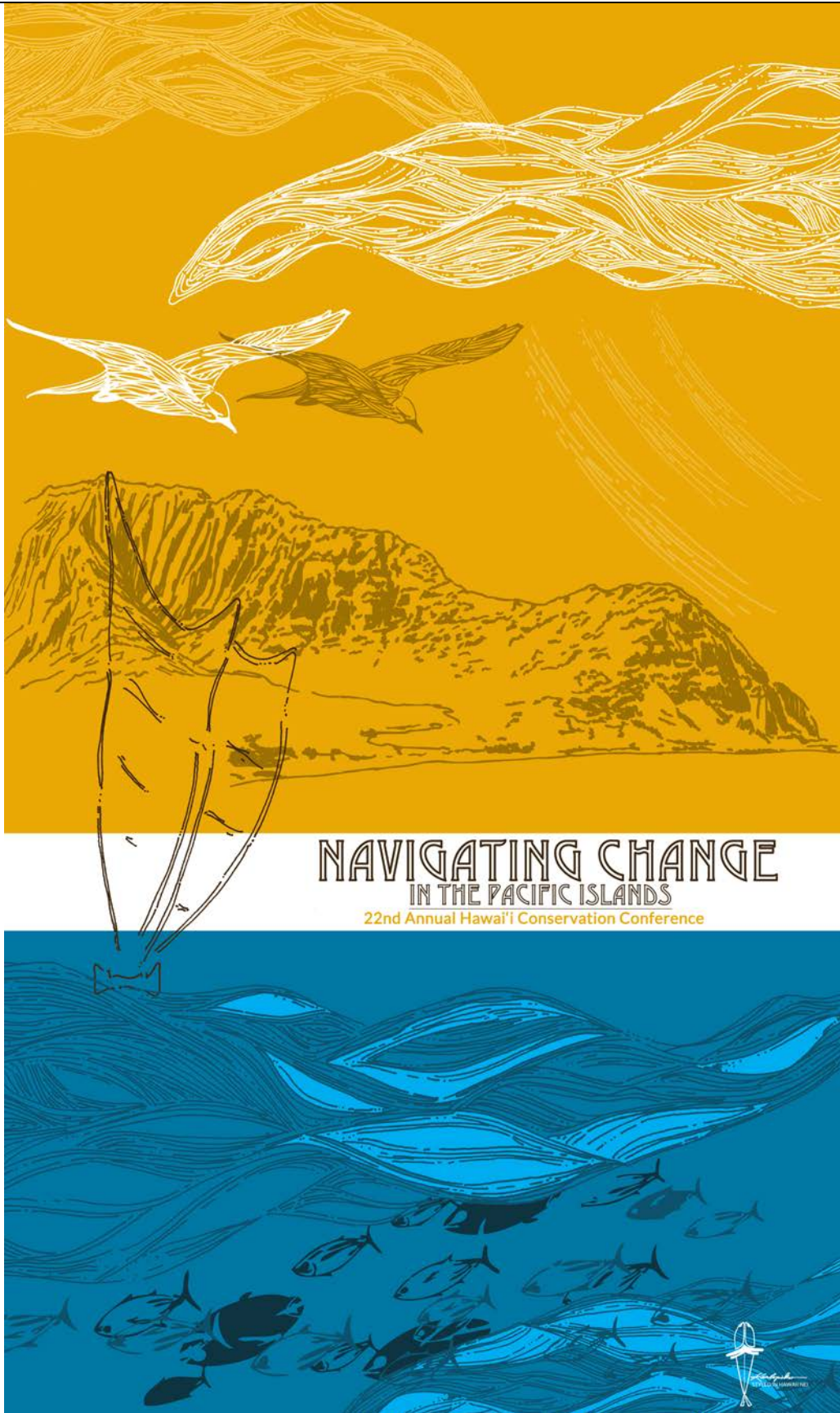


2014 Hawai'i Conservation Conference

ABSTRACTS



Hawai'i Conservation Alliance Foundation

2014 Hawai‘i Conservation Conference

ABSTRACTS

Navigating Change in the Pacific Islands

July 15 - 17, 2014

Hawai‘i Convention Center, Honolulu, HI

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1-1 Nā 'Āina Ho'oilina Exploring the Relationship Between the Ali'i Trusts of Hawai'i and the Lands Managed to Support their Missions

Neil Hannahs^{1,2}, LeAnne Crabbe³, Eric Martinson², Jobie Masagatani⁴

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Prior to the Mahele of 1848, 'āina had been held in trust by the ali'i for the welfare of the kanaka, who in turn provided for the ali'i by cultivating the 'āina. The ali'i ruled at the will of the kanaka, and with the guidance of the ali'i, the kanaka nurtured and respected the 'āina. The transition to a private system of land tenure was one of many significant changes experienced by native Hawaiians after foreign contact. The additional introduction of diseases and new religious and economic systems altered Hawaiian society forever. Many ali'i, granted large holdings of land during the Mahele, witnessed this decline and dedicated their holdings in trust to meet the health, educational, and other social and spiritual needs of their people.

The forum will explore the contemporary role of ali'i trusts in land management and conservation. The forum will feature representatives from Kamehameha Schools, the Queen Emma Land Company, and the Queen Lili'uokalani Trust, as well as representatives from other Hawaiian-serving organizations: The Department of Hawaiian Home Lands and the Office of Hawaiian Affairs.

The forum will ask:

- How is each organization accomplishing their mission in today's society?
- What is the relationship between the lands they manage and their mission? Has this evolved over their organization's history?
- How does the management of our watersheds, landscapes, sacred places and native Hawaiian plants and animals, contribute to the well-being of their beneficiaries?

Each trust is different, offering a unique perspective on this complex topic. Join us as we explore these differences and the modern day roles ali'i trusts play in the management of Hawai'i's lands.

The forum will feature a fifteen minute introduction provided by the moderator which will describe the time period during which these trusts were established and provide context for the following presentations. This will be followed by five, 15-minute presentations, sharing the mission and approach toward land management of each trust. Following the presentations, presenters will engage in thirty minutes of facilitated discussion with the panel. Written questions will be accepted from the audience and posed to the panel during this time.

1-2 Crossing the Blue Highway: Video Analysis of Dolphin Swim Participants Behavior During Wild Hawaiian Spinner Dolphin (*Stenella longirostris*) Tourism

Carlie Wiener^{1,2}

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The recent popularity of interactive cetacean activities has led to the expansion of businesses that incorporate in-water "swimming" experiences. The Hawaiian Islands are one of these hotspots due to their predictable Hawaiian spinner dolphin (*Stenella longirostris*) population. Baseline research exploring the types and frequency of in-water human interactions with spinner dolphins was completed over 257 boat hours from February 2012 to March 2013. Utilizing 11 different tour vessels as research platforms, data was collected at 14 known dolphin resting-sites along the coasts of Kona and Waianae. Underwater interactions between snorkelers and dolphins were assessed using video footage collected from randomly selected and willing dolphin-swim participants. Over 85 hours of footage was coded for human behavior, position and estimated distance from individual or groups of dolphins,

characterizing 564 encounters. Swimmer behavior captured on video was also linked to a survey exploring participants understanding of impacts to dolphins, conservation values, and perceptions towards management. Direct contact between snorkelers and dolphins occurred in less than 3% of interactions; however, this number went up significantly when dolphins were within arm's reach of participants. Based on the data, a first look at the controversial role of snorkeler behavior during wild dolphin swim tourism is presented.

1-3 An Operator Perspective on Wild Dolphin Swim Tourism in Oahu

Victor Lozano, Lisa Dotty, Jenna Morris
Dolphin Excursions, Waianae, HI, USA

Human-dolphin interactions have been in existence since the first millennium evidenced by representations of deities with dolphin symbols spanning from Iran to England. Best examples are seen in Corinthian and Minoan art from 800 - 1000 B.C. This human fascination with marine mammals has continued into present day fueling a thriving global marine tourism industry. With this expansion, dolphin-swim tourism has become one of the largest marine attractions creating a new interest in cetaceans and their habitats. In Hawaii, marine tourism is a significant contributor to the tourist economy, in which the state is dependent upon for 22% of income, employing over 176,200 people (University of Hawaii SeaGrant, 2007). With growing visitation to the islands of approximately seven million visitors per year, Hawaiian spinner dolphin tourism is quickly becoming a cornerstone of marine activities. This presentation will provide a rare insight into the wild dolphin swim tourism industry on the West side of Oahu from an operator and captain's perspective. Sharing over ten years of experience, an oral historical perspective of the changing industry will be shared including tourist demographics, business etiquette and general observations of the dolphin population themselves.

1-4 Gathering Mana‘o: Involving Native Hawaiian Community Members in the Spinner Dolphin Management Process

Jayne LeFors
NOAA Fisheries, Honolulu, HI, USA

Development of regulations aimed at reducing the harmful effects of human interactions with Hawaiian spinner dolphins in their nearshore resting habitats requires careful assessment of potential impacts to the human environment, including culturally significant properties and cultural activities. Section 106 of the National Historic Preservation Act (NHPA) requires federal agencies to consult with Native Hawaiian organizations on the effects their actions may have on properties having historic and/or cultural significance. To fulfill this obligation under the NHPA, NOAA Fisheries has engaged with Native Hawaiian organizations and individuals having lineal or cultural ties to provide their mana‘o (thoughts) on how proposed management actions in essential spinner dolphin resting habitats might affect their usage and enjoyment of these culturally important areas. Community members were asked to identify the cultural activities that take place at several locations, and how management of the sites could be accomplished while minimizing impacts to those activities. By utilizing this information, and continuing to work with community members on potential solutions to the challenges of managing human interactions with spinner dolphins, the agency aims to develop management measures that will avoid negative impacts to the significant historic and cultural properties and cultural activities that occur in these areas.

1-5 Dolphin SMART in the Pacific Islands Region: Educating the Public About the Conservation of Wild Dolphins

Laura McCue
NOAA Fisheries Service, Honolulu, HI, USA

Dolphin SMART is a voluntary, education program for dolphin tour operators, whose mission is to promote environmental stewardship of wild dolphins in coastal waterways and aid in dolphin conservation, by reducing human activities that may cause dolphin harassment. The Program depends on working with local businesses to participate, and help raise awareness, as both local partners and Proud Supporters. Together, we educate the general

public, including both residents and tourists alike, about the Dolphin SMART program and the issues of human interactions with wild dolphins. Human interactions with Hawaiian spinner dolphins (*Stenella longirostris*) in their resting habitat have increased over the past three decades, with these dolphins being the target of the viewing or swim-with tours on a daily basis. These human interactions are disrupting the dolphins' natural behavioral patterns and are disturbing their daytime rest. Many of these dolphins may be targeted multiple times per day, which could lead to population-level effects from a reduction in the dolphins' overall fitness. A key message the Dolphin SMART coordinators, partners, and Proud Supporters of the program express is educating the public about the importance of reducing our disturbance to these animals.

1-6 Responsible Marine Wildlife Viewing: Tailored and Unique Outreach Options for Driving Behavioral Change

Elia Herman¹, Jennifer Berstein², Sarah Courbis³, Trisha Kehau Watson⁴, David Johnston⁵, Alison Rieser²
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Many visitors come to Hawaii to view marine wildlife, but their increasing harassment of these animals – touching, swimming with, feeding, etc. – impedes species' ability to forage, rest, and reproduce. As a result, there is increasing concern about the negative long-term impacts of improper wildlife viewing. To increase the effectiveness of an anti-wildlife harassment communications campaign, we conducted an online survey measuring relevant attitudes, knowledge, and behaviors of likely Hawaii visitors to better understand the motivations driving inappropriate behavior. Notably, we found that visitors most likely to harass wildlife also have a strong pro-environmental orientation; the majority of visitors are unaware of marine conservation laws and eco-friendly recognition programs; and visitors tend to trust third parties, like guidebook authors, as sources of environmental information. Using this information we developed three Public Service Announcements that are available for distribution and have been evaluated for effectiveness by likely Hawaii visitors. Additionally, we are partnering with operators, residents, and tourists to develop new ways of gathering sighting and behavioral information on spinner dolphins and other cetaceans in Hawaii using a “dolphin-spotting” app under development. Together, these products offer new opportunities to create a more knowledgeable public, reduce wildlife harassment, and inform management.

1-7 Overview of Efforts to Standardize Monitoring and Expedite Permitting for Offshore Aquaculture in Hawaii and the U.S. Pacific Islands

Alan Everson
NOAA/NMFS, Honolulu, HI, USA

The U.S. Pacific Islands, which include Hawaii, American Samoa, Guam and the Commonwealth of the Northern Mariana Islands, appear to be ideal locations to support offshore aquaculture. They all feature fairly pristine coastal waters, access to deep ocean environment within a few kilometers from shore and prospective markets in both Asia and the continental U.S. One of the major constraints that has been identified preventing offshore aquaculture from moving forward in these areas is the lack of a clear monitoring protocol that is acceptable to all of the various federal and state resource agencies that are involved in the permit process. A working group was convened in late 2012 comprising representatives of many of these agencies as well as University of Hawaii researchers, NOAA aquaculture experts, private consultants, and members of the aquaculture industry to implement a standardized protocol. As an offshoot of this effort, it is hoped that working group can also come up with a methodology to streamline the entire permit process for offshore aquaculture in these Pacific Island locations.

1-8 Marine Cage Culture and Environmental Interactions: Monitoring and Modeling for Responsible Stewardship

James Morris, Carol Price, Kenneth Riley
NOAA, Beaufort, NC, USA

The NOAA National Ocean Service's Coastal Aquaculture Planning and Environmental Sustainability (CAPES) program works to develop coastal planning tools and services to support growth of an environmentally sustainable marine aquaculture industry in the United States. We are reviewing monitoring protocols from around the world to integrate the most practical and effective monitoring methods into guidance for national policies. Proper environmental monitoring provides data to characterize and predict aquaculture interactions with the environment such as changes to water quality, benthic community, and marine life. These data can be used to verify models for adaptive management and tools used for siting or expanding aquaculture operations. We are using this knowledge base to develop location specific models and siting tools. For example, for finfish aquaculture in Hawaii, we are developing a model to forecast the size of dispersion fields along depth gradients commonly found along the Hawaii coastline. This model will assist coastal managers in developing monitoring protocols at various depths to ensure responsible environmental stewardship.

1-9 Open Ocean Mariculture as a Marine Conservation Imperative

Neil Anthony Sims, Gavin Key
Kampachi Farms, LLC, Kailua-Kona, HI, USA

The conservation community has long held a deep animosity towards aquaculture, based largely on romanticized notions of the pristine seas, and outdated or misinformed impressions of the actual impacts of culturing marine organisms in the ocean. Yet expanding open ocean mariculture offers both global and local conservation benefits.

Conservation International's 2012 report "Blue Frontiers" highlighted the lower LCA footprint of aquaculture compared to other sources of animal protein. With global population growth and increasing affluence driving more meat consumption, it is imperative that aquaculture provide a greater proportion of future animal protein needs. Much of this increased production should come from freshwater aquaculture, but the growing fishing pressure on the higher-value marine fishes will only be alleviated by developing scalable mariculture for snappers, groupers, trevallies and tunas. These species can now be cultured on diets containing no marine-derived proteins or oils. From a global perspective, then, increased marine fish culture is essential to containing greenhouse gas emissions, improving the efficiency of protein production, and reducing pressure on wild fish stocks.

The local and regional impacts of open ocean mariculture have been demonstrated to be either positive, or insignificant. Data will be presented to show how in deep water sites, further offshore, dynamic currents and rapid assimilation ensure that fish farm impacts on water quality and benthic habitat are barely and rarely measurable. Offshore farm operations act as oases in the ocean's desert, with the structures and nutrient inputs increasing biodiversity and abundance of some organisms, and aggregating others. Data from operations in Hawaii demonstrates that previous concerns about impacts on wild fish stock abundance and health are minimal. Marine mammal interactions have proven to be insignificant. A case can be made for synergistic benefits of locating open ocean mariculture in all but the most strictly-preserved marine protected areas.

Continued opposition to development of offshore mariculture has no basis in science. The industry's expansion should be encouraged, and the impacts of scaling – both detrimental and beneficial - should be objectively measured, and used to scribe future limits to growth and suitable locations under marine spatial planning scenarios.

1-10 Potential for Bivalve Culture and Use of Ecological Services in Traditional Hawaiian Fishponds

Maria Haws

University of Hawaii, Honolulu, HI, USA

Grow-out and sale of adult bivalve shellfish became legally possible in Hawai'i in 2012, opening the door to a new form of aquaculture for the State. As such, shellfish production will contribute to food sustainability, food security and a new source of income for farmers. Foremost among the sites for bivalve aquaculture are traditional Hawaiian fishponds due to their protected waters, presence of microalgae and management by groups trained in aquaculture. Bivalves such as Pacific oysters (*Crassostrea gigas*), Hawaiian oyster (*Dendostrea sandvicensis*) and Manila clams (*Ruditapes philippinarum*) The first fishponds in which bivalves have been cultured in modern times are Keawanui (Moloka'i) and Moli'i and He'eia (O'ahu). Fishponds are also among the few coastal areas that can be permitted for aquaculture. New efforts to streamline the permitting process will provide more opportunities for revitalization and utilization of these fishponds, including bivalve culture. Bivalves can also play an important role in restoration and management of the fishponds and near coastal areas due to the ecological processes they provide such as habitat mitigation and improvement of water quality. As such, they may help alleviate impacts on the fishponds from external factors. Bivalves can also be a part of future efforts in multi-tropic aquaculture whereby polyculture of fish, macroalgae (limu) and bivalves can occur. On-going efforts at the Pacific Aquaculture and Coastal Resources Center (PACRC) at the University of Hawaii Hilo (UHH) to develop native seaweed species and produce fish fingerlings to support these efforts will be described. Despite the magnitude of the opportunities for sustainable aquaculture that now exist, significant challenges continue to impede progress. Strategies to overcome these challenges will be described.

1-11 Ho'āla Loko I'a - Restoring Traditional Hawaiian Fishpond Systems

Michael Cain

Office of Conservation and Coastal Lands, Honolulu, HI, USA

In 2012, a group of government agencies and nonprofit organizations committed to streamlining the permitting process for the restoration of lolo i'a, traditional Hawaiian fishpond systems.

Hawai'i once had close to 400 functioning ponds. By 1901 there were 99. Today only a handful remain. There have been many attempts to restore the ponds to functionality since the 1900's, but practitioners have been repeatedly stymied by the cost and complexity of securing the necessary government permits.

Ho'āla Loko I'a is the Department of Land and Natural Resource's latest attempt to simplify the permitting process for practitioners. The intent is to offer a single application and permit which will encompass the five potential permits that are currently required. The program has been designed to be in compliance with seventeen distinct federal and state regulations.

1-12 Cultural Conservation of the National Marine Sanctuary of American Samoa

Genevieve Brighthouse

National Marine Sanctuary of American Samoa, Pago Pago, American Samoa

In 2012, the National Marine Sanctuary of American Samoa became the largest and only site south of the equator of a system of marine protected areas for the US. The expansion from a .25 sq mile original site size known as Fagatele Bay to five additional units for a total of 13,581 sq miles as the newly designated National Marine Sanctuary of AS, the process of 4 years included close consultation, respect and cultural protocol observance that is touted as a model for management. The tenets of our fa'asamoa were fully embraced throughout all program activities with check in and validation from village councils from each of the sites being considered for sanctuaries based on biological, social, economic and cultural values. Working hand in hand with village leaders, the Office of Samoan Affairs, and local communities a set of new sites can now bring attention to people and place with 6 ocean

treasures of the sanctuary system for American Samoa. The success stories of community engagement, improved livelihoods, and capacity have been realized and more is intended for future years.

1-13 Enabling Community Action to Foster Climate Resiliency - Amouli Village, American Samoa

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Coastal communities are vulnerable to climate change due to their proximity to and reliance on the ocean. Fostering climate resiliency requires an approach that can inform community members about potential climate impacts, obtain community input, and turn community needs, priorities, and ideas into actionable items. Participatory Learning and Action (PLA) is one such approach that is well suited to community climate vulnerability assessment and adaptation planning. PLA is a bottom-up approach that uses a diverse range of activities and tools to facilitate local participation to strengthen community capacity to engage, learn, and act.

Amouli village, in American Samoa, used the PLA process, strengthened by local scientific studies, to develop a Village Climate Resiliency Plan and course for action. Researchers mapped predicted sea-level rise impacts onto a model that illustrated the effects of sea-level rise on village lands and infrastructure. Results were presented back to the community in video form, along with other predicted climate impacts. Amouli village then engaged in a PLA workshop and prioritized climate impacts to address in their village resiliency plan. A village climate committee was formed to formalize recommendations and create actionable items for the community to address, facilitating direct village action to improve climate resiliency.

1-14 The Establishment of a Bio-cultural Education Center on Mo'orea, French Polynesia

Orlo Steele

Haw Com. College, Hilo, HI, USA

It is often difficult for scientists to communicate their knowledge to local people, and even more so when there are linguistic and cultural hurdles to overcome. To address this challenge, the University of California at Berkeley (UCB) formed the Atitia Center in partnership between the UCB Gump Station and a Tahitian non-profit "association" called Te Pu 'Atiti'a, which is composed of local educators and traditional experts. The Atiti'a Center pursues common educational and research programs focused on marine and terrestrial biodiversity, traditional knowledge, culture, and the relationship between human societies and natural ecosystems. This presentation outlines the formation of this cross cultural association and the establishment of an ethnobotanic garden from 2002 - 2013.

1-15 First Conservation Easement in Micronesia: Yela Forest Legacy project as a Pioneer Under the Micronesian Challenge

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A conservation easement protecting Yela Valley in Kosrae, Federated States of Micronesia, was put in place last March 2014. The parcel to be protected is the "gateway" to a larger valley encompassing freshwater swamp forest, pristine native upland forest, and mangrove forest. The extended family of landowners, descended from a farmer who lived in the valley after World War II, partnered with government and non-government agencies to build vision and consensus for conservation and education programs using the valley. The partners averted potentially

destructive road development and navigated their way past numerous legal, financial and bureaucratic obstacles over a period of several years. The completed easement has been made possible by clear land title under a land tenure system eligible for financial assistance from conservation easement programs; its success in securing funding is due to the inherent values of the valley and their documentation by visiting scientists. The family retains ownership, management responsibility, an endowment for the development rights given up, and respect due to them for their achievements. The project is the first such easement in Micronesia, and may serve as a model for partnerships with private landowners to protect private forestlands under the Micronesian Challenge.

1-16 Changing Cultures: Lessons from Conservation Programs in Papua New Guinea

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¹*University of Canberra, Canberra, Australia,* ²*Tenkile Conservation Alliance, Wewak, Papua New Guinea*

With biodiversity declining globally, conservation efforts are becoming increasingly important to conserve species and maintain protected areas. This is especially important in developing countries which are incurring significant development pressures due to ongoing resource extraction and population expansion. Papua New Guinea (PNG) is known for extremely high biodiversity and cultural diversity, and most of the country is under private land tenure, making community awareness and participation in conservation very important. We describe three current conservation programs in PNG which are achieving success in conserving highly threatened, culturally important species while also addressing some of the social needs of local communities. Firstly, we outline the Tenkile and Weimang tree kangaroo program established by the Tenkile Conservation Alliance in the Torricelli Mountains (Sandaun Province) of northern PNG in 2001. Secondly, a more recently established Pig-nosed Turtle program in the Kikori River catchment (Gulf Province) of southern PNG combines biological research with conservation awareness in local schools and capacity building of PNG citizens. Thirdly, the Ailan Awareness program is empowering coastal communities in sustainable management of their marine resources. We contrast the similarities and differences between these programs in order to synthesise key lessons applicable to effective conservation programs in PNG and other biodiverse, developing countries.

1-17 SCUBA Divers' Environmental Perceptions, Preferences, and Willingness to Contribute to Conservation Actions in Guam

Shanna Grafeld¹, Kirsten Oleson¹, Catherine Chan- Halbrendt¹, Mariska Weijerman²

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SCUBA divers have been involved in several conservation efforts globally, but their environmental preferences and willingness to contribute to conservation in the Pacific is poorly understood. In August 2013, we surveyed 220 SCUBA divers in Guam (30% local divers, 70% tourist divers) to determine diver environmental perceptions, coral reef ecological preferences, and willingness to contribute financially to conservation efforts. Our results indicate that divers prefer more diverse reefs with greater fish biomass and more numerous Napoleon wrasse. Diver willingness to pay for improved reef state reveals that SCUBA divers in Guam are willing to pay more to dive on a reef with improved ecological conditions. We also find that divers are willing to contribute a one-time payment of \$10 (mean, +/- \$5) to runoff reduction projects in Guam. This quantification of economic benefits of improved reef conditions can provide leverage for conservation actions, and indicates that SCUBA divers may be willing partners for conservation initiatives in Guam.

1-18 Sustainable Ocean Management and The Human Element: Coral Reef Management on Ulithi Atoll, Yap State, FSM

Nicole Crane^{1,2}, Peter Nelson³, Michelle Paddack², Giacomo Bernardi⁴, Avigdor Abelson⁵

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Micronesian outer Island communities are on the front lines of ecological and cultural change, and are facing declines in critical reef resources, and the benefits that healthy reefs provide. Climate change, cultural change, historical events, and local human impacts have all contributed to large-scale ecological changes on these reefs. A loss of traditional management and a dearth of research in the region have led to weakened conservation measures. However, these autonomously governed communities, whose cultural identity is tied to their oceans, have great potential for leading conservation and management efforts across one of the most biodiverse regions on Earth.

We present our unique approach to working with the communities of Ulithi Atoll to re-establish traditional management within the current ecological context. We present our ecological data characterizing the reefs and fish stocks with respect to human habitation and fishing pressure, and our interview and community meeting data characterizing the issues from the communities' perspectives. Our ecological data compare 18 sites throughout the Atoll, including relatively pristine as well as all 4 inhabited islands and associated fishing grounds.

1-19 Socio-Economic Analyses of Villages under the Community-Based Fisheries Management Program in American Samoa

Faleselau Tuilagi

DMWR, Pago Pago, American Samoa

A socio-economic survey was undertaken of villages under the Community-Based Fisheries Management Program in American Samoa to assess the impacts of the village-managed marine protected areas. The program was started in 2001 by the Department of Marine and Wildlife Resources and each Marine Protected Area is co-managed by each of the 10 participating villages. The results indicated that village respondents, especially large villages, are not aware of the Marine Protected Areas. Most of the village communities are also not involved in implementing these Marine Protected Areas. The results indicated that there is a need for more activities to increase awareness of these Marine Protected Areas among villagers. The results will help resource managers modify existing management regimes to better fit the needs and resolve challenges with management activities. The results also indicated that there is a need to develop new activities and partnerships with other relevant environmental agencies that are critical to community-based ecosystem approach to management.

1-20 Climate Model Projections of Acidification and Thermal Bleaching in the World's Coral Reef Areas

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Coral reefs and the services they provide are seriously threatened by ocean acidification and climate change impacts like coral bleaching. Our team produced updated global projections for these key threats to coral reefs based on ensembles of IPCC AR5 climate models using the new Representative Concentration Pathway (RCP) experiments. For all tropical reef locations, we project absolute and percentage changes in aragonite saturation state (Ω_{arag}) for the period between 2006 and the onset of annual severe bleaching (thermal stress >8 degree heating weeks); a point at which it is difficult to believe reefs can persist as we know them. Severe annual bleaching is projected to start 10–15 years later at high-latitude reefs than for reefs in low latitudes under the fossil-fuel aggressive emissions scenario that best characterizes current conditions (RCP8.5). In these 10–15 years, Ω_{arag} keeps declining and thus the effects of acidification may negate any benefits for high-latitude reefs of later onset of annual bleaching. There are no long-term refugia from the effects of both acidification and bleaching. Of all reef locations, 90% are projected to experience severe bleaching annually by 2055. Furthermore, 5% declines in calcification are projected for all reef locations by 2034 under RCP8.5, assuming a 15% decline in calcification per

unit of Ω rag. Drastic emissions cuts, such as those represented by RCP6.0, result in an average year for the onset of annual severe bleaching that is ~20 years later (2062 vs. 2044). However, global emissions are tracking above the current worst-case scenario devised by the scientific community, as has happened in previous generations of emission scenarios. The projections are now all presented within an interactive tool that is publicly accessible. Development of the projections and tool was a collaborative process undertaken with support from and in partnership with the Pacific Islands Climate Change Cooperative.

1-21 Climatic Changes and Their Effects on Rainfall in Hawai‘i

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In the past three decades rainfall has been decreasing over many parts of the Hawaiian Islands. In this presentation, I review the latest estimates of future rainfall changes for the Hawaiian Islands. The results are based on global climate model simulations used in fifth climate change assessment report from the Intergovernmental Panel on Climate Change (IPCC). I will briefly illustrate how statistical tools help us to refine the coarse-resolution model scenarios (the Islands of Hawai‘i are not well represented in those models). The *statistical downscaling* process was applied to 64 model simulations from 1900 to present and through the 21st century. The results show that the dry leeward sides of the Islands are going to experience a continued drying trend. Wet windward sides, where trade winds provide most of the rainfall, are likely to see small changes to moderate increases in the rainfall during the wet season. In the dry summer season, however, Oahu, Maui Nui and most parts of Hawai‘i Island could experience a reduction in rainfall. Currently, the confidence in the trend pattern is higher for the wet season than for the dry season.

1-22 Temporal and Spatial Patterns of Sea-level Rise Impacts to Coastal Wetlands and Other Ecosystems

Haunani Kane, Chip Fletcher

University of Hawaii Department of Geology, Honolulu, HI, USA

As sea-level rises the greatest challenge will be prioritizing management actions in response to impacts. We provide two solutions to adaptively manage impacts and apply these methods to three coastal wetland environments at Keālia National Wildlife Refuge, Kanaha State Wildlife Sanctuary, and James Campbell National Wildlife Refuge. Firstly, due to the low gradient of most coastal plain environments, the rate of SLR impact will rapidly accelerate once the height of the sea surface exceeds a critical elevation. We calculate a local SLR critical elevation and joint uncertainty that marks the end of the slow phase of flooding and the onset of rapid flooding. The critical transition period provides an important planning target for achieving adaptive management. Secondly, within highly managed areas, landscape vulnerability is related to the site-specific goals of stakeholders. We develop a threat-ranking process that defines vulnerability from a management perspective and characterize. We provide maps of SLR impacts for each wetland that characterize these two solutions and highlight the geographic distribution of potential vulnerabilities. The tools developed here can be used as a guide to initiate and implement strategies that meet the challenges of SLR in advance of the largest impacts.

1-23 A Hydrology Based Decision Support Tool for Tropical Watersheds

Richard MacKenzie¹, Christian Giardina¹, Keith Reynolds², Paul Hessburg³, Chris Heider⁴, Ed Salminen⁴, Ayrton Strauch⁵

¹Institute of Pacific Islands Forestry, Hilo, Hawaii, USA, ²Pacific Northwest Research Station, Corvallis, Oregon, USA, ³Pacific Northwest Research Station, Wenatchee, Washington, USA, ⁴Watersheds Professionals Network, Philomath, Oregon, USA, ⁵University of Hawaii at Manoa, Honolulu, Hawaii, USA

Ensuring the continued capacity of tropical landscapes to provide clean, fresh water to sustain life is among the greatest natural resource challenge facing tropical land managers. Climate change and invasions by high water use non-native plants are growing threats to Hawaii. We present a tropical decision support tool (TDST) designed to increase hydrological function via prioritized watershed management. To do this, we targeted 90 watersheds on

windward Hawaii Island, and divided the landscape into 100 ha subcatchments that were prioritized for restoration based upon: 1) hydrological response to strawberry guava removal or fencing; 2) cost of travel and management; 3) stream ecological condition; and 4) land designation. Using Ecosystem Management Decision Support (EMDS), the TDST creates color coded maps that show those subcatchments that if cleared of invasive species or protected by fencing would provide the greatest hydrological benefit while also providing data diagnostics for identifying which criteria drives prioritization scores. This TDST is an adaptive management tool that can be modified for use in other Hawaiian watersheds or Pacific Island landscapes to address similar hydrology based management concerns as well as modified to include other important management factors (e.g., endangered species habitat, reducing sediment loads).

1-24 Shifting Hawaiian Forest Bird Distribution under Climate Change and the Need to Consider Novel Conservation Strategies

Lucas Fortini^{1,2}, Adam Vorsino³, Fred Amidon³, Eben Paxton², Jim Jacobi²

¹*Pacific Islands Climate Change Cooperative, Honolulu, HI, USA*, ²*U.S. Geological Survey, Honolulu, HI, USA*,

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Past analysis has shown that temperature-dependent avian malaria is likely to reduce overall available Hawaiian forest bird habitat with temperature increases. We used a comprehensive database of forest bird sightings (over 42,000 points), the most up to date regional climate projections and state-of-the-art ensemble species distribution models to project shifts in distribution of all Hawaiian forest bird species due to climate change. Our results show that all forest bird species are expected to suffer large range losses by end of this century with single island endemics at a greater risk than more widespread species. Because most species require structurally complex forest habitat that may take decades to develop, the additional consideration of available habitat for each species strongly constrains the possibility of range expansion for most species. While the vulnerability of forest birds to climate change is not new, the robustness of our spatial projections of individual species shifts provide a powerful set of information for management planning and decision making. As our results suggest conventional conservation approaches will not indefinitely safeguard Hawaiian forest birds from climate change, we briefly outline how we plan to facilitate discussion and serious exploration of novel climate-based conservation strategies.

1-25 The Hylaeus Project: A Multimedia Documentation of the Native Hylaeus Bees and their Habitats

Lisa Schonberg, Aidan Koch
independent artist, Portland, USA

The 63 species of Hylaeus endemic to Hawaii are the only native bees known from these islands. When R.C.L. Perkins explored Hawai'i he called the Hylaeus "almost the most ubiquitous of any Hawaiian insects", but both the Hylaeus and the native Hawaiian plants they visit have since experienced precipitous declines. The Hylaeus Project is a multimedia documentation of the native Hawaiian Hylaeus. This project explores the potential for the dissemination of information about overlooked taxa to new audiences through creative means. In 2008 I co-authored petitions to the US Fish and Wildlife Service to list 7 species of native Hawaiian Hylaeus bees as endangered, and they have since been added to the waiting list of candidates in need of protection. In 2013 I visited Hylaeus habitat sites in Hawai'i with illustrator Aidan Koch to investigate the genus. We visited over 17 present and historic Hylaeus collection sites and documented the bees and their habitats through writing, photography, illustration, field recording and music composition. We produced a book, *The Hylaeus Project*, which includes natural history writing, field notes, interviews, illustrations, and watercolors. I composed several new music compositions based on the soundscapes and character of our field sites. Aidan and I will be presenting a short talk on our project that will include a slideshow, examples of field recordings and percussion compositions, and a showing of our book. We look forward to engaging with our audience at the conference in regard to the potential for collaborations between artists and scientists in Hawaii, and on the potential for artists to give added momentum to conservation efforts through expanding the audiences for conservation issues related to rare or overlooked species.

1-26 Aloha+ Challenge: A Culture of Sustainability, He Nohona 'Ae'ōia

Audrey Newman, Breanna Rose
Hawaii Green Growth, Honolulu, Hawaii, USA

Hawai'i is working towards a high-level commitment to sustainability and getting ready to take the world stage as an island leader. Hawai'i hopes to share this commitment with other islands from around the world during the United Nations Conference on Small Islands Developing States later this year in Samoa. The Governor is working in partnership with the four Mayors, elected Chair of the Office of Hawaiian Affairs, the Legislature and Hawai'i Green Growth public-private leaders on this commitment, the **Aloha+ Challenge: A Culture of Sustainability, He Nohona 'Ae'ōia**. The Aloha+ Challenge embodies an integrated approach to sustainability with six ambitious targets in clean energy, local food, natural resource management, green jobs, waste reduction, and smart sustainable communities. Please join us to learn about this exciting opportunity for Hawai'i. This session will discuss how the Aloha+ Challenge can help accelerate action in sustainability at home and allow Hawai'i to share and learn with others islands across the Pacific and globally. Learn how the work of the conservation community fits into the bigger vision of building a secure, sustainable, and resilient Hawai'i.

1-27 Pacific Island Managed and Protected Area Community (PIMPAC): A Pacific Approach to Developing Capacity for Conservation

Mike Lameier¹

¹*National Marine Fisheries Service Pacific Island Region Office, Honolulu, HI, USA,* ²*NOAA Coral Reef Conservation Program, Washington D.C., USA*

The Pacific Island Managed and Protected Area Community (PIMPAC) is a social and learning network of protected area managers and conservationists working in the Pacific. It is also a long-term capacity building program for protected area management. It is co-coordinated by the National Oceanic and Atmospheric Administration's (NOAA) and the Micronesia Conservation Trust (MCT). Since 2005, PIMPAC has been collaborating with protected area managers to adapt to change and address the many challenges of effectively managing protected areas in isolated parts of the Pacific. This network provides peer-to-peer learning opportunities,

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trainings and technical assistance to managers on many key topic areas critical to effectively managing protected areas. In order to ensure capacity development is integrated and coordinated at necessary levels, PIMPAC also works closely with other learning networks that serve similar partners. PIMPAC works closely with the Locally Managed Marine Area Network (LMMA), which supports community-based marine conservation efforts, as well as the Micronesians in Island Conservation (MIC) Network. MIC provides coordination support and learning opportunities for leaders of management agencies and conservation organizations. Additionally, in an effort to more effectively develop capacity PIMPAC strives to institutionalize training opportunities and trains partners to be trainers.

1-28 Thinking Macro in Micronesia: Setting the Standard for Regional Invasive Species Coordination & Planning

Joshua Atwood

Hawaii Department of Land and Natural Resources, Honolulu, USA

1-29 A Strategic Vision for Achieving Effective Community-Based Marine Conservation in Hawai'i: An Overview of the Harold K.L. Castle Foundation's Approach

Eric Co

Harold K.L. Castle Foundation, Kailua, Hawaii, USA

Our culture, economy, and livelihood are inextricably interwoven with the health of our nearshore marine resources. Consequently the conservation of our environment is critical to the perpetuation of our people. But while Hawai'i is well loved it is not well cared-for. The complex problems facing our oceans necessitate comprehensive solutions. This comprehensive approach must include broad-based partnership with the community at the lead, and must span the strengths of both traditional marine management and western science. And while our goals are biological, the ways we will accomplish them are invariably social. Biological ends via social means manifest themselves as short-term social outcomes and long-term biological outcomes...

These represent a sample of the foundational values guiding one funding organization's overarching strategy to achieve effective marine conservation in Hawai'i. A reflection of a collective vision assembled from a broad cross section of organizations active in marine conservation efforts across the state, the Harold K.L. Castle Foundation—celebrating its 50th year as a permanently endowed source of support in Hawai'i—shares its new theory of change which attempts to articulate what it will take to attain healthy nearshore marine systems toward a healthy community that relies on them.

1-30 Science Framework at the Department of Interior Pacific Islands Climate Science Center

David Helweg

Pacific Islands Climate Science Center, Hawaii, USA

In 2009 the U.S. Department of Interior established two partner-based entities to address challenges of climate change: Climate Science Centers (CSCs) and Landscape Conservation Cooperatives (LCCs). CSCs provide region-focused climate science to support management of natural and cultural resources. The Pacific Islands Climate Science Center (PICSC) was launched in 2012 and serves Hawai'i and the US-Affiliated Pacific Islands region. The PICSC is hosted by a university consortium led by University of Hawai'i. Partnership with academia provides scientific expertise along with commitment to capacity building in the region. In close partnership with the PICSC is the Pacific Islands Climate Change Cooperative (PICCC), which serves as the regional LCC. Together, they work with federal, state, and other partners to deliver scientific research and interpretation. A biocultural framework emphasizes interconnected natural and anthropogenic systems and seeks to integrate multiple knowledge systems and modes of investigation. The vision for the PICSC is to develop knowledge products and tools to inform and support sustainability and climate adaptation of human and ecological communities in the Pacific islands. Emphasis is on actionable science—science with a clear path for integration with resource stewards, with research organized around themes that guide progress of the PICSC.

2-1 Perspectives on Hawaii's Wildfire Problem - from Science and Management to Community Action

Clay Trauernicht¹, Rhonda Loh², Creighton Litton¹, Andrew Beavers³, Wayne Ching⁴, Elizabeth Pickett⁵
¹University of Hawaii, Honolulu, HI, USA, ²Hawaii Volcanoes National Park, Volcano, HI, USA, ³Center for Environmental Management of Military Lands, Fort Collins, CO, USA, ⁴Division of Forestry and Wildlife, Honolulu, HI, USA, ⁵Hawaii Wildfire Management Organization, Kamuela, HI, USA

Wildfire is a growing threat to landscapes and communities in Hawaii that is connected to complex changes in vegetation, climate, and human activities. The purpose of this forum is increase participants' understanding of the scale, drivers and impacts of Hawaii's wildfire problem, and the strategies for improving wildfire research, mitigation, and suppression. The forum will consist of six, 20 minute discussion sessions led by a panel of experts on wildfire science, management, and community engagement. Each panel member will share their knowledge on the topics below for 10-12 minutes, after which audience members will be prompted to identify the information most relevant to their own work. The discussions that arise will be facilitated and expanded by the panel and be used to develop wildfire-focused education and extension material produced by the Pacific Fire Exchange.

Program:

Introduction - The scope and context of Hawaii's wildfire problem

Summarizing the first-ever statewide wildfire history, this introduction will consider the full scope of drivers and impacts of fire on Hawaii's natural resources, communities, and economy.

Clay Trauernicht, Extension Specialist in Wildfire Management, UH Manoa

Fire Management at Hawai'i Volcanoes National Park

A brief overview of the park's fire management program focusing on 1) building capacity and resources to monitor and suppress wildfires, 2) evaluating fire risk, 3) supporting research on fire effects and restoration tools.

Rhonda Loh, Chief of Natural Resources Management, National Park Service

The challenges and need for improved fire modeling in Hawaii

Overview of recent and ongoing efforts by the Ecosystem Ecology Laboratory at the University of Hawaii to tackle the challenges Hawaii's unique vegetation poses for predicting wildfire danger and behavior.

Creighton Litton, Associate Professor in Forest Ecology and Management, UH Manoa

Information needs for effective fire management in Hawaii

Improved information on weather and vegetation and greater interest from local and national agencies have dramatically altered the trajectory of fire management in Hawai'i. A major challenge is to effectively use this information to improve on-the-ground fire prevention and suppression.

Andrew Beavers, Fire Ecologist, Center for Environmental Management of Military Lands

The Division of Forestry and Wildlife's Fire Management Program

DOFAW not only manages Hawaii's forests, but is the only statewide fire response agency specializing in wildland fire suppression with primary responsibility for 1.6 million acres and sharing responsibility with county fire departments for 81% of Hawaii's total land area.

Wayne F. Ching, Fire Management Officer, Division of Forestry & Wildlife

Adapting to wildfire through Community Wildfire Protection Plans

Hawaii Wildfire Management Organization works with community members, decision makers, and local/state agencies to develop CWPPs that identify wildfire hazards and prioritize the actions needed to create fire-adapted communities and landscapes.

Elizabeth Pickett, Executive Director, Hawaii Wildfire Management Organization

2-2 The Coral Reefs of Maui Nui

Michael Field, Curt Storlazzi, Ann Gibbs, Susan Cochran, Josh Logan
US Geological Survey, Santa Cruz, CA, USA

The Maui Nui island group hosts the largest, most complex, and richest coral reefs of the Main Hawaiian Islands. Nearshore regions of Maui, Moloka'i, Lana'i, and Kaho'olawe contain over 10,000 acres of reefs having >50% live coral cover. Reefs having <50% live coral easily double the total acreage. The reefs' success stems largely from the wave shelter provided by the islands. Where large swells and storm waves are effectively blocked, reefs have high productivity and growth: >6000 acres of rich coral reef off south Moloka'i, and >2000 acres off both eastern Lana'i and western Maui.

The reefs display geomorphic complexity; many exhibit a classic reef flat and forereef pattern, commonly with well-developed spur-and-groove features extending to 28 m water depth. Other contrasting morphologies include apron reefs and large, isolated, 14 m-high coral ridges.

The extensive distribution, large size, variable character, connectivity, and natural wave sheltering, make Maui Nui reefs potentially resilient candidates for surviving regional-scale threats from climate change if other stresses are eliminated. Currently, however, the reefs are largely unmanaged and unprotected, with few restrictions on fishing or pollution. As such, they remain vulnerable; preliminary evidence indicates that widespread reef die-offs have triggered regime shifts that prevent reef recovery.

2-3 Over a Decade of Change in Spatial and Temporal Dynamics in Hawaiian Coral Reef Communities

Eric Brown¹, Skippy Hau³, Paul Jokiel², Ku'u'lei Rodgers², Russell Sparks³

¹*Kalaupapa National Historical Park, Kalaupapa, HI, USA*, ²*University of Hawaii-Manoa, Honolulu, HI, USA*,

³*State of Hawaii, Division of Aquatic Resources, Kahului, HI, USA*

Little statewide monitoring data exists prior to 1999, limiting our understanding of the current status and future stability of Hawaiian reefs. The Hawai'i Coral Reef Assessment and Monitoring Program (CRAMP) was established in 1999 to describe spatial and temporal variation in Hawaiian coral reef communities in relation to natural and anthropogenic factors. Analysis of change over 14 years (1999 to 2012) was based on data from 60 permanent reef stations at 30 sites in the main Hawaiian Islands. Mean statewide coral cover, richness, and diversity did not vary significantly since initial surveys, although variations in coral cover trends among stations were detected. The greatest proportion of stations with significant declines in coral cover were on Maui (0.40) compared to Hawai'i Island, with the highest proportion of stations (0.58) with significant increases. Stations with increasing coral cover or with the potential for recovery from disturbances were identified for possible management actions in the face of future climate change. Temperatures have been increasing over the past several decades and models predict more severe bleaching events with an increase in frequency and intensity in coming decades. Therefore, it is imperative to identify and protect resilient Hawaiian reefs that will survive future stressors.

2-4 Response of Reef Corals to Extreme Turbidity on the South Moloka'i Reef Flat

Paul Jokiel, Ku'u'lei Rodgers

University of Hawai'i-Hawai'i Institute of Marine Biology, Kaneohe, USA

A long-term (10 month exposure) experiment on effects of sediment and turbidity on the mortality, growth and recruitment of the reef corals *Montipora capitata* and *Porites compressa* was conducted along an extreme turbidity gradient on the shallow reef flat off Kawela and Kamiloloa, Moloka'i, Hawai'i. Corals were grown above the sediment deposits on wire platforms with associated coral recruitment tiles along a turbidity gradient that ranged from 37 mg l⁻¹ (inshore) to 3 mg l⁻¹ (offshore). Coral mortality increased with increased levels of turbidity. Coral recruitment did not occur in the areas of high turbidity, with a few settlements in the areas of lowest turbidity. However, coral skeletal growth did not show a strong relationship with turbidity. The study demonstrated that corals can persist under highly turbid conditions, but cover is limited by muddy substrate. Corals
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occur at relatively high levels of turbidity if they can avoid burial by occupying hard substrata above the muddy sediment deposits. Thus coral communities are sometimes found in highly turbid areas on vertical faces and rock outcrops. Nevertheless, mortality and low recruitment will restrict the populations of corals under such conditions.

2-5 Putting Human Impacts on Fish Populations in Perspective: Spatial Variation on a Local Scale

Kelvin Gorospe¹, Megan Donahue², Ivor Williams¹

¹*NOAA Coral Reef Ecosystem Division, Honolulu, HI, USA*, ²*Hawaii Institute of Marine Biology, Kaneohe, HI, USA*

It is well known that humans have had profound impacts on the overall status of natural fish populations. Far from being homogenous, however, we at least intuitively believe these effects to exhibit spatial variation. Understanding how human impacts vary across different fish populations requires that we also control for the effect of habitat variation between sites (e.g., coral cover, substrate complexity, depth, etc.). Our dataset includes fish visual census data from throughout the Hawaiian archipelago, and thus encompasses a full range of both human population density and fish habitat characteristics. Using these fish survey data, along with site-specific data on habitat quality and human population density, we present a Bayesian statistical framework that teases apart the effects of various habitat characteristics and human population indicators on natural fish populations. Doing so allows for an assessment of spatial variation in these effects as well as an estimation of potential fish biomass in the absence of humans (i.e., a baseline estimate). We focus our analysis on 10 economically and culturally important fish species and center our geographic scope on Maui Nui. Finally, the implications of our results for spatial planning and resource management will be discussed.

2-6 Lesson Learned from Maui's Algal Blooms in the Last Decade

Celia Smith, Meghan Dailer

University of Hawaii, Honolulu HI, USA

Over the last two decades, persistent algal blooms in coastal Maui waters have triggered a diversity of studies aimed to better understand drivers and consequences of large biomass accumulations in specific regions. In the last decade, we used experimental applications of stable isotope analysis, delta ¹⁵N, for bloom tissues, growth of reef algae and an economic assessment of algal blooms funded by the Hawai'i Coral Reef Initiative to gain great insight into the drivers of these blooms and some of their ultimate economic considerations. Details of some of our recent studies will be presented to demonstrate the utility of algae as monitoring bioassay system for future biological assessments, especially in locations where submarine groundwater discharge may deliver elevated nutrients to coastal waters.

2-7 Larval Dispersal on the Big Island: Connecting Reefs, Fish, and People

Mark Hixon¹, Mark Christie², Brian Tissot³, James Beets⁴, Yanli Jia¹, Delisse Ortiz⁵, Stephen Thompson⁶

¹*University of Hawaii at Manoa, Honolulu, HI, USA*, ²*Oregon State University, Corvallis, OR, USA*, ³*Humboldt State University, Arcata, CA, USA*, ⁴*University of Hawaii at Hilo, Hilo, HI, USA*, ⁵*National Marine Fisheries Service, Silver Spring, MD, USA*, ⁶*Marine Environmental Research, Kailua-Kona, HI, USA*

Documenting where fish are spawned and where their larvae disperse is essential for understanding connectivity of coral-reef ecosystems. At 10 reefs around the Big Island, including 3 Fishery Replenishment Areas (FRAs), we collected fin clips from 1,073 adults and recently settled recruits of yellow tang or lau'ipala (*Zebrasoma flavescens*) during the summer settlement season. Using new genetic parentage approaches, we identified 4 parent-offspring pairs along the Kohala-Kona coast. In every case, larval dispersal was northward, indicating that northern reefs depend on larval replenishment from southern reefs. Documented dispersal distances ranged from 15 km (9 mi) to 184 km (114 mi). The tracked larvae were spawned either within an FRA (2 fish) or at a seldom fished reef (2 fish), and they ultimately settled in either FRAs (2 fish) or fished reefs (2 fish). Combining our data (Christie et al. 2010 PLoS One) with those of Kittinger et al. (2013 Stanford University) on fish catch distribution indicates that reefs and people are broadly connected and interdependent across the Big Island. Fish landed on the Kohala coast

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are distributed across the northern half of the island, and those fish likely are spawned from reefs around the southern half of the island.

2-8 Numerical Modeling of Coral Connectivity in the Maui Nui Complex of Hawai'i

Curt Storlazzi¹, Maarten von Ormondt², Yi-Leng Chen³

¹*USGS Pacific Coastal and Marine Science Center, Santa Cruz, CA, USA*, ²*Deltares, Delft, The Netherlands*,

³*University of Hawai'i, Honolulu, HI, USA*

Connectivity is one of the most important factors in evaluating the size, number, and spacing of individual marine protected areas to design an integrated network of marine protected areas. To provide such information for federal, state, and local managers in Hawaii, the US Geological Survey, Deltares, and the University of Hawai'i worked to develop a physics-based numerical circulation model to determine the role of ocean currents in transporting coral larvae from natal reefs in Hawaii's Maui Nui complex (Maui, Lanai, Moloka'i, and Kaho'olawe). Spatially- and temporally-varying WRF-ARW wind, WAVEWATCH III wave, and NCOM circulation model output were used to drive a three-dimensional, physics-based Delft3D circulation model for the Maui Nui complex. The Delft3D model was then used to simulate the movement of reef-building coral *Montipora capitata* larvae from 17 reefs during 5 spawning events in 2010-2012. These simulations show allow us to investigate not only the general dispersal patterns from individual coral reefs, but also how anomalous conditions during individual spawning events can result in large deviations from those general patterns. Overall, the data suggest that many of the coral reefs in Maui Nui seed reefs on adjacent islands, demonstrating the interconnected nature of the coral reefs in Maui Nui.

2-9 Using Genetics to Infer Connectivity Among the Hawaiian Islands for the Rice Coral, *Montipora capitata*.

Rob Toonen¹, Greg Concepcion^{1,3}, Iliana Baums²

¹*Hawaii Institute of Marine Biology, Kaneohe, HI, USA*, ²*Penn State University, University Park, PA, USA*, ³*Pacific Biosciences, Menlo Park, CA, USA*

Montipora capitata is one of the most successful reef-building corals in the Hawaiian Archipelago, both in terms of geographic distribution and relative abundance. We used genetic markers (eight microsatellite loci) to determine population genetic structure and make inferences about exchange among geographical regions throughout Hawaiian waters. In an effort to inform management and conservation efforts, we collected biopsy samples (n = 560) from colonies at each of 11 islands/atolls along the entire length of the archipelago in addition to Johnston Atoll, about 1328 km to the southwest. We found very few potential clones (<2%) in our sampling (551 of 560 colonies had unique multi-locus genotypes), indicating that reproduction is predominantly sexual. Likewise, significant genetic structuring among nearly all locations (pairwise $F'_{ST} = 0.10$ to 0.49 , $P < 0.01$) indicates that successful dispersal between islands is highly limited. Overall, we found four main regional genetic groupings of *M. capitata* within state waters, one comprised of the Main Hawaiian Islands, one off the three northwestern-most NWHI, and two groupings encompassing the middle of the northwestern chain and Johnston Atoll. Despite the potential for extended pelagic larval development in these corals (>200 d), estimates of contemporary dispersal were uniformly low, with many sites being estimated at >90% self-recruitment. Although self-recruitment for Maui Nui was among the lowest in the archipelago at 70%, the majority of colonies were still locally derived. These data imply that the vast majority of *M. capitata* colonies found at any given island across the entire Hawaiian Archipelago are derived from adults at that same island, and argue for local-scale management of Hawaiian coral reef resources.

2-10 Population Connectivity Modeling in Hawai'i with a Focus on Maui Nui

Johanna Wren¹, Donald Kobayashi², Robert Toonen¹

¹*University of Hawai'i at Mānoa, Honolulu, HI, USA*, ²*NOAA Fisheries, Pacific Islands Fisheries Science Center, Honolulu, HI, USA*

The majority of Hawai'i's marine animals have a biphasic lifestyle with a dispersive larval stage and a reef-associated adult form. Understanding connectivity of marine organisms is imperative to effectively manage and protect marine ecosystems, but little is known about the dispersal patterns of marine larvae in the Hawaiian

Archipelago. In this computer simulation study we examine the transport of pelagic propagules using a 1/25th degree daily resolution ocean circulation model (HYCOM), in which release occurred from May 2nd 2009 until November 1st 2011. The simulation was parameterized to mimic eggs and larvae of the yellow tang (*Zebrasoma flavescens*), an herbivorous reef fish species common in Hawaiian waters and a popular target species in the aquarium trade. Simulation results indicate that predominant dispersal from Maui Nui is northwest, but with high retention and self-recruitment within the Maui Nui complex. In contrast, Maui Nui is receiving most of their incoming propagules from Hawai'i Island.

2-11 Future Coral Community Projections for the Hawaiian Islands: A Look at Maui Nui

Erik Franklin¹, Curt Storlazzi², Eric Trembl³, Robert Toonen¹

¹University of Hawaii, Kaneohe, Hawaii, USA, ²United States Geological Survey, Santa Cruz, California, USA,

³University of Melbourne, Melbourne, Australia, Australia

The conditions of coral reefs in the Hawaiian Islands are predicted to decline significantly from climate change perturbations through the year 2100. To provide a more comprehensive model system to evaluate climate scenarios, we integrate a regional-scale biophysical model of larval connectivity between coral reefs, a local-scale ecological community dynamics model, and projections of physical phenomenon (wave, wind, precipitation, sedimentation, eutrophication, sea level rise, thermal stress, and ocean acidification) to parameterize environmental forcing functions on shallow reefs for two CMIP5 climate scenarios (medium mitigation and high emissions) within the Hawaiian Islands. This presentation will present an overview of the scope of the work and preliminary results from the project.

2-12 Diagnosing and Treating the Causes of Coral Reef Decline

Robert Richmond

University of Hawaii at Manoa, Kewalo Marine Laboratory, Honolulu, Hawaii, USA

Coral reefs worldwide are in decline as a result of human activities, from local stressors associated with poor land-use practices within watersheds and overfishing, to the regional and global impacts of climate change. In such multi-stressor and scale situations, it has been difficult to accurately assess the relative effects of individual stressors and to quantitatively evaluate the effectiveness of specific mitigation activities. New technologies in molecular biology are providing tools that can address such fundamental questions with a greater degree of accuracy than ever before. Data being collected from corals living along gradients of watershed discharges on Oahu and Maui are providing the basis for designing and evaluating management programs designed to protect coastal coral reefs and support reef resilience to the increasing impacts of global climate change. In order to achieve the positive outcomes needed by coral reefs and their community stakeholders, the results of the scientific studies must be translated into effective policies and actions. Outputs include a framework for directing the limited financial, human and institutional resources available for coral reef and marine resource protection towards those activities with the greatest chance of achieving the desired outcomes of coral reef resilience and persistence.

2-13 Perpetuating Traditional Conservation through Blending Cultural Practice with Modern Science

Ku'ulei Keakealani^{2,3}, Hannah Springer³, Rebecca Most¹, Keolohilani Lopes¹, Chad Wiggins¹

¹The Nature Conservancy, Hawaii, USA, ²Hui Aloha Kiholo, Kiholo, North Kona, Hawaii, USA, ³Kaupulehu Marine Life Advisory Committee, Kaupulehu, North Kona, Hawaii, USA

Traditional conservation practices sustained and strengthened the connection between people and resources in Hawai'i for generations. In communities across Hawaii, many of these cultural practices are still alive and can offer important lessons and knowledge, while others are being revived and adapted in a modern context to answer questions about ecosystem health using modern science as a tool to help document loss and recovery in natural and socio-cultural systems. Such systems must function to support traditional practice. Blending cultural practice and knowledge with modern science to better inform management is gaining momentum as communities work to protect and restore their natural resources to perpetuate cultural practice.

On Hawai'i Island, coastal communities are working together to blend scientific research and cultural practice to help restore Kiholo fishpond, replenish near-shore fish populations at Ka'ūpūlehu, and evaluate how communities are linked culturally and ecologically.

As connected communities build momentum for change, they are challenging current management structures and identifying opportunities to improve the process of management in Hawai'i. Engaged community leaders will join scientists from The Nature Conservancy to share their challenges and successes as they forge ahead from different perspectives in pursuit of a common goal - healthy and abundant marine and coastal life. Specific projects that will be discussed include blending cultural activities and modern science to restore Kiholo fishpond, hukilau sampling of reef fish for larval parentage research, and adapting the traditional conservation measures of kapu and kanawai in a modern context in North Kona.

2-14 Aquaponic Versus Soil Cultivation of 'Auhuhu and 'ōlena: Comparisons of Plant Growth and Nutrient Dynamics for Effective Propagation and Use

Leina'ala Bright, Danielle Hull

University of Hawai'i at Manoa, Honolulu, HI, USA

The investigation of 'auhuhu (*Tephrosia purpurea*) and 'ōlena or turmeric (*Curcuma longa* L.) was prompted by the desire to promote the propagation and conservation of Hawaiian and other medicinal plants using aquaponic technologies. Ongoing research under the Waihona Lā'au Lapa'au Project encompasses the holistic investigation of medicinal plants and their varied uses by Native Hawaiians as herbal medicines, as well as fish anesthetic and poison. The fish anesthetizing property of 'auhuhu renders it potentially useful for natural resource management as a tool for invasive species removal. Through the COSEE-Island Earth Collaborative Fellowship traditional ecological knowledge and modern scientific research are combined to: (1) propagate 'auhuhu and 'ōlena via three agricultural methods: soil, aquaponics-bell siphon, aquaponics-trickle filter, (2) compare difference in yield, growth, and quality of leaf and 'ōlena rhizome from each agricultural method, (3) monitor the composition and cycling of nutrients to determine why agricultural methods yield different results, (4) teach propagation, conservation, scientific monitoring, and preparation techniques to the community. Integration of traditional ecological knowledge with modern technologies, resource management, and education is a necessary approach to addressing the many challenges we face today in striving to become better stewards of our land.

2-15 Using Botanical Footprints to Delineate Social-Ecological Zones such as Sacred Forest on Kaua'i in the Pre-colonial Era

Kawika Winter, Mathew Lucas

National Tropical Botanical Garden, Kalaheo, HI, USA

Policy makers and resource managers often look to the ancient Hawaiian system of resource management (i.e., the ahupua'a system) as a model for holistic and sustainable mountains-to-sea management of a social-ecological system. Many components of this ancient system—such as agriculture, aquaculture, and near-shore fishery management—have been documented, studied, and revived in the name of both sustainability and the perpetuation of Hawai'i's host culture. One relatively glaring hole in this context of our understanding of this ancient system is the management of forest resources on a system (i.e., not a species) level. Various terms for identified and managed social-ecological zones—such as Wao kanaka, Wao Nāhele, Wao Akua, and others—have been documented for Hawai'i Island; however, details of what the delineations were, and how these were managed remain unclear. What is also not clear is whether or not these terms were applied on other islands. Using ethnobotanical methods, GIS technology, and climate modeling we studied Limahuli Valley in NW Kaua'i to estimate where the social-ecological zone of “sacred forest” would have been; and extrapolated out to cover the entire island. The result is a GIS map identifying the potential area for the “sacred forest” of ancient Kaua'i.

2-16 The Laua'e Legacy: The Bi-Cultural Approach was the Key to Unlocking the Mystery of the laua'e maoli (*Microsorium spectrum*) Fern

Puanani Anderson-Fung

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In the mid 1990s, controversy arose between the Hawaiian and scientific communities when the latter asserted that the laua'e fern, *Microsorium grossum*, was an alien species introduced about 100 years earlier. Hawaiians asserted that the laua'e was mentioned in old mele, oli, mo'olelo and 'olelo no'eau (songs, chants, stories and proverbial sayings) and must have been present when their ancestors arrived. The author, native Hawaiian by descent and scientist by training, took it as her kuleana (responsibility) to resolve this conundrum. The study began with the assumption that both sides were correct, which could only be true if there were two laua'e. Data were collected from early scientific explorations, Polynesian names for *Microsorium* were compiled, and knowledge of Hawaiian scientists was extracted from Hawaiian language materials of the 1800s. This, combined with knowledge and experience of modern field botanists suggested that the name laua'e was first applied to the fragrant endemic fern, *Microsorium spectrum*. Herbarium specimens at Bishop Museum confirmed this. Cultural memory kept the emotional attachment alive. Combined wisdom of modern and Hawaiian scientists resuscitated knowledge on the brink of extinction, deepening our connection to the plants of our ancestors and compelling us to aid their conservation.

2-17 Pilinakai: Conservation Through Relationships

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Community engagement and social support are an important element in the successful implementation of conservation and ecosystem healing. **Pilinakai** addresses conservation and ecosystem health by going beyond the sole utilization of Western Science and academic driven research to include the core values and relationships a community has to place. Pilinakai is redefining how we perceive health and balance with the world around us to initiate the evolution of how we, as a whole, manage and care for our natural environment. Pilinakai trains and works with communities across Hawaii monitoring our ever-changing landscape utilizing multiple lenses collecting a breadth of information to better understand the natural cycles of place. These natural cycles then guide and define appropriate activities and interactions that ensure a healthy, sustainable environment, which continues to support a healthy, thriving community of people and place. Pilinakai stresses, not only the input and participation of community, but stresses the relationships of local and indigenous communities to place as well as local and traditional knowledge, as an integral component in research, policy development, and management strategy. Pilinakai's overall vision is to engage and include community participation in the care of our island resources and to provision our communities with members who will continue to care for our islands through intimate and communal relationships utilizing multiple knowledge systems to address the care and healing of our island home.

2-18 Na Kilo Aina: A Digital Tool for Monitoring Natural-cultural Resources and Supporting Management Strategies, Strengthen Healthy, Balanced Communities in Hawaii

Pelika Bertelmann^{1,2}, Kehau Springer^{2,4}, Heather McMillen³, Tamara Ticktin³

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The benefits of community-based marine resource management are well-established in the Pacific Islands generally (Johannes 2001), and Hawai'i specifically (Poepoe et al. 2007). This presentation focuses on the development of and applications for an observation network and a digital knowledge-base of natural-cultural resources in Ka'ūpūlehu (North Kona). Na Kilo 'Aina (NKA) refers to the watchers and observers of sustenance. It is a guiding

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concept for strengthening a community of observers that understand the needs of people and place, and that provides direction to ensure the 'aina sustains communities into the future. We use place-based and community-based approaches for this work that integrates diverse sources and types of data. We describe: the processes for creating NKA, the structure and content in NKA itself, and its contributions to: 1) facilitating a renewed understanding of mauka-makai relationships 2) supporting knowledge sharing; 3) monitoring change to natural-cultural resources and shedding light on the effects of seasonal variability as well as the effects of long term cycles like El Niño Southern Oscillation; and 4) highlighting practices and worldviews that strengthen resilience to the effects of environmental change and promote sustainable use of natural-cultural resources.

2-19 Re-Designing Predator Proof Fences for Hawaii: Results of a Survey of Sanctuaries in New Zealand and Hawaii

Lindsay Young, Eric VanderWerf
Pacific Rim Conservation, Honolulu, HI, USA

Predator-proof fencing capable of excluding all mammalian pests ranging in size from large ungulates to mice has been used for almost 20 years in New Zealand, but is only in it's infancy in Hawaii. To better understand the performance of existing fences and improve the design, we developed a survey of pest-proof sanctuaries in New Zealand and Hawaii (N=28) and sent it to managers; 15 responded. Questions included fence size, components, and design, maintenance needs and problems, ability to eradicate and exclude pests, and conservation outcomes. All managers felt that the height, mesh size, and hood design were sufficient to keep out mammalian pests. Open ends on peninsula-style fences and water culverts were the main sources of pest incursions. Common maintenance challenges included erosion on the skirt edge as a result of water run-off from the hood, and lichen growth on the hood which allowed cats to gain purchase. Most (13/15) projects eradicated all pests inside, but many experienced regular incursions. Despite the presence of mice in several sanctuaries, all respondents felt they were still able to achieve their conservation goals. We will present details on suggested fence design modifications specific to Hawaii based on the results of this survey.

2-20 Effects of Non-native Ungulate Removal on Vegetation and Ecological Processes in Pacific Island Forests

Rebecca Cole¹, Creighton Litton¹, Michael Long¹, Christian Giardina², Jed Sparks³
¹*University of Hawaii at Manoa, Honolulu, HI, USA*, ²*Institute of Pacific Islands Forestry, Hilo, HI, USA*, ³*Cornell University, Ithaca, NY, USA*

Fencing and non-native ungulate removal are required for biodiversity conservation across the Pacific Island region. This approach is labor and cost intensive, but long-term outcomes are not well quantified. In particular, little is known about: (i) the degree and timing of native plant recovery; (ii) the response of non-native plants; and (iii) changes to underlying ecological processes. In 2010, we established a series of paired ungulate presence vs. removal plots representing a 20 year chronosequence of feral pig removal in tropical montane wet forests on Hawaii Island to quantify the impacts and temporal legacy of ungulate removal on plant communities and ecological processes. Both native and non-native vegetation responded rapidly and positively to release from top-down control by feral pigs, but species of high conservation concern recovered only if initially present at the time of ungulate removal. Further, feral pigs had large impacts on soil biogeochemistry, and these effects lasted for ≥ 20 years following ungulate removal. We hypothesize that altered soil biogeochemistry facilitates continued invasions by non-native plants for decades after ungulate removal. Future work will concentrate on comparing wet and dry forest ecosystems, and testing management techniques to restore ecological processes and promote native biodiversity.

2-21 Zero Tolerance: The Kaua'i Watershed Alliance's East Alaka'i Protective Fence Project

Nicolai Barca¹, Lucas Behnke¹, Trae Menard¹, Melissa Fisher¹, Sheila Berry¹, Kyle Kagimoto¹, Jeff Schleuter², James Macaulay¹, Allan Rietow¹

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Uncontrolled non-native ungulates can pose a serious risk to native Hawaiian forest ecosystems and the water resources upon which we all depend. In 2010, The Kauai Watershed Alliance completed a 4.6-mile long pig-proof fence on the eastern end of the Alaka'i Plateau, linking with cliff faces to enclose approximately 2000 acres of extremely wet and rugged, highly-intact native montane forest and bogs around the remote Waialeale summit, at the core of Kaua'i's watershed. Over the past four years, all feral pigs and goats have been removed from within the fence using a variety of techniques and the project has now entered an early-detection rapid-response phase. Feral pig population dynamics have been back-calculated to a population of ≥ 43 pigs at the time of the fence closure. Vegetation and ungulate monitoring plots set up when the fence was completed are yielding positive results on the impact of management action on forest health. In order to expand the Alliance's commitment to watershed protection, management activities are expanding to adjacent areas and an increasing focus is being placed on developing novel, cost-effective solutions to animal detection and control.

2-22 A Glimpse at the Future of Pest Control in Upper Limahuli Valley

John-Carl Watson, Chiemi Nagle

National Tropical Botanical Garden, Kalaheo, Hawaii/ Kauai, USA

The field of pest control is constantly advancing. The National Tropical Botanical Garden (NTBG) is staying on the cutting edge of this changing science by employing improved methods and technology to increase its effectiveness at controlling pests in the Upper Limahuli Preserve (ULP).

The ULP is a 144.07 ha (356 ac) hanging valley located on North-west Kauai. As a home to intact native forests, rare plants, protected seabirds, forest birds, and invertebrates; pest control the ULP is an imperative task. With the use of state of the art technology such as radio transmitters, Goodnature automatic rat traps, remote cameras, and improved methods for trap concealment and site selection, NTBG has been executing pest control on a landscape scale. We will discuss how new advances can benefit the conservation world and share the pros and cons of using new technology to implement a landscape scale control program in one of the most rugged and remote parts of Hawaii.

2-23 Pathway Analysis and Dissemination of New Insect Records in Hawai'i

Francis Howarth, Bernarr Kumashiro, Janis Matsunaga

Hawaii Department of Agriculture, Honolulu, Hawaii, USA

Hawai'i is at the Crossroads of the Pacific with goods and transportation originating from a vast area of the world. An estimated 25-30 insect species hitch-hike with goods and find their way to Hawai'i and become established each year. Those involved in Hawai'i, U.S. and world agriculture are keenly interested in learning about the insect fauna in Hawai'i. Knowledge of which pest species are or are not already established in Hawai'i is critical to making informed decisions on quarantine and rapid responses. The pathway analysis of these recently detected agricultural pests will aid in identifying newly emerging potential entryways as well as in devising methods to close the gaps. The objectives of this project were (1) to compile a list of the new state records of insects that have become established in Hawai'i during the past 12 years. This will supplement the comprehensive Hawaiian Terrestrial Arthropod Checklist last published by the Bishop Museum Press in 2002 and (2) to determine the likely pathways used by these recently established species to better understand the risks and improve quarantine protocols. This presentation is a summary of a comprehensive study conducted by the Hawai'i Department of Agriculture as a USDA Farm Bill project.

2-24 Are We There Yet? Eradicating Little Fire Ants from Kauai, Hawaii

Michelle Montgomery¹, Keren Gundersen², Craig Kaneshige³, Casper Vanderwoude¹

¹*Hawaii Ant Lab, University of Hawaii, Hilo HI, USA*, ²*Kauai Invasive Species Committee, Kauai, HI, USA*,

³*Hawaii Department of Agriculture, Kauai, HI, USA*

Little Fire Ants are one of the most damaging invertebrate invasive species in the Pacific region. Although present on Kauai, Hawaii since 1999, they have been confined to a single location on the north shore. A multi-agency project to eradicate this species commenced in earnest in 2012, harnessing the combined resources of the Kauai Invasive Species Committee, The Hawaii Department of Agriculture, Hawaii Ant Lab and the County of Kauai. We outline progress to date and explain how complex projects with ambitious outcomes can be successfully achieved when agencies collaborate with each other in meaningful ways.

2-25 Preventing the Entry and Spread of Invasive Species: A Regional Approach for Invasive Ants

Casper Vanderwoude¹, Phil Andreozzi¹

¹*Hawaii Ant Lab, University of Hawaii, Hilo HI, USA*, ²*National Invasive Species Council, Washington DC, USA*

Countries within the Pacific region face enormous and unique biosecurity challenges not experienced elsewhere. Geographical, social, cultural and political boundaries are often not well aligned. Resources are limiting and potential biosecurity threats abound. Here, we present a proposed regional strategy for preventing the entry and spread of invasive ants for the Pacific.

2-26 Costa Rican Caterpillars Show Promise as Candidates for Control of *Miconia calvenscens*

Kenneth Puliafico, Tracy Johnson

US Forest Service, Volcano, Hawaii, USA

The Neotropical tree *Miconia calvenscens* (Melastomataceae) is considered one of the world's worst weeds and is a growing problem throughout Hawai'i, several other Pacific Islands, and Australia. Biological control is regarded as the best strategy for long term management for *Miconia* due to the scale and spread of this tree and its potential to damage sensitive Hawaiian ecosystems. The gregarious defoliating caterpillar, *Euselasia chrysippe* (Lepidoptera: Riodinidae), has shown promising specificity in host testing for the biological control of *M. calvenscens*. No-choice host testing of over 60 plant species, including several economically and culturally important plants, conducted in the native range of Costa Rica and in the quarantine laboratory in Hawai'i Volcanoes National Park have indicated sustained feeding and larval survival only on a few close relatives of *M. calvenscens*. Development of *E. chrysippe* larvae beyond the second instar was achieved only on a few species of plants within the Miconieae tribe. As there are no native Melastomes in Hawai'i, and all cultivated and native species tested have been unacceptable to the caterpillars, our results indicate that *E. chrysippe* may be a good candidate to protect Hawaii's agriculture and native forests from further *Miconia* invasion.

2-27 Saving Hala: Chasing Pandanus Scale in Native Habitats for Biological Control Agents

Mohsen Ramadan

State of Hawaii Department of Agriculture, Division of Plant Industry, Plant Pest Control Branch, 1428 South King Street, Honolulu, Hawaii 96814, USA

The Hala tree, *Pandanus tectorius* (Pandanaceae) is a large indigenous shrub or small tree that is naturally spreads into coastal plant communities in the Pacific Islands of Southeast Asia and the eastern coasts of QLD Australia. The plant is prominent in Hawaiian culture and tradition throughout the tropical and subtropical Pacific. The Hala Scale, *Thysanococcus pandani*, (Hemiptera: Coccoidea: Halimococcidae) is a minute black bug with a scale of white spots that cover the leaves and fruit of *Pandanus* and sucking sap from the plant causes the leaves to turn from a vibrant green to a pale yellow and branches to snap off. Infestation weakens and kills young plants. Infested leaves become useless to Hala weavers. The scale has a restricted host range, described from *Pandanus* species in Indonesia, and Singapore. It was first observed in Hana, Maui in 1995 and slowly spread to all Hala forests on Maui

Island and the offshore islets. Five interceptions were found in Los Angeles County, California on tropical flower shipments originating from Maui. It reached Oahu in September 2013. There are no known effective pesticides to control the Hala Scale and local natural enemies have proven unsuccessful. A survey was initiated during Nov - Dec 2013 in the native range of Pandanus (Australia, Indonesia, and Thailand) to study key natural enemies. Several potential biological control agents of Coccinellids, Cybocephalids (Coleoptera), and Cecidomyiids (Diptera) were discovered and the most promising candidates are currently being studied in HDOA Containment Facility for non-target impacts. It may take up to two years to obtain approval to release a biocontrol agent for this invasive pest.

2-28 An Urban Weed Programme with a Focus on Wild Ginger (*Hedychium gardnerianum*)

Neil Gallagher³, Craig Davey²

¹Horizons Regional Council, Marton, New Zealand, ²New Zealand Biosecurity Institute, New Zealand, New Zealand, ³Weedbusters New Zealand, New Zealand, New Zealand

The ecology of urban pest plants is complex and strategic management of Pest Plants needs to acknowledge and incorporate such complexes. The focus for urban areas will always be awareness campaigns, self responsibility and behaviour change

This community orientated urban weed programme involves promotional and activity (control)phases weighted heavily on promotion i.e. , live radio interviews, a weed warrior "the ginger ninja" , home visits ;social media, road signage; flyers, newspaper articles ;

The promotional phase is the key to success. Radio and the Ginja Ninja weed warrior creates interest and draws in a number of important organisations and people i.e. Local body Politian's , Local Conservation staff, a recycling business , have all appeared live on radio talking enthusiastically about weeds.

The programme has been run for 3 years. The measure of success is recorded in the number of responses created during the promotional phase. 2013 saw the responses increase 100% on previous years.

This New Zealand urban weed programme is a campaign that engages the community. Although unique to this country the model could be recreated in any urban space.

3-1 Moon Phase Project: Braiding a Cord of Knowledge

Brenda Asuncion⁴, Jamie Makasobe^{1,4}, Kanani Frazier⁴, Alizon Atkins^{10,8}, Eva Schemmel⁹, Kalei Nuuhiwa⁵, Mahinapoepoe Paishon Duarte⁶, Pelika Bertlemann^{2,3}, Rick Barboza⁷

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The foundation of place based traditional ecological knowledge is observation and record keeping. Utilizing record keeping techniques that organize observations and outline environmental patterns in a particular area will expedite the search for and analysis of these patterns.

The purpose of the Moon Phase Project (MPP) is to promote and simplify environmental observation and record keeping throughout Hawai'i. Utilizing social media outlets, a website blog and printed journals, the MPP strives to get people to look at their surroundings, pay attention to what is going on all around them, and to record and share what they see.

Education and knowledge reinforcement about the lunar cycle and the Hawaiian names of moon phases along with various types of record keeping is the foundation of our methodology. Supporting lunar curriculum already being taught in local schools is also a large part of the MPP. Observing ecological patterns at a young age as well as understanding their relationship to the lunar cycle will increase a persons ability to mentally keep records of the patterns they see. Just as we all know the names of the days of the week and can relate them to local traffic patterns, being observant of natural patterns and relating them to the moon phases can be similarly engrained into our minds.

The MPP has generated significant interest from local schools ranging from elementary to the university level. While some schools already have lunar based curriculum already being incorporated into their daily teachings others are just starting and are interested to see what others have done and just want to learn more. Growing interest is also seen on our social media outlets with many photo uploads of observations by people who are not a part of the core group of bloggers who were initially invited to help start the project.

This forum will feature different methods that some educators are using to highlight the lunar cycle and environmental observations in formal classroom settings as well as community-based outreach efforts. The audience will be encouraged to contribute their perspectives and ideas throughout the forum.

3-2 Integrating Local Monitoring and Ecological Knowledge with a Novel Scientific Tool to Refine Traditional Community-Based Fishing Moon Calendars

Eva Schemmel, Alan Friedlander
Department of Biology, UH Manoa, Manoa, HI, USA

We are working with local communities to combine traditional ecological knowledge and community monitoring with scientific assessment to better understand and protect valuable marine resources in Hawaii. Through this process we developed monitoring programs to identify fish spawning seasonality to help inform community-based management, including the development of place-specific Hawaiian moon calendars. These moon calendars predict seasonal, monthly, and daily ecological cycles of harvested fish species, and are being used to develop pono (sustainable) harvest practices at the community level. To aid in the refinement of these Hawaiian moon calendars, we developed endocrine steroid assays that are used along with histology techniques, and community observations to determine fish spawning periodicity. This information is being used to determine temporal and spatial variation in reproductive characteristics and timing of spawning for resource species among five bays spread across a broad

geographic area within the Main Hawaiian Islands (1. Hanalei Bay, Kauai, 2. Maunaloa Bay, Oahu, 3. Kahekili-Ka'anapali, Maui, 4. Kahului, Maui, 5. Kīholo Bay, Hawaii). This approach is providing reproduction information needed for local resource management for several nearshore species of fishes with the ultimate goal of enhancing community stewardship of Hawaii's precious marine resources.

3-3 Determining the Status of the *Parupeneus porphyreus* Fishery in the Main Hawaiian Islands

Martha Maciasz

Hawaii Pacific University, Honolulu, HI, USA

Parupeneus porphyreus, an endemic Hawaiian goatfish, had been identified as a priority for conservation by Hawaii's Statewide Aquatic Wildlife Conservation Strategy (SAWCS), as well as a priority for population assessment by Western Pacific Regional Fisheries Management Council (WPRFMC), and as a priority for stock enhancement by the Oceanic Institute (Leber 1994; Meyer et al. 2000; Meadows et al. 2005; DBEDT 2011). The central goals of this project were to perform a stock assessment to determine whether *P. porphyreus*, a commercially targeted reef finfish in the Main Hawaiian Islands, has been increasing, stable, or in decline, and to characterize the fishery temporally and spatially. Using the Hawaii'i Division of Aquatic Resources commercial catch data, a delta-log normal generalized linear model (GLM) was used to develop a standardized index of abundance, which was used in non-equilibrium surplus production model to estimate the biomass at maximum sustainable yield (MSY). The results are expected to facilitate informed management plans and regulations, such as setting annual catch limits (ACLs) specific to the *P. porphyreus* stock.

3-4 An Angler-based Tagging Program for Bonefish (*Albula* spp.) in Hawai'i: Engaging Fishers in Science and Conservation

Kimberlee Harding¹, Alan Friedlander², Keith Kamikawa²

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Bonefish were an important food resource for early Hawaiians and are targeted today by a mix of commercial, recreational, and subsistence fishers. Most recreational anglers used cut bait, although a growing number are fly fishing in the Hawaiian Islands. Two species of bonefish are present in Hawai'i, the larger and more commonly caught roundjaw (*Albula glossodonta*) and the smaller sharpjaw (*A. virgata*). Bonefish recruit to sandy beaches during the summer and declines in recruitment since the mid-1990s have raised concerns about overfishing. In 2003 a tagging program was initiated to characterize the resource and encourage a catch-and-release ethic. After a two year hiatus in 2008, the angler-based tagging program was re-started. Between May 2003 and December 2012, 2,329 bonefish were tagged, 81% of which were roundjaws. There were 56 recaptures (2.4%) with most fish (64%) recaptured close to their initial tagging location (mean < 3 km). The current program focuses on higher resolution data collection to better understand fine-scale patterns in bonefish movement and a better knowledge of the fisheries. Understanding the differences in the ecology and fisheries for the two Hawaiian bonefish species will contribute to our understanding of how these two closely related species coexist in Hawai'i.

3-5 Understanding and Measuring Seafood Security in the Hawaiian Islands

Jason Chow^{1,2}, Jack Kittinger¹, Nicole Chatterson², Lida Teneva¹

¹*Conservation International Hawaii'i Fish Trust, Honolulu, HI, USA*, ²*Kupu Hawai'i, Honolulu, HI, USA*

Seafood security is comprised of three primary components: (1) physical availability of sufficient quantities of seafood through production from natural ecosystems; (2) economic and physical access to seafood through existing distribution systems; and (3) consumption or utilization of seafood for basic nutrition and sustenance. Each of these components must be stable over time. Historically Hawai'i was completely seafood self-sufficient. However, with 75% of our fish stocks in depleted or critical condition, we have seen a shift in seafood security in Hawai'i. We have initiated a project to assess seafood security in the Hawaiian Islands, in order to identify key intervention points that can strengthen local food systems, while increasing the sustainability of our fisheries ecosystems. We focus on three major components of seafood value and supply chains: production, distribution and access, and consumption. We have identified indicators in each of the three components, and present preliminary findings on

these indicators as part of a full seafood security assessment for Hawai'i. This assessment will be used to raise community awareness, in conjunction with a policy and sustainability action agenda, to determine best management and conservation actions.

3-6 Barriers to Effective Fisheries Co-management in Hawai'i and Opportunities for Robust Governance

Adam Ayers

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Co-management is widely touted as a solution to management problems in many of the world's fisheries. Over the past two decades, several Hawai'i communities have worked to build capacity, deepen their connection to the land and sea and many have attempted to cultivate co-management relationships with the State of Hawai'i to improve site-based marine resource management. To date, co-management in Hawai'i exists via the establishment of community-based subsistence fishing areas (CBSFAs). Despite significant community interest across the state, just two CBSFAs have been permanently established in the 20 years since enabling legislation was passed by the state Legislature in 1994. In this study, a mixed methods approach was used that combined a meta-analysis of the co-management literature, a robust policy analysis, and a set of key respondent interviews to examine the barriers preventing successful fisheries co-management implementation in Hawai'i. Barriers were associated with an organizational culture at the state level that was resistant to change, capacity issues at both the community and state level, a complicated and onerous rulemaking process, organized interests mobilized against community-based management, and challenges associated with building consensus. Potential solutions and opportunities for more robust co-management governance are presented that could improve social and environmental outcomes.

3-7 Using the Principles of Reef Resilience to Inform Management of West Maui Coral Reefs

Eric Conklin, Rod Salm, Emily Fielding, Dwayne Minton

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Maui's coral reefs are showing evidence of long-term decline in overall health, as evidenced by decreases in coral and fish abundance and increases in the incidences of coral diseases bleaching events. These declines are presumably due to the combined effects of many local stressors, as well the early impacts of climate change. Without local management actions to restore the health of Maui's reefs and better prepare them for climate change impacts, further degradation is likely. Coral reef scientists and managers from around the world are working to identify the processes and characteristics of coral reefs that will most reliably predict whether a reef will continue to grow and thrive in the face of increased environmental stress, i.e., to predict reef "resilience." Through identifying these critical processes and characteristics and how they vary among reefs, managers can prioritize actions to a) protect reefs that have the greatest potential to withstand increases in environmental stresses expected with climate change, and b) reduce the stressors that most impinge on reef resilience at priority sites, to improve overall resiliency against impending climate change. Using data from West Maui, we will highlight how reef resilience principles can be used to inform local management actions.

3-8 Coral Disease as an Indicator of Reef Resilience in Maui Nui

Darla White¹, Megan Ross^{2,5}, Thierry Work³, Bernardo Vargas-Angel⁴, Jamie Sziklay^{2,5}, Greta Aeby⁵

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Coral disease is one of a number of threats and indicators of reef resilience worldwide. In response to this growing threat, resource managers and researchers have worked together in Hawaii to gather baseline disease data critical to monitor reef health through time. In the Maui Nui complex (Maui, Molokai, Lanai, Molokini) disease surveys were initiated in 2005 and are now included in biennial monitoring surveys conducted by NOAA's Coral Reef Ecosystems Division. Surveys revealed coral disease to be widespread and included *Porites* trematodiasis, growth anomalies, and tissue loss diseases on *Montipora* and *Porites*. In general, disease levels were low but unfortunately,

outbreaks are now starting to occur. A 2008 outbreak of chronic Montipora white syndrome (MWS) at Ahii Kinau on Maui resulted in significant loss of host coral from an average of 48% cover in 2008 to 8.3% in 2013. An outbreak of acute and chronic MWS occurred in Molokini in 2013 and is currently under investigation. Baseline surveys of skin cancer in populations of butterflyfish and the surgeonfish, *Ctenochaetus strigosus* were initiated in 2005 on Maui and Lanai and in 2009 on Molokai. Diseased fish were found on all three islands with distinct "hotspots" of high disease prevalence occurring.

3-9 Evaluation of the Nearshore Benthic Habitat and Marine Biota Adjacent to Kahului Commercial Harbor, Maui, Hawai'i

Yuko Stender¹, Michael Foley², Ku'ulei Rodgers¹, Paul Jokiel¹, Armajit Singh²

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Artificial structures offer engineering solutions for coastal protection and other human activities, however little effort goes toward understanding their ecological roles and impacts within coral reef ecosystems. A submerged breakwater has been proposed as a solution to mitigate impacts of large waves and to provide hard substrate for reef-building corals, potentially enhancing their recruitment and growth near Kahului Commercial Harbor. The design of such a multi-objective artificial structure requires ecological and environmental considerations to successfully enhance coral-dominant communities and to minimize its potential impacts on the distribution of harmful invasive species to native reef communities. To assess its feasibility as a habitat enhancement, a preliminary survey was conducted characterizing benthic habitats and biota in and adjacent Kahului Commercial Harbor in 2013. Live corals were continuous to sparse on the neighboring natural reef. The proposed site fell within habitat characterized by a continuous to patchy mix of carbonate rock, reef rubble, and sand with no live corals. The presence and richness of reef organisms varied among natural and artificial habitats. The greatest species similarity was observed between the outer and inner harbor breakwater while species at the proposed site and the inner harbor breakwater were least similar. Results indicate that an existing gradient of habitat and water quality may greatly affect patterns of relative abundance and species composition for reef communities. Our data provide updated, high resolution information on benthic habitats and biological characteristics that will influence the preliminary design. Ecological considerations and the role of a submerged breakwater in the Kahului area are discussed.

3-10 The Kahekili Herbivore Fisheries Management Area: A New Approach to Control Invasive Algae on Maui's Coral Reefs

Russell Sparks¹, Darla White¹, Ivor Williams²

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Overgrowth of coral reefs by algae is a severe and growing problem along much of Maui's coastlines. Although the causes of these observed coral to algal shifts are complex and vary among affected locations, contributing factors include: elevated nutrients; invasive algae; and over-harvesting of herbivores. The reefs offshore from Maui's North Ka'anapali Beach have shown clear signs of these ecosystem stresses with 20 years of monitoring demonstrating significant declines in coral cover (54% - 37%). To help stabilize this reef ecosystem, the State of Hawaii established the Kahekili Herbivore Fisheries Management Area in July of 2009. This new management strategy was designed to utilize fisheries management tools to help protect and restore the coral reef ecosystems. Implementation efforts have focused on public participation in volunteer monitoring and other stewardship projects, with new collaborative research programs developed to utilize the efforts of citizen scientist. Working together, resource managers, scientists, and the community, are monitoring the effectiveness of these management actions with early signs showing increasing parrotfish biomass, and some corresponding improvements in reef health. Other signs of success include a renewed focus on watershed management in the area, and broad support for the management effort within the fishing community.

3-11 Characterization of "Dead Zones" and Associated Environmental Variables at Kahekili Beach Park in Kaanapali, Maui

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Long-term monitoring, conducted by the Hawaii Coral Reef Assessment and Monitoring Program (CRAMP) and the Hawaii Division of Aquatic Resources (DAR), shows a decrease in coral cover of approximately 30% over the past 15 years at the Kahekili Herbivore Fisheries Management Area (HFMA), located in Kaanapali, Maui. Resource managers with the Maui branch of DAR observed discrete patches of degraded corals, referred to as "dead zones", within the HFMA. In 2010, benthic data were collected in 1,115 contiguous, non-overlapping 5 x 5m cells in order to quantify and characterize "dead zones" along the dominant stretch of reef at Kahekili Beach Park. These census data were used to create a baseline map of the "dead zones" and relative coral condition. The increased spatial resolution and extent, relative to the ongoing monitoring in the area, revealed that coral coverage varied dramatically within the HFMA (0-70%), and that the variation in coral coverage was clustered, resulting in patches of high or low coral coverage. Spatial regression analyses were used to investigate the effect of environmental variables, such as herbivore density and surface ground water input, on the observed distributions and relative conditions of reef building corals.

3-12 Overview of Olowalu Reef – Its Composition, Unique Aspects and Importance for Maui Nui and all of Hawaii

Pauline Fiene

No institution, Kihei, Maui, USA

Compared to an island's land mass, its coral reefs are usually mere slivers around its coastline. Maui is no exception. In fact, Maui has only three areas of significant aggregate reef along its shores. One of these, the largest, is the Olowalu reef area. Within this reef area are an outer reef slope dominated by finger and lobe corals; an inner area dominated by huge lobe coral colonies, some hundreds of years old; and a rare, very protected area containing numerous micro-atolls, the largest area of its kind in the whole state. This protected area is also home to many rare species of corals and unusual growth forms. Unfortunately, Olowalu Reef's proximity to the shoreline and location downslope from years of sugar cane cultivation has resulted in coral loss due mainly to siltation. Proposed development on these abandoned sugar cane fields is the newest threat. Also, a lack of understanding about the special nature and fragility of this reef combined with lack of a community watchdog resulted in recent damage. Now, however, the attention of Maui residents is focused on protecting this unique reef and a Coral Reef Recovery Plan is being implemented.

3-13 Human Threats to Maui's Manta Rays and the Olowalu Reef; Is Science Enough?

Mark Deakos^{1,2}

¹Hawaii Association for Marine Education and Research, Lahaina, Hawaii, USA, ²Maui Nui Marine Resource Council, Kahului, Hawaii, USA

Late maturity, few offspring and a residential nature are typical characteristics of Manta alfredi that make this species vulnerable to localized anthropogenic threats. Photo-identification surveys conducted between 2004 and 2013 at Olowalu Reef, a manta ray aggregation area off West Maui, describe a resident population of over 350 manta rays. Although the biological significance of the study area is not well understood, it appears to be an important staging area where individuals make routine year-round visits to either rid themselves of parasites or to find available mates. One in ten mantas rays has evidence of entanglement in fishing line; many observed with disabled or dismembered cephalic fins, an important appendage used to direct plankton into their mouth when feeding. Threats to their habitat include the continued fortification of the Olowalu shoreline against rising sea levels, and the proposed Olowalu Town development directly uphill from the already declining coral reef habitat. These alarming trends of "business as usual", environmentally destructive practices, despite warnings by the

scientific community, suggest new conservation strategies are needed. Community Based Social Marketing is explored as a new weapon in the fight to preserve Maui's manta ray populations and the Olowalu Reef.

3-14 Cultural Science Edwin "Ekolu" Lindsey
Polanui Hiu, Lahaina, HI, USA

Science is derived from the Latin word Scientia, meaning knowledge. Knowledge is acquired through observation. Kanaka Maoli were keen observers of nature and the ancestral scientists of Hawaii. Cultural Science puts culture first and utilizes science to validate cultural observations. Cultural values and observations supported by science will hanau pono science practices.

3-15 Community Managed Makai Area (CMMA) at Maunalei, Lana'i
Sol Kaho'ohalahala
Community Managed Makai Area, Lanai, HI, USA

After experiencing decades of declining coral cover and native fish populations on his home island of Lana'i Sol Kaho'ohalahala began community management efforts at Maunalei. Prior to starting the Maunalei CMMA Sol participated in a series of weekend long "train the trainers" classes offered by The Nature Conservancy on Maui. Sol, Ekolu Lindsey and Jay Carpio, separately started what are now successful CMMAs at Maunalei, Polanui and Wailuku - all in Maui County.

3-16 Ola na Papa i Malama 'ia: A Practical Plan for the Technical and Cultural Restoration of Maui's Coral Reefs

Robin Newbold
Maui Nui Marine Resources Council, Kihei HI, USA

Because the largest and most complex coral reefs of the Main Hawaii Islands are found around the islands of Maui Nui, and because those reefs are threatened by human activities from both land and sea, the Maui Nui Marine Resource Council assembled a Maui Coral Reef Recovery Team (MCRT) of Hawai'i's eminent coral reef scientists, management experts, cultural leaders, government officials, fishers and community representatives to develop a coral reef recovery plan (MCRP). The plan is intended to be an easy-to-follow and practical guide for communities throughout Hawaii interested in management of their marine resources.

During eight workshops held over two years team members focused their considerable experience and knowledge on developing and publishing a science-based, results-driven, community- and peer-reviewed MCRP. Elements of the plan include a vision, tenets and cultural values, goals and objectives, strategies for achieving reef recovery and methods for measuring success.

Three coral reef priority sites were selected as focal points for plan implementation and a MCRP coordinator chosen to facilitate implementation and coordinate efforts. The MCRT will continue to provide guidance over the next two years.

Details of the MCRP will be described during this presentation. Copies of the plan are available at www.MNMRC.org.

3-17 Nahululeihwakuipapa (Students, Stewards and Emerging Professionals): Trending Conservation: Building a Social Media Strategy that Informs and Activates

Jennifer Barrett¹, Moana Ching², Christy Martin³

¹*Taming Tech for Good, Honolulu, HI, USA*, ²*UH-Hilo, Hilo, HI, USA*, ³*CGAPS-Coordinating Group on Alien Pest Species, Pacific Cooperative Studies Unit, UH Manoa, Honolulu, HI, USA*

Join us for a collaborative learning experience exploring the use of social media to advance conservation initiatives in the Hawaiian Islands. While social networks provide new platforms for community-building, advocacy, education, and fundraising, few conservation initiatives have successfully leveraged these tools to increase impact. This workshop will begin with a brief introduction presenting a collection of common social media pitfalls, and a showcase of effective mission-driven social media tactics. Participants will then work in small groups to conduct a social media audit to assess the effectiveness of selected Hawai'i conservation organizations' web + social media presence and brainstorm ideas for improvement. Each break-out group will be comprised of a mix of seasoned and emerging conservation professionals, and supported by a pre-selected facilitator. The feedback and ideas developed by each multi-generational, interdisciplinary group will be collected and shared with the audited organizations. The blending of various perspectives and knowledge is expected to challenge assumptions of the role of social media in conservation and spark thoughtful discussion. Through this collective effort, our goal is to inspire fresh and reflective approaches to the use of social media by participating conservation professionals, as well as the organizations they audit.

3-18 Rapid Decline in Kauai's Native Forest Bird Community

Eben Paxton¹, Richard Camp², Marcos Gorresen², David Leonard⁵, Eric VanderWerf⁴, Lisa Crampton³, John Vetter³

¹*USGS Pacific Island Ecosystem Research Center, Hawaii National Park, HI, USA*, ²*Hawaii Cooperative Studies Unit, Hilo, HI, USA*, ³*Hawaii Division of Forestry and Wildlife, Honolulu, HI, USA*, ⁴*Pacific Rim Conservation, Honolulu, HI, USA*, ⁵*US Fish and Wildlife Service, Portland, OR, USA*

Kauai's forest birds are a group of great conservation concern. Largely restricted to the Alakai Plateau, the only high elevation (>1000 m) forest on Kauai, these birds have been affected by several threats over the years, including hurricanes, invasive alien plants, invasive animals including predators and ungulates, and introduced diseases. Four forest bird species endemic to Kauai went extinct in the 1970s and 1980s, and three more endemic species currently are critically endangered. Bird surveys carried out from 1981 to 2012 indicate declining numbers and contracting ranges for most species. We present the results of the surveys, evaluate trends and current ranges, and discuss how different patterns among the species can provide us with insight into what is happening with Kauai's forest birds.

3-19 Changes in Kauai's Forest Bird Community

Kyle Pias¹, Lisa Crampton¹, Richard Camp², Kevin Brinck²

¹*Kauai DOWFAW, Lihue, HI, USA*, ²*USGS, Volcano, HI, USA*

Kauai's avifauna represents a unique imperiled community found nowhere else in the world. This species assemblage has faced many threats throughout the years including disease, introduced predators, natural disturbance events, and potentially competition from non-native birds. Yet it was considered relatively intact until 1975. To determine how Kauai's bird community has changed since the 1980s we analyzed point count data collected from 1981 to 2012. We performed a hierarchical agglomerative cluster analysis to determine the number of communities detected over the study period, and an indicator species analysis to identify bird species associated with each community. We performed a non-metric multi-dimensional scaling ordination on the community data and overlaid that ordination with environmental, spatial, and temporal variables. Over the study period, three distinct bird communities were detected: a community dominated by native species including the endangered Akikiki and Akeke'e, an intermediate community dominated by a mix of native and exotic species, and an exotic dominated community. These three communities existed across both temporal and environmental gradients, with the native community being found predominantly in the earlier surveys and at higher and wetter locations, and the exotic community existing mainly in more recent surveys and at drier and lower elevations.

3-20 Occupancy and Survival of the Critically Endangered, Highly Cryptic, Single Island Endemic, the Puaiohi

Lisa "Cali" Crampton¹, Kevin W Brink², Richard J Camp², Marcos Gorresen², Eben Paxton³, Barbara AH Heindl¹
¹*Kauai Forest Bird Recovery Project, Hanapepe, HI, USA*, ²*University of Hawaii at Hilo, Hilo, HI, USA*, ³*USGS Kilauea Field Station, Volcano, HI, USA*

The federally endangered Puaiohi (*Myadestes palmeri*) numbers 200-800 individuals, and is restricted to 25km² of the island's interior. The species is cryptic and found only along deeply incised, meandering streams; thus using standardized point transect surveys to determine abundance and distribution is problematic. Therefore, we developed a survey and modeling approach based on occupancy analysis to improve accuracy and precision of population estimates. In 2011-2013, we surveyed 20 stations along each of 12 randomly selected streams at least five times during the breeding season, using a combination of passive listening and playback. In 2013, we measured habitat variables at each station. We used a maximum likelihood model to estimate both the probability that a given site was occupied (within a bird's territory) and the probability of detecting a bird given the site was occupied. Analyses indicated that 1) playback increased detection probability, and 2) occupancy of survey stations varied with stream channel topology. We will combine this information with survival estimates of wild and captive release birds and remotely-sensed data to produce a landscape model of Puaiohi population size and distribution, and provide insight into threats facing the Puaiohi.

3-21 Occupancy and Habitat Use of the Endangered Akikiki and Akekee on Kauai Island

Lucas Behnke^{1,3}, Liba Pejchar¹, Lisa Crampton²
¹*Colorado State University, Fort Collins, CO, USA*, ²*Kauai Forest Bird Recovery Project, Hanapepe, HI, USA*, ³*The Nature Conservancy, Lihue, HI, USA*

The Akikiki (*Oreomystis bairdi*) and the Akekee (*Loxops caeruleirostris*) are critically endangered honeycreepers endemic to the Hawaiian island of Kauai. Evidence of recent dramatic declines and potential contraction of already-limited ranges have spurred investigation of these little known species to inform recovery efforts. We conducted occupancy sampling for Akikiki and Akekee and vegetation surveys on the Alakai Plateau of Kauai to assess range-wide occupancy and habitat use. Occupancy rates for both species increased from west to east along the Plateau (Akikiki: $\psi = 0.02 \pm 0.07$ to 0.55 ± 0.21 Akekee: $\psi = 0.03 \pm 0.10$ to 0.53 ± 0.33), but were low throughout the range for both species. Canopy height was correlated with occupancy for both species, which suggests the damage done by hurricanes in 1982 and 1992 may be restricting these birds to remaining intact habitat. Habitat surveys across the range of these species indicated several differences in vegetation, such as ground and shrub cover by invasive species and disturbance by feral ungulates, which are indicative of broader changes occurring across the Plateau. Without significant investment to protect and restore suitable habitat for, and address threats to, these species, it is unclear how long these birds will persist.

3-22 Changing Climate and the Altitudinal Range of Avian Malaria on Kaua'i

Carter Atkinson¹, Ruth Utzurrum^{2,7}, Dennis LaPointe¹, Richard Camp², Lisa Crampton³, Jeffrey Foster⁴, Thomas Giambelluca^{5,6}

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Potential consequences of global warming on transmission of avian malaria in Hawaii have been recognized for over a decade with concerns that increases in mean temperatures could lead to expansion of malaria into habitats where cool temperatures currently limit transmission to highly susceptible endemic forest birds. Recent declines in two endangered species on the island of Kaua'i, the 'Akikiki (*Oreomystis bairdi*) and 'Akeke'e (*Loxops caeruleirostris*), and retreat of more common honeycreepers to the highest reaches of the Alaka'i Plateau suggest that predicted changes in disease transmission may be occurring. We compared prevalence of malarial infections in forest birds that were sampled at three locations on the Plateau between 1994-1997 and again between 2007-2013, and also evaluated changes in the occurrence of mosquito larvae in available aquatic habitats during the same time periods. Prevalence of infection increased significantly at the lower (1,100 m, 10.3% to 28.2%), middle (1,250 m, 8.4% to 12.2%) and upper ends of the Plateau (1,350 m, 2.0% to 19.3%). Increasing mean air temperatures, declining precipitation, and changes in streamflow that have taken place over the past 20 years are creating environmental conditions throughout major portions of the Alaka'i Plateau that support increased transmission of avian malaria.

3-23 Decision Making for Conservation of Two Endangered Kauai Passerines

John Vetter¹, Megan Laut², Eben Paxton³, Steve Morey⁴

¹*State of Hawaii Division of Forestry and Wildlife, Honolulu, HI, USA*, ²*U.S. Fish and Wildlife Service, Honolulu, HI, USA*, ³*U.S. Geological Survey Biological Resources Division, Volcano, HI, USA*, ⁴*U.S. Fish and Wildlife Service, Portland, OR, USA*

The Akikiki and Akekee are small, insectivorous passerines endemic to the island of Kauai, where they are currently restricted to the forests of the Alakai Plateau. Recent surveys have documented a steep decline and range contraction in both species, prompting the need for a management strategy to develop the most efficient and successful means to conserve these species. A group of fourteen experts was convened to analyze the currently available information, develop alternatives to consider, and rank these alternatives to create a recommended management plan for decision-makers. Fifteen action alternatives were examined based on the likelihood of the alternative to prevent the immediate extinction of each species, set the foundation for having a genetically viable, reproducing, and stable population in 10 years, and allow for the long-term persistence of each species in the wild. The probability of success of each alternative was also weighed against the constraints of implementing that action, including uncertainty of achieving the objective given current understanding of the technique, time required to implement the action, time required for actions to provide positive effects, public support of the action, and cost of the action.

4-1 Embedding the Science of Ocean Tipping Points in Coral Reef Conservation and Management

Jack Kittinger¹, Kirsten Oleson², Carrie Kappel³

¹Stanford University, Center for Ocean Solutions, Monterey, CA, USA, ²Department of Natural Resources and Environmental Management at UH Manoa, Honolulu, HI, USA, ³National Center for Ecological Analysis and Synthesis at UC Santa Barbara, Santa Barbara, CA, USA

In response to anthropogenic stressors, coral reefs can “tip” into undesirable alternative states or regimes with reduced benefits to coastal communities. In this introduction to a symposium, we provide an overview of the science of coral reef tipping points and practical ways to integrate these concepts into conservation and management. We showcase the ways in which this emerging field can help managers understand the safe operating space for actions, as well as the early warning signs that can inform proactive strategies to avoid tipping points. We will briefly introduce how the Ocean Tipping Points project (www.oceantippingpoints.org) is developing science-based solutions that community organizations, practitioners, and coral reef managers can implement in ridge-to-reef approaches, together with traditional Hawaiian principles, in ecosystem based management approaches.

4-2 Identifying Multiple Regimes of Hawaiian Coral Reefs and Implications for Conservation

Mary Donovan¹, Jean-Baptiste Jouffray², Lisa Wedding³, Gareth Williams⁴, Albert Norström², Magnus Nyström², Alan Friedlander¹, Ivor Williams⁵

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Characterizing regimes of coral reef ecosystems and understanding their drivers is critical for managers and policymakers seeking to protect ecosystem services generated by coral reefs, especially in a context of ecosystem-based management. Preliminary work in Hawaii has shown that multiple ecosystem states exist, moving beyond the traditional view of only coral- or macroalgal-dominated reefs. We suggest that simply testing for bimodality in the frequency distribution of reef state is not sufficient and rather that new insights on coral reef ecological functioning will be informed by a holistic analysis of multiple ecosystem components including fish, coral, algal and invertebrate communities. An unprecedented magnitude of existing data from the Hawaiian Archipelago provides us with an unparalleled opportunity to obtain novel insights into multi-scale dynamics of reef states and resilience, leading to a better understanding of the relative influence of natural and anthropogenic drivers in dictating regime shifts. The outcome will be a step toward practical implementation of ecosystem-based management by helping managers define tangible targets, and better understand the ecological effects of human activities.

4-3 People and reefs: Cumulative human impact mapping for marine ecosystems of Hawai'i

Joey Lecky^{1,3}, Kim Selkoe², Kirsten Oleson¹

¹University of Hawaii at Manoa, NREM Department, Honolulu, HI, USA, ²National Center for Ecological Analysis and Synthesis, Santa Barbara, CA, USA, ³Hawaiian Islands Humpback Whale National Marine Sanctuary, Honolulu, HI, USA

Understanding the spatial distribution, intensity, overlap, and cumulative influence of human activities, both on land and at sea, is essential for effective management of ocean resources. In order to assist marine managers with these issues, we are building a database of all available geospatial data related to human impacts on the marine environment in Hawai'i. Next we will use information from expert opinion surveys and other ongoing research to determine the relative significance of each human activity to ecosystem function. This information will be used to conduct geospatial analyses and produce maps of the level of cumulative impact sustained across the marine environment of the populated Hawaiian Islands. Previous applications of this analysis in other regions has helped

marine managers identify priority areas for protection, surveillance, threat mitigation, ocean zoning, and monitoring for climate change effects.

4-4 Predictive Models and Trade-off Analysis for Guiding Cost-Effective Land-Based Management Actions for Conserving Coral Reefs

Crow White¹, Kirsten Oleson², Kim Falinski²

¹*Cal Poly, San Luis Obispo, CA, USA*, ²*University of Hawaii, Manoa, HI, USA*

Land-based source pollutants (LBSP) are an active threat to coral reef ecosystems in west Maui and around the world. Managers recognize that changes in land use directly affect the export of sediments and nutrients to reefs, and are targeting management actions towards mitigating LBSP. To be successful and cost-effective in their efforts, managers require appropriate tools to estimate how alternative land use, land cover change, and management practices may drive sediment and nutrient runoff into coastal waters. To meet this demand and advance effective and efficient land-based ocean conservation practices, we are developing a novel, spatially explicit predictive model that quantifies change in LBSP from alternative potential management actions across the landscape in West Maui. We will then employ the tool to investigate changes in LBSP arising from alternative spatial configurations of individual and multiple coordinated land use practices deployed under different management and climate scenarios. Finally, we will integrate our model with a trade-off analysis to identify effective and efficient land-based management strategies that enable managers to maximize the value (and/or minimize the cost) of mitigation efforts while minimizing LBSP.

4-5 Environmental Drivers and Local Human Impacts Shape Coral Reef Communities across the Pacific

Jamison Gove^{1,3}, Gareth Williams²

¹*Joint Institute for Marine and Atmospheric Research, University of Hawaii, Honolulu, Hawaii, USA*, ²*Scripps Institution of Oceanography, San Diego, California, USA*, ³*NOAA Coral Reef Ecosystem Division, Honolulu, Hawaii, USA*

Coral reef communities are shaped by local- and regional-scale gradients in natural environmental drivers. Long-term environmental conditions determine both the rate of successional states and the position of the community along a dynamic trajectory of change. Anomalous environmental events, or those that exceed long-term environmental conditions, often result in coral reef ecosystem change. As such, naturally coupled biophysical relationships in coral reefs are a major determinant of ecological community composition. Superimposed on natural drivers are the effects of anthropogenic disturbance, which can homogenize landscapes and "change the rules of the game" such that community composition no longer reflects long-term adaption to background environmental conditions. Using 39 individual atolls and islands across the Hawaiian Archipelago and the greater Pacific, we show that clear biophysical relationships exist in the absence of local human impacts and that key environmental drivers (temperature, irradiance, waves and phytoplankton biomass) are strong predictors of coral reef benthic community composition. In contrast, the presence of local human impact appears to break down or reverse these naturally coupled biophysical relationships, and in some cases, novel relationships appear to develop. Increased understanding of natural versus human drivers of reef ecosystems will help us predict how coral reef communities may respond to increased human population and future climate change.

4-6 Using Modeling Approaches to Understand and Respond to LBSP Impacts on Coral Reefs

Kirsten Oleson, Jade Delevaux, Kim Falinski, Hla Htun
UH Manoa, Honolulu HI, USA

In Hawaii, coral reefs provide important benefits to society, including shoreline protection, recreational opportunities, food, income, and cultural identity, but those ecosystems are under threat from growing anthropogenic stressors, including overfishing, land-based pollution, and climate change. In response to those stressors and in order to restore reef health and their services, the Ridge-2-Reef initiative, in west Maui, is

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managing the watershed to minimize land-based source pollution. To support these efforts, we are developing an ecosystem services trade-off decision support tool. The tool will quantify, map, and value changes in ecosystem services mauka to makai under alternative policy and/or climate change scenarios. The tool will estimate impacts on sediment and nutrient loads of specific management actions, and translate those into changes in reef services supply. As part of this effort, we are building appropriate models to estimate (i) how land use, land cover change, and management practices will impact water, sediment, and nutrient runoff into coastal waters; and (ii) how changes in water, sediment, and nutrient loads reaching the coastal environment will impact the delivery of coral reef ecosystem services. Gaining an understanding of the impacts of land management on ecosystem service delivery will promote a shift towards a watershed approach.

4-7 Getting Stakeholders to the Table: The Collaborative ‘Au‘au Planning Initiative

Anne Walton¹, Charles Steinbeck²

¹NOAA International MPA Capacity Building Program, Honolulu, HI, USA, ²Point 97 (a company of Ecotrust), Portland, OR, USA

The ‘Au‘au Planning Project aims to address a high-level goal that is common among coastal communities and marine conservation groups in Hawaii: abundant marine resources and sustainable practices. The project will provide the groundwork to achieve that goal in the ‘Au‘au Channel area by implementing a planning process which involves communities and jurisdictional authorities in the marine and coastal areas of west Maui, then south Moloka‘i, and north Lāna‘i. Local communities will work alongside county, state and federal agencies in a facilitated, yet self-directed, planning process which includes steps such as: visioning (e.g., describing common goals for the future state of the ‘Au‘au Channel area), information-gathering (e.g., compiling known data about the habitat, ecosystem processes, human uses), conflict and compatibility analysis (e.g., discussing what aspects of the environment and human components are compatible with each other or not), and innovative solution-building (e.g., identifying a range of solutions and commitments for realizing the goals for the future). The project will honor the holistic nature of marine ecosystem-based management by drawing on traditional Hawaiian practices and relationships to the land, coastal and marine environment with the focus on building the capacity for communities to determine their future, and contribute to making it a reality.

4-8 The Maui Nui Makai Area Learning Network Experience

Edwin Lindsey⁴, Sol Kaho‘ohalahala⁷, Jay Carpio¹, Maile Carpio¹, Manuel Mejia⁸, Emily Fielding⁸, Leimamo Lind-Strauss⁶, Claudia Kalaola⁵, Robin Newbold², Legario Eharis⁵

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Collaborative management and adaptive learning are some of the most effective and powerful ways to engage stakeholders to improve local management at the site level. Especially in the marine realm, where coastal areas and reef ecosystems are in the public domain, a participatory and community-based approach is necessary. The Maui Nui Makai Area Learning Network was established in 2013 by 6 communities from Maui, Lanai and Molokai and 2 supporting organizations. This emerging network would like to share their experiences and lessons learned on how to form networks that build capacity for communities that rely on the health of their marine and coastal environments.

45 mins - Presentations by convenors and the 6 Maui Nui communities (Kipahulu, Mu‘olea, Polanui, Wailuku, Maunalei, Mo‘omomi)

15 mins - interactive discussion and activity that will raise awareness on how to start up and follow through with the support of these critical learning networks, how to establish scientific baselines by which to measure the

effectiveness of management efforts and to foster networking among site- and culturally-based conservation practitioners at the 22nd HCC.

4-9 Stretching the Boundaries: Long-Distance Translocation of Millerbirds Facilitates Endangered Species and Ecosystem Recovery

Sheldon Plentovich¹, Chris Farmer², George Wallace³

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³*American Bird Conservancy, The Plains, VA, USA*

The Laysan Millerbird (*Acrocephalus familiaris familiaris*) went extinct in the 1920s after habitat destruction by introduced rabbits and livestock. A second Millerbird subspecies, *A. f. kingi*, persists on Nihoa and is listed as Endangered. We established a second population of Nihoa Millerbirds on Laysan by translocating 50 Millerbirds 1,037 km by sea from Nihoa to Laysan in September 2011 and 2012. The translocation reduces the extinction risk for the Millerbird and has the ancillary benefit of re-establishing an insectivorous passerine bird to Laysan. As of September 2013, the new Millerbird population was estimated to be 121 birds (71 adults and 50 hatch-year birds). We predict that this population will grow quickly, based on the following evidence: 82% (32/39) of active nests in 2013 produced at least one fledgling; a high proportion of banded nestlings were resighted as independent juveniles, indicating successful fledging; all eight young birds banded in 2012 survived over the winter; and annual adult survival was high. This translocation provides a model that can inform progressive endangered species and restoration programs seeking novel methods for conserving populations of endangered species and considering the use of ecological analogues to replace extinct, but closely related, species.

4-10 Home-Range Patterns of Kiwikiu (*Pseudonestor xanthophrys*) and Maui ‘Alauahio (*Paroreomyza montana*)

Chris Warren, Hanna Mounce

Maui Forest Bird Recovery Project, Makawao, USA

The critically endangered kiwikiu (*Pseudonestor xanthophrys*) and the threatened Maui ‘alauahio (*Paroreomyza montana*) and are now largely restricted to native, wet forest on the windward slopes of east Maui, above 1300m. Current conservation efforts are aimed at reintroducing kiwikiu to the historically occupied native, mesic forest on the leeward slopes of east Maui. This forest will likely retain lower tree density than the forests the birds currently occupy and little is known of how much area individuals will require within this forest type. We compared the home-range size of both species as a measure of space-use in three sites dispersed across the birds’ current range. We calculated home-ranges as minimum convex polygons and using kernel density estimators from resighting data of color-banded birds from 2007-2013. We found kiwikiu home-ranges to be between $4.45 \pm 0.84\text{ha}$ and $7.93 \pm 1.43\text{ha}$ ($\pm\text{SE}$) depending on estimation technique and ‘alauahio home-ranges to be between $0.65 \pm 0.06\text{ha}$ and $1.19 \pm 0.12\text{ha}$. ‘Alauahio home-ranges varied slightly among sites while kiwikiu home-range size did not. Though we are not likely to know how these species will react to the leeward forests, these results provide a baseline indicator of their space and habitat requirements.

4-11 Native Hawaiian Forest Birds Using Non-Native Habitat on Maui

Peter Motyka^{1,2}

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With so many threats to the persistence of Hawaii's native forest birds, knowledge of any habitat that can support viable populations will contribute to effective conservation. On Maui, four species of native Hawaiian Honeycreeper persist in the Kula Forest Reserve, a high-elevation forest dominated by non-native vegetation. This forest represents a significant portion of the limited habitat available above the elevation where cold temperatures restrict mosquito-borne avian disease. Understanding how these native forest birds are using this non-native vegetation will help inform management decisions and potential restoration efforts. We measured bird occupancy and density with distance sampling surveys and compared results among varying forest composition and structure.

We also observed the Maui Alauahio (*Paroreomyza montana*), an endemic insectivorous honeycreeper, to investigate smaller scale habitat use. Our study confirms that the native forest birds are successfully reproducing and exploiting the resources provided by the non-native vegetation. Bird densities and occupancy vary among habitat types within the forest, and in some areas, bird densities are similar to those found in native habitats. These findings will be valuable to conservation efforts because we can recommend preferred forest conditions to managers and potentially increase native forest bird populations.

4-12 Preliminary Molecular Phylogeny of the Endangered Hawaiian Leaf Mining Moth Genus *Philodoria* (Lepidoptera: Gracillariidae)

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The leaf mining moth genus *Philodoria* (Lepidoptera: Gracillariidae) includes 30 poorly studied species that are endemic to the Hawaiian Islands. Most species are monophagous, feeding internally within the leaf of a single endemic plant species, but the genus as a whole is known to feed on as many as 12 different plant families. Approximately 75% of the group's host plants are threatened or endangered, making these moths particularly vulnerable. A comprehensive systematic treatment has not been conducted in over thirty years, and the systematics, phylogenetics, and conservation status of many of these moths remains largely unknown. Here, we present preliminary data from recent systematic and phylogenetic work on *Philodoria*, and discuss future plans to study the biogeography of the group. In addition, we outline our efforts to raise awareness for *Philodoria* conservation in both conservation and public audiences alike.

4-13 Preliminary Identification of Protected Areas with High Diveristy of *Tetragnatha* Spiders on Big Island and Maui Nui

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Knowing the biological resorces present on an area is fundamental to develop management and conservation plans. The Hawaiian Islands are well known for their highly endemic and threatened biota. The *Tetragnatha* spiders correspond to a group with two spectacular adaptive radiation with 37 described species (<11% world's diversity) and many more to be describe. One of these radiations, Spiny leg clade, presents radical ecological transformations. Which are the protected areas of high diversity of *Tetragnatha* spiders in Hawai'i? Based on more than 4 months of sampling spread over five field seasons (2010-2013), we will present a preliminary overview of the species richness on different state, federal and private reserves located on the Big Island and Maui Nui. We will also indicate areas of high genetic diversity for three particular species (*T. brevignatha*, *T. waikamoi* and *T. anuenue*). This species and genetic diversity could be the result of a more general diversification phenomenon which could have produced high endemicity in other groups of organims. This study corresponds to a preliminary assessment, but we hope that this information will be useful for land managers and conservation organizations.

4-14 Inbreeding Depression Leads to Decline in a Majority of Captive-Bred Species in the Hawaiian Tree Snail Subfamily Achatinellinae

Melissa Price, Michael Hadfield

University of Hawai'i at Manoa, Honolulu, HI, USA

Taxa with long life histories, late maturity, and low fecundity, may be less likely to recover from severe or prolonged bottlenecks than taxa that mature quickly and produce many offspring. Over 50 species of endemic Hawaiian tree snails (Achatinellinae) descended from a single island introduction less than 3.7 Ma. Historical

records indicate tree snails were once abundant, thriving from sea level to 1500 m. A majority of captive-bred populations, founded as a hedge against extinction after devastation by habitat fragmentation, predation, and over-collection, have declined over the past decade. We investigated whether these populations showed genetic and demographic indicators of inbreeding depression following a constricted bottleneck. Demographic analysis of captive population trends across ten species, combined with genetic analysis of microsatellite data for wild and captive populations, suggest wild, fragmented tree-snail populations were already inbred when captive populations were founded. Bottleneck effects probably increased the likelihood of homologous, detrimental alleles in offspring, leading to significant decreases in fecundity, juvenile survival, and survival to maturity in the majority of species studied. These results suggest tree-snail populations retained in predator exclosures in the field are at high risk of inbreeding depression, and should be carefully monitored and managed to maximize genetic diversity.

4-15 Propagation of Three Critically Endangered Fern Species of Kaua'i: *Asplenium dielpallidum*, *Asplenium dielmannii* and *Asplenium diellaciniatum*

Ruth Agurajuja

Tallinn Botanic Garden, Tallinn, Estonia

The endemic fern species *Asplenium dielpallidum* N. Snow, *Asplenium dielmannii* Viane and *Asplenium diellaciniatum* Viane are globally critically endangered, and have been considered as difficult to propagate. The propagation by sowing their spores to the soil substrate in laboratory conditions was studied in 2011-2014. The aim was to gain information about the germination rates of the spores, subsequent developmental rates of the gametophytes and duration of different sporophyte life stages in cultivation. The average germination rate of the spores varied from 30 to 74 days. The growth, development and maturation of their gametophytes were much slower than that of contaminating fern species. The whole cycle from germination of the spores to the beginning of the spore formation on new sporophytes lasted at least four years. The propagation tests approved the perennial growth of the gametophytes and their good capability for vegetative and regenerative growth, which may be the adaptations to periodical variation of environmental conditions in their natural habitats in mesic forest. These phenomena could serve well as an *ex situ* tool for preserving the gene pool of these species, and their propagation for the restoration and reinforcement of the natural populations.

4-16 Navigating Restoration Tradeoffs: Long-term Outcomes of Using Māmane (*Sophora chrysophylla*)

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¹University of California, Santa Barbara, CA, USA, ²US Geological Survey, Hawai'i Volcanoes National Park, HI, USA

Nitrogen (N) fixing plants are commonly used in restoration for their ability to colonize degraded and disturbed habitats. The native N-fixing tree māmane (*Sophora chrysophylla*) is a popular restoration choice in seasonally dry Hawai'ian habitats because it regenerates from both seed and resprouting after fire and supports native birds. We have found however, that māmane can also promote the growth of invasive species such as molasses grass (*Melinis minutiflora*) and lantana (*Lantana camara*). This talk will discuss the tradeoffs inherent in restoration decision making in the long term by comparing the understory communities that have developed under created stands of māmane and other N-fixing trees eg. koa (*Acacia koa*) with unrestored burned sites including open grassland as well as faya (*Morella faya*) invaded burned areas nearby in the seasonally dry submontane zone of Hawai'i Volcanoes National Park.

4-17 Bridging Agriculture and Conservation Initiatives

David Morgan¹, Stephanie Whalen², Nicklos Dudley², Irene Sprecher³, Steph Dunbar-Co⁴

¹Kualoa Ranch, Ka'a'awa, HI, USA, ²Hawaii Agriculture Research Center, Kunia, HI, USA, ³Division of Forestry and Wildlife, DLNR, Honolulu, HI, USA, ⁴Kainalu Ranch, Kainalu, HI, USA

In recent years, there's been a growing movement within the Hawaii agricultural industry to shift towards a more environmentally sustainable model. The connection between agricultural activities and the health of our natural

resources has been recognized by leaders in both the agricultural industry and the conservation community. Restoring previously farmed areas to native forest, implementing conservation practices that reduce runoff into Hawaii's streams, and protecting habitat for endangered species are some ways that our panelists have promoted conservation initiatives.

This panel represents both farmers and conservationists in Hawaii who have demonstrated a commitment to healthy landscapes and sustainable agriculture, paving the way for others to follow. Their work has highlighted the possibility of successful partnership and cooperation between two groups that historically have had competing interests. The panelists will share their experiences, discussing their challenges and successes, and illustrate how their work with the agricultural industry has contributed to conservation initiatives. They will also identify successful strategies for encouraging environmentally sustainable behavior when working with farmers and members of the agricultural industry. The forum will conclude with a question and answer session.

4-18 Empowering Farmers for Conservation: Case Studies from California

Melanie Cheng^{1,2}, Evan Wiig^{1,2}

¹*FarmsReach, Berkeley, USA*, ²*Farmers Guild, project of FarmsReach, Berkeley, USA*

When it comes to conservation, the farming community needs to be a part of the conversation. The preceding Forum will spotlight some examples of how sustainable agriculture and cooperation have helped foster healthy landscapes in Hawaii. In this brief follow-up session, we'll discuss a successful program in California as a framework to accelerate innovation and learning among farmers so they are empowered to become impactful agents of change. Integrating both in-person farmer meet-ups and online information-sharing and toolkits, the Farmers Guild and FarmsReach are rebuilding a cohesive farming community focused on environmental sustainability, conservation and viability. We invite anyone interested in a similar program in Hawaii to engage and support farmers.

4-19 I KA WĀ MA MUA KA WĀ MA HOPE-The Future is in the PastSTEM STEWARDSHIP via the Lens of Voyaging

Amber Inwood, Jenna Ishii, Moses Goods

Bishop Museum, Honolulu, United States Minor Outlying Islands

If we stare into the future we'll see...nothing. The future hasn't happened yet. Turn around however and the view is endless. Through the lens of Pacific voyaging, the *I KA WĀ MA MUA KA WĀ MA HOPE* program helps students and educators to explore the works of our ancestors and discover that S.T.E.M (science, technology, engineering and mathematics) is nothing new to us and that Hawaii, is a place where the land and sea are cared for, and people and communities are healthy and safe.

Developed in partnership with the University of Hawai'i College of Education and Polynesian Voyaging Society this interactive workshop will provide participants the opportunity to be guided through the new Bishop Museum Education Online Learning Center, which is home to the STEM through the lens of Voyaging Middle School and Informal Education Curriculum. Participants will also experience the Bishop Museum cultural storytelling of *I KA WĀ MA MUA KA WĀ MA HOPE* while making connections to the Polynesian Voyaging Society Malama Honua World Wide Voyage and online learning center. Participants are required to bring a laptop and/or IPAD.

Funding has been provided by the Department of Education Native Hawaiian Education Program under the Bishop Museum 'All Together Now' Project.

5-1 Hui Mālama Loko I‘a: A Growing Network for Fishpond Practitioners and Organizations across Hawai‘i

Brenda Asuncion

Kua‘aina Ulu ‘Auamo, Honolulu, HI, USA

Hui Mālama Loko I‘a (hui) is a growing consortium of fishpond practitioners, owners, stewards, and supporters who have been meeting opportunistically since 2004. They have recently gained coordination support from Kua‘āina Ulu ‘Auamo (KUA), which is an organization providing connection, capacity, and resources for grassroots community stewardship work statewide. The hui currently represents over 35 fishponds and complexes on Kaua‘i, O‘ahu, Moloka‘i, Lāna‘i, Maui, and Hawai‘i, and involves nearly 150 individuals interested in honoring the unique and important history and role of loko i‘a in Hawai‘i.

This network provides an opportunity to recognize the collective knowledge and experience represented within Hui Mālama Loko I‘a. The hui also carries the potential to revive an important aspect of place-based sustainability and community capacity.

The forum will feature practitioners from five different islands, and they will each discuss their general perspectives on the role of loko i‘a in their communities, as well as their specific experiences in fishpond advocacy, restoration, policy, and education.

The forum convener and panel participants will also suggest ways that people can get involved and support the fishpond community, either as a collective hui or at particular loko i‘a.

5-2 Innovative Research in Hawaiian Estuaries to Improve Sustainable Fishing in Hawaii

Kimberly Peyton¹, Troy Sakihara², Troy Shimoda², Skippy Hau³, Lance Nishiura², Tim Shindo²

¹*Division of Aquatic Resources, Honolulu, Hawaii, USA*, ²*Division of Aquatic Resources, Hilo, Hawaii, USA*,

³*Division of Aquatic Resources, Maui, Hawaii, USA*

Estuaries play key roles in coastal productivity; however this important ecosystem is understudied in Hawaii. Our research focuses on Hawaiian estuarine ecology with a strong emphasis on fish communities. Juvenile fishes and invertebrates are especially abundant in estuaries because of two key factors. Extensive productivity in estuaries yields food resources that are essential for rapidly growing juveniles. Also, while concentrations of larvae and juveniles attract predators to estuaries, interactions of seawater, freshwater and land in estuaries create diverse habitats that provide critical refuges from predation. Our overarching goal is to improve management of estuaries and, in turn, increase survival and growth rate of juvenile fish. Healthier juvenile fish populations in estuaries can improve the number of fish recruiting to adult habitat, which contributes to sustainable fishing in Hawaii.

5-3 What's a Polyp to Do? Hawaii's First Coral Nursery Dedicated to Mitigation and Restoration

Dave Gulko, Michael Cavazos, Zac Forsman

Hawaii Division of Aquatic Resources, Honolulu, HI, USA

The mitigation of impacts to coral reefs in Hawaii has been extremely difficult due in part to the inability to properly replace the lost ecological services incurred with impact to corals in these ecosystems. Because of Hawaii’s high latitude location, isolation and high endemism, this takes on even greater value; resulting in much longer natural recovery times than coral reef regions elsewhere. By taking individual, healthy coral polyps and extracting tissue explants or polyp assemblages which are then grown into larger assemblages under biosecure conditions and then either re-combined with other genetically-identical assemblages or individually distributed within microcosms which replicate the field conditions targeted, we can fast-track this process with exceptionally

healthy batches of colonies which are genetically identical and can therefore grow together to form a single larger colony in a fraction of the time it would take to occur in the wild. In concert with DLNR's new Coral Reef Mitigation Bank and our new DAR Hawaiian Coral Ecological Value Assessment Tool, the coral nursery will provide a practical and applied means for restoring both impacted areas and mitigating losses to Hawaii's unique and ever-decreasing coral reef habitats

5-4 Implementing Hawaii's Rapid Response Contingency Plan: Strengthening Our Framework for Responding to Coral Disease, Bleaching, and Crown-Of-Thorns-Starfish Events

Anne Rosinski

DLNR/Division of Aquatic Resources, Honolulu, HI, USA

In 2009, the Division of Aquatic Resources (DAR) developed Hawaii's Rapid Response Contingency Plan (RRCP) through a collaborative process with several agency partners. This three-tiered plan provides a framework for managers to respond to unusual events of coral disease, coral bleaching, and Crown-Of-Thorns-Starfish (COTS). It includes the Eyes of the Reef Network, a community-based early reporting and education program resource management and science teams, and a Rapid Response Team who deployed to conduct the initial assessment of each event.

Starting in 2013, DAR began to revise and strengthen this plan to incorporate valuable lessons and look for innovative research, novel management techniques, and inclusive communication strategies that are being used to ensure coordinated and timely assessments and responses. This revision is particularly timely with the current coral disease outbreak on Kauai and several events taking place around the Pacific region. A strategic decision-making model, event outreach plan, and matrix of feasible management actions will enhance the RRCP and support managers and scientists to navigate in this emerging field and through the changes we observe in Hawaii's coral reef environment.

5-5 Japan Tsunami Marine Debris: A New Threat for Aquatic Invasive Species Management

Sonia Gorgula

Department of Land and Natural Resources, Honolulu, Hawaii, USA

On March 11, 2011, a 9.0 magnitude earthquake struck off the coast of Honshu, Japan, creating a devastating tsunami that reached heights of up to 130 feet and inundated 217 square miles. The tsunami sent millions of tons of Japan Tsunami Marine Debris (JTMD) into the ocean, originating both from land and from coastal environments. The release of this debris field brought a new management challenge to Hawaii. We now had more marine debris arriving that was not only larger, but that also had the potential to introduce aquatic invasive species. Scientists did not anticipate that debris would arrive with intact communities of non-native organisms.

What has emerged is a Pacific-wide network of managers, scientists, researchers and agencies brought together by a common goal: to respond quickly to the arrival of JTMD and mitigate any potential threats. In Hawaii this has led to the development and implementation of a new rapid response team comprised of multiple agencies and follow-up surveys of JTMD landing sites to check for the presence of non-native species. We are also engaged in a national project that will predict the impacts to Hawaii of the non-native species that arrive on JTMD.

5-6 Community Fisheries Enforcement Units - A New Model for Fisheries Management

Brooks Tamaye

DLNR/Division of Conservation and Resource Enforcement, Honolulu, HI, USA

Hawaiians traditionally manage their fisheries sustainably and reflected the tremendous value placed on food resources. Unfortunately today, the State of Hawai'i's lack of resources to establish and enforce effective marine regulations is one of the most significant barriers to improving coastal ocean health and seafood security. To

address this issue, State of Hawaii has partnered with the Hawai'i Fish Trust and the Harold K.L. Castle Foundation to transform fisheries enforcement in Hawai'i. The partnership successfully launched an innovative fisheries enforcement unit on Maui, designed to work hand in hand with the local community while improving compliance to fisheries rules and regulations. Hawai'i Fish Trust also provides support for key positions and initiatives within the Department of Land and Natural Resources, Division of Conservation and Resource Enforcement.

5-7 What Do We Know And How is it Related? Organizing Data Based On a Ridge-To-Reef Concept

Glenn Higashi, Eko Lapp

Division of Aquatic Resources, DLNR, Honolulu, HI, USA

The Division of Aquatic Resources (DAR) has the leading role in managing Hawaii's aquatic resources. Governor signed the Department of Land and Natural Resources (DLNR) Watershed Initiative protecting forests and watersheds. This includes streams originating from mountain ridges, down to nearshore reefs. In the last decade, DAR has been inputting, organizing, and geo-referencing data associated with aquatic animal occurrence and habitats. Relational databases focused on different ecosystems (freshwater, estuarine, reef) linked with Geographic Information System (GIS) to understand spatial patterns. Databases provide information on the abundance and distribution of native and introduced species to help support conservation of species and ecosystems along with fisheries.

DAR is embarking on an integrated approach to link ecosystem databases under a Ridge-to-Reef concept. These internal databases will be linked providing integrated reporting and analysis with the goal of improving Ridge-to-Reef data sharing. DAR plans to link with land-based GIS databases from other DLNR divisions and eventually with databases from other government agencies. Linked databases will facilitate information dissemination that focuses on the relationships between watershed, stream, estuary, reef, and ocean environments. Linked databases form a major component to improve watershed management by providing insights for freshwater, estuarine and marine ecosystems, functions, and interactions.

5-8 Artisanal Fisher Perceptions Regarding the Sustainability of Bottom Long Line Use in Bejuco, Guanacaste, Pacific Coast, Costa Rica

Andy Bystrom¹, Patricia Cardenas Valenzuela², Ingo Wehrmann²

¹Universidad Estatal a Distancia, San Jose, Costa Rica, ²Universidad de Costa Rica, San Jose, Costa Rica

This study evaluates artisanal small-scale fishers' perceptions regarding the socio-economic and environmental sustainability of bottom long line use in the Bejuco spotted snapper (*Lutjanus guttatus*) fishery, Northern Pacific coast, Costa Rica. Both quantitative and qualitative techniques were used to measure the study's four constructs: (1) perceptions regarding the fishers' economic situation, (2) perceptions regarding the sustainability of bottom long line use, (3) perceptions regarding the significance of a sustainable fishery, (4) perceptions regarding the fishery's impact on the spotted snapper population. Fisher information was collected using a questionnaire with responses measured via a Likert scale. Results were analyzed with factor analysis and complemented with information gathered through focus groups and open interviews. Fishers - despite having a strong relationship among environmental groups - do not have a clear concept of what "sustainable fishing" means. During the last decade they have been forced to increase their fishing effort in order to capture/earn the same quantities/amounts as before. Despite this, they have a positive perception of their quality of life and foresee fishing with the same technique in the years to come. They are concerned for the future of their industry but do not have the capacity to develop appropriate alternative livelihood strategies.

5-9 From Inspiration to Action: Using Social Marketing Approaches to Encourage Behavioral Change for Coral Reef Health in Saipan and Maui

Sheila Sarhangi

SeaWeb Asia Pacific, Honolulu, USA

Social marketing applies the same commercial marketing principles used to sell products—from soda to perfume and automobiles—to the design and implementation of programs that encourage behavioral change for social or environmental benefit. This presentation will share social marketing approaches in action through two campaigns funded by the National Oceanic and Atmospheric Administration's Coral Reef Conservation Program. The Our Laolao campaign aimed to reduce litter at Laolao Bay on the island of Saipan in the Commonwealth of the Northern Mariana Islands. Through the use of market research, the initiative motivated Bay users into action by promoting value-based messaging, empowering a diverse group of well-respected community spokespersons, and employing behavior change tools such as on-site pledges. As a result of the initiative, there was a 69 percent decrease in the amount of litter collected in March 2012 (pre-campaign implementation) compared to March 2013, a year after the launch. To reduce polluted runoff entering nearshore waters in West Maui, the West Maui Kumuwai campaign encouraged residents to play a critical role in ensuring the health of their ahupua'a, or watershed, through such activation points as yard care practices and community volunteer projects. The campaign used powerful storytelling and attention-getting public relations tactics, while lowering barriers that may prevent action by launching a point-of-purchase program with retailers that labeled fertilizer and pesticide products that are less harmful to the marine environment, and a pledge program that asks landscapers to adopt ocean-friendly yard care practices. After 10 months of implementation, four retail partners had labeled 2,000 products as "Ocean Preferred," three landscape professionals committed to use ocean-friendly practices on their combined 222 commercial and residential acres, and more than 700 individuals took action with West Maui Kumuwai by volunteering at events, buying Ocean Preferred products, and taking personal pledges to reduce polluted runoff. The purpose of this discussion is to demonstrate the social marketing approach, and present the successes, challenges, and lessons learned of these two case studies.

5-10 Rivers of Resilience: Information Flow within the Socio-Ecological Systems of Hawai'i

Nathan Albritton

Hawai'i Pacific University, Honolulu, HI, USA

This study investigates how local ecological knowledge (LEK) flows among fishers and natural resource managers in the State of Hawai'i. To do this, this study explores social networks, their structure, and the social capital and trust levels within them, in an effort to answer two key questions: (1) Who are the key individuals who can best represent various groups' collective knowledge and interests?, and (2) How do social relations alter and/or distort the flow of information? The findings of the research contribute to the growing body of literature surrounding community-based natural resource management, and offer a case study of a wealthy, developed nation - which traditionally relies on a centralized form of governance. The results of this study indicate that while information flow does occur, there are a number of issues which prevent a wider dissemination of the valuable data that fishers have painstakingly acquired over years of observation. An inability to clearly define the fishing community and a lack of community cohesiveness appear to be significant obstacles to crafting a common understanding needed for sustainable community-based management. This is further weakened by a severe deficit of trust between fishers and government personnel, and more importantly among fishers themselves. This study highlights the need for a greater understanding of social relations and social capital building mechanisms in both natural resource management efforts and grander experiments in participatory governance and democracy throughout society.

5-11 Acacia Koa: Silviculture and Breeding for Effective Conservation and Restoration

Faith Inman-Narahari^{1,2}, Charles Michler^{3,5}, Christian Giardina⁴, Robert Hauff⁶, Nicholas Koch⁷, Thomas Baribault⁷, Irene Sprecher⁶, James B. Friday¹, Nicklos Dudley⁸

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Advances in Acacia koa (koa) silviculture and breeding can make reforestation with this important native species more attractive to land owners/managers. Ultimately, this could enable large areas of deforested land to be restored; providing economic, ecological, and cultural benefits to Hawai'i. The purpose of this forum will be to bring together experts in koa silviculture and breeding and to present information to land owners/managers who want to know about recent advances, current research, and future directions in koa forestry.

Recognized experts will lead short presentations (10 minutes) to stimulate discussion on each of the topics listed below. Each presentation will be followed by a short discussion session (10 minutes) with audience members. Discussions will be facilitated by the topic leaders with input from the rest of the forum organizers. Additionally, forum organizers will prepare questions to engage the audience, and take questions and comments from the audience. This forum will provide a valuable opportunity for land owners/managers to have an open dialogue about koa forestry and to share knowledge with each other and topic experts.

Program:

Hawai'i State Koa Action Plan and funding opportunities.

Summary of plan describing funding priorities for koa projects for the next five years and review of current funding opportunities offered by the state for koa related research and management.

Robert Hauff and Irene Sprecher

How tree improvement can help restore native forests: lessons from temperate forests.

A successful tree improvement program can help to meet conservation and restoration goals by making forestry with native species economically attractive to landowners.

Charles Michler

Breeding wilt-resistant koa to restore native forests: progress and process.

Update on the progress of breeding wilt-resistant koa with an emphasis on high-throughput screening methods and seed orchard establishment.

Nick Dudley, Hawai'i Agriculture Research Center

Koa silviculture: reducing yield uncertainty with growth modeling tools.

Recently-developed models to predict growth based on widespread field trials and how they can be used to assist landowners with making planting decisions.

Nick Koch and Tom Baribault

Capacity building, extension, and partnerships: keys to success.

Discussion of the need to build human capital in Hawai'i to meet current and future needs in forestry and tree breeding and how building partnerships with diverse groups can help us achieve that goal. Examples of successful reforestation resulting from these partnerships.

Christian Giardina and James B. Friday

Into the future: highlights of ongoing and planned koa research

Overview of the latest scientific research to discover keys to the koa genome, map patterns of koa moth damage, understand the causes of koa forking, and more.

5-12 Nā Kia‘i Kūmukuhāli‘i: Forest Guardians Project Inspires Conservation Leaders in Hawai‘i and Peru

Lahela Camara¹, Emily Leucht¹, Colleen Cole¹, Robin Keith², Samantha Young², Jill Korach³, Gustavo Florez⁴, Tina Flower⁵, Frances Kinslow Brewer⁶

¹Three Mountain Alliance, Hawaii National Park, HI, USA, ²San Diego Zoo Institute for Conservation Research, Escondido, CA, USA, ³Project Dragonfly/Miami University, Oxford, OH, USA, ⁴Sicán National Museum, Ferreñafe, Peru, ⁵Hualalai Academy, Kailua Kona, HI, USA, ⁶Laupahoehoe Community Public Charter School, Laupahoehoe, HI, USA

The connections of land and sea are ever-present in Hawai‘i and that network is supported by a kuleana (responsibility) to keep conservation in our hearts and minds. The Forest Guardians project is focused on establishing a network of (Forest Guardians) schools that demonstrate a commitment to bio-cultural literacy and environmental stewardship. We believe that when students develop a personal connection to a particular natural area, this furthers a passion for local conservation and ecology. In this way, we will build a cadre of conservationists working to protect endangered wildlife and habitat in Hawai‘i and beyond. We are working primarily with teachers from K-12 schools to build capacity for co-learning, co-researching, and encouraging a voice and personal responsibility in conservation action. Nā Kia‘i Kūmukuhāli‘i teachers are given the tools necessary to create a long-lasting conservation impact on their students and their communities.

In order to provide a global perspective on conservation issues around the world and inspire our local community, Nā Kia‘i Kūmukuhāli‘i is linked to a sister program in Peru, known as “Guardianes del Bosque” (Forest Guardians). Employing similar capacity building techniques, coordinators in Peru are working with teachers and communities to build their own cadre of local Forest Guardians. In addition, graduate students in Project *Dragonfly*’s Global Field Program participated in project planning, bringing in yet another avenue of conservation impact on a local and global scale.

In this one-hour forum, program leaders and educators will offer an overview of how Hawai‘i Island educators of Nā Kia‘i Kūmukuhāli‘i have built the foundation for a model of participatory education in conservation with support from Three Mountain Alliance, San Diego Zoo Global, Project *Dragonfly*, the Sicán National Museum, and Museums Connect. We will also discuss how the Forest Guardians concept can be more widely applied throughout Hawai‘i and the world, the lessons learned of community-driven approaches to conservation, and the benefits of global partnerships. Additionally, forum presenters will lead the audience through a facilitated discussion and audience participation activities focused on wai (water), a key inquiry exercise of the Nā Kia‘i Kūmukuhāli‘i program.

5-13 The Marine Fellowship Program: Building Capacity for Conservation Success in Hawaii

Sean Marrs

The Nature Conservancy, Honolulu, HI, USA

The Nature Conservancy’s Marine Fellowship Program began in April 2008 to provide experiential and practical training to build the base of skilled marine resource managers in Hawai‘i. By providing new promising professionals with the training they need, the fellowship program aims to lay the foundation for the next generation of marine conservation leaders for Hawai‘i.

This forum will give an overview of the Marine Fellowship Program and include discussions with a panel including representatives from the three fellowship cohorts, current program partners and funders. We will discuss overall experiences with the program, what benefits are derived, and what challenges are associated with development and implementation.

6-1 An Ocean of Partnerships: Regional and State Ocean Resources Management Planning and Collaboration

Leo Asuncion¹, Takiora Ingram², Maria Carnevale³, Sarah Pautzke⁴, Emma Anders⁵

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The entire state of Hawai‘i is located in the coastal zone, with nearly half of the state's geographic area (41%) comprised of ocean. The connection between our ocean and our communities is so inseparable that the State has been taking initiatives to manage ocean resources since the first State ocean plan was drafted in 1969. Fast forward forty-five years: Hawai‘i is leading the country in ocean resources management planning, natural heritage and cultural heritage reserves, and regional collaboration. Hawai‘i is the only state to have a nationally recognized partnership for ocean resources management. In addition to successful partnerships at home, the State also collaborates with other Pacific jurisdictions to manage resources within an Exclusive Economic Zone (EEZ) nearly equal to the combined EEZ of the entire mainland United States. The purpose of this forum is to share successes and lessons learned from navigating changes in the Pacific Islands through ocean resource management plans and partnerships.

Following panel member presentations, participants will take part in a facilitated discussion based on the following questions:

Question 1: Individual agencies can't do it all. What is the one area where you receive the greatest support from these collaborations?

Question 2: Share examples of how these efforts are being used as being a mechanism to jump start other conservation efforts.

Question 3: How do collaborative efforts help the State navigate changes in ocean management?

Question 4: Many of the management plans you use were created through partnerships. Are they also implemented through these partnerships?

Question 5: Share examples of impacts of these collaborations at the community level or resource level.

The panel will also invite the audience to join the conversation during a live question and answer session during the last thirty minutes of this interactive forum.

6-2 Expressing the Benefits of Tree Improvement for Forest Restoration through Innovations in Propagation and Silvicultural Management

Douglass Jacobs, Kyle Earnshaw

Purdue University, West Lafayette, IN, USA

Land clearing for cattle grazing has caused prominent losses of forest cover across Hawaii, yet ongoing efforts exist to restore these sites with native trees. The Tropical Hardwood Tree Improvement and Regeneration Center was formed to advance science in tropical hardwood tree genetics and disseminate new knowledge to improve conservation projects. For genetic gains to be fully realized, it is essential to apply new advances in reforestation technologies. Studying native trees over the past 10 years in Hawaii, we have explored treatments to aid in development of high quality plant materials in the nursery as well as field techniques that may improve survival and

early growth of planted seedlings. Major limiting factors to establishment success on sites in Hawaii include competition from exotic grasses (e.g., kikuyu grass) and frost damage at higher elevations. We have found that larger, nutrient rich nursery seedlings are most resistant to these biotic and abiotic stresses. Key cultural treatments in the nursery include optimizing fertilization and irrigation regimes, as well as use of containers appropriate for the planting site. In the field, control of competing vegetation is a ubiquitous need and tree protectors can help to moderate harsh climatic conditions.

6-3 Dynamics of a Koa Looper Moth (*Scotorythra paludicola*) Outbreak at Hakalau Forest National Wildlife Refuge

Robert Peck¹, Paul Banko², David Foote², Laura Petteway¹, Kelsie Ernsberger¹

¹Hawaii Cooperative Studies Unit, University of Hawaii at Hilo, Hawaii National Park, Hawaii, USA, ²U.S. Geological Survey, Pacific Island Ecosystems Research Center, Hawaii National Park, Hawaii, USA

Irruptions of the endemic koa looper (*Scotorythra paludicola*) have defoliated stands of the endemic koa (*Acacia koa*) over the past 125 years, but the last outbreak on Hawai'i Island was reported in 1953. In January 2013, the largest recorded outbreak was first observed along the Hāmākua Coast of Hawai'i, and by April it had spread to Hakalau Forest National Wildlife Refuge. We monitored larval and adult koa loopers and their natural enemies at old growth and koa restoration sites (1600-1920 m elevation) during April-December 2013 to understand the dynamics of this unusual interaction between native species and the potential consequences for forest restoration. We clipped branch tips to evaluate caterpillar abundance and development; used traps to track moth, parasitoid and western yellowjacket (*Vespula pensylvanica*) abundances; and reared caterpillars to determine parasitism rates. The outbreak peaked during 16 May-20 June when 4.4-18.9 million caterpillars/ha were recorded. Moths peaked during 19 July-11 September. Parasitoids tracked the abundance of caterpillars, but the low (<5%) rate of attack suggested little influence on outbreak dynamics. Western yellowjackets showed no response to caterpillar abundance. A subsequent outbreak following the regrowth of foliage was not observed at Hakalau, as it was elsewhere in Hāmākua.

6-4 Response of Koa (*Acacia koa*) and Birds to an Outbreak of the Koa Looper Moth (*Scotorythra paludicola*) on Hawai'i Island

Paul Banko¹, Robert Peck², Kelsie Ernsberger², Danny McCamish², Eben Paxton¹, Linda Pratt², Stephanie Yelenik¹, Laura Petteway²

¹U.S. Geological Survey, Pacific Island Ecosystems Research Center, Hawaii Volcanoes National Park, HI, USA,

²Hawaii Cooperative Studies Unit, University of Hawaii at Hilo, Hawaii Volcanoes National Park, HI, USA

A massive outbreak of the endemic koa looper moth (*Scotorythra paludicola*) at Hakalau Forest National Wildlife Refuge in June 2013 resulted in extensive defoliation of koa (*Acacia koa*) and changes in the diet and foraging behavior of birds. We monitored defoliation and recovery of 510 koa seedlings, saplings, and trees at two old growth forest sites and two restoration (plantation) sites. We also observed 492 koa and 525 'ōhi'a (*Metrosideros polymorpha*) trees to evaluate changes in bird activity before and after the peak in caterpillar abundance. Koa of all sizes were extensively defoliated in both habitat types, but large koa were most severely defoliated in old growth forest. Foliar biomass was reduced by 78–93% at old growth sites (low koa density) and by 64–79% at plantation sites (high koa density). Six months after defoliation, less new foliage had been produced by plantation koa compared to old growth koa. Birds used 'ōhi'a more frequently than koa in both habitats, but their heavy use of koa relative to its abundance in old growth habitat suggests that they were attracted to caterpillar swarms. After defoliation, bird activity in koa declined in both habitats, and birds were observed less often in heavily defoliated trees.

6-5 It's Raining Caterpillars! A Massive Koa Moth Outbreak on Hawaii Island

Robert Hauff⁵, William Haines¹, Robert Peck³, Paul Banko², Cynthia King⁵, James B. Friday¹

¹University of Hawaii at Manoa, Honolulu, HI, USA, ²U.S. Geological Survey, Pacific Island Ecosystems Research Center, Hawaii National Park, HI, USA, ³Hawaii Cooperative Studies Unit, University of Hawaii at Hilo, Hawaii National Park, HI, USA, ⁴University of Hawaii, College of Tropical Agriculture and Human Resources Cooperative Extension Service, Honolulu, HI, USA, ⁵DLNR-DOFAW, Honolulu, HI, USA

The koa looper (*Scotorythra paludicola*), is an endemic geometrid moth that specializes on koa (*Acacia koa*), and undergoes infrequent, natural population explosions. In winter 2012-2013, one of these outbreaks began on the eastern slopes of Mauna Kea, causing near complete defoliation of a vast swath of koa forest, and prompting a multi-agency effort to monitor the spread and impacts of the outbreak. The outbreaking populations quickly spread via multiple generations of swarming moths, and within six months had reached most of the large tracts of koa forest on the island. Over 70,000 acres (280 km²) were affected, making this the largest koa looper outbreak ever documented. The outbreak continued in some areas until at least March 2014. Damage varied among sites, with some being only patchily defoliated, and others being subjected to multiple rounds of severe defoliation. The speed and degree of tree recovery also varied among locations, and may be related to rainfall and other site-specific characteristics. Research is also underway to relate koa defoliation to future survival and growth. The outbreak was a valuable opportunity to study the ecology of koa looper caterpillars, and revealed some life history characteristics that may contribute to its tendency to outbreak.

6-6 Assembly of Arthropod Communities In Hawai'i: Interactions and Response to Changes in Immigration Rate

Curtis Ewing¹, Rosemary Gillespie², Daniel Gruner³, Kari Roesch-Goodman², John Harte², Karl Magnacca⁶, Neo Martinez⁷, Rasmus Nielsen², Patrick O'Grady², Diana Percy⁵, Donald Price¹, Dan Robosky⁸, Kylie Roy¹, Kerry Shaw⁴

¹UH Hilo, Hilo, HI, USA, ²UC Berkeley, Berkeley, CA, USA, ³University of Maryland, College Park, MD, USA, ⁴Cornell University, Ithaca, NY, USA, ⁵Natural History Museum, London, UK, ⁶Oahu Army Natural Resource Program, Honolulu, HI, USA, ⁷Pacific Ecoinformatics and Computational Ecology Lab, Berkeley, CA, USA, ⁸University of Michigan, Ann Arbor, MI, USA

While tremendous strides have been taken to mitigate invasion, we have no models to show how native communities can accommodate, resist, or succumb to the new dynamic. To this end, the Hawai'i Dimensions Project aims to understand biodiversity dynamics, focusing on arthropods on Hawaii Island, asking specifically: What is it about the community that confers vulnerability or resilience?

Quantitative ecological assessments will determine relative abundance and diversity among *Metrosideros* dominated wet forest sites in the Kohala Mts, Laupāhoehoe, Kīlauea and the Kaū District. This data is coupled with genomic data from 7 lineages of insects and spiders to determine evolutionary response under different conditions. Additionally next generation environmental sequencing techniques are being used to assess endo-fungal and bacterial associations.

We are in the initial stages of integrating ecological and population genetic data that will provide baseline parameters for how communities change over time. From this, we will be able to assess the importance of priority, sequence, abundance, and interaction strengths in determining how a community has formed naturally. We will then be able to use this data to predict response to higher rates of immigration from non-native taxa, construct food webs and analyze spatial patterns of species distribution and diversification.

6-7 Evaluating the Net Benefits of Primary and Restored Koa Forest Ecosystem Services

Katherine Wilson, Bikash Paudel, Brinton Reed, James B. Friday, Catherine Chan-Halbrendt
University of Hawai'i at Manoa, Honolulu, Hawaii, USA

The ecosystem services that Hawaiian forests provide are very important to the functioning of island ecosystems as well as Hawaiian culture and heritage. These diverse ecosystem services include carbon sequestration, nutrient cycling, aesthetics, and habitats for endemic species. Koa (*Acacia koa*) forests are endemic to Hawai'i and provide high value ecosystem services. This is the first study conducted in Hawai'i to comprehensively evaluate the ecosystem services provided by a koa forest. The results from this study will fill a data gap in ecosystem service values of Hawaiian forests and provide baseline data for other researchers globally. Using primary and secondary data, this project will assess and calculate the value of 19 ecosystem services provided by koa forests. Primary data will be collected using willingness to pay surveys. The net present value benefits of the ecosystem service values from preserving koa forest will be compared to timber revenue and the cost of restoration using a dynamic cost-benefit analysis. It is expected that the majority of ecosystem service values will be higher in primary forests than restored forests. The calculated differences in ecosystem service values will help improve the management of koa forests and could potentially change investment in restoration efforts.

6-8 Archipelago-Wide Demography of Hawaii's Most Abundant, but Declining, Native Tree, *Metrosideros polymorpha*

Kasey Barton¹, Tiffany Knight²

¹*University of Hawaii at Manoa, Honolulu, Hawaii, USA*, ²*Washington University, St. Louis, Missouri, USA*

As anthropogenic alterations threaten natural ecosystems, much of the focus of conservation biology is on minimizing effects for the rarest species. Yet, the majority of individual plants in natural ecosystems come from a few common species. While common species might be at lower risk of extinction, they engineer environments, are involved in many biotic interactions, and contribute disproportionately to ecosystem function. Thus, declines in their abundance and distribution have broad ramifications for other species and for ecosystem functioning. On each of the six largest Hawaiian Islands, the dominant tree species is *Metrosideros polymorpha* ('ōhi'a lehua), and 'ōhi'a has experienced a dramatic shift in its abundance over the past several decades. At present, the few studies that have been conducted on the population ecology, growth, and decline of 'ōhi'a have been limited to a few locations and life stages. We are investigating the demography of 'ōhi'a using stage structure distribution analysis across the six largest islands to assess population dynamics (stable, growing, declining). We are quantifying biological threats (invasive plants and natural enemies) and abiotic features at each site to test which factors correlate with declining populations to inform conservation. Preliminary analyses of data collected in Winter 2014 will be presented.

6-9 Conservation Tools for Commercial Forestry in Hawai'i: What's Available and What's Needed

Paul Conry¹, Don Bryan², David Johnston¹, Gregory Spencer¹, Scott Terrill¹

¹*H. T. Harvey & Associates, Honolulu, Hawai'i, USA*, ²*Hawai'i Forest Industry Association, 'O'okala, Hawai'i, USA*

There has been a great deal of interest in developing a sustainable commercial forestry industry in Hawai'i to produce trees for renewable energy and wood for the local and export market. Over \$250 million dollars has been invested or planned for developing the industry on Hawai'i and Kaua'i including cultivating over 60,000 acres of eucalyptus and other non-native timber and developing biomass, biofuel, and commercial sawmill facilities. Investors, facility developers, and landowners are ready to commit resources but need confidence they will be able to carry-out their business plans. Developing ways to deal with listed, candidate, and rare species while conducting timber harvest operations is a challenge. Hawai'i and federal law provide for a suite of conservation tools including best management practices, voluntary conservation agreements, agency guidance, candidate conservation agreements, safe harbor agreements, habitat conservation plans, and federal Section 7 consultation that can be employed to enable forest harvest operations while enhancing the survival and recovery of protected species. This presentation will describe the range of conservation tools available, provide real life

scenarios of where and how they can be applied, discuss the pros and cons of different approaches, and suggest potential advancements in policy and procedures.

6-10 The Hawaiian Monk Seal: Status, Trends and Recovery Efforts

Tracy Wurth¹, Thea Johanos², Jason Baker², Charles Littnan²

¹*Joint Institute for Marine and Atmospheric Administration, Honolulu, HI, USA*, ²*National Marine Fisheries Service, Honolulu, HI, USA*

The Hawaiian monk seal (*Monachus schauinslandi*) population has been declining for more than 20 years, and the species is in crisis. Though most monk seals inhabit the remote Northwestern Hawaiian Islands (NWHI) where the population is declining at approximately 3% per year, there is a small thriving sub-population in the main Hawaiian Islands (MHI). Threats to the species differ between these two regions. The decline in the NWHI is multifaceted but largely driven by long-term poor juvenile survival associated with food limitation, while the greatest risks to seals in the MHI are anthropogenic and consist of fisheries interactions, intentional killing, and disease exposure. Ongoing recovery efforts are directed at mitigating these various regional threats. The focus in the NWHI is on improving juvenile survival through actions such as mitigating shark predation, treating for parasites, and translocations to areas of higher survival. In the MHI the focus is largely on managing interactions between seals and humans and disease prevention. While these combined efforts account for 30% of the population being alive today and have successfully lowered the rate of overall species decline, the situation is still critical and we need to continue current efforts and develop new tools for recovery.

6-11 Male Dominance and Aggression in the Endangered Hawaiian Monk Seal (*Monachus schauinslandi*)

Thea Johanos¹, Jason Baker¹, Albert Harting², Brenda Becker¹, Charles Littnan¹

¹*Pacific Islands Fisheries Science Center, NOAA, Honolulu, Hawaii, USA*, ²*Harting Biological Consulting, Bozeman, Montana, USA*

Losses due to intraspecific aggression led us to investigate aspects of the mating system of the endangered Hawaiian monk seal (*Monachus schauinslandi*). Because mating is aquatic and rarely observed, dominance was inferred from terrestrial attendance patterns and agonistic encounters over a 30 year period. Males compete over the right to attend and defend adult females, and male agonistic rates increase with increased female attendance up to a point and then decline, with the most successful males experiencing few challenges. Subordinate males are unable to gain access to adult females and compete over younger seals. Some level of male harassment is expected, however a few males become focused on younger seals, repeatedly biting and mounting them, causing possible injury and death. One aggressor can decimate a cohort of pups. In a recent example from Kure Atoll, males injured 10 of 13 weaned pups, and one male caused multiple injuries and 2 probable deaths. Several techniques have already proved useful in lowering aggression related losses. Here we examine the emergence and persistence of negative traits among aggressors with the proximate goal of continuing to refining strategies to mitigate aggression, and the ultimate goal of increasing juvenile survival and female reproductive potential.

6-12 Status of Preparedness Efforts for Vaccination of Hawaiian Monk Seals (*Monachus schauinslandi*) Against Morbillivirus

Michelle Barbieri^{1,2}, Jason Baker², Albert Harting², Mark Sullivan², Frances Gulland¹, Charles Littnan²

¹*The Marine Mammal Center, Sausalito, CA, USA*, ²*Hawaiian Monk Seal Research Program, Pacific Islands Fisheries Science Center, National Oceanic and Atmospheric Administration, Honolulu, HI, USA*

Morbilliviruses affect many mammalian taxa and vaccination is a routine prevention strategy (e.g., measles in humans and distemper in dogs). Canine distemper virus (CDV) and phocine distemper virus (PDV) are morbilliviruses that have caused dieoffs of tens of thousands of phocids. Exposure to CDV or PDV has not yet been detected in Hawaiian monk seals (HMS). Risk factors for HMS include cetaceans and out-of-habitat pinnipeds that carry morbillivirus in Hawaiian waters and interactions between HMS and infected dogs. The 1,100 remaining HMS are distributed widely across the Hawaiian archipelago, complicating detection and outbreak

response. Hence, introduction of morbillivirus into this immunologically naïve population could devastate the survival of this critically endangered species. Immunization trials of captive seals with a commercially available canine distemper vaccine have documented antibody production without adverse effects. An implementation strategy is being developed for emergency vaccination of wild HMS in the event that exposure or disease is detected. Efforts to model the timeline and trajectory of an outbreak and the effect of vaccination schemes on disease spread are also underway and will inform the strategic approach to an emergency vaccination response. Prophylactic vaccination of wild HMS is also under consideration.

6-13 iSeals: Integrating Multiple Technologies to Understand the Foraging Behavior and Fisheries Impacts of Monk Seals in the Main Hawaiian Islands

Kenady Wilson¹, Charles Littnan², Andrew Read¹

¹*Duke University Marine Lab, Beaufort, NC, USA*, ²*NOAA Hawaiian Monk Seal Research Program, Honolulu, HI, USA*

Monk seal conservation and recovery efforts in the Main Hawaiian Islands have been hindered by the perception that seals do not belong there, that they compete with fisheries, and damage coral reefs. We believe it is important to provide community members with an accurate picture of monk seal behavior to dispel commonly held misperceptions. To achieve this goal we coupled 3-axis accelerometers, National Geographic Crittercams, and GPS phone tags to study monk seal foraging behavior. We tagged eight seals in 2012 and 2013 on Molokai, Kauai, and Oahu. Each instrument package was recovered 3-6 days after deployment, resulting in an average of 6.14 hours of video footage per seal. On average, foraging trips lasted 0.78 days and seals traveled up to 26 km per trip. Most seals began benthic dives shortly after entering the water, with most foraging occurring between 20-40 m. These monk seals ignored over 300 potential prey items for every individual item consumed or attacked. We hope that a detailed understanding of the foraging behavior of monk seals will provide insight into their true role in the ecosystem and help dispel some of the myths surrounding their foraging behavior.

6-14 Promoting the Conservation of Hawaiian Monk Seals through Scientific Collaboration and Outreach with Local Communities

Charles Littnan¹, Kenady Wilson², Andy Read², Kyler Abernathy³, Greg Marshall³

¹*NOAA Hawaiian Monk Seal Research Program, Honolulu, HI, USA*, ²*Duke University, Beaufort, NC, USA*,

³*National Geographic, Washington, DC, USA*

Monk seal conservation in the main Hawaiian Islands has been hindered by misperceptions including the idea that seals are destroying the marine ecosystem. These misperceptions and general distrust of the federal agency responsible for monk seals have resulted in animosity towards and intentional killing of seals. It is important to provide community members with a more accurate picture of monk seal diet and to dispel commonly held misperceptions regarding their foraging. We developed a research paradigm to investigate monk seal foraging that involved community members at all phases of the project. This process included community meetings to understand the questions and concerns our research should address and public participation in the field research. It also involved the sharing of raw data with local students so they could serve as a validation of the results that would eventually be presented to the community. The final component was to present results in near real time to allow community feedback on the ongoing research design and influence current perceptions of the seals. This inclusive research program has been a success and we hope continued collaboration will help to dispel some of the myths and mistrust that hinder monk seal recovery in the MHI.

6-15 Complexities of Conflict: Lessons from the Critically Endangered Hawaiian Monk Seal

Rachel Sprague¹, Megan Draheim², Francine Madden³

¹*NOAA Fisheries Pacific Islands Regional Office, Honolulu, HI, USA*, ²*Virginia Tech Center for Leadership in Global Sustainability, Arlington, VA, USA*, ³*Human-Wildlife Conflict Collaboration, Washington, DC, USA*

Human-wildlife conflicts often grow in complexity beyond what traditional conservation management strategies can address. Multi-layered conflicts move from the substance of conservation into how conservation takes place:

the relationships and process by which conflict is addressed have the power to reduce or perpetuate the conflict. The critically endangered Hawaiian monk seal has only ~1,100 remaining individuals and the species is declining across most of its range. Recent growth of a small population in the main Hawaiian Islands is encouraging, but creates complicated recovery challenges involving human interactions, misconceptions, animosity, and even violent intentional killing of seals. Using the levels of conflict model (humanwildlifeconflict.org), we explore the multiple layers of conflict, from disputes about seal management, to underlying conflict based on a history of distrust and unresolved disputes, to strong identity-based conflict fueled by Hawai'i's history. The recovery program struggles to secure community support for seal conservation, in part because for a vocal subset of people, the conflict has become less about seals and more about the complex dynamics among government agencies, conservation groups, communities, and cultures. We will suggest how using conservation conflict transformation (CCT) to build relationships and make small changes in process could move recovery forward.

6-16 Traditional Knowledge Systems and Climate Change Adaptation: An Essential Attribute of Indigenous Nationhood

Mervyn Tano¹, Daniel Wildcat², Dr. Charles Pe'ape'a Makawalu Burrows³

¹*International Institute for Indigenous Resource Management, Denver, Colorado, USA*, ²*Haskell Indian Nations University, Lawrence, Kansas, USA*, ³*Ahahui Malama i ka Lokahi, Honolulu, Hawaii, USA*

The view that climate change impacts pose a direct threat to indigenous societies because of their reliance on resource-based livelihoods is prevalent in much of the works by the United Nations University, IPCC, Secretariat of the Convention on Biological Diversity, UNDP, and UNESCO.

Their view is that Traditional Knowledge offers valuable insights, complementing scientific data with chronological and landscape-specific precision and detail that is critical for verifying climate models and evaluating climate change scenarios developed by scientists at much broader temporal and spatial scales.

Dr. Wildcat will describe how the Indigenous Peoples Climate Change Working Group is working to decolonize and indigenize the rhetoric of Traditional Knowledge. Dr. Burrows will describe efforts to ensure Hawaiian traditional cultural presence at the sacred sites proposed for the DLNR/HHF Kawainui Master Plan. The presentations of the panelists and the facilitated dialogue between panelists and symposium participants, we will examine these characterizations of climate vulnerabilities of indigenous peoples and suggest that adaptive management policies, plans, research, and programs undertaken by international organizations, NGOs, governments, and corporations based on these characterizations may prove inadequate, ill-adapted, and even inimical to the nationalistic interests and aspirations of indigenous peoples.

6-17 Kū'ula: Integrating Western and Indigenous Sciences in Hawai'i

Misaki Takabayashi

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

Integration of biology and culture for "biocultural conservation" in Hawai'i needs to be founded on integration of epistemologies and scientific practices of indigenous and non-indigenous origins. Although many people like the concept of bio-cultural and epistemological integration, determining appropriate ways to integrate knowledge systems is very challenging. Over the last six years, student researchers of the Kū'ula class at UH-Hilo have conducted a number of environmental research projects in Hawai'i by drawing from both Native Hawaiian and Western sciences with assistance from cultural practitioners, resource managers, academics, and agency partners. Research outcomes of the latest projects will be presented along with an introduction of the process of inquiry in Kū'ula research and an opportunity to share perspectives from agencies and community members striving to broaden knowledge bases in their management work in Hawai'i.

7-1 Sustainable Tourism Benefits Everyone - Overview of The Hawaii Ecotourism Association's Sustainable Tourism Certification Program "Travel Pono"

Linda Cox¹, Aaron Lowe², Tim McKeague³, Annette Kaohelaulii⁴, Liz Foote⁵

¹University of Hawaii, Honolulu, HI, USA, ²Department of Land and Natural Resources, Honolulu, HI, USA, ³Atlantis Adventures, Honolulu, HI, USA, ⁴Annette's Adventures, Honolulu, HI, USA, ⁵Coral Reef Alliance, Honolulu, HI, USA

Over the past decade, The Hawaii Ecotourism Association (HEA) has developed an independent certification program to support the use of best practices by identifying tour operators who lead the industry. In addition to employing a variety of best practices, certified tour operators must meet all federal, state, and local regulations, have a written sustainability statement, offer guided experiences, provide accurate information, and contribute to the conservation of Hawaii and the communities in which they operate.

HEA's Sustainable Tourism Certification Program has certified over a dozen tour operators throughout the State who have shown a commitment to protecting Hawaii's unique environment and culture through responsible travel. Certification has proven to be a benefit to travelers, tour operators, and the people of Hawaii, as certified operators provide genuine experiences, give back to the environment and their communities, and distinguish themselves to a growing segment of travelers interested in sustainability.

The forum will be made up of a panel of five members. The forum is intended to 1) Present an overview of the certification program and 2) Engage the audience in a discussion about the challenges of sustainable tourism and the need for certification.

7-2 Guns for Hire: Challenges and Benefits of Utilizing Contractors in Natural Resource Management

Alison Cohan¹, Lisa Hadway², Namaka Whitehead⁵, Greg Czar³, Luke Estes⁴, Trae Menard⁶

¹The Nature Conservancy Maui Program, Makawao, HI, USA, ²Hawaii Department of Forestry and Wildlife, Honolulu, HI, USA, ³Feral Animal Removal Experts, Kahului, HI, USA, ⁴Pono Pacific, LLC, Honolulu, HI, USA, ⁵Kamehameha Schools, Honolulu, HI, USA, ⁶The Nature Conservancy of Hawaii, Honolulu, HI, USA

Conservation managers today in Hawai'i are faced with managing larger landscapes with limited resources. The statewide "The Rain Follows the Forest" Initiative has triggered a flush of new fenced acres with promises of more to come. Along with this ever increasing management footprint comes a commensurately greater push to "do more with less". The conservation community will increasingly need to grapple with the cost and effectiveness of managing our natural resources, and will need to consider a variety of options to increase their capacity - whether it be utilizing their own field crews or a hiring a contractor. This forum will explore different approaches to accomplishing resource management in Hawaii, with perspectives from nonprofit, government, and private sectors, in addition to contractor companies.

Agenda:

1. Introduction - Alison Cohan, The Nature Conservancy (5 min)
2. Panelist presentations (25 min)
3. Panel Discussion, including questions from the audience (30 min.)

Panelists:

- Lisa Hadway - DOFAW Administrator
- Namaka Whitehead - Ecologist, Kamehameha Schools
- Greg Czar - President of F.A.R.E (Feral Animal Removal Experts)
- Luke Estes - President and COO, Pono Pacific, LLC
- Trae Menard - Director of Forest Conservation, The Nature Conservancy

7-3 Experimental Removal of the Introduced Grouper, Roi (*Cephalopholis argus*) in Puakō, Hawai‘i: Methods for Assessing and Managing Marine Invasive Species

Jonatha Giddens^{1,2}, Alan Friedlander^{1,2}, Eric Conklin³, Chad Wiggins³, Kostantinos Stamoulis^{1,2}, Mary Donovan^{1,3}
¹*UH Manoa Biology, Honolulu HI, USA*, ²*Fisheries Ecology Research Lab, Honolulu HI, USA*, ³*The Nature Conservancy, Honolulu HI, USA*

Invasive species are a growing concern for marine biodiversity, particularly in Hawai‘i with its large proportion of endemic species. This research focused on the feasibility of removing the introduced predatory peacock grouper, locally known as roi (*Cephalopholis argus*), as a management tool for Hawaiian coral reef ecosystem restoration. The objectives of this study were to investigate the dynamics of *C. argus* on 1.2 hectares (ha) of coral reef at Puakō, west Hawai‘i, and 1) compare population density estimate methods in order to accurately evaluate abundance 2) estimate population mortality and catchability rates, and 3) quantify the re-colonization rates by mapping distribution and movements in response to a depletion experiment. The actual number of individuals removed during a fish-down experiment at the study site provides a direct measure of the initial population abundance (19.5 roi ha⁻¹). A Leslie depletion model yielded the most accurate assessment of initial density (-12.7% error) compared to belt transects (+82.3% error) and tow-board census (-69.1% error). Estimates of natural mortality were relatively low (0.0-0.08), and fishing mortality ranged from negligible to 8.0 % yr⁻¹ in west Hawai‘i. Roi movement was monitored through a mark and re-capture program. Tagged individuals traveled 50-150 m from the periphery of the removal area toward its center at a rate of one roi entering the treatment reef every 1-2 months. This study engaged the local Hawaiian fishing community in quantifying the feasibility of roi removal as an ecosystem management tool, and provides methods for assessing and controlling marine invasive fish species.

7-4 Marine Biosecurity in Hawaii: Progress in Minimizing Further Arrivals of Aquatic Invasive Species

Sonia Gorgula

Department of Land and Natural Resources, Honolulu, Hawaii, USA

Both shipping and boating have long been recognized as vectors that facilitate the introduction and spread of non-native aquatic species. Global vessel networks connect ecosystems that were once separated by natural barriers and in the absence of predators or natural controls, organisms introduced to novel environments can become invasive. In Hawaii, the majority of the 343 introduced & cryptogenic marine and estuarine species arrived as biofouling; that is, attached to hulls or to other protected areas on the wetted portions of vessels. A number of these have become invasive and cause negative impacts to the environment, economy, human health and social/cultural values.

The Department of Land and Natural Resources is taking action to manage this vector and this talk will provide an update of this process. Here we present the challenges, successes and progress towards biofouling management in Hawaii. This will include data representing maintenance practices of vessels and their movement patterns, and an early assessment of behavioral gaps that could be closed to further minimize aquatic invasive species impacts in Hawaii. The good news is that Hawaii is ahead of the game and joins two other states and countries worldwide in their attempts to progress biofouling management.

7-5 Native Collector Sea Urchins: Not so Hāwa‘e (Useless) After All

Grace Chon¹, Catherine Unabia¹, Dwayne Minton², Jonathan Blodgett³

¹*Hawaii Pacific University, Kaneohe, HI, USA*, ²*The Nature Conservancy, Honolulu, HI, USA*, ³*Division of Aquatic Resources, Honolulu, HI, USA*

Invasive algae *Kappaphycus striatum*, *Kappaphycus alvarezii*, and *Eucheuma denticulatum* are outcompeting native algae and coral and smothering reefs in Kāne‘ohe Bay, Hawai‘i. The Nature Conservancy and Hawaii’s Division of Aquatic Resources are working together to restore these reefs by removing invasive algae with super suckers, or underwater vacuums. This step alone is insufficient in controlling the invasive algae and they can regrow to prior levels or higher within four months. Therefore, reefs are stocked with hatchery-reared native collector urchins, *Tripeustes gratilla*, which have been shown to be effective grazers. However, the optimal release size and stocking

density needed for invasive algae control is unknown. This study investigated the effectiveness of two initial sizes of urchins at three stocking densities on controlling invasive algae regrowth in enclosures (n=28) on a patch reef in Kāneʻohe Bay. After manual removal of invasive algae, the reef benthic community within pens was monitored monthly for one year to find the optimal urchin stocking density and size that controls invasive algae without adversely impacting the native benthic community algae. It is hoped that this strategy can be used to promote the recovery of corals in Kāneʻohe Bay.

7-6 Native Collector Sea Urchins: Friend or Foe?

Laura Stanley

Hawaiʻi Pacific University, Kaneohe, HI, USA

In an attempt to restore the reefs of Kāneʻohe Bay that have been damaged by several invasive macroalgae species, Hawaiʻi's Division of Aquatic Resources and The Nature Conservancy are working in partnership to remove the invasive algae and allow for natural recovery. Invasive algae are manually removed using the super sucker, and underwater vacuum, and regrowth is controlled by releasing hatchery-reared, native collector sea urchins (*Tripneustes gratilla*). By controlling regrowth, "open," suitable habitat for coral settlement can be maintained, provided urchins are not deployed at a high enough density to have an adverse effect on newly settled recruits or settlement habitat. This study quantified early post-settlement survival for six coral species on a patch reef in Kāneʻohe Bay, Oʻahu under three different sea urchin densities and two different test sizes. Average coral settlement from June through September 2013 was 635 recruits m⁻². Under the urchin densities and sizes investigated, no effect was found on coral settlement and survival, and follow-up laboratory experiment using *Pocillopora damicornis* recruits found no effect from urchin grazing even at density, corresponding to 70 urchins m⁻².

7-7 Management of Alien Invasive Algae in Kaneohe Bay, Oahu through the use of Mechanical Removal and Bio-Control Efforts

Jono Blodgett, Brian Neilson, David Cohen, Travis Thyberg

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The negative impacts of invasive algae on coral reefs in Hawaii have been well documented however, relatively few management techniques have been developed to protect threatened and restore impacted coral reefs. The State of Hawaii's, Division of Aquatic Resources (DAR) and partners have developed novel approaches to manage invasive algae. The partnership developed a modified dredge nicknamed the "Super Sucker," that is capable of removing large quantities of invasive algae per day.

The fast growth rate of the invasive algae and low herbivore density in Kaneohe Bay limit the effectiveness of physical removal efforts alone. As a supplement to physical removal, DAR began to increase the density of native collector sea urchins, *Tripneustes gratilla* to serve as a bio-control agent.

Three large patch reefs (13 acres in area) in Kaneohe Bay received hatchery raised sea urchins at a density of 1-2/m². These reefs are monitored to follow regrowth of invasive algae, fish diversity/abundance, coral coverage, and population dynamics of added sea urchins. The artificial propagation and out-planting of the native sea urchin, *Tripneustes gratilla*, is a viable solution until longer-term solutions can be implemented.

7-8 Developing Removal Strategies to Control Invasive Algae in Kāneʻohe Bay

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Invasive alien marine algae are a significant problem in the Hawaii and particularly in Kāneʻohe Bay, where several alien species aggressively overgrow coral reefs and alter ecosystem structure and function. Removal efforts in

Kāneʻohe Bay have been ongoing for over a decade, but control of marine invasive species presents numerous challenges, and the techniques available for control are currently limited, including mechanical removal, biocontrol, and combinations thereof. In many cases, determining the most effective strategy for applying these techniques, including in what combination, is difficult for any given reef. In an effort to increase the effectiveness and efficiency of algal removal and control, we examined the current suite of available techniques, both underway and in development, and created a streamlined framework for creating a removal strategy that will aid managers in prioritizing removal efforts and in selecting the most effective removal techniques. We will present an example of one such strategy that was developed for an ongoing removal and restoration effort on a reef in north Kāneʻohe Bay.

7-9 Evaluating the Efficacy of Marine Protected Areas in Controlling Invasive Algae

Kostantinos Stamoulis^{3,2}, Robert Toonen^{1,2}, Carl Meyer^{1,2}, Alan Friedlander^{3,2}

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Blooms of nonindigenous marine algae have become common in the Hawaiian Islands over the last several decades, greatly altering the health and stability of near shore ecosystems. On reefs subjected to anthropogenic disturbances, high algal growth rates may result in overgrowth of corals and other benthic invertebrates. Herbivorous fishes have been severely overfished in Hawaiʻi which has been thought to contribute to the increase in macroalgae. We used a three pronged approach to test the hypothesis that Marine Protected Areas (MPAs) will be more resistant to alien algal invasion owing to a higher biomass of herbivorous fishes. We conducted ecological surveys of fish and benthos at the Hawaiʻi Marine Laboratory Refuge in Kāneʻohe Bay and on adjacent patch reefs open to fishing over a two year time period. Simultaneously, we used acoustic telemetry to examine movements of herbivorous fishes captured in the reserve and applied next-generation sequencing to analyze their fecal samples. Results from the ecological surveys indicated significantly higher herbivore biomass in the MPA compared with outside, while invasive algal cover was significantly lower. Herbivorous fish movements were confined to the MPA and fecal analysis indicated presence of invasive algae, suggestive of MPA resistance to invasive algae invasion.

7-10 Building an Ecosystem Service Tool to Support Ridge-to-Reef Management and Conservation in Hawaiʻi

Kirsten Oleson¹, Leah Bremer³, Tova Callendar⁴, Ken Bagstad², Jade Delevaux¹, Kim Falinski¹, Hla Htun¹, Gan Jin¹
¹*UH Manoa, Honolulu, HI, USA*, ²*USGS, CO, USA*, ³*The Natural Capital Project, Stanford, CA, USA*, ⁴*West Maui R-2-R Initiative, HI, USA*

Faced with increasing anthropogenic stressors and declining coral reef states, managers concerned with restoration and resilience of coral reefs are increasingly recognizing the need to take a ridge-to-reef, multi-objective approach. An ecosystem services framing can help managers move towards these goals, helping to illustrate trade-offs and opportunities of management actions in terms of their impacts on society. In this presentation, we describe a research program to build a spatial ecosystem services-based decision-support tool, and its use to guide ridge-to-reef management in a NOAA priority site in West Maui. We use mixed modeling methods that link biophysical processes to ecosystem services and their spatial flows in an integrating platform. The models capture terrestrial and coastal ecosystem services, and the linkages between them. Together, they can be used to illustrate how land management affects coral reef ecosystem service provisioning. Coupled with valuation studies, we can use model results to assign economic values to ecosystem services. This research forms the building blocks of an ecosystem service decision support tool that we ultimately intend to test and apply in other Pacific Island settings.

7-11 Modeling Coral Reef Ecosystem Goods and Services to Guide Management: A Case Study of Maui Nui

Jade Delevaux¹, Kirsten Oleson¹, John Kittinger^{2,3}, Alan Friedlander¹, Susan Crow¹, Kostantinos Stamoulis¹, Mary Donovan¹, Anders Knudby⁴, Susan Yee⁵

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Coral reefs provide diverse ecosystem goods and services critical to human wellbeing. In Hawaii, reefs are threatened by human activities and climate change. Observed declines in reef state jeopardize the delivery of these goods and services. To support innovative policy-making, we are constructing an ecological-economic model linking reef state to ecosystem services provisioning. We are applying predictive spatial modeling techniques to characterize the current ecological state of coral reefs and populate a spatially dynamic ecological coral reef model (CORSET). Then, we will link CORSET to a set of production functions to map and quantify the potential supply of key coral reef services based on health state of reefs. Expected results will identify specific coral reef ecological attributes potentially responsible for the supply of key services (e.g., key nearshore fisheries). By employing an ecosystem service approach, our results will provide management targets expressed in ecological terms while being grounded in the local socio-economic context. The model can be used to evaluate the impact of alternative land and coastal management options on reef services. Scenarios could include management actions aimed at reducing land-based stressors. This approach can promote adaptive management by accounting for critical linkages and feedbacks connecting people and reefs.

7-12 The Importance of Coral Reefs for Coastal Protection

Greg Guannel¹, Kirsten Oleson², Jade Delevaux²

¹Stanford University, California, USA, ²University of Hawai'i, Hawai'i, USA

Coral reefs break oceanic waves, limit the height of wind-waves, and reduce the height of waves and currents that reach the coast. Thus, coral reefs protect people, properties and infrastructure. Here in Hawai'i, most of our islands are protected by 250 square miles of coral reefs. Because of the cultural services as well as the food from fisheries and recreational services that they provide, a recent study estimated that Hawaiian reefs are worth over \$30 billion. However, little is known about the coastal protection value of the reefs. In order to start filling this gap, we initiated a study to quantify the level of wave attenuation by the reef and the amount of shoreline erosion avoided due to its presence, currently and in the future. Additionally, we are also building a simple and easy-to-use tool to quantify and visualize the coastal protection benefits that reefs provide. In our talk, we will present some preliminary results of this effort. We will show how different levels of improvement or degradation of the reef health affect its capacity for delivering protection services. We will also share initial methods that we developed for publicizing our results and making our model accessible to the public.

7-13 Using ARIES to Map Ecosystem Service Flows for Coral Reef Conservation and Management

Kenneth Bagstad¹, Kirsten Oleson², Gan Jin², Kim Falinski²

¹U.S. Geological Survey, Denver, CO, USA, ²University of Hawaii, Manoa, HI, USA

Spatial relationships are critical to both the ecosystem service benefits that ecosystems provide to people and the biophysical processes that sustain or threaten ecosystems. A better understanding of the movement of people, materials, and energy can yield stronger ridge-to-reef ecosystem service assessments.

The Artificial Intelligence for Ecosystem Services (ARIES) modeling platform (www.ariesonline.org) is designed to represent spatial processes in ecosystem service models, generating maps of ecosystem service flows. These maps show sources of matter and energy flows (e.g., points of origin for sediment, nutrients, or freshwater), sink regions that deplete such flows (e.g., areas of sediment deposition, nutrient uptake, evapotranspiration), and users or beneficiaries of each ecosystem service. ARIES combines deterministic and probabilistic models, reports uncertainty, and is compatible with other modeling systems. ARIES can inform economic valuation of ecosystem

services by distinguishing regions capable of providing a service from those that are connected to and directly used by human beneficiaries.

We will describe how ARIES, a novel modeling technique, is being used to support ridge-to-reef decision-making in west Maui. Our goal is to develop the underlying data and models to more broadly apply ARIES to ecosystem services-based management in diverse Pacific Island settings.

7-14 Incorporating Ecosystem Services in Management and Planning: Experiences with InVEST

Leah Bremer¹, Lisa Mandle¹, Greg Guannel¹, Joshua Goldstein², Giorgio Calderon³, Neil Hannahs³, Ulalia Woodside³, Ka'eo Duarte³

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Sustainable natural resource management requires improved understanding of the multiple impacts of management and planning decisions on biodiversity and ecosystem services (e.g. the benefits people enjoy from ‘nature’). Here we present InVEST (Integrated Valuation of Environmental Services and Tradeoffs), a suite of ecosystem services models developed by the Natural Capital Project, an NGO-academic partnership among Stanford University, the University of Minnesota, The Nature Conservancy, and the World Wildlife Fund. InVEST provides a user-friendly and open-source platform to map and quantify the impacts of terrestrial, coastal, and marine management coastal use decisions on ecosystem services. InVEST quantifies ecosystem services in biophysical terms (e.g., changes in water quality and quantity), and where desired, economic (avoided water treatment costs etc.) or non-monetary (number of people benefitting etc.) terms. InVEST has been used in over 20 locations around the world to inform management decisions. We provide several examples of InVEST in practice, including an example from the North Shore of O'ahu. We conclude with a discussion of the potential and challenge for InVEST, and other ecosystem services tools, to simultaneously provide a feasible and user-friendly tool for real-world decision-making, while also adequately representing unique and diverse biophysical, socio-economic, and cultural conditions in Hawai'i.

7-15 Modeling to Connect Land Management to Hydrologic Ecosystem Services: Opportunities and Challenges

Kim Falinski, Hla Htun, Kirsten Oleson
University of Hawaii at Manoa, Honolulu, HI, USA

Land use decisions affect the water quantity and quality, but it remains difficult to predict what management efforts will provide the most beneficial combination of ecosystem goods and services using limited financial resources. In west Maui, decision makers are faced with a changing landscape that threatens the coral reef. Continuing changes in the native forest, the presence of feral pigs, and changing agricultural practices are just some of the land use changes that contribute to the ability of the land to retain water, sediment and nutrients.

In order to directly link land use changes to changes in water-related ecosystem services, it is important to choose a modeling instrument that can capture the processes relevant to the hydrologic system, while also providing data for managers that is spatially and temporally appropriate.

We will construct a framework to assess existing hydrological (both surface and groundwater) model capabilities, identify Hawaii-specific gaps in knowledge, and adapt appropriate models for a decision-support tool. Connecting land use management decisions to hydrologic ecosystem services will create opportunities for managers to explore the tradeoffs inherent to managing small yet diverse watersheds such as those in west Maui.

7-16 Valuing Ecosystem Services through the Eyes of the Beneficiaries

Gan Jin¹, Ken Bagstad², Kirsten Oleson¹

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Coral reefs provide numerous ecosystem goods and services that benefit society and which society values, including food, shoreline protection, and opportunities for recreation or cultural practices. This research values coral reef ecosystem goods and services by identifying how ecosystem goods and services flow to distinct user groups, quantifying and mapping the source and flow paths of services, and applying novel valuation techniques that capture specific user group preferences and values. We quantitatively differentiate between theoretical service provision - the landscape's in situ capacity to provide services - and actual service flow when accounting for the location of beneficiaries and ecosystem service flow paths. When appropriate, we monetize the benefits derived from the latter using locally appropriate economic valuation techniques. Managers can use our results to identify high-value sources of ecosystem services, trace the flow of services, examine equity implications of management decisions, assess the portion of total services being used, or estimate the economic benefit of management actions. This presentation will describe the valuation approach and present preliminary diagrams of service sources, flows, and beneficiaries for West Maui. We will also discuss appropriate non-market valuation studies planned.

7-17 Avian Malaria in Hawaiian Forest Birds: Infection and Population Impacts across Species and Elevations

Michael Samuel¹, Bethany Woodworth³, Carter Atkinson², Pat Hart⁴

¹U.S. Geological Survey, Madison, WI, USA, ²U.S. Geological Survey, Volcano National Park, HI, USA, ³University of New England, Portland, Maine, USA, ⁴University of Hawaii, Hilo, HI, USA

Avian malaria in Hawaiian birds illustrates how invasive diseases can impact biological diversity in naïve populations. However, empirical evidence describing the rate of infection, species and elevation differences, and population impacts is limited. We evaluated malaria epidemiology during 7-year and 3-year studies of Apapane, Amakihi, and Iiwi in low-, mid-, and high-elevation forests on Hawai'i. Malaria infection was highest in low-elevation forests, moderate at mid-elevation, and limited at high-elevation. Malaria infection rates were highest for Apapane and Iiwi, and lowest in Amakihi. Mortality rates were highest for Iiwi, intermediate for Amakihi, and lowest for Apapane; except for low-elevation Amakihi which had the lowest malaria mortality rates. Population impacts depended on species susceptibility to malaria, the proportion of susceptible birds, and rates of infection. Our results support the hypothesis that avian malaria is the primary factor influencing the distribution of forest birds: 1) Amakihi across the elevational gradient; 2) Apapane at mid and high elevations; 3) Iiwi restricted to high elevations; and 4) malaria-tolerant Amakihi in low-elevation forests. These results demonstrate the key role of malaria on these relatively common native species and in the decline and extinction of Hawaiian forest birds.

7-18 The Effects of Climate Change on Avian Malaria and Hawaiian Forest Birds

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Avian malaria, a mosquito-borne pathogen, has caused extinctions, population declines, and limited the distribution of Hawaiian birds. Disease transmission varies across altitudes and is strongly impacted by temperature and precipitation. Currently, malaria transmission is limited or absent in high-elevation forests, which serve as a disease refuge for many Hawaiian birds. This refuge is threatened by future climate change which may bring higher rates of malaria infection. Our research uses a mechanistic epidemiological model of avian malaria, mosquitoes, bird demographics, and future climate change scenarios, to evaluate the future malaria transmission and impacts on native birds. We use the downscaled weather patterns (Weather Regional Model, RCP4.5, and RCP8.5) for the coming century to predict future dynamics of the bird-mosquito-malaria system on the island of Hawai'i. Our results indicate malaria transmission and bird abundance will remain relatively constant until mid-Century, when

infection rates increase. In low-elevation forests, with high malaria transmission, climate changes will have little additional impact. In middle- and high-elevation forests, malaria transmission and bird impacts during the last half of the century will be significant in areas with higher mosquito abundance compared to areas where mosquitoes are managed. We evaluate potential benefits of mosquito management on these future predictions.

7-19 The Perplexing Problem of Avian Pox in Hawaiian Forest Birds

Michael Samuel¹, Bethany Woodworth³, Carter Atkinson², Pat Hart⁴, Dennis LaPointe²

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Although avian pox is considered an important factor in the demise of Hawaiian forest birds, the epidemiology of this disease in Hawai'i is unknown. Transmission of both avian malaria and pox by mosquito, susceptibility of native birds, and high frequency of coinfection makes it challenging to understand the epidemiological patterns and demographic impact of pox. We conducted 3-year and 7-year studies of pox infection in marked birds on Hawaii. We analyzed longitudinal pox infections using Bayesian models to estimate capture, survival, infection, and recovery rates for three native birds. Pox infection rates were highest in low-elevation forests, intermediate at mid-elevation, and lowest at high-elevation. The rate of recovery from pox infection was highest in Apapane and lowest in Amakihi. At high elevation, infection rates appeared to be higher in Iiwi, but estimates were imprecise. Infection with avian pox had no demonstrable impact on survival rates of the three species. However, capture rates of pox infected Amakihi at low elevation were lower than uninfected birds, which suggests a potential fitness effect and lower pox prevalence estimates from cross-sectional disease data. High recovery rates indicate that pox infections may be similar to malaria and that both are transmitted by mosquito vectors.

7-20 Next-Generation Sequencing Reveals Major Histocompatibility Complex Class II Alleles Associated with Survival to Avian Malaria (*Plasmodium relictum*) in Hawaiian Honeycreepers

Susan Jarvi¹, Margaret Farias¹, Kiara Bianchi¹, Ann Txakeeyang¹, Thomas McFarland¹, Sarah Skinner¹, Carter Atkinson²

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While most species of Hawaiian honeycreeper are highly susceptible to avian malaria, some Hawaii amakihi (*Hemignathus virens*) are thriving at low elevations despite high infection rates. The major histocompatibility complex (Mhc) may play a role in survival. A 454 Roche platform was used to generate 44,014 sequences representing 158 Mhc alleles from 46 captive amakihi involved in experimental challenges to avian malaria and 88 wild amakihi from Hawaii Island. Analysis of a NJ tree revealed 6 clusters of alleles occurring most often in surviving amakihi, and a significant association between survivorship and the presence of one or more alleles from these clusters was detected ($p = 0.00006$). Several of these alleles were also found in higher frequencies in low vs. high elevation populations. A similar analysis of 6,417 sequences representing 31 Mhc alleles from 19 experimentally infected iwi (*Vestiaria coccinea*) revealed a significant association between survivorship and the presence of one or more alleles from two clusters ($p = 0.02$). This is the first documentation of an Mhc association with survival to malaria in Hawaiian honeycreepers and is expected to enhance our understanding of host-parasite interactions in this natural disease system while also providing a predictive tool for conservation and management.

7-21 Acoustic Detections of Avian Power Line Collisions: A Novel Monitoring Solution for a Global Problem

Marc Travers¹, Andre Raine¹, Matthew McKown²

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Avian power line collisions are estimated in the 100's of millions per year. Reliable methods to quantify collision rates are necessary to identify lines that pose a threat to birds, especially Hawaii's endemic seabirds. Currently, strike estimates are based on the number of carcasses found under wires. However, ground searching is limited by the fact that many areas are unsearchable due to habitat constraints. In addition, ground searching is ineffective at

quantifying 'wounding' bias, where birds collide with lines but continue to fly. We tested the effectiveness of using autonomous acoustic recording devices to monitor for the sound of avian power line collisions. We placed acoustic devices at the base of power poles for 1-10 months in 2012 and 2013. To validate the technique, observers visually and acoustically monitored bird collisions with power lines and strikes heard by observers were compared with audio files. After 811 hours of human observations we have recorded 57 incidents where seabirds collided with power lines and produced an audible strike sound. We report the reliability of acoustic devices for recording the sound of a bird striking a power line and the effectiveness of computer analysis for detecting strike sounds present on the audio files.

8-1 Overview of the Research Cyberinfrastructure Core (RCC)

Michael Kido

University of Hawaii at Manoa, Honolulu, USA

Emerging cyberinfrastructure (CI) technologies can transform environmental research and STEM education, inform environmental management and conservation efforts as well as help to build knowledge systems, local community capacity and effective transdisciplinary collaboratories. This has been the goal of developing UH-CCRT's Research Cyberinfrastructure Core (RCC) which integrates hardware for computing, data and networks, digitally-enabled sensors, ahupua'a-based observatories, web-based Portals and interoperable suites of software - middleware services for data discovery, integration and retrieval. Examples of integrated RCC applications including wireless sensor network-based monitoring of local climate and/or stream condition established in fourteen ahupua'a across the state will be presented. Sensor and biophysical data are integrated at the server level in SQL databases where they may be exported to mapping services for visualization (e.g. ArcGIS Online, Google Earth, IntelView) or standard relational database software (Access/FileMaker Server) for data management. Integration of FileMaker Server into the RCC makes possible field-based data entry into server databases using iPhones and iPads. The RCC also extends into the Amazon Web Services (AWS) Cloud to create supercomputer equivalent processing capabilities to support data intensive "knowledge systems". An AWS application using the Distributed Hydrology Soils Vegetation Model will be discussed.

8-2 Environmental Monitoring in Hawaiian Ahupua'a using IntelSense-Based "Smart" Wireless Sensor Networks

Kevin Montgomery^{1,2}, Michael Kido³

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InteleSense Technologies is a Honolulu-based company with fabrication and server facilities in California that was "spun off" in 2005 as a product of an NSF award to the University of Hawaii. The company has also become a global leader in geospatial infrastructure development with its release of "Collaborate.org". The core InteleSense environmental monitoring platform being deployed in Hawaiian ahupua'a consists of dedicated data acquisition devices (InteleCells™) which are able to interface generically with individual or groups of sensors which are deployed to form a "smart" distributed mesh sensor network (InteleNet™). This "smart mesh network" is able to relay data across long distances to a remote base station. At the base station, sensor data are uplinked over the internet to an InteleSense-server. "Next Generation" units are loaded with advanced capabilities that improve user configuration, sensor integration and power optimization from solar panels. Unique to InteleSense Technologies is its ability to integrate any research or commercial analog-serial sensor into the monitoring platform making it adaptable to a wide range of applications, including local-to-regional climate monitoring, water and air quality monitoring, imagery and audio capture, earthquake monitoring, buoy networks, tsunami warning, and emergency telemedicine and disaster response all occurring in rugged real-world environments.

8-3 Effective Conservation Restoration in the Kawainui Marsh Wetlands (Windward Oahu)

Jason Misaki

Department of Land & Natural Resources/DOFAW, Honolulu, HI, USA

The Oahu Division of Forestry and Wildlife (DOFAW) is managing restored wetland habitat within the southern portion of The Kawainui Marsh State Wildlife Sanctuary. Kawainui Marsh, the largest remaining lowland emergent wetland in the State, provides critical habitat for endangered Hawaiian waterbirds. In order to ensure proper habitat is maintained in restoration areas, environmental data collected will be applied to an adaptive management strategy. This will allow biologists to make and apply science-based decisions effectively as conditions change. Maintaining water quality and specific water levels within the managed wetland ponds is key to controlling and managing both

abiotic and biotic factors associated with wetland ecosystems to maintain habitat suitability for each of the managed waterbird species. An IntelSense-based “smart” wireless sensor network was installed in the management area to monitor environmental conditions. Sensor data are uploaded hourly to UH CCRT’s Research Cyberinfrastructure Core’s and IntelSense Technology’s Data Servers where they are made available to managers in near real-time through an internet-based “DOFAW Portal”. The Portal connects DOFAW personnel to RCC-based information management tools, data analyses applications and map-based visualization services built around customized SQL Databases integrated with FileMaker Pro Server which makes possible field data collection with I pads and I phones.

8-4 A Community-Based Aedes Mosquito Study and Surveillance Program in Kona, Hawaii Island

Sylvia Teixeira

West Hawaii Explorations Academy, Kailua-Kona, HI, USA

The West Hawaii Explorations Academy (WHEA) located in Kona, Hawaii became Hawaii’s first Charter School in 2000. WHEA uses a somewhat unorthodox approach to learning as students “learn by doing”. Their vision is “to cultivate critical thinkers who are able to solve real world, complex problems” by “...providing learning opportunities through integrative, hands-on, self-selected projects related to authentic, real world problems”. Research Cyberinfrastructure Core (RCC) applications were developed to conduct a “Disease Carrying Mosquito Vector Monitoring and Intervention” program in West Hawaii. The project focuses on determining what factors lead to the coexistence of two vectors of Dengue virus on the Kona Coast, *Aedes aegypti* and *Aedes albopictus*. As part of their science curriculum, students at WHEA are conducting research to understand the links between climate, weather and disease carrying mosquito vectors. Students monitor population densities and distributions and obtain field data to study the interaction between these two species across an altitudinal gradient from the WHEA campus on the coastline to higher elevations of Mt. Hualalai. As there is no systematic mosquito surveillance being conducted in West Hawaii, this community-based project could become the “first line of defense” against a future Denque Fever outbreak in the region.

8-5 Building Community Capacity to Address Water and Land Management Challenges in Waipa Valley

Matt Rosener

Waipa Foundation, Hanalei, HI, USA

Waipa Valley is a complete mountain-to-sea ahupua’a located on the wet windward side of Kauai’s North Shore which has been drastically altered by human uses. Except for remnant patches near the headwater reaches of Waipa Stream, human activities have decimated nearly all of the native forest in the valley. The Waipa Foundation was established to restore the biophysical resources of Waipa and to perpetuate Hawaiian culture by revitalizing the cultivation of wetland kalo as a food staple. To help build the capacity of the Waipa Foundation to more effectively manage its watershed landscape, Research Cyberinfrastructure Core (RCC) applications were developed - deployed with a wireless sensor network which monitors local climate as well as stream condition in Waipa Valley. Climate data transmitted to the RCC data server were used to validate use of the Distributed Hydrology Soils Vegetation Model (DHSVM) to link actual rainfall monitoring to forecast stream response. Vegetation surveys were integrated into an RCC web-based modeling – simulation application”. With the watershed simulation tool Waipa land managers can sketch alternative future land use change scenarios to evaluate the predicted effects on surface water resources in the Waipa ahupua’a under current or future climate scenarios.

8-6 Collaborate.org - A Worldwide Collaboration Geospatial Infrastructure

Kevin Montgomery^{1,2}

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Collaborate.org - A Worldwide Collaboration Geospatial Infrastructure

As we look to the future, humankind faces challenges that are increasing, while our resources are ever dwindling. To survive and thrive we need to work together- no one individual or organization, agency or even government can

address these global challenges all by themselves. As we look across many groups in government, academia, and industry, we see similar trends and needs emerge- the need to access and integrate many types of multimodal data from many sources, the need to collaborate with others both inside and outside our own organizations irrespective of geographic location, and the desire to develop a shared understanding, better decision-making, and to coordinate action.

What if we could integrate our data and leverage our shared resources? What if we could harness our shared knowledge and enthusiasm? What if together we could be much more than we could be alone? How would the world be impacted if such a shared, global collaboration and geospatial infrastructure were available?

Collaborate.org is an open global online community of people, working together and sharing resources, expertise and enthusiasm, empowered with advanced technologies like collaboration and visualization tools, and all the world's geospatial data at your fingertips- including real-time sensor data, GIS and database information, news/RSS and social media, and satellite and aerial imagery. It currently hosts over 2.2M layers, estimated at over 5PB of data, with the easy ability for users to upload and share their own data with those they wish. It's Very Big Data leveraging a worldwide cloud computing infrastructure, with crowdsourced data acquisition and quality, and advanced visualization and collaboration tools- everything people need to work together in one place to empower them to do Great Things.

8-7 Understanding the Adaptive Ability of Lobe Corals

Kaho Tisthammer, Robert Richmond
University of Hawaii at Manoa, Honolulu, HI, USA

Corals in Maunalua Bay, Hawai'i are under chronic pressures from sedimentation and terrestrial run-off containing multiple pollutants. However, some individuals thrive despite the prolonged exposure to these environmental stressors, which suggests that these individuals may have been under selection to withstand such stresses. The lobe coral *Porites lobata* in Maunalua Bay showed increasing levels of stress response along the environmental gradient that exists from nearshore toward offshore. Therefore, the lineage-scale population genetic structure of *P. lobata* was investigated to understand the genetic basis for observed differential stress responses. The genetic structure was analyzed using known mitochondrial and nuclear DNA markers. The clear genetic differentiation in *P. lobata* was found between the offshore and inshore individuals, which suggests that the individuals nearshore may have been selected for higher tolerance to these stressors. Understanding the little-known, small-scale genetic variation will provide critical information for saving not only severely degraded corals in Maunalua Bay, but also for global coral reef conservation, since the coping ability of corals to environmental stressors depends on the underlying genetic variability. The results will also help predict the effects of climate changes on coral reef and resilience based on population genetics.

8-8 Using Molecular Tools to Identify Stress in Corals in a Changing Reef Environment

Narrissa Spies, Robert Richmond
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Ancient Hawaiians were Hawaii's first conservationists, and developed sustainable methods of coral reef management. Changes in our lifestyles, development within watersheds, and climate have left modern Hawaiians with declining coral reef ecosystem health and resilience. Traditional management practices are often at odds with current piece-meal approaches to coral reef management, where marine protected areas are established, without taking into account adjacent sources of land-based pollutants. In an effort to conserve existing coral reefs and protect the genetic diversity found in a healthy reef ecosystem, we can turn to molecular biology to help identify specific coral stressors and responses to mitigation activities. Development of tools to detect coral stress before physical signs are present allows us to take a proactive approach to management, rather than responding to already damaged reefs. Using this targeted approach gives conservationists points on which to focus their efforts, as well as a method to detect effectiveness of pollution mitigation. With the predicted impacts from a changing climate, it is important that we reduce anthropogenic stressors by implementing targeted mitigation strategies. It is important that

we practice sustainable conservation practices, and be stewards of the coral reef ecosystem entrusted to us by our predecessors.

8-9 Local or Exotic Cuisine? Quantifying Herbivory Pressure and Preference for Macroalgae

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Although assessments of Hawai'i's reefs document fish biomass and assemblages, herbivory pressure and preferences by fish remain understudied. Herbivore studies presented here attempt to evaluate preferences exhibited by native reef fish by offering pairwise and multiple-choice comparisons of native and invasive macroalgae for grazing. These studies were conducted in situ and in a simulated reef environment to quantify grazing pressure and preference. Grazing pressure in situ varied in summer seasons 2012 and 2013, however was moderately low for all macroalgae in both years. Preference for the invasive algae *Gracilaria salicornia* and *Acanthophora spicifera* were both detected in the pairwise comparisons and in the controlled multiple-choice preference study. Observed fish bites in timed tests showed native reef herbivores *Zebrasoma velliferum*, *Acanthurus xanthopterus*, and *Kyphosus cinerascens* were top contributors towards the consumption of *G. salicornia* and *A. spicifera*. These results may suggest low herbivore abundance, rather than preference in grazing, is an obstacle to re-establishing native reef communities. Among many steps leading to healthier reefs, further feeding experiments of *Z. velliferum*, *A. xanthopterus*, and *K. cinerascens* could lead to new management options for the control of invasive algae.

8-10 Investigating Coral Reef Ecosystem Responses to Increasing Nutrients and Other Disturbances: Herbivore Control of Algal Overgrowth in Two Hawaii Parks

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Recent studies in Hawai'i have shown that increased coastal nutrient inputs can encourage nuisance algal growth. However, in areas with increased grazer density, algal growth is controlled. Our study investigates the bottom-up effects of benthic nutrient inputs (through submarine groundwater discharge) and the top-down effects of fish and invertebrate grazing on algal growth rate within two Hawai'i parks (Kaloko-Honokōhau NHP (KAHO) and Kalaupapa NHP (KALA)). Ten sampling stations were randomly selected at each park and surveyed during summer months from 2011-2014. Herbivore surveys showed an exponentially higher level of fish biomass at KALA, and a significantly higher abundance of urchins at KAHO. Macroalgal grazing assays revealed a similar difference in grazing intensity between Parks. Benthic water samples were collected at low tide, and nutrient concentrations were highly variable among stations. Comparisons of algal growth rate were made by experimentally controlling herbivory at each station. Fish herbivory exclusion treatments at KALA and urchin herbivory exclusion treatments at KAHO resulted in significantly higher algal growth relative to control treatments. These findings establish a baseline understanding of nutrient and herbivory interactions in the parks, and will guide future management practices.

8-11 Context-Specific Effects of Disturbance on Coral Reef Communities in the Cook Islands: A Case Study

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Coral reef ecosystems experience human-caused stressors that may compromise their natural ability to recover from disturbance. We surveyed coral reef fish and benthic communities at Rarotonga and Penrhyn in the Cook Islands of the south Pacific and evaluated trends in reef health in the context of human population differences. Penrhyn (~200 people) supported higher total fish biomass, higher biomass of apex predators, and was dominated by calcifying benthic organisms. Rarotonga (~15,000 people) had lower total fish biomass, lower biomass of apex predators, and

was dominated by non-calcifying benthic organisms. Similar patterns related to human population have been recorded in other remote Pacific island systems, highlighting the importance of using standardized metrics to assess relative reef health. The dominance of algae at Rarotonga has been linked to ciguatera outbreaks, emphasizing that reefs should be also managed for human health. This is the first study of coral reef community health in the Cook Islands, providing baseline data to inform effective management of the Cook Islands Marine Park and other protected areas. Finally, the cooperation and interest of local government agencies provides a valuable opportunity for ongoing collaboration regarding scientific research approaches and management strategies.

8-12 Characterization of Mesophotic Benthic Communities in the Northwestern Hawaiian Islands

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Mesophotic coral ecosystems (MCEs) are light-dependent coral reefs found below the depth limits of conventional SCUBA diving (>30 m), and extend to the deepest portion of the photic zone, which may be over 150 m in some locations with high water clarity like Hawaii. MCEs are notoriously undersurveyed worldwide, and especially in remote locations like the Northwestern Hawaiian Islands (NWHI). Since 2009, annual research expeditions have surveyed the flora and fauna of mesophotic reefs (50-80 m) across the NWHI using mixed-gas technical diving. Here we present the first transect-based quantitative assessments of mesophotic benthic communities in the NWHI. Our results indicate that benthic communities in the NWHI are dominated by crustose coralline algae and macroalgae, with corals covering less than 1% of hard substrates. Furthermore, several new species of algae and sponges were identified as part of these efforts, as well as numerous species of algae, sponges and corals which were previously not known from this region. Collectively, these findings highlight the importance of surveying the deeper depth range of coral reef ecosystems, which remains largely unexplored in many locations around the globe, and particularly in remote locations like the NWHI.

8-13 Understanding the Impact of a Molasses Spill and Lessons to Prevent Future Damage

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In order to improve marine conservation and restoration efforts, we must take a proactive approach to handling potentially damaging products and activities. Observations following the September 2013 molasses spill in Honolulu Harbor found substantial amounts of coral bleaching and death. Many colonies of *Pocillopora damicornis* and *Montipora capitata*, along with thousands of other marine organisms, were found dead adjacent to the spill and in surrounding areas. Further tests were conducted to assess the effect of molasses on *P. damicornis* and *M. capitata* at varying concentrations. Treatment corals at all molasses concentrations exhibited some degree of stress as indicated by tissue loss, bleaching, and polyp bail-out over a 24-hour exposure period. However, following placement in fresh seawater, some nubbins exposed to the lower concentrations survived while those at higher concentrations did not. These findings suggest that even at low concentrations, molasses has a measurable, negative effect on the health of corals, although recovery, upon water quality restoration, can occur. Healthy Hawaiian reefs are not a luxury, but a necessity for the survival of coastal marine ecosystems, and better safeguards and a greater understanding of how reefs respond to stress at the molecular level are needed to address intervention when accidents occur.

8-14 Population Structure of Spiny Lobsters in Hawaii Following a Fishery Closure and the Implications for Contemporary Spatial Management

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We compare genetic data for two spiny lobsters in Hawai'i with different geographic ranges and histories of fishing pressure to better understand the best management strategy for these species. *Panulirus marginatus* is endemic to Hawai'i, and experienced a short, intense fishery in the Northwestern Hawaiian Islands (NWHI) and long-term, less intense exploitation in the Main Hawaiian Islands (MHI). In contrast, *Panulirus penicillatus* is found across the tropical Indo-West Pacific, was not targeted by the NWHI fishery, but has experienced long-term exploitation in the MHI. *Panulirus marginatus* has significant overall genetic structure, with regional differentiation between the MHI and the NWHI. Additionally, specific sites (Maui, Kaua'i, and the northernmost NWHI atolls) are genetically distinct from most other sites in the archipelago. *Panulirus penicillatus* has no overall population structure in Hawai'i, although regional differentiation between the MHI and the NWHI is significant. Our data indicate the establishment of the Papahānaumokuākea Marine National Monument will not in isolation replenish lobster stocks in the MHI. While neither lobster species has suffered a loss of genetic diversity from fishing, our results highlight that only by incorporating knowledge of fishing history with genetic connectivity data can we understand the most beneficial management strategy for each species.

8-15 Promoting Indo-Pacific Coral Health and Building Capacity through the Action Network for Coral Health and Resilience (ANCH&R)

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Coral disease is emerging as a significant threat to the highly diverse reefs of the Indo-Pacific. Increasing disease has been linked to environmental stressors such as increasing temperatures and declining water quality. The Action Network for Coral Health and Resilience (ANCH&R) we formed in 2012 to assist reef managers in the Indo-Pacific assess disease risk and prioritize threat-reduction strategies. Obtaining baselines and identifying disease risk factors is only possible using standardized methodology across a range of impacted and 'near pristine' regions. However, relatively few in-country scientists in the Indo-Pacific are trained to assess coral disease, resulting in inconsistent datasets and reef managers' inability to accurately document and report disease outbreaks. During this project, we are building capacity within reef monitoring programs across the Big Ocean Network, Micronesia and the Coral Triangle to develop coral disease monitoring programs and implement comprehensive training workshops. These workshops will provide training in disease identification, survey methods and data analysis, as well as assist Indo-Pacific reef managers incorporate disease risk into reef resilience planning through ANCH&R.

8-16 Assessing Impacts of Watershed Projects on Reducing Sediment Erosion and Transport in West Maui – Lessons Learned and Future Directions

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The West Maui Region is currently the focus of Federal, State, and private watershed planning efforts to improve the overall health of coral reefs, nearshore waters, and watersheds. One of the most problematic land-based pollutants identified by scientists is suspended sediment. Although watershed improvement projects are being implemented throughout the State of Hawaii, there is a significant gap in our ability to prove that these projects are reducing sediment erosion and transport to nearshore waters.

Forum Goals:

- Gather perspectives from funding agencies, researchers, watershed planners, and watershed partnerships.
- Create an awareness of the existing gap in our ability to prove through multiple lines of evidence that watershed improvement projects are reducing sediment erosion and transport
- Communicate importance of, challenges in, and recommendations for assessing impacts of watershed improvement projects on reducing sediment erosion and transport

8-17 Reconstructing the Biogeographic History of the Hawaiian Hoary Bat

Amy Russell¹, Maarten Vonhof², Corinna Pinzari³, Kevin Olival⁴, Frank Bonaccorso⁵

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Bats represent some of the furthest natural dispersal events among mammals, with taxa inhabiting most continental and oceanic islands. With regard to these island populations, phylogeographic questions might be raised concerning the continental source of island populations, the timing and frequency of dispersal events, or the frequency of speciation events within island systems. We investigate the evolutionary history of Hawaiian hoary bats (*Lasiurus cinereus semotus*) within the context of samples from both North and South America to reconstruct the biogeographic history of Hawaii's only native terrestrial mammal. We apply phylogenetic and coalescent-based analyses of nuclear and mitochondrial DNA sequence data and microsatellite data to (1) determine the continental source of Hawaiian populations, (2) estimate the number of independent dispersal event(s) to the Hawaiian islands, (3) estimate the time(s) of arrival of dispersing lineages, and (4) estimate the effective size of island populations. These parameters are of critical importance in assessing the conservation status of this Hawaiian taxon and evaluating the frequency of long-distance dispersal events in populating isolated oceanic islands.

8-18 Inter-Island Variation and Potential Geographic Structure in Ōpe'ape'a: Implications for Conservation Management in Hawai'i

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The Ōpe'ape'a, or Hawaiian Hoary Bat (*Lasiurus cinereus semotus*), is a federally endangered subspecies whose current distribution, population size, and potential movements across the Hawaiian Islands are unknown. Recent research into the biogeographic history of Hawaiian bats has produced a fascinating picture of multiple colonization events and investigated the effective population sizes, rates of gene flow, and time of dispersal that separated this subspecies from North America. As part of a collaborative effort to understand current bat distribution and delimit population boundaries that may exist across the major islands, this presentation will share preliminary population genetic data and examine the implications that might arise for management of distinct island populations. As the state of Hawaii's only endemic land mammal, research yielding information on population structure and genetic variation will aid local conservation management efforts to protect this species from threats such as habitat loss and the impacts of wind energy.

8-19 A Previously Undescribed Extinct Vespertilionine Bat from Hawaii

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This presentation will introduce a Hawaiian endemic bat that is now extinct but represented from Late Pleistocene and Holocene fossils and sub-fossils from several islands. The ecological and evolutionary context of this important mammal discovery will be discussed. Ancient DNA studies are currently underway as of Jan 2014, and findings from these investigations will be discussed in addition to morphological analyses. Relationships to the family Vespertilionidae and present day hoary bats will be examined to place this newly described fossil species in a phylogenetic context.

8-20 Winter Distribution and Use of High Elevation Caves by the Endangered Hawaiian Hoary Bat, *Lasiurus cinereus semotus*

Kristina Montoya-Aiona¹, Frank Bonaccorso¹, Corinna Pinzari², Christopher Todd²

¹*U. S. Geological Survey, Hawaii National Park, HI, USA*, ²*Hawaii Cooperative Studies Unit, University of Hawaii at Hilo, Hilo, HI, USA*

We examine winter and spring presence of Hawaiian hoary bats, *Lasiurus cinereus semotus*, in the Mauna Loa Forest Reserve (MLFR), Hawaii Island. Acoustic detection of hoary bat vocalizations, were recorded with regularity outside 13 lava tube cave entrances situated between 2,200 to 3600 meters ASL from November 2011 to April 2012. Vocalizations were most numerous in November and December with the number of call events and echolocation pulses decreasing through the following months. Visual searches found no evidence of hibernacula nor do these bats appear to shelter by day in these caves. Nevertheless, many bats fly deep into such caves as evidenced by numerous carcasses found as mummies or skeletons in cave interiors. The occurrence of feeding buzzes around cave entrances and observations of bats flying in acrobatic fashion in cave interiors point to the use of these spaces as foraging sites. It is very likely that *Peridroma* moth species (Noctuidae), the principal flying insects sheltering in large numbers in rock rubble and on cave walls in the MLFR, serve as the principle prey attracting hoary bats during winter to the upper MLFR. MLFR lava tubes appear to be an important winter foraging area for Hawaiian hoary bats. Caves above 3,000 meters on Mauna Loa harbor temperatures suitable for *Pseudogymnoascus destructans* fungi, the causative agent of White-nose Syndrome that is highly lethal to some species of North American cave-dwelling bats. We discuss issues concerning bat management and the potential for White-nose Syndrome to establish and affect Hawaiian hoary bats.

8-21 Seasonal Occupancy in a New Mitigation Area for the Endangered Hawaiian Hoary Bat

Christopher Todd¹, Corina Pinzari¹, Frank Bonaccorso², Kristina Montoya-Aiona²

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The State of Hawaii has mandated a clean energy initiative that strives to have 70% renewable energy by the year 2030 in an effort to reduce the consumption of fossil fuels. In response to this initiative six wind-energy facilities have received operational permits and seven additional facilities are in the planning stages in Hawaii. Bat fatalities at wind farms are increasingly recognized as an important environmental concern in the United States and elsewhere. In an effort to mitigate take while continuing to meet substantial state alternative energy goals, Hawaii's Division of Forestry and Wildlife created Kahikinui Forest Reserve Conservation Area encompassing 4,986 ha on the southeast slope of Haleakala Volcano on the island of Maui. We here present the results of acoustic surveys (July 2012 to present) across a 1500 m elevation gradient in order to identify seasonal trends in occupancy of Hawaiian hoary bats (*Lasiurus cinereus semotus*). Bat detectability was highest during the months of July and

August, corresponding to the annual period of hoary bat lactation and declined thereafter. Low elevations within the reserve (1200-1700 m) had the highest cumulative detectability although bat vocalizations were recorded throughout the year at our high elevation sites (2400-2700 m). Results from this study will provide information to assist efforts to better manage endangered Hawaiian hoary bats through improved mitigation and habitat restoration.

8-22 The Restoration of an O'ahu Wetland for Ōpe'a'pea

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As part of the mitigation for the take of Hawaiian hoary bats (*Lasiurus cinereus semotus*) at the Kawailoa Wind Energy LLC facility on O'ahu, a 135-acre site referred to as the 'Uko'a Wetland with 90 acres of wetland and 45 acres of upland is being restored, largely to enhance Hawaiian hoary bat roosting and foraging habitat. To enhance foraging opportunities, open lanes will be cut into the forest to improve and increase the amount of edge-effect foraging. Controlling prey resource competition will include the removal of bullfrogs (*Lithobates catesbeianus*), cane toads (*Rhinella marina*), and the suppression of non-native fishes including mosquitofish (*Gambusia affinis*). For vegetative management, over a mile of enclosure fencing was installed and all ungulates including feral pigs (*Sus scrofa*) will be excluded. Additionally, many exotic trees will be removed and replaced with native trees that support roosting opportunities and shrubs that can host potential prey species such as hawk moths. Monitoring the success of the wetland restoration for Ōpe'a'pea comprises acoustic monitoring, the removal of non-native resource competitors, and an increase in potential aerial prey.

8-23 Using Multiple Approaches to Detect and Understand Bat Fatalities at Wind Turbines: A Case Study from North O'ahu

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Bat fatalities at utility scale wind turbines are a recent phenomenon with the potential to detrimentally affect entire populations. Few well-developed and integrated methods exist for observing bat occurrence and behavior at turbines at multiple spatial and temporal scales. From mid-May to mid-November 2013 we conducted a study on north O'ahu, Hawai'i, to simultaneously monitor bats at four turbines with thermal and near-infrared cameras, and nacelle-mounted acoustic detectors. Hawaiian hoary bat (*Lasiurus cinereus semotus*) activity, coupled with the results of daily ground-searches for fatalities, was examined for correlative patterns with weather and turbine operation metrics. Bat acoustics at over 20 locations in the leeward north Ko'olau Mountains were also monitored for a full year to assess seasonal occupancy at the extent of the landscape. We present the results of these analyses and make comparisons to observations of bat-turbine interactions at a wind facility in Indiana in 2012.

8-24 The Efficacy of using Ultrasonic Acoustic Deterrents to Reduce Hawaiian Hoary Bat Fatalities at Wind Turbines

Cris Hein, Michael Schirmacher

Bat Conservation International, Austin, Texas, USA

Wind energy development presents a potential threat to Hawaiian hoary bats (*Lasiurus cinereus semotus*), a federally endangered subspecies. The North American subspecies (*L. c. cinereus*) has the highest known turbine-related fatality rate comprising approximately 38% (range: 247,040-633,882 bats) of all bat fatalities north of Mexico. Although fatalities are not as numerous as the North American subspecies, the impact of wind turbines on the Hawaiian hoary bat remains unknown and methods to minimize potential take are needed. Our objective was to investigate the effect of an acoustic deterrent on bat activity. In October 2013, we conducted a preliminary field test near Kea'au, Hawai'i. We used thermal cameras and acoustic detectors to monitor activity at control and deterrent sites. On paired sample nights, we observed a significant difference in video observations, with 2,399 and 300 passes recorded at control and deterrent sites, respectively. The number of echolocation passes was similar on pre- and post-treatment nights, indicating bats resumed their normal behavior in the absence of the device. The next phase will involve testing deterrents at an operating wind facility to determine their effectiveness at reducing bat fatality. If successful, deterrents may provide an economically feasible approach to reducing bat fatalities.

9-1 Utilizing High-Tech Solutions to Monitor Fish and their Habitats

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Just as technology has changed the way we communicate, watch TV and movies, and drive our cars, so too has it changed oceanographic research and surveying. From remote stereo camera stations, to remotely-operated vehicles (ROVs), to completely autonomous underwater vehicles (AUVs), Honolulu-based Pacific Islands Fisheries Science Center (PIFSC) has a suite of advanced, fishery-independent technologies for unobtrusively surveying habitats for fish and deep-water corals and for characterizing the seafloor habitat associated with specific fish assemblages. The use of these high-technology solutions is intended to augment and extend the reach of human-conducted surveys. This presentation will highlight how PIFSC, part of NOAA's National Marine Fisheries Service (NMFS), has used AUVs in coastal Hawaiian waters, as well as the wider Pacific Ocean region, to collect data useful for monitoring the health of marine ecosystems.

9-2 Using Song Meters to Monitor Endangered Seabirds on Kaua'i

Andre Raine¹, Brooke McFarland¹, Matthew McKown²

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Rare nocturnal seabirds nesting in remote upper montane forests are notoriously difficult to study. The Kaua'i Endangered Seabird Recovery Project has been working extensively with song meters (acoustic recording devices) to assess how this technology can be most effectively used in monitoring efforts for the Newell's Shearwater *Puffinus newelli* and Hawaiian Petrel *Pterodroma sandwichensis*. Units have been deployed at fixed locations within colonies throughout the breeding season to monitor seasonal patterns of colony attendance. Initial results suggest that average call rates are related to the density of breeding burrows around acoustic survey sites. This relationship may allow us to use acoustic metrics to (i) estimate relative abundance at breeding colonies and (ii) create an index for monitoring population trends over time. A second use of song meters is to find unknown breeding sites in inaccessible locations. Roving units were deployed on an exploratory basis by helicopter into previously un-surveyed areas and subsequently identified new activity hotspots of both species. The use of song meters to monitor and locate endangered seabirds in remote montane areas promises to be an effective tool that has broad applications both on Kaua'i and other areas with similar species, habitats and challenges.

9-3 Mapping and Monitoring with Unmanned Aerial Vehicles (UAVs)

Miguel Castreñe¹, Stephen Ambagis¹, Iam Bouret¹, Manuel Mejia², Chuck Devaney³

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UAVs are promising tools for monitoring changes in ecosystem conditions. We developed a custom fixed-wing system for low altitude aerial photography and mapping. We tested our UAV over Hoi, a wetland site located in the ahupua'a of He'eia in the moku of Ko'olaupoko on the Island of O'ahu. We will share what we have learned in our process of system development, mission planning, data collection and analysis. We will also discuss the challenges and opportunities in designing effective, low cost solutions to ensure data continuity for long-term monitoring of small restoration sites.

9-4 Modeling Climate-Driven Changes to Dominant Vegetation in the Hawaiian Islands

Tamara Wong¹, Jonathan Price¹, Jim Jacobi²

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Predictive species distribution modeling (SDM) is an important tool in addressing conservation biology and global change issues. Changes in climate could also alter species' abundance, capacity to persist within predicted ranges, and compete for local regeneration sites. We have compiled 145,000 vegetation data records for over 4,000 locations and these sites represent a considerable proportion of the overall climate variability in Hawai‘i. We developed novel correlative species abundance models using powerful nonlinear statistical methods, quantitative vegetation plot data, functionally relevant environmental variables, and downscaled climate models to identify trends and predicted future shifts in key native plant species in the Hawaiian Islands. Initial model results indicate that climate change may increase the potential abundance of some native species; however, potential abundance of invasive species is also projected to rise. Projecting species-specific abundance changes can complement and improve predictive mapping of habitat quality, inform the prioritization of habitat conservation and restoration efforts for resource managers, and support ecological resilience in the future.

9-5 GPI “Island Style”: Introducing the Genuine Progress Indicator to Hawaii

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Gross domestic product (GDP) is commonly measured within and across economies. Initially intended solely as a measure of economic health, it is now inextricably linked with social welfare. Growth in GDP automatically implies an increase in society’s well-being regardless of negative byproducts. Movements to push “beyond GDP” include use of the Genuine Progress Indicator (GPI), a more holistic measure that includes economic, environmental, and social factors not captured by GDP but which nevertheless impact society. GPI affixes a dollar value to these factors, sums the results across the categories, and is directly comparable with GDP. Environmental indicators, for example, track biophysical changes in units (like change in acres of forests) that are assigned a monetary value per unit to derive a total cost or benefit associated with that change. Developed in 1995, GPI is currently gaining traction at both national and state levels, including in Hawaii, because it promotes better informed decision-making. We will present findings and lessons learned from our recent application of GPI to Hawaii, showcased in the State of Hawaii Environmental Council 2013 Annual Report. Additionally, we will discuss the implications of an “island style” GPI as a broader measure of sustainability within our state.

9-6 The O‘ahu Greenprint: A New Set of Maps and Related Tools Available to Help Prioritize Conservation Opportunities

Laura Kaakua¹, Koalani Kaulukukui²

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The Trust for Public Land and Office of Hawaiian Affairs just completed a draft Greenprint for O‘ahu. The Greenprint's mission is: To understand the values O‘ahu residents associate with land and water resources and use that community-based knowledge to develop a dynamic conservation plan that includes GIS-based maps and implementation strategies that will help ensure those values can be perpetuated for present and future generations by guiding purchases of threatened, privately-owned land and resources through fee simple acquisition or conservation easements. Public input revealed the need to protect cultural and historic places, natural habitat, agricultural lands, view planes, coastal regions, recreation/public access, and water quantity/quality. Anticipated impacts such as climate change were also factored into the analyses.

The Greenprint is intended to help strengthen existing conservation networks island-wide. The project partners will present the results, including GIS maps and related tools to assist conservationists. They will also share constraints/lessons learned and highlight opportunities for coordinated efforts. They would like the Greenprint to be

widely available to assist others in pursuing conservation opportunities with the highest impact possible, and they appreciate the opportunity to get feedback from the conservation community on this process and its products.

9-7 Transforming Statewide Watershed Reporting and Data Collection

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The Department of Land and Natural Resources, Division of Forestry and Wildlife funds watershed protection and management throughout the state of Hawai'i. In fiscal year 2014, over \$8.5 million was provided to over 14 different managing entities. Recipients include state, nonprofit, and private organizations. To consistently account for the actions performed with these funds and measure the cost and long term impacts of watershed management we have implemented a standardized spatial data reporting system. This is a big change from the narrative based reporting of the past. We will discuss the methods, challenges, and long term goals of this transition. We will explore how multiple programs and agencies are already using this data. We will share our methodology so other programs can measure success that scales from project to management unit to ecosystem to archipelago.

9-8 Two Sciences: Towards Developing an Integrated Bioassessment for Hawaiian Stream Mouth Estuaries

Kelly Ratana

Hawai'i Pacific University, Kaneohe, Hawaii, USA

Stream mouth estuaries (SMEs) are threatened by increased human impacts to the adjacent lands and the forthcoming risk of compaction from sea level rise. US EPA's EMAP amassed data describing general habitat condition, water quality indicators, pollutant exposure indicators and benthic condition indicators for estuaries in the main Hawaiian Islands in 2002; however, native Hawai'ian cultural knowledge systems have yet to be utilized to inform and support robust measures of ecological condition. In an attempt to integrate the indigenous knowledge systems of the Māori in New Zealand, Dr. Gail Tipa developed a Cultural Health Index (CHI). We used the CHI in Hawaii to explore the feasibility of integrating native Hawai'ian knowledge systems into the development of biological indicators of SME condition on O'ahu. We will report the successes and lessons learned from the application of the CHI to Hawai'ian SMEs.

9-9 A Focus Area Approach to Habitat Conservation

Lani Watson¹, Gerry Davis², Kristina Kekuewa³, Malia Chow⁴

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In January 2013 the National Oceanic and Atmospheric Administration (NOAA) launched the Habitat Blueprint effort in the Pacific Islands Region as part of a national initiative on habitat conservation. The Habitat Blueprint approach is to bring together capabilities across NOAA programs to support partner and community efforts in the focus areas to achieve measureable outcomes for coastal and marine habitats and communities. With stakeholder input, two Habitat Focus areas were selected and announced in February 2014 - West Hawaii on the island of Hawai'i and the Manell-Geus Watershed in Guam. This presentation will provide an overview of the focus area approach and share where NOAA could complement existing efforts and management plans to achieve sustainable and abundant fish populations, recovered threatened and endangered species, protect coastal and marine areas and habitats at risk, promote resilient coastal communities and/or increase coastal/marine tourism, access and recreation.

9-10 Honohonou Coastal Resource Assessment: An Integrative Approach to Coastal Resource Management

Hökū Pihana, V. Kalani Quiocho, Misaki Takabayashi
University of Hawai‘i, Hilo, Hawai‘i, USA

Natural resource management strategies in Hawai‘i must integrate indigenous Hawaiian and non-indigenous epistemologies in order to effectively and sustainably manage coastal resources. Our project focused on the traditional Hawaiian land division of Honohonou along the Keaukaha coastline in Hilo Hanakahi, Hawai‘i Island. Our goal was to develop a project in collaboration with stakeholders and community members that met the needs of the Keaukaha community and investigated the ecology of the coastal marine environment, both of which would support a functional model for community-driven resource management. The study location focused on five sites within Honohonou; Hale o Lono, Kaupō, Laehala, Kaumealani and Kamokuna. Hawaiian oral traditions such as mo‘ōlelo, ‘ōlelo no‘eau, and oli were utilized for the inception of our methodologies and understanding of these places. The Initial data from each site consisted of water quality parameters, benthic substrate type, and the presence of native and non-native terrestrial and shallow water reef species. The preliminary findings of our study indicated that there is a large variability in water quality, species diversity, and human interactions amongst the sites. The next phase of our project is to develop monitoring techniques that enable the Keaukaha community to participate in effective coastal resource management efforts.

9-11 Using Plastic inside Shearwaters to Monitor Marine Debris around O‘ahu

Shannon Lyday^{1,2}, Dana Ahlin², Michelle Hester¹, K. David Hyrenbach¹
¹*Oikonos Ecosystem Knowledge, Kailua, HI, USA*, ²*Hawai‘i Pacific University, Waimanalo, HI, USA*

The goal of this study is to develop metrics for monitoring marine plastics around O‘ahu using an abundant local predator, the wedge-tailed shearwater (*Puffinus pacificus*). We necropsied 142 salvaged chicks from O‘ahu during two fledging seasons (2009 and 2010) to quantify the incidence, amount, and type of plastic ingestion. Our study revealed the highest incidence rate for this species to date (73%), and the presence of five different plastic types. Most plastic consisted of white and clear fragments ranging from 0.3 – 7.7 millimeters, with one individual containing 42 fragments. To understand ingestion patterns, we investigated three potential sources of variability: year, stomach compartment, and presence of prey (squid). The amount of plastic was significantly influenced by stomach compartment, year, and the amount (number) of squid beaks. There were significantly higher amounts of plastic in the gizzard, and in birds from the 2010 fledging season. The amount of squid beaks was also significantly related to the amount of plastic. Yet, there were no relationships between health/body condition and plastic or squid ingestion. These results underscore the utility of shearwaters as bio-indicators of micro marine debris around the Main Hawaiian Islands, and provide a baseline for future monitoring efforts.

9-12 Market Prices of Coral Reef Fish--Undervaluing a Valuable Resource?

Manuel Mejia, Kim Kanoë Morishige, Leilani Warren, Ilysa Iglesias, Dwayne Minton
The Nature Conservancy of Hawaii, Honolulu, HI, USA

Coral reef fisheries are an important biosecurity and economic asset to Hawaii. Our study of monitoring fish market prices on Oahu, Maui and Hawaii Island indicates that native reef fishes are usually undervalued in the marketplace and as a result, may perhaps reflect the way in which this precious resource is unmanaged. Most unique native and endemic fish often fetch lower prices than common aquacultured species and other imports. Through a year-long study of fish prices in the main fish markets on Oahu, we look at what fish species are commonly available, their seasonality, and the economic drivers that influence supply and demand. Fish prices during holidays are examined closely to see if prices are a function of these cultural events. Comparisons with historical records of what was found in fish markets in the last century and their prices are also made, showing that there is less diversity of reef fish being sold in markets. Recommendations and solutions on how fish markets can thrive and positively influence the health of these coral reef fisheries.

9-13 The Kaua'i Seabird Habitat Conservation Program: Adaptive Management for the Future

Paul Belson, Yuki Reiss

Kauai Seabird HCP, Lihue, HI, USA

The Hawaii Division of Forestry and Wildlife (DOFAW) in coordination with the USFWS is creating the Kaua'i Seabird Habitat Conservation Program (KSHCP) to address light attraction and collisions with manmade structures which affect the threatened Newell's shearwater (*Puffinus newelli*) and the endangered Hawaiian petrel (*Pterodroma sandwichensis*). The KSHCP is a unique island-wide approach to work with multiple entities whose activities have potential to cause "incidental take" of listed seabirds. Adaptive management is an essential tool to inform and adjust management in response to new information gathered. The KSHCP planning process includes an adaptive management model which will respond to programmatic changes, biological uncertainties, and site-based conditions to adjust the program to meet mitigation needs and maximize species benefit. This presentation will provide a brief overview of the KSHCP and focus on the adaptive management model approach.

9-14 Mauka to Makai: Heeia Estuary and the National Estuarine Research Reserve System

Leo Asuncion, Rebecka Arbin

Office of Planning, Honolulu, HI, USA

Estuaries are partially enclosed bodies of water where freshwater from rivers mixes with salt water. These important coastal habitats are spawning grounds and nurseries for at least two-thirds of the nation's commercial fish and shellfish. Wetlands associated with estuaries buffer uplands from flooding. Estuaries also provide many recreational opportunities, such as swimming, boating, fishing and bird watching. Some familiar examples of estuary ecosystems in around the state include Kaneohe Bay, Oahu; Kealia Ponds, Maui; Waipio Bay, Hawaii and Wainiha Bay, Kauai.

The National Estuarine Research Reserve (NERR) System is a federal-state partnership of 28 research reserves representing different biogeographic regions of the United States. NERRs function as living laboratories where multidisciplinary programs and partners come together to implement long-term research, monitoring, education programs for K-12, community, and coastal decision-makers, and coastal stewardship.

Currently the Pacific region is not represented in the network, which means a site designated in Hawaii would add to the network's diversity and provide a resource for researching coastal issues that are of concern in the Pacific. Research conducted at research reserves is intended to support local knowledge and management decisions pertaining to the coastal resources of that biogeographical region.

In support of the Governor of Hawaii's interest in establishing a research reserve in the state, the Office of Planning's Coastal Zone Management (CZM) program is coordinating the site selection process. The CZM program solicited proposals from the public, and received inquiries about potential sites located in all four counties. Two site proposals were submitted for review – Heeia Estuary and Hilo Bay. The Site Selection Committee, made up of state agency, county and community representatives as well as scientists from Hawaii universities, reviewed the proposals against a set of criteria and selected Heeia Estuary as the preferred site.

This presentation will provide an overview of the preferred site and local partners, highlight potential benefits of a NERR for the state, and give an update on the nomination process. We invite you to come learn about the Heeia community and their vision to restore the Heeia Ahupuaa and ultimately create and sustain a living, breathing ecological system.

9-15 Engaging Students as Scientists in a Community Invasive Algae Removal Project

Wendy Kuntz¹, Rae DeCoito², Sean Marrs³

¹*Kapi'olani Community College, Honolulu, HI, USA*, ²*Malama Maunalua, Honolulu, HI, USA*, ³*The Nature Conservancy, Hawaii Program, Honolulu, HI, USA*

In the Fall of 2009, Kapi'olani Community College (KCC), The Nature Conservancy (TNC), and Mālama Maunalua (MM) entered into a collaborative partnership designed to address student learning in a Biology 124 Ecology Lab (1-credit) and to assist the community both in restoration and data collection needs by involving students in a community-based project removing invasive algae (*Avrainvillea amadelpha*) in Maunalua Bay, Oahu, Hawaii. Since project initiation, over 100 KCC students have removed more than 13.5 tons of invasive algae and have presented the community with data on re-growth patterns of both invasive and native algae. A Student Assessment of Learning Gains (SALG) survey, with questions aimed not only at content knowledge acquisition but also at concept development, was used to assess student learning (<http://www.salgsite.org>). The majority of students reported good or great gains in questions related to their understanding of science and student learning was reported to be best supported by participation in the community invasive algae removal project. This project can serve as a model of an effective way to engage early career college students in restoring Hawaii's native ecosystems.

9-16 From the Classroom to Conservation: College Student Perspectives on Early Experiences in Sustaining, Preserving and Restoring our Native Ecosystems

Wendy Kuntz

Kapi'olani Community College, Honolulu, HI, USA

As we move into the 21st century of conservation in Hawaii, there is a growing consensus that we need to expand participation of local students in the conservation pipeline, both as professionals and as engaged community members. Specifically, how can we produce more locally grown natural resource managers? Community colleges can serve an important role for introducing local students to Hawaii's amazing biodiversity and for engaging students in the long-term sustainability and restoration of Hawaii's native ecosystems.

In this presentation, current students and graduates of Kapi'olani Community College (KCC) will share their perspectives on the experiences that engaged them in sustaining, preserving and restoring native ecosystems in Hawaii. Discussion will focus on their own experiences growing up in Hawaii and what sparked their interest and involvement with conservation issues. A special focus will be on the importance of early college experiences (freshman and sophomore level) in both conservation research and management.

9-17 Building a New Generation of Young Leaders in the Western Tropical Pacific Islands

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The National Science Foundation has funded the Partnership for Advanced Marine and Environmental Science Training (NSF-ATE) for Pacific Islanders since the year 2006. This project seeks to reduce the reliance on expatriate and outside expertise by supporting capacity development at the institutional and community level in a locally relevant and globally responsive manner. The NSF-ATE project provides education and capacity-building opportunities to five community colleges across the western Pacific Islands to improve technological education at the undergraduate school level. The partnering institutions cover a geographical area over 8,000km including islands north and south of the equator and serve Pacific Islanders, a highly under-represented group in the Science Technology, Engineering & Mathematics (STEM) disciplines. By making new technologies available along with training students how to collect, interpret and apply the data, this NSF-ATE project equips indigenous culturally connected students with the skills to prepare for and adapt to their islands' environmental changes. The project's measures of effectiveness indicate substantial outcomes in building a new generation of young leaders. The NSF-

ATE project will be applied this spring in Palau with a focus on climate change, specifically monitoring coral bleaching and alterations in marine biodiversity and species abundance of coral reef ecosystems.

9-18 Powerhouse Internship Programs: Building Local Leaders for Hawai‘i’s Sustainability Movement

Amy Brinker¹, Ella Aki^{1,3}, Nicole Fisher², Michel Arakaki³

¹*KYA Sustainability Studio, Honolulu, USA*, ²*Rewarding Internships for Sustainable Employment, Honolulu, USA*,

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A strategically designed internship program is a great way to give your organization a competitive edge while also providing critical educational opportunities to Hawai‘i’s emerging workforce. You will learn about the different program models of three organizations quickly gaining attention for their success: RISE, KYA Sustainability Studio, and Kamehameha Schools. The panelists will talk about how their internship programs result in “win-wins” for participating interns as well as the organizations.

First, KYA Sustainability Studio will discuss **why** internships matter to interns and organizations as well as **why** hosting an internship program serves to increase Hawai‘i’s sustainability.

Second, RISE will discuss **how** interns can work with organizations, **how** organizations can efficiently manage interns and **how** RISE alleviates some of the work associated with the intern acquisition process for participating organizations.

Lastly, Kamehameha Schools’ KOIP will discuss **what** types of sustainability projects are available to interns, **what** the potential outcomes are due to increased labor capacity with intern support and the unique role that KS KOIP plays in sustaining Hawai‘i.

9-19 Conducting Science in the Public Sphere: Educating National Park Visitors about Climate Change and its Effects on the Haleakalā ‘Āhinahina

Jesse Felts¹, Paul Krushelnycky², Matt Brown¹, Kuhea Asiu¹

¹*Haleakala National Park, Kula, HI, USA*, ²*University of Hawai‘i - Manoa, Honolulu, HI, USA*

Climate change is one of the most pressing problems facing society, yet the threats posed by it lack sufficient recognition among large segments of the public. The difficulty experienced in effectively communicating scientific research and findings often inhibits their acceptance by lay people. In Hawai‘i, the Haleakalā ‘āhinahina (silversword) presents an ideal opportunity to relay information about the potential impacts of climate change on biodiversity. This species is highly charismatic, is viewed by 1-2 million annual visitors to Haleakalā National Park, and is showing significant signs of decline from changing climate conditions. In 2013, Haleakalā National Park interpreters and resource managers, UH scientists, and Hau‘oli Mau Loa Foundation joined together to conduct research on ‘āhinahina drought tolerance, which appears to be central to its future survival and management. The partnership includes a full-time intern who conducts this research on ‘āhinahina seedlings at two different elevations, in two greenhouses next to busy visitor centers, making the research directly visible to park visitors. We report on the project's progress and findings, and discuss how it actively promotes educational dialogue with the public about climate change. Interactive efforts such as this one can be highly important for advancing conservation causes in Hawai‘i.

9-20 Building an Optimized Baseline Soil Carbon Map for the State of Hawaii

Michelle Lazaro¹, Susan Crow¹, Creighton Litton¹, Christian Giardina², Paul Selmants¹

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Hawaii has a diverse array of soils that exhibit unique physical, chemical, and mineralogical properties, which play a key role in governing the quantity of carbon (C) found within soil. Currently, NRCS has been working to create an ideal product to establish a baseline map showing soil C pools across the state in order to improve our understanding of potential C sequestration and the impact that anthropogenic activities may have on the soil resource. This specific project undertakes a different approach using spatial interpolation to test new methods of modeling soil organic C. Using NRCS soil survey data and published literature values for soil C, kriging was used to calculate soil C storage down to 30cm and 1m depths. Navigating future change in Hawaii requires a strong understanding of current conditions while identifying gaps in the data for additional refinement and improvement of the overall product. Establishing baseline conditions allows for the prediction and monitoring of future changes in soil C pools in response to climate change, and the evaluation of the landscape over time, increasing understanding of soil C storage and serving as an important tool to direct future conservation and restoration efforts in Hawaii.

9-21 Seabird Contribution to Nutrient Deposition in Hawaiian Tropical Montane Ecosystems

Julia Rowe, Creighton Litton, Chris Lepczyk

University of Hawaii at Manoa, Honolulu, HI, USA

Seabirds were historically more widespread and numerous in Hawaii than they are today. In other places, seabirds deposit significant amounts of nutrients to ecosystems where they roost and breed. This nutrient flow impacts resident organisms and neighboring ecosystems. However, no evaluation of seabird inputs had been conducted for tropical montane systems, in Hawaii or elsewhere. We quantified how the current sparsely populated seabird colonies in wet montane ecosystems of Hawaii contribute to allochthonous nutrient deposition. To do this we compared 24 seabird and non-seabird plots in two sites on the island of Kauai by assessing nutrient availability in soils and plant community structure. Resin probes were used to quantify soil nutrient supply rate, and we surveyed plants to detect differences in community structure. Seabird areas were found to have significantly more NH₄ than non-seabirds areas. These montane areas are dominated by native vegetation and many endangered endemic plants are found here as well. This information will be useful to managers working in ecosystem conservation and restoration to understand historical nutrient inputs into these ecosystems vs. what is being supplied today. These calculations highlight the importance of taking the necessary actions to protect seabirds as an integral part of the ecosystem.

9-22 The Pacific Fire Exchange - Partnership Driven Contributions to Fire Management on Pacific Islands

Christian Giardina¹, Pablo Beimler², Susan Cordell¹, JB Friday³, Creighton Litton³, Eric Moller⁴, Elizabeth Pickett², Clay Trauernicht³

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The Pacific Fire Exchange (PFX) meets land manager needs in Hawaii and the US-affiliated Pacific Islands for collaborative fire prevention and management by stimulating and utilizing the best available research to reduce fire management costs and enhance effective protection of natural and cultural resources. The PFX is currently addressing the following challenges: 1) easier access to better and more comprehensive fire information; 2) improved technical assistance to land managers and communities; and 3) creation of a collaborative, two-way information transfer environment. Products include development of a PFX website, field tours, webinars, newsletters, symposia, outreach visits, trainings and workshops, and fire science material delivery to users in Hawaii, Guam and Palau. In the coming years, PFX will: 1) hire two Fire Leadership Fellows (Palau and Yap); 2) create theme based knowledge materials (video, webinar, factsheet, full report) addressing climate change, cultural

resources, fire risk mitigation, post-fire response in restoration and erosion control, and decision support; 3) release "Hot Spots", a monthly fire science and management information series featuring new publications and projects, and a summary of local to national fire events; 4) produce PFX News, a quarterly newsletter with feature stories and knowledge highlights; and 5) organize annual, island-based fire summits.

9-23 Baseline and Projected Future Carbon Storage and Flux in Terrestrial and Freshwater Aquatic Ecosystems of Hawaii

Paul Selmants¹, Christian Giardina², James Jacobi³, Creighton Litton¹, Susan Crow¹, Todd Hawbaker⁴, Richard Mackenzie², Zhiliang Zhou⁵

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As part of a nationwide carbon sequestration assessment required by a congressional mandate, we are conducting a comprehensive assessment of carbon storage and flux for terrestrial and freshwater aquatic ecosystems on the major islands in the State of Hawaii for both baseline (2005-2010) and potential future (2080-2100) conditions. This effort is the first of its kind in the State of Hawaii and involves multiple State and Federal agencies including the US Geological Survey, the USDA Forest Service, the USDA Natural Resources Conservation Service, and the University of Hawaii at Manoa. To conduct this assessment, we are using existing inventory, monitoring, vegetation mapping and remote sensing data combined with statistical methods and simulation models. The Carbon Assessment of Hawaii will provide statewide estimates of current and projected future carbon storage, carbon sequestration and carbon dioxide fluxes, along with how the carbon balance in the state's ecosystems may be influenced by climate change, wildfire, biological invasions, and land-use change. This ambitious effort will also provide estimates of uncertainty and identify knowledge gaps in an effort to improve the accuracy and predictive power of future iterations of comprehensive carbon assessments in Hawaii, and in other regions worldwide.

9-24 Projecting Hawaiian Terrestrial Biome Shifts under Climate Change

Lucas Fortini^{1,2}, Jim Jacobi²

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Anticipating potential shifts in plant communities has been a major challenge in climate change ecology. In Hawaii, where conservation efforts tend to be habitat-focused, the lack of projections of habitat shifts is a major knowledge gap for climate change adaptation. As a first approximation of such changes, we have modeled potential shifts of terrestrial biomes across the Hawaiian landscape between now and the end of this century. Our novel approach relies on modeling the relation between current climate and the distribution of broad climatically-determined biomes (e.g., wet forests, dry forests) using multivariate environmental distance metrics and on a calibration algorithm that provides unbiased projections of current and future of Hawaiian biomes.

Our results show we can accurately replicate the current distribution of several native Hawaiian biomes using simple climate metrics such as mean annual temperature and precipitation. With our models we have identified areas in the landscape where projected shifts in climate may lead to biome shifts and thus provide valuable information for habitat conservation planning.

9-25 Mapping the Battlefields Before the War: Modeling and Understanding Invasion Potential of Hawaiian Weeds

Matthew Lucas, Brooke Mahnken, Adam Radford
Maui Invasive Species Comitee, Makawao, Hawaii, USA

Invasive species pose a significant risk to Hawaii's biodiversity, watersheds, agriculture and tourism economy. Huge efforts have been made to detect and control invasive species on all the main Hawaiian Islands. With similar environmental gradients but relative individual isolation, each island has its own list of species at various stages of invasion. This presents a unique opportunity to access potential ranges of key invasive species across similar climates on different islands. We created distribution models of invasive plant species that are widespread on a

particular island, but are only an incipient population or not present on other main Hawaiian islands. These distribution models were created from detection and treatment point data for these species on the Hawaiian Island where they are widely distributed. The model highlights the invasion potential of the species on the other main Hawaiian islands. We used three samples of highly invasive species to demonstrate that even with an exponential rate of alien species naturalization in Hawaii more emphasis should be placed on inter-island biosecurity. We also discuss the need and feasibility of expanding use and access of these geographic products to help inform land managers of invasive species threats without having to perform these complicated analyses.

9-26 Controlling the Albizia Monster in Hawaii's Forested, Agricultural, and (Sub)Urban Landscapes: The What, Where, When, How and Why of Current Efforts

Flint Hughes¹, Springer Kaye², James Leary³

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Purposefully introduced to Hawaii in the 1900's, the large, fast-growing, albizia (*Falcataria moluccana*) tree is a serious threat to the native diversity, structure, and function of Hawaiian ecosystems. There is growing acknowledgment that albizia also poses a costly nuisance and danger to vital public infrastructure and cash-strapped residential communities, and resulting socio-political forces are increasing interest to manage this species. Currently, albizia distribution across Hawaii Island is estimated at just over 70 km², with the most extensive infestations in Hilo and Puna Districts. Large infestations also occur on Oahu, Maui, and Kauai. While the task of controlling large albizia stands appears daunting even at local scales, highly effective herbicide treatments have been developed that allow managers and landowners to kill large numbers of large trees in an efficient and economical manner. In addition, we have been able to exploit the particular ecological characteristics of this species, namely its inability to tolerate shade at any point in its life cycle, to constrain albizia recruitment in treated areas; retaining as much understory vegetation as possible before, during, and after treatment is essential to ensure that control of large individuals doesn't simply lead to a proliferation of next-generation seedlings and saplings. At present, increased ecological understanding, advances in technical control approaches, heightened public and private concern, and active engagement by agencies and stakeholders are combining to make meaningful control of albizia a both a necessity and an attainable goal.

9-27 Herbicide use in Wainiha Valley, Kaua'i to Control Australian Tree Fern, *Cyathea cooperi*

Trae Menard, Theresa Menard

The Nature Conservancy, Honolulu, Hawaii, USA

As the state's third largest private nature preserve, the 7,050-acre Wainiha Preserve includes one of Kauai's largest river systems, magnificent mountain cliffs, and portions of the famed Alaka'i wilderness and Mt. Wai'ale'ale summit region, one of the wettest spots on Earth. Yet Wainiha is under threat from the invasive Australian Tree Fern, a fast-reproducing ornamental that was brought to Kaua'i almost 50 years ago. In an effort to control this weed, The Nature Conservancy has deployed "the Stinger", a precision herbicide dispenser mounted underneath a helicopter, which is used to spray extremely small quantities of Imazapyr. Over a three year period, The Nature Conservancy treated over 4,000 tree ferns in a 5,000 acre area and only used 11 gallons of herbicide. As part of the control effort, The Nature Conservancy has worked with Resource Mapping Hawaii to develop an aerial mapping system. This mapping system has produced ultra-high resolution imagery (1 to 2 cm per pixel side) from before and after herbicide treatment. Visual inspection of the natural color imagery confirms that nearly all herbicide treated individuals of Australian Tree Ferns have died. More than 90 percent of the mapped Australian tree ferns in the Wainiha Preserve have been treated and killed. These tools hold promise for controlling and monitoring other invasive weeds in Hawai'i and beyond.

COMMUNITY

P-1 American Samoa Go GREEN: Building Local Capacity and Awareness for a Sustainable Environment

Fatima Sauafea-Le'au¹, Trevor Kaitu'u², Solialofi Tuamu³

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Village communities in American Samoa have for many years managed their reef areas and watersheds with strong enforcement. As a tradition, villagers will practice their traditional fishing methods when utilizing their reef areas. Safe and effective fishing practices were often used and the results were plenty of fish and shellfish caught for family consumption. Effective management in the early days was well practiced and enforced by villagers. As the years passed by, American Samoa has gone through major changes as change is inevitable. These changes include new technologies and advance methods that have altered the approaches and perceptions of the local people on how to earn more and live better.

In American Samoa, an inter-governmental resource education group called Le Tausagi has been in existence for over 15 years, providing education and outreach programs to communities. These programs include an annual summer environment camp for students from ages 8-13, teachers' workshops, presentations to schools and villages, and coordinated outreaches to support an ongoing management program. Le Tausagi has been implementing and facilitating education and outreach campaigns to build the local community capacity for an improved management and conservation of coral reefs and watersheds in American Samoa.

P-2 Reef Kahu: Educating our Keiki to Conserve and Protect

Ashley Watts

Miami University, Miami OH, USA

Reef Kahu, meaning those who tend and care for the reef in Hawaiian, is the name of a program I created to educate our children. Education and conservation awareness of both visitors and members of the local community are fundamental to the survival of the surrounding reefs here in Hawai'i. (Friedlander et al., 2005).

The pestering power of children is an under used, yet very powerful tool that is harnessed here in order to get maximum results. The presentation begins with a short introduction and summary of types of marine ecosystems, then flows to the identification of marine organisms from one of the smallest to largest, coral to whale respectively. Visual aids in the form of exoskeletons and testes of invertebrates and teeth, bone and other various preserved parts of vertebrates are passed around the classroom for the children to touch and examine. A 'touch pool' of sorts also fulfills this concept as well. A five-gallon bucket and air pump are used to transport a few marine organisms into the classroom from a nearby beach.

Hope needs to be portrayed in order to encourage environmental stewardship, as most people do not respond well to inevitable negativity. Fear is a good basis for dominant behavior- the exact opposite of conservation behavior. One does not want to save what is feared, so decreasing fear about creatures of the sea at a young age is crucial to developing a conservation friendly future for the world. This is the reason Reef Kahu was created- to teach keiki in local schools the importance of marine organisms and give them a chance to interact with several harmless species.

Empowering the community in their capacity to create change can help reduce the negative feelings held about the environment, and one's connection to the environment. Whether through social pressure, changing environment, or other factors, peoples' values change their behavior (Pocock, 2006). One's value set must include the value of nature in order for conservation to even become an option for one's behavior. Exposing young children to this value and educating them on the significance of environmental relationships helps foster conservation behavior. Human

interaction also holds great value in motivating people to take action and change behaviors (Pocock, 2006). Therefore, the combination of hands-on activity, human interaction, and education within this presentation will create change. Increased awareness on marine conservation can positively influence one's thinking and behavior concerning the marine environment. As stated in Jickling (1997), environmental education is designed to inform others so that they can develop concern and motivation to further conservation and find ways to confront environmental problems.

P-3 The Honolulu Rail Transit Project: Improving Hawaii's Sustainable Transportation Alternatives

Aki Marceau

Honolulu Authority for Rapid Transportation, Honolulu, HI, USA

The purpose of this presentation is to share the environmental benefits of the Honolulu Rail Transit Project with the greater conservation community. HART will highlight these benefits within the framework of ground transportation as one of Hawaii's largest energy consumers.

500 million gallons of petroleum or 28 percent of Hawaii's petroleum use goes towards ground transportation (DBEDT 2013). This is equivalent to the amount petroleum used for electricity production across the entire state. While Hawaii boasts an award-winning bus system, there remain limited options outside of auto-oriented travel. The Honolulu Rail Transit Project will provide a grade-separated high capacity opportunity for commuters, tourists, and families seeking a reliable and expedient means of travelling along Oahu's congested east west corridor.

The Honolulu Rail Transit Project will reduce transportation energy demand on Oahu by three percent, or an annual reduction of greenhouse gas emissions by 52,700 metric tons of CO₂ (FEIS 2010). This is equivalent to 5.9 million gallons of gasoline. Areas around the stations will use Complete Streets and Smart Growth principles, allowing communities to conveniently use alternative green modes of transportation such as rail, the bus, bicycles, and walking. The Honolulu Rail Transit Project provides a foundation of transportation infrastructure that will allow for more sustainable development and in turn more opportunities for environmental conservation.

P-4 Pahole Adopt-A-Forest Program: Growing Forests and the Future Conservationists to Manage Them

David Anderson¹, Sandy Webb²

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²*Mililani High school, Mililani, Hawai'i, USA*

The Pahole Adopt-A-Forest (AAF) program grew out of a random encounter at the 2011 Hawaii Conservation Conference. It was developed with the idea of introducing Hawaii's young adults to learning about our natural resources through participating in hands-on conservation and preservation work. It focuses on getting students out into the forest to implement management goals while learning about the unique plants and animals of Hawai'i and the basic resource management skills to protect them.

Principal management goals include invasive species control, forest health monitoring, endangered species protection, outreach and education, and fostering natural resource managers for the future. Students have the opportunity to conduct randomized surveys, use dichotomous keys, maps, and gps units. Teachers may elect either a campout or a day trip.

We initially started with upper-level high school environmental science students. However, the program has the ability to adapt itself to various academic levels and to the changing needs of teachers, students, and managers. The program was piloted by Mililani High school students and now has expanded in three years to include four more high schools. Various elementary schools are also growing koa for outplanting by the high school students.

P-5 Ocean Swimming/Ocean Science Program, Educating Students about the Ocean and Swimming Safety Skills Exposing them to the Underwater World

Isabel Gaoteote Halatuituia

National Marine Sanctuary of American Samoa, Pago Pago, AS, American Samoa

In January 2012, the National Marine Sanctuary of American (NMSAS) and U.S open water/marathon swimmer Bruckner Chase, launched the first swimming and marine science course, “Ocean Swimming/Ocean Science” program in American Samoa. Since then, over 100 high school students have participated in the program and have shown interest in marine science and in improving their swimming skills.

The Ocean Swimming/Ocean Science (OS/OS) program was designed to educate high school students about American Samoa's marine environment and to improve swimming and safety skills exposing them to the underwater world. The program goals are to increase participant's knowledge about the local marine environment and its associated challenges, develop skills to address the challenges, and foster lifestyle and behavioral changes that reduce negative pressures on the environment.

As widespread impacts of climate change, pollution, and over-fishing continue to progress, efforts to increase environmental awareness and promote conservation is more important than ever. OS/OS provides opportunities and activities for young participants to learn, explore, and experience their natural environment and marine wildlife. Participants are encouraged to respect and appreciate their natural surroundings and understand how their simple acts can make a significant change for the future state of American Samoa’s environment.

P-6 Navigating Change through Climate Education

Corrin Barros, Daniel Lin

Pacific Resources for Education and Learning, Honolulu, USA

Producing locally grown natural resource managers requires educators with the resources and capacity to cultivate students' curiosity about and understanding of their environment. With the impacts of climate change already occurring throughout the Pacific region, it is more important than ever to have decision-makers and resource managers with the deep understanding and aloha for their ‘āina that comes through lifetime personal connections with the environment and community of a place.

The Pacific islands Climate Education Partnership (PCEP) is a collaboration of partners—school systems, nongovernmental organizations, and government agencies—working to support learning and teaching about climate in the Pacific through relevant resources, teacher professional learning, and community-school partnership. Core partners include PREL, WestEd, College of the Marshall Islands, and University of Hawai‘i.

Since PCEP’s presentation at the 2013 Hawai‘i Conservation Conference, partners have piloted several models that advance the field of climate education. For this year’s conference, PCEP would like to present the findings of these models and engage the audience in a discussion about next steps to continue improving climate education, both through the formal and informal systems of education. This is an effort to produce local resource managers that are aware of and prepared for the impacts of climate change on Pacific island communities.

One model to be presented is the college-level course on climate science piloted during the Spring 2014 semester at the College of the Marshall Islands. This course, which targets resource managers and 6-12 teachers, demonstrates how post-secondary institutions can take a leading role in climate education by offering opportunities for educators to build both their background content knowledge and pedagogical skills to teach about climate effectively.

Another model to be presented is a video series of elder perspectives on their mangrove environment. Local educators and environmental professionals created the video series with the support of PCEP. The development process – from selecting a topic and generating questions, to identifying elders and telling their story – models a

process for gathering local ecological knowledge for the purpose of bringing community knowledge about the environment into the classroom.

Through these models, an audience will have opportunity to reflect on their own next steps and on how we, as a community, are navigating towards a brighter climate future for the Pacific region. We welcome others to share with us resources and best practices and, ultimately, strengthen the networks that are working to prepare and cultivate our next generation of resource managers

CULTURAL

P-7 Traditional Fishing Practices among Tribes of Andaman and Nicobar Islands

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TRADITIONAL FISHING PRACTICES AMONG TRIBES OF ANDAMAN AND NICOBAR ISLANDS

Andaman Nicobar islands situated in the Bay of Bengal between 6°45' -13 45' N and 92°10' - 94°15'E, consist of 352 islands 220 islets and rock and cover a distance of almost 470 km over North South, with a coastline of 1962 km, and bring in for India an Exclusive Economic Zone (EEZ) of 600 thousand sq km. The Andaman group of Islands is the homeland of four primitive tribes viz., Great Andamanese, Onges, Jarawas and Sentinelese. All of them are of negrito stock and are residing in separate pockets. In the Nicobar group of islands, two Mongoloid tribes viz., Nicobarese and Shompens reside. The Jarawas, Sentinelese, Shompens and Onges, are still in primitive food-gathering stage, while the Nicobarese who are already in the main stream of civilization. They use different types of dug outs and out trigger canoes with some minor differences among the tribes. The gears they used for the catch of marine resources are multi-pronged spear, bow-arrow, line and hook. They fishes mainly octopuses and fishes, they also collect shells and sea cucumbers. They use narcotic agents like seeds of *Barringtonia asiatica* to narcotise the octopuses and fishes. The present investigation, it was noticed that people of same races and communities are practicing different techniques and methods. The present need is to preserve their traditional knowledge. In this paper an attempt is made to provide a brief account of the different fishing methodology and the gears used by the tribes of Andaman and Nicobar Islands.

P-8 Uncovering the Science behind the Legend of Ka'au Crater's Red Spring

Melanie Keliipuleole

Kapi'olani Community College, Honolulu, HI, USA

In Hawaiian culture there are many mo'olelo about waters running red after a battle or a death. Within the vicinity of Kapi'olani Community College, there is a mo'olelo that tells of a spring that runs red due to a great battle. This project seeks to identify the biological and/or chemical factor(s) that may be contributing to the red color of this spring. Water samples were taken in Nov 2012, Jan 2013, Mar 2013, and Apr 2013 from four different sources. In addition to the water samples, plankton from the "red spring" and macroalgae samples were also collected for examination. Iron, tannin, and turbidity analyses were conducted, and dissolved oxygen, conductivity, temperature, and pH levels were taken. The data collected by the spectrophotometer indicated that the "red spring" had much more significant amounts of Iron when compared to the other water sources, which may lead to a possible explanation to the spring's red color. A trend in low pH levels and water color variation of the "red spring" may also add to an explanation of the spring's color. As this is an on-going project, further data analysis, and tests need to be conducted in order to conclude the task of uncovering the science behind the "red spring".

P-9 LONO-KU MANA - Hawaiian Gods of Sustainability

Jackie Kahookele Burke¹

¹*Hawaiian Civic Club, Hawaii, USA*, ²*MAMo, Hawaii, USA*, ³*Pa'i Foundation, Hawaii, USA*

This original painting, "LONO KU MANA", is an interactive project to promote sustainability through cultural awareness of past traditional Hawaiian values. This can create a presence of mind as it relates to ancient Hawaiian worldviews that divided a year into two seasons: KU (dry) and LONO (rainy), reflective of strict laws (kapu) and regeneration practices.

MAKAHIKI, is the Hawaiian new year, with LONO, presiding over a time that represents the beginning of the regeneration of the cycle of life. This occurs when the star Makali'i rises in the Pleiades constellation in late November and sets in mid-March. Cultural historian David Malo described Makahiki in his book, *Hawaiian Antiquities*, as an astonishing change in the normal fabric of life. For at least half of every eight-day period, everyone abstained from fishing and farming. Ceremonies honoring Lono, the god of fertility, health and agriculture, dominated social and religious activities.

"This time of regeneration also worked as a system of conserving resources," writes Malo. "During the Makahiki certain kapu would be enacted, forbidding the gathering of specific limu (seaweeds), i'a (fish), 'ai (foods), or other important materials. By doing this, these things were allowed to replenish and maintain a healthy population.

The end of MAKAHIKI ushered in the time of KU, god of prosperity, politics and of war and sorcery. KU was also god of the deep forest, of the mountains, of dry and wet farming and the god of fishing. KU represents the ocean from which all life descended. Ku feeds the people (gives life) in good crops and fishing, and provides the water that is the foundation of life. KU is prayed to for long life, and family and national prosperity for a whole people. Politics included strategies for preparing for the year ahead to ensure the regeneration process of resources and supplies for food, shelter, canoe building and all community needs. KU also takes life, which meant wars and other political maneuvers.

Symbolically and in unison: a family, a community, a nation and the world, can reawaken this connection by positioning the LONO - KU MANA painting on different planes according to the season. When you place the BLUE colors on the top, it represents Makahiki and the time of LONO. Then when by "huli" (turning), changing the plane to place the ORANGE colors on the top, you now bring KU into his domain and season. (Blue is Lono and Orange is Ku)

We have a way to connect to our Hawaiian MANA (power), this simple painting of LONO and KU can help us to reawaken, reconnect, regenerate and reinvigorate our awareness across time and generations. It allows us to honor the knowledge of sustainability from our ancient traditional Hawaiian worldview.

MARINE

P-10 Capacity Building and Outreach Efforts of the Coral Reef Ecosystem Division's Fish Team

Jill Zamzow^{1,2}, Amanda Dillon^{1,2}, Megan Moews^{1,2}, Annette DesRochers^{1,2}, Russell Brainard¹

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The Coral Reef Ecosystem Division (CRED) of the NOAA Pacific Islands Fisheries Science Center (PIFSC) in Honolulu has a number of outreach and capacity building activities to inform stakeholders and enhance their ability to manage and conserve coral reef ecosystems across the U.S. Pacific islands. We will provide an overview of CRED's various programs in Hawaii, across the U.S. Pacific islands, nationally, and internationally. Programs, such as the NOAA Hollings Scholar program, PIFSC Young Scientist Intern Program, and Reef Smart and JASON Learning projects, as well as capacity building and curricula development on an Ecosystem Approach to Fisheries Management (EAFM) and incorporating considerations of climate and ocean change into an EAFM as part of work

supported by the U.S. Agency for International Development (USAID) in the Coral Triangle of the western Pacific will be discussed. We hope to attract and inform scientists and resource managers so that they may work with us, learn from us, teach us, and contribute to maintaining healthy coral reef ecosystems in Hawaii and throughout the Pacific Islands.

P-11 Benthic Habitat Mapping of the USCRTF Ka'anapali Priority Study Area and the State of Hawai'i Kahekili Herbivore FMA, West Maui

Susan A. Cochran¹, Ann E. Gibbs¹, Darla J. White²

¹*U.S. Geological Survey Pacific Coastal and Marine Science Center, Santa Cruz, CA, USA,* ²*Hawai'i DLNR Division of Aquatic Resources, Wailuku, HI, USA*

Over the past decade, notable changes have occurred in benthic habitats along West Maui, Hawai'i. Nearshore areas, once dominated by live coral, are now mostly turf or macroalgae. To help improve the health and viability of the coral reef ecosystem, the State of Hawai'i established the Kahekili Herbivore Fisheries Management Area in 2009 to help increase the number of herbivores in an effort to reduce algal overgrowth of corals, and in 2011 the U.S. Coral Reef Task Force designated the Ka'anapali region as a priority study area to reduce land-based impacts to coral reefs.

To support these efforts, the U.S. Geological Survey has created a high-resolution (100 m² minimum mapping unit) benthic habitat map of the area to establish baseline conditions and assist with monitoring. Nearly 5 km² of seafloor was mapped using a combination of QuickBird-2 satellite imagery, SHOALS lidar, sidescan sonar, and underwater video and photographs. Integration of data allows detailed mapping to depths of 35 m. Unconsolidated sediment makes up 65% of the study area. Of the 1.69 km² of hardbottom potentially available for coral habitat, 0.85 km² (51%) is covered with at least 10% coral, mostly found in water depths between 5 and 10 m.

P-12 Mālama ko Hawai'i iā Kanaloa: Hawai'i's People Care for Kanaloa: Hawai'i's People are Cared for through Kanaloa

Dean Tokishi, Jen VanderVeur

Kaho'olawe Island Reserve Commission, Wailuku, Hawaii, USA

Through funding provided by NOAA's Restoration Center/Marine Debris Program, the KIRC has begun the process of removing at least 10 tons of marine debris from the coastal environment around the island of Kaho'olawe/Kanaloa. This goal can only be met with the help of volunteers from throughout the state of Hawaii. The removal of the debris will directly benefit the marine environment by reducing the threat of entanglement and ingestion, as well as providing habitat restoration for all marine species. A secondary benefit will occur when selected types debris will be strategically placed in gulches to reduce the amount of sedimentation run off entering the waters around the island. Through this grant we will also be able to conduct outreach and education sessions with community members on the effects marine debris has on our environment and the benefits of reducing plastics from our everyday lives. Volunteers will have a first-hand look at how everyday items like toothbrushes to straws to deodorant sticks and everything in between finds its way into the ocean and onto our shores, and the dramatic impact marine debris has on even one of the most remote islands in the state. Thus, Mālama ko Hawai'i iā Kanaloa.

P-13 Rolling Out the Red Carpet: Invasive Algae Fostering the Spread of Invasive Stomatopods

Brian White, Wendy Kuntz

Kapi'olani Community College, Honolulu, HI, USA

The purpose of this research is to understand the spread of invasive *Gonodactylaceus falcatus* stomatopods in Maunaloa Bay. Previous research by Robert Kinzie III (1968) suggested that the initial displacement of *Psuedosquilla ciliata* by *G. falcatus* would be limited to coral head habitats and would not occur in reef flats. My research shows that among invasive algae habitats on the reef flat there are populations of *G. falcatus*. Populations

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of each stomatopod are determined by collection and sorting of removed algae, in correlation with time since algae was previously removed as well as from areas where invasive algae was never removed. Preliminary research indicates a correlation between invasive algae removal and reduction of invasive *G. falcatus* populations. The areas of undisturbed invasive algal growth exclusively contained the invasive stomatopod, and areas of previous algal removal showed closer ratios of the two species. This suggests that the removal of the invasive algae, which provides a niche not previously found on reef flats, can also limit the spread of invasive stomatopods. (Further data collection ongoing)

P-14 Evaluating the Status of Scaridae Species in Shallow Coral Reef Habitats on O'ahu

Nicole Williams

Hawai'i Pacific University, Kaneohe, HI, USA

Large, bright parrotfish, once quite common on O'ahu reefs, are now abundant only where protected by difficult access or law. Contrasts between the diversity and abundance of 5 parrotfish species in 3 marine protected areas with nearby similar unprotected reefs demonstrates that while protection is successful, the continued existence of these important herbivores may require further management measures. Parrotfish species are targets for recreational and commercial fishing, while closely related wrasse species are not targeted by fishermen. This study compares patterns of diversity and abundance of 5 parrotfish species and 5 non-targeted wrasse species between protected and unprotected site pairs using rover-diver surveys. Parrotfish size, sex, and substrate occupied were also recorded. As expected, adult and juvenile parrotfish diversity and abundance were higher at protected sites. Wrasse species were more abundant in protected sites, although all 5 wrasse species were observed at all sites. Male and female parrotfish were only observed at protected sites. The larger parrotfish species (Ember and Spectacled) were the most abundant within the protected areas. However, in the unprotected areas there were more smaller species (Stareye, Bullethead, and Palenose). There were also more parrotfish species observed in areas with a higher percentage of healthy coral cover.

P-15 Securing a Future for Endangered Corals and Monk Seals

Miyoko Sakashita, Shaye Wolf

Center for Biological Diversity, San Francisco, CA, USA

In 2012, the federal government proposed to protect 66 corals, including some that occur in Hawai'i, as endangered species. We will present about what this landmark decision means for protecting coral reefs from a variety of threats ranging from overfishing and pollution to ocean acidification and climate change. Over the course of 2014, the government will make a final determination about the coral protections.

Several monk seals have been killed in recent years on the islands of Moloka'i and Kaua'i, which is a terrible tragedy for this critically endangered marine mammal. Additionally, federal measures to enhance monk seal protections are also under consideration. In June 2011, the federal government proposed to protect critical habitat for monk seals. This decision has yet to be finalized. We will present information about what critical habitat means, and why it is important.

The Center for Biological Diversity authored the scientific petitions which resulted in the proposed rules for the corals and monk seal critical habitat.

P-16 What's Beneath the Waves? Seafloor Imagery, Bathymetry, and Acoustic Classification in the Nearshore Waters of the Hawaiian Islands

Ann Gibbs, Susan Cochran, Gerald Hatcher, Joshua Logan, David Finlayson
U.S. Geological Survey, Santa Cruz, CA, USA

Geo-located, digital underwater video, acoustic backscatter, and swath bathymetric data were collected in the nearshore waters (< 60 m) of the Hawaiian Islands between 2002 and 2013 as part of the U.S. Geological Survey (USGS) Coastal and Marine Geology Program's Pacific Coral Reef Project. The optical and acoustic data were collected to improve seafloor characterization for the development and groundtruthing of benthic habitat maps, and to provide qualitative visual information on gross coral species distribution, the general physical condition of the reef, and geologic controls on the islands' nearshore ecosystems. The imagery represents a 'snapshot' in time and can be used as a baseline to evaluate ecosystem change through time. Nearly 53 hours of video footage, over 10,000 still images extracted from the video footage, and a report on the different camera systems and methods used to collect the imagery are available online as a USGS Digital Data Series (<http://pubs.usgs.gov/ds/735/>). Here we present an overview of the data set, including examples of the morphologic and biologic variability of the coral reefs of Maui Nui, and highlight locations where differences in benthic cover were identified compared to existing regional benthic habitat maps derived from aerial and satellite photography.

P-17 Environmental Variability on a Coral Reef, Kiholo Bay, HI

Steven Colbert
University of Hawai'i at Hilo, Hilo, HI, USA

Much of the environmental data from the marine environment, especially chemical data, are collected at a low temporal resolution. However, environmental variability can be relatively large, including changes in salinity and reactive compounds like carbon dioxide. Over the last year, we have been working on methods to examine environmental variability at Kiholo Bay, HI. For fresh groundwater, the input to the ocean was controlled by tides, but transport across the reef was controlled by winds. Carbonate saturation, a measure of the ability for calcifying organisms such as coral to precipitate calcium carbonate, was dependent on salinity. Looking ahead, the impact of ocean acidification on the reef ecosystems will be complicated by changes in the freshwater supply.

P-18 Effects of *Vibrio* Bacteria in Global Fish Trade Industry

Mareike Duffing Romero¹, Linda Amaral-Zettler², Victor Schmidt²
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Ornamental fishes are the third most common pets in the United States and are largely imported from harvest locations and aquaculture facilities in Southeast Asia. Disease along shipment routes is a major obstacle to fish welfare and industry profitability, yet little is known about the microbial communities associated with these fish shipments. The objective of this research is to further understand the behavior of potential bacterial pathogens while transported from one location to another, and the major role they play in microbial communities, the environment, and fish and human health. My research will focus on the genus *Vibrio*, a known bacterial fish pathogen. The proposed methods are to measure and contrast the diversity of vibrios using next-generation DNA sequencing data. My analyses will determine whether any increases in pathogenicity occur during shipment both inside and outside fish in transit and upon arrival to pet shop aquaria. I hypothesize that due to stressful conditions of fish shipments, more pathogenic *Vibrios* will be found after transit. The findings of the research will provide clues to fish disease in trade and hopefully influence regulatory measures to control the treatment and handling of ornamental fishes that carry such potential pathogens.

P-19 A Summary of Albatross Band Recovery Data in the Hawaii Deep and Shallow Set Longline Fisheries

John Peschon

NOAA Fisheries Service, Honolulu, HI, USA

This project is a summary of Hawaii Longline Fisheries observer program seabird band recovery data that has been accrued during the January 01, 2002 through December 31, 2012 period. The National Marine Fisheries Service Pacific Island Regional Office Fisheries Observer Program has been deploying observers on board Hawaii-permitted longline fishing vessels, as part of a mandatory requirement, since February of 1994. Seabirds, most commonly the Black-footed and Laysan Albatross species, are known to occasionally interact with the observed longline fisheries. As a part of their regular responsibilities, observers deployed on longline fishing vessels record seabird sightings, document any observed fisheries interactions, assist with handling hooked or entangled seabirds, salvage dead seabirds, and report on compliance with all existing fisheries-related regulations (many of which are aimed at mitigating seabird interactions). Observers also opportunistically record seabird band recovery data. All banding-related data, is maintained in an 'in-house' database, and is also submitted to the United States Geological Survey, Patuxent Bird Banding Laboratory (BBL) where it is joined with existing banding data provided by the United States Fish and Wildlife Service, and others, into a centralized bird banding laboratory database. The results presented here represent a cooperative effort between the NMFS, USFWS, USGS, as well as other governmental and non-governmental agencies.

TERRESTRIAL

P-20 Invasive Plant Management in Maloata Village, American Samoa

Jolie Goldenetz Dollar, Ritofu Lotovale

American Samoa Community College, Pago Pago, American Samoa, American Samoa

A number of invasive plant species are present in the village of Maloata, located on the western end of the island of Tutu'ila in American Samoa. There is a need to better understand the impacts of these invasive plants on other plants, on wildlife, and on the people living in and visiting Maloata. There is also a need to determine if, and how, these invasive plant species are spreading to other areas of Tutu'ila. This poster gives details on the initial stages of compiling necessary information for a formal invasive plant management plan for Maloata. Photos show the beginning stages of setting up experimental plots to help determine the effectiveness of various invasive plant management techniques. Lastly, the use of GIS technology to aid in on-going management in Maloata is described.

P-21 An Update to the Nene Translocation from Kaua'i to the Big Island

Raymond McGuire, Joey Mello, Jennifer Tietjen

DLNR DOFAW, Hilo, HI, USA

In the 1950's, the estimated population of the Hawaiian nene goose numbered in the 30's and all were located on the Big Island. Intense recovery was enacted, and now nene have begun to recover, none more successfully than on the Island of Kaua'i. Although the recovery of any endangered species is a good thing, when such a charismatic endangered animal becomes more common, human-wildlife interactions increase. Nene have proliferated in the Kaua'i Lagoons Golf Course, which is adjacent to the Lihue Airport and therefore a danger, not only to the nene, but also to any person traveling by air to or from Kaua'i. Seeing the threat, Governor Abercrombie enacted a proclamation to translocate nene from the dangerous Kaua'i Lagoons location to other islands including, Maui, Moloka'i and the Big Island. In February 2012, the State Dept of Land and Natural Resource, Division of Forestry and Wildlife began to capture and translocate nene that nested on Kaua'i Lagoons property and placed them on the slopes of Mauna Kea in newly built predator proof enclosures at Pu'u O'o. Over the course of two years, 451 nene have been translocated to the Big Island and these birds are not only interacting with the local nene populations, but also with Big Island farmers, tourists, golfers, fisherman and ranchers. Although widely believed that nene cannot make long distance travel due to their relatively short wings, with the use of satellite transmitters, individual nene have been recorded to fly hundreds of miles in a couple of days and settle in an area where they have not been seen

in decades. Two nene that have been translocated to the Big Island have even been spotted on the North Shore of O'ahu, perhaps making their way back to Kaua'i?

P-22 Reducing Excessive Sedimentation in the Hakioawa Watershed of Kaho'olawe by Restoring Native Ecosystems

Lyman L. Abbott, James C. Bruch, Lopaka White, Paul K. Higashino
Kaho'olawe Island Reserve Commission, Wailuku HI, USA

Due to the limitation of Unexploded Ordnance (UXO) clearance to the surface only, a new technique vegetating rock mulch mounds with native plants was developed on top of the landscape, in a 44ha project site in Hakioawa Watershed on the island of Kaho'olawe. The two year Hawai'i State Department of Health, Clean Water Branch project is located along the South Trail that leads from the summit of the island down to Hakioawa Bay. Over thirteen hundred rock mulch mounds were constructed using rocks, native soil, kiawe (*Prosopis pallida*) chips, soil amendments and outplanted with native plants. They were placed along contours and irrigated using rain catchment water from a 128,000 gallon tank. Soil erosion control devices such as wattles, swales and check dams, made using geotextiles and burlap bags have been installed as Non-Point Source Management Measures and capture sediment during rain events. Monitoring the progress of the restoration work in the project site includes measuring changes in native vegetation cover and density, baseline photopoints, soil erosion rates and near ocean sediment deposition.

P-23 Daniel K. Inouye Solar Telescope Hawaiian Petrel Monitoring Project on Haleakalā

Huisheng Chen, Ciara Ganter, Jayson Panglao
DKIST/NSO, Makawao, HI, USA

The Daniel K. Inouye Solar Telescope (DKIST) Resource Management Team monitored burrows of the Hawaiian Petrel (*Pterodroma sandwichensis*) on the summit area of Haleakalā. A total of 287 Hawaiian Petrel burrows were monitored within the Conservation Area. Of these burrows, 163 were active and 21 were known to be successful at producing a fledged chick at the end of the nesting season. An additional 6 burrows may have been successful however, evidence of a successful fledge were not definite. Twenty six Hawaiian Petrel burrows were monitored within the Control Site, where 8 were classified as active but none produced successful fledglings. Statistical analysis reveals active burrow densities continue to decline in the DKIST Conservation Area (by 22%) and the Control Site (by 38.5%) yielding an overall decline of 23.43%. This year, invasive mammalian predators were not the primary cause ($n=3$, 68.18%) of mortality as in previous years. The breeding success rate in the Conservation Area was 16.67% -21.43% (taking into account the possible successful burrows), and 0% in the Control site, yielding an overall reproductive success rate of 15.67%-20.15%. The data showed a strong positive correlation ($R^2=0.5952$) between the density (per hectare) of successful burrows and elevation from 2011 to 2013.

P-24 Mariana Avifauna Conservation: Utilizing the Resources and Expertise of Zoos to Save Mariana Birds

Peter Luscomb
Pacific Bird Conservation, Kailua, HI, USA

The Mariana Avifauna Conservation (MAC) Program was initiated in 2004 when the Commonwealth of the Northern Mariana Islands (CNMI) Wildlife department approached the Association of Zoos and Aquariums to assist them in developing conservation programs for their native bird species.

The purpose of the MAC Project is to safeguard the unique avian diversity of Rota, Tinian, and Saipan, from potential extinction that could result from introduction of the brown tree-snake (*Boiga irregularis*). The effects of such an introduction have been borne out on the nearby island of Guam; the CNMI does not want them repeated within its jurisdiction.

The MAC Project long term plan is two-fold: 1) the establishment and maintenance of captive populations of potentially affected bird species, through the generous contributions of both space and personnel by the Association
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of Zoos and Aquariums; and 2) establishment of satellite populations of these species on islands in the Mariana Archipelago deemed “safe” from the brown tree-snake.

P-25 Parent Tree Selection and Evaluation of Frost Resistance and Wood Quality of Acacia Koa

Oriana Rueda Krauss¹, Charles Michler^{1,2}

¹*Purdue University. Hardwood Tree Improvement and Regeneration Center, West Lafayette, IN, USA,* ²*USDA Forest Service, Northern Research Station, USA*

This project is part of a tree breeding program for *Acacia koa*. The questions addressed were: Which are the best families to maintain to convert a planting of plus trees into a seed orchard? Does frost resistance fluctuate between seasons and between selected families? What are the wood quality characteristics of young koa trees?

Experiments were conducted at Hawai'i Agriculture Research Center (HARC) A stand on Department of Hawaiian Home Lands property. The best half of the original families was selected based on morphological traits. Through selection heritability estimates of maximum branch angle, stem lean, and height to crown increased. Heritability of height decreased, while heritability of height to first fork and diameter at breast height remained constant.

We also found that heartwood tends to be less dense, less elastic, and shrinks more than sapwood. Frost resistance does not fluctuate between families from different elevations, but increases during winter, indicating that koa goes through a hardening process.

This project has the potential to support koa conservation. It forms the basis to create good quality koa planting stock, which can increase the revenue from growing this native tree, making it more attractive for landowners than other activities that are detrimental to native ecosystems in Hawai'i.

P-26 Hawaiian Trail and Mountain Club: Building and Maintaining Oahu's Hiking Trails for Over 100 Years

Barbara Bruno

Hawaiian Trail and Mountain Club, Honolulu, HI, USA

O'ahu has an extensive network of backcountry hiking trails. Hundreds of trails cover thousands of foot-miles on state, federal, local and private land. Volunteer groups have assumed responsibility for maintaining many of these trails, often working in partnership with governmental or private landowners. Their efforts are essential in containing the spread of invasive vegetation and promoting the growth of native plants. This is essential in keeping the trails clear and reducing hazards to hikers.

Foremost among these volunteer groups is the Hawaiian Trail and Mountain Club (HTMC), which has been building and maintaining Oahu's hiking trails for over 100 years, since the club's formation in 1910. The HTMC trail maintenance crew goes out each Sunday to clear a different trail, for a total of about 50 trails per year. In this poster, we share the club's "tried-and-true" recommendations on best hiking and trail-clearing practices. It is our hope that these best practices become adopted by other hikers and volunteer organizations to ensure the trails stay open, damage is minimal, relations with the State and landowner remain positive, hikers stay safe, and hiking continues to flourish on Oahu.

P-27 Tropical Hardwood Tree Improvement and Regeneration Center: Tree Breeding and Silviculture for Native Forest Conservation and Restoration

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The Tropical Hardwood Tree Improvement and Regeneration Center (TropHTIRC.org) is the first tree improvement research and extension center for tropical hardwoods in the US. Our mission is to advance the science of tropical hardwood tree improvement, utilization, conservation genetics, and reforestation. TropHTIRC profits from a unique partnership between industry, university, private, state and federal entities including the U.S. Forest Service, the University of Hawaii, and Purdue University. Our strategy to build the center is to create a successful program with one species, then expand to other species. Our initial focal species is Acacia koa (koa), Hawai'i's premier timber tree. Koa is a fast-growing species that produces high-value lumber, improves endangered species habitat, and is a cultural icon. Through traditional breeding for increased disease resistance, growth, form, and wood quality, we are developing improved trees to increase forest productivity and the economic value of reforestation programs. Current activities include establishing seed orchards to provide improved seed for large-scale reforestation of degraded lands, developing systems for nursery production and plantation establishment, and conducting research on ecological tolerances and disease management. Our vision is to become the internationally recognized leader in sustainable production, protection, and utilization of tropical hardwoods.

P-28 Geospatial Analysis of Herbicide Application Amounts at The Nature Conservancy of Hawai'i

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The Nature Conservancy (TNC) maintains 12 nature preserves in Hawai'i and manages additional acres in the State's Watershed Partnership Program. On these managed lands, TNC strives to remove invasive weeds in order to promote the recovery of native vegetation and retain watershed functionality. Besides removing weeds through hand pulling or with hand held tools, we also use herbicides when it is the most feasible alternative. In order to ensure that we do not exceed the annual legal limits listed on the herbicide labels, we conduct geospatial analyses using ArcGIS. As part of this process, we developed easily understood maps which show the amount of herbicide used per acre per year. Each acre is color-coded to show the amount of herbicide used in relation to the legal limit of the herbicide in question. This method of mapping allows land managers to quickly visually inspect their maps and pinpoint acres where care must be taken to avoid additional herbicide applications so that legal limits are not exceeded.

P-29 A History of Gorse in Haleakala National Park

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Ulex europaeus (gorse) was purposely introduced to Hawaii in the early 1900's to serve as a 'natural' barrier for livestock and subsequently spread to cover over 15,000 acres on Maui. Because of gorse's long seed life, and its ability to spread and outcompete native plants, it was declared to be noxious. Gorse forms impenetrable stands, crowding out native shrubland and valuable pastureland and has the potential to threaten nearly all locations within Haleakala National Park (HALE).

Five gorse populations have been discovered within park boundaries since the mid 1900's. The populations were mapped and assigned a priority based on the ecological threat they pose. Larger populations were divided into 20x20m plots, and all the populations were treated using biological, mechanical, or chemical means, or a combination of the three. Bio-control methods are long-term and have involved moths, weevils, and mites; Mechanical methods include pulling and cutting and have been most successful when implemented by larger groups of people; Chemical methods have involved foliar and cut-stump applications. To date, the most successful method used to control gorse in HALE, has been chemical.

P-30 Capture Rates Using a Variety of Traps, Baits, and Lures

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Haleakala National Park has been conducting predator and pest control to protect ground nesting endangered birds for over 30 years. Trapping in endangered bird nesting areas is especially challenging. Staff trained and skilled on capturing target species uses a variety of traps, baits, and lures, while avoiding capture of endangered ground-nesting bird species. Traps include cage traps, footholds, and Good Nature kill traps. We present challenges in trapping and baiting, trapping techniques and capture rates of predator and pest species.

P-31 The Presence of an Ecological Trap in the Juvenile Dispersal the 'Ākohekohe (*Palmeria dolei*), a Population-Limiting Life Stage?

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Movement patterns of the critically endangered 'Ākohekohe (*Palmeria dolei*) endemic to the island of Maui are unknown. While observed nest success of this species is relatively high, the population has apparently not increased over the last 30 years even with habitat protection and restoration through the removal of damaging feral pigs. 'Ākohekohe are extremely vulnerable to avian malaria (*Plasmodium relictum*) spread by mosquitoes (*Culex quinquefasciatus*) constrained to low elevations by temperature. It has been suggested that in summer, the nectarivorous 'Ākohekohe follows seasonal blooms of the dominant canopy tree, 'ōhi'a (*Metrosideros polymorpha*) to lower elevations where they experience increased mortality from malaria, and that this mainly occurs with juvenile birds. This may represent an ecological trap, whereby these birds preferentially choose habitat that leads to higher mortality rates relative to other habitats. I am currently testing this hypothesis by tracking individual 'Ākohekohe movements in conjunction with assessments of 'ōhi'a bloom across the landscape in Waikamoi Preserve. To date, I have attached radio-transmitters to 10 Aokohekohe to document how their movements vary with sex, age, and ohia flower density. Results from this study will greatly improve our understanding of the ecology and movement patterns of this species and can help direct future management actions such as the potential translocation of individuals to Nakula, Natural Area Reserve.

P-32 Achieving Optimal Slug Control in Forest Settings

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Hawaii's fauna lacks native slugs. Slugs cause dramatic declines in the survival of rare native Hawaiian plants. Control of slugs using the organic molluscicide Sluggo was shown to encourage seedling germination and recruitment among certain rare plant species. In 2010 Sluggo was approved for conservation use under a Special Local Needs (SLN) permit valid through Oct. 2015.

We investigated how the frequency of Sluggo application along with the size of the treatment area affects slug abundance. We carried out the research in forest settings in the Waianae Mountains. There we measured slug response to frequent (once per two weeks) and infrequent (once per month) Sluggo application against an untreated control group. At some sites, we experimentally changed the size of the treatment area to see how slugs responded.

Expanding the area significantly improved slug suppression and allowed for a longer interval between treatments. When treating areas less than a minimum size, effective slug control can only be reached by frequent Sluggo application. Sluggo application on individual plants should be avoided in favor of treating a large buffer around all plants in the area. Our work should help rare plant managers improve their pest control strategies.

P-33 The Kauai Watershed Alliance's Wainiha Valley Protective Fence Project: An Overview

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The Wainiha Valley Protective Fence Project is the Kauai Watershed Alliance's second large-scale watershed and native species protection effort. The project is located at the uppermost reaches of Wainiha River and is contiguous to the East Alakai Protective Fence Project at the core of Kauai's watershed. The ungulate-proof fence was constructed in 2010 and together with natural barriers, protects approximately 4,000 acres of lowland-wet native forest from the devastating impacts of feral pigs. This biologically unique area is home to 222 native plant species, 63 of which are endemic to Kauai and 19 of which are considered rare. In addition, it is an important nesting ground for Newell's shearwater and Hawaiian petrel. The project goals are to eradicate feral pigs, control the worst weeds in the preserve: Australian tree fern, Kahili ginger, African tulip, *Clidemia hirta*, and *Buddleia asiatica*, and monitor the recovery of native vegetation. The remoteness and extreme environmental conditions of the project area will require the development and implementation of innovative solutions such as pig traps that can be monitored and activated remotely, a network of cameras to monitor traps and trails, and the use of aerial imagery and helicopters to detect and treat invasive weeds.

P-34 Establishment Risk of Exotic Reptiles and Amphibians to Hawai'i

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Not all species introduced to Hawai'i become invasive, but those that do can impact native ecosystems, local economy and human health. In Hawai'i 31 alien species of reptiles and amphibians have successfully established. The pet trade industry has contributed to the majority of successful introductions, despite laws to prevent these species from being legally owned. The risk of herpetofauna establishing within a region may be estimated using the Reptile and Amphibian Model (RAM), designed by the Bureau of Rural Sciences, which quantifies their invasiveness by ranking potential establishment on four variables: propagule pressure, climate matching, previous establishment elsewhere, and taxonomic family. The purpose was to test the RAM to check if it could accurately predict establishment potential of herpetile invasion to Hawai'i.

The O'ahu Invasive Species Committee (OISC) used the RAM to filter through 57 species of herptiles, 31 successful and 26 unsuccessful species in Hawai'i. It was determined statistically that the RAM can accurately predict herpetofauna invasiveness in Hawai'i. Though prevention remains the best tool to avoid invasion, the RAM can be used by agencies as a tool to prioritize and assess target species of reptiles and amphibians for eradications.

P-35 3D Landscape Maps for University-Managed Lands on Maunakea

Amber Stillman, Fritz Klasner

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Inventive approaches like plan oblique relief, or 3-Dimensional landscape maps and computer animation offer unique means of sharing information and providing new perspectives that may significantly impact visitors' experiences and attitudes. Plan oblique relief mapping provides a 'birds eye' perspective, with map features such as management boundaries and roads appearing as in a conventional map while elevation is shown laterally to create a 3-dimensional effect. The Office of Mauna Kea Management (OMKM) has applied technological advances in cartography and geographical information systems (GIS) to improve its outreach materials.

One way to broaden Maunakea visitors' environmental stewardship and cultural preservation attitudes is through innovative outreach. These 3D landscape maps foster stronger connections between people and places on Maunakea. Many potential Maunakea visitors do not know what to expect or are ill-prepared when visiting the mountain. Through these products, visitors and the local community can enjoy the mountain remotely without experiencing the unwelcomed side effects of Maunakea's harsh and unforgiving environment. The 3D media and

animation can also serve as an alternative for off-site visitors to virtually explore the mountain's fragile resources from afar, while still preserving all its majesty for future generations.

P-36 Monitoring Arthropod Communities on Maunakea, Hawaii

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Arthropod monitoring is a necessary tool to understand and manage ecosystems, but is often difficult to conduct given the small size, cryptic life history, and diversity of arthropods. Effective management strategies can be implemented once ecosystem components (stability, function, and biodiversity) are understood. Since 2009 the Office of Mauna Kea Management (OMKM) has supported annual arthropod monitoring on University of Hawaii (UH) managed lands on Maunakea, Hawaii. This monitoring emphasizes endemic wēkiu bug (*Nysius wekiuicola*) presence/absence locality surveys and detection of potential invasive species, and facilitated refinement of methods and approaches used in additional arthropod invasive species and biodiversity monitoring. Consistent with recent insect conservation recommendations, OMKM is transitioning from a species based (descriptive taxon) monitoring approach to a broader arthropod community and quantitative biodiversity based approach, while still including targeted information gathering for focal species such as the wēkiu bug.

Monitoring results from 2013 identified no new invasive species threats to UH managed lands. A total of ~5,700 arthropod individuals were captured, representing 12 distinct taxonomic orders, and 45 families. Approximately 4,500 of the captured individuals were wēkiu bugs, thereby displaying a successful and abundant wēkiu bug year.

P-37 The Capture, Captive Maintenance and Translocation of Rufous Fantails and Mariana Fruit Doves from Saipan to Sarigan 2013

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To safeguard the unique avifauna of Rota, Saipan and Tinian from introduced predators such as the Brown Tree-snake and other catastrophic events the Honolulu Zoo has been working with the Mariana Avifauna Conservation (MAC) Project to develop capture, husbandry and translocation methods. The MAC project includes Pacific Bird Conservation, Association of Zoos and Aquariums, Commonwealth of the Northern Mariana Islands' Department of Fish and Wildlife and U.S. Fish and Wildlife Service. In 2013 the MAC Project translocated 32 Rufous Fantails and 25 Mariana Fruit Doves from Saipan to Sarigan. Birds were captured, held in captivity and maintained on captive diets for up to 16 days to select healthy individuals before translocation.

P-38 Natural Resources Conservation at Pōhakuloa Training Area: Effective Management in a Difficult Landscape

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Pōhakuloa Training Area (PTA) is the largest military training facility in the Pacific. Located in the saddle region between Mauna Kea, Mauna Loa, and Hualālai volcanoes on the island of Hawai'i, the region is classified as subalpine, tropical, dryland forest; one of the rarest ecosystems in the world. The U.S. Army Natural Resources Office (NRO) manages 132,800 acres for 20 federally-listed threatened and endangered species, including 3 designated bird and plant preserves. The PTA NRO was created in 1995 and consists of more than 35 full-time environmental professionals. Conservation operations include the maintenance of 87 miles of fence units protecting

nearly 38,000 acres of dryland habitat, the construction and maintenance of 36 miles of firebreaks to minimize the potential for catastrophic loss of habitat from wildfire, weed control around listed plant habitat, surveys and control for incipient weeds, rare plant genetic conservation and outplanting, and installation-wide surveys to assess the landscape-scale distribution of native botanical biodiversity. The PTA NRO continually seeks to identify and fill scientific knowledge gaps which potentially limit the effective and efficient fulfillment of federally mandated conservation requirements by building and fostering collaborative relationships with the local conservation and scientific communities.

P-39 Prioritizing *Miconia calvenscens* Survey Areas on O‘ahu

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Miconia (*Miconia calvenscens*) has been a top priority target species for the O‘ahu Invasive Species Committee (OISC) for over a decade. It is a highly invasive tree that has been cited as among the top threats to Hawai‘i’s rainforest ecosystems. *Miconia*’s prolific, long lived seed bank combined with a robust growth rate, shade tolerance and effective seed dispersal mechanisms create the need for a long term management strategy for island wide eradication to be plausible. OISC’s management strategy aims to survey areas where *miconia* is likely to occur, 800m around a mature plant location, and may contain outlier plants while controlling plants as they are found. The goal is to prevent reproduction and to continue control until the seed bank is exhausted. This methodology has served OISC well, however, funding and staffing short falls combined with access permission challenges create survey delays. Our data shows that 99% of the immature plants found fall within 400m of a mature plant. To address survey delays, OISC has adjusted its survey strategy to prioritize surveys areas within 450m of mature plants. Analyzing survey data, we will see if creating a prioritized buffer of 450m around mature plants leads to effective control of *miconia*.

P-40 Change in Gene Expression of *Acacia koa* along with Elevation and Precipitation Gradients

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Koa (*Acacia koa*) is an endemic Hawaiian tree with high economic, ecological and cultural value. Land use change, deforestation and invasive species reduced the coverage of native forests. Successful reforestation of native forests requires using genetically appropriate seed sources. However, little is known about *koa* genetics. This study aims to identify the genetic basis to adaptations to environmental conditions in different ecosystems in Hawai‘i. Genetic adaptations to elevation and precipitation gradients can be evaluated using genetic expression analysis. We will isolate mRNA from the leaf tissue collected from 205 samples from 13 sites located in 8 ecozones in the Island of Hawai‘i. The genetic expression patterns of *koa* samples will be obtained using next-generation sequencing technology (Illumina® Sequencing Technology). Using geostatistical tools, we will evaluate the effect of selected environmental variables on genetic patterns. The results of a genetic cluster analysis will allow us to identify the adaptive potential of populations to specific ecozones; a useful tool for mapping seed sources. A product of this research will be a *koa* seed source map that can be used by landowners to facilitate planting by matching genetic fitness to local sites.

P-41 Is the Timing of Leaf Form Change in *Acacia koa* Gray Seedlings Adaptive and What are the Implications for Reforestation?

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Frost, poor stem form, and herbaceous competition regularly hinder restoration and plantation management of *Acacia koa* Gray (*koa*). In response, partial shade has been proposed to provide a buffer against frost, discourage low forking, control invasive grasses and improve bird habitat. This greenhouse study looked at how the transition period in *koa*, from true leaves to phyllodes, is modified by *koa* in partial shade and drought conditions. We had the following hypotheses: first, light intensity speeds the development of phyllodes; second, wet ecotypes are more responsive to competition signals and delay transition relative to dry ecotypes; third, drought speeds up transition to phyllodes across light levels; fourth, transition is more highly correlated with ontogeny than age; and lastly, that partial shade discourages lateral branching and increases the height of the first fork. Findings from this study could help identify populations for seed collection, develop standards for plantation management, and establish norms for higher survival in restoration plantings.

P-42 Lineage Diversity, Host Range, and Effects of Land Use on Prevalence of Avian Malaria in American Samoa

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We investigated lineage diversity, host range, and effects of land use on the prevalence of avian malaria (*Plasmodium* sp.) in forest bird communities on the islands of Ta'u and Tutuila between 2002 and 2011. Two previously described parasite lineages from passerines in Australasia were present on both islands based on partial sequence data from parasite mitochondrial genes. Overall prevalence was higher on Ta'u (22%, 75/341) than Tutuila (9.2%, 27/294), with most infections occurring in Polynesian Starlings, Samoan Starlings, and Wattled Honeyeaters. Prevalence was relatively constant from year to year and between seasons at each of four study sites, but varied among study sites, with highest rates of infection in areas with agricultural activity at Faleasao (37.4%, 73/195, Ta'u Island) and Amalau Valley (9.7%, 21/216, Tutuila Island). Prevalence in more remote areas of the National Park of American Samoa was lower, ranging from 1.4% (2/146) at Laufuti and Luatele on Ta'u to 7.7% (6/78) at Olo Ridge on Tutuila. Our data support previous studies that have suggested that *Plasmodium* is part of the indigenous parasite fauna in American Samoa. Transmission dynamics appear to be affected by land use practices that may affect vector populations.

P-43 Improving Rooting Success of Cuttings and Stock Plant Management for *Acacia koa*

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Tree improvement programs based around vegetative propagation can increase productivity, product quality, and lower production costs. For some species, this has become an important mechanism for increasing rooting success in timber planting (de Assis, 2001). However, reforestation using propagules from superior tree can also balance different management goals. These include, financial returns from timber and supporting plant and animal communities linked in the various stages of forest succession (Pejchar & Press, 2006). *Acacia koa* is an important species in Hawaii for both timber and native biodiversity. Past work has demonstrated that *koa* has clonal forestry potential, but low rooting success of vegetative propagules inhibits this from becoming commercially operational for timber or reforestation purposes.

This study aims to improve rooting success of koa vegetative propagules through pre-severance shading and fertilization treatments of stock plants and manipulations of light and nutrient levels to stimulate root production of cuttings. Optimizing these techniques is crucial for scaling up production of locally adapted and superior koa genotypes to achieve restoration and timber management goals.

P-44 Preserving Genetic Integrity in an In-Situ Living Collection of *Geranium arboreum* (nohoanu), at Haleakala National Park

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Geranium arboreum (nohoanu), once widespread across East Maui, is the only bird-pollinated geranium in the world. Factors such as habitat loss, predation, invasive plants, loss of pollinators, and possibly climate change have all reduced it to critical low numbers in the wild. Park staff have propagated this species from nine founder populations from Park, State, and TNC lands. Of these, three are now extirpated. Over the last three years, 121 individuals were outplanted in a semi-shaded, east-facing gulch in the Park. To ensure genetic integrity of founder populations, cuttings from the same source were planted in densely clustered plots. The plots were placed close enough, however, for cross-pollination and sexual reproduction, bringing together founders to increase genetic diversity. Growth, vigor, phenology and environmental factors such as shade are monitored at least twice a year. 90% survivorship was observed in 2014. Most plants exhibited vigorous growth. Flowering, fruit capsules, and dehiscence were observed in three plots. Greatest growth occurred in plants under approximately 40% shade. Phenology is similar within plots, but differs between plots. These plots are a thriving in-situ genetic bank but also a laboratory for exploring an optimum environment for *G. arboreum*'s reproduction and survival.

P-45 A Proposed Adjustment to the Hawai'i-Pacific Weed Risk Assessment Protocol

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Invasive plant species can have significant negative impacts to native ecosystems, the human economy, and human health. Because the suite of invasive plants includes species that are intentionally introduced, a screening tool to identify which species are likely, or not likely, to become invasive is highly desirable. The Hawai'i-Pacific Weed Risk Assessment (HP-WRA) is a tool which attempts to predict the outcome of weed behavior of a given plant species following its introduction. This system has been tested for accuracy and was found to correctly identify 95% of pest species. However, this test of efficacy was necessarily done on a subset of plants which were both planted with high propagule pressure, and introduced with sufficient residence time. Because these conditions need to be met to calibrate the system, there is uncertainty in predictions for species which have not been introduced with high propagule pressure somewhere worldwide. Presented here is a proposed adjustment, developed in cooperation with stakeholders, to the HP-WRA protocol. The adjustment would change designations for species meeting criteria of low propagule pressure and residence time to reflect the uncertainty inherent in their weed risk. It also incorporates increased risk of low propagule pressure species which are significantly established.

P-46 Aquaponic Versus Soil Cultivation of 'auhuhu and 'ōlena: Comparisons of Plant Growth and Nutrient dynamics for Effective Propagation and Use

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The investigation of 'auhuhu (*Tephrosia purpurea*) and 'ōlena or turmeric (*Curcuma longa* L.) was prompted by the desire to promote the propagation and conservation of Hawaiian and other medicinal plants using aquaponic technologies. Ongoing research under the Waihona Lā'au Lapa'au Project encompasses the holistic investigation of medicinal plants and their varied uses by Native Hawaiians as herbal medicines, as well as fish anesthetic and poison. The fish anesthetizing property of 'auhuhu renders it potentially useful for natural resource management as a tool for invasive species removal. Through the COSEE-Island Earth Collaborative Fellowship traditional

ecological knowledge and modern scientific research are combined to: (1) propagate 'auhuhu and 'ōlena via three agricultural methods: soil, aquaponics-bell siphon, aquaponics-trickle filter, (2) compare difference in yield, growth, and quality of leaf and 'ōlena rhizome from each agricultural method, (3) monitor the composition and cycling of nutrients to determine why agricultural methods yield different results, (4) teach propagation, conservation, scientific monitoring, and preparation techniques to the community. Integration of traditional ecological knowledge with modern technologies, resource management, and education is a necessary approach to addressing the many challenges we face today in striving to become better stewards of our land.

P-47 Cover Crop Planting in Hawai'i: An Assessment of the Impact of Sunn Hemp, Oats and Buckwheat on Commercial Crops.

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Cover crops are fundamental sustainable agriculture tools that improve soils, crops and water quality by reducing losses of nutrients, pesticides, or sediment from agricultural fields. There are both environmental and economical benefits that come from incorporating cover crops with cash crops. To increase adoption of cover crop use in Hawai'i, field trials were established at 14 large scale demonstration sites throughout the islands of O'ahu, Kaua'i, Maui, Moloka'i and Hawai'i. The three cover crops selected for this demonstration were sunn hemp, oats and buckwheat. All three cover crops were planted in combination with diverse crops such as papaya, pineapple, sweet potato, and other various commercial crops. This study shows the benefits and drawbacks of applying specific cover crops with commercial crops. Highlighting the advantages of cover crop usage in Hawai'i will increase the knowledge of sustainability to landowners and increase soil life for future generations. Furthermore, the adoption of cover crops will also prevent sedimentation into Hawaii's streams and ocean.

P-48 'Ōhi'a Growth Dynamics: Competitive Release during Secondary Succession in a Lowland Wet Forest on Hawaii Island

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Metrosideros polymorpha ('ōhi'a) is a notoriously conservative species when it comes to resource use and growth. However much of the work that has been conducted on this species has been done on old growth and very young growth trees. This study aims to expand the current understanding of 'ōhi'a growth characteristics in second-growth lowland wet forests by comparing the response of 'ōhi'a growth between native stands and *Falcataria moluccana* (albizia) invaded stands where albizia has been killed with an herbicide treatment. This project established a set of five study sites within native stands and seven study sites within albizia-invaded stands within Wao kele o Puna forest reserve on Hawaii Island. Soil nutrient dynamics (i.e., nitrogen (N) and phosphorous (P) availability) were measured using mixed-bed exchange resin bags. 'Ōhi'a growth rates were measured on a subset of trees within each site using spring-loaded dendrometer bands. Previous measurements taken within our study sites indicated that 'ōhi'a within these forest stands are growing remarkably fast. Our preliminary results from this study will most likely confirm these initial observations, and will help to give ecologists and forest managers a more complete understanding of this keystone forest species.

P-49 Update on Infestation of Hala pepe (*Pleomele hawaiiensis*) by the Invasive Banana Moth (*Opogona sacchari*)

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Effective conservation and restoration of rare Hawaiian plants requires an understanding of the threats that plants face, as well as follow-up monitoring to determine the success of conservation measures. Previously, we reported

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on an infestation of the endangered hala pepe (*Pleomele hawaiiensis*) by the invasive banana moth (*Opogona sacchari*). Here, we report on follow-up monitoring of plant condition and infestation status as well as the outcome of a pesticide trial designed to eliminate banana moth on treated individuals.

The infestation was discovered at Pu'u Wa'awa'a Forest Reserve in late November 2012, and surveys were conducted in 2012, 2013, and 2014 to determine the severity and extent of the infestation. In mid 2013, 7 pairs of hala pepe (14 trees total) were chosen for the study. Pairs were chosen such that infestation levels, condition, and tree sizes were similar between pairs at the start of the trial. Individuals within a pair were randomly assigned to 1) be injected with the insecticide Tree-äge (active ingredient: Emamectin Benzoate), or 2) be left untreated as a control for comparison purposes. Tree infestation levels and condition, as well as banana moth larvae presence/absence, were checked in early 2014. Results showed that infestation levels were not reduced by the application of Tree-äge, and 2 of the 14 trees, one treatment and one control tree, died during the course of the study. Furthermore, banana moth larvae were discovered in 10 of the 14 trees, and of those 10, half were treated, and half were untreated. The lack of effectiveness of the pesticide may have been due to a variety of factors, but two of those could include 1) difficulty in injecting the chemical into living tissue, 2) uptake issues potentially related to low soil moisture, and 3) translocation problems. In sum, other methods of banana moth control may need to be employed in order to reduce infestation levels of hala pepe.

P-50 Establishing Biocontrol of Strawberry Guava in Hawaiian Forests

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Tectococcus ovatus, a biocontrol agent for the invasive plant strawberry guava, was first established in demonstration plots in Volcano (4000 ft. elevation) in 2012. During 2012-13, the agent was released and established at a second demonstration site at 500 ft. elevation. Most recently, several forest sites across the state, on Hawaii'i, Oahu and Lana'i, have received applications of the biocontrol agent. Forest release sites have been prepared by cutting small patches of strawberry guava stems to generate new sprouts, which then are exposed to gall-bearing potted plants. Newly hatched *T. ovatus* nymphs ("crawlers") move from mature galls on potted plants to newly sprouting leaves, establishing new galls which grow as leaves expand to full size. Establishment of initial populations of the biocontrol agent via this method has been confirmed at several forest sites.

P-51 Impact of Defoliation on Growth and Survival of Naturally Regenerated and Planted Koa

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Lack of information about the effects of koa moth defoliation on survival and growth of planted and naturally regenerated koa hinders development of management options following a defoliation event. We quantified koa moth defoliation and growth of planted and natural stands of koa trees at Hakalau National Wildlife Refuge to quantify koa moth damage and determine whether growth rate was related to the relative impact of koa moth. We found large variation among trees within stands, with some trees having high defoliation and others very little, ranging from <10% up to 100%. Percent defoliation averaged 75% (\pm SE 1.0%) in the natural regeneration stand and 84% (\pm SE 1.2%) in the planted stand. The majority of trees suffered >50% defoliation in both stands. Both stands had similar variability (natural stand CV = 35, planted stand CV = 31). Koa moth defoliation was significantly, though weakly, correlated with stem diameter growth rate during the five years prior to the defoliation event, with faster growing trees having relatively lower rates of defoliation (planted stand $R^2=0.03$, natural stand $R^2=0.09$, all $P<0.001$). We are continuing measurements to determine rates of refoliation and koa moth effects on growth and survival over the next five years.

P-52 Comparison of Control Measures for Naio Thrips in Hawaii

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The Hawaiian tree species naio (*Myoporum sandwicense*) is threatened by naio thrips (*Klambothrips myopori*), an introduced insect pest. Naio thrips were first observed in Kona, Hawai'i Island in 2008 and have since dispersed through elevations up to 7,000 feet, severely impacting growth and survival of naio. Strategies to combat naio thrips include biological and chemical control. Effective biocontrol agents, e.g. minute pirate bug (*Orius* spp.), are commercially unavailable or untested in Hawaii. Chemical control of naio thrips appears to be practicable, although given the widespread distribution of naio thrips on Hawai'i Island, chemical control is appropriate only for critical habitats or areas with incipient thrips infestations. In California, several insecticides controlled *K. myopori* infestations on *Myoporum laetum*. The current study will investigate effects of Conserve, Safari, Movento and several other insecticides on infestations of naio thrips near Volcano, Hawai'i Island. Although broad scale application of chemical insecticides in native forests is impractical and inadvisable, critical habitats and uninfested areas could be conserved with targeted chemical treatments. Non-native insect pests will continue to invade Hawaiian ecosystems; this study, conducted with the Hawaii Community College Forest TEAM program, emphasizes the importance of training Hawaiian conservation practitioners in adapting to new threats.

P-54 Monitoring Montane Dry Forest Structure Using High Resolutions Aerial Imagery

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Leeward montane dry forests on Hawai'i Island are threatened by wildfire, feral ungulates, and invasive grasses, but ecosystem assessments are difficult in this large, remote area. Conserving existing populations of major tree species will require accurate measurements of current forest structure and condition. Inferences from traditional ground-based forest monitoring may be multiplied by analysis of high resolution aerial imagery. The objective of this study is to assess the population, spatial distribution, structure, and health of 'iliahi (*Santalum paniculatum*) on the slopes of Mauna Loa. We focus on 'iliahi because its economic importance may contribute to more significant population declines than for other species; methodology developed for assessing 'iliahi populations will be applicable to the other major tree species. Field measurements have identified locations and crown diameters of individual trees for each of the five principal species at several locations across a multi-thousand acre parcel. Principal components analysis of color signatures from centimeter-resolution aerial imagery will distinguish among vegetation types and tree species. A pixel aggregate averaging technique will be used to calculate tree size. This work will enable accurate, cost effective forest monitoring across large, inaccessible land areas, with the goal of prioritizing areas and populations for conservation actions.

P-55 Conservation Value of *Pritchardia* spp. in National Tropical Botanical Garden's Living Collection at McBryde Garden

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Pritchardia spp. (loulou) are the only palm species endemic to the State of Hawai'i, and as such are iconic of native Hawaiian culture and landscape. Comprised of 24 discrete species, the majority of which are Federally Listed, National Tropical Botanical Garden (NTBG) curates 21 species in its ex situ Living Collection at McBryde Garden on Kaua'i. While not as effective as protecting and restoring wild habitat, this ex situ conservation plays an important role by keeping wild collected threatened and endangered species alive. Since *Pritchardia* seeds are sensitive to drying and freezing, they cannot be stored in seed banks and their survival depends in part on continued cultivation in botanic gardens. How much conservation value NTBG's collection of *Pritchardia* has will remain largely unanswered without specific genetic research into each species of the genus; however, using a newly published guide from Botanic Gardens Conservation International (BGCI) and statistics from NTBG's Plant Records, a broad conservation value can be derived and recommendations for future collections made. BGCI's

guide for public gardens, *Building living plant collections to support conservation*, provides several criteria for this purpose, which we explore in examining NTBG's efforts to conserve Hawaiian endemic *Pritchardia* spp. to date.

P-56 Cultural Use and Importance of Mangrove Species in Samoa, Tonga and Fiji

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Mangrove forests are ecologically and economically important ecosystems that occur along protected coasts in tropical and sub-tropical regions. They serve as habitat for marine and terrestrial organisms and support artisan and commercial fisheries. In contrast to many areas of the world, cultural uses of mangrove forest products in the southwest Pacific have not been well documented. This study compares the contemporary use and importance of mangrove species in the historically related cultures of Samoa, Tonga and Fiji. In each archipelago, 30 household consensus interviews were conducted to determine the vernacular nomenclature, use and importance of each mangrove species. Uses were categorized and described according to level three states. The highest number of uses of mangrove species was found in Fiji (147) as compared to Tonga (85), which shares the same species. Biodiversity declines in an eastward direction with Samoa having only 3 of the 7 mangrove species found in Fiji and Tonga. For these 3 species, Samoa reported the lowest number of total uses (33) relative to Tonga (42) and Fiji (68). These results suggest that there is an attenuation of technology transfer moving eastward in the southwest Pacific and that use level does not necessarily increase with decreasing biodiversity.

P-57 Refining Volume Prediction for 'Iliahi Conservation Objectives

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Montane dry forest tree species on Hawai'i Island are in decline due to climate factors and invasive species, but 'iliahi (*Santalum paniculatum*) is further affected by timber extraction. Responsible harvest practices may facilitate recovery of 'iliahi populations by replacing dying trees. This restoration work could be self-funding, but accurate resource value must be assessed before projects can develop. 'Iliahi could be valued for its function as a key species in the forest (ecosystem services), for its ability to sequester carbon in a challenging environment (carbon markets), or for traditional timber products. These valuations hinge on a volume prediction equation developed for local conditions. The purpose of this project is to parameterize an allometric equation that predicts the standing volume of *S. paniculatum* for leeward Hawai'i. Dimensional data, including sapwood and heartwood diameter, root system mass, segment length, and tree height will be collected from an ongoing 'iliahi harvesting operation. Non-linear regression methods will be employed to identify functions that predict taper, heartwood volume, and carbon sequestration potential as a function of diameter and height. This project, which engages students from Hawai'i Community College, will improve 'iliahi conservation outcomes while training the next generation of Hawaiian forest conservation practitioners.

P-58 Rapid Multiplication of Palapalai (*Microlepidia strigosa*) through Micropropagation

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There has been no reported research on the micropropagation of palapalai. The present study depicts the use of growth regulators to induce callus formation from juvenile leaf segments. Calli produced are sequentially transferred to multiplication medium and rooting medium. The advantage of this technique is the availability of the species once a pure culture has been obtained.

P-59 Utilizing Partnerships to Improve Island-Wide Early Detection of Invasive Plants on O‘ahu

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To accomplish effective island-wide early detection of invasive plants, two components are needed: a reliable record of all plant species' distributions, and thorough island-wide surveys. Since no single agency can accomplish this, an effective system of interagency communication is critical. Multiple agencies across O‘ahu conduct botanical surveys, though each operates in disjunct areas and has its own goals and restrictions. Despite this, collaboration can result in effective management, as is demonstrated by the partnership between the Bishop Museum, the O‘ahu Early Detection program (OED), and the O‘ahu Army Natural Resources Program (OANRP). The Bishop Museum was designated by the State of Hawai‘i as the official reference collection documenting plant and animal distributions in Hawai‘i. The OED program conducts island-wide surveys of plant introduction sites, identifies new invasive species, and uses Museum records to assess species' distribution. The OANRP manages significant island acreage, and draws on the expertise of OED staff to identify unknown plant collections. Sharing information is mutually beneficial for all partners, keeping Museum collections current, increasing the geographic reach of OED, and assisting OANRP in prioritizing weed control actions. Most importantly, any newly-documented invasive plants are evaluated and well-informed decisions can be made regarding the feasibility of eradication.

P-60 Genetic Variation in Endemic Species of Hawaiian Hibiscus Section Lilibiscus (Malvaceae) Based on RAPD Analysis

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There are 9 taxa of endemic Hibiscus section Lilibiscus in the Hawaiian Islands and three of these are federally listed as endangered. In an effort to clarify species boundaries, randomly amplified polymorphic DNA (RAPD) markers were used to assess variation within and among populations and species. RAPD analysis demonstrated that the four previously recognized red-flowered taxa were genetically distinct as well as morphologically distinct from each other, suggesting that the four red-flowered taxa should be recognized by their previously used names, *H. clayi*, *H. kahilii*, *H. kokio*, and *H. saintjohnianus*. RAPD analysis of the white-flowered taxa demonstrated that five genetically distinct taxa were evident. Because of these genetic distinctions, in addition to morphological distinctions described in earlier treatments, each of these five taxa is being recognized as a distinct species: *H. arnottianus*, *H. immaculatus*, *H. hannerae*, *H. punaluuensis*, and *H. waimeae*. The Manoa Cliffs, Oahu population of *H. arnottianus* subsp. *punaluuensis* was genetically distinct from *H. arnottianus* and *H. waimeae*, and may represent an isolated hybrid population of *H. arnottianus* x *H. punaluuensis*.

P-61 Management Actions to Prevent the Disappearance of the Hawaiian Petrels (*Pterodroma sandwichensis*) and Newell's Shearwaters (*Puffinus newelli*) From West Maui, Hawaii

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We implemented measures to ensure survival of endangered Hawaiian petrel (*Pterodroma sandwichensis*) and threatened Newell's shearwater (*Puffinus newelli*) populations on West Maui. Both species appear relegated to the extreme highlands and predation by introduced mammals the leading cause of their continued decline. Population models to evaluate effects of predator control predicted likely trajectories of each population under different management regimes. Results indicate positive population growth can only be achieved by establishing predator-free colonies. The management site is adjacent to an active but previously undisclosed Hawaiian petrel colony exhibiting high levels of mongoose activity in the West Maui foothills. Newell's shearwaters are observed vocalizing and flying through this area toward remote highland breeding sites where colony management has

proven cost-prohibitive and logistically infeasible. Predator-excluding fences were erected around two, roughly 4.25 acre sites; mongoose, feral cats, and rats have been removed and artificial nesting burrows installed. Social attraction measures implemented in 2014 are being used to attract prospecting birds to the sites. We present research that informed selection of management actions, modeled projections of success, project status, conservation merit, and collaboration that helped shape the project and contribute to the value of recovery ambitions for Hawaiian petrels and Newell's shearwaters.

P-62 Knemidokoptic Mange in Hawai'i 'Amakihi on the Island of Hawaii: Current Distribution and Prevalence of an Emerging Disease

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Knemidokoptic mange is caused by the mite *Knemidokoptes jamaicensis* and was first observed on Hawai'i 'Amakihi (*Hemignathus virens*) in Manuka Natural Area Reserve (NAR) in June, 2007. Increased mortality has been associated with infected birds in field and laboratory studies. Surveillance at Manuka NAR (2007-2009) documented 26% prevalence of mange among Hawai'i 'Amakihi distributed from coastal habitat to 1500 m above sea level (asl). In 2012-2014, we conducted an island-wide survey and examined wild birds from both leeward and windward sites. We examined a total of 1498 passerines, including 622 Hawai'i 'Amakihi, and found knemidokoptic mange to be present in Hawai'i 'Amakihi at the following sites: Manuka NAR (595 and 305m asl), Kahuku Ranch Unit of Hawaii Volcanoes National Park (Glover) (1200 m asl), and Keauohana Forest Reserve (293 m asl). No other passerine birds (N = 876) were infected with knemidokoptic mange. Mange prevalence ranged from a high of 69% (39/56), in Keauohana Forest Reserve to a low of 2% (2/81) in Kahuku. At Manuka NAR, prevalence had decreased from 26% (13/47) (2007-2009) to 9% (7/82) (2012-2013). Our results suggest that knemidokoptic mange is currently limited to Hawai'i 'Amakihi and is prevalent in low elevation at both windward and leeward sites.

P-63 Evaluation of Field Regeneration Methods for Āulu (*Sapindus oahuensis*) at Pahole Natural Area Reserve, Oahu

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The draught-resistant Āulu (*Sapindus oahuensis*) Forest found principally on O'ahu is impaired globally. Information on best propagation practices in the field is limited. A study was undertaken to evaluate propagation methods for efficacy, ease, and cost.

It was conducted using five treatments randomized within rows and replicated five times across a talus draw within the Pahole Natural Area Reserve on O'ahu. The treatments were outplanted plants, transplanted plants, a pretreated treatment, and two whole seed treatments with seeds kept in place in the plots using a simple cage made out of wire.

Preliminary results show that 100% of outplanted plants have survived, roughly 50% of the transplanted plants have survived, no treated seeds have survived, while less than 1% of the transplanted seeds have germinated by February 26, 2014, the first year anniversary of the starting of the experiment. Thus, relying on natural or scattered seed is probably a slow or inefficient method of augmenting natural forest. Outplanting trees has been the most successful method for high survivalship. Transplanting *Sapindus* has potential to be the most cost efficient for restoring an area with *Sapindus*--if seedlings are readily available nearby--despite difficulty in transplanting this strongly-tap rooted species.

P-64 Kōke‘e Resource Conservation Program-Involving the Public in Protecting Native Ecosystems

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"The Kōke‘e Resource Conservation Program (KRCP) is a volunteer based alien species control program. KRCP involves the public in protecting native ecosystem resources by coordinating volunteers to conduct invasive weed removal in select areas, mainly in Waimea Canyon and Kōke‘e State Parks, and the Alaka‘i Wilderness Preserve. KRCP's main weed targets are Kahili ginger (*Hedychium gardnerianum*), Strawberry guava (*Psidium cattleianum*) and Australian Tree Fern (*Cyathea cooperi*), and a short list of incipient weeds. The project uses weed control strategies that have been tested and proven by numerous conservation agencies and organizations. Weed removal methods are manual and mechanical where feasible, but generally involve the judicious use of herbicides instead of chemical techniques. Over the past 16 years, KRCP has shown how crucial volunteers and the public are to protecting Kauai's native biodiversity and natural resources. Without the help of thousands of volunteers this work would not be possible. It is important to continue to educate the community and get everyone involved. To volunteer please contact KRCP at rcp@aloha.net or 808-335-0045."

P-65 Population Variation in *Hibiscus brackenridgei* (Malvaceae) Based on RAPD Markers

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Randomly amplified polymorphic DNA (RAPD) markers were used to assess variation within and among populations in the two extant subspecies of the endangered Hawaiian *Hibiscus brackenridgei*: subsp. *brackenridgei* D. Bates and subsp. *mokuleianus* D. Bates. RAPD analysis demonstrated that three of the four O'ahu populations clustered closely together, and were clearly distinct from all the populations on the other islands as well as the Makua O'ahu population. The Makua plants clustered most closely with the populations from the other islands, particularly the Keomuku, Lana'i population. The analysis of the relationship of the two Lana'i populations indicates that they are more closely related to populations on other islands than to each other: Kanepu'u to Hawai'i Island individuals, and Keomuku to Maui individuals. The RAPD data are mostly in agreement with the current circumscription of extant *H. brackenridgei* subspecies: *H. brackenridgei* subsp. *brackenridgei* on Lana'i, Maui and Hawai'i Island, and *H. brackenridgei* subsp. *mokuleianus* on O'ahu. The one exception is the Makua O'ahu population that does not align closely with the other O'ahu populations sampled. A more in depth study of the Makua plants based on morphology and molecular analyses is recommended.

P-66 Monitoring Wetlands in Leone Bay: A Pilot Study

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Wetlands provide a valuable ecosystem service and are critical habitats for several species of American Samoa. As the human population grows American Samoa's wetland become stressed due to urban development and pollution. This study aimed to monitor the health of wetland species *R. Mangle* and *brester* in Leone Bay, American Samoa. Lidar imagery was used to develop a base line of wetland health and to analyze historical conditions. Seven transects were constructed along Leone Creek. Transects were monitored every seven days for five months. It was found that during the wettest months recruitment on propagules was at a minimum while during the driest months it was at a maximum. At the end of the study period several areas were designated as potential restoration sites. The results of this study can be used to guide the future of American Samoa's wetland restoration efforts.

P-67 Sudden, Stand-level Mortality of ‘Ōhi‘a (*Metrosideros polymorpha*) in Lower Puna, Hawai‘i Island

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Within the past 5 years, landowners in the Puna District on Hawai‘i Island have noticed an increase in mortality of ‘ōhi‘a, *Metrosideros polymorpha*. Individual, heretofore healthy trees die rapidly, leaving a canopy of dead leaves. Symptoms do not match those of infections by the foliar rust pathogen *Puccinia psidii* but rather a belowground problem. We conducted a preliminary survey of 31 dieback sites. A GIS analysis showed no correlation with rainfall or elevation. Most mortality occurred on soils developed over pāhoehoe lava and most sites occurred on substrates aged 400-750 years before present. Most of the mortality lined up with mapped fault lines along the Kīlauea volcano's NE-SW rift zone. Despite the mortality of the canopy ‘ōhi‘a trees, understory vegetation, most of which consists of *Psidium cattleianum* but in some sites includes kōpiko (*Psychotria* sp.) and other native species, remains healthy. Subsequent analysis of Pictometry imagery has indicated that the total dieback area is over 500 ha. Future work will test hypotheses that the dieback is caused by 1) a root pathogen, 2) water competition by invasive plant species, 3) heating and drying of roots caused by volcanic activity, or 4) root mortality caused by elevated soil CO₂ levels.

P-68 The Pulelehua Project: Help Map Distributions of Our State Insect, the Kamehameha Butterfly (*Vanessa tameamea*)

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The Kamehameha butterfly (*Vanessa tameamea*) is one of our most beautiful endemic insects, and was recently officially adopted as our State Insect. Although the butterfly is recorded from most of the main Hawaiian Islands (Kaua‘i, O‘ahu, Moloka‘i, Lana‘i, Maui, and Hawai‘i), it is no longer found in many parts of its historical range, even where hostplants (māmaki, ōpuhe, olonā, and other Urticaceae) remain common. The Pulelehua Project, funded by the Native Invertebrate Program of DLNR-DOFAW, is a “citizen science” effort to map populations of the Kamehameha butterfly using observations submitted by the public, combined with surveys by scientists. We have created a website (www.KamehamehaButterfly.com) to which anyone can upload photos of butterflies, immature stages, or distinctive feeding damage, along with date and locality data. The target audience for the project includes hikers and other members of the conservation community. Submitted observations will be used to create a map of suitable habitat using environmental niche modeling, which will identify areas where the butterfly is likely to occur, as well as areas where reintroductions may be most promising. We have also collected genetic data to determine whether populations on different islands or mountain ranges are distinct, which will help inform reintroduction efforts.

P-69 Effect of Strawberry Guava on the Native Land Snail *Leptachatina cerealis*

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The endemic Hawaiian land snail *Leptachatina cerealis*, of the endemic family Amastridae, was fed differing diets of mamaki (*Pipturus albidus*) leaves, its preferred food in the wild, and strawberry guava leaves (*Psidium cattleianum*), an invasive that forms vast monocultures in Hawaii: 100% Mamaki, 100% strawberry guava, and mixed mamaki-strawberry guava leaf diets. Survivorship, wet weight and cumulative number of eggs laid were recorded during a course of 66 days for four groups of these snails (10 adults, 10 juveniles, and a few neonates) fed these different diets. The number of eggs laid was highest for snails fed 100% mamaki, virtually zero for snails fed on 100% strawberry guava. Snails fed 100% strawberry guava showed a decline of 35% over the 66 days, while

snails on 100% mamaki showed only a 5% mortality. Snails fed 100% strawberry guava showed the greatest decline in aggregate weight, while snails on 100% mamaki showed a small gain. Strawberry guava is not likely to sustain populations of *Leptachatina*, or any other terrestrial amastriids, and is likely to lead to their localized extinction. This is the first experimental demonstration of a negative effect on an endemic snail of an invasive species of weed in Hawaii.

P-70 Manu-o-Kū of Diamond Head: Kapi ‘olani Community College Student Monitoring Project

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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. In spring 2014, Kapi‘olani Community College (KCC) students initiated a white tern monitoring program prior to the construction of the KCC Culinary Institute of the Pacific, formerly known as the Fort Ruger Officer's Club. As part of the KCC construction agreement, students trained in tern biology and worked with faculty to prepare information on white fairy terns, developed a survey plan, and reported to appropriate UH, federal and state agencies. For behavior monitoring purposes and data collection, the surveyed area was expanded to include the present KCC campus, Kapi‘olani Park and the Diamond Head shorelines. After training in species identification and behavior, monitoring surveys were scheduled between 7 and 9 a.m., three times a week. Students observed nesting behaviors from an unobtrusive location at a minimum distance of 10 m. All tern statistics will be used to establish baseline monitoring data. This project serves as an example of an avenue for building capacity among local students for avian monitoring and survey techniques.

P-71 Establishment of a Vegetation Monitoring Project in Wailupe Valley Forest Exclosure

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Community partnerships are an important avenue for increasing the effectiveness of ecosystem restoration projects. In 2013, the Hawaii Department of Land and Natural Resources (DLNR), Division of Forestry and Wildlife (DOFAW) implemented a restoration project in Wailupe Valley, Oahu that included a fenced exclosure to remove herbivore ingress, primarily feral pigs. During the spring 2014 semester, students from Kapi‘olani Community College (KCC) joined in partnership with DOFAW to establish a vegetation monitoring protocol in the exclosure area. DOFAW plans include the removal of non-native vegetation to improve habitat for native plants and animals, including the endangered Oahu ‘Elepaio. The initial design for the KCC-DOFAW project consisted of installing permanent transects throughout the exclosure that will be used to implement research and invasive species removal. Our goals were to document current forest composition in order to establish a baseline for comparison prior to invasive species removal. The primary target monitoring species was Strawberry Guava (*Psidium cattleianum*), but all native and introduced species were recorded. Future research interests include the effects specific invasive plants have on native plants, soil, insects, and wildlife. Our work will hopefully establish opportunities for future KCC students to conduct research and conservation every semester.

P-72 Water Resources Sust‘ainability: Vision for Moku o Loe (Coconut Island, O‘ahu)

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Moku-o-Loe is the proper Hawaiian name for a 28-acre island off the coast of Kāne‘ohe Bay, O‘ahu that houses a premier Marine Biology Institute. It is the institute’s vision to be an independent island and model of sust‘ainability in water, waste, and energy. Hence, the major goal of our study is to complete a portion of this work by designing and developing an independent public water system that will supply the entire Moku-o-Loe from the present-day and long-term. It is our aim to practice sustainable engineering and best management practices by using available resources as well as to create a meaningful and sensitive development that is harmonious to the environment. The

poster presentation will detail initial plans to achieve these aspirations by sharing the design & development of a Rainwater Harvesting Catchment System for the island. Moku-o-Loe hopes to serve as a model to mainland O'ahu in water resources sust'ainability and innovation.

P-73 Stretching the Gap: A Reflection on the Collaboration of Watershed Partnerships and Governmental Agencies Constructing Remote Fence in East Maui.

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Over the past decade the East Maui Watershed Partnership (EMWP), collaborated with the State of Hawai'i's Department of Land & Natural Resources and Division of Forestry and Wildlife; The Nature Conservancy; County of Maui, Department of Water Supply; National Park Service at Haleakalā National Park; and private landowners to plan, fund, and install a six mile long ungulate-proof fence in the east Maui watershed area. This six mile section of fence encompasses the Upper Hana Forest Reserve area and the Eastern portion of the Ko'olau Forest Reserve and protects one of the largest contiguous, pristine native rain forests remaining in the state, including fragile bog ecosystems found only on East Maui.

This poster presentation recaps the process of completing this project, from conceptualization and partner collaboration to environmental assessment and community input, to funding and actual fence construction. Topics specifically included are the importance of using satellite imagery in combination with aerial and ground reconnaissance for fenceline determination and effective placement of natural barriers, as well as discussing specific challenges and lessons learned while building in sensitive wet forests and bogs.

P-74 Status of *Myoporum sandwicensis* on Hawaii Island 5 years After the Introduction of a New Pest

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Myoporum thrips, *Klambothrips myopori*, was detected in California in 2005, where it has caused high levels of mortality on the ornamental *Myoporum* species used for landscaping residential and freeway margins (Mound and Morris 2007). It was first detected in Hawaii in March of 2009 attacking the native *Myoporum sandwicensis*, locally known as naio. Its distribution in Hawaii is currently restricted to the Big Island. The high mortality rate seen in California is a cause for alarm for forest managers in Hawaii, where naio is an appreciated native species. In September of 2010, the Department of Land and Natural Resources (DLNR) Division of Forestry and Wildlife (DOFAW), and the University of Hawaii initiated efforts to determine spatial distribution, infestation rates and overall tree health of naio populations on the Big Island. Results show that the thrips has spread to natural habitats on the leeward side of Hawaii Island and that infestation rates are increasing at all sites, causing branch die back and tree mortality. Results of the monthly monitoring during the last three years show that at low and medium elevation sites infestation and dieback rates are significant, with over 60% of the shoots inspected rated with the highest infestation and dieback score. Mortality rates have also increased at these sites, and range from 30 to 60%. Sites that initially showed no signs of thrips infestation at the start of the monitoring are currently experiencing high infestation and dieback levels that might soon lead to tree mortality. Efforts have also been directed to assess the relationship of a Mymarid wasp, in the genus *Polynema*, and naio thrips. Unfortunately, after multiple exposures of naio thrips eggs to adult wasps, there is no evidence of successful parasitism. The poster will also discuss potential management options, such as hybridization with other *Myoporum* species known to have resistance to the thrips.