to protect them is more important than ever. There are inherent challenges in mapping benthic habitats with typical methods such as scuba surveys and satellite photo interpretation. This study aims to use unmanned aerial vehicles to map damage to coral reefs related to boating in Kāneʻohe Bay. Images were taken at relatively low altitudes from an unmanned aerial vehicle and then mosaicked together using commercially available software. The image orthomosaics were georeferenced and digitized into vector files for further analysis. The vector files can reveal patterns and concentrations of vessel related damage to coral reefs in the bay. Continued data collection can serve to monitor damage and predict future locations of boat interactions with these important marine resources.

3-19

Water Quality Monitoring 101 Training: Citizen Science + Quality Assurance = Actionable Data that improves Hawaii's waters

Manuel Mejia[1,3], Kalisi Mausio[8,3], Kim Falinski[1,3], Tova Callender[9], Alana Yurkanin[1], Dana Reed[6,3], Stuart Coleman[2], Erica Perez[5], Robin Newbold[7], LorMona Meredith[3], Emma Anders[4] *[1]The Nature Conservancy, Hawaii, USA, [2]Surfrider Foundation, Hawaii, USA, [3]Promise to Pae 'Aina (Polynesian Voyaging Society), Hawaii, USA, [4]Hawaii Conservation Alliance, Hawaii, USA, [5]CORAL, Hawaii, USA, [6]Hui Ka Wai Ola, Hawaii, USA, [7]Maui Nui Marine Resources Council, Hawaii, USA, [8]Office for Coastal Management (NOAA), Hawaii, USA, [9]West Maui Ridge to Reef Initiative, Hawaii, USA*

This training workshop on community-based water quality monitoring program is offered in response to a growing demand and high interest statewide in water quality and how citizen science can contribute to crowdsourcing data that can help imporve our water quality. However, quality assurance of the volunteer-collected data must be unassailable for it to be recognized and acted upon by state agencies and to give communities confidence in the data they collect so that they can inform and take strategic actions to address water quality issues in their region. This training workshop will focus on the basic parameters of water quality monitoring, provide examples of successful citizen science programs and how to forge a quality assurance pathway so that monitoring efforsts are useful and valuable.

WEDNESDAY, JULY 19TH, 2017

CONCURRENT SESSION 4

4-1

Papahānaumokuākea: Large-Scale Progression of Co-Management and Cultural Integration

Kalani Quiocho[1], Athline Clark[1], Matthew Brown[2], Keola Lindsey[4], Brad Ka'aleleo Wong[4], Kekuewa Kikiloi[5,6], William Aila[6,7] *[1]NOAA ONMS Papahanaumokuakea Marine National Monument, Hawai'i, USA, [2]U.S. Fish & Wildlife Service, Hawai'i, USA, [3]State of Hawai'i, Department of Land & Natural Resources, Hawai'i, USA, [4]Office of Hawaiian Affairs, Hawai'i, USA, [5]University of Hawai'i at Manoa, Hawai'inuiakea School of Hawaiian Knowledge, Hawai'i, USA, [6]Native Hawaiian Cultural Working Group, Hawai'i, USA, [7]Fisherman, Hawai'i, USA*

Large-scale protected areas require a collaborative approach to address the broad range of challenges. For nearly two decades the Northwestern Hawaiian Islands (NWHI) have received a number of designations: a) the NWHI Coral Reef Ecosystem Reserve in 2000 by President Clinton; b) the NWHI Reserve in 2005 by the State of Hawai'i; c) the NWHI Marine National Monument in 2006 by President Bush; d) the inscription of the region as the first, and currently only, mixed (natural and cultural) UNESCO World Heritage Site in the country in 2010; and e) the recent proclamation for the expansion of Papahānaumokuākea Marine National Monument (PMNM) in 2016 by President Obama. Throughout this timeline of events, the co-managing agencies and Native Hawaiian community have taken critical steps towards integration which now offers a model for collaborative partnerships. With the recent expansion of PMNM, a mix of federal and state agencies collectively known as the Co-Trustees - NOAA, US Fish & Wildlife Service, the State of Hawai'i and the Office of Hawaiian Affairs - are now poised to begin a planning process to shape the next chapter of management in this vast expanse of Moananuiākea. This tremendous task will require intra-governmental collaborative relationships and community partnerships to leverage the resources and expertise within each agency to conserve and protect resources and connect people and communities to this effort. This forum will introduce the progression of protection within Papahānaumokuākea, highlight how culture has influenced the overall management, and discuss collaborative approaches towards effective conservation and management.

4-2

Successes and Challenges of Restoring the Landscape of Hawaii's largest Ahupuaa, Kahuku

Sierra McDaniel[1], Rhonda Loh[1], Mark Wasser[1], Susan Dale[2], Caitlin French[2] *[1]National Park Service, Hawaii National Park, HI, USA, [2]Pacific Cooperative Studies Unit, Manoa, HI, USA*

Biodiversity and ancient connections are re-establishing in the state's largest ahupuaa, Kahuku, following extensive management actions over the past 14 years. The landscape we see today has been shaped by thousands of years of unique climate, volcanic and biologic activity, in addition to the more recent impacts of humans over the past several centuries. In 2003 the majority of this ahupuaa (~150,000 acres) was added to Hawaii Volcanoes National Park. No longer a place of resource extraction, work has been initiated to protect and restore the plants and animals found in the Wao Kualono, Wao Akua, Wao Maukele, and Wao Kanaka. Careful scientific studies revealed the great biological diversity held in Kahuku despite extensive cattle ranching, logging, and invasive mouflon sheep, pigs and goats. Emergency actions were taken to protect those species that were barely clinging to survival. To date we have planted over 15,000 rare and endangered plants. Native insects and birds are now utilizing these planted species. Across the larger landscape, 50 miles of fencing was constructed followed by ungulate control. The response of native species has been rapid in upland areas where we have gone from just having ancient solitary trees with bare ground to the forest being filled with young trees and ferns. A more intensive approach, including soil scarification, invasive grass removal and native species planting, is required to restore the former cattle paddocks, the most altered portion of the landscape. Ongoing challenges include disease, climate change, maintenance of fences, sustained funding and invasive species.

4-3

The Restoration and Protection of Kaho`olawe's Ecosystem

Paul Higashino, Lyman Abbott, James Bruch *Kaho`olawe Island Reserve Commission, Wailuku, HI, USA*

Restoration on the island of Kahoʻolawe is reaching its 20th year and progress has been made in increasing plant cover, seed reproduction, and reducing rates of soil erosion. During the last project in a 50 ha Tier I (surface cleared only of unexploded ordnance) area in Hakioawa Watershed, 24,000 plants of 23 species were planted in rock mulch mounds on irrigation. In restored areas in the project site, native plant cover increased significantly ($p=0.041$) and bare soil cover decreased significantly ($p=0.024$). In restored areas, soil retention was 2.4 tons/acre/yr, whereas 13.4 tons/acre/year were lost in areas without restoration. A 1:5 ratio. In the near shore ocean environment off of Hakioawa Bay, after 2.5 times more precipitation between two deployments, a significantly greater amount of clay sized particles were observed in nine sediment tube traps.

A Comprehensive Biosecurity Implementation Plan has been written with three main action items 1) prevention 2) detection and 3) response to prevent invasive alien Species (IAS) into the Kahoʻolawe Island Reserve. Linked to the Hawaiʻi Interagency Biosecurity Plan (2017-2027) in detecting and controlling invasive species in natural areas, education of the many volunteers is a key component in the Biosecurity program.

With the goal of eradicating non-native predators, the Kahoʻolawe Island Seabird Restoration Project is working towards setting the framework to ensure a hospitable environment for native Hawaiian animals to flourish. Wildlife surveys conducted last year confirmed the presence of the Hawaiian hoary bat and the endangered Band-rumped

storm petrel on island.

4-4

Pooling together a comprehensive inventory of Hawaiian anchialine pools

Troy Sakihara, Kimberly Peyton, Annette Tagawa *Division of Aquatic Resources, Department of Land and Natural Resources, State of Hawaii, Hilo, Hawaii, USA*

The Main Hawaiian Islands is home to one the highest concentrations of anchialine habitats throughout the world. These unique land-locked brackish pools host a highly endemic biota and a cryptic ecosystem of which we have a limited, but burgeoning, understanding. Through collaboration among local organizations, community groups and agencies, we have initiated a State-wide effort to compile a comprehensive inventory of Hawaiian anchialine habitats, their current status and any new and novel information on these systems. In 2016, over 80 research scientists, educators, managers, students, Hawaiian cultural practitioners and community organization representatives convened in Hilo to share new information and ideas, and discuss current issues on Hawaiian anchialine pools. Currently, efforts are being made to map and survey pools not inventoried or monitored previously, while any volunteered information among collaborators is being compiled in a single database, which is to be openly available. This collective effort to provide sharable up-to-date information on Hawaiian anchialine pools is directly intended to inform better awareness, enhance knowledge and research, and establish new and strengthen existing partnerships towards adaptive Hawaiian anchialine pool management. Funding and support for this project was provided by the Hawai‘i Fish Habitat Partnership, National Fish Habitat Partnership, US Fish and Wildlife Sport Fish and Wildlife Restoration Program and Pacific Islands Coastal Program, and the Division of Aquatic Resources.

4-5

Facilitation or Competition? The Role of the N-fixing *Acacia koa* in Ecological Restoration

Wailea Collins[1], Rebecca Ryals[1], Creighton Litton[1], Stephanie Yelenik[2], Sierra McDaniel[3] *[1]University of Hawaii at Manoa, Honolulu, HI, USA, [2]US Geological Survey, Hawaii Volcanoes National Park, HI, USA, [3]Hawaii Volcanoes National Park, Hawaii Volcanoes National Park, HI, USA*

The decline in ranching in Hawai‘i has spurred a desire to restore abandoned pastures to native forest. Many such efforts use the nitrogen (N)-fixing native tree *Acacia koa* to initiate ecological restoration back to native forest. However, recent evidence has shown that increased soil N associated with *A. koa* can increase non-native grass biomass which suppresses native regeneration, resulting in a stable state characterized by *A. koa* overstory, non-native grass understory, and a lack of native recruitment. This study sought to address the question of whether *A. koa* facilitates or hinders the development of a diverse native forest by examining the impact of *A. koa* density on leaf area index (LAI; an index of shade) of the *A. koa* canopy, extractable inorganic soil moisture, soil N, grass biomass, and native understory outplant survival (*Sophora chrysophylla* and

Dodonea viscosa). The study was conducted at an 11-year-old mesic forest restoration site in Kahuku, Hawai‘i Volcanoes National Park. Results showed that *A. koa* can outcompete invasive grasses, resulting in a decrease in grass biomass with increasing *A. koa* density. In addition, we found a positive relationship between *A. koa* density and both LAI and soil N, and a negative relationship between *A. koa* density and soil moisture. There was no significant relationship between *A. koa* density and outplant survival 6 months after outplanting. Understory enrichment plantings of shade and N-tolerant species should target high density *A. koa* in order to increase restoration success.

4-6

Metabarcoding as a Tool for Exploring the Diet of Herbivorous Reef Fishes and Providing Data for Management in Hawai‘i

Eileen Nalley, Robert Toonen, Stephen Karl *Hawaii Institute of Marine Biology, University of Hawaii at Manoa, Kaneohe, Hawaii, USA*

Coral reefs are diverse and important ecosystems that experience significant anthropogenic impacts. Herbivorous reef fishes serve a vital role in coral reef communities by consuming algae that may compete with corals for benthic space, and the process of herbivory on coral reefs is relatively well studied. The partitioning of resources within functional groups of herbivores is less well understood, however, because most studies that examine fishes' diets do not differentiate between species of turf algae. Turf is a major food source for grazing herbivores, including many surgeonfishes, but is difficult to identify live, let alone during passage through the gut of herbivorous fishes. We address this need by employing molecular metabarcoding, in which primers are used to amplify algae from the guts of collected fishes, and the species of algae in the gut contents of grazing herbivores are identified by high-throughput sequencing. We focus on species commonly targeted by fishermen, such as manini (*Acanthurus triostegus*), and species that are abundant on degraded reefs, such as the brown surgeonfish (*A. nigrofuscus*). This approach allows for the identification of herbivores that are consuming invasive algae, as well as species that may be more specialized and vulnerable to habitat disturbance. Applying molecular methods to explore diet breadth in herbivores will provide critical information about the ecology of species that are vital to the maintenance of healthy Hawaiian reefs and assist in the development of management strategies that reflect the complexity of reef communities and their responses to human impacts.

4-8

Collaboration across worldviews: utilizing knowledge coproduction on Hawai‘i Island to thrive through change

Sharon Ziegler-Chong, Scott Laursen, Kamala Anthony, Cherie Kauahi, Rose Hart, Joanna Norton, Louise Economy *University of Hawai‘i at Hilo, Hilo, HI, USA*

Meadow et al. (2015) define knowledge coproduction as "the process of producing

usable, or actionable, science through collaboration between scientists and those who use the science to make policy and management decisions." This process can be applied at any stakeholder scale and effectively builds diverse professional networks that are inherently powerful in maximizing communities' adaptive capacities during socio-ecological change (e.g. climate change, land-use change, invasive species impacts, or cultural change). Collaborative networks unite multiple knowledge forms across diverse worldviews creating the capacity for effective stewardship of our island earth. Our forum will begin with a panel session that introduces the concept of knowledge coproduction and offers Hawai`i Island examples of this collaborative, manager-driven process as applied to loko i`a, county planning, agriculture, and community health research efforts. The panel will consist of short presentations by graduate students and partner researchers on their research projects. A facilitated small group session will then provide the audience time to discuss the process of knowledge coproduction, defining stakeholders, and creating long-term relationships within diverse professional networks across the islands.

4-9

Working together to understand, quantify and manage for tipping points on the reefs of Hawai'i

Kimberly Selkoe[2], Kirsten Oleson[1], Carrie Kappel[2], Mary Donovan[1], Alan Friedlander[1], Joey Lecky[3], Jean-Baptist Jouffray[4], Gareth Williams[6], Kim Falinsky[8], Jamie Gove[3], Lisa Wedding[7], Crow White[5] *[1]University of Hawaii Manoa, Honolulu, Hawaii, USA, [2]NCEAS, UC Santa Barbara, Santa Barbara, CA, USA, [3]NOAA, Honolulu, Hawaii, USA, [4]Stockholm University, Stockholm, Sweden, [5]Cal Polytechnic State University, San Luis Obispo, CA, USA, [6]Bangor University, Bangor, UK, [7]Stanford University, Monterey, CA, USA, [8]The Nature Conservancy, Honolulu, Hawaii, USA*

Tipping points occur when small shifts in human pressures or environmental conditions bring about large, sometimes abrupt changes in a system – whether in a human society, an ecosystem or our planet's climate. This talk introduces the Ocean Tipping Points project, a multi-year, multi-organization collaboration of scientists and management partners that seeks to guide new approaches to ocean management with integrative science. We present results of our research on ecological shifts on Hawaiian reefs and discuss implications for reef management. By integrating an unprecedented body of newly synthesized benthic and fish community data and novel, spatially explicit datasets representing environmental and anthropogenic drivers across the Main Hawaiian Islands, we provide evidence for 5 distinct reef regimes and nonlinear relationships between regimes and their human impacts. These quantified relationships can provide reference points to inform targets for reef protection and restoration. Using an economic tradeoff analysis, we demonstrate the costs and benefits of different management actions aimed at reaching management targets. We conclude by discussing how these analyses are supporting efforts to mitigate local stresses and enhance resilience of Hawaiian reefs.

4-10

Population Threats to Hawaiian Hawksbill Sea Turtles Revealed from Three

Decades of Strandings

Shandell Brunson[1], Kyle Van Houtan[2], Stacy Hargrove[3], Thierry Work[4] *[1]NOAA, Pacific Islands Fisheries Science Center, Marine Turtle Biology and Assessment Program, Honolulu, Hawaii, USA, [2]Monterey Bay Aquarium, Monterey, California, USA, [3]NOAA, Southeast Fisheries Science Center, Science Planning and Coordination Office, Miami, Florida, USA, [4]U.S. Geological Survey, National Wildlife Health Center, Hawaii Field Station, Honolulu, Hawaii, USA*

Hawksbill turtles (*Eretmochelys imbricata*) and green turtles (*Chelonia mydas*) are the most common species of marine turtles in nearshore Hawaiian waters; however, green turtles outnumber hawksbills by over an order of magnitude. The low population numbers has led researchers to suggest that the Hawaiian hawksbill population is one of the smallest known marine turtle populations. To gain a better understanding of the magnitude and distribution of threats facing hawksbills, we analyzed stranding data collected in the Hawaiian Islands between 1984 and 2014. Strandings of sick, injured, or dead turtles on all islands were reported to the NOAA Marine Turtle Research Program, presently known as the Marine Turtle Biology and Assessment Program. In this study, we synthesize these records to evaluate the basic trends in time, demographic composition, and distinguish the type and mortality of various threats. Over the 33 years, there were 88 hawksbill sea turtle strandings in the Hawaiian Islands ranging in size class from juvenile to adult (15-89 cm SCL). We classified threats into categories representing typical injuries facing Hawaiian hawksbills. Wounds related to fishing gear were by far the most prevalent threat and cause of death. Stranded turtles of known sex were female biased (female = 36; male = 5) suggesting sex-specific threats or possibly nesting location and sand temperatures are affecting sex-ratios. Future studies are needed to focus on the foraging ecology of hawksbills to understand possible resource limitations as well as conservation and research efforts to mitigate anthropogenic threats in Hawaii.

4-13

Uncovering the Hidden Blue Economy in Coral Reef Fisheries

Shanna Grafeld[1], Kirsten Oleson[1], Lida Teneva[2], Jack Kittinger[2,3] *[1]University of Hawaii at Manoa, Honolulu, HI, USA, [2]Conservation International, Honolulu, HI, USA, [3]Arizona State University, Tempe, AZ, USA*

Despite their importance for human well-being, nearshore fisheries are often data poor, laxly managed, and drastically undervalued and underappreciated in policy and development programs. We assess the supply chain for nearshore Hawaiian fisheries (post-catch distribution and disposition), as well as the value this seafood adds to the economy as it travels through the supply chain, the food provisioning potential of the fishery, and the cultural benefits it supports. We estimate that the total annual value added by the nearshore fishery in Hawaii is $13.9- 14.2 million, composed of a noncommercial ($10.80 million) and a commercial ($2.97 million licensed + $148,500-$445,500 unlicensed) fishery. Hawaii's nearshore fisheries provide >7.7 million meals annually, with 1/3 of those meals from planktivores. About 70% of meals come from the noncommercial fisheries sector. Additionally, nearshore fisheries support fundamental

cultural values including subsistence, activity, traditional knowledge, and social cohesion. A poor understanding of the value of near-shore fisheries and the flow of fish through the local economy hampers management efforts and marginalizes nearshore fisheries in policy. We have used a mixed methods design, pulling information from varied sources to illuminate the economic and social importance of the fishery and bring a hidden economy to light.

4-14

Mesopredator release: Moray eels inconspicuously predominate heavily fished reefs

Julie Zill, Clara Schlieman, Megan Donahue *Hawai`i Institute of Marine Biology, Honolulu, HI, USA*

Populations of apex predators have declined globally due to human activities. In the absence of sufficient top-down control, mid-level predators can increase drastically in number, termed “mesopredator release”. On densely populated, accessible coastlines of the Main Hawaiian Islands, few large piscivorous fish remain, and fishermen act as the top predators in the system. However, prey selectivities of humans likely differ from that of the natural predator assemblage, resulting in high levels of top-down control on targeted fishes and, we hypothesize, mesopredator release of non-target species, such as moray eels.

Moray eels are cryptic and greatly underestimated in visual fish surveys. Consequently, almost no accurate data is available on eel abundances over space or time. Here, we developed a novel eel surveying technique that involves baited camera deployment on a defined transect to obtain a more accurate eel density estimate. We conducted these eel-specific surveys on shallow, coastal reef habitats in the pristine Northwestern Hawaiian Islands and the human-influenced Main Hawaiian Islands.

First, we show that moray eels are a large component of the reef fish biomass in the Main Hawaiian Islands, and comprise almost all of the (otherwise low) piscivore biomass. Second, we examine how the eel biomass density relative to that of other reef fishes changes across a gradient of fishing intensity. We evaluate whether the reduction of natural apex predators has led to an asymmetrical release of moray eels from top-down control in heavily fished areas of the Hawaiian Archipelago.

4-16

The Potential of Biodiverse Native Hawaiian Agroecosystems for Food Production Under Climate Change

Natalie Kurashima[1] [1]*Kamehameha Schools, Kailua-Kona, HI, USA,* [2]*University of Hawai'i at Manoa, Manoa, HI, USA*

The need to promote land use strategies that increase food production while conserving biodiversity is increasingly recognized. This is of particular concern in Hawai‘i, where

development pressure, rates of food importation and threats to native species are among the highest in the world. Many indigenous food production systems are productive, adaptive, culturally essential, and support native species, yet, indigenous agroecosystems have been largely overlooked in terms of their potential to meet current and future needs. In this study, I develop spatial distribution models, using environmental and climatic parameters, of three main Kānaka Maoli (indigenous Hawaiian) agroecosystems under current and three future downscaled climate change scenarios to determine their past extent, production, carrying capacity, and future potential given land-use and climate changes. Results indicate that Hawai'i could have sustained >250,000 acres of traditional agricultural systems, potentially producing more than 1 million mt/yr of food, levels comparable to food consumption in Hawai'i today. Carrying capacity estimates provide support for hypotheses of large pre-colonial Kānaka Maoli populations (>800,000). Though current development has slightly reduced (-12 %) areas identified by the model, the majority of remaining lands (75 %) are zoned agriculture. Estimations of the effects of climate change on indigenous agricultural production vary, from no change in potential production, to considerable decreases (-23 %) in the driest scenario. This study demonstrates the food producing potential of indigenous agriculture even under land use and climate changes and highlights the value of their restoration into the future to meet sociocultural and conservation goals.

4-17

Integrating Climate Projections into a Population Model for the Hawaiian Green Turtle

Summer Martin[1], T. Todd Jones[1], Jeffrey Maynard[2], Shawn Murakawa[1], George Balazs[1] *[1]NOAA Fisheries, Pacific Islands Fisheries Science Center, Honolulu, HI, USA, [2]Marine Applied Research Center, Wilmington, NC, USA*

Climate change is a known critical knowledge gap limiting the ability of the NOAA Fisheries Science Centers and the U.S. Fish and Wildlife Service to comprehensively review the status of marine turtles listed under the Endangered Species Act (ESA). To estimate the future risk of populations falling below important biological thresholds, ESA status review teams use the best available science to conduct population viability analyses (PVAs). To date, PVAs for Pacific turtle populations have relied almost exclusively on nester abundance data and have not quantitatively included climate change impacts. However, increased temperatures may influence turtle populations through temperature-dependent sex determination and embryonic death, where temperatures above critical thresholds produce female biases and cause nest failures. Our objective here is to incorporate climate projections into a stage-based population model for the Hawaiian green turtle to explore possible impacts of warming sand temperatures on the population. Our approach includes: 1) compiling sand temperature data for East Island, Hawaii, the primary nesting site for the population, 2) using remotely-sensed data to develop sea/air and sand temperature regression models, 3) generating climate model projections of sand temperatures, 4) developing a stage-based population model of the turtle population, and 5) conducting population viability analyses inclusive of the implications of sand temperature projections on sex ratios and nest success. Results from this research will feed directly into the next status review for green turtles, and the climate integration approach can be applied to future assessments of turtle populations in the Pacific and other regions.

4-18

Nowhere to Go: Perceived Barriers to the Use of Assisted Colonization for Climate Sensitive Species

Shannon Noelle Rivera[1], Melissa Price[2] *[1]University of Hawai'i at Mānoa, Honolulu, Hawaii, USA, [2]University of Hawai'i at Mānoa, Honolulu, Hawaii, USA*

The Hawaiian Islands are home to an array of species that are as vulnerable as they are unique with the highest rate of extinction per square mile on earth, Predictions indicate that climate change will lead to further declines and extinctions of the more than four hundred listed Endangered Hawaiian species. Therefore, drastic and timely actions must be taken to counter the additional climatic pressure.Assisted colonization, the intentional movement and release of an organism outside its indigenous range, is one management alternative for those species that are predicted to lack suitable habitat under likely climate change scenarios. This study used first person interviews with employees of federal, state and non-profit agencies to evaluate both the perceived and existing obstacles concerning the use of assisted colonization.We found several potential barriers to utilization of this management tool. Assisted Colonization is considered by many to be a high-risk tool, due to the cost of preparing the target habitat, the mortality often experienced by translocated individuals as well as the novelty of this method. Our results suggest that, despite existing policies that allow for assisted colonization in cases where it is warranted, this action is rarely considered. Since assisted colonization is best carried out when populations are robust enough to tolerate the removal of individuals for translocation, we recommend that this management action be considered when planning for the conservation of those endangered species in Hawai'i that are projected to have little or no suitable habitat remaining as climate change progresses.

4-19

Daily to seasonal plant growth responses to environmental variability in Hawaii: implications to management under shifting conditions

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Recent studies show that past and ongoing environmental changes have been substantial and have likely already affected conservation efforts in Hawaii. Much of the state has experienced substantial drying, including decreases in mean annual precipitation since the 1920s, longer rainless periods, and decreasing stream flow. Temperatures have been increasing in the state for the last 40 years, especially at higher elevations where most native habitats and species currently persist. Unfortunately there are few long term monitoring efforts that allow us to understand plant species responses to these past, ongoing and future shifts in environmental conditions. Consequently, we know little about how environmental shifts may be limiting the success of current conservation and management efforts. I have adapted high resolution digital dendrometer methods to the harsh field conditions of Hawaiian forests. The resulting

autonomous dendrometer sensor array monitors growth of individual plants (1-100 cm diameter in size) and local environmental conditions at sub-daily intervals. A recent test on native and non-native species in Hawaiian wet forests indicates we can use these techniques to monitor growth of native plants as an integrated measure of plant fitness and relate it to variable environmental conditions such as precipitation, temperature, light, and soil moisture. The digital dendrometer sensor array is unobtrusive, autonomous and provides real-time data relevant to a large number of conservation related potential applications.

4-20

Considering species distribution and life history traits to determine the vulnerability of native Hawaiian plants to climate change

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In 2013, our first species vulnerability assessment showed we can use a novel modeling approach to assess the vulnerability of each individual native Hawaiian plant species to climate change (Fortini et al. 2013). While that assessment provided a landscape-based picture of vulnerability across all native plant species, it lacked consideration of species traits known to contribute to the vulnerability of species to climate change (e.g., reproductive capacity, population numbers, dispersal characteristics, etc.).

As a major expansion of that past work, we modeled vulnerability by creating an expert system - a network model linking biological traits of various plant species with the projected changes in species ranges under the effect of climate change. This effort expands on past spatial-based assessments by 1) utilizing a novel ecologically-based framework of species vulnerability; 2) considering several life history traits relevant to climate change vulnerability; and 3) considering multiple end-of-century climate scenarios to evaluate the robustness of our assessment to future climate uncertainty. A panel of experts in Hawaiian plant species participated in the model design, identifying factors expected to affect a species' ability to successfully respond to climate change. An expert elicitation process also helped collect information on several relevant species characteristics not previously available. The results of our assessment describe the relative vulnerability of 1,056 native Hawaiian plant species and may be used as an additional tool to assist resource managers in effectively allocating limited resources to efficiently preserve and protect current and future habitat for native plants.

4-21

Rapid ʻŌhiʻa Death Seed Bank Initiative Seed Collection Training

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Rapid ‘Ōhi‘a Death (ROD) caused by the vascular wilt fungus (Ceratocystis spp.), poses a serious risk to the health and future of native forests statewide. As part of a comprehensive response plan, ‘ōhi‘a seed collections are urgently needed. Seeds of ‘ōhi‘a can be held by the members of the Hawai‘i Seed Bank Partnership (HSBP) to secure long-term germplasm storage to mitigate against potential loss of genetic diversity. Stored seeds provide appropriate plant material for restoration, watershed rehabilitation, and a propagule source for saplings for research and testing for resistance or tolerance to the pathogens causing ROD. The statewide strategy and goals for securing seed collections that are representative of this widespread tree and appropriate for restoration projects will be presented. Training on identification, seed collection and sanitation protocols, recording collection data, proper handling and curation, and long-term seed storage will allow for broad participation by conservation groups and the wider community. This session will provide detailed instructions on how participants can properly plan and conduct collections of ‘ōhi‘a seeds for long-term storage in a seed bank. Conservation groups will be able to incorporate this into their field work, but more importantly, this training will also appeal to our community for broader involvement. ‘Ōhi‘a is the foundation of our native forests, an iconic cultural resource, provides habitat for native animals, and is an iconic symbol of Hawai‘i. This training will enable individuals from across our community to participate in the effort to secure seed collections.

CONCURRENT SESSION 5

5-1

Introduction and overview of Rapid ‘Ōhi‘a Death

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Rapid ‘Ōhi‘a Death is a new fungal disease that has caused extensive mortality across tens of thousands of hectares of ‘ōhi‘a (*Metrosideros polymorpha*) forests on Hawai‘i Island. Loss of these native forests threatens native species, watershed protection, and landscape and cultural values. The disease is caused by fungi in the genus *Ceratocystis*; different species in this genus cause disease around the world in plants such as coffee, cacao, eucalyptus, and many other species. The disease was first diagnosed in the Puna and South Hilo districts on Hawai‘i Island in 2014; by 2015 it had spread through the Ka'u and Kona districts and in 2016 was found in Hāmākua. It has not been found in Kohala or on the other Hawaiian islands. Movement of infected wood, plants, or soil is likely one way the disease spreads. Wind-blown frass produced by ambrosia beetles attacking infected trees is another likely mode of transmission. An agricultural quarantine for Hawai‘i Island bans shipment of untreated ‘ōhi‘a wood products from the island in an effort to prevent the fungus from spreading. While treatment with fungicides may have value for individual trees, such methods are too expensive to be applied over large areas of forest. Management has focused on preventing the spread of the Rapid ‘Ōhi‘a Death to other forests, in part by felling infected trees adjacent to uninfected forests. An outreach program has engaged affected communities with information as to how to manage the disease on private lands and how to avoid spreading it.

5-2

Two New Pathogenic Fungi as the Cause of Rapid ʻŌhiʻa Death

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Rapid ʻŌhiʻa Death (ROD) is a newly discovered disease complex causing widespread mortality of ʻōhiʻa on Hawaii Island. The disease is commonly referred to as ROD due to the amount of time it takes for a tree to die once symptoms are visible. Greenhouse and growth chamber inoculation experiments on ʻōhiʻa seedlings and saplings have proven that two new species of *Ceratocystis* cause ʻŌhiʻa Wilt and ʻŌhiʻa Decline, collectively called ROD. For both *Ceratocystis* species, growth occurs within ʻōhiʻa wood tissue with characteristic staining patterns. Neither of the species are known to exist outside of Hawaii Island, or on Hawaii Island prior to the current Rapid ʻŌhiʻa Death epidemic. Both *Ceratocystis* species are currently being described and renamed. This research provides critical information necessary for early detection and management strategies to minimize short and long distance spread.

5-3

Infection biology of the *Ceratocystis* fungi involved in Rapid ʻŌhiʻa Death: Growth, Morphology, and Differential Host Resistance

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Rapid ʻŌhiʻa Death (ROD) is a complex of diseases caused by two new species of pathogenic fungi within the genus *Ceratocystis* (herein referred to as *Ceratocystis* sp. A and B). These fungi have been associated with a recent outbreak of ʻōhiʻa (*Metrosideros polymorpha*) tree mortality in the Puna District of Hawai'i Island within the last 5 years. To date, little is known of the host-parasite interactions of these diseases and how they spread throughout the landscape. To better ascertain how healthy ʻōhiʻa trees become infected and succumb to ROD, inoculation experiments were conducted to determine the infectivity of various propagules. Ambrosia beetle boring dust and sawdust from recently ROD killed trees were assessed for their ability to induce disease and mortality in greenhouse experiments. Additionally, to provide greater detail of the more widely distributed of the two ROD pathogens, morphological characteristics of various isolates of *Ceratocystis* sp. A were described. Inoculation experiments of *Ceratocystis* sp. A onto four ʻōhiʻa varieties (*M. polymorpha* var. *glaberrima*, *incana*, *newelli* and *polymorpha*) were conducted to assess the potential of host resistance

and/or tolerance to the pathogen. The results of these experiments will provide a better understanding of the biology of ROD, as well as the vulnerability of uninfected stands, potentially leading to improved management options.

5-4

Molecular detection of Ceratocystis species infecting ‘ōhi‘a:

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Fungal isolations from diseased forests affected by Rapid ‘Ōhi‘a Death have revealed the presence of two different Ceratocystis species, tentatively known as A and B, both of which have infected and killed ‘ōhi‘a on Hawai'i Island. In order to expedite testing of samples for the presence of these fungi, a quantitative real-time PCR assay which differentiates the two species has been developed. Extracts prepared directly from infected wood, insect frass, and soil are all suitable sources of template DNA for the assay. The assay can be performed on up to 92 samples plus positive and negative controls, all in duplicate, on a real-time thermocycler equpped with a 384 well block. Additionally, we have developed a rapid diagnostic "Lab-in-a-Suitcase" platform for in-field detection of Ceratocystis DNA. This isothermal amplification assay utilizes recombinase polymerase and a battery operated fluorometer to simultaneously measure the amount of fungal DNA. The entire assay from DNA extraction to results can be completed on the mobile platform in less than 90 minutes on up to 6 independent samples plus a positive and negative control. The capacity for direct molecular detection of the fungi within infected trees enables research efforts aimed at understanding the biology of host-pathogen interactions. Additionally, timely detection of new disease outbreaks, both in new forests on Hawai'i Island and on neighbor islands, is critical to preventing further spread and is essential for disease management efforts.

5-5

Monk seals and their ecosystems - what factors drive their population dynamics ?

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The Northwestern Hawaiian Islands share comparable biological community structures and have similar histories of fishing pressure, yet endangered monk seal subpopulations show different trends of decline between locations. Using trophic models, we compared the ecosystem structure and energy flows of two monk seal populations (on Laysan Island and the other at French Frigate Shoals (FFS) Atoll), each with varied rates of decline (1998-2015). Through simulated perturbations, we showed that the Laysan community had much higher productivity and was mainly forced by bottom-up

processes, but prey and predator abundance also controlled the energy flow and community structure. The FFS ecosystem was less productive and strongly influenced by a change in primary productivity. Although the FFS system responded to a change in predator and prey abundance, the monk seals were more influenced by benthic bottomfish biomass than by a change in predator abundance. We clarified the role of external drivers (Pacific Decadal Oscillation [PDO] and benthic bottomfish fishery); while the PDO did show correlation with monk seal population trends, the best models were driven by prey biomass as impacted by bottomfish removals. However, trophic dynamics were not sufficient to explain the observed decline in monk seal biomass. We suggest that other factors amplifying mortality played a role; for example, shark predation on monk seal pups at FFS. These results can help direct management or future research efforts in the recovery of endangered monk seal population.

5-6

#Monkseal: Social media as a tool for science, conservation, and public relations for Hawaiian monk seals

Mark Sullivan *NOAA/ NMFS/ HMSRP, Honolulu, Hawaii, USA*

As social media platforms become ever more ubiquitous, they provide potentially valuable information for wildlife researchers and managers. NOAA's Hawaiian Monk Seal Research Program (HMSRP) is exploring how social media can help scientists understand the biology, ecology and threats to this endangered species. By using the media sharing and social networking service Instagram, we extracted pertinent data while disseminating information and inspiring support for Hawaiian monk seals. Specifically, we investigated how Instagram could: 1) expand our normal sightings data set 2) help categorize type and severity of human interactions, 3) provide early warning of concerning seal behaviors, and 4) help assess public perceptions of monk seals. Searching the keyword #monkseal revealed a total of 2,392 public posts from one year. Of these, seals were individually identifiable in 396 posts representing 27.5% of the Main Hawaiian Island subpopulation and 426 human-seal interaction events ranging from close approaches to physical interactions. Besides gaining useful information, we were also able to advise the public about seals of concern and solicit feedback to aid HMSRP's emergency response. This relatively new tool has the potential to yield considerable amounts of data and soon, developments will streamline data collection, utilization and sharing. Science and technology continue to evolve, and wildlife programs should take advantage of progressive and broadly inclusive tools like social media for the benefit of species conservation.

5-7

Prevalence of interactions between Hawaiian monk seals and nearshore fisheries in the main Hawaiian Islands

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We determine the prevalence and characteristics of interactions between the endangered Hawaiian monk seal (*Nemonachus schauinslandi*) and nearshore fisheries in the main Hawaiian Islands and examine the impacts to this subpopulation. Documented monk seal-fisheries interactions have generally increased over the last 2 decades. We documented 161 incidents of monk seal hooking and entanglement between 1976 and 2016. Approximately one quarter of all individually identifiable monk seals in the main Hawaiian Islands recorded between 1976 and 2016 have had at least 1 documented fisheries interaction, and most of the monk seals involved were 2 years old or younger. Documented fisheries interactions typically occurred at a monk seal's natal island and most frequently on the islands of Kauai and Oahu. Hookings occurred in 153 cases and typically involved large circle hooks accompanied by slide-bait rigging. Entanglements occurred in 8 cases, all of which involved gillnets. Fisheries interaction was implicated in 12 monk seal deaths and was slightly more frequent than other known mortality factors. Without creative solutions to mitigate the problem, monk seal-fisheries interactions will continue to have negative impacts on both monk seals and fishers in Hawaii. Information on monk seal-fisheries interactions in fishery statistics is extremely limited and there is virtually no self-reporting of events. Reliable and increased reporting and cooperation from the fishing community would help us to better understand the true scope of the problem and prove valuable in the development of mitigation and management measures.

5-8

The power of proactive efforts to help turn a corner in Hawaiian monk seal recovery

Charles Littnan[1], Jason Baker[1], Albert Harting[3], Thea Johanos[1], Tracy Mercer[2], Stacie Robinson[1] *[1]NOAA Fisheries Hawaiian Monk Seal Research Program, Honolulu, HI, USA, [2]JIMAR Hawaiian Monk Seal Research Program, Honolulu, HI, USA, [3]Harting Biological, Bozeman, MO, USA*

This presentation reviews the last 35 years of research and recovery efforts that have been implemented to conserve the Hawaiian monk seal. Since being listed as endangered under the ESA in 1976 the monk has been the focus of ever evolving conservation actions that now constitute one of the most proactive marine mammal recovery programs in the world. The program is built on a foundation of high quality science, innovative conservation, and community engagement. In the past decade alone there have been over 460 lifesaving interventions including disentanglements, dehookings, translocations, rehabilitation and medical interventions. The cumulative result of these efforts over decades has resulted in 28% of Hawaiian monk seals that are alive today have benefitted from an intervention or are the offspring of a female that did. A variety of strategies to engage the public has also resulted in a shift in public perceptions towards monk seals and greater acceptance and support of the species as it reestablishes itself in the main Hawaiian Islands. The most recent population estimate also shows that the monk seal population has been growing at 3% per year over the last 3 years and has risen to 1400 individuals. All of this is good news for the species but there a long road to recovery still remains.

5-9

***Nā Waʻa Mauō* Canoe sustainability The application of Hawaiian canoes, in marine resource management, research, and education in the Hawaiʻi**

Hokuokahalelani Pihana[1] [1]*University of Hawaii at Hilo, Hilo, Hawaii, USA,* [2]*Keaholoa STEM Program, Hilo, Hawaii, USA*

Throughout Moananuiakea, Pacific Ocean, *waʻa* (canoes) are of significant cultural identity. During the time of our Polynesian ancestors the *wa'a kaulua* and *wa'a kaukahi*, single-hull and double-hull canoes, were primary sources of transportation and food acquisition. The technologies of the voyaging era were large double-hull canoes and celestial navigation. Today the application of *wa'a* in scientific research and ocean resource management throughout the Hawaiian Islands enable communities to perpetuate ancestral practices using cultural tools in a modern context. *Nā Waʻa Mauō* is a program that uses single-hull outrigger canoes, *waʻa kaukahi*, in marine science research and resource management in Hawaiʻi. It is currently a course at the University of Hawaii at Hilo and is intended to introduce students to a holistic research methodology that is grounded in Native Hawaiian practice. The primary purpose of this Native Hawaiian program is to perpetuate the practice of our ancestors by implementing our native tools like the *waʻa kaukahi* and *waʻa kaulua* into ocean resource management strategies and education programs that are currently being conducted. *Nā Waʻa Mauō* is a practice created for the love of our ocean resources and Native Hawaiian culture that aim to further perpetuate our ancestral practices for future generations.

5-10

The *Teaching Change* Program – Outdoor, Immersive, Experiential Education Opportunities for Local Students and Teachers

Catherine Spina[1], Creighton Litton[2], Christian Giardina[2], Ming Wei Koh[2] [1]*University of Hawaii, Honolulu, Hawaii, USA,* [2]*United States Forest Service, Hilo, Hawaii, USA,* [3]*Pacific Resources for Education and Learning, Honolulu, Hawaii, USA*

The long-term future of bio-cultural resource management in Hawaiʻi requires local students and teachers to gain better access to stimulating and transformative STEM educational opportunities. In particular, there is a large need for outdoor, immersive educational opportunities in environmental sciences in Hawaiʻi to inform and inspire students to attain careers in natural resource management. Since 2011, the *Teaching Change* program, a Hawaiʻi Island-based youth education program in forest ecology and natural resource management, has worked to inspire and empower ~8,500 students and teachers by providing outdoor, immersive experiential education opportunities that include: (1) monthly overnight field trips with middle and high school students; (2) an annual Conservation Career Day; (3) monthly day trips with 4th graders; (4) an annual Bio-cultural blitz at Puʻu Waʻawaʻa; and (5) annual Teacher Training Workshops. *Teaching Change* has a strong emphasis on citizen science via the concept of 'phenology' – the timing of life cycle events, and their response to environmental cues such as climate. Phenology is a particularly useful concept for educational activities that center on global change, and once trained in its use it provides local teachers with a medium to develop and deliver outdoor curricula to their students, thereby broadening

the reach of *Teaching Change*. In particular, by demonstrating to local teachers how phenology can be used as a central concept in outdoor educational activities, we empower teachers to provide immersive, outdoor, place-based learning opportunities for students in their classrooms for years to come.

5-11

Cultivating Conservation and Community Leaders Through the Wai'anae Mālama 'Āina Field School

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The Waiʻanae Coast housed a proud population that thrived on kalo (taro), ʻuala (sweet potato), limu (seaweed), and abundant marine life. While its natural resources and social conditions have become strained over time, Waiʻanae is now an emerging force for bio-cultural conservation. The Mālama Learning Center, in partnership with a dynamic collective called the Waiʻanae Alliance for Wellness and Place-based Learning, has been leading the Mālama ʻĀina Field School (Field School) for the past five years. To date, the Field School has served more than 150 students, some who were at risk of dropping out of school. The Field School offers a credit-bearing five-week summer school course for middle and high school students of Nānākuli Valley, which has one of the highest concentrations of native Hawaiian people in the state. Taught by dedicated and professional educators from the community, the Field School strengthens students' core skills in science, math, and English through studying the environment and culture. Two core values of the Field School are building pride for your heritage and community and creating a safe and respectful learning environment. While a career in conservation may not have been a consideration at first, some students have begun to envision a future as a 21st century konohiki (land manager). This presentation will describe some of the innovative techniques used in the Field School that can be adapted elsewhere. It will also share the program's highlights and challenges, and how it has inspired nearly everyone it has touched.

5-14

Kamakakūokalani - Mālama ʻĀina and Mālama Honua academic pathways

Noelani Puniwai, Lilikalā Kameʻelihiwa, Kamana Beamer, Kekuewa Kikiloi, Malia Akutagawa *UH Manoa, Honolulu, HI, USA*

Mālama ʻĀina and Mālama Honua [Caring for the land and the earth as a beloved grandmother] - Two concepts interwoven that will decide the future of our natural Hawaiʻi. Kamakakūokalani Center for Hawaiian Studies has five tracks to understand and research Ancestral Hawaiian Knowledge at the University of Hawaiʻi at Mānoa, with Mālama ʻĀina attracting the majority of our students. The breadth and depth of classes currently offered in the bachelors and masters curriculum will be discussed as well as the potential offerings of Mālama Honua Certificates to include Hoʻokele (Traditional

Navigation), Hui ʻĀina Momona, ʻImi Palapala (Land Title & Genealogical Research) and Ola/Lāʻau Lapaʻau/Hoʻoponopono. Faculty at Kamakakūokalani focus on curriculum that nurtures our haumānaʻs aloha ʻāina to place while providing them the skills to Mālama ʻĀina and Mālama Honua in the 21st century. Our graduates have achieved careers in conservation, environmental education, and academia with many of our Masterʻs students integrated in mālama ʻāina efforts across the State. Building upon our Ancestral Hawaiian Knowledge, we empower our students with the kuleana to aloha ʻāina.

5-15

Building a Collaborative Community of Undergraduates, Teachers, Students, and Scientists with Our Project In Hawaii's Intertidal (OPIHI)

Joanna Philippoff, Florybeth La Valle *University of Hawaii at Manoa, Honolulu, USA*

Our Project In Hawaii's Intertidal (OPIHI) is an undergraduate internship program and a citizen science program for teachers and their students. The scientific purpose of both programs is to characterize the Hawaiian rocky intertidal to determine if and how the community is changing over time. The educational purpose of the programs is to enhance participants' scientific literacy skills. Place-based, field-based research experiences help participants connect directly with their local environment and make better-informed environmental decisions. Hawaii's intertidal is a culturally and ecologically important ecosystem susceptible to climate change and land-use practices, but it has historically been understudied due to seasonal wave activity and a small tidal range. However, this area is ideal for engaging youth and emerging scientists in authentic research experiences because, although accessible, a large number of trained individuals are needed to monitor the environment. OPIHI enables the collection of intertidal data that would otherwise be too time-consuming or labor-intensive; this data is generated and analyzed in collaboration with partnering scientists. Teachers are trained in OPIHI content and protocols through statewide workshops. In spring 2017 over 50 teachers and their students (~1000) went on OPIHI field trips. The year-long OPIHI undergraduate internship (N = 14; 2016–2017 cohort) has a unique nested structure that spreads mentoring responsibilities between project facilitators, partner scientists, and collaborating college departments. Undergraduates are not only exposed to an array of mentors and community partners, they participate in service learning—assisting teachers on field trips, thus modeling the next step in the STEM pipeline.

5-16

Bio-Cultural Blitz at Puʻuwaʻawaʻa Ahupuaʻa: Integrating Native Hawaiian Culture and Environmental Education

Melanie Leilā Dudley[1], Catherine Spina[2], Kainana Francisco[3], Tabetha Block[3], Edith Adkins[1], Christian Giardina[3], Creighton Litton[2], Elliott Parsons[1] *[1]Hawai`i Division of Forestry and Wildlife, Hilo, Hawaiʻi, USA, [2]Department of Natural Resources and Environmental Management, University of Hawai`i at Mānoa, Honolulu, Hawaiʻi, USA, [3]Institute of Pacific Islands Forestry, U.S. Forest Service, Hilo, Hawaiʻi, USA*

Integrating Native Hawaiian cultural values and practices in global conservation efforts and environmental education is a key goal of the Hawai‘i Conservation Alliance and an integral part of motion-83 of the International Union for the Conservation of Nature. To address these goals, we integrated Native Hawaiian culture and youth environmental education to create the first-ever Bio-Cultural Blitz in the Ahupua‘a of Pu‘uwa‘awa‘a on Hawai‘i Island. Modeled after Bioblitz events in National Parks across the USA, we provided 250 4th graders from the moku (districts) of Kona and Kohala, with an integrated experience focused on dry forest ecology in the context of Native Hawaiian culture. We achieved this by having participants move through a series of place-based activity sessions covering the ahupua‘a system, cultural geography, traditional stories, and chants as well as geology, botany, wildlife ecology, and plant community restoration. Current environmental education activities that have a strong biological focus, but lack cultural integration, provide only limited opportunities for youth to learn about connection to responsibility for the land. Feedback from teachers and students indicated that our approach to the Pu‘uwa‘awa‘a Bio-Cultural Blitz effectively educated students on the values of aloha ‘āina (love for the land), kuleana (responsibility), and mālama honua (care for our island earth). We conclude that cultural integration enhances the power and the value of environmental education in Hawai‘i, and provides a valuable tool for enhancing conservation objectives of land management organizations.

5-17

Building a Movement for Sustainable Futures: Intergenerational Talk Story Circles

Elizabeth Fujii *Kupu, Hawai'i, United States Minor Outlying Islands*

Facilitated by Kupu staff and alumni, these Talk Story Circles are simultaneous, uninterrupted, intergenerational dialogues about important issues related to conservation in Hawai'i. Each table can accomodate up to 20 participants, including both experienced professionals and young adults who have been selected in advance, along with conference attendees and members of the public who choose to drop in. Participants will discuss life experiences, professional pathways, and pressing goals and challenges related to the topic of concern, while exploring possible partnerships or joint ventures. The goal is to empower young leaders, generate new ideas, and support strong cross-sector intergenerational professional networks within the conservation movement. The talk story circles will be followed by a round of speed networking so that all participants have an opportunity to connect. Topics:

- Who's 'Ono for Pono?: Pathways to Being an Environmental Advocate
- I Ka Wa Ma Mua, Ka Wa Ma Hope: Programs and Strategies to Heal Hawaii By Looking to the Past
- Restoring Land, Restoring People: Community-Based Land Management
- Creating a Triple+ Bottom Line: Integrating Hawai‘i’s Culture into Entrepreneurism
- Environmental Entrepreneurs: Taking the Idea to the Next Step
- An Ocean of Possibility: Marine Conservation and Climate Change
-

5-18

A Nuts and Bolts Approach to Community Organizing and Planning: The Maui Nui Network's Guidebook for Makai Managed Areas Success

Manuel Mejia[1,2], Emily Fielding[1,2], John Parks[9], Sol Kahoohalahala[2,10], Edwin Ekolu Lindsey[5,2], Kelson Mac Poepoe[8,2], Claudia Kalaola[6,2], Leimamo Lind-Strauss[7,2], Scott Crawford[6,7], James Carpio[11,2], Maile Carpio[11,2], Lisa Agdeppa[5,2], Robin Newbold[3,2], Alana Yurkanin[1,2], Roxie Sylva[1,2], Alex Connelly[4,2], Karin Osuga[2] *[1]The Nature Conservancy, Hawaii, USA, [2]Maui Nui Makai Network, Hawaii, USA, [3]Maui Nui Marine Resources Council, Hawaii, USA, [4]Kua'aina Ulu 'Auamo (KUA), Hawaii, USA, [5]Polanui Hiu, Hawaii, USA, [6]Na Mamo O Mu'olea, Hawaii, USA, [7]Kipahulu 'Ohana, Hawaii, USA, [8]Hui Malama O Mo'omomi, Hawaii, USA, [9]Marine Management Solutions, Hawaii, USA, [10]Maunalei Ahupua'a Community Managed Mauka-Makai Area, Hawaii, USA, [11]Wailuku Community Managed Makai Area, Hawaii, USA*

The Maui Nui Community Managed Makai Area Learning Network is comprised of six communities that support each other in actively caring for land and ocean resources. We seek to protect and restore the healthy coastal and marine ecosystems that the people of Maui Nui depend on through sharing of lessons and best practices. By learning together, we accelerate effective conservation and culturally grounded malama 'aina efforts in our communities.

The Maui Nui Network is launching a Guidebook on Makai Managed Areas entitled: “A Guide for Communities on Managing Makai Areas—Sharing Tools and Experiences from the Maui Nui Makai Network” and would like to share this practical guide with the participants of the 2017 HCC. The Network believes that other communities that want to pursue coastal management efforts could benefit from the guidebook’s many tools and activities. After a brief overview of the guidebook's contents and the process by which it was developed, the forum will break out into small working groups and go through various interactive stations corresponding to the chapters of the guidebook. These hands-on, highly participatory learning activities will walk participants through the content and how to use the tools and activities in the guidebook. In doing so, the Maui Nui Network would be able to share with the right audience and continue the acceleration of capacity building of people that support community-based conservation across Hawaii. At the same time, the Maui Nui Network would gain feedback from the participants on how to improve this guidebook.

5-19

Seeing Beyond the Horizon: Emergent Trends and Innovation in Mālama ʻĀina

Keoni Kuoha[1], Pauline Sato[2], Keola Nakanishi[3] *[1]Papahana Kuaola, Heeia, HI, USA, [2]Malama Learning Center, Kapolei, HI, USA, [3]Mana Mele, Honolulu, HI, USA*

Innovation and tradition are often treated as opposing forces. However, it is precisely the synergy of these two forces that has provided some of the most enduring and inspiring accomplishments of the past four decades, from establishment and management of one of the world’s largest marine protected areas to the Worldwide Voyage of Hōkūleʻa,

training the next generation of wayfinders while inspiring young and old around the world to take hold of the “steering paddle” of their communities.

As we embrace innovation and tradition as dual progenitors of positive change and chart our course into the future, let us consider what may lay ahead of us. What innovations are just out of sight? And what course will bring us upon them? This forum offers visions of the future of mālama ‘āina, allowing both invited speakers and forum attendees to offer—through the use of interactive technologies and for our collective imagination—a glimpse of the innovations that lie just beyond the horizon.

5-20

The Impact Feral Cats on Endangered Seabirds on Kaua’I and the Challenges for Managing the Threat

Andre Raine[1], Kyle Pias[2,3], Alexandria Dutcher[2,3] *[1]Kauai Endangered Seabird Recovery Project, Kauai, HI, USA, [2]NEPM, Kauai, HI, USA, [3]Hono O Na Pali Seabird Mitigation Project, Kauai, HI, USA*

Kaua’i is an important refuge for two endangered seabird species that breed in remote upper montane forests – the Newell’s shearwater *Puffinus newelli* and the Hawaiian petrel *Pterodroma sandwichensis*. A key threat to birds in their breeding colonies is depredation by feral cats *Felis cattus*, black rats *Rattus rattus* and pigs *Sus scrofa*. The impact of predators was studied at several monitored seabird colonies in the north-west of Kaua’i between 2012 and 2016. Each of these colonies are actively managed for seabirds, including predator control operations. Within each colony, burrows were monitored throughout the breeding season using remote cameras and/or burrow checks and their final outcome (fledged or failed) was recorded each year. Cats were responsible for a very large proportion of depredations, and targeted breeding adults as well as chicks. Burrows where an adult was depredated by a cat were rarely active or failed in the following season. Cats were also found to be capable of killing multiple birds in a colony over a very short period of time. Recent efforts to better understand predator behavior have been focused on tracking feral cats using GPS collars and using the data to assess home ranges, access routes and other variables. Preliminary results have been applied to improve current trap placement methods and alter current trap line locations. Finally, we explore the factors that complicate predator control in a wilderness setting (*i.e.* environment and cultural and political considerations) and offer solutions to these complexities to better conserve the seabirds of Kaua’i.

5-21

***Toxoplasma gondii* Infections in Hawaii's Marine Mammals**

Michelle Barbieri[1], Charles Littnan[1], Kristi West[2], Angela Amlin[3] *[1]National Oceanic and Atmospheric Administration, Pacific Islands Fisheries Science Center, Protected Species Division, Hawaiian Monk Seal Research Program, Honolulu, HI, USA, [2]University of Hawaii at Manoa, Hawaii Institute of Marine Biology, Honolulu, HI, USA, [3]National Oceanic and Atmospheric Administration, Pacific Islands Regional Office, Protected*

Resources Division, Honolulu, HI, USA

Toxoplasma gondii is a microscopic protozoan parasite that can infect any warm-blooded animal. Since 2001, eight Hawaiian monk seal (*Neomonahcus schauinslandi*) mortalities have been diagnosed as disseminated toxoplasmosis, in which infection caused rapid failure of multiple organs. Mortalities from toxoplasmosis have also been detected in two spinner dolphins (*Stenella longirostris*) to-date. Exposure occurs via ingestion of oocysts, which are eggs spread into the environment in the feces of cats, the definitive host of the parasite. Because they are so resistant to environmental degradation, oocysts deposited anywhere on the islands pose a threat via runoff. Identifying the risk factors for *T. gondii* exposure and the development of toxoplasmosis are of great interest yet are difficult to discern, especially given that marine mammals are highly mobile and have diverse movement patterns and foraging habits. The cryptic nature of failed pregnancies, the lack of perfect carcass recovery, and the potential sublethal impacts of infections further complicate this risk assessment. These complexities also limit options for mitigating exposure in wild marine mammals or curing them once infected. The monk seal population in the main Hawaiian Islands has grown in recent decades, which means that there is increasing overlap between seals and areas of high human (and cat) density, and that this problem may pose an increasingly important threat to the species' survival. Solutions are needed to reduce environmental contamination with oocyst-contaminated cat feces and thus the threat of this disease to Hawaii's native and protected marine mammals.

5-22

***Toxoplasma Gondii* in Hawai'i Kills Native Birds and is Widespread**

Thierry Work *USGS-NWHC-HFS, Honolulu, USA*

Hawaii has the highest number, per capita, of endangered birds in the United States. Threats to native birds include loss of habitat, introduced predators, and disease. Feral cats were introduced into Hawai'i in the late 18th-early 19th century, have since expanded to all the main Hawaiian islands, and are a known cause of predation-induced mortality for endangered seabirds such as dark rumped petrels and Newell's shearwaters. Additionally, the parasite *Toxoplasma gondii* that originates from felids has caused significant mortality in endangered Hawaiian crows and was partly responsible for extirpation of the crows from their native range. This presentation is a review of existing data on the impacts of *T. gondii* on Hawaii's bird life. Recent data show that waterfowl such as nene geese, Hawaiian coots and Hawaiian ducks also die from *T. gondii*. This along with recent serological surveys showing antibodies to the parasites in nene from Kaua'i, Maui, and Moloka'i indicate that the parasite is widespread and that nene are commonly infected. In mammals, *T. gondii* has the potential to make infected animals more prone to trauma and accidents. One of the main causes of death in nene is trauma, and it remains to be seen if the parasite somehow plays a role in this. Given the perilous state of many native birds in Hawaii, there is a need to consider and implement a variety of proactive measures (*i.e.* responsible cat ownership) so as to minimize contacts between feral cats and native avifauna.

5-23

Free-roaming Outdoor Cats as a Human-made Species and the Challenge of Integrating Conflicting Stakeholder Views Into Effective Management Policy

Kirsten Leong[1], Chris Lepczyk[2] *[1]NOAA Fisheries, Honolulu, HI, USA, [2]Auburn University, Auburn, AL, USA*

Like urban wildlife, feral domestic animals are not viewed through a uniform cultural lens, which can lead to controversies over management. In anthropology, this has been termed an "ambiguous animal." Feral cats are a prime example of this phenomen. The fact that feral cats pose significant conservation challenges to Hawaii's wildlife and island ecosystems and are considered a public nuisance, particularly on public lands is well described. However, Increasingly many feral cats are managed or subsidized in colonies, typically with minimal management putting multiple stakeholders in conflict on how to deal with feral cat issue. This presentation will provide an overview of wildlife as a social construct, where meaning is assigned by society via cultural rules. We will then present a conceptual framework outlining the range of elements that have factored into controversies over the management of free-roaming outdoor cats. This conceptual framework will be used to illustrate how the differences in the dominant frames utilized by different stakeholder groups can lead to talking past each other with respect to the way the problem is identified and solutions are suggested. Management of free-roaming outdoor cats and conservation planning will require acknowledging the multiple ways that people understand and relate to these animals to identify effective and socially acceptable management strategies.

5-24

Role of insects in transmitting Rapid ʻŌhiʻa Death

Curtis Ewing[1], Gordon Bennett[2] *[1]UH Manoa, Plant and Environmental Protection Sciences, Hilo, HI, USA, [2]UH Manoa, Plant and Environmental Protection Sciences, Honolulu, HI, USA*

Inoculum responsible for the spread of Rapid Ohia Death (ROD) is believed to be spread primarily through the activity of boring insects, specifically ambrosia beetles (Coleoptera: Curculionidae: Scolytinae). Both direct and indirect transmission is possible and we will present our research into this aspect of ROD epizootiology.

5-25

Influences of Rapid ʻŌhiʻa Death on the current and future status of Hawaii's ʻŌhiʻa forests.

R. Flint Hughes[1], Travis Sowards[1], James B. Friday[3], Leif Mortensen[4], Lisa Keith[2] *[1]USDA Forest Service, Hilo, Hawaii, USA, [2]USDA Agricultural Research Service, Hilo, Hawaii, USA, [3]University of Hawaii at Manoa, Hilo, Hawaii, USA, [4]USDA Forest*

Service, Davis, California, USA

Pathogens that kill trees may fundamentally alter forest composition, structure and function. Throughout the last six years, large areas of healthy ʻŌhiʻa (*Metrosideros polymorpha*) trees have been dying rapidly across forests on Hawaiʻi Island. *Ceratocystis fimbriata* was identified and routinely found associated with rapidly dying individuals of ʻŌhiʻa. Pathogenicity of this fungus was proven, and *M. polymorpha* was recorded as a new host for *C. fimbriata*. This desease has been given the moniker, Rapid ʻŌhiʻa Death or ROD. Currently, areas of ROD induced mortality have increased to approximately 75,000 acres - a rapid increase during only the past 3 years. These areas of ROD mortality represent about 10% of current ʻŌhiʻa forests island-wide. Results from a collection of 50+ forest plots inventoried annually revealed average annual ʻŌhiʻa tree mortality rates of 12%. Mortality rates varied greatly with some plots exhibiting less than 1% and some exhibiting greater than 40%. Small stature forests growing on younger, more rocky substrates exhibited lower mortality rates than taller ʻŌhiʻa forests growing on older, more developed soils. On average, ʻŌhiʻa trees accounted for approximately 80% of the total stem basal area across all sampled forest plots. This fact, coupled with the dearth of apparent ʻŌhiʻa seedling recruitment and characteristic understory dominance of non-native species documented within sampled plots, suggests that, in the absence of effective managment approaches to control ROD, Hawaii's future forests will be shorter, scrubbier, and increasingly dominated by non-native species. Given the risk ROD poses to our remaining intact ʻŌhiʻa forests, it is critical that we do our utmost to protect them in the smartest most effective manner possible.

5-26

Management of Rapid ʻOhiʻa Death on Hawai'i; Hawaii Volcanoes National Park, Big Island Invasive Species Committee and Division of Forestry and Wildlife.

David Benitez[3], Steven Bergfeld[1], William Buckley[2], Springer Kaye[2] *[1]Hawai`i Division of Forestry and Wildlife, Hilo, Hawaii, USA, [2]Big Island Invasive Species Committee, Pacific Cooperative Studies Unit, University of Hawaii, Manoa, Hilo, Hawaii, USA, [3]National Park Service, Hawai'i, USA*

Rapid ʻOhiʻa Death (ROD) is causing mass mortality to the keystone forest species on Hawai'i Island. The potentially devastating impacts to native ecosystems and watersheds are a top concern for land managers throughout Hawai'i, and have prompted a multifaceted and unified interagency response. Land managers with DOFAW, NPS, and BIISC are among the many who have responded to this call to action by participating in the ROD interagency working and outreach groups, and by adopting the stringent sanitation measures these groups recommend. Rich partnerships have facilitated surveys to map ROD throughout Hawai'i, as well as development, implementation, and evaluation of a range of treatments in consultation with the ROD science team and specialists. These treatments include evaluating the potential infectiveness of individual trees and stands, as well as felling trees, and covering felled trees with tarps. Information exchanges between managers and outreach specialists from multiple organizations have facilitated communications to staff and the public. Communications have included educational material at trailheads and visitor centers, as

well as press releases, web content, and video content. Though the synergies of the interagency cooperation have improved the response to this terrible disease, many challenges remain, and additional resources and continued interdisciplinary collaboration are needed to more thoroughly map the spread of ROD and identify the most appropriate management actions.

5-27

Fostering Partnerships to Balance Science, Culture, and Urgency in Rapid ʻŌhiʻa Death Outreach -It's a Kākou Effort

Corie Yanger[1], Anya Tagawa[2], Christy Martin[3], Ardena Saarinen[4], Kainana Francisco[5], Evelyn Wight[6], J.B. Friday[1] *[1]University of Hawaii-College of Tropical Agriculture and Human Resources, Cooperative Extension Service, Hilo, HI, USA, [2]Department of Land and Natural Resources -Natural Area Reserves System, Hilo, HI, USA, [3]Coordinating Group on Alien Pest Species, Honolulu, HI, USA, [4]KUPU Americorps -USDA Forest Service, Hilo, HI, USA, [5]USDA Forest Service, Hilo, HI, USA, [6]The Nature Conservancy-Hawaii, Honolulu, HI, USA*

When scientists uncovered the serious threat that Rapid ʻŌhiʻa Death (ROD) poses to native forests and people in Hawaiʻi, an ad hoc ROD Outreach Team began working to understand current knowledge about the disease and how it could spread. The outreach team translated technical data, developed target audience strategies, and created science-driven messages and materials focused on how to prevent spread via soil, the movement of ʻōhiʻa or its parts, and the use of tools. The team created a website, signs, and messages that are still in use. The team also recognized the extraordinary cultural significance of ʻōhiʻa and its central role in the Merrie Monarch Festival. To determine how to avoid unintentional spread via inter-island and global travel, and via traditional practices such as the gathering, use, and movement of ʻōhiʻa, the team reached out to the festival organizers and kupuna and asked to share information and get input. The key leaders of the festival took the information and decided internally how to proceed. This unprecedented collaboration led to culturally-rooted messages, materials, and activities at the festival. The ROD Outreach team has grown and now has two full time staff, as well as many collaborators from across the state. The team is using traditional tools such as exhibits, workshops, public service announcements, and community talks, as well as new methods such as crowdfunding campaigns, social media, an "ʻōhiʻa love" festival, hunting tournaments, and community organizing. Ongoing efforts will continue this collaborative outreach partnership model – a kākou effort.

CONCURRENT SESSION 6

6-2

THE COMMUNITY WATERSHED SNAPSHOT: LOCAL MEASURES OF AHUPUAʻA HEALTH

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Hawaii, USA, [2]The Nature Conservancy, Hawaii, USA

The Hawai‘i Conservation Alliance (HCA) Community Watershed Snapshot (CWS) is a tool used to evaluate the health of Hawai‘i’s watersheds. Through a collaborative process, the CWS incorporates existing and collected site-based information gathered collaboratively by participating community groups, local stakeholders, and relevant agencies to create simple and visually-appealing images of watershed health, from mauka to makai (mountain to sea). Between 2013 and 2015, HCA worked closely with local leaders and stakeholders from eight communities across the Hawaiian Islands to design and pilot the CWS process in local watersheds. Choosing from a set of *mauka* (terrestrial), *makai*/*wai* (ocean/fresh water), and *na‘ike* (socio-cultural) measures, communities can summarize the current status (i.e., a “snapshot”) of the health of their ahupua‘a. During 2015 and 2016, three communities volunteered to conduct the first three watershed snapshots for Hā‘ena (Kaua‘i), Hau‘ula (O‘ahu), and Maunalua (O‘ahu). Through sharing and using their “snapshot” results, these three communities are advancing local natural resource management efforts within their own *ahupua‘a*. HCA is developing an easy-to-use guide so that interested communities can conduct their own watershed snapshot. During the first part of this session, snapshot results and lessons will be shared by participating community and partner representatives, including a presentation on how their snapshots are catalyzing and informing local management efforts. During the second part of this session, a facilitated discussion will explore the snapshot process and ways to effectively engage with knowledgeable users and the next generation of local stewards.

6-3

One Canoe, One Island, One Planet: Governor David Ige's Sustainable Hawai‘i Initiative

Governor David Ige[1], Scott Glenn[1], David Smith[2], Bruce Anderson[2], Josh Atwood[2], Scott Enright[4], Terry Surles[5] *[1]State of Hawaii, Executive Branch, Honolulu, Hawaii, USA, [2]State of Hawaii, Department of Land and Natural Resources, Honolulu, Hawaii, USA, [3]State of Hawaii, Department of Agriculture, Honolulu, Hawaii, USA, [4]State of Hawaii, Department of Agriculture, Honolulu, Hawaii, -, [5]State of Hawaii, Department of Business, Economic Development & Tourism, Honolulu, Hawaii, -*

Hawai‘i is blessed with thousands of species of plants, birds, fish, marine mammals, and other wildlife found nowhere else on earth. Today, these unique species, and the ecosystems on which they depend, are in peril. Hawai‘i also faces rising fuel costs and the loss of important agricultural lands. We know the limits of our natural environment. We see the impacts of our actions very close to home. We are a microcosm of our planet earth. Like the Hawaiian voyaging canoe, we are one canoe, one island, one planet. As part of the effort to move Hawai‘i on a path toward a more sustainable future, Governor Ige has launched an ambitious statewide initiative that identifies five commitments. This includes a commitment to double local food production by 2020, implement Hawaii's interagency biosecurity plan by 2027, protect 30% of our priority watersheds by 2030, effectively manage 30% of our nearhsore ocean waters by

2030, and achieve 100% renewable energy by 2045. This forum is designed to inform the public about the Governor's Sustainable Hawai‘i Initiative, discuss the commitments and the agencies responsible for implementing them, and reflect on the milestones achieved to date and during the 2017 legislative session.

6-4

Integrating Meaningful Scientific and Cultural Learning Grounded in Place: Experiences of Papahana Kuaola's Lelekamanu Program

Noelani Lopez, Penny Martin *Papahana Kuaola, Kaneohe, HI, USA*

Papahana Kuaola's Lelekamanu Program (LP) addresses the need for a blend of science and culture-based educational opportunities for students, teachers, and communities in Hawai'i. With a combination of classroom instruction and corresponding field trips, LP educators maximize learning for students by using a multi-sensory education experience. Several projects have been completed developing curriculum materials and activities with a focus on Hawaiian mo‘olelo (stories, history). The purpose of these projects is to encourage students to read and appreciate traditional Hawaiian literature focused on wai (freshwater), geology, and wahi pana (special places) around our islands using an approach that educates from both scientific and cultural perspectives. With the use of both student pre- and post-tests, teacher evaluations, and community feedback, the program has been able to measure or track project success.

Participants in LP's programs are provided with meaningful education experiences with an emphasis on learning about the cultural and natural history of Hawai‘i, including how people impact the natural resources. With increased understanding and appreciation of our islands' resources, students, teachers, and community members are encouraged to become responsible stewards of Hawai‘i and to have a positive effect on real world problems. Papahana Kuaola's mission of creating education programs focused on Hawai‘i, environmental restoration, and economic sustainability, connects closely to the conference theme of "He wa'a he moku, he moku he wa'a".

6-5

Mālama No I Ka Loko I‘a

Ikaika Lum[1,2], Nitasha Stiritz[2], Graydon "Buddy" Keala[2] *[1]Leeward Community College, Pearl City, O‘ahu, HI, USA, [2]Mālama Loko Ea Foundation, Hale‘iwa Hawai‘i, USA*

Ho‘olaulima ku nā kūpuna,

Mālama no i ka loko i‘a,

E ho‘omau i neia waiwai ho‘oilina.

Let us work in the manner of our ancestors,

Let us preserve the fishponds,

To continue this part of our heritage.

Loko Ea is indeed an ancestral place of importance, a significant Wahi Pana to the people of Waialua. This loko i‘a is associated with ancient deities, cultural practices and historical events. This fishpond once helped to sustain its community by providing aquatic food resources like native fish and seaweed. Over time, Loko Ea has unfortunately taken on an unprecedented amount of stress due to surrounding developments, mismanagement of resources and lack of continuous cultural practices. Today, Loko Ea is on a path to restoration with the help of the Mālama Loko Ea Foundation.

Loko i‘a, Native Hawaiian fishponds, are impressive structures. The piko of an ahupua‘a, loko i’a are located where the land meets the sea; thus, are incredible indicators of the health of an ahupua‘a and are beginning to garner much scientific attention and support. Affirming the role of indigenous cultures in global conservation efforts, they represent one of the ancient world‘s most significant aquacultural achievements. The art of Hawaiian aquaculture practices are self-sustaining and will ensure Native Hawaiian cultural values and practices are adequately integrated into contemporary conservation strategies. Newly restored loko i‘a are a vehicle for economic and educational opportunity while establishing an important system dedicated to mālama honua and growing food sustainably for the people of Hawai‘i.

6-6

***Kaiaulu:* Community, the Growing Sea Perpetuating Presence and Connection to Ancestral Coastal Lands in Halele‘a, Kaua‘i**

Mehana Vaughan *UH Manoa, Honolulu, United States Minor Outlying Islands*

This presentation explores sustainability of social ecological systems by investigating the rights and responsibilities that come with being of a place, and means to perpetuate indigenous connections to land within imposed western property systems. In Hawaiian, the same word, kuleana, means rights and responsibilities, both of which are inextricably based in ‘āina, land. The word kuleana expresses a value, while also referring to lands given by governing ali‘i (chiefs) to a family as their responsibility, without right of ownership. Over the past quarter-century, popularity of Hawai‘i’s coasts as luxury retreats for the super wealthy, escalating property taxes, and resulting land commodification have made it increasingly difficult for Hawaiian families to own, live in and access coastal areas. Despite these struggles, Hawaiian fishing communities on the north shore of Kaua‘i continue to exercise kuleana to ancestral lands and gathering areas. Through interviews, analysis of land records, and focus groups conducted by a community research team, this study explores how Hawaiian families maintain presence and connection in ways that emphasize not ownership, but caretaking. Some negotiate stewardship agreements to restore taro patches their families once farmed, now on public lands condemned by the state. Other families continue to care for parcels they no longer own, or return to their home area regularly for gatherings, educational programs, to fish and share harvests. Community actions offer possibilities and kīpuka through which to restore lost connections while growing new ones, rebuilding caretaking relationships with ‘āina based upon kuleana.

6-7

The Future of Hala (*Pandanus tectorius*) in Hawai'i.

Michael Opgenorth *National Tropical Botanical Garden, Kalaheo, Hawaii, USA*

Hala (*Pandanus tectorius*) is a culturally and ecologically important resource in Hawai'i. Used in a wide range of important daily tools and materials, hala is now in threat.

Hana is home to the largest remaining hala forest in Hawaii, much of it located within the Kahanu Preserve, managed by the National Tropical Botanical Garden (NTBG). Unfortunately, these type of coastal wet and mesic hala forests are at risk. Invasive plants, spreading pests and other threats stand to effectively eliminate this forest if nothing is done.

Come learn more about the issues surrounding hala with recommendations on what can be done next to preserve this important resource in the Hawaiian Islands.

6-8

Enhancing Heritage Management and Food Security through Cultural Revitalization at Maluaka

Jack Rossen[1], Māhealani Pai[2], Brooke Hansen[1], Keonelehua Kalawe[2] *[1]University of Hawai`i at Hilo, Hilo, HI96720, USA, [2]Kamehameha Schools, Keauhou, HI 96739, USA*

We wish to contribute a model of how to support mālama honua through protection and promotion of kānaka maoli culture, heritage plants and agricultural systems. The Maluaka Project in the ahupua`a of Keauhou, Hawai`i Island, combines education, community engagement and research to seek new insights on how to combine Native wisdom and science. Through edutourism and service learning at Maluaka, Hansen and Rossen were introduced to the project and were able to teach many students the critical relevance of cultural revitalization and food sovereignty. Agricultural tourism, edutourism and voluntourism are underexplored avenues of sustainability education and Maluaka is a model for how these can be developed to support heritage management. The partnership with Pai and Kalawe led to the development of archaeological field excavations to better understand the ancient cultural landscape and its importance for sustainability today. One of the goals of the Maluaka Project is to restore the landscape to its original functions. With over 80% of food imported to Hawaii Island, the Maluaka Project will contribute to modeling innovative partnerships for food sovereignty.

6-9

Exploring biocultural connections in the Pacific to better monitor the resilience of social and ecological communities

Rachel Dacks[1], Eleanor Sterling[2], Tamara Ticktin[1], Manuel Mejia[3], Stacy

Jupiter[4] [1]*University of Hawaii at Manoa, Honolulu, HI, USA,* [2]*American Museum of Natural History, New York, NY, USA,* [3]*The Nature Conservancy, Honolulu, HI, USA,* [4]*Wildlife Conservation Society, Suva, Fiji, Fiji*

Pacific Island communities are facing unprecedented challenges in conserving natural resources and maintaining human well-being. In these place-based communities, biocultural connections, or the integrated social, economic, cultural and environmental linkages between people and nature are widely believed to play a critical role in improving and maintaining the resilience of both human and ecological communities. However, indicators of human or ecological well-being rarely reflect the integrated nature of these systems. This presentation will address (1) What are good indicators of ecological and social well-being in the Pacific? and (2) How can we use indicators which have relevance across the Pacific Islands and translate between local and global needs?

We have carried out visioning exercises across multiple Pacific Island archipelagoes (Hawai‘i, Fiji, Solomon Islands, Marshall Islands) to better understand the perspectives of Pacific Islanders on characteristics of vibrant biocultural landscapes and seascapes. From these visioning sessions, we have identified key dimensions that describe a resilient biocultural state for Pacific Island communities and developed example indicators that measure the state of these dimensions. Additionally, we have assessed the United Nation's Sustainable Development Goals and the Convention on Biological Diversity's Aichi Targets to determine which of these goals or targets are relevant to Pacific Island communities. For goals or targets that were not obviously relevant, we have come up with recommendations for how they can be adjusted to be relevant or translated between local and global needs, in order to better resonate with communities and better reflect important connections between people and nature.

6-10

The Hawaiian Ecological Footprint, 1870: A Pivotal Period in the History of Ecosystem Change in Hawai‘i

Sam ‘Ohukani‘ōhi‘a Gon[1], Jim Jacobi[2], Stephanie Tom[1] [1]*The Nature Conservancy, Honolulu, Hawai‘i, USA,* [2]*U.S. Geological Survey Pacific Island Ecosystems Research Center, Kilauea, Hawai‘i, USA*

The history of Hawaiian biological diversity has seen losses and changes as a result of the presence of people and their biological introductions. Post-western contact human presence in the Hawaiian archipelago led to significant changes to native ecosystems as the result of great expansion of introduced ungulate range with heavy impacts throughout lowland forests, and increasingly large-scale monotypic agriculture in both wet and mesic lowland and montane settings. Using geospatial modeling and historical sources describing cattle pasture, the beginnings of sugar plantations, and lava flows between 1770 and 1870, the areas of ecosystem displacement and direct change were modeled for the island of Hawai‘i. The longer term goal is to provide a geospatial history of land use and change in the Hawaiian Islands, with milestones including the pre-contact Hawaiian footprint (presented at Hawai'i Conservation Conference 2013), the spread of introduced ungulates and the era of widespread sugar and pineapple agriculture (this presentation), and other major contributors to the current patterns of ecosystem loss and remaining biological diversity. For this iteration, observations of

naturalists at the beginning of the 20th century, such as Joseph Rock, Albert Koebele, Vaughan MacCaughey, and Archibald Menzies, offer a picture of the changing landscape of that time. Understanding the details of the history of Hawaiian ecosystem change can provide us with insights on the maintenance and restoration of what remains.

6-12

Hawaii's Feral Cats Session 2 - Panel Discussion: What are pathways for success in effectively managing Hawaii's feral cat dilemma?

Chris Lepczyk[1], Grant Sizemore[2], Kate Atema[3], Kirsten Leong[4], Joshua Atwood[5], Pam Burns[6], Justin Gruenstein[7] *[1]Auburn University, Auburn, Alabama, USA, [2]American Bird Conservancy, The Plains, Virginia, USA, [3]International Fund for Animal Welfare, Washington D.C., USA, [4]NOAA, Hawaii, -, [5]DLNR, Hawaii, USA, [6]Hawaiian Humane Society, Hawaii, USA, [7]City and County of Honolulu, Hawaii, USA*

This session will build on the information presented in session one of this two part symposium and will be comprised of a panel discussion and a public question and answer session. The panel will be comprised of scientists, managers, advocates for cats, and others that have been involved in this issue at both local and national levels. The discussion will touch on a variety of topics including impacts of cats on native wildlife, animal welfare concerns, different strategies that can be applied to managing the situation, techniques to encourage an informed and civil dialog on this complex issue, and more. The objective is to help educate the conservation community and broader public on Hawaii's feral cat dilemma and push a positive conversation forward towards action.

THURSDAY, JULY 20TH

CONCURRENT SESSION 7

7-1

IUCN World Conservation Congress Legacy: Lasting Outcomes & Next Steps for Hawai‘i

Celeste Connors[1,3], Neil Hannahs[5,3], Chipper Wichman[4,2], John DeFries[6,2], Janis Reischmann[7] *[1]Hawaii Green Growth, Honolulu, Hawaii, USA, [2]IUCN National Host Committee, Honolulu, Hawaii, USA, [3]IUCN National Legacy Committee, Honolulu, Hawaii, USA, [4]National Tropical Botanical Gardens, Lihue, Hawaii, USA, [5]Hookele Strategies, Honolulu, Hawaii, USA, [6]Native Sun Business Group Inc, Kona, Hawaii, USA, [7]Hau‘oli Mau Loa Foundation, Honolulu, Hawai‘i, -*

The 2016 IUCN World Conservation Congress was a tremendous success for Hawai‘i, with record attendance, high-level leadership engagement, lasting policy outcomes, and new partnerships. It took over eight years and many hands to bring this important opportunity to Hawai‘i for the first U.S hosted Congress. Against the backdrop of evolving federal climate and energy policy, Hawai‘i’s investment in hosting the Congress will have important long-term impacts.

At the first Hawai‘i Conservation Conference since hosting the “Olympics of Conservation” in 2016, this session will highlight the legacy for Hawai‘i from the catalytic global congress – and most importantly - the ongoing momentum for continued leadership both locally and globally.

This interactive panel discussion with IUCN Legacy Committee and National Host Committee members will take stock of key outcomes from the IUCN Congress, on-going action, and next steps on the horizon for Hawai‘i as an island leader.

IUCN Legacy: Hawai‘i's Sail Plan for a Sustainable Future

He Wa'a He Moku, He Moku He Wa'a

Like the two hulls of a voyaging canoe, the Mālama Honua Worldwide Voyage and the Aloha+ Challenge together form Hawai‘i’s Sail Plan, inspiring collective action on sustainability for future generations. Building on the forty-year journey of Hōkūle‘a, Hawai‘i applied these guiding values and principles in 2014 to launch the Aloha+ Challenge - a statewide framework to achieve six integrated sustainability goals by 2030.

Hawai‘i’s legacy is our unified sail plan to navigate toward a more sustainable and resilient future for our islands, and our canoe, island earth.

7-2

Monitoring and predicting spatial patterns of Ceratocystis fimbriata across the Hawaiian landscape

Lucas Fortini[1,2], Lauren Kaiser[3], Jim Jacobi[1] *[1]USGS Pacific Island Ecosystems Research Center, Honolulu, HI, USA, [2]Pacific Islands Climate Change Cooperative, Honolulu, HI, USA, [3]Hawai'i Cooperative Studies Unit, Hilo, HI, USA*

Anomalous, rapid death of 'ohi'a was first observed in 2010 and has since spread to over thousands acres in the island of Hawaii. USDA plant pathologists have identified the causal agent as an introduced fungus, Ceratocystis fimbriata (CF). The potential impacts of this invasive pathogen are still poorly understood, but its spread could be a significant setback to decades of forest restoration and management efforts by DOI agencies and partners. Effective management requires increased understanding of the extent of potential CF distributions, along with patterns of spread and resulting 'Ohi'a tree mortality. We are working with multiple partners to document the spreading distribution of CF-related 'ohi'a mortality across the island of Hawaii. Our approach relies on two stages: First, we have developed a real-time web portal where the most up-to-date information on the distribution of CF-related 'ohi'a mortality is available along with real-time analyses of possible environmental correlates to CF distribution and spread. Second, we anticipate integration with other ROD monitoring efforts to devise spatial predictive models that allow for a pro-active reduction of ROD-related risks to 'ohi'a forests. These models will identify areas for additional field surveys and for those where preventative steps should be taken to reduce the potential for spread of CF into other areas, particularly those supporting important ecological habitats (e.g., national parks and wildlife refuges, forest reserves, etc.).

7-3

Application of Very High-resolution Pictometry Imagery to Assessing Rapid 'Ohi'a Death (ROD) in Hawai'i

Jim Jacobi[1], Theresa Menard[2] *[1]U.S. Geological Survey, Pacific Island Ecosystems Research Center, Hawaii National Park, HI, USA, [2]The Nature Conservancy of Hawaii, Honolulu, HI, USA*

Pictometry International provides very high-resolution (ca. 20 cm pixel) georectified imagery for many locations throughout the United States, including most areas in the main Hawaiian Islands. It is available for use with a fee through an annual license. This standard color red-green-blue (RGB) imagery is collected along designated flight-lines using small fixed-wing aircraft. The resulting images are stitched together into a continuous mosaic so that at any point you can view the imagery from five different perspectives: vertical, and obliquely from the each of the four cardinal directions; roughly equivalent to viewing the landscape from 150 m (500 ft) above the vegetation canopy. Image dates range from 2008 - 2016, depending on the area. The images can be viewed using the Pictometry online viewer or can be integrated into ArcMap with a Pictometry toolbar. This imagery has been used for various purposes in Hawai'i ranging from simple site familiarity, identifying helicopter landing zones, and for the establishment of virtual vegetation plots to characterize plant communities or identify particularly species. We are also now using Pictometry imagery to assess the progression of change in canopy tree vigor at sites where rapid 'ohi'a death (ROD) caused by fungal pathogens has been confirmed. In this presentation we will give an overview of the imagery, its user interface, and analysis tools, and provide several examples of its use.

7-4

Mapping the progression of Rapid Ohia Death via small unmanned aerial systems

Ryan Perroy[1], Nathan Stephenson[1], Lisa Keith[2], Wade Heller[2], Marc Hughes[2] *[1]UH Hilo, Hilo, USA, [2]USDA Ag. Reseach Service, Hilo, USA*

‘Ōhi‘a (*Metrosideros polymorpha*), a dominant native tree of high ecological and cultural importance, is experiencing widespread mortality across Hawai‘i Island due to two distinct strains of the fungal pathogen *Ceratocystis fimbriata*. We have been using small unmanned aerial systems to map the progression of ‘Ōhi‘a mortality on a monthly basis since February, 2016. Within our ~40 hectare study area along Stainback Highway in the Waiakea Forest Reserve, we have generated a time-series of very high resolution (cm-scale) imagery and derived spatial datasets. These data have allowed us to document the spatial progression of the disease over time as healthy-appearing, asymptomatic trees completely defoliate. Field samples collected from symptomatic trees and tested using quantitative polymerase chain reaction confirm the presence of both species (A and B) of *Ceratocystis fimbriata* within the study area. Remote sensing using small unmanned aerial systems can provide valuable, timely imagery and assist researchers and managers as they work to prevent the spread of this serious forest disease.

7-5

Detecting and Mapping Rapid ‘Ōhi‘a Death Early and Cost-Effectively – DLNR's Aerial Survey Program Using Digital Mobile Sketch Mapping

Philipp LaHaela Walter *DLNR, Honolulu, USA*

Starting in January 2016, DLNR's Division of Forestry and Wildlife has continuously conducted aerial surveys for early detection, mapping, and monitoring of Rapid ‘Ōhi‘a Death (Ceratosystis; ROD). Using the Digital Mobile Sketch Mapping (DMSM) technology developed and provided by USDA Forest Service Forest Health Protection, a team of two surveyors per helicopter flight visually and systematically assess and digitally map any ‘Ōhi‘a trees detected that show symptoms of Rapid ‘Ōhi‘a Death. However, infection with ROD can only be positively confirmed through laboratory testing requiring field crews to sample detected trees. Until now, the surveys targeted all forest areas with known ‘Ōhi‘a presence on Hawai‘i Island, Maui, Molokai, Lanai, Oahu, and Kauai. Results of the first survey period found over 50,000 acres of ‘Ōhi‘a forest on the Big Island potentially impacted by ROD. Also, the surveys indicate a continuing, rapid spread of the fungal disease in certain areas.

The aerial survey program provides a number of valuable lessons to the conservation community. The program proved to be a showcase for successful and effective collaborations among various organizations on the federal, state, and local level. Further, the integration of new technologies for mobile collection of geospatial data on natural resources and online access to such information often in real-time opens up new opportunities for efficient conservation and natural resource management.

This presentation will provide an overview of the statewide aerial survey program, its

methodologies and results, and will discuss strengths and weaknesses of the methodologies applied.

7-6

Conservation Matchmaker: Bridging Minds, Resources and Needs to Enhance Youth Engagement and Program Capacity

Liana Murillo[1,2], Julia Meurice[1] *[1]NOAA, Hilo, Hawaii, USA, [2]Lynker Technologies, Hilo, Hawaii, USA*

A round table forum organized to hone methods and pathways for collaboration, youth engagement and skill building in order to increase the capacity for conservation and effective stewardship within the Hawaiian Islands. Forum will be broken into multiple facilitated sessions including a brainstorming and affinity protocol session - which will facilitate connections between conservation organizations to address how needs and resources can be met through creative collaboration.

This will lead to interactive break-out groups focusing on the "Four Cardinal Directions of Growth" within conservation and youth enrichment programs. This component aims to increase success and longevity of conservation programs through sharing current best management practices, specifically for youth development, through meaningful programs that integrate scientific integrity with Hawaiian cultural practices and values. Additional outcomes include identifying shared priorities, successes, and challenges groups are facing in creating balanced, inspiring, and successful programs that increase our capacity to conserve natural resources and culture.

Participants will be engaged through use of equal voice and timed share-backs in circles focused around the topics developed in the affinity protocol as well as guiding questions of their choice. After groups have had time to collect their ideas and outcomes, a share-back to the whole group will follow recorded by the notekeeper. At the end of the forum, participants will leave with a take-home sheet including contacts, networks to fit their identified needs, collaborative partners operating in the same vision, and a list of best-practices for each topic generated by the group.

7-7

Battles Over Bats and Birds: Links Between Litigation, Legislators, and Community Engagement

Maxx Phillips[1,2], Senator Gil Riviere[2,1] *[1]Keep The North Shore Country, Hale`iwa, HI, USA, [2]Hawai`i State Senate, Honolulu, HI, USA*

One of the greatest conservation conundrums of the 21st century is the question about how we can create green energy solutions that don't come at the expense of endangered species populations, local agricultural economies, and/or environmental justice for rural communities. Viable solutions to this question can be found when empowered communities explore the nexus between legislative actions and legal proceedings. Some of the many nuances of this philosophical enigma will be explored

via a case study of the cumulative impacts of “takes” of the endangered Hawaiian Hoary bat (`ōpe`ape`a) by wind farms in rural communities on O`ahu. The results reveal a new realm of effective conservation that should be explored by conservation professionals, researchers, resource managers, and policy makers to ensure that healthy ecosystems, economies, and communities exist in Hawai`i long into the future.

7-8

Asking the Public to Spot the Ant, Stop the Ant: Supporting the Little Fire Ant Response

Christy Martin[1], Erin Bishop[2], Chris Frohlich[2], Becky Azama[3], Derek Arakaki[3] *[1]Pacific Cooperative Studies Unit-Coordinating Group on Alien Pest Species, University of Hawaii at Manoa, Honolulu, Hawaii, USA, [2]Pacific Cooperative Studies Unit-Oahu Invasive Species Committee, University of Hawaii at Manoa, Honolulu, Hawaii, USA, [3]Hawaii Department of Agriculture, Honolulu, Hawaii, USA*

The December 2013 discovery of little fire ants (LFA) in hapuʻu logs being sold at nurseries and garden shops on Oʻahu, Maui, and in a landscape on Lānaʻi prompted the formation of an interagency LFA Response in the spring of 2014. The Hawaiʻi Ant Lab (HAL) provided the training and guidance on where and how to survey, and how to eradicate infestations. Together with the Hawaiʻi Department of Agriculture (HDOA) as the lead agency, the Oʻahu Invasive Species Committee (OISC) and HAL crafted and implemented a plan to survey high risk locations including nearly 200 nurseries, garden shops, landscape contractors, and similar businesses, successfully detecting and controlling miniscule to multi-acre infestations over the past three years. However, some of the hapuʻu logs that had been sold to the public likely contained LFA, and they were untraceable. Therefore, an outreach subgroup formed to engage the public in surveying for LFA through the "Spot the Ant, Stop the Ant" campaign. Looking back, data collection and metrics for this project on Oʻahu have been better than for many outreach projects due to the use of Podio, an online project and data management program. The team's work with Oʻahu schools has garnered 1,202 samples from students' yards, and a total of 499 ant samples have been submitted by the public to HDOA. Several LFA infestations were found through these public reports, and while none of the student samples have been LFA, the data helped agencies delimit the size and scope of some LFA infestations.

7-9

Steps to control mosquito-vectored avian diseases in Hawaiʻi

Jolene Sutton[1], Cynthia King[2], Floyd Reed[3] *[1]University of Hawaiʻi at Hilo, Hawaiʻi, USA, [2]Hawaiʻi Department of Land and Natural Resources, Hawaiʻi, USA, [3]University of Hawaiʻi at Manoa, Hawaiʻi, USA*

A group of over 40 experts in the fields of biology, biotechnology, wildlife management and public health met on Hawaiʻi Island in September 2016 to discuss viable solutions to control mosquito-vectored diseases in Hawaiʻi. One outcome was an identified interest in

pursuing local development of *Wolbachia*-based control strategies. *Wolbachia* is a genus of bacterium that occurs naturally in about half of all insect species, including some invasive mosquitoes that have become established in Hawai‘i. When a male mosquito that carries one strain of *Wolbachia* mates with a female mosquito that carries a different strain, a form of reproductive sterility can result. In the lab, scientists can introduce strains of *Wolbachia* that do not normally occur in a given mosquito species. This ability has been used to suppress populations of mosquitoes and/or the spread of some mosquito-borne illnesses, such as Dengue. We are currently pursuing development of *Wolbachia*-based strategies to mediate the spread of mosquito-borne avian diseases by targeting the southern house mosquito, *Culex quinquefasciatus*. In the lab, we use antibiotics to clear naturally-occurring bacteria then introduce a different strain of *Wolbachia*. Since the bacterium is passed only from mother to offspring, future applications could release males only to prevent spread of novel *Wolbachia* strains.

7-10

Humans and Wildlife in the Same Canoe: Science-guided Resolutions to Human-Wildlife Conflicts on Invaded Pacific Islands

Shane Siers[1], Craig Clark[2] *[1]USDA APHIS Wildlife Services National Wildlife Research Center, Hilo, Hawaii, USA, [2]USDA APHIS Wildlife Services Hawaii State Office, Honolulu, Hawaii, USA*

The mission of the Hawai'i Field Station of the US Departement of Agriculture Wildlife Services National Wildlife Research Center is to develop and evaluate methods and strategies to manage invasive species impacts to agriculture, natural resources, and human health and safety. We discuss the objectives of our new 5-year project cycle beginning in 2017, including: development of products, methods, and strategies for the eradication of rodents from small islands; formulation and application strategies to reduce the use and undesirable side effects of rodenticides; evaluation of the potential for reproductive inhibition of rodents; development and testing of tools to reduce mongoose damage; solutions for the management of rose-ringed parakeet damages on Kaua'i; interdiction and landscape-scale suppression of brown treesnakes on Guam; and response to new research needs as novel invasive species problems arise. A primary focus of this research is to develop tools that can be implemented by US Department of Agriculture Wildlife Services operational programs and other stakeholders. We also provide an overview of specific recent, current, and near-term research projects.

7-11

Establishment and maintenance of instream flow standards for the State of Hawai‘i

Ayron Strauch[1,2] *[1]State of Hawaii, Department of Land and Natural Resources, Honolulu, HI, USA, [2]University of Hawaii, Department of Natural Resources and Environmental Management, Honolulu, HI, USA*

Water is a public trust resource in the State of Hawai‘i that must be managed to protect current and future needs. Surface water in its natural state provides for multiple uses

including aesthetic and recreational value, ecosystem services, habitat for freshwater fauna, navigation, instream hydropower, water quality, maintenance of riparian vegetation, and cultural uses. Water is also valued for off stream use including municipal and domestic water supply, irrigation for agriculture, industrial use and off stream hydropower. Under the State Water Code, off stream uses are permitted as long as they are weighed against the importance of instream uses. Quantifiable instream flow standards (IFS) established by the Commission on Water Resource Management, are the primary mechanisms for protecting surface water resources in the State of Hawai'i. To this date, IFS have been established for particular streams on Oahu, Maui and Hawai'i following the submission of formal complaints and comprehensive assessments of water use. As surface water diminishes due to climate change and population growth demands increasing amounts of water, proactively establishing IFS values for streams will protect instream uses without extensive litigation efforts.

7-12

Impact of climate change on the natural flow regime of Hawai'i's streams

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Warming climate will have fundamental impacts on freshwater which is a critical driver for island ecosystems. Streamflow is highly variable across the Hawaiian Islands in response to precipitation, and steep gradients in orographic (mountain) rainfall. Changes in the hydrological conditions of streams are likely to be diverse and complex as catchment hydrological responses change with shifts in precipitation, evapotranspiration, and altered vegetation assemblages. Changing streamflow patterns will likely place additional pressure on native aquatic fauna that are already threatened by introduced species, degraded water quality, and stream diversion. We examined 50-year (1967-2016) and 30-year (1987-2016) hydrographic records in 24 unregulated streams across the five largest Hawaiian Islands to determine climate-induced changes in annual and seasonal runoff, and the magnitude and persistence of high and low flows. For each stream, flow was separated into direct runoff and baseflow, and high and low flow statistics (e.g. Q10, Q90) and ecologically important hydrologic indices (e.g. number of no-flow days, stream flashiness) were derived. Mean annual stream flows varied significantly among streams (range: 0.04-7.03 $m^3 s^{-1}$) associated with differences in localized precipitation and drainage area. Almost all streams show a "decreasing" trend in annual baseflow and runoff, which has accelerated over the last 30 years, with an average decline in runoff and baseflow of 10.6% and 14.5% per decade, respectively. A significant decline in dry season flows (May-Oct.) has led to an increase in the number of no-flow days in leeward areas, indicating that more streams may become ephemeral.

7-13

The Future of Water Budget Components under Climate Change for Selected Watersheds of O'ahu Island, Hawai'i

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Due to small watershed sizes, Hawai'i's freshwater resources are very sensitive to climate change. This study assessed the impact of future climate change on the water budgets of selected watersheds on the island of O'ahu. To assess current and future water budgets of the watersheds, the Soil and Water Assessment Tool (SWAT) model was applied, calibrated, and validated at multiple daily streamflow gauging stations across the watersheds. Climate change analyses utilized the Representative Concentration Pathways (RCP) of 4.5 and 8.5, including A1B emission scenarios. Compared to baseline, the water budget components generally showed decreasing trends mainly due to rainfall change. Despite future temperature increase, the actual monthly watershed-scale evapotranspiration will decrease due to the overall decrease in rainfall and soil moisture availability. Surface runoff and groundwater recharge showed the largest changes (-58% and -57%, respectively) compared to the other water budget components. Streamflow and baseflow will consistently decrease by as much as 39% and 30%, respectively, by 2100. In addition, more changes in streamflow and baseflow are predicted in the leeward watersheds of the island. Overall, toward the end of this century, the effect of rainfall on water budgets is expected to be more critical under RCP 8.5 scenarios, particularly during the dry season. The consequences may have negative implications on freshwater sustainability, aquatic inhabitants, and ecological functioning of the riparian ecosystems. Such predictions emphasize the need for water resources managers, decision makers, and ecosystem conservationists to develop appropriate mitigation measures to climate change impacts in Hawai'i and similar islands.

7-14

Na Wai 'Ekolu: Stream outreach education activities in the Ala Wai and Honolulu Watersheds

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As a stream outreach and restoration project, to educate the public about Hawai'i's unique native freshwater species and the effect of anthropogenic influence on their populations, a collaborative effort was established between the University of Hawai'i at Mānoa Center for Conservation Research and Training (UH-CCRT) and 'Iolani School. Together, classroom curricula and field protocols were developed for use in K-12 public, private, and charter schools in the Ala Wai Watershed, emphasizing environmental awareness through three sequential freshwater stream and watershed health lessons. From November 2015 to March 2017, we have worked with 3862 students and 816 educators from 27 educational and professional institutions around the island of O'ahu. Over this 17-month period, Lessons 1, 2, and 3 were performed 99, 54, and 54 times, respectively. The total number of fish and macroinvertebrates captured during field lessons was 6759, of which only 73 were native species. All invasive animals were removed from the stream, totaling 492.6 pounds, and converted into compost or adopted

as household pets from students/parents and school staff. Native species were always released back to their capture location following the field activity. Although we have received high support for this activity in a relatively short time, improvements in stream biological integrity and/or health of Hawaiian Streams will require more participation from more educational and professional institutions. By engaging in more environmental education workshops and symposia, we also hope to stimulate more interest and create more intensive efforts to improve stream health in Hawai‘i’s watersheds that need it most.

7-15

Lawai‘a Pono: Implementing intergenerational observation and place-based solutions. The Mo‘omomi vision, community co-managed marine areas and fostering monitoring practices

Mac Poepoe, Hannah Springer, Presley Wann, Noelani Lee, Shaelene Kamakaala *E Alu Pu, Hawaii, USA*

Uncle Mac Poepoe attributes much of his learning process as a lawai‘a (fisher) to first being a “bag boy” for his elders. He gained years of experience and knowledge simply through observation and listening to what they shared with him, which since has been the foundation of his gathering practices. Uncle Mac has catalyzed communities across the archipelago to apply their observations into solutions to reverse the decline in our nearshore resources. This forum will highlight the Mo‘omomi (Moloka‘i) vision of abundance, biological indicators and scientific process. Leadership from the communities of Hā‘ena (Kaua`i) and Ka‘ūpūlehu (North Kona) will share updates on their CBSFA & rest period initiatives enacted into law in 2014 and 2015 respectively. Following, there will be break-out groups for the audience and lawai‘a pono from Hawai‘i, Maui, Lāna‘i, Moloka‘i, O‘ahu and Kaua‘i to further discuss place-based observation and monitoring.

CONCURRENT SESSION 8

8-1

Linking Indigenous Knowledge and Sovereignty, Emerging Technologies and Conservation Challenges

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At this critical juncture, should Hawaiians allow our fragile ecosystems to be used for testing unproven, genetic engineering technologies? Or should we explore how Hawaiians together can develop holistic strategies and responses to environmental

crises built upon indigenous knowledge, techniques and sovereignty? Do we pursue the unproven technological “quick fix?” Or do we strive for creating lasting international cultural, social and ecological impacts, which originate from a Kanaka Maoli-led movement, consistent with the ethos that the “'aina and the people are one.”

In this Forum, panelists will discuss the challenges that new genetic engineering proposals pose to indigenous Hawaiian cultural practices and sovereignty, and what a sustainable and local evaluation and response might be. We will also discuss several proposed applications targeting Hawaiian biodiversity, such as gene drive mosquitoes and genetically engineered trees. The forum also asks "how can a process of culturally grounded critical reflection and technology assessment be built into conservation practices aligned with IUCN Motion 83?” This will build upon our presence at the IUCN World Conservation Congress in September 2016, where two of our panelists presented a Knowledge Café forum.

8-2

Evaluating the Airsoft Electric Gun for Control of Invasive Reptiles: Ballistic Tests and Impact on Brown Treesnakes

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Firearms are often used in lethal control of invasive vertebrates, but safety and regulatory aspects limit the circumstances under which they can be used. Here we evaluate if hobby-grade Airsoft Electric Guns (AEGs)-a lower-powered, less hazardous, and less regulated alternative-could potentially be used in the control of small animals, with specific emphasis on invasive Brown Treesnakes (Boiga irregularis). Tests of different AEGs with ammunition (plastic pellets) masses ranging from 0.20 to 0.39 g, fired at gelatin blocks from distances of 4, 8, and 12 m, confirmed that heavier ammunition penetrates deeper. The 0.39-g pellets even penetrated more deeply at 12 m than did 0.20-g pellets at 4 m. Inspection of tissue damage in Brown Treesnake carcasses subjected to fire with the 0.39-g ammunition from the same distances suggested that injuries sustained by a direct hit from 12 m away would often be lethal, and that Brown Treesnakes would be unlikely to survive multiple hits from automatic fire (ca. 17 s-1). Limited trials with live snakes helped us understand what the behavioral response may be in a snake hit by one or more pellets, and to assess the risk that an injured snake might avoid subsequent capture. We discuss regulatory advantages, and what type of invasive reptiles and other taxa (in terms of size, morphology, and habitat) might be suited to control with AEGs.

8-3

Manipulating Soil Nutrient Availability to Promote Native Species Following Nonnative Ungulate Removal

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Nonnative ungulates such as feral pigs negatively impact native biodiversity, particularly on islands. As a result, fencing and ungulate removal is a common management strategy for conserving native biodiversity. However, nonnative ungulates also impact underlying ecological processes such as soil nutrient availability. While typically overlooked, ungulate impacts on ecological processes are important because they: (i) can persist for decades following removal; and (ii) at least partially control the response of vegetation to removal (e.g., competitive dynamics between native and nonnative plants). Our research on feral pigs in Hawaiian wet forests shows that their removal results in an increase in soil nutrient availability that lasts for ≥20 years. Increased nutrient availability, in turn, typically favors nonnative invasive species (resource exploitative) to the detriment of native species (resource conservative). We established two chronosequences of ungulate removal units on Hawai‘i Island that span several decades each, one in tropical wet forest (feral pigs) and one in dry shrublands/woodlands (feral goats/sheep). For each ecosystem type, we quantified vegetation response to removal, and conducted both greenhouse and field trials to examine how variability in soil nutrients impacts competitive tradeoffs between native vs. nonnative plants. Results demonstrate that nonnative species are competitively superior under conditions of high resource supply, while most native species are more competitive under conditions of reduced resource availability. Collectively, this research highlights that nonnative ungulate removal alone is not enough to attain long-term conservation goals, and that management strategies to reduce resource availability are needed to promote native over invasive plants.

8-4

Predator Control in The Nature Conservancy's Waikamoi Preserve

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The Nature Conservancy's Waikamoi Preserve (Waikamoi) on the island of Maui is home to six native forest bird species, three of which are endangered. This includes Kiwikiu (*Pseudonestor xanthophrys*), a species with just 500 individuals. Native bird species and populations have been greatly reduced throughout Hawai'i due to avian disease, introduced species, and habitat degradation. Invasive species are a major threat to the endemic flora and fauna. In particular, introduced mammalian predators, like rats, mongooses, and cats are devastating to bird populations. Predator control is considered an essential component to endangered species and habitat management. In October 2015, Maui Forest Bird Recovery Project installed 82 Conibear traps in Waikamoi covering ~178.5 ha. We used a variety of baits to lure predators. Game cameras were installed throughout the area to monitor activity. Traps were open for 412 nights and were re-set 22 times. Overall, 205 predators were captured including 163

rats, 41 mongooses, and 1 cat. Any reduction in predators will reduce pressure on native birds, particularly during the breeding season. Bait theft by rodents was a common occurrence and reduced the efficacy of traps for target animals like cats and mongooses. In the future, installation of A24 traps within the area could reduce this theft. Continued predator control for the next few years will help ensure that Waikamoi contains the most robust Kiwikiu population possible before managers translocate the species from the preserve to the Nakula Natural Area Reserve.

8-5

Research and development track toward a toxic bait for management of invasive small Indian mongooses: current work and future needs

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Small Indian mongooses (*Herpestes auropunctatus*) were introduced to Hawai'i in the 1890's to control invasive rats (*Rattus* spp) in sugarcane fields. Mongooses were ineffective in controlling rodents and are now considered an invasive pest species across most of the Hawaiian Islands (including Hawaii, Oahu, Maui and Molokai) where they prey upon the eggs and nestlings of native ground-nesting and upland bird species. Previously absent on Kauai, a roadkill lactating female mongoose was found in 1976, and 3 live mongooses were captured (2014-2016) on that island. To reduce these damages and the potential for further spread of this harmful predator, effective mongoose population management is necessary. Mongoose eradication in other regions has been attempted with limited success. Improved techniques for mongoose control under a variety of scenarios will allow for more effective management of existing mongoose populations and reduce the potential for accidental introductions to mongoose-free islands. An understanding of the foraging ecology, food habits, and lure/bait attractiveness is a vital component in developing mongoose control strategies. Herein we summarize studies conducted by USDA APHIS WS NWRC Hawai'i Field Station researchers on foraging ecology, home range estimation, attractiveness to preferred lures and food baits, and palatability and toxicity of several potential toxicants for mongoose control. Future work toward a registered toxic bait formulation will include selection of an effective and practical toxicant, development of a palatable and long-lasting bait formulation, laboratory and field trials of bait efficacy, development of delivery methods that exclude non-target consumers, and regulatory compliance.

8-6

Assessment of a Hand-Broadcast Rodenticide Bait Trial to Control Rats in the Waianae Mountains, Oahu

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Oahu Army Natural Resources Program (OANRP) has been engaged in rodent control since 1995 using various techniques including snap traps, automatic traps, rodenticide applied in bait stations and physical barriers. Relying solely on traps has not been effective in keeping populations below the targeted 10% tracking in monitoring tunnels, particularly during the period of peak rat abundance (typically Fall/Winter). In an attempt to combat this problem in Hawaiian habitats, OANRP in cooperation with the United States Department of Agriculture Wildlife Services National Wildlife Research Center conducted a trial to determine the effectiveness of a "one-time" two-application hand-broadcast (applications spaced approximately 5-7 days apart) and "canopy baiting" of rodenticide bait (Diphacinone-50) during a period of high rat abundance within Kahanahaiki Management Unit in the Waianae Mountains. Non-target monitoring was conducted to: 1) determine the distribution, density, and fate of bait from the two-application hand-broadcast of Diphacinone-50, 2) monitor rodent activity and fate before, during, and after the rodenticide application, and 3) document the non-target effects through carcass searches and analysis of diphacinone residues throughout the consumer food web. We found that the one-time hand-broadcast of diphacinone bait was highly effective, as it reduced rat tracking from >40% to 2%. The method also proved to be safe, as the only non-target mortality was mongoose, despite diphacinone residues being found throughout the animal food web. This presentation will discuss results of this trial, highlight some successes and obstacles, and provide insight into the uses for this technique across the Hawaiian Islands.

8-7

Laboratory testing of a non-toxic reproductive inhibitor for non-lethal suppression of rat populations

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In Hawai'i, invasive black rat (Rattus rattus) populations are a threat to agriculture and natural resources. Shifting societal values are increasing the demand for non-toxic, non-lethal alternatives for resolution of human-wildlife conflicts. Recently, a non-toxic liquid chemosterilant became commercially available (ContraPest® from SenesTech, Inc.). This product contains two chemicals, one which impairs spermatogenesis in male rats and both chemicals reduce ovarian function in females. We tested the efficacy of this chemosterilant in wild-caught adult black rats from the island of Hawai'i in a short-term laboratory trial. A control group (n=25) was offered placebo bait and the treatment group (n=25) was offered chemosterilant bait. Liquid baits, water, and dry feed were provided *ad libitum* during a 15 day bait introduction and the first breeding round. After the treatment period of 58 days, all rats were provided placebo bait for the remainder of the study and randomly paired for each of two additional breeding cycles. The treatment group produced zero (0) pups during the first and second breeding rounds. In the third breeding round, 70 days after stopping treatment, the treatment group produced 6 live

pups compared to 24 in the control group. This study demonstrates that the reproduction rate of wild-caught black rats can be chemically suppressed if provided *ad libitum* access to the chemosterilant under laboratory conditions. Further studies are needed to assess the effect of long-term exposure on fertility. Refinements of this or other chemosterilants might meet some rodent management objectives to help protect Hawai'i's natural resources.

8-8

What We Know And What We Need To Know About The Invasive Mullet, Kanda (*Mugil engeli*) in Hawaiian Estuaries

Eva Schemmel[1], Keith Kamikawa[2], Troy Sakihara[3], Troy Shimoda[3], Kim Peyton[3] *[1]Conservation International, Hawaii, USA, [2]University of Hawaii, Manoa, Hawaii, USA, [3]Division of Aquatic Resources, Hawaii, USA*

Three mullet species are present in Hawai‘i including two native species, ‘ama‘ama (*Mugil cephalus*) and uouoa (*Neomyxus leuciscus*), and one non-native species, kanda (*Mugil engeli*). All three species co-occur in estuary habitats in Hawai‘i, with kanda often a dominant species. Until now, the biology of kanda has not been studied in either its native range or its introduced one curtailing our ability to perform and model assessments of potential impacts of the introduced mullet on native populations and estuarine habitats. To address this gap, we sampled two kanda populations from locations where they are known to be abundant: Hilo Bay and Maunalua Bay. We examined female and male size (L50) and age (A50) at maturity, spawning season, and population size structure in estuaries. Our study shows that kanda reach reproductive maturity at a small size and young age, and reproduce year round. Thus kanda may have the potential to out-compete native mullet for local resources if resources become limited. This research lays the foundation for future studies to examine impacts caused by this non-native species.

8-9

Environmental Storytelling in the 21st Century: Communicating in a Changing Social, Ecological, and Technological Landscape

Kauwila Hanchett[4,2], Jeff Orig[3], Ehulani Kane[5,2], Deanna Spooner[1], Peggy Foreman[1], Wendy Miles[1] *[1]Pacific Islands Climate Change Cooperative, Honolulu, Hawai'i, USA, [2]Ka Honua Momona, Moloka'i, USA, [3]Orig Media, Honolulu, Hawai'i, USA, [4]Ma Ka Hana Ka 'Ike, Hana, Maui, USA, [5]Na Pu'uwai Native Hawaiian Rural Health Center, Kaunakakai, Hawai'i, USA*

Social media and video production technologies are enabling non-profit organizations, government agencies, and public citizens to share their experiences with environmental change in new ways and with larger audiences. To examine the use of film by natural and cultural resource managers in Hawai‘i, this forum utilizes two locally-produced film projects as conversation starters. We invite you to come watch these short films on environmental resiliency in Hawai‘i alongside the natural and bio-cultural resource

managers featured in the films, the film makers, and the organizations behind these projects (Pacific Islands Climate Change Cooperative and Ka Honua Momona). The goal of this forum is two-fold: (1) to learn about local experiences with environmental change and climate adaptation in Hawai‘i, and (2) to discuss concerns, ideas, and experiences with the use of film for conveying environmental and cultural values in Hawai‘i.

8-10

The Whole is Greater: Unlocking the Collective Conservation Capacity of West Hawai‘i

Lani Watson[1], Chad Wiggins[2], Kim Hum[2], Eric Conklin[2], Courtney Couch[3], Douglas Harper[4], Stuart Goldberg[5] *[1]NOAA Fisheries, Office of Habitat Conservation, Honolulu, Hawaii, USA, [2]The Nature Conservancy of Hawaii, Honolulu, Hawaii, USA, [3]Hawaii Institute of Marine Biology, Kaneohe, Hawaii, USA, [4]The Baldwin Group, contracted at NOAA NOS, Office for Coastal Management, Honolulu, Hawaii, USA, [5]Lynker Technologies, contracted at NOAA Fisheries Pacific Islands Regional Office, Habitat Conservation Division, Honolulu, Hawaii, USA*

The proverb "many hands make light work" is common across many cultures. In Hawai‘i, a culture of collaboration and collective effort contributed to remarkable advances in agriculture and mariculture, including the construction of field systems and fishponds. These advances are evident in West Hawai‘i, and serve as reminders of the balance that was sought and found. Today, collective action is a necessity to address the complex challenges that exist where land meets the sea to maintain and improve coral reef and coastal habitat.

This presentation will provide an introduction to the symposium including an overview of the partnerships in West Hawai'i Island and how multiple actions are aligned with common objectives. Specifically, we will highlight how partnership-driven projects are: 1) Improving coral health by reducing land-based pollutants, such as sediments and nutrients, 2) Reducing vulnerability of communities and natural resources to the localized effects of climate change, 3) Ensuring that communities are informed and empowered to contribute to the sustainable use and restoration of natural resources and 4) Providing better management tools and easily accessible information for informed decisions. This presentation will highlight the performance tracking measures being developed to show progress towards achieving objectives.

The collective impact of many is greater than the sum of its parts. By focusing on outcomes for coastal and marine life, the partnerships in West Hawai'i have led to actions focused on improving coral reef health to the benefit of natural ecosystems and local communities, and can provide lessons learned to other local partnerships.

8-11

Mapping, monitoring, and modeling geomorphic processes to identify terrestrial sources of nearshore sediment pollution in West Hawai‘i

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Geological Survey, Menlo Park, CA, USA, [2]The Baldwin Group, contracted at NOAA NOS, Office for Coastal Management, Honolulu, HI, USA, [3]Kohala Watershed Partnership, Kamuela, HI, USA

USGS, NOAA and Kohala Watershed Partnership (KWP) are working to map, monitor, and model terrestrial sources of nearshore sediment pollution from Pelekane Bay watersheds. USGS is 1) mapping geomorphic processes generating fine sediment using field observations and remote sensing from NOAA, 2) determining erosion rates with monitoring sites, and 3) integrating mapping and monitoring using modeling to estimate sediment loading to the nearshore. To monitor erosion rates, USGS worked with KWP, Parker Ranch, and Queen Emma Land Company to install rain gages, anemometers, dust traps, soil moisture probes, and erosion bars and pins. Three main sites are distributed along a transect up Kohala to sample different rainfalls, vegetation covers and geomorphic processes. Rates from these monitoring sites can be integrated into a crude annual sediment budget by applying them to mapped geomorphic units throughout the watershed. Preliminary data show that December 2016 rainfalls provided soil moisture for plants, but rainfall intensities mostly below 10 mm/hour did not generate widespread erosion of bare soils. Dust monitoring shows that wind speeds greater than 15 meters/second are required to generate dust entrainment from the same bare soils. These two estimates define preliminary thresholds for erosive winds and rainfalls. We anticipate refining these values, but they illustrate how we will begin to answer questions about the sources, timing and rates of sediment production. Future maps and models will provide land managers with field-validated tools to assess susceptibility to rapid erosion across the watershed, giving the community the power to make the most informed decisions.

8-12

Relative Resilience Potential and Climate Vulnerability of Coral Reefs Along the West Coast of Hawai'i Island

Jeffrey Maynard[1,2], Eric Conklin[3], Dwayne Minton[3], Rebecca Most[3], Courtney Couch[4], Gareth Williams[5], Jamison Gove[6], Dieter Tracey[7], Brett Schumacher[8], William Walsh[9], Jonathan Martinez[10], Douglas Harper[11], Danielle Jayewardene[12], Britt Parker[13], Lani Watson[14] *[1]SymbioSeas and the Marine Applied Research Center, Wilmington, NC, USA, [2]Laboratoire d'Excellence CORAIL USR 3278 CNRS – EPHE, CRIOBE, Papetoai, Moorea, French Polynesia, [3]The Nature Conservancy of Hawaii, Honolulu, HI, USA, [4]Hawaii Institute of Marine Biology, Kaneohe, HI, USA, [5]School of Ocean Sciences, Bangor University, Menai Bridge, Anglesey LL59 5AB, UK, [6]NOAA Fisheries, Ecosystems and Oceanography Program, Pacific Islands Fisheries Science Center, Honolulu, HI, USA, [7]28 Dalziel Street, Stratford, QLD 4870, Australia, [8]NOAA Fisheries, Coral Reef Ecosystem Program, Pacific Islands Fisheries Science Center, Honolulu, HI, USA, [9]Hawaii Division of Aquatic Resources, Kailua-Kona, HI, USA, [10]Hawaiian Islands Humpback Whale National Marine Sanctuary, Honolulu, HI, USA, [11]The Baldwin Group, contracted at NOAA NOS, Office of Coastal Management, Honolulu, HI, USA, [12]Malu Consulting, Kailua, HI, USA, [13]The Baldwin Group contracted at NOAA Coral Reef Conservation Program, Silver Spring, MD, USA, [14]NOAA Fisheries, Office of Habitat Conservation, Honolulu, HI, USA*

NOAA coordinates activities and expertise in the West Hawai‘i Focus Area on the NW side of Hawai‘i Island to address objectives on coral health, climate change and community capacity. To support and help guide these efforts, we have assessed the ecological resilience potential of 40 sites in this area by examining indicators of resilience processes (e.g. herbivore biomass and coral recruitment), and how spatial variation in anthropogenic stress and projected future climate stress influences exposure and resilience. We found: 1) exposure to anthropogenic and projected climate stress is higher in the northern part of the survey area than in the south, and 2) resilience potential varies greatly across the survey area. The assessment results are used to identify and tailor management strategies to improve resilience at low resilience sites and maintain resilience at high resilience sites. We have an expansive engagement plan to socialize and disseminate the project results in a strategic way to key stakeholders, including local community members. These communication and capacity building efforts are critical to increase support for and compliance with any management strategies implemented in the near future. This multi-disciplinary project uniquely combines recent advances in resilience science and application with climate modeling and social science. This powerful case study describes how scientists, managers and local community members can work together to examine and then reduce the climate vulnerability of coral reefs in Hawai‘i.

8-13

Fishpond Restoration in WestFishpond Restoration in West Hawai‘i: Connecting Conservation, Community and Culture: Connecting Conservation, Community and Culture

Rebecca Most[1], Barbara Seidel[1] *[1]The Nature Conservancy of Hawaii, Honolulu, HI, USA, [2]The Nature Conservancy, Kamuela, HI, USA*

The Hui Loko network is composed of practitioners and managers who are working together to revitalize fishponds and anchialine pools in West Hawai‘i. The Hui Loko network is actively restoring habitat quality for these brackish water ponds for the benefit of native ecosystems, food security, and perpetuation of cultural practices. Through regular meetings and sharing of resources, those with a kuleana to care for ponds are identifying solutions to shared challenges with a foundation of kinship and guided by spiritual, ecological, biological, social, cultural, and intellectual values and goals. Efforts include rebuilding fishpond walls, removing invasive species, education and outreach, sharing of cultural knowledge, perpetuating traditional practices, and scientific monitoring. The perpetuation of stewardship for these culturally and biologically rich ecosystems is exemplified through the actions of the Hui Loko network, and continues to strengthen community support for conservation, community and culture.

8-14

Pono Fishing: Sharing messages of sustainable and traditional fishing practices from West Hawai‘i

Ku`ulei Keakealani *Hui Aloha Kiholo, Hawaii Island, HI, USA*

Pono fishing is a term often used to describe fisheries practices that are sustainable and

derived from traditional management approaches and place-based knowledge. The perpetuation of pono fishing practices is a useful tool to ensure food security are maintained for future generations. Through kupuna interviews of 10 North Kona fisherman, common themes were identified from the knowledge shared. These pono fishing practices and common themes were developed into outreach messages and shared through posters hung at fish markets throughout the island and through community events.

8-15

Sea-Level Rise Modeling as a Catalyst for Effective Ecological Management in West Hawai‘i

Chad Wiggins[1], John Marra[2], Lisa Marrick[3], Eric Conklin[1], Douglas Harper[4], Ayesha Genz[5], Rebecca Most[1], Zach Ferdana[1], Laura Flessner[1], Kim Falinski[1] *[1]The Nature Conservancy of Hawaii, Honolulu, HI, USA, [2]NOAA Pacific Region NESDIS/NCEI, Honolulu, HI, USA, [3]UC Berkeley, Department of Science, Policy, and Management, Monterey, CA, USA, [4]The Baldwin Group under contract at NOAA NOS Office of Coastal Management, Honolulu, HI, USA, [5]The University of Hawaii, Hilo, HI, USA*

The Nature Conservancy, NOAA, UC Berkeley, and the University of Hawaii are collaborating to produce fine-scale sea level rise (SLR) scenarios in NOAA's West Hawaii Habitat Focus Area/Sentinel Site, and to use that data to assess the potential impact on coastal ecosystems. The project will address: (1) the potential ecological impacts of changes in sea level on coastal and marine conservation priorities within groundwater-fed wetlands, fishponds, and anchialine pools; (2) the potential impacts of changes in sea level on ecosystem services; (3) the priority management and policy actions that can be implemented to reduce the vulnerability of coastal and marine habitats and communities; and (4) the proper bodies for implementing priority management and policy actions. An easy-to-use viewer will show SLR scenarios, potential resource impacts, and new ecosystems locations under various scenarios.

The project is utilizing a series of steps to achieve its goals. Sea-level rise models were developed for west Hawai‘i incorporating the current location of priority ecosystems, high resolution LiDAR data, extreme water levels from local tide gauges, and future SLR scenarios. Studies on groundwater levels were also incorporated into the models. The model outputs will map various SLR scenarios showing existing habitat inundation, potential new habitat locations, and introduced species locations. The planning team is incorporating the input of local managers to ensure the maps and planning tool fit their needs. Ultimately, the South Kohala Conservation Action Plan will be amended to incorporate management recommendations and local managers will continue to be engaged.

8-16

The Future of Carbon Markets in Hawai‘i: An Exploration of Promising Opportunities for Leadership

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Honolulu, Hawaii, USA, [3]The Nature Conservancy of Hawai'i, Honolulu, Hawaii, USA, [4]State of Hawaii, Division of Forestry and Wildlife, Honolulu, Hawaii, USA, [5]Hawaiian Legacy Hardwoods, Honolulu, Hawaii, USA

Climate change is already changing patterns in hydrological cycles, ocean ecosystems, forests, and other life-support systems critical to the wellbeing of Hawai'i's people and economy. Despite these challenges, Hawai'i is on the cutting edge of sustainability. Innovative adaptation and mitigation strategies developed and implemented in Hawai'i and other island economies can help deliver on the global commitments made under the Paris Agreement and the UN Sustainable Development Goals. These include recent efforts to pilot locally appropriate land use management and carbon mitigation initiatives linked to reforestation efforts. However, the lack of incentives and capital to support forest health and agricultural land stewardship means that for most landowners (public and private), degraded lands have become financial liabilities rather than assets.

Building on momentum from the IUCN World Conservation Congress, a group of business, nonprofit, and government stakeholders are assessing the potential to adapt carbon mitigation and Payments for Ecosystem Services initiatives to incentivize restoration and conservation efforts in Hawai'i.

To explore this further, Conservation International Hawai'i will moderate a panel with key stakeholders who will highlight voluntary models already being tested in Hawai'i. In addition, panelists will discuss opportunities for innovative approaches to ecotourism that could support existing and future restoration and conservation projects. Some of the models that will be highlighted include a nonprofit-led initiative (presented by The Nature Conservancy of Hawai'i), a state government-led initiative (presented by Hawai'i's Division of Forestry and Wildlife), and a private entity-led initiative (presented by Hawaiian Legacy Hardwoods). Panelists will share what they have learned and explore with the audience what will be required to secure a viable, carbon market in service of Hawai'i's long-term natural, cultural and economic sustainability.

POSTERS

POSTER GROUP 1

P1-1

Fishing Among Sea Turtles: Best-Practice Suggestions for Recreational Shore-based Fishermen in Hawaii

Irene Kelly[1], Mathew Ramsey[1], Kurt Kawamoto[1], George Balazs[1], Earl Miyamoto[2], Kristen Kelly[2], Susannah Welch[2], Kehau Kimokea[2], Mimi Olry[2] *[1]NOAA Fisheries, Honolulu, HI, USA, [2]State of Hawaii Department of Land and Natural Resources, Honolulu, HI, USA*

Nearshore recreational fisheries are one documented threat to sea turtles. Interactions with hook-and-line fishing gear can cause entanglement, flipper amputation and death. To address this threat, a multi-agency partnership has established a *Fishing Among Sea Turtles* (FAST) program to promote coexistence and responsible recreational fishing around a recovering green turtle population. FAST serves as a platform to disseminate information which includes best-practice guidance developed by fishermen and local experts to reduce or mitigate the effects of accidental interactions. The program also promotes "Turtle Friendly" fishing gear, barbless circle hooks (BCH), and encourages reporting to NOAA's sea turtle stranding program. Multi-agency field staff throughout Hawaii freely disseminate BCH and FAST materials that provide guidance for assisting a hooked or entangled turtle. BCH allow for catch-and-release of undersized or unwanted fish to conserve valuable nearshore resources and facilitate the easy release (dehooking) of other non-target species, such as protected species. Through this program, Hawaii fishermen are becoming empowered to contribute to ongoing conservation efforts, and communication between fishermen and state/federal partners has greatly improved. The resulting open and honest conversation between fishermen and Hawaii state/federal staff is likely the greatest success of the program which will continue to improve over time. This poster will provide FAST program highlights and lessons learned which includes key messaging: "It's OK to Help." We have found this messaging effectively resonates with Hawaii fishermen, and has helped to create proud allies who carry forward mitigation measures and feel like sea turtles are also their responsibility.

P1-2

Progress in reducing seabird interactions in the Hawaii longline fisheries

Sarah Ellgen *National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Honolulu, HI, USA*

Fresh-caught fish from the Hawaii pelagic longline fisheries are important to the economy, domestic food supply, and self-sufficient coastal communities and cultures. These fisheries, carefully managed by the U.S. National Marine Fisheries Service and

Western Pacific Fishery Management Council, have achieved high compliance with the U.N. Food and Agriculture Organization's Code of Conduct for Responsible Fisheries. Part of this successful management includes requirements to minimize fishing interactions with protected resources, including seabirds. The Northwestern Hawaiian Islands support the largest colonies of Laysan albatross, more than 99% of the world population, and more than 95% of the global breeding population of black-footed albatross. While feeding at sea, these birds may encounter longline fishing operations, resulting in hooking or entanglement. To reduce the impact of these fisheries on seabirds, managers require, among other things, the use of line shooters and weighted branch lines designed to sink the baited hooks quickly, or setting at night when seabirds are not feeding. The requirements have significantly reduced annual seabird interactions**.** NMFS also trains and certifies longline vessel owners and operators annually on techniques for handling and releasing protected species they encounter while fishing. This presentation will include a retrospective of progress towards reducing seabird interactions in the Hawaii longline fisheries, current research on reducing seabird impacts, and a new training effort for fishermen on best practices for handling and releasing seabirds.

P1-3

Seed Dispersal in a Novel Hawaiian Ecosystem: Can Mutualisms between Exotic Birds and Endemic Ornithochorous Plants be Cultivated?

Sean MacDonald[1], Jinelle Sperry[1], Michael Ward[1], Kapua Kawelo[2] *[1]University of Illinois at Urbana-Champaign, Urbana, Illinois, USA, [2]U.S. Army Garrison Hawaii, Environmental Division, Oahu Army Natural Resources Program, Schofield Barracks, Hawaii, USA*

Land managers arduously outplant threatened and endangered flora on O'ahu, yet recruitment varies drastically. Seed dispersal is vital for the persistence of rare plant populations as it supports population expansion, recolonization of historic sites, and increased gene flow. Fifty percent of Hawai'i's endemic flora are ornithochorous, yet on O'ahu all native frugivorous birds are functionally extinct. Introduced avian frugivores may serve to fill this missing role, but their relative impact on rare native plants, and how that can inform management, has not been fully studied.

We investigated the presence and abundance of nonnative birds within endangered lobeliad restoration sites, frugivory rates of fruit, and tested the effectiveness of attracting birds to consume target fruit using audio lures. We conducted avian and fruit count surveys, and deployed game cameras and rat traps throughout restoration sites. Additionally, we recorded and broadcasted vocalizations of the four most abundant and widespread avian frugivores.

Preliminary results suggest that exotic frugivores dominate mountainous, forest bird communities, but rarely exploit lobeliad fruit as a resource. Fruit depredation by rodents may be a limiting factor. We conducted 59 playback attraction experiments across 21 plants (15 native, 6 nonnative). The average number of foraging frugivorous birds within 10 m of target fruit was 2.64 ± 0.5 during controls and increased to 8.46 ± 1.03 during treatments. Birds consumed target fruit in 5 percent (3 out of 59) of control periods

growing to 28.8 percent (17 out of 59) during treatments. Data collection will be conducted until August 2017.

P1-4

Risky Business: Male Aggression and Female Choice in the Hawaiian Monk Seal

Thea Johanos, Stacie Robinson, Jason Baker, Charles Littnan *Pacific Islands Fisheries Science Center, NOAA, Honolulu, Hawaii, USA*

Young Hawaiian monk seals (*Neomonachus schauinslandi*) encounter multiple threats to survival resulting in poor reproductive recruitment in the Northwestern Hawaiian Islands (NWHI). Historically, male seal aggression was a major cause of female mortality at Laysan Island, which hosts the largest NWHI subpopulation, and aggression remains a concern; i.e., two young seals were severely injured and one died in 2016. These concerns led us to investigate female risk at Laysan as part of a larger evaluation of translocation as a tool to enhance survival. Data were collected annually from 1983 to 2016 during 3-5 month field seasons. We recorded 221 serious mounting injuries leading to 82 deaths. Most (55%) injuries were incurred by adult females, with 21% of injured females attacked multiple years. Immature females and males were injured in equal numbers. Despite the threat of aggression, Laysan often has higher juvenile survival than many NWHI sites and 15 weaned female pups were translocated from French Frigate Shoals, an area of very low survival, to Laysan during 2012-2014. The average age of injury is 5.9 yrs. (SD 4.4, range 0-18) and risk peaks as females are just reaching reproductive maturity. Translocation of weaned pups within the NWHI is a promising enhancement tool, yet questions remain including when/if older females should be returned to donor sites. Results from this study contribute to our understanding of female risk and will inform future efforts to refine translocation strategies and other enhancements designed to increase female survival and ultimately recover this endangered species.

P1-5

What is Lurking in O‘ahu , HI Harbors: Marine Bioinvasions in the 21st Century

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Hawaiian marine ecosystems are highly susceptible to invasion by non-native species due to biogeographical isolation, lack of natural predators, extensive harbor and port habitats, and a year-round growing season. It is estimated that over 460 non-native (333) and cryptogenic (130) species are established in Hawai‘i's marine waters, arriving primarily through ship vectors (biofouling, solid ballast, and ballast water). Non-native species have the potential to cause adverse impacts on biodiversity, ecosystem function, and ecosystem services. Early detection is important in preventing the establishment of non-native species, for once an alien species is established the cost and physical effort

to remove them increases drastically over time (and may be impossible for most marine species). The objectives of this study were to 1) conduct a follow-up to surveys completed in 2006, 2) determine if new species have established following the 2011 Japanese tsunami, and 3) evaluate new monitoring techniques using settlement plates and next-generation sequencing (NGS). Settlement plates were deployed at nine commercial and recreational harbors around O‘ahu . All organisms were vouchered for identification and genetic analysis. Over 1,000 organisms were collected, resulting in 126 positively identified species of which 53 (42 %) were known non-natives. Expectedly, the main commercial and military ports had a higher number of introduced species compared to small boat harbors. Genetic analysis of the identified species will aid rapid detection in future biosecurity surveillance studies using NGS and eDNA technologies. Further work includes an invasive species risk assessment and comparison with other local, national, and international ports.

P1-6

Determining the Effectiveness of Watershed Management Activities to Reduce Land-Based Sources of Pollution on West Maui

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As an approach to reduce the effects of land-based sources of pollution on coral reefs, the United States Coral Reef Task Force and the National Oceanic and Atmospheric Administration's Coral Reef Conservation Program identified West Maui as one of two Pacific Region priority areas for the implementation of the Ridge-to-Reef management initiative. There are five priority watersheds in West Maui: Wahikuli, Honokōwai, Kahana, Honokahua, and Honolua. This study summarizes work completed to establish a baseline against which to assess the effectiveness of future upland management activities aimed at reducing sedimentation stress to the adjacent coral reefs. Permanent, replicate coral community monitoring transects were established adjacent to seven water drainages within the five priority watersheds. Benthic reef community structure and coral population demographic parameters, including percent cover, coral colony density, size class structure, and health condition data were collected. In addition, terrestrial sediment loading was evaluated by turbidity, sediment composition, and sediment accumulation data at a subset of sites. While this baseline assessment provides a framework to assess change over time, it also underpins the wide range in the overall health status and condition among adjacent coral communities in relation to land use, in addition to highlighting data and informational gaps. This information is a pivotal component of the watershed characterization process as it helps support decision-making regarding watershed restoration efforts aimed at reducing land-based pollution impacts to high-priority reefs.

P1-7

Effective *ex situ* Conservation of Hawai‘i's Rare Plants with Micropropagation at

Lyon Arboretum

Matthew Keir[1], Nellie Sugii[2], Emily Grave[2] *[1]Laukahi: The Hawaii Plant Conservation Network, Honolulu, Hawaii, USA,[2]Lyon Arboretum, Honolulu, Hawaii, USA*

Since 1997, the University of Hawai‘i Harold L. Lyon Arboretum's Hawaiian Rare Plant Program's Micropropagation Laboratory has used cutting-edge horticultural techniques to grow and maintain *ex situ* collections of Hawai‘i's rare plants. Collections of 283 native taxa made by Hawai‘i's finest field botanists are now secured in this facility. This invaluable collection provides propagules for restoration outplanting, research on new conservation methods, and a secure place for maintaining native species until habitats can be stabilized for reintroduction. Several native plants have been saved from extinction by these efforts. In 2016, the program received support from the Institute of Museum and Library Services (IMLS) to conduct a comprehensive inventory and assess the conservation value of its collections. This project will prepare the collection to be transferred to a new state-of-the-art building at the Arboretum. By linking each collection in the facility‘s database to the population classification system developed by the Hawai‘i Rare Plant Restoration Group, this project will enable conservation groups to easily identify collections that can serve as propagative material for restoration outplantings. It will also identify collections that are aging or mutating to ensure that the propagules are still representative of the plants and populations from which they originated and appropriate for use in restoration projects. This project serves as a model for other plant collections in botanical gardens, seed banks, conservation nurseries, and in other regions.

P1-8

The Conservation of *Polyscias bisattenuata* (Araliaceae), a Rare Critically Endangered PEP Species Endemic to Eastern Kaua`i Island

Randy Umetsu[1], Natalia Tangalin[1], Jesse Adams[2], Marian Chau[3], Michael DeMotta[1], Ashly Trask[1] *[1]National Tropical Botanical Garden, Lawai, HI, USA,[2]The University of Hawaii at Manoa, Manoa, HI, USA,[3]Lyon Arboretum, Manoa, HI, USA*

Polyscias bisattenuata is a U.S. Federally listed endangered, single-island endemic PEPP plant with only three known wild populations restricted to steep slopes and cliffs on Eastern Kaua‘i. In 2016, The National Tropical Botanical Garden (NTBG) undertook a project to make diverse collections from all subpopulations to preserve the genetic diversity and resilience of this species. Effective germplasm conservation of recalcitrant seeds, which cannot be stored, requires living germplasm banks to provide propagules for future restorations. This poster will share the methodology, challenges, and successes of this multifaceted project guided by The Hawaii Strategy for Plant Conservation (HSPC) and to prevent the extinction and guide the restoration of this species.

NTBG undertook rough terrain collecting utilizing innovative lightweight rodent resistant bags; efforts resulted in over 50,000 seeds. Germination rates are being tracked at the NTBG nursery to better understand seed germination behavior. Germination trials using dormancy breaking treatments were conducted at Lyon Arboretum's Seed Conservation

Laboratory on seeds of multiple individuals from each population. All individuals had viable seeds. Preliminary results showed no significant difference in germination percentage between dormancy breaking treatments, indicating that some seeds are nondormant. Trials are ongoing to investigate possible seed dimorphism and other dormancy class. Genetic testing is being conducted by The University of Hawai'i at Mānoa to investigate atypical outlier subpopulations and inform conservation outplantings.

As of January 2017, NTBG's nursery has successfully transplanted 4,000 seedlings to be used to establish *ex situ* collections as well *in situ* outplantings slated to begin in April 2017.

P1-9

Breeding System of the Kaua'i Endemic *Hibiscus waimeae* subsp. *waimeae* (Malvaceae)

Blanca Begert, Seana Walsh *National Tropical Botanical Garden, Kalaheo, HI, USA*

Hibiscus waimeae subsp. *waimeae* is a Kaua'i endemic taxon possessing floral traits conforming to a moth pollination syndrome, yet the pollinator is unknown. It is also unknown if a pollinator is required for fruit and seed set (physical self-incompatibility). Disruption of obligate pollinator mutualisms can lead to decline of one or both partners. Understanding the breeding system of *H. waimeae* subsp. *waimeae* is important for conservation management of the taxon in case populations start to decline, as is the case for *H. waimeae* subsp. *hannerae* with less than 100 individuals remaining in the wild. To examine the breeding system, three treatments and a control were applied to cultivated plants in McBryde Garden of the National Tropical Botanical Garden. Flowers were 1) bagged to exclude pollinators, 2) hand self-pollinated, 3) hand outcross-pollinated, and 4) open pollinated (control). Percent fruit set was highest in hand outcross-pollination (54%) and lowest in flowers that were bagged (7%). Hand self-pollinated flowers resulted in 41% fruit set. Only 8% of control treatments set fruit. Average seed count was highest in fruits resulting from the hand outcross-pollination treatments. Results demonstrate that the species is predominantly physically self-incompatible, relying on pollinators for adequate fruit and seed set, and that cultivated plants growing on the south shore of Kaua'i are pollen limited. Wild populations would likely decline drastically if the plant/pollinator mutualism for this taxon is disrupted.

P1-10

Halapepe in Trouble: The Decline of *Chrysodracon hawaiiensis* at Pu`uwa`awa`a, and Potential Recovery Actions

Elliott Parsons[1], Edith Adkins[1], Lyman Perry[1], Patrick Conant[2] *[1]Hawaii Division of Forestry and Wildlife, Hilo, Hawaii, USA, [2]Hawaii Department of Agriculture - retired, Hilo, Hawaii, USA*

Effective conservation of endangered Hawaiian plants requires knowledge and understanding of population trajectories and threats so that declining taxa can be targeted for recovery actions. In 2012 we found banana moth (the well-known

agricultural pest *Opogona sachari*) infesting endangered halapepe (*Chrysodracon hawaiiensis*), causing massive die-back of terminal leaves on affected individuals at Pu`uwa`awa`a, Hawai`i. To determine population impacts, we individually tagged 74 halapepe trees at three sites in Pu`uwa`awa`a Forest Reserve in 2012-2013, resampling them again in 2016 to assess survival, health, reproduction, and infestation. Overall, survival was 66% across Pu`uwa`awa`a, but differed by site; survival of the main population (Main) was 57%, the Pu`uwa`awa`a cone (Cone) was 100%, and inside weed and ungulate free exclosures (Makai) survival was 87%. Trees in the Cone and Makai sites were significantly healthier than the Main site, and outplants fared better than wild plants. Similar to 2012, banana moth infestation was present throughout the area in 2016, but it did not negatively affect plant health across sites. Infestation did reduce reproductive rates significantly, however, and 10% fewer outplants were infested compared with wild trees. In conclusion, recovery actions should focus on outplanting as well as protecting wild halapepe on the Pu`uwa`awa`a Cone where survival and reproductive output are high, and health is comparable to fenced weed-free areas. Finally, a classical biological control program for the pest should be considered due to its serious impacts on crops, and lack of any native Hawaiian species of *Opogona* that could be put at risk.

P1-11

Impact of Marine Debris Entanglements on Hawaiian Monk Seals

John Henderson, Thea Johanos, Charles Littnan *NOAA National Marine Fisheries Service,, Honolulu, HI, USA*

Entanglement in derelict marine debris is a cause of mortality for the endangered Hawaiian monk seal, *Neomonachus schauinslandi*. We examined data collected by field personnel to quantify the impact of debris entanglements on seal populations, and to determine spatial or temporal trends. We also assessed the demographic profile of entanglements relative to seal size classes. During 1982-2016, a total of 366 entanglements were documented, involving 155 pups, 43 juveniles, 58 subadults, 104 adults, and 1 seal of unknown size. For all years when the minimum population size was known, entanglement rates were determined by dividing total entanglements for each size class by the summed population total of that size class over the appropriate years. Pups (both weaned and nursing pups) experienced the highest rate of entanglement (3.47% of pup population), followed by juveniles (1.46%), subadults (1.35%) and adults (0.74%). Entanglement rates were highest at Midway Atoll (2.71% of total population), followed by Kure Atoll (1.88%), Lisianski Island (1.37%), Laysan Island (0.95%), Pearl and Hermes Reef (0.82%) and French Frigate Shoals (0.39%). The two most northwest islands of the Hawaiian Archipelago showed the highest rates, which may result from closer proximity to the Central Pacific Gyre, a documented area of high debris concentration. Research personnel, have mitigated the impact of debris entanglements: Of the 366 entanglements, researchers removed debris in 253 instances, 96 seals escaped unaided, 9 seals died due to entanglement and the seals' fate remained unknown in 8 cases.

P1-12

Pollination and Breeding System of the Endangered Hawaiian Tree *Hibiscus waimeae* subsp. *hannerae* (Malvaceae)

Susan Deans, Seana Walsh *National Tropical Botanical Garden, Kalaheo, HI, USA*

Hibiscus waimeae subsp. *hannerae* is a federally listed Endangered taxon endemic to the north shore of Kaua'i. With fewer than 200 individuals remaining in three valleys, low natural regeneration in the wild could lead to extinction. The large, white, fragrant flowers of this small tree indicate possible coevolution with moth pollinators. However, the pollinator, and whether it is dependent upon a pollinator for fruit and seed set, is unknown. To evaluate the importance of pollinators for fruit and seed set, flowers were either 1) bagged to exclude pollinators, 2) hand self-pollinated, 3) hand outcross-pollinated, or 4) unmanipulated and unbagged as a control. Fruit set, seed set, seed weight, and viability were compared among these four treatments. Only one fruit formed in the bagged pollinator exclusion treatments, suggesting that this species is predominantly physically self-incompatible. Fruit set and seed count were highest in the hand outcross treatment. Diurnal, crepuscular, and nocturnal observations of floral visitors were carried out on plants in Limahuli Garden. All floral visitors were non-native, and most were nectar thieves. Japanese white eyes, ants, and honey bees accessed nectar from behind the flower, failing to contact stamens or stigmas. Honey bees were observed occasionally pollinating as they foraged for pollen and brushed against the stigma in the process. The most numerous, potentially legitimate pollinators were three introduced species of crepuscular Sphingid moths. For this rare taxon reliant upon pollinators for seed production, introduced nectar thieves and loss of native Sphingid moths are major threats.

P1-13

CCA and Fleshy Algal Cover as an Indicator of Reef Recovery

Christina Jayne[1], Emily Kelly[1], Darla White[2], Yoan Eynaud[1], Russell Sparks[2], Nicole Pedersen[1], Clinton Edwards[1], Brian Zgliczynski[1], Stuart Sandin[1], Jennifer Smith[1] *[1]University of California, San Diego, La Jolla, CA, USA, [2]Department of Land and Natural Resources, Wailuku, HI, USA*

In 2015, prolonged warming caused severe bleaching across reefs in the Main Hawaiian Islands resulting in coral mortality across these reefs. In addition to understanding changes in coral populations, it is also important to study algal dynamics on these reefs, especially with a focus on crustose coralline algae (CCA). CCA can serve as indicator species for coral growth and recovery, thus playing a significant role in determining the future of bleached coral reefs. In order to assess the state of these reefs, a large-scale mosaic imaging technique has been in use since 2014 to document the conditions of select sites before and after the bleaching event. These $100m^2$ mosaics cover three reefs in leeward Maui across a gradient of herbivore biomass and terrigenous sediment input. In each mosaic image, the full algal community was outlined and categorized by species and functional group. Analysis of spatial distribution and composition of the algal community in the mosaics shows differences in CCA cover between sites as well as variability in turf and fleshy macroalgal assemblages. Importantly, these results show how local management and stressors around a reef can influence CCA growth, and

therefore influence coral recovery. The mosaic imaging method may serve as a useful model for analyses of reef resilience on coral reefs.

P1-14

Japanese Tsunami Marine Debris: an Aquatic Invasive Species Perspective

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The Tōhoku earthquake and tsunami of March 2011 caused concerns throughout the North Pacific of increased marine debris landings. Furthermore, concerns of invasive species introduction were raised when tsunami debris were found to have non-native invertebrate and algae species rafting on the material. Scientists, managers, debris clean-up groups, and beach users worked together to respond to Japanese debris item reports to collect biological samples, catalogue debris items, and remove items from shorelines. In addition, a statewide aerial marine debris survey was conducted of the coastline of the main Hawaiian Islands in order to identify potential Japanese marine debris items and identify debris accumulation areas throughout Hawai'i. In Hawai'i, over forty Japanese tsunami marine debris items have been confirmed and hundreds of suspected items have been reported, with new items being reported regularly. Taxonomists have identified 79 different non-native invertebrates and algae species on arriving JTMD. Aerial surveys identified and mapped over 20,000 individual debris items, of which four vessels could be owner-traced as JTMD. The state-wide aerial survey also identified marine debris accumulation areas which occurred primarily on northeast (windward shorelines) of the main Hawaiian Islands. Monitoring efforts are underway to detect the possible establishment of any new species transported by the debris with plans to focus primarily in debris "hotspots" identified in the aerial survey.

P1-15

Human Interventions to Enhance Hawaiian Monk Seal Pup Survival at French Frigate Shoals

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In efforts to promote survival and recovery the endangered Hawaiian monk seal population, *Neomonachus schauinslandi*, the National Marine Fisheries Service conducts a variety of opportunistic interventions. Specific field actions undertaken to enhance pup survival include detaching placentas which inhibit pup mobility, reuniting and fostering pups with mothers, forced pup weanings, and/or translocation of newly weaned pups from areas with high mortality risk. Primarily because of the uniquely high

level of Galapagos shark predation on pups at French Frigate Shoals (FFS), over 85% of all pup interventions during 2007-2016 were conducted at FFS. Crucial considerations for safely intervening include the body condition, stage in lactation and behavior for both the pups and mothers; the pup's gender; and the type and level of threats present (e.g., shark predation and aggressive adult male seals). During the ten year period, 33% (124 of 379) of the pups born at FFS were involved in a total of 200 pup interventions, including 148 translocations, 23 fostering events, 14 mother-pup reunites, 10 forced pup weanings, and 5 placenta detachments. Only 17 interventions were unsuccessful: in 2 reuniting attempts the pup was apparently unhealthy, and the mother's behavior negated the efforts in 7 reuniting, 7 fostering, and 1 forced weaning attempts. These types of field interventions provide an opportunity to enhance pup survival with minimal effort compared to resource intensive options such as captive rehabilitation. Identifying factors which affect intervention success will assist in refining our methods to foster monk seal recovery.

P1-16

Looking Out for the Little Guys: a New Captive Rearing Program for Native Invertebrates

William Haines, David Sischo, Lindsay Burnside, Cynthia King *Hawaii Department of Land and Natural Resources, Division of Forestry and Wildlife, Honolulu, HI, USA*

In terms of sheer numbers, invertebrates account for the bulk of Hawaiian biodiversity, with over 5,000 endemic arthropod species and over 750 endemic land snails. Some native invertebrates are federally protected as endangered, and many more are imperiled, but unlisted. Captive propagation for the purpose of reintroduction is a common strategy for plants and many vertebrates, but it has rarely been attempted for invertebrates. The DLNR-DOFAW Hawaii Invertebrate Program (HIP) recently established two new captive rearing laboratories: one focusing on insects and the other on snails. The laboratories, located at Kawainui Marsh on Oahu, have begun rearing native insects and snails, with the goal of reducing the risk of species extinction. For most species, the objective is to collect individuals from a source population, ramp up populations over one or two generations, then release offspring into restored habitats within the historical range. For some critically endangered species, threats in the wild are too severe to attempt releases in the immediate future, and the facility functions as a safety net to hold populations in captivity until threats can be mitigated. Initial target species include the Kamehameha butterfly (*Vanessa tameamea*), Hawaiian orange-black damselfly (*Megalagrion xanthomelas*), and 11 species of Hawaiian land snail, including the families Achatinellidae and Amastridae. Our goal is to expand rearing efforts to include many other groups of endangered and threatened invertebrates across the Hawaiian Islands.

P1-17

Pollen Desiccation Tolerance of two Kauaʻi Single Island Endemic *Hibiscus* Taxa: Implications for *ex situ* Pollen Conservation

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Storage of pollen allows for gene exchange between geographically isolated individuals, and for controlled pollination when flowering of staminate and pistillate flowers or plants are asynchronous. Desiccation is essential for pollen longevity, yet research into pollen storage behavior is infrequently performed. *Hibiscus clayi* and *H. waimeae* subsp. *waimeae* are Kaua'i single island endemic plant taxa assessed as Critically Endangered and Near Threatened by the IUCN Red List of Threatened Species, respectively. With respect to both taxa we ask; 1) how does pollen viability respond to length of time stored *ex situ* and, 2) what are the lower limits of desiccation tolerance? Pollen was collected from the National Tropical Botanical Garden, McBryde Garden. Only samples with >50% initial pollen viability were used. Subsets of pollen were desiccated to 5%, 11%, 29.5%, 42%, 55%, and 77% RH at ambient temperatures (~20°C). To ensure equilibrium was reached, pollen was tested for viability after four days of desiccation. *Hibiscus clayi* and *H. waimeae* subsp. *waimeae* pollen final viability was equal to initial viability (p= 0.424 and 0.283, respectively), and was statistically similar across all RH treatments (p=0.151 and 0.431, respectively). However, lowest viability was found in pollen desiccated to the lowest RH (5%) for both taxa. Research into optimal pollen storage methods by species is needed to better understand the effects of desiccation on pollen viability and longevity. Considering the current rate of plant extinction in Hawai'i, pollen storage is an important conservation tool for conducting controlled crosses that might otherwise not be possible.

P1-18

Emerging In-Water Hull Cleaning Technologies and Policies can Significantly Reduce the Biosecurity Risks Associated with In-Water Hull Husbandry

Julie Kuo *Department of Land and Natural Resources, Honolulu, HI, USA*

Aquatic invasive species (AIS) introductions into Hawai`i threaten natural aquatic habitats, socioeconomic prosperity, and may have implications on human health. Among the many ways that AIS are introduced to Hawai`i, vessel biofouling ranks as the top vector of introduction. Unlike ballast water, biofouling is much more complex in its threat to the environment since the abstinence of removing biofouling will allow the organisms to release propagules wherever the vessel goes, but removing the biofouling on vessels in-water, also known as in-water cleaning (IWC), may subsequently provide AIS a chance at propagating in a foreign port. Furthermore, if IWC operations are not performed appropriately, toxic chemical constituents in the anti-fouling paint on the vessel hull may be released into the environment, which would have water quality implications. Biofouling and IWC operations remain a contentious issue among commercial harbor stakeholders, including the commercial maritime industry and state agency groups. This presentation will discuss potential solutions for minimizing AIS introductions into Hawai`i by managing biofouling through regulatory action, IWC policies, and emerging IWC technologies that capture organisms and neutralize harmful chemicals during IWC operations.

P1-19

Ke Kai Ola: the Role of Rehabilitation in Hawaiian Monk Seal Recovery

Shawn Johnson, Frances Gulland *The Marine Mammal Center, Sausalito, USA*

Ke Kai Ola is a hospital for Hawaiian monk seals in Kailua-Kona, Hawaii that also serves as a hub for education and outreach by engaging the local community in monk seal health care. Ke Kai Ola provides veterinary care for sick, injured, and malnourished Hawaiian monk seals, and returns them to the islands they were collected from once recovered, with the aim of enhancing the number of breeding females. Since opening, 12 weaned pups and 3 yearling seals that had poor probabilities of survival were rehabilitated and released from 2014-2016, and a further four seals were released in early 2017. Seals were treated for malnutrition, gastrointestinal cestodiasis, skin wounds, abscesses, and Campylobacter enteritis, and vaccinated against canine distemper virus. Upon admission, pups weighed 27.6 ± 7.4 kg and yearlings weighed 40.8 ± 7.2 kg. Average time in rehabilitation for the seals was 162 ± 69 days, with weight gains of 83.5±26.0 kg. Hawaiian monk seals rehabilitated during the 1980-1990s, and their offspring currently comprise 12-14% of the Hawaiian monk seal population at the three northernmost breeding colonies in the NWHI. To date, 1% of the current HMS population has been treated at Ke Kai Ola, thus contributing to species survival and enabling the children of Hawai'i to grow up in a world they share with "Ilio-holo-i-ka-uaua."

P1-20

Distribution of Pueo or Hawaiian Short-eared Owl: Utilizing Citizen Science to Aid Monitoring Surveys

Javier Cotin, Melissa R. Price *University of Hawaii at Manoa, HI, USA*

The Pueo or Hawaiian Short-eared Owl (*Asio flammeus sandwichensis*), once common across the islands, is now state-listed as Endangered on Oʻahu. Three characteristics make this owl particularly vulnerable: (1) reliance on intact grasslands; (2) unpredictable food resource (preference for a diet of small mammals, which often vary substantially spatially and temporally); (3) and low site fidelity (with variable seasonal and annual movements). These characteristics also lead to great challenges in monitoring population size and distribution. Although the Pueo has been recorded in a variety of habitats in the Hawaiian archipelago, including wet and dry forests, it is most commonly detected in open habitats such as grasslands, shrublands, and montane parklands, including urban areas and those actively managed for conservation. However, documentation is lacking for several factors: historical population data, basic life history characteristics and the species' key habitat variables, which are difficult to determine. In order to amend this situation, we created a project, in partnership with the Hawaiʻi Division of Forestry and Wildlife, to improve population monitoring and define habitats important to population stability. Public participation was engaged through a citizen science component. A website and several other materials were created for public distribution. In addition, information was gathered by several volunteers. Owl surveys and habitat use characterization, combined with the aid of citizen science, resulted in improvements for monitoring and new insights to population and distribution of Pueo.

POSTER GROUP 2

P2-1

Auwahi Wind Predator Control Program: Saving Kahikinui's Last Hawaiian Petrels.

George Akau, Marie VanZandt *Auwahi Wind Energy, Kula,HI, USA*

The Hawaiian ecosystem is threatened by the introduction of non-native predators. These predators eat native seeds, plants, insects and the unique Hawaiian avifauna. Predator control techniques are continuing to evolve, with new technologies improving efficiency and effectiveness. Auwahi Wind Farm has set up, and effectively maintains, two extensive predator control operations on the leeward slopes of Haleakalā for the past three years. Traps utilized included: Besile Body Grip; Goodnature A24; DOC 250; Victor Foothold; and Ka Mate style traps. Auwahi's main predator control efforts are within a remote area of the Kahikinui Petrel Management Area (8530-9514ft) and encompass approximately 800 acres of land. Predators are managed to protect a remnant population of endangered Hawaiian petrels (ʻuaʻu), nesting in underground burrows. The management objective is to increase reproductive success and adult survivorship. Predator control is also implemented at the Auwahi Wind Farm (492-1312ft), within approximately 70 acres. Predators are managed to ensure an accurate assessment of potential impacts to birds and bats at the facility. The management objective is to reduce carcass scavenging and increase detection. Results of predator control efforts will be discussed in the context of catch per unit effort (CPUE) and the ability to reach management objectives. The techniques and lessons learned while implementing predator control strategies at both sites can be applied to management efforts across the islands and guide conservation agencies to effectively protect native species.

P2-2

Is an Increase in the Number of Flooding Events Impacting Nesting Success in the Endangered Hawaiian Stilt (Himantopus mexicanus knudseni)?

Kristen Harmon, Melissa Price, Yinphan Tsang, Ayron Strauch *University of Hawaii, Manoa, Honolulu, HI, USA*

The Hawaiian stilt (Himantopus mexicanus knudseni) is an endangered, native Hawaiian waterbird that inhabits wetlands across the Hawaiian Islands. In recent years sea level rise has increased the elevation of groundwater tables, contributing to increases in flooding events during heavy rainfall, particularly in wetland environments where wildlife populations are vulnerable. The contribution of high precipitation events to Hawaiian stilt nest failures should be quantified to inform effective conservation decisions for this endangered species. In this study we examined the relationship between high precipitation events and Hawaiian stilt nesting success. We utilized observational surveys and camera traps to determine nesting success of Hawaiian Stilts in Kawainui Marsh on the windward side of Oʻahu. The relationship between high precipitation events and Hawaiian stilt nesting success was determined using regressions analyses.

High precipitation events were found to be positively correlated with nest failures. Under future climate change scenarios precipitation is projected to increase in wetlands on the windward side of O‘ahu, potentially leading to more frequent flooding events. The results of our study may be used to inform decisions for managing hydrological conditions of Hawaiian waterbird habitat given future climate predictions.

P2-3

Community Based Efforts to Promote Native Species Regeneration in a Heavily Invaded Hawaiian Mesic Forest Ecosystem

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Community partnerships can be one effective way to focus attention and resources towards restoration efforts and revitalizing Mālama ‘Āina (taking care of the land and natural resources). On the island of O‘ahu, Hawai‘i, Kapi‘olani Community College (KCC) has partnered with the Hawai‘i Division of Forestry and Wildlife (DOFAW) and the local community to establish a mesic forest restoration project. In 2013, DOFAW fenced a small exclosure in Wailupe Valley to remove herbivore ingress, primarily feral pigs. Restoration goals include providing habitat for native plants and an endemic endangered bird, O'ahu ‘Elepaio (Chasiempis ibidis). In Spring 2014, KCC students set up a transect grid for the exclosure and began monitoring current vegetation composition. In 2015, local community members and KCC students continued monitoring and began removing invasive vegetation in select 10m x 10m plots. We are currently monitoring these plots to determine if native plants regenerate. Early analysis has shown that Strawberry guava (Psidium cattleianum), Christmas berry (Schinus terebinthifolious), and Cook Pine (Araucaria columnaris) are the main invasive species within the exclosure and the primary target for removal. Alahe'e (Psydrax odorata), Lama (Diospyros sandwicensis), Koa (Acacia koa), are the most abundant native species observed. Invasive species have taken a dramatic toll on both the biological and cultural heritage of Hawai‘i. These types of community-based projects can help initiate broader restoration efforts across the state and potentially world-wide.

P2-4

Laulima: Community Partnership in Mapping Invasive Algae Along Moloka`i’s Southern Shoreline

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Several invasive algae species have established on Moloka`i and have become dominant benthic features on reef flat habitats, spanning miles of the southern shoreline. Invasive algae species impact reef ecosystems by overgrowing native algae and corals. Local community leaders recognizing this threat to their marine resources, initiated efforts to develop an invasive algae management plan. Community members, conservation groups, managers, researchers, and practitioners were brought together to

provide input into the management plan. In 2015, a large survey effort was implemented including over 40 Molokai `i community members. The goals of the project were to: 1) map invasive algae species distribution; 2) map additional coastal features including sediment and mangroves; 3) train volunteers on the identification of invasive algae and Global positioning system (GPS) mapping techniques; 4) Use the data to inform community led discussions by the end of the 4-day survey period. In total teams mapped over 30 miles and 2,800 acres of shoreline. Gorilla ogo (*Graciliara salicornia)* was one of the most prominent invasive algae species, and seemed to concentrate around mangrove stands (another invasive species). In addition, local volunteers were trained on GPS mapping technique and continued with three additional survey events. Using these results a community driven action plan is underway to help prioritize removal of the densest sections of algae and begin the restoration o---f reef flat habitats. The project was also successful in bringing together a wide range of participants and establishing a new partnership to help implement invasive algae management in Moloka`i.

P2-5

Persistence of a small population of the endangered Orangeblack Hawaiian damselfly (*Megalagrion xanthomelas*) at Kaloko-Honokōhau National Historical Park

Robert Peck *Hawaii Cooperative Studies Unit, University of Hawaii-Hilo, Hawaii National Park, HI, USA*

The Orangeblack Hawaiian damselfly (*Megalagrion xanthomelas*) was once among the most abundant and widespread native damselflies, but is currently limited to small, isolated populations at low elevation on O`ahu, Moloka`i, Lāna`i, Maui and Hawai`i Island. Due to numerous threats to these populations, this species was listed as federally endangered in September 2016. On Hawaii Island, Kaloko-Honokōhau National Historical Park provides habitat for a very small population that persists in eight closely associated anchialine pools. These coastal pools provide essential habitat for both the aquatic immature and terrestrial adult stages. The objectives of this study were to identify spatial and temporal patterns of abundance, determine key components of habitat structure and document reproductive behaviors. Population counts suggest that 6-16 males and 0-4 females occupy the pools at any one time; additional individuals may be present away from pools but are difficult to detect. Occupied pools generally support significant amounts of structural cover in the form of poolside or emergent vegetation. Pool salinity fluctuates with tidal flow and ranged from about 10-14 ppt in four core pools. Behaviors of females that suggest egg laying (oviposition) indicate that partially immersed branches are most commonly used (57.3% of oviposition events), but eggs are also deposited on rocks (25.6%) and floating leaves (7.9%). Factors that limit Orangeblack damselflies within the park are being investigated, and may affect either life stage. Pool restoration, including the removal of storm sediments and invasive fish and plants, may provide additional habitat for this damselfly.

P2-6

The Environmental, Social, and Cultural Benefit Spillovers of the Pūpūkea Marine

Life Conservation Districts

Maxx Phillips, Jenny Yagodich *Malama Pupukea-Waimea, Haleiwa, HI, USA*

In 1983, after a marked decline in near-shore marine resources, the State of Hawai‘i designated the Pūpūkea Marine Life Conservation District (MLCD) on the North Shore of O‘ahu in an effort to provide protection for biodiversity. As seen over the past 35 years at the Pūpūkea MLCD, benefits of marine protected areas (MPA) can go beyond biodiversity, extending into a range of ecological, social, and cultural benefits. The extent to which these benefits can be achieved is largely dependent on the integrated and transdisciplinary approaches to management involving governmental agencies, research, placed based ancestral knowledge, and arguably most important, community. The North Shore community's dedication to protecting, replenishing, and sustaining the Pūpūkea MLCD has had unforeseen conservation, cultural, and restoration "benefit spillovers." The Makai Watch program has empowered the local community resulting in better protections for the Pūpūkea MLCD. Community outreach, education, and human-use/biological monitoring inform not only the local community, but also offer support to governmental agencies and scientific research. Marine science educational programs offered to keiki about the Pūpūkea MLCD ensure a new generation of active place based stewards. Efforts to better understand the Pūpūkea MLCD has led to a revitalization of traditional place names and practices of the area. Productive partnerships have resulted in increased resilience and maintenance of ecosystem services adjacent to the Pūpūkea MLCD through coastal erosion projects, native plant restorations, and beach clean ups. The Pūpūkea MLCD demonstrates how MPAs have the power to build concentric circles of protection and restoration that span far beyond biodiversity.

P2-7

Rodent Trapping Drives Down Invasive Rat Populations in Key Endangered Bird Habitat on Kaua’i

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The continuing decline of the critically endangered ‘Akikiki (*Oreomystis bairdi*; pop <500), ‘Akeke'e (*Loxops caeruleirostris*; pop <1000), and Puaiohi (*Myadestes palmeri*; pop <500), all Kaua'i endemics, is attributed to several threats, including predation by non-native rodents, specifically rats. We previously demonstrated that bird reproductive success and survival have been impacted by rats preying on bird eggs, nestlings, and incubating females. To boost forest bird reproductive output and survival, we deployed 146 Goodnature A24 rat traps in a 50x100m grid in core critical endangered bird habitat prior to the 2015 forest bird breeding season. In 2016 we deployed 157 more A24 traps in and along two streams adjacent to the grid. Corresponding control plots without traps were also established for each treatment plot. Track tunnels with ink plates were placed in all experimental and control plots to monitor relative rodent abundance. In 2015, the trapping grid killed more than three rodents each night. By the fall of 2016 this rate dropped to just more than one rodent per night. These numbers were reflected in

changes in relative rodent abundance. The 2015 control and treatment plots started with 20.6% and 18.4% rodent presence, respectively. Abundance increased to 54.3% on the control and declined to 5.7% on the treatment, primarily due to a decrease in rats (as opposed to mice). The two new plots killed more than two rodents per night in 2016. In a short time, trapping has effectively decreased rodent abundance in treatment areas, while numbers increased in a control unit.

P2-8

Long-term history of vehicle collisions on the endangered Nēnē (*Branta sandvicensis*)

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Millions of birds in the United States die annually due to vehicle collisions on roads, which is a concern for species of conservation concern. One species affected by vehicle collisions is the endangered Hawaiian goose (Nēnē) which is endemic to Hawai'i. Using a 40-year data set of Nēnē mortality in and around Hawai'i Volcanoes National Park we sought to answer the following research questions: 1) has Nēnē mortality changed over time and space? 2) are there times of the year in which mortality is greatest and does it relate to specific events in the species lifecycle? 3) does mortality rate show any density dependence? and, 4) are mortality rates related to numbers of visitors or vehicles? A total of 92 Nēnē died from vehicle collisions, with mortality increasing over time. Mortality was greatest in December and November (breeding season) and lowest in June. Between 1995 and 2013 the Nēnē population size and mortality rates were not correlated. Furthermore, Nēnē mortality was unrelated to the number of visitors or traffic volume in the park. These findings suggest vehicle collisions are a growing concern for Nēnē.

P2-9

Collaborative and Integrative Management of Invasive and Rare Species on UH Managed Lands of Maunakea

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The Office of Maunakea Management (OMKM) manages over 12,000 acres in the upper reaches of Maunakea including the Mauna Kea Science Reserve, summit access road, and Halepōhaku mid-level support facilities. Maunakea is known for its tropical alpine environment, cultural significance, astronomical sciences, and tourist allure. To manage these potentially competing uses, OMKM employs collaborative and integrative natural resource management practices. We work with various organizations and volunteers to identify species, develop management recommendations, determine potential cultural site protections, enlist mapping expertise, assist in biological monitoring efforts, and aid in environmental decision-making processes. For example, the Hawai'i Ant Lab and the Big Island Invasive Species Committee collaborated with OMKM to develop and

implement invasive species management guidelines as outlined in the 2015 Maunakea Invasive Species Management Plan (ISMP). The ISMP was approved by the community-based Maunakea Management Board and includes guidelines for invasive species prevention, early detection, rapid response, monitoring, and control. ISMP implementation requires the support of multiple program partners and monitoring results show highly variable arthropod density oscillations over time for species on Maunakea. For example, from 2013-2016 there is an overall downward trend in total captures, but the diversity of taxa (as measured by the number of families captured) remained relatively consistent. Not only have these efforts highlighted the variable nature of arthropod populations on Maunakea, but also led to the discovery of several target invasive species threats (e.g. *Wasmannia auropunctata* and *Camponotus variegatus*) and rare native, cryptic arthropod species (e.g. *Micromus usingeri* and *Nesosydne spp.*).

P2-10

Using Remote Cameras to Augment Hawai'ian Monk Seal Survey Data From Hard-to-Reach Islands

Johann Becker, Stacie Robinson, Mark Sullivan, Brenda Becker *NOAA, Honolulu, HI, USA*

Hawai'ian monk seals are endemic to Hawai'i, and inhabit islands throughout the archipelago from the island of Hawaii to the Kure Atoll. The large span of the monk seals' range, along with the remoteness of many islands, creates challenges in monitoring this endangered population. Population assessment methods vary from gathering public reports in the populated main Hawai'ian islands, to deploying seasonal camps at 5 sites in the Northwest Hawai'ian Islands. But at sites without human populations and unsuited for setting up camps, it can be difficult to collect adequate data to describe monk seal population trends and vital rates. To fill such data gaps, we have stationed remote cameras on Nihoa Island. The cameras collect data year-round while only require human presence twice a year to deploy the cameras and collect the footage. From 2014-2016 we collected over 80,000 photos of Nihoa's primary monk seal haul-out beach. We used a photo sub-sampling strategy and collect data from photos to describe beach conditions, seal numbers, and events such as pupping, deaths, or interactions between seals. This data will improve population estimates and help to calculate survival and reproductive rates so that we can better understand how Nihoa contributes to the Hawai'ian monk seal population at the regional level.

P2-11

Assessing Public Awareness of Rapid ʻŌhiʻa Death for Outreach and Education Needs

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Rapid ʻŌhiʻa Death (ROD) is caused by two new species of the fungal pathogen (Ceratocystis) causing severe mortality to ʻōhiʻa (Metrosideros polymorpha) on the

island of Hawaiʻi. The fungus has been detected in soil which means that there is a risk that hikers may inadvertently spread the disease to other islands if they do not decontaminate their boots between hikes. In order to gauge public awareness of the disease and to assess the willingness of trail users to use decontamination stations if provided, the Oʻahu Invasive Species Committee (OISC) conducted a series of public opinion surveys at trailheads based on methodology developed and implemented by Jeff Bagshaw with the State Natural Area Reserve System (NARS) on Maui.

The survey also aimed to assess the decontamination practices of hikers by asking respondents if they had hiked inter-island in the past 2 years and if so, whether or not they cleaned their shoes. 24% of Oʻahu inter-island hikers were using the same untreated hiking shoes, while none of the respondents surveyed on Maui had cleaned theirs. If the fungus can indeed be transported by hikers, the human vector via untreated hiking shoes could pose a substantial risk.

The low number of people that are familiar with ʻōhiʻa indicates that ROD outreach will have to be very basic and targeted to introducing people to this important watershed species. The high number of people willing to use decontamination stations suggests that ROD decontamination messages may have a receptive audience.

P2-12

Cultivating Capacity through ʻIke Hawaiʻi

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With an ever increasing high cost of living, limited resources for diversified funding and a growing interest and demand for conservation in Hawaiʻi building pressure on our natural systems, innovative capacity building approaches are essential to the success of conservation in Hawaiʻi now more than ever.

Mālama Loko Ea Foundation (MLEF) is currently in the process of restoring Loko Ea, a Native Hawaiian Fishpond or “loko iʻa”, located in Haleʻiwa Hawaiʻi. To continue the growth of this organization and to once again bring Loko Ea, a 400 year old historical wahi pana, to a fully operational, sustainable, and natural food resource for the community, the Holomua Leadership Series (HLS) was created. HLS is a volunteer based leadership training program with a vision to nurture diverse, powerful leaders for a sustainable and strong MLEF. HLS aims to catalyze this partnership with the community by enabling emerging leaders through rigorous ʻIke Hawaiʻi, or “Hawaiian cultural knowledge”.

Though the Holomua Leadership Series is our most innovative capacity building program, MLEF has created diversified channels for engaging the community so that we may accomplish many feats with little resources i.e. Kulaiwi Nani Program, Communications ʻOihana, and new technological advances through opportunistic partnerships. MLEF has seen many successes and generated a large interest in our

capacity building programs, largely contributing to our current status today. We see the value in these accomplishments and want to share this ‘ike with our community of conservationists.

P2-13

Invasive Species Removal at ‘Uko‘a Pond

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‘Uko‘a Pond is a large freshwater wetland located on O‘ahu's North Shore. Kawailoa Wind LLC is conducting invasive species management at ‘Uko‘a Pond to mitigate for impacts to listed species at the Kawailoa Wind Farm on O‘ahu, and improve habitat for several endangered waterbirds and the endangered Hawaiian hoary bat (*Lasirus cinereus semotus*). Water hyacinth (*Eichhornia crassipes*), a highly invasive floating plant, has been manually removed to create open water habitat for native waterbirds and increase food availability for Hawaiian hoary bats. Additionally, a predator control program at ‘Uko‘a has targeted removal of pigs, feral cats, mongoose, and rats. A grid of three different trap types (A24, Doc 250 and body grip traps) were installed to control rodents and mongoose within ‘Uko‘a. Trials were conducted between Doc-250s and body grip traps to compare their effectiveness. Tracking tunnels were used to monitor the percent activity of these species prior to and during the trapping program. Results of trap trials and monitoring methodologies will be presented. Ongoing waterbird and bat monitoring will occur to help assess the effect of invasive species removal on listed species.

P2-14

Wireless Watershed: Internet Protocol Based Video Monitoring Network in Remote Montane Forest on the Island of Kaua‘i, Hawai‘i.

Lucas Behnke, Melissa Fisher *The Nature Conservancy, Honolulu, HI, USA*

Vigilance is an important component in the monitoring of animal populations and ingress in management areas where the goal is the complete removal of all individuals. As the coordinator of The Kaua‘i Watershed Alliance, The Nature Conservancy’s (TNC) Kaua‘i Program currently manages approximately 6,000 acres of extremely remote, rugged priority watershed as ungulate-free. The use of strategic fencing to complement steep “natural barriers” to animal movement cut down on initial costs of large-scale watershed protection projects. Successful initial removal and the subsequent maintenance of those areas has necessitated extensive helicopter access-only field work including traditional on-the-ground monitoring methods. In order to increase both the efficiency of remote animal removal operations and sustained monitoring and maintenance efforts, TNC has developed a remote video monitoring system to record feral animal activity in some of the most remote, windiest and wettest areas of the island. Beginning in 2012, with a multi-phase project, TNC has deployed a remote monitoring network of high-capacity

point-to-point radios, linking strategically placed motion-activated security cameras with stand-alone solar power supply systems. The remote system of five cameras is wirelessly connected to the program office in Lihue, spanning an initial 10.7-mile distance, two multi-point hubs linking camera sites at key ingress points and a remotely-activated pig trap in the Wainiha Valley and East Alakaʻi management units. Ideally, in addition to providing a critical management application, the design and development lessons of the TNC-Kauaʻi Program's remote monitoring system can benefit the statewide effort toward managing remote natural areas.

P2-15

Plant Pono, a Proactive Approach to Combatting Invasive Horticultural Species

Molly Murphy[1], Charles Chimera[1] *[1]Big Island Invasive Species Committee, Hilo, Hawaii, USA, [2]Hawaiʻi Pacific Weed Risk Assessment, Kula, Maui, USA*

Horticultural plants are being imported to Hawai'i and dispersed by humans at an accelerated rate due to the advent of the internet age and fast shipping. Invasive plants are among the biggest threats to Hawai'i's biodiversity. 90% of invasive plants were imported intentionally. The horticultural industry brought in $67 million to Hawai'i's economy in 2015. How can this industry serve their customers, protect the ʻāina, and save tax payers millions of dollars?

Plant Pono (www.plantpono.org) fills in the gaps left by Hawai'i's permissive laws regarding the importation of new species and the sale of invasive weeds. Plant Pono nurseries choose alternatives over species likely to become invasive. Plant Pono vets plants using the Hawaii-Pacific Weed Risk Assessment (HPWRA); a background check that uses published information to answer 49 questions about the plant's characteristics.

Plant Pono's code of conduct asks nurseries to use the HPWRA before importing new plants, to follow best management practices regarding pests, and to phase out the sale of proven invasive plants.

Plant Pono's successes on Hawai'i Island include: Walmart discontinued the sale of *Cestrum* and *Medinilla* statewide; 1,850 plants have been screened by the HPWRA; Pono nurseries have phased out *Cestrum*, *Medinilla*, and *Spathodea*; 3 online plant-vendors have ceased shipments of *Cryptostegia* to Hawai'i; little fire ants have been detected at 9 nurseries; 44 nurseries have been surveyed and 19 have been endorsed. Kauai has a partner program, and in the future, we anticipate Plant Pono will become a statewide program that national chains can join.

P2-16

Seed Storage and Germination Condition for *Flueggea Neowawraea* (Phyllanthaceae) to Promote Seed Longevity and Increased Germination

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Critically Endangered *Flueggea neowawraea* (Phyllanthaceae), the only member of the genus endemic to Hawaii, has less than fifty individuals remaining in the wild. *Ex situ* seed conservation is an important conservation strategy but managers need to be able to predict storage longevity and methods to germinate seeds after storage duration. With respect to *Flueggea neowawraea*, we ask, 1) how will seeds respond to storage temperatures of +5 & -18°C, 2) how long do seeds persist in storage before viability dramatically declines, and 3) how do seeds respond to antifungal treatments? Three replicates of seed collected 3, 10, and 26 years before present and stored at +5 and -18°C of 20-40 seeds were weighted and placed in a germination chamber receiving a 12/12-hour photoperiod and 25/15°C temperature regime per day. Two replicates of ten seeds from each sample was treated with 0.79% and 7.9% chlorine bleach solutions for five-minutes, 2% Plant Protective Material (PPM) solution for seven-hours, and distilled water for seven-hours. The 2% PPM treatment showed the highest percent germination. There was no significant difference in seed mass across collections (p=0.226). Seeds collected three years before present had the highest percent germination. No seeds stored 26 years before present including at temperature +5°C germinated. To determine the regeneration interval and increase germination, further research should include increasing the frequency between intervals at which seeds are tested during long term storage and to determine if physiological dormancy is present, and if so, methods to alleviate dormancy.

P2-17

Conservation Breeding and Reintroduction of the ʻAlalā (*Corvus hawaiiensis*): 2017 update

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Since the ʻAlalā nearly became extirpated from the wild in the late 1990s, intensive and pioneering conservation breeding techniques have been carried out at facilities on both Hawaiʻi and Maui Islands. These efforts have resulted in the increase in the population of the entire species to a maximum of 131 birds in late 2016, compared to a low point of about 20 birds in the 1990s. This population peak in combination with extensive forest habitat preservation and restoration efforts in the Keauhou-Kūlani region of Hawaiʻi Island resulted in the initiation and implementation of a long-term reintroduction program in 2016. Following the release of the first five birds in December 2016, ʻAlalā were observed foraging on supplemental food, endemic fruit, and in bark and crevices of tree branches presumably on invertebrates. All birds released were observed within 500m from the release site, with the exception of one bird which exhibited dispersed ~2km. Three ʻAlalā died within 7 days after release, two of which were due to predation by ʻIo, and one due to poor condition and/or exposure. The remaining two released birds were returned to a field aviary shortly thereafter. Future release efforts will address these results in part by designating a new release site, implementing more rigorous

antipredator training, and decreasing the interval between release groups. As the releases continue in 2017, subsequent learning opportunities will require innovation and persistence on the way to the establishment of a wild population of this iconic and ecologically and culturally important species.

P2-18

Biocontrol of weeds releases current and pending

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Our Forest Service team focuses on development of natural enemies for long term suppression of invasive plants in forests of the Hawaiian Islands and elsewhere across the Pacific. Here we summarize the current status of biological control projects targeting some of the most disruptive weeds in Pacific ecosystems: *Psidium cattleianum* (strawberry guava), *Miconia calvescens*, *Clidemia hirta*, *Tibouchina herbacea* and relatives. We are collaborating with forest managers in Hawaii to distribute and monitor efficacy of *Tectococcus ovatus*, with the goal of slowing the spread of strawberry guava in native forests. Two agents currently proposed for biocontrol of weedy melastomes are under review, and progress with other promising species is updated.

P2-19

Impacts of Alien Freshwater Turtles on Native Hawaiian Wetland Birds

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Exotic species introductions to islands contain many different taxonomic guilds and the susceptibility of islands to invasive species introductions is high and may be due to whole taxonomic groups missing from native faunal communities. Reptile and amphibian communities are absent from native terrestrial ecosystems in Hawai‘i. It remains uncertain the cumulative impacts certain herpetofauna pose to ecological functions in native Hawaiian ecosystems. The aim of this study was to examine the ecological effects exotic freshwater turtles pose to a Hawaiian wetland ecosystem. Specifically, do exotic freshwater turtles impact native waterfowl in Kawai Nui Marsh, O‘ahu through direct predation of adults, juveniles, or eggs? Through trapping and collecting freshwater turtles in Kawai Nui Marsh an assemblage of dietary components in the stomachs of two exotic freshwater turtles, the Pond Slider (*Trachemys scripta*) and Chinese Softshell Turtle (*Pelodiscus sinensis*), were analyzed for contents. Pond Slider and Chinese Softshell Turtle stomachs did not contain native wetland birds or their eggs. Although exotic freshwater turtles were not found to directly impact native waterfowl in Kawai Nui Marsh, indirect impacts remain plausible since the Pond Slider is omnivorous and an opportunistic feeder and Chinese Softshell Turtles are strictly carnivorous. The diets of both alien freshwater turtles, collectively, contain potential overlap with native wetland bird diets, thus, serving as potential competitors for foraging resources.

P2-20

Preliminary Results from an In-Situ Coral Nursery in Hawai'i: Can Corals of Opportunity be used as a Restoration Tool?

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Coral reefs in Hawai'i are suffering the consequences of multiple damaging events and there are currently an extremely limited number of direct strategies to promote and accelerate recovery following these disturbances. In this study, we collected 48 fragments of *Montipora capitata* and *Porites compressa* that broke off from eight boat strikes in Kāne'ohe Bay and grew them in three in-situ coral nursery sites. We deployed a PVC platform at three different nursery environments (lagoon, intermediate, and reef flat) within the Hawai'i Institute of Marine Biology (HIMB) and attached the coral fragments to mesh on the platforms. We monitored the fragments in the nursery environments for six months, tracking survivorship and growth rates. We also measured environmental parameters including temperature, water motion, and sediment at each nursery site. We predict that we will see differences in both survivorship and growth rates between the two species and between nursery environments. This study represents one of the first efforts to establish an in-situ coral nursery in Hawaii and our results could provide a foundation for future active restoration efforts in Kāne'ohe Bay and beyond.

POSTER GROUP 3

P3-1

Malama na Honu Educational Outreach and Public Management in Hawaii

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Malama na Honu (MnH) aims to protect Hawaiian green turtles (*honu*) through educational outreach in the spirit of Aloha. Hawaii is the only location where green turtles deliberatly bask (sleep) on the beach and MnH provides awareness via "Honu Guardian" volunteers at Laniakea Beach, Oahu. Volunteers promote low-impact viewing flavored with engaging facts about the 18 - 25 *honu* that regularly bask at Laniakea, known as "turtle beach." Laniakea has become a "must see" location on Oahu with over 600,000+ people visiting annually. The soaring popularity of ecotourism and social media means potentially harmful and disrespectful interactions between people and turtles may occur. MnH guardians deal with this contingency daily. To reduce potential harassment to

basking turtles, in collaboration with NOAA Fisheries and other state and federal partners, MnH has determined that a viewing distance of 10 feet (3 meters) results in little to no change in a turtles' behavior, and the public can enjoy turtles while getting their desired photos. It also supports our island culture which encourages viewing wild animals in their natural habitat safely and respectfully. Further, the basking data collected by volunteers produces vital information about basking *honu*. For instance, data indicates that peak basking activity is between March to June, peak basking occurs between 11 am and 3 pm, and individual turtles show distinct basking frequency patterns year to year. These data combined with the successful results of the responsible viewing guidance developed by MnH helps support sea turtle conservation and public management in Hawaii.

P3-2

Herbivore Biocontrol and Manual Removal Successfully Reduce Invasive Macroalgae on Coral Reefs

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In the Hawaiian Islands, several invasive algae species (*Eucheuma denticulatum* (clade E), *Kappaphycus alvarezii* (clade A and B), *Gracilaria salicornia*, and *Acanthophora spicifera*) pose a serious threat to coral reef biodiversity by monopolizing habitat and overgrowing and smothering reef corals. To address this threat a consortium of researchers and managers developed a novel two-pronged approach to control invasive macroalgae. Divers, equipped with an underwater vacuum system ("The Super Sucker") manually removed invasive macroalgae, followed by outplanting of hatchery-raised juvenile native sea urchins (*Tripneustes gratilla*) to control macroalgal regrowth. These techniques have been evaluated with small-scale experiments, but have not been thoroughly evaluated at the reef-wide scale. Here, we conducted benthic surveys on two treatment patch reefs and two control reefs in Kāne'ohe Bay where invasive macroalgae cover accounted for 15 - 26%. The effectiveness of manual removal and biocontrol of invasive macroalgae in a natural reef ecosystem was tested by analyzing the change in percent cover of invasive macroalgae before (2011 - 2012) and four time points after (2012-2014) macroalgae removal and urchin outplanting. Mechanical removal and biocontrol significantly reduced invasive macroalgae cover by 85% at treatment reefs over the study period relative to pre-experimental levels (Treatment × Time: $p = 0.001$). Our results show that manual removal in combination with hatchery raised sea urchin biocontrol is an effective management approach for controlling invasive macroalgae at the reef-wide spatial scale over the course of months to years.

P3-3

Hand-Pollination of Critically Endangered *Schiedea haleakalensis* at Haleakalā National Park

Monica Lomahukluh, Michelle Osgood *Haleakala National Park, Makawao, USA*

Schiedea haleakalensis is an endemic-endangered Caryophyllaceae found in Haleakalā National Park. *S. haleakalensis* was first described in 1939, but little information is known about the historical extent of the habitat range, how pollination occurs or the reproductive biology of the species. A gynodioecious species (having only female or bisexual flowers), *S. haleakalensis* occurs along cliff faces ranging from 1,798 to 2,560 meters in elevation. Currently, there are two declining and disjointed natural populations of *S. haleakalensis* found in the western crater area and on Haleakalā Peak. From these wild populations, cuttings and seeds have been collected and grown in the park nursery. Since 2004, the nursery has maintained four living collections from the wild populations, three from the western crater and one from Haleakalā Peak. Propagating cuttings from parent materials had a low (~25%) success rate with 6-8 months to root. As a result of low success rates of cuttings and its gynodioecious physiology, hand pollinating was introduced as another means of reproduction in 2014. Recent trials have yielded 6635 seeds from nursery stock and were successfully propagated. Due to disjointed populations, where inbreeding depression occurs, outcrossing by means of hand-pollination could be an advancement in recovering *S. haleakalensis* and other Hawaiian rare plants.

P3-4

Composition of Native Forest Birds Captured On East Maui

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Bird banding is used as an important research tool worldwide. The capture of birds in the wild can provide insight into population health and demographics. Maui Forest Bird Recovery Project has used this technique to research native forest bird species in three locations on the island of Maui: Hanawi Natural Area Reserve (NAR), The Nature Conservancy's Waikamoi Preserve, and Nakula NAR. Hanawi and Waikamoi are located on the northeast slope of Haleakalā volcano dominated by intact native forest communities. Nakula is on the southeast slope characterized by remnant native forest patches. Birds were caught in mist nets, banded, and measured for a variety of morphometric parameters. Herein we analyzed banding data from 2009-2017 to better understand demographics, including sex and age ratios and breeding status, within these populations of native bird species. Hanawi and Waikamoi had six native bird species, representing 73% of the birds captured in those sites; whereas Nakula only had two native species, 37% of birds captured. A large proportion of the birds captured were juveniles providing an excellent opportunity to estimate longevity in the future. Overall males were captured more often than females. Some variation was present in breeding condition among sites possibly indicating variation in timing of breeding behaviors as a function of habitat. While our data are biased toward birds that tend to forage in the understory, banding is invaluable to our ability to understand morphometric and demographic traits of native bird species.

P3-5

Response of Hawaiian Coral to Long-term Contact with Invasive Gorilla Ogo,

Using Non-molecular Biomarkers.

Victoria Sindorf *University of Hawaii at Manoa, Honolulu, HI, USA*

Local and global stressors such as overfishing and nutrification work synergistically to encourage the growth and proliferation of algae on coral reefs, damaging coral colony health and fecundity and reducing coral larval recruitment. *Gracillaria salicornia*, commonly known as Gorilla Ogo, was introduced to Oahu in the 1970's and has since spread to all parts of the island, where it forms thick mats over coral reefs. Previous coral-algae interaction research has focused on very short-term, acute exposures of coral to algae, which do not account for the long-term associations that exist in Hawai'i with the invasive Gorilla ogo. Over a 3 month experimental exposure of coral nubbins to *Gracillaria salicornia* mats, alterations to the growth, metabolism, and photosynthetic potential of *Porites lobata* (lobe coral) were observed. The largest changes in coral physiological health were in the first month of exposure, with the coral showing signs of acclimation after three months of exposure. While both zooxanthellae density and photosynthetic pigment concentrations decreased, reflected as increased incidences of paling or partial bleaching, very low rates of total bleaching or death resulted from the exposure.

P3-6

Effects of Loss of Seed Dispersers on Rare Lobelioids: Assessment of Seed Viability in Senescing Fruits

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Limited recruitment of the endangered Hawaiian plants *Cyanea superba* subsp*. superba* and *Delissea waianaeensis* occur at reintroduction sites managed by the Oahu Army Natural Resources Program. Non-harvested fruits of both species senesce prior to abscission. Laboratory tests were conducted to examine recruitment limitations associated with fruit senescence, including seed germination rates from senesced versus fresh mature *C. superba* subsp. *superba* and *D. waianaeensis* fruit, and the rate of seed viability loss in *C. superba* subsp. *superba* as fruits senesce in the laboratory. In the event that seed sowing becomes a management tool for long-term stability of *C. superba* subsp. *superba*, germination rates with and without pulp extract were also examined to assess the effects of fruit pulp on germination during seed sowing. *Cyanea superba* subsp. *superba* seeds were 50% less viable in senesced vs. fresh mature fruit. Seed viability declined significantly within five days among fruit that senesced in the laboratory. No germination occurred in seeds from fruit that senesced for 15 to 19 days. Fruit extract had no effect on germination. Viability remained high among senesced *D. waianaeensis* fruit. Reduced seed germination from senescing *C. superba* subsp. *superba* fruit suggests this species is dispersal limited. Without effective dispersers, long-term self-sustaining populations may not occur, and populations may require on-going replacement via outplanting or seed sowing. *Delissea waianaeensis* fruits not removed by frugivores retain the potential to germinate upon senescence. However, the extent to which seeds of either species remain viable after senescing fruits fall to the

ground remains unexplored.

P3-7

Banking from Scratch: How to Set up a Seed Bank for Native Hawaiian Plants

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The Hawai‘i Department of Land and Natural Resources, Division of Forestry and Wildlife (DLNR-DOFAW) manages much of the native forest across the state. In addition to more traditional plant conservation actions that DOFAW utilizes to combat threats to the native flora, we are now beginning to integrate seed banking into our operational capacity. Thanks to pioneering research by DOFAW partners, over the last decade our knowledge of the seed storage potential of native Hawaiian plants has grown dramatically, bringing this powerful technique to the fore and opening possibilities for wider use among conservation organizations. In 2012 four founding seed banks formed the Hawai‘i Seed Bank Partnership (HSBP) to share knowledge, standardize protocols, and promote science-based seed banking to preserve genetic diversity of native plant species for conservation and restoration. Through collaboration with the HSBP, DOFAW's Kaua‘i branch has developed a working seed bank in a previously forgotten storage room at their Līhu‘e baseyard over the course of approximately 2 years. We will detail exactly how this transformation occurred - grant funding, estimated start-up costs, specific equipment purchased, and trainings attended - in the hopes of providing a simple, easy to follow recipe for any individual, organization, or agency wanting to integrate this relatively simple yet powerful technology into their own operations. We aim to create a replicable model that will enable others to learn from our mistakes and successes, and make their own seed bank from scratch.

P3-8

Manu-o-Kū of Diamond Head: Breeding Behavior of an Indigenous Seabird on the Kapi‘olani Community College Campus

Paul Alexander Awo, Kristen Feato, Ka'iulani O'Brien, Katie Gipson *Kapi'olani Community College, Hawai'i, USA*

The manu-o-Kū or white fairy tern (Gygis alba) is an indigenous seabird, named the official bird of the City and County of Honolulu. The species is listed as Threatened by the State of Hawai‘i and is protected under the Migratory Bird Treaty Act. In the spring of 2014, Kapi‘olani Community College (KCC) students initiated a manu-o-Kū monitoring program on the university’s campus. Monitoring surveys were conducted between 6 and 9 a.m., several times a week in order to record tern abundance and behavior during both peak breeding and non-breeding periods. As nests were located, students continued to observe nesting behaviors from an unobtrusive location at a minimum distance of 10 m. Nesting locations were recorded and mapped using GPS. In order to communicate with the college’s Auxiliary Services, a protocol was established to notify staff of the birds’ presence. Data is continuously being used to establish a baseline monitoring program for the campus, and to identify new approaches within our research to quantify the growth of the terns as well as recognize their significance within indigenous cultures

across the Pacific. As of the fall 2016 semester, ten undergraduate students have participated in the research, most of whom are working towards undergraduate degrees in biology or natural resources. The project continues to serve as an avenue for building capacity among local students for avian monitoring and survey techniques.

P3-9

30 Years of Interns: Benefits to Participants and Endangered Wildlife at Haleakalā National Park

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The endangered wildlife program at Haleakalā National Park began in 1987. Since then, interns have been integral to the continuity of protection and monitoring of the park's populations of the endangered nēnē (Hawaiian goose) and 'ua'u (Hawaiian petrel). They assist with protecting and monitoring endangered wildlife by conducting a variety of activities: conducting predator control, searching for and monitoring birds and nests, retrieving injured birds, banding birds, controlling invasive plant species. This assistance has resulted in population increases for endangered birds, especially 'ua'u and nēnē. In addition to assisting with recovery of endangered wildlife, interns receive valuable skills in the conservation field. Many interns from this program have gone on to careers in this field.

In this poster, we present the value of interns to endangered wildlife recovery, quality of interns, the programs and process for obtaining interns, and subsequent intern career paths. The development of this 30-year internship program presents a uniquely tailored program where participants start as interns from various local and national venues, continue their work at Haleakalā as student hires while in school, and eventually find careers in the field.

P3-10

Federal Pathways Program Provides Careers in Resource Management at Haleakalā National Park

Joy Tamayose, Cathleen Natividad Bailey *Haleakala National Park, Haleakala-Maui, HI, USA*

In 2010, the President signed an Executive Order to recruit and hire students and recent graduates. The Executive Order established the Pathways Program, which provides paths to internships and careers in the Federal Government for students and recent graduates.

The Internship program is targeted towards students enrolled in a wide variety of educational institutions. It offers opportunities to work with the National Park Service and explore careers while completing their education. This program replaces the Student Career Experience Program (SCEP) and Student Temporary Employment Program

(STEP).

The Recent Graduates Program is a one year program that is targeted towards recent graduates of trade and vocational schools, community colleges, universities, and other qualifying institutions.

Several employees in the resources management program at Haleakalā National Park have successfully secured permanent or long-term positions through this program. These positions are integral to preserving and protecting Native Hawaiian cultural and natural resources at Haleakalā.

In this poster, we highlight these individuals who completed the program and share their stories and advice.

P3-11

Development of a Rodent Bait with Slug-repellent Properties

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Since 1995 the O‘ahu Army Natural Resources Program (OANRP) has been controlling rodents in O‘ahu's forests to protect native plants, invertebrates, and birds. Bait longevity and attractiveness are keys to successful rodent trapping. Our success is impeded when slugs interfere with bait intended for rodents. Slugs can consume all or a portion of the bait, make it less attractive to rodents via their slime, and large slugs can trigger the snap traps. Our goal was to determine whether food grade citric acid (5% concentration) added to bait would repel slugs while remaining attractive to rodents. We conducted several trials including: 1) a two-choice food experiment where captive slugs were offered both a test (5% citric acid added) and control bait, 2) a single-choice feeding experiment where slugs were provided only the test bait for two weeks 3) a field trial comparing the catch success of rat (Rattus sp.) and mouse (Mus musculus) snap traps set with either the test or control bait 4) a lab trial evaluating whether wild-caught house mice (M. musculus) avoided the test bait. In the lab, we found slugs significantly preferred the control bait in the two-choice feeding experiment and starved rather than consume the test bait when no alternative was given. In the field, snap trap success was unaffected by bait type. Finally, mice showed no aversion to the test bait in the lab. This indicates that the addition of citric acid can improve the longevity and attractiveness of bait thereby aiding rodent control programs.

P3-12

Community-managed “Rest Areas” and The Effectiveness on Broadcast-Spawning ‘Opihi Fishery

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TX, USA,[2]The Nature Conservancy, Makawao, HI, USA,[3]Na Mamo O Muolea, Koali, HI, USA,[4]Kipahulu Ohana, Kipahulu, HI, USA,[5]University o f Hawaii at Manoa, Honolulu, HI, USA,[6]Haleakala National Park, Kipahulu, HI, USA,[7]Hawaii Institute of Marine Biology, Kaneohe, HI, USA

The resources that organisms need to survive have been negatively affected by human activities, for example, overharvesting, habitat loss, and pollution. Several of these impacts have led to the decline of most fisheries. ‘Opihi, the Hawaiian limpet (Cellana spp.) are endemic to the Hawaiian Archipelago and are culturally, ecologically, and economically important to the Hawaiian Islands and its people, as ‘opihi is one of the most expensive shellfish in the Hawaiian Islands. The ‘opihi fishery crashed in the early 1900’s and has not yet recovered. In 2014, local communities self-imposed “rest areas” (small marine protected areas or Community-managed areas), where ‘opihi are not harvested and the populations are frequently monitored. Community-managed areas bring empowerment to the stakeholders by managing their resources in their respective areas. These rest areas will hopefully allow the ‘opihi to revert back to natural population patterns prior to harvesting. It is expected that the abundances of ‘opihi populations inside the rest areas will increase due to decrease of adult mortality. Given the increase in abundance, we also expect spillover and larval subsidy to neighboring outlying areas. Surveys at these areas have been done regularly, prior to and after the establishment of the rest areas and the data has been analyzed to determine the effectiveness the rest areas (by comparing the populations of managed zones and the neighboring unmanaged zones). This study will help with future management strategies to assist with the population rehabilitation process.

P3-13

A Community on O'ahu, a Hawaiian Monk Seal, and Toxoplasmosis

David Schofield *NOAA/NMFS/PIRO/PRD, Honolulu, HI, USA*

Community engagement is crucial to nurturing coexistence between people and monk seals, which is a key element for species conservation when monk seal and human populations meet in Hawai'i. The story of RN36 (nicknamed by the community “Uilani”) illustrates how familiarity with a charismatic animal can bring multiple members of a community together around issues surrounding wildlife conservation. This seal, born on 5/17/2013 on the ‘reef runway’ beach of the Honolulu International Airport, began, as it grew, to frequent the Ke'ehi Lagoon area adjacent to Mokauea Island. Overtime, daily experiences with this seal endeared it to a caring community and a canoe club. This seal died of toxolplasmosis infection in 11/13/2015. Following an investigation of the seal’s death, cremated remains were provided to the canoe club which performed a traditional Hawai'ian cultural ash scattering ceremony and later renamed a canoe after the seal, a tribute to the animal as well as marking a time of increased acceptance of monk seals among communities in Hawai'i. Communicating the complexities of the impact of toxoplasmosis on wildlife is a difficult concept for the public to understand until it “hits home” in a tangible example. Losing their favorite seal to toxo led to community-initiated outcry for change which lead to a partnership with NOAA to create a video for public awareness on what this seal meant to the community and the concern for toxoplasmosis in the environment.

P3-14

Abundance and breeding success of Hawaii elepaio in mesic montane forest in Hawaii Volcanoes National Park

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Invasive predators and numerous other factors have contributed to the decline of Hawaiian forest birds, but small, highly-dispersed populations have made it difficult to identify the key threats to many species. The Hawaii elepaio (HAEL; *Chasiempis sandwichensis*) is an ideal species for investigating factors that limit Hawaiian forest birds because it is locally common, maintains year-round territories, and is relatively easy to observe. We are investigating the impacts of invasive black rats (*Rattus rattus*) on the abundance, survival, and reproductive success of HAEL on treatment plots, where rats are being removed (as of January 2017), and on nearby non-treatment plots within montane mesic forests in Hawaii Volcanoes National Park. During 2015–2016, HAEL density was 2.3 birds/ha on two 49-ha (700x700 m) plots (treatment and non-treatment) at low (1360 m) elevation and 5.0 birds/ha on two plots at high (1670 m) elevation. Across all four plots, 124 active HAEL nests were monitored 2–4 times per week with 46 (37%) of the nests producing fledglings. Of 78 nests that failed, 50 (64%) failed during the egg stage and 28 (36%) failed during the nestling stage; 46 of 63 (73%) nests failed at low elevation and 32 of 61 (52%) nests failed at high elevation. Video cameras documented nest predation by rats on our plots, but the frequency of predation is unknown. As rats are removed from the treatment plot at each elevation in 2017, we will better assess the impact of predation on HAEL.

P3-15

A Bottom-up Approach to Biosecurity on Kauaʻi: the Pono Endorsement Program Partnership

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Prevention and early detection of high-risk invasive species are key strategies for effective biosecurity. While many introduced plants have little impact on agriculture or native biodiversity, some become aggressive invaders and the horticultural industry is a well-known vector of plant introductions on Kauaʻi. We present Kauaʻi's Pono Endorsement Program, developed by Kauaʻi Invasive Species Committee in collaboration with Plant Pono, a project of the Coordinating Group of Alien Plant Species. This program was implemented in 2016 and is a voluntary partnership between individual businesses within the horticulture industry and invasive species management agencies. This community-level process fills biosecurity gaps on Kauaʻi by 1) requiring

businesses to screen new plant species using the Hawaii Pacific Weed Risk Assessment before importing, 2) ceasing or phasing out the sale of certain invasive plants, 3) requiring businesses to mitigate the spread of pests by adopting Best Management Practices (BMPs) and 4), educating consumers about responsible landscaping. We outline innovative solutions for successful collaboration with private industry, including customizing BMPs for each business and receiving industry feedback before establishing no-sell lists. We emphasize the need to inventory plants currently in the nursery industry and discuss the benefits and costs of a soft approach to curbing human-caused invasive species transport. This program provides a first step toward current state-wide biosecurity goals by developing resources that help for-profit businesses implement "pono" protocols and promoting collaboration among government agencies, university experts, conservation partners and the horticulture industry on Kaua‘i.

P3-16

Prioritizing Management Strategies to Alleviate Avian Botulism Impacts on Endangered Hawaiian Waterbirds on Hanalei National Wildlife Refuge (NWR), Kaua‘i, Hawai‘i

Tristan Luxner, Kimberly Uyehara, Bryn Webber, Daniel Dewey *Kaua'i National Wildlife Refuge Complex, Kilauea, HI, USA*

Avian Botulism C (*Clostridium botulinum)* is a paralytic disease transmitted via the ingestion of a bacterium-produced neurotoxin. Although spores are widely distributed, outbreaks occur when bacteria replicate and produce a deadly toxin. Conditions favorable for outbreaks include warm temperatures, protein sources, and an anaerobic environment. This disease is responsible for millions of bird mortalities worldwide, and the magnitude to which outbreaks threaten isolated island populations is not fully understood. Hanalei NWR hosts breeding populations of five federally-endangered Hawaiian waterbird species and provides wintering habitat for migratory waterbirds. Over 1,200 birds have been killed or sickened by the disease since 2011, 89% are endangered. An Avian Botulism Task Force Meeting was held at the Refuge in 2014 with the purpose of bringing experts from within and outside of the U.S. Fish and Wildlife Service together in collaboration to (1) gain a better understanding of specific triggers for avian botulism and (2) prioritize strategies and tools to detect, respond to, and prevent disease outbreaks. The panel of experts identified the following priorities: improve water infrastructure, monitor water flow and quality, develop toxin detection kits, conduct pilot study using detector dogs, collect comprehensive environmental data, and test new taro (*Colocasia esculenta*) nutrient and water management farming practices. This work provides a two-year status update of these priorities and how improved methods may reduce future risk of outbreaks. We emphasize that long-term support is imperative for implementing research and management strategies, particularly in light of climate change.

P3-17

Prescriptions for Novel Rodent Control Devices to Protect High Elevation

Endangered Species from Non-native Rats at Hawaii Volcanoes National Park

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Invasive species, including rats, threaten the existence of many of Hawaii's native species pushing them to the brink of extinction. Hawaii Volcanoes National Park has a long history of successfully managing ecosystems and providing rare species habitat through systematic invasive species control. Landscape level rat control is prohibitively expensive; however, localized control has proven cost effective while providing significant resource benefit. A trapping program using self-resetting Goodnature A24 technology was implemented at two remote sites in Hawaii Volcanoes National Park in an effort to protect five endangered plant species and three endangered bird species from black rat (Rattus rattus) predation. This trapping method has been successfully implemented on other islands, but implementation requirements are site specific. Techniques and maintenance schedules were developed for subalpine dry shrubland environments and also high elevation wet forest environments. Trap performance, recommended grid spacing, and new chocolate long-life lure formula were evaluated over the course of this investigation. Rodent control trends and subsequent native species responses were captured over the course of four months by conducting biweekly trap visits and analyzing motion triggered camera footage. Clear declines in rodent activity was documented at each site. Trapping activity appeared to prevent major damage to flowers and fruit of endangered Campanulaceae species at the forested site, however it is unclear what effect trapping efforts had on native bird species at the subalpine shrubland site.

P3-18

Acoustic Variability of a Native Hawaiian Thrush in a Fragmented Landscape

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Acoustic behavior used for communication is important to understand because it transmits different types of information such as mate attraction and species recognition. In oscines, songs are culturally learned and passed down, and when individuals disperse they can spread their song culture to other populations. Fragmented habitats may alter natural patterns of cultural transmission because the matrix surrounding the fragments can discourage dispersal of birds, thus affecting the transmission of songs. This can result in different fragments having different songs that may create reproductive barriers and speciation through female choice because females prefer mates whose songs they recognize. Naturally occurring habitat fragments, called kīpuka, are islands of forest created by lava that flowed through

a continuous forest leaving isolated forest patches of varying sizes. We hypothesized that the size and degree of isolation of these patches can affect different aspects of bird populations, including their acoustic behavior. We characterized the acoustic diversity of the `ōma`o in different kīpuka and we studied how fragmentation can affect the transmission and diversity of songs. The `ōma`o (*Myadestes obscures*) is a native Hawaiian thrush found only on Hawai`i Island and little is known about their vocalizations. We found that larger kīpuka had a greater acoustic variability than smaller kīpuka and as distance increased between the kīpuka there was a decrease in shared songs. The results indicated that fragmentation is likely influencing acoustic communications in the `ōma`o and we can use this information to further understand how fragmentation can affect speciation and bird movement patterns.

P3-19

Population Dynamics of Feral Pigs in a Lowland Wet Forest - Wainiha Preserve, Kauai

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The negative effects of non-native ungulates on Hawaiian ecosystems are well documented resulting in the desire to exclude them from native forests. Meanwhile, the pigs' status as both game mammal and pest species requires scientific data on their biology in order to inform management. The Nature Conservancy's Wainiha Preserve contains a Hawaiian lowland wet forest, intermixed with non-native vegetation along the stream corridor and through much of its lower reaches. Beginning in February of 2014, The Nature Conservancy removed 145 feral pigs, over a three-year period and as of the beginning of 2017, only one pig remained. Game cameras were set up throughout the preserve to aid in monitoring the eradication process, and every pig removed was aged using a tooth eruption schedule. Due to steep cliffs over much of the landscape, we developed a novel approach to calculating population density by defining suitable habitat using GIS methods. We back-calculated the population (*p*) to come up with a minimum *p* of 84 pigs in Feb 2014 and a population density (*pd*) of 85.71 pigs/sq. miles, occupying only 627 acres (0.98 sq. mi.) within a 3500 acre preserve. The annual recruitment rate (*rr*) was analyzed, suggesting that *rr* increased as *p* decreased. When *pd* was highest, *rr* = 40%, but rose to upwards of 150% before declining as *pd* got very low. From game camera data, we calculated *p* (using a mark-recapture method), average litter sizes, and home ranges. Birthing occurred year round and we observed no pronounced season.

P3-20

Predator control and monitoring during Year 1 of the `Alalā reintroduction in Pu'u Maka'ala Natural Area Reserve

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Non-native predatory mammals can limit the success of reintroduction attempts for captive-raised endangered species through predation and the transmission of diseases. Hawaiian birds evolved in the absence of predatory mammals; as a consequence of being removed from the wild for generations, captive-raised ʻAlalā (*Corvus hawaiiensis*), may have lost any naturally acquired vigilance of predators. The predatory mammals present in Pu`u Maka`ala NAR include rats (*Rattus rattus*, *R. norvegicus*, and *R. exulans*), small Indian mongooses (*Herpestes auropunctatus*), and feral cats (*Felis catus*). Baseline monitoring commenced in August, 2016; rodents and mongooses were monitored using tracking tunnels with ink cards, and cats were monitored using trail cameras. Predator control of the three predatory mammals included conibear traps, live traps, and self-resetting Goodnature A24 traps. To date, 79 rats, 5 mice, 43 mongooses, and 8 cats have been removed from the ʻAlalā release area. Monitoring of rodents showed a 62% decrease (71% to 27%) in rat tracks, and a 53% decrease (19% to 9%) in mouse tracks in the treatment area since the baseline was conducted. Conibear traps were the least effective of all traps for catching mongooses and cats. While captures of cats in live traps has been steady, captures of rodents and mongooses appears to be declining, however, it is too early to know whether this is due to trapping pressure or related to seasonal fluctuations in population. Future directions for our program include consultation with an external Advisory Council, expansion of live trapping, and exploration of bait and trap types.

POSTER GROUP 4

P4-1

Habitat Features that Influence Nest Success and Depredation of Endangered ʻAlae ʻUla Nests on Hanalei and Hulēʻia National Wildlife Refuges

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Hanalei and Hulēʻia National Wildlife Refuges (NWRs) on the island of Kauaʻi in Hawaiʻi are designated as core wetland areas essential to the recovery of five endangered Hawaiian waterbird species. These two sites support approximately 50% of the ʻAlae ʻula (Hawaiian Common Gallinule, *Gallinula galeata sandvicensis*) population statewide. On Hanalei NWR, taro (*Colocasia esculenta*) farming provides dense emergent aquatic vegetation needed for breeding gallinules, but previous research suggests that dikes, water drawdowns, and harvested fields may increase access by introduced mammalian predators. Although these studies documented egg depredations, researchers were unable to determine nest fates for 25% of the nests using observer-based methods. In this pilot study, we evaluated the use of remote motion detection cameras to determine gallinule nest fates and elucidated factors related to depredation events through the early brooding phase. We predicted that taro farming practices influence depredation by invasive vertebrates (e.g., feral cats [*Felis catus*], rats [*Rattus* spp.]) and negatively affect gallinule nest success in taro fields, when compared to managed wetland units that have fewer dikes, suitable vegetative cover, and stable water levels. Higher gallinule nest success in managed wetland units, coupled with reliable data regarding drawdowns and depredation of nests in taro fields, would allow managers to implement more specific management and monitoring methods to control and reduce access of invasive vertebrates that prey on endangered gallinule nests in these critically-important wetland,

riverine, and agricultural landscapes.

P4-2

Temporal Variation in the Fish Community of He‘eia Stream Mouth Estuary, Oahu, Hawai‘i

Spencer Mallette, Susan Carstenn *Hawai‘i Pacific University, Honolulu, HI, USA*

Stream mouth estuaries (SMEs) are known as nursery grounds for native Hawaiian fishes, yet few studies have investigated the temporal variance in the fish communities of these ecosystems. In Hawai‘i, SME physico-chemical properties fluctuate seasonally, which can result in changing community composition. This study investigates the change in abundance and life stages of the most common fish species in He‘eia SME. He‘eia SME, emptying into Kane‘ohe Bay, was sampled biweekly from November 2015 to September 2016 to encompass equal sampling events across the wet and dry seasons. Fish community data and abiotic factors were analyzed simultaneously using multivariate statistical methods to determine community temporal differences between seasons and across the sampling period.

Of 16 total species caught, the most abundant were two mullet species, the native *Mugil cephalus* (193 individuals) and non-native *Valamugil engeli* (132 individuals). Over 99% of these two mullet were juveniles, as were all other individuals for other common species with reported L50 maturity values. Non-metric multidimensional scaling analysis of community data showed *M. cephalus* is more abundant in shallower, higher salinity, and higher temperature waters, and *V. engeli* are more abundant in opposite conditions. Considering this, *M. cephalus* juveniles are more common during the wet season and *V. engeli* juveniles during the dry, this suggests times when management can target protecting native species and start removal programs for non-natives. Future research should address temporal changes in the fish communities of other Hawaiian SMEs to further support that these systems benefit native species as nursery habitat.

P4-3

Recent Red Listing efforts in Hawai‘i and why it matters

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Since 2015, conservation professionals in Hawai‘i have worked together in an unprecedented collaboration to target native Hawaiian plants for the IUCN Red List of Threatened Species (Red List). The Red List is the most comprehensive source of information on species’ extinction risk at the global level, based on the best available scientific knowledge. Unlike the Endangered Species Act, which is legally binding

legislation restricted to the United States, the Red List defines a plant's conservation status but does not prescribe specific actions to be taken to save it. The list can guide species management and relevant legislation, direct scientific research, and generate public awareness of the growing biodiversity crisis and its impact on human well-being. A large number of plant taxa that were initially targeted for the Red List are rare, but some common species that are important as part of wildlife habitat or are seriously threatened by disease were focused on as well. As of January 2017, the total number of Hawaiian plant taxa on the Red List is 494. This recent effort has increased the number of listed taxa by about one-third. The IUCN and The Nature Conservancy have produced a free online training course to learn how to assess species for the Red List. It is our hope that this work, along with the recent IUCN World Conservation Congress held in Hawai'i, will inspire more Red Listing of Hawai'i's unique native organisms.

P4-4

Comparing a Model Scenario to the Spread of Miconia on O'ahu

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Miconia's (*Miconia calvescens*) ability to form monotypic stands and outcompete native plants makes it a serious threat to biodiversity, forest structure, and watershed function. In 2009, we created a spatial model to illustrate the potential spread of miconia and incorporated variables such as rainfall, reproductive age, dispersal distance, and a very conservative ratio of progeny reaching maturity. Initially, we explored the spread of miconia if systematic control efforts had stopped and ran the model over a 10-year period. Recently, we compared the model's results (years five-seven) with our most recent round of miconia surveys (2014-2016). The model predicted between 2,864 and 15,108 mature miconia with all miconia covering 1,191 to 3,427 hectares in 29 to 38 watersheds. Field data for 2014-2016 reported 29 mature miconia with all miconia covering 54 ha in 13 watersheds. Our results show field data with at least 99% fewer mature miconia, 95% fewer ha, and 55% fewer watersheds infested with miconia compared to the model's results. Although we continue to find mature miconia on O'ahu, the comparison of field data to conservative spatial model results illustrates the progress made through our systematic control efforts as opposed to no management action occurring during the past seven years.

P4-6

A Novel Methodology for Mapping Invasive Species Albizia (*Falcataria moluccana*) Using High Spatial Resolution Satellite Imagery

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Albizia (Falcataria moluccana) is one of the fastest growing trees in the world. In Hawaii, Albizia has become naturalized in many wet lowland areas where it spreads rapidly due

to large numbers of wind-blown seeds. In order to release the damage of Albizia tree, detection and mapping the spatial distribution of Albizia trees in Hawaii is crucial. Remote sensing has been used for decades to measure and map the biophysical characteristics of vegetation. The recently launched WorldView-2 satellite is able to provide eight multi-spectral bands with a 2-m spatial resolution. The conventional methods for classifying high resolution images suffer from spectral similarity between classes and large variability within classes. In this study, we proposed a novel classification methodology by using the state of the art machine learning algorithms and by combining image features from both spectral and spatial domains. We tested this method in the Manoa Watershed along a coast-to-mountain gradient that is characterized by a large variety of tree species. The results showed that the accuracy of our classification methodology is substantially higher than the conventional pixel-based maximum likelihood classifier. This methodology will be extended to map Albizia for the whole state of Hawaii.

P4-7

Investigating abundance and behavior of black rats (*Rattus rattus*) prior to rodenticide treatment in mesic montane Hawaiian forest

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Black rats (Rattus rattus) have impacted native Hawaiian ecosystems since their arrival in the islands in the late 1800's. As part of an effort to quantify their effects on native forest birds within montane mesic forest in Hawaii Volcanoes National Park, we assessed rat abundance and behavior before removing them from treatment plots, starting in January 2017. We evaluated rat density during fall 2015 and 2016 and spring 2016 within central 9-ha portions of paired 49-ha plots at low (1360 m) and high (1670 m) elevations. Using capture-recapture techniques (636 ear-tagged rats), we estimated rat density at about 6 rats/ha at both elevations overall, with a high of 6.9 rats/ha during fall 2015 and a low of 4.8 rats/ha during fall 2016. Passive detection of rat activity using tracking tunnels and chew blocks showed rats to be utilizing all of the study area. Radio transmitters placed on 48 individuals allowed us to locate den sites and observe nocturnal behavior using night vision technology. Rats were active throughout the night and foraged most often in trees (63% of all observations). Territory size was 0.46 ha for males (n=3) and 0.17 ha for females (n=3). Infra-red cameras recorded predation at bird nests by rats, and removing rats using toxicants, which began in January 2017, will allow us to compare bird productivity in treatment and non-treatment plots.

P4-8

Evaluating Population Viability and Conservation Options for the Endangered Puaiohi

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Evolution in the Hawaiian Islands has produced a unique assemblage of forest birds, many of which are endangered or extinct. While great effort has focused on saving endemic birds, we lack basic science necessary for understanding many of them, including the endangered puaiohi (Myadestes palmeri). Given the puaiohi's population size (~500 birds) and restricted range in the Alakaʻi Wilderness Preserve on Kauaʻi, understanding conditions that affect its population dynamics is essential. Our goal was to investigate which management activities might aid species recovery and provide the most cost-effective management strategy. Based on currently planned or proposed interventions for the puaiohi, we constructed stochastic population models and estimated financial costs for proposed management activities over 25 years. Management scenarios included rat management, habitat restoration, supplemental feeding, provision of nest boxes, and translocation to another island. Female and juvenile survival most influenced puaiohi population viability, and rat control, even at conservative levels, was the most effective method of increasing puaiohi abundance. While translocation offers hope of increasing puaiohi population and decreasing extinction risk, success depends on the conditions established at the release site. Total management costs ranged from $378,701 to $245,213,905, with translocation being one of the most cost-effective means of managing puaiohi and supplemental feeding the least. Cost-efficiency of rat control varied based on scale and method, and restoration of habitat was moderately cost-effective. Findings indicate that management activities can increase puaiohi and bring it back from the brink of extinction, serving as a model for other endangered species conservation efforts.

P4-9

Depth is more potent at structuring reef crab assemblages than latitude, geography, or human impact across the Hawaiian Archipelago

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Shallow coral reefs are extensively studied, and although scleractinian corals have been recorded to 165 m, little is known about other mesophotic coral reef ecosystem (MCE) inhabitants. Brachyuran crabs fill many ecological and trophic niches on reefs, making them ideal candidates for evaluating species composition among depths. Here we ask if MCEs host the same communities as the shallower reefs spread across the entire 2400 km Hawaiian Archipelago. We deployed Autonomous Reef Monitoring Structures (ARMS) for two years among shallow sites (12 m) across the latitudinal gradient of the Hawaiian Archipelago to compare directly with a depth gradient (12, 30, 60, and 90 m) south of Oʻahu island. Over 650 brachyuran crabs representing 130 morphospecies (21 families) were found. Community composition was not significantly different among shallow sites spread across the archipelago, but was significantly different and highly stratified across the depth gradient. We show that 90 m of depth is a more potent determinant of brachyuran community composition than the latitudinal, geographic (high

vs low islands), or anthropogenic impact (human population size) gradient across the archipelago. Deeper reefs host significantly different brachyuran communities than shallow ones in Hawai'i, and only 3 of 130 morphospecies (~4%) occurring across the entire depth range (mesophotic to shallow) sampled. Further research on the cryptic reef-dwelling fauna is needed for identifying areas of unique biodiversity, as well as boundaries between depth- stratified reef ecosystems.

P4-10

Ulu Lā'au Kahiko. Natural Regeneration of Ancient Natives. A new chapter of rare dryland plant regeneration at Ka'ūpūlehu dryland forest.

Yvonne Yarber Carter[1,5], Tamara Ticktin[2], Wilds Pihanui Brawner[3,5], Reko Libby[2], Lehua Alapai[1,5], Kuulei Keakealani[1,5], Keoki Apokolani Carter[1], Alexandra Moore[4], Natalie Kurashima[5] *[1]Hawaii Forest Institute, Hawaii, USA, [2]University of Hawaii, Manoa, Hawaii, USA, [3]HFIA, Hawaii, USA, [4]Cornell University, New York, USA, [5]Kamehameha Schools, Hawaii, USA*

Ulu Lā'au Kahiko. Natural Regeneration of Ancient Natives. A new chapter unfolds in the homelands of Ka'ūpūlehu dryland forest in the Kekaha lands of North Kona, Hawai'i island. Intensive collaborative management, monitoring and climate change mitigation with the forest is teaching us new restoration possibilities for natural regeneration strategies. This poster is a graphic representation of some hopeful results of rare plant natural regeneration from 15 years of community engagement evolution and environmental stewardship. A marriage of TEK, restoration science, education and community offers an adaptive approach to revitalizing this rare ecosystem.

Collaborative monitoring and natural regeneration counts of rare plant regeneration at Ka'ūpūlehu dryland forest between 2008 and 2016 provides survival rates among species that include; Uhiuhi, Kauila, Ma'o hau hele, Halapepe, Aupaka, Ma'aloa, and Bonamia. This poster tells a new story of resilience among certain species within intensively managed areas where many hands have helped to steward this rare ecosystem. Several participants in this ongoing work will be present to share multiple perspectives and these new findings.

P4-11

Does 'A'ā Lava Field Roughness Affect Outplant Growth in the Keaukaha Military Reservation on Hawai'i Island?

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Roughness can be described as the variation in elevation range from one cm to as much as a meter. Surface roughness has been found to affect plant communities in a variety of ways including accelerating ecological succession, improving conditions for plant germination and improving plant diversity. The objective of this study was to determine if 'a'ā lava field roughness had any affect on plant growth rates within the Keaukaha Military Reservation on Hawai'i Island. The project consisted of developing Structure-

from-Motion models to create a high resolution bare earth digital elevation model, which would then be analyzed to determine roughness values for the sampled forest restoration plots. Those values were then compared to multiple outplant and plot characteristics, within a data set collected by the Liko Nā Pilina project investigators, to determine if roughness had any significant relationships with said characteristics. There was no significant relationship found between roughness and outplant growth. However, it was observed that there was a significant positive relationship found between roughness and both seedling density and the basal area of plants in the height class of 5-10m within each plot. A negative relationship between roughness and canopy openness was also observed This study suggests that it would be more advantageous for restoration efforts, in a lowland wet forest on an ʻaʻā lava flow, to take place on areas that are higher in roughness. This study also implies that using this information would make restoration efforts more targeted and thus increase both feasibility and opportunity for success.

P4-12

Albizia Rust Gall Fungus - the First Potential Biocontrol Agent for Albizia in Hawai'i

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During recent surveys for potential biological control agents for albizia (*Falcataria moluccana* [Fabaceae]) an extremely damaging disease was identified from trees in Indonesia. The albizia rust gall fungus from the genus *Uromycladium* has spread across the commercial albizia plantations of Indonesia, Malaysia and the Philippines causing economically significant damage to timber production. This fungus causes growing tissues of albizia trees to form large twisted knots which can lead to the death of trees of all ages. The primary isolate from albizia is a newly recognized species, *U. falcatarium*, which a recent publication suggests is specific to only *F. moluccana*. Researchers at Universitas Gadjah Mada and the US Forest Service conducted a series of experiments with this fungus on both Indonesian and Hawaiian albizia populations, and a suite of Fabaceae species from Hawai'i. Plants were exposed to fungal spores under laboratory, greenhouse and natural field conditions. Although several non-target test plants showed signs of initial spore germination in the laboratory there was no signs of infection or disease progression in plants other than the target *F. moluccana*. Galls and spores were only formed on the target plants in deliberately inoculated pathogen greenhouse conditions. Field tests are still ongoing but have not shown any signs of non-target impact. The results of these experiments suggest that this or other isolates of *U. falcatarium* may be suitable candidates for further research as potential biological control agents. We also discuss how our study can help address concerns about the biosecurity threats posed by *Uromycladium* species.

P4-13

Invasive Pine Management and Target Detection using Satellite Remote Sensing at Haleakalā National Park, Maui, Hawaiʻi

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Haleakalā National Park is home to shrubland and subalpine ecosystems that are critical habitat for many endangered Hawaiian plants and animals. In recent decades, invasive pine trees have threatened to outcompete and displace native vegetation within the park. Nearby pine forests and recent fires have resulted in a continual influx of pine seeds across the park and much of East Maui. Ongoing ground-based sweeps and aerial herbicide spot treatments on inaccessible slopes in the crater are vital to prevent competitive exclusion of essential native habitat. Due to the remoteness of the park, early detection ability is an important tool for setting management priorities. Traditional field and airborne reconnaissance methods often lack the ability to comprehensively detect remote incipient populations or are too expensive to use frequently. To improve detection capability, we examined the utility of WorldView-3 multispectral and pansharpened satellite images and software land cover classifiers to map pines across East Maui. This process relies on the ability to spectrally differentiate pines from surrounding vegetation types. We compared two years of study imagery to assess the presence of pine trees within conservation areas and to monitor ground and aerial control through mortality detection. Post-classification accuracy assessment has verified an 80% agreement between process derived pine detection points and validation ground surveys. The results of this project provide a basis for the addition of a remote sensing component to invasive species management at Haleakalā National Park and will assist with management prioritization and post-control monitoring.

P4-14

Defense Against Invasive Species: Biosecurity in Papahānaumokuākea

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Papahānaumokuākea Marine National Monument is home to unique marine and terrestrial environments. One of the greatest threats to the Monument's ecosystems is the introduction of invasive species. Here we will discuss the implementation of biosecurity protocols and their results using examples of past and current invasive species presence in the Monument. Preventative biosecurity protocols were enacted in the 1990s to protect against continued establishment of invasive species. Invasive rodent species are a major concern, having caused the extirpation and extinction of multiple seabird populations worldwide. The black rat was introduced to Midway Atoll in 1943. After active invasive species management, it was eradicated throughout the Northwest Hawaiian Islands. Their reestablishment has been successfully prevented by the institution of strict biosecurity protocols, such as mandatory rat-free certification required for all vessels entering protected waters, allowing seabird populations such as the Bonin petrel, to bounce back from near decimation. Invasive plants are also a concern within the Monument. Since the institution of biosecurity protocols, coupled with active invasive species removal, numbers of non-native plants at Laysan Island have

declined from a peak of 14 species present in 2001 to 11 in 2014 despite the annual visits of scientists, managers, and the large volume of materials they bring to operate remote field camps. With the continued implementation and execution of these preventative biosecurity protocols, as well as ongoing invasive species management, the unique ecosystems harbored within the Monument will be protected and preserved for future generations.

P4-15

Groundwater Recharge from Kaua‘i Watershed Alliance Managed Forests

Stephanie Tom *The Nature Conservancy, Honolulu, Hawai‘i, USA*

Are you interested in how much groundwater recharge is occurring in a specific conservation area? See this example analysis of Kauai Watershed Alliance management units' contribution to groundwater recharge of the island's aquifer based on the water budget components GIS layer from the 2016 USGS Volcanic Aquifers of Hawai‘i Report. Fog drip and runoff can be roughly quantified using the same dataset. To save you time, Steph Tom shares her GIS analysis geoprocessing method and key equation.

P4-16

Transforming Middle School Science Education: Investigating Culturally Responsive Teaching Through Place Based Education

KEKAHA SPENCER, BRIGITTE RUSSO, MARGARITA ALO-CHU *UNIVERSITY OF HAWAII College of Education, Honolulu, HI, USA*

A study that implemented culturally relevant pedagogy effectively increased student academic achievement and engagement. In this study, two Hawai’i public school science teachers, and a science instructional coach created culturally-relevant opportunities for student engagement and leadership in curriculum-aligned community stewardship experiences. By partnering with various organizations focused on environmental conservation, teachers organized diverse stewardship experiences for middle school students to develop deeper understanding of ecosystem pressures and the skills necessary to become conservation leaders. These included place-based site visits and hands-on activities right in our Wai’anae community. This study incorporated Native Hawaiian values of aloha ‘āina and Mālama Honua within the curriculum and cultivated broad awareness and concern for local conservation. Student interest in natural resource management careers and community stewardship increased, as well as their leadership skills, socio-emotional learning and academic achievement. Through this study we see teachers fostering partnerships to build a conservation community and conservation leaders.

AFFILIATED WORKSHOPS & TRAININGS

Basics of R for Conservation

Kevin Brinck *University of Hawaii at Hilo, Hilo, Hawaii, USA*

The R data analysis environment allows for the standardized and reproducible organization, display, and analysis of data. It has many advantages: it is available free of cost, runs on most computer systems, and is therefore a common platform that can be used to exchange data and methods worldwide. R is the leading tool for data analysis today.

It can also seem opaque to beginners, which can prevent people from making use of this powerful and widespread tool. This day-long training session will introduce participants into the basics of using R for data analysis. We will cover how to get data into the R environment and how to find the tools and packages appropriate for your specific data questions. We'll learn how to organize datasets using intuitive tools such as the 'dplyr' package. From there we will learn how to easily create publication-quality graphics and perform analyses such as linear regression and ANOVA. The end goal is that participants will come out of this training with the tools and confidence to begin using R for their own conservation projects.

Developing an Ocean Health Index for Hawai‘i

Eva Schemmel *Conservation International, Hawaii, USA*

The health and sustainability of Hawai‘i's communities relies on the health of our ocean. However, a comprehensive assessment of our ocean resources has never been done and is needed to better understand our current ocean resources and assess management trade-offs. The Ocean Health Index (www.oceanhealthindex.org) is a global tool that was developed to meet this need by providing a comprehensive assessment tool to better understand the benefits that our oceans provide people now and into the future. An Ocean Health Index for Hawai‘i is being adapted from a global to local context by integrating community values, local data sets, management actions, and ecosystem indicators (www.ohi-science.org/mhi). The Hawai‘i Ocean Health Index is comprised of ten locally defined goals: Food Provision, Artisanal Fishing Opportunities, Biodiversity, Coastal Protection, Livelihoods & Economies, Sense of Place, Clean Water, Sustainable Tourism, Recreation, and Natural Products. At this workshop we will present our progress on the Hawai‘i Ocean Health Index and seek input to make this tool as informative and useful as possible for Hawai‘i. We envision this tool to support our local communities, managers, and policy makers to better and more holistically understand, track, and communicate the status of our oceans.

An Introduction to Hawai'i Project Learning Tree; Empowering Educators, Inspiring youth

Makana Kaha'ulelio *DLNR-DOFAW Project Learning Tree, Honolulu, HI, USA*

Project Learning Tree is committed to creating a future where the next generation values the natural world and has the knowledge and skills necessary to make informed decisions and take responsible actions to sustain forests and the broader environment. Formal and nonformal educators, park and place-based interpreters, naturalists and youth program leaders who attend this training will learn to incorporate fun science-based, interdisciplinary lessons and hands-on activities into their environmental education practice. This interactive session will focus on invasive species with adaptations to specifically address current concerns in Hawaii.

Tools for Wildland Fire Risk Assessment and Mitigation on Pacific Islands.

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The proportion of land area affected by wildland fire in Hawaii and other Pacific Islands such as Yap, Guam, and Palau in many years greatly exceeds that of states in the Western US. The impacts of fire are particularly acute on islands given the proximity of communities, watersheds, and nearshore resources. This workshop, co-developed by the Pacific Fire Exchange (www.PacificFireExchange.org) and the Hawaii Wildfire Management Organization (www.HawaiiWildfire.org), will help participants understand the social and environmental factors that drive fire risk as well as the resources and strategies available to asess and mitigate fire risk and fire impacts. Workshop participants will learn how climate, vegetation, and human activities create hazardous conditions and how existing information and strategies such as fire weather forecasts, public outreach efforts, pre-fire planning and fuels management, and post-fire response can inform their management and conservation efforts. After this intrdocution, participants will learn how to apply and integrate fire-related resources and information through a problem-based learning exercise to develop pre- and/or post-fire planning strategies at the landscape scale using participatory mapping and GIS. This exercise will integrate case studies either brought by workshop participants or drawn from the organizers' extensive work on wildland fire issues in Hawaii. The training will conclude with a facilitated discussion among participants about knowledge gaps, further training needs, and future partnerships. The workshop will ultimately illustrate the importance of local knowledge in fire planning efforts and the learning outcomes will be relevant for planners, educators, and both marine and terrestrial resources management programs.

'Opihi Partnership: Charting a course for abundant 'opihi across the Hawaiian Islands

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The objective of the workshop is to share what's being learned and to chart a course forward to achieve effective management and abundant ‘opihi across the Hawaiian Islands. The workshop, convened by the ‘Opihi Partnership, provides a forum for the many community groups, researchers, NGOs, and government agencies working across Hawaii to share about their work. Through this conversation, participants can learn how, together, we can continue to build community capacity, use place based management practices, and inform management decision-making. This workshop is designed for organizations, Individuals, and agencies who have, are, or would like to conduct ‘opihi research or management activities.

- Community members and groups actively engaged in intertidal monitoring - Universities & Scientists actively engaged in intertidal monitoring - Managers engaged in intertidal monitoring Others interested in engaging in intertidal monitoring (new partners)

In order to sustainably harvest from Hawaii's rocky shorelines and prevent the complete removal of ‘opihi, a group with one common interest - reversing the decline of Hawaii's intertidal resources while promoting sustainable harvest met in Hana, Maui in 2008 to discuss their common concerns. That meeting birthed the ‘Opihi Partnership which has grown into an successful collaboration between Hawaiian practitioners, community organizations, university scientists & students, NGO's, and government agencies. The partnership embraces both scientific and traditional Hawaiian knowledge and supports Hawaiian community groups and managers in monitoring their shorelines and effecting positive change in their marine resources.

Integrated Intertidal Monitoring Training

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Hawai‘i's intertidal ecosystems are faced with many threats from climate change and human use and impacts. To develop effective resource management strategies, we need to build a holistic knowledge base of our intertidal communities including invertebrates such as ‘opihi and hā‘uke‘uke, and limu (algae) and how these communities change over time. This effort stems from the collaborative ‘Opihi Partnership and has grown into on-going community-based monitoring throughout Hawai'i. This training will introduce methods for examining intertidal communities and seasonal spawning. Particular emphasis will be given to the incorporation of traditional knowledge systems as a foundation for this work. We welcome participants who are interested in learning about and applying these tools, especially community groups. Methods we will cover are Huli'ia (describe/define), comprehensive intertidal transects, rapid ‘opihi counts, and gonad dissections of hā‘uke‘uke. Participants will need to sign a volunteer waiver and be prepared for working on the shoreline in the wave impact zone. Felt-bottom tabis, protective sun gear (rashguards, hats, etc.), and water are required.