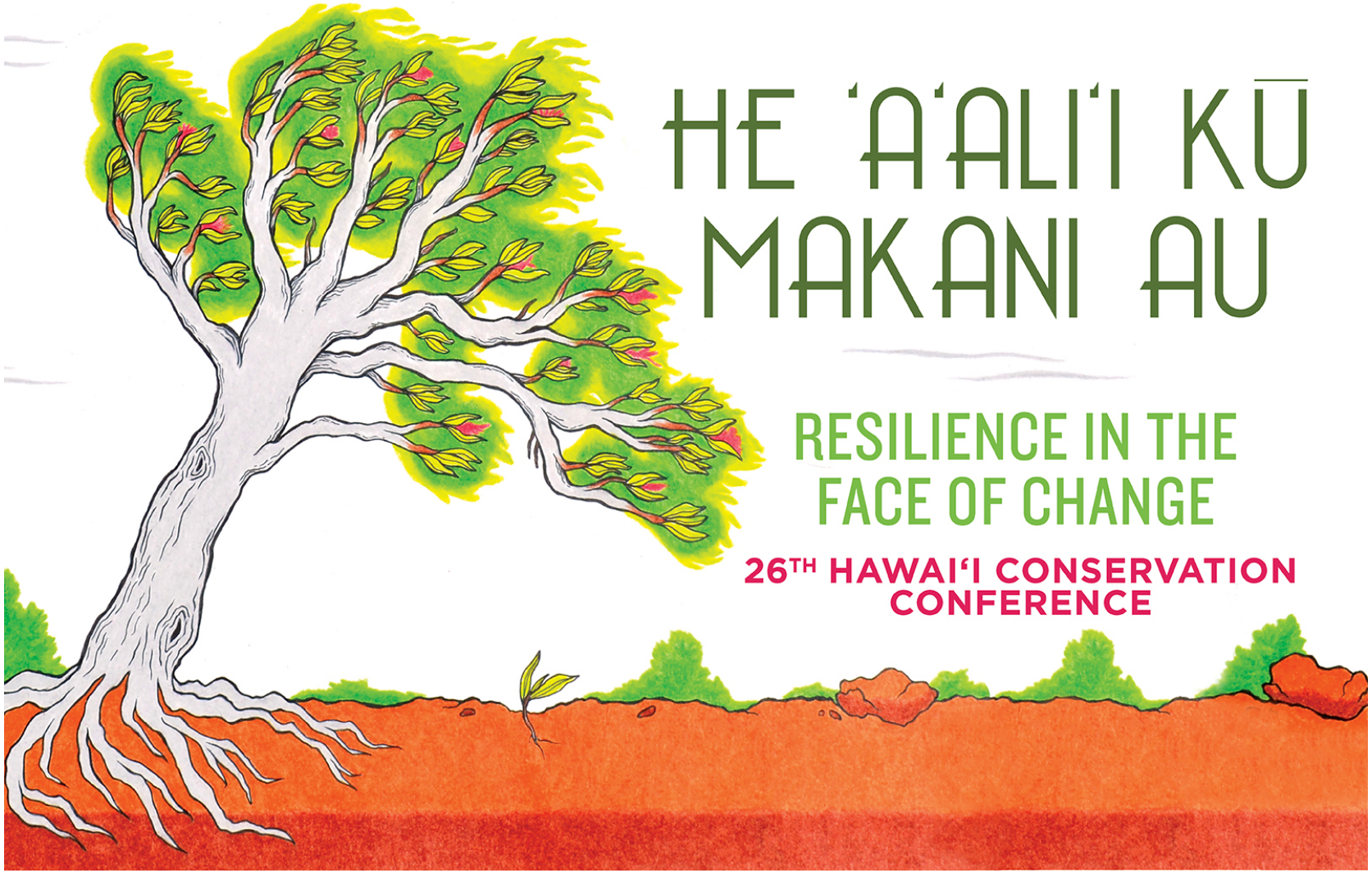

Abstract Book

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Sampling, fast and slow: Examining tradeoffs in surveying low-density populations

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There likely exists an empirical tradeoff between survey efficiency and survey coverage in most study designs. Surveys performed slowly are time-consuming and thus cover a limited area; however, they also have a higher probability of detecting individuals. On the other hand, when surveys are performed quickly, they cover more area at the expense of lower detection rates. Here we explored two types of surveys for the aquatic invasive species, zebra mussel. We applied two types of surveys. The first, transect surveys with distance sampling, covers a larger area but has imperfect detection. The second, quadrat surveys, represents a low-efficiency survey with high detection probability. We examined how each design performed under a range of densities of an invasive freshwater mussel. Finally, we used these empirical studies to explore a general model that allowed us to examine the determine the best survey approach for a given problem based on empirical tradeoffs in survey coverage and detection.

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Native Hawaiian ecological knowledge (NHEK) as a culturally- and place-based learning platform in Hawai‘i's education system: a case study on the 2018 Nā Hopena A‘o (HĀ) Summit

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The 2018 Nā Hopena A‘o (HĀ) Summit held March 9th-10th at Windward Community College in Kane‘ohe on the island of O‘ahu allowed teachers, principals, administrators, and other educational staff throughout Hawai‘i and elsewhere to come together for the second time to be introduced and trained in an educational framework that emphasizes the integration of Hawaiian culture and values throughout all forms of learning in Hawai‘i's schools. Specifically,in the teaching of biological, natural, and environmental sciences; participants were immersed in discussions, excursions, and workshops that illuminated the foundations of NHEK and how place-based learning, transformative learning, and language prepare students to be able to mālama their natural environments. The purpose of this research was to first, investigate the 2018 HĀ Summit to determine how educators might apply and implement NHEK by the HĀ framework into their lessons, second, to look at how the Office of Hawaiian Education and other organizers of the HĀ summit interpret NHEK and the strategies they use to pass this knowledge on to educators, and third, to explore Hawai‘i educator‘s adaptability and responses to the HĀ framework. Through participant observations and semi-structured interviews, results were obtained. Although challenges still remain for the full integration of the HĀ framework in Hawai‘i's education system such as the misunderstanding of the strategies the HĀ summit uses to influence teachers and educational curriculum; both the 2017 and 2018 HĀ summits suggest a growing interest and support for the framework amongst teachers, administrators, students, and the Hawai‘i Department of Education.

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Conservation's Best Friend? Detection Dog's utility, efficacy, and science explored

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Trained detection canines can greatly aid conservation, and new applications are constantly emerging. However, dogs have not been utilized broadly in Hawaii for conservation purposes, yet. By training dogs on specific scents, dogs can help find elusive "targets" such as avian botulism carcasses and early fungus infections in trees, provide rapid response to new accidental introductions (invasive weeds, rats and mongoose), and aid research and provide data on cryptic and endangered species. This symposium will explore how detection dogs might be integrated to assist land managers with a variety of crises impacting our island ecosystems. Experimental applications, pilot studies, lessons learned, funding models, considerations for dog selection and training, limitations, and examples from Hawaii and elsewhere in the Pacific will be presented at this exciting symposium featuring conservation detection dog projects and international experts. For all interested an informal forum to discuss Hawaii based project proposals utilizing detection dog applications will be planned with the speakers.

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Lawai‘a Pono: Engaging Recreational Anglers in Sea Turtle Conservation and Evaluating Impacts

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Maui Ocean Center Marine Institute (MOCMI), coordinates response to sick, injured, or expired sea turtles on the island of Maui, Hawai‘i in partnership and coordination with NOAA Fisheries. Recreational fishing gear is identified by NOAA as the primary cause of strandings of sea turtles in Hawai‘i. To prevent pollution and decrease harmful interactions between sea turtles and fishing line, MOCMI launched the Fishing Line Recycling Program (FLRP) in June 2018. The FLRP provides an accessible method for fishers to take a proactive approach to prevent pollution and reduce entanglement hazards by properly discarding their line. Fishing line recycling bins and educational signage are installed at 26 high-traffic fishing locations along Maui’s shoreline, and on four sites in Hilo, Hawai‘i Island. The fishing line is routinely collected, sorted of hooks and weights, and shipped to the Berkley Conservation Institute where it is melted down and repurposed. Since December 2018, a total of 14,919.65 meters of fishing line has been collected in MOCMI fishing line recycling bins. MOCMI staff and interns conduct surveys each week to gather baseline knowledge of fishers’ awareness of proper methods for discarding line and willingness to participate in a conservation initiative. To date 92 fishers have been surveyed. With more targeted outreach and increased contact with the recreational fishing community, we have been able to improve our understanding and engagement. As we evaluate the impacts of the FLRP, we hope that our findings will help determine best management practices in regards to fishing gear.

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Efficacy of Detection Canines for Avian Botulism Surveillance and Mitigation at Hanalei National Wildlife Refuge

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Avian botulism is paralytic food poisoning caused when birds ingest prey concentrating a neurotoxin produced by the bacteria *Clostridium botulinum*. Waterbird carcasses initiate and spread avian botulism. Early detection and removal is an effective mitigation strategy for reducing the magnitude of epizootics and preventing avian mortality. Early detection is challenging across large areas with dense vegetation. We tested scent trained canines as a surveillance tool for avian botulism at Hanalei National Wildlife Refuge (NWR) on Kaua‘i Island in 2017-2018. We established methods for training and deploying four detector canines at Hanalei NWR and collected data to quantify koloa maoli (*Anas wyvilliana*) carcass discovery under a variety of environmental conditions and habitat features. We used three approaches: 1) We quantified detection for canine assisted surveillance and with traditional search methods, 2) we covertly and randomly hid carcasses prior to surveillance surveys to quantify detection probabilities, and 3) we conducted a time limited randomly paired double-blind trial. We concluded that trained detector canines improved detection probability of carcasses and share lessons learned.

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Closing the Nutrient Loop: Methods of Green Waste Management to Regenerate Hawaiian Soils

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McBryde Garden of the National Tropical Botanical Garden on Kaua`i, formerly a sugar cane plantation, is now home to extensive plantings of rare and native Hawaiian plants, as well as the Regenerative Organic Breadfruit Agroforest. Regenerative agroforestry strives to mimic forest succession in nature, resulting in a closed system of organic matter and nutrient cycling. In Hawai'i, sugarcane and pineapple plantations have depleted organic matter and microbial biomass from soils for decades.

Every plant's strength, persistence, and ability to bounce back from disturbance relies on the quality of soil in which they grow. This study will examine two methods of organic matter reclamation—Bokashi fermentation and the Berkeley Method of hot composting. In order to analyze the immediate effects of each treatment, we are measuring biomass, root length, above ground height, number of leaves, and dry weights of each harvested plant within the 21 research plots.

The goal is increasing the efficiency in conservation of energy and nutrients stored in green waste materials, which will also provide a dynamic and strong foundation for Hawaiian flora. Bokashi fermentation and composting have the potential to improve plant growth rates and soil health in degraded areas, repurpose food scraps and invasive weeds, create a more diverse microbiological community, and improve the safety and affordability of farming by bypassing the need for artificial fertilizers. As stewards of the Hawaiian Islands, not only must our foundation be firmly grounded, but the plants we are collectively working to sustain must be rooted in strong, resilient soil.

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Patterns in Coral Reef Fisheries of the Main Hawaiian Islands Revealed Through Creel Surveys

David Delaney[1], Lida Teneva[2], Kostantinos Stamoulis[3], Jonatha Giddens[4], Haruko (Hal) Koike[1], Tom Ogawa[1], Alan Friedlander[5], Jack Kittinger[6,7]

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Hawai'i's coastal environment is important for both non-commercial and commercial fishing, which provides significant social, cultural, and economic benefits to communities. To effectively manage and monitor coral reef fisheries, managers require better information on total catch, effort, and value to communities. Reef fisheries are affected by a range of factors, and critical information on catch, effort, and value is currently not well defined. Creel surveys can provide detailed information, but these studies are expensive, labor-intensive and are usually only conducted on small spatial scales. Similarly, monitoring for commercial and recreational fisheries across the state have flaws that preclude an accurate assessment of fisheries production and value. To address this gap, we developed the most comprehensive regional shore-based fishing catch and effort analysis using broad-based creel surveys from a diverse group of geographies and contexts. Line fishing was by far the dominant gear type employed. The most efficient gear (i.e., highest catch-per-unit-effort [CPUE]) was spear (0.64 kg/hr), followed closely by net (0.61 kg/hr), with CPUE for line (0.16 kg/hr) substantially lower than the other two methods. Most catch was retained for consumption or given away, suggesting cultural practices and food security are the primary drivers of nearshore fishing. Creel surveys also documented illegal fishing activity across the studied locations, although these activities were not consistent across sites. This information can help inform approaches to refine future creel survey sampling designs as well as efforts for practitioners and managers to better manage fisheries and nearshore environments in Hawai'i (e.g., 30x30 Marine Initiative).

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How Do Seabirds See Light? Effects of Color on Retinal Response to Light

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Artificial lights at night cause high mortality in fledgling seabirds due to attraction and subsequent grounding. Seabirds species of concern on Kaua'i are ʻuaʻu (Hawaiian Petrel - *Pterodroma sandwichensis*), ʻaʻo (Newell's shearwater -*Puffinus newelli)*, and ʻuaʻu kani (Wedge-tailed shearwater - *Ardenna pacifica)*. ʻAʻo fledglings have the highest rates of light attraction, suggesting differences in behavior and/or vision between species as well as between fledglings and adults. Previous studies on migratory birds suggest that the color of light can affect attraction. To understand visual perception in seabirds and light attraction, the speed and strength of response of the retina to different colors of light was measured in ʻuaʻu , ʻaʻo, and ʻuaʻu kani. Seabirds attracted to light and rescued by Save Our Shearwaters were anesthetized, then retinal response to flashing LED lights was measured using electroretinography. Up to five different intensities of light were tested using three different colors of light- ultraviolet (385nm), blue (450nm), and white light (peak at 594nm). Seventeen juveniles representing all three species of concern and three adult ʻuaʻu kani have been tested in the project's first year. Preliminary results suggest each species responds quickest to white light and slowest to UV light. ʻAʻo have the strongest response to blue light, and ʻuaʻu kani have a stronger response to white light, indicating a shift in color perception toward blue and green light in ʻaʻo. These results have negative implications for using green and blue light in outdoor lighting in areas near seabird colonies.

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Behavioral Landscape of ‘Ōma‘o (Myadestes obscurus) Vocalizations in a Naturally Fragmented Habitat

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Habitat use has long been studied by ecologists to understand how organisms utilize their environment, but they often do not evaluate the diversity of behaviors that coincide with resource selection. The ‘Ōma‘o are the last functionally extant native frugivore providing critical ecosystem services to the structure of native forests. The population in the Upper Waiakea Forest Reserve has adapted to live at relatively high densities within a highly fragmented landscape. We combined movement and vocalization data to create a behavioral landscape model that identifies where different types of vocalizations (*i.e.*song, call, whisper song) most frequently occur across the landscape, while linking these locations with their underlying habitat features. Using automated telemetry towers, we collected precise location data from radio-transmittered ‘Ōma‘o to establish core zones and movements across the landscape. In addition, we recorded individual bird vocalizations using a new transmitter technology, which broadcasts all sound emitted from an individual through a miniature microphone. We found calls were more strongly associated with shrub habitat in the matrix while whisper songs were associated more often with the forested kīpuka. Furthermore, as distance from a bird’s core zone increases, total time spent vocalizing decreased. Determining the effects of habitat, vocalization type, and distance from the core zone may clarify context specific uses of sound across the landscape, which can assist in conservation and management efforts. Moreover, this study provides a comprehensive methodology to document the relationship between habitat use and vocalizations, which can be applied to many taxa across different ecological landscapes.

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Mauri Moana, Mauri Tangata, Mauri Ora – Making Space to Enact Diverse Māori and Social Values of Āotearoa New Zealand's Marine Environment

Kelly Ratana[2], Caine Taiapa[3], Kimberley Maxwell[4], Kate Davies[2], Shaun Awatere[5]

[1]Ngāti Tūwharetoa, Te Arawa, Āotearoa, New Zealand, [2]National Institute of Water and Atmospheric Research (NIWA), Hamilton, New Zealand, [3]Manaaki Te Awanui, Tauranga, New Zealand, [4]University of Victoria, Wellington, New Zealand, [5]Manaaki Whenua - Landcare Ressearch, Hamilton, New Zealand

This research project aimed to identify the diversity of values New Zealanders hold for the marine environment and develop a framework for equitably recognizing these values in marine planning, policy and decision-making processes. This is important for supporting agencies to balance societal objectives and uphold indigenous rights when implementing marine ecosystem-based management (EBM).

We reviewed New Zealand-based and international literature on indigenous marine values focusing on works involving indigenous knowledge systems and looked at how these compared with Māori specific marine values. While there are similarities among indigenous groups, the unique context, practices and beliefs of each shapes the way in which those values are expressed. Conservation of the marine estate is recognized as imperative with the challenges ahead (e.g. climate change); however, prioritizing conservation value while neglecting the other diverse indigenous values, (e.g. harvest practices), does not go far enough towards equitable EBM.

Indigenous peoples have a legacy of resilience to change. The values and approaches within a Māori knowledge system are an integral part of any resilient, and equitable approach to marine EBM. We present a framework that conceptualizes how indigenous and broader social values can engage in a unique Āotearoa Marine Ecosystem Based Management system to achieve equitable outcomes and outline how it might be populated using some examples from Tauranga Moana.

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Kids Creating Conservation Innovations: Students Share Their Hawaii Youth Sustainability Challenge Projects

Elia Herman[1], Natalie McKinney[2], Emily Ishikawa[1]

[1]Kupu, Honolulu, United States, [2]Kokua Hawaii Foundation, Haleiwa, United States

The Hawai‘i Youth Sustainability Challenge (HYSC) helps students develop innovative solutions to the conservation challenges they identify in their schools and communities. In 2018, Kupu and Kokua Hawai‘i Foundation (KHF) launched Year 3 of HYSC, providing mini-grants and mentorship to students in grades 6-12 from across the state. Student projects include reef-safe sunscreen exchanges; outreach initiatives to engage community members and young students on topics including watershed, forest, coral, and shoreline health; sustainable lunchtime food waste systems that generate compost for school gardens, which in turn feed school and community members; innovative recycling initiatives, including reuse of 3D printing materials and a greenhouse built from repurposed materials; a hanging garden kit for those without access to outdoor space; as well as many others. Each of these projects seeks to improve the community and achieve real change on a local level. Projects will be conducted throughout Spring 2019 with the support of mentors from Kupu, KHF, and other technical experts. Five exemplary project teams will join the forum to present their work and engage in a meaningful exchange with the audience on the opportunities and challenges they encountered as young people building a more sustainable world. The forum also provides an opportunity for intergenerational learning and inspiration, and will help aspiring students begin to build a network of environmental professionals they can draw from moving forward.

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Journeys in Conservation from Across the Pacific: Pacific Resiliency Fellows Share Their Efforts to Build Resiliency in Their Communities

Elia Herman[1], Neil Hannahs[2]

[1]Kupu, Honolulu, United States, [2]Hoʻokele Strategies, Honolulu, United States

A legacy initiative of the World Conservation Congress, Kupu launched the first cohort of Pacific Resiliency Fellows in 2018. The program aims to build local capacity, create a network of environmental professionals, and amplify real-time, on-the-ground natural and cultural resource management efforts in the Pacific by developing and empowering rising local leaders and social entrepreneurs working to build more sustainable and resilient communities. The inaugural cohort includes fellows from Hawaii, American Samoa, Guam, Northern Mariana Islands, Palau, and Rapa Nui. As part of the program, fellows develop and implement projects that improve the resiliency of their communities. As a result, they are advancing clean multi-modal transportation; using 'āina-based education to strengthen the Kona community and increase graduation rates; developing strategies to help Chefs serve sustainable seafood on their menus; creating models for place-based management grounded in Indigenous knowledge and values; working with businesses to reduce land-based pollution; identifying strategies to support disaster preparedness and recovery in under-resourced communities; partnering with landowners to remove invasive species; working with communities to develop actionable plans to improve resiliency in the face of climate change while also creating local employment opportunities; and much more. The fellows will present their work and engage in a meaningful exchange with the audience, as well as each other, on shared as well as divergent opportunities and challenges that face Pacific islands communities. The forum also provides an opportunity for intergenerational and cross-cultural learning, and will highlight efforts to improve resiliency in the face of change across the Pacific.

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Mālama ʻĀina Wiki Student Presentations

Noelani Puniwai[1]

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Wiki Presentations is designed to allow undergraduate students a format to present mālama ʻāina research conducted in the Spring or Summer of 2019. Students will be solicited from among different Hawaiʻi-based colleges and programs to share their learning in this professional space. Listen and support our young, local scientists and managers as they talk about their research and internship experiences. Presentations are limited to 10 minutes each.

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Using Quantitative Strengths, Weaknesses, Opportunities and Threats (SWOT) Analysis to Improve Planning and Decision-Making of Reintroduction Efforts of ‘Alalā (Corvus hawaiiensis)

Jackie Gaudioso-Levita[4], Rachel Rounds, Donna Ball, Jay Nelson[3], Paul Banko[2], Colleen Cole[1], Thomas White[5]

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The ‘Alalā (*Corvus hawaiiensis*) is the only one of five known endemic Hawaiian corvid species that is still extant. Today, over 125 individuals are held in captivity in a conservation breeding program and current reintroduction efforts that began in 2016 are ongoing. Inherent to avian reintroductions are extensive logistical considerations, intensive staffing, landscape-scale habitat protection, and long-term funding needs. Following the 2016 release of 5 ‘Alalā, which resulted in high mortality within days of the release, the ‘Alalā Working Group made several integrative changes to the release strategy, one of which was a quantitative SWOT analysis. This method is a relatively new application for reintroduction biology, used previously for reintroductions of avian species in Brazil and Puerto Rico. A SWOT analysis was used to select the ‘Alalā reintroduction sites in 2017 and 2018 by a team of experts in the focal species and their habitat. We created a framework of 33 (2017) and 36 (2018) descriptive indicators and sub-indicators to evaluate candidate reintroduction sites. Each indicator was further described with spatial, temporal, and probability coefficients. The team selected the sites with the highest “quality scores” based on consensus rankings for each SWOT session. The SWOT analysis has served as an efficient decision-making tool and has reduced initial subjectivity in site selection. As the survival and behavior of released birds are assessed through an intensive monitoring program, we will continue to evaluate how the quantitative SWOT analysis has aided the recovery program in reaching measurable objectives and milestones for the reestablishment of the species.

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HAWAIIAN FOREST BIRDS SYMPOSIUM – DEVELOPING CONSERVATION STRATEGIES TO ADDRESS CURRENT AND FUTURE THREATS

Lainie Berry[2], Megan Laut[3], Eben Paxton[4], Steve Kendall[5]

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Globally, Hawaiian forest birds have suffered one of the highest rates of extinction of any avian group. Of the 21 endemic Hawaiian forest bird species remaining, 12 are federally threatened or endangered. Those currently extant, including non-listed species, continue to decline and/or display greatly reduced ranges. Current key threats include nonnative diseases to which Hawaiian forest birds are extremely susceptible; predation by invasive mammals; damage to habitat from invasive ungulates; nonnative plants altering native habitat; and competition from introduced birds. Today, most species are restricted to high elevation areas where the last remnants of native forest habitat remain. Climate change is predicted to further exacerbate these threats by reducing the area of suitable high-elevation habitat in which Hawaiian forest birds can persist. While addressing climate change needs to be undertaken on a global scale, locally we can mitigate its impacts on Hawaiian forest birds through translocations and high-elevation habitat restoration. In this symposium, we present multiple talks describing innovative efforts in Hawaii to manage these threats and prevent future extinctions within this unique avian group.

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Motions and Governance Process for the 2020 IUCN World Conservation Congress

Ryan McDermott[1], Denise Antolini[1], Emily Gaskin[1], Emily DeVille[1], Miranda Steed[1], Rachel Goldberg[1], Luke Hollingsworth[1], Kekoa Andrade[1]

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The Environmental Law Program (ELP) at the University of Hawai'i at Mānoa's William S. Richardson School of Law is a member of the International Union for the Conservation of Nature (IUCN). The students of ELP played an exciting role in the last IUCN World Conservation Congress here in Honolulu in 2016. ELP successfully marshaled seven motions through to become IUCN Resolutions. ELP intends to build on the momentum generated in Honolulu and carry it through to the 2020 IUCN Congress in Marseille, France. The students seek to achieve this goal by submitting strategic motions on new and emerging issues in Hawai'i and the Pacific to the Marseille Congress. In addition, ELP seeks to train more students and conservationists to navigate the governance process of the IUCN for this and many more future IUCN Congresses.

ELP would like to hold a Symposium at the Hawai'i Conservation Conference to "report out" to potential sponsors or collaborators on the progress it has made in the motions-to-resolutions process ahead of the August 28thmotions deadline. ELP is interested in working with local Hawai'i organizations to collaborate and fine-tune its proposed resolution to optimize its efforts in Marseille. ELP's goal for the 2020 Congress is to influence the future direction of international law and environmental agreements to conserve our natural resources.

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Strengthening Coastal Resilience Through Community Networks in West Hawai'i

Malia Kipapa[1], Charles Leslie[2], Krista Johnson[3], Charles Young[4], Ku'ulei Keakealani[5], Hannah Kihalani Springer[1,3], John Kahiapo[1], Karen Anderson[1], Reggie Lee[1]

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Community leaders from Kai Kuleana Network will share tangible examples of successes and new questions that have arisen from community-driven conservation action. At Napoʻopoʻo, ʻōpelu fishermen have used the same methods for generations and are still able to sustainably harvest to meet commercial and subsistence needs while cultural sites and coastlines suffer from unmanaged use. At Miloli'i and Ho'okena, re-establishing traditional ʻōpelu fishing starts with education and collaborations between scientists, practitioners, and youth but institutionalizing these practices requires broad statewide support. At Kohanaiki, enduring testaments to kūpuna and traditional practice deepen community connections and educate residents and visitors alike. At Kaʻūpūlehu, as fishers ʻTry Waitʼ for 10 years and fish populations increase, new questions arise about what productive ecosystems look like in a subsistence context. At Kīholo, a collaboration between state government, kama ʻāina, and non-profit partners is reaching a broader community and making measurable progress to increase fish populations through habitat restoration. Kamehameha Schools and the KipapaʻOhana, strong supporters of community-based stewardship efforts in Kahaluʻu in Keahou, discuss challenges and opportunities that come with malama ʻaina. Puakō is learning from a process to upgrade their wastewater infrastructure. And, a representative from the Division of Aquatic Resources will share how DLNR is supporting these and similar efforts to help the state meet its conservation goals. These stories will be shared via an engaging Pecha Kucha format and network members seek reciprocity in the transmittal of knowledge around care of place. Questions, comments, suggestions, and connections are welcomed in a lively discussion after.

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How Do Our Nearshore Fisheries Measure Up?

Eva Schemmel[1]

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Understanding the status of our nearshore fisheries is needed to set the foundation for effective management. A myriad of approaches to measure the status of Hawai‘i’s nearshore fisheries have previously been conducted, including fisher catch and effort surveys, ecological scuba surveys, formal stock assessments, and multiple modeling approaches. The information coming from these different approaches can be hard to interpret and understand across assessment methods and management scales. For example, state-wide assessments have revealed that some but not all species are overfished, and in water surveys have revealed evidence of declines in some areas but have also shown large spatial variability in the overall biomass of fisheries species. This session explores the status of our nearshore fisheries across scales and assessment methods to broaden the discussion about the state of Hawai‘i’s nearshore fisheries. Presenters will discuss patterns in fisheries resources from across knowledge sources and scales to inform and communicate a more comprehensive understanding on nearshore fisheries status.

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Community-Based Marine Resource Monitoring

Eva Schemmel[4], Supin Wongbursarakum[1,3], Luna Kekoa[2]

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Multiple monitoring types and methods have been used in communities across Hawai‘i and vary depending on community's concerns, management interests, local variability in habitat types and coastal environmental conditions, skill/knowledge levels of community participants, and support of facilitating governmental agencies and NGOs. It can be hard to understand what method makes the best use of community time and resources. We are reviewing the methods that are commonly utilized in communities to better understand marine resources and community well-being, looking at method design, the ability of each method to detect changes in the resource and social conditions, and the costs and benefits to the community for undertaking the monitoring. This analysis of the monitoring methods used in communities is to assess the feasibility of each monitoring method, to support the development and application of a guide for communities and managers. The workshop will make it possible to convene a group composed of community members, researchers, staff from non-profit organizations and governmental agencies/programs, and managers to gather input and feedback on how to incorporate community-based marine monitoring into management. We will engage participants to better understand the needs of communities and provide recommendations to supporting researchers, non-profit organizations, and the Department of Land and Natural Resources (DLNR) Division of Aquatic Resources (DAR) on the enabling conditions, costs, and benefits of community-based monitoring methods. This workshop will support a collective understanding of how Hawai‘i's community-based monitoring methods can be used to support tracking changes in resources and well-being of communities for management purposes.

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Developing An Underdominance Gene Drive System In The Southern House Mosquito

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Since its initial introduction to Hawai'i, avian malaria has decimated native Hawaiian forest bird populations. The main vector for avian malaria, the southern house mosquito (*Culex quinquefasciatus)*, continues to threaten native birds and will become a larger threat with climate change expanding the range in which both the vector and disease can develop. We are developing an underdominance-based gene drive system in the southern house mosquito to potentially transform and control wild mosquito populations with the goal of mitigating the decline of native Hawaiian birds. An underdominance gene drive has safety measures in that the transformed population is geographically stable and the transgene can be removed from the population if desired. Such a system has already been established in *Drosophila melanogaster* and was shown to remain stable for over 200 generations. In the current study, we perform the first steps to adapt this underdominance gene drive system for use in mosquitoes for the first time, by integrating a synthetic genetic construct containing a "self-docking site" in a lab colony of southern house mosquitoes. As a component of our overall gene drive system, this self-docking site is intended to allow subsequent constructs (e.g., disease refractory genes) to be site-specifically integrated in the mosquito genome. We are now working on assessing a new phenotypic marker for the synthetic construct to increase screening efficiency. Possible future integration and expression of the underdominance gene drive in the southern house mosquito would open possibilities to control wild mosquito populations, whether for animal or human diseases.

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Laukahi Plant Conservation Network's Research Agenda and Applicative Research Question Design

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Hawai'i has benefited from the large amount of research published by local institutions, government agencies, and others from around the globe which has shaped the practices used today to conserve our flora. Still, there is an urgent need to foster communication between researchers and practitioners on refining current management practices and developing novel tools to meet new conservation challenges. The Laukahi Network, an alliance of organizations dedicated to native plant conservation in Hawai'i, is hoping to facilitate this communication. A "Knowledge Café" forum will build on Laukahi's recent survey of priority topics for research by inviting researchers, students, and managers to transform these research needs into feasible experiments. Doing so will create a space for interaction to engage next-generation conservationists and researchers. The objectives of the forum are to: present research that has profoundly influenced the course of plant conservation in Hawai'i, identify options for practitioners to get help with answering research questions, help format questions about the efficacy of complex management scenarios into achievable research projects, and how to disseminate new research for the broadest impact and deepest benefit. Panelists representing important stakeholders will introduce the topics, followed by a facilitated discussion in break-out groups. By fostering communication around this need at HCC, Laukahi can tap into the diverse audience of policymakers, students, scientists, and practitioners for guidance on how to build our network to serve Hawai'i's native plants. The results of this Forum and an updated Research Agenda for Hawaiian Plants will be posted on the Laukahi website.

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Does Predator-Proof Fencing Improve Fledging Success of the Hawaiian Stilt (Himantopus mexicanus knudseni)?

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The Hawaiian Stilt (*Himantopus mexicanus knudseni*) is one of five Hawaiian waterbirds listed in 1970 under the Endangered Species Act. The predation of chicks by invasive species continues to hinder Hawaiian Stilt recovery. In June 2018, the US Fish and Wildlife Service built a predator-proof fence around one wetland within the Pearl Harbor National Wildlife Refuge complex on O'ahu to protect Endangered waterbirds from mammalian predators. In this study we compared reproductive success in a site where mammals are completely excluded to a nearby wetland where trapping is the main form of mammalian predator reduction. This study evaluated predator impacts on the hatching period and fledging success of Hawaiian Stilts inside and outside of protective fencing. Several methods were used, including game cameras, VHF radio tags, and evaluation of predator removal efforts. Game cameras were deployed to monitor chicks during the hatch period. At each site, we attached VHF radio tags to five chicks ≥10 days old and tracked them until they fledged, molted, or died. Predator trapping data from the USFWS were analyzed, alongside game camera detections, to determine predator type and presence/absence in the nesting area. Fledging success within the exclosure was not significantly greater when compared to wetlands outside the exclosure, potentially due to predation from avian predators. These results may inform adaptive management strategies as managers work to recover Hawaiian waterbirds.

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Can compost from a nitrogen-fixing tree, Falcataria moluccana, replace synthetic fertilizer and store carbon in agricultural systems?

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The challenges of food production, invasive species control, and climate change intersect with each other, and while solutions in one field have generally exacerbated problems in the others, some new approaches seek to create co-benefits. Climate-smart agriculture is a suite of management practices that can create co-benefits for the climate by lessening emissions from agriculture and storing carbon in croplands. One climate-smart practice is application of compost, which can supply key nutrients and add organic matter to the soil while decreasing the need for synthetic fertilizers. Abundant biomass for producing this compost is present in the nitrogen-fixing albizia tree (*Falcataria moluccana*), which is highly invasive across the Hawaiian Islands; a use for chipped albizia could facilitate its control. This research applied albizia compost to croplands and compared those results to treatment controls of no inputs and synthetic fertilizer only, and a combination of compost and fertilizer. The test crops used were cassava and corn, and the resulting plant yields and plant and soil nutrients (C, N, P and more) were analyzed. We found that corn had higher yields using synthetic fertilizer, and cassava yields remained the same across all treatments. Results from nutrient tests and an analysis of carbon storage/loss will be reported at the upcoming conference.

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‘Āina Kaumaha: Kamehameha Schools' Genealogy of Indigenous Resource Management

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Though there is growing recognition of the essential role indigenous people have in biocultural conservation, there are few cases of applied indigenous resource management today, especially from the indigenous standpoint. We provide an example of the maintenance and adaptation of a indigenous resource management system over generations, told from the perspective of Kānaka ‘Ōiwi resource managers at Kamehameha Schools. Kamehameha Schools is not only the largest private landowner in Hawai‘i, but is uniquely tied to a lineage of traditional ali‘i (chiefs) resulting in present-day influence, decision-making authority, and wealth to fund a perpetual vision for its ancestral lands and communities. We share our journey to (re)discover what it means to steward in an indigenous way. We provide a guide for indigenous organizations (re)defining their ancestral ways of stewardship, as well as for the many non-indigenous agencies with obligations to native lands and people today working to incorporate indigenous systems into their current management. Given that all of Hawai‘i’s lands and seas are indigenous spaces, we argue that the restoration of effective biocultural resource management systems requires the maintenance, and in some cases reestablishment, of indigenous institutions at multiple levels.

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Wedge-tailed Shearwater Persistence in Human-Dominated Areas

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Management actions on O‘ahu’s offshore islets have resulted in an increase of Wedge-tailed Shearwater (*Ardenna pacifica*, WTSH) populations to the point that new WTSH colonies have formed on coastal areas of O‘ahu that primarily support human activities. We hypothesized that WTSH colonies residing in human-dominated areas may have lower fledging success than colonies occurring in restricted access areas, and may not be able to persist over time. The objectives of this study are to: (1) compare fledging success between WTSH colonies at Kailua Beach Park (KBP), a human-dominated area, and Marine Corps Base Hawai‘i - Kāne‘ohe Bay (MCBH-KB), a restricted access area; (2) determine the maximum density of the KBP colony; (3) determine the population viability of the KBP colony. Nest monitoring and human presence surveys were conducted weekly at both sites during nesting and fledging season. Maximum density was estimated for the KBP colony using offshore islet WTSH density estimates, and Vortex was used to perform a population viability analysis (PVA) for the KBP colony. Human detections were significantly different between sites ($p<0.001$) but no significant difference in fledging success was observed ($p=0.3842$). Depending on the level of management, it is predicted that the KBP colony will reach a maximum density of 94 to 750 individuals. Under current conditions, the KBP colony was predicted to likely persist for the next 100 years. Our results suggest that existing colonies on O‘ahu will likely expand to their maximum densities, and new colonies will form in more human-dominated areas on O‘ahu, resulting in a need for management strategies of native seabirds in human-dominated coastal regions.

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Resilience in Aquatic Ecosystems: Robust, Yet Fragile

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What causes one ecosystem to fall apart after an extreme disturbance, and another one to rebound? This session will highlight current work at DLNR Division of Aquatic Resources with a special emphasis on ecological resilience in aquatic ecosystems of Hawai‘i, including robust, yet fragile: streams, estuaries, wetlands, and coral reefs.

Resilience is an ecosystem’s ability to keep from being irrevocably degraded as well as its capacity to maintain its core ecological functions in the face of dramatically changing circumstances. Robust, yet fragile is a phrase that describes how a complex ecosystem can be resilient when that ecosystem evolved with a stressor (i.e., flash flooding), while being highly susceptible to a novel stressor (i.e., invasive species). The challenges of managing coastal resources will be discussed.

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You CAN try this at home: Breakthroughs in aerial operations for invasive species management.

Ryan Perroy[3], James Parker[4], David Benitez[1], Adam Knox[2], Timothy Sullivan[3], Adam Radford[2], James Leary[5,6], Brooke Mahnken[2], Springer Kaye[4], Roberto Rodriquez[5,7]

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Managing the onslaught of invasive species is essential to preserving biodiversity, ecosystem function, and our enjoyment of natural areas, but these efforts consume an ever-increasing share of limited time, capacity, and financial resources. To gain ground in the battle against invasive species, conservation programs are taking to the air with new, innovative platforms! Like the `a`ali`i, we will persist in the face of any difficulty…with a little tech support!

This symposium highlights four projects that demonstrate new aerial technology, techniques, or workflows leading to a significant mission breakthroughs. The key message in each talk: You CAN try this at home (well, at work, anyway)! Getting started can be the hardest part: BIISC will present their new technical guide, describing how and why to integrate small unmanned aerial systems into your operations, with an easy to learn, affordable workflow. MISC will describe new aerial solutions to control three challenging pests on Maui, and explain new regulations for using the popular Herbicide Ballistic Technology. Helicopters may be familiar platforms, but we may be under-utilizing the survey capacity of all that costly flight time. SDAV & HAVO will explain how they gather high-resolution georeferenced imagery to guide Rapid `Ohi`a Death response. Finally, how to get around the image-processing bottleneck? How about an automated computer vision classifier built on a convolutional neural network? The SDAV Director explains. Attendees will leave with a clear understanding of the improved efficiencies that can be achieved, and the support available to make it happen.

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The urbanization of the Hawaiian stilt: meet the new neighbors

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The Hawaiian stilt, or Ae'o, is an endangered waterbird endemic to the Hawaiian Islands. Loss of suitable wetland habitats due to anthropogenic development is a leading cause for decline, as well as the introduction of non-native predators and invasive wetland plants. While other Hawaiian waterbirds are largely restricted to wetlands, Hawaiian stilts appear to be adapting to the urban environment, using heavily modified upland habitats. In our study, we fitted four Hawaiian stilts with GPS satellite tags to document their use of developed areas, undeveloped fields, sports fields and wetland habitats over a 6 month period. We found a high use of non-wetland habitat, with significant differences in habitat occupancy among the individual stilts and across different times of day. Wetlands were the dominant habitat occupied from morning to early afternoon, but non-wetland habitats were occupied in higher frequency in the evening and early morning hours. The use of habitats outside wetlands implies management strategies may need to be updated to encompass these additional habitats.

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The Impacts of Light Pollution and other Fallout Factors on Wedge-tailed Shearwaters (‘Ua‘u Kani): Examining Population Sources and Sinks for Targeted Management

Brooke Friswold[2], Keith Swindle[1], Melissa Price[2]

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Attraction to light was a previously beneficial behavior for seabirds but is now negatively impacting their survival due to distraction and disorientation, leading to fallout (land collision) and often death. Hundreds of Wedge-tailed Shearwaters (WTSH, ‘Ua‘u Kani, Ardenna pacifica), a native and prolific seabird, experience fallout each fledging season across O‘ahu. It was hypothesized that the presence of artificial light was a significant factor contributing to fallout. An eight-year survey was conducted on Southeastern O‘ahu during fledging season. Fallout location and presence of a light source or power line within 8 meters was analyzed along transects. Spatial analyses in GIS were employed to determine multiple factor influences on fallout and to identify regions and time periods of greatest impact. Light presence was confirmed in 94% of fallout events, power lines in 83%, and that fallout has increased over time, despite yearly oscillation. A hotspot containing 60% of all fallout, light sources with highest proximal fallout, and peak fallout days during the new moon were identified. Targeted management through light alteration/eradication at hotspots during the new moon is recommended to prevent maximum fallout and increase adoptability. Previous research indicates similar findings with broad management as a recommendation. Establishing regions most susceptible to fallout and colonies at greatest risk through use of multiple fallout factors will allow mitigation of light at the most vulnerable regions and periods. As O‘ahu shorelines become increasingly light-polluted this information will assist with proactively resolving human-wildlife conflict across the state of Hawai‘i concerning a federally protected species.

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Population Trends of Humpback Whales Inferred from the Strength of Male Song Chorusing off Maui, Hawai‘i since 2014/15

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Each winter, humpback whales (*Megaptera novaeangliae*) migrate from their polar feeding grounds in Alaska to breed in the shallow tropical waters around the Main Hawaiian Islands. Population estimates suggest that following recovery from whaling depletion, up to 12,000 animals winter in Hawai'i, more than half of the total North Pacific stock. There, mature males produce an elaborate acoustic display known as song, which becomes the dominant source of ambient noise during the reproductive season (ca. December-April). In 2015/16, commercial operators, researchers, and citizen-science counts anecdotally reported an unusually low number of whales compared to previous years off Maui. Data from long-term passive acoustic monitoring with autonomous bottom-moored Ecological Acoustic Recorders (EARs) during the 2014/15 to 2016/17 seasons at three shallow- and two deep-water sites off Maui were analyzed using male chorusing as a proxy for relative whale abundance. We calculated root-mean-square sound pressure levels (RMS SPLs) to compare low frequency acoustic energy (0-1.5 kHz) among all seasons. Our results showed that despite a similar overall trend reflecting the migratory pattern of humpback whales, average monthly SPLs remained more than 6 dB (50%) lower since 2014/15 on all sites, suggesting that the number of singing males were lower during all subsequent years. Further, chorusing peaks within the seasons shifted, suggesting that whales leave the region earlier than in the past. It remains unclear whether our observations reflect a decrease in population size or a behavioral response to a potential stressor. Continued monitoring efforts, including examining previously unsurveyed areas, is needed.

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Population status of the critically endangered Laysan duck at Midway Atoll National Wildlife Refuge

Kelly Goodale[1], Jonathan Plissner[2], Beth Flint[1]

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The critically endangered Laysan duck (*Anas laysanensis*), once found throughout the Hawaiian archipelago, became restricted to Laysan Island in 1865. In 2004 and 2005, the threat of sea-level rise and restricted range of this species prompted US Fish and Wildlife Service and partners to translocate 42 birds from Laysan Island to Midway Atoll National Wildlife Refuge (NWR) in order to establish a second, more secure population. In the 15 years since introduction, Laysan ducks faced challenges from poor habitat quality, severe avian botulism outbreaks, and a tsunami that was generated by Japan's 2011 Tohoku earthquake. Nevertheless, through habitat and wetland restoration, intensive monitoring to prevent botulism outbreaks, and restoration actions to ensure long-term resilience of coastal habitats, the Laysan duck population at Midway Atoll NWR is thriving, with a record high population of 1,020 individuals (95% CI = 945-1077) as of February 2019. Future recovery actions include duck diet analysis, eradication of the non-native house mouse (*Mus musculus*), reassessment of population models due to drastic habitat changes, and further understanding of duckling and adult survivorship.

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Using Citizen Science to Monitor Whale Sharks (Rhincodon typus) throughout the Hawaiian Islands

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Limited tagging studies in the Pacific have documented whale sharks (*Rhincodon typus*) traveling through Hawaiian waters, however, no known previous studies exist specifically monitoring this endangered species in Hawai‘i. In October 2017, Hawai‘i Uncharted Research Collective launched a citizen science effort to learn more about the poorly studied whale sharks in Hawai‘i including sighting frequency, size distribution, and movement patterns. This effort enhances conservation efforts and improves resiliency of this endangered species by tracking localized threats such as vessel strikes, entanglements and intense human interaction. Working with international collaborators, identifying global aggregation sites and identifying localized threats will become key to proper management for this disappearing species in our rapidly-changing oceans.

Community members were encouraged to submit photos/videos from any documented whale shark sightings. Interactive Individual Identification System (I^3S) software was used to compare individual spot patterns from submissions. Information was compiled, analyzed and summarized through multiple databases including both sighting information metadata and photographs/videos.

Since inception, ocean-going professionals/enthusiasts submitted more than 1300 photos and videos from 293 distinctive sightings dating as far back as 1991. From January 1 to December 31, 2018 there were sightings of 69 new individuals and 50 sightings of unknown individuals (identification was not possible due to image quality/angle). Total length of individuals ranged from 2.1-10.5 meters, with a mean estimated total length of 5.8±1.6 meters (n=90). Submitted sightings indicate a year-round presence in Hawai‘i. Mean number of sightings per month was 11.5±6.7 (n=119) with the highest number (27) occurring in December.

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Nest Initiation Time and Distance to Water Predict Nesting Success of the Ae‘o (Hawaiian Stilt - Himantopus mexicanus knudensi) in Wetlands on O‘ahu

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In temperate waterbirds, early nesters often have higher nesting success than late nesters, but because nesting seasons are typically longer in tropical regions and many birds are year-round residents, tropical waterbirds may lack an early-bird advantage. The objective of this study was to examine seasonality in nesting success of the Ae‘o (Hawaiian stilt - *Himantopus mexicanus knudensi*), an endangered Hawaiian waterbird that nests from February to August in wetlands across the Hawaiian Islands. Weekly field surveys and game cameras were used to monitor nests. Nest status, approximate nest initiation time, and nest-site characteristics, such as distance to water, vegetation type, vegetation height, and vegetation cover, were recorded for each nest. Early nesters had higher nesting success than late nesters (p<0.001). Early nests were located closer to water than late nests (p=0.02). Correspondingly, distance to water and nest initiation time were identified as predictors of nesting success (p=0.01 and p=0.04, respectively). Water level may be predictive of other factors, such as food availability, and therefore, parental involvement or nest-site competition. Further, sea level rise has led to an increase in flooding events, particularly in wetlands, by raising the water table. In order to effectively manage hydrological conditions of Ae‘o nesting habitat, further investigation is needed to better understand the impact of water level (as it corresponds to distance from nests to water) on Ae‘o nesting success.

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The Benefits of sUAS Integration - Cost-Saving Techniques for Early Detection of Invasive Plants

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The ability to survey from the air is a dream of land managers. However, conservation work and land management have to operate on fixed budgets, making it difficult to acquire your own aerial imaging from fixed wing or helicopter surveys. Lucky for us, consumer drones have changed the game. The technology behind small Unmanned Aerial Systems (sUAS) allows conservation workers to dream big and fly high. With a conservative budget and minimal training, we can now utilize flying cameras to assist our planning efforts and maximize ground crew efficiency.

Low-cost and quick delivery of imagery are two of the factors that make our program unique. With a suite of apps specially designed for autonomous missions, we are able to utilize terrain awareness to design our flights to be as low to the ground as is safe for maximum resolution of plant features, on the ground as well as in the canopy. When flying low and close to vegetation, the quad-copter has sensors that will pause movement when an obstruction is detected. These new advancements have given us the ability to detect plants which were too cryptic to be picked out from a high altitude. We have found that a majority of our plant targets are detectable from the air.

This talk will focus on the benefits of integrating sUAS into your conservation program, featuring detailed cost-analyses of new eradication targets (e.g. Moluccan raspberry, *Rubus sieboldii*) on Hawai'i Island. Highlights from the new technical guide will offer poignant comparisons between traditional ground crew surveys and speedy video surveys, and how to make use of photo mosaic surveys for repeatable, long-term monitoring. The technical guide is designed to give you the confidence you need to get your sUAS program off the ground and integrated into your operations.

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MarineGEO Hawaii Ola I Ke Kai: Results From The Comprehensive Bioassessment of Kaneohe Bay, 2017

Claire Lager[1,2]

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Kāneʻohe Bay is an important cultural and biological site. Scientific collections in Kāneʻohe Bay have been made sporadically since the early 1900s but no comprehensive baseline survey had been done prior to MarineGEO Ola i ke kai in 2017. Twenty-four institutions from nine countries participated in this bioassessment of Kāneʻohe Bay and we collected 3,700 voucher specimens across the six target groups: fishes, meiofauna, macrofauna, marine algae, bacteria, and Autonomous Reef Monitoring Structures. All these specimens have had high-resolution images taken and will be, or have already been, genetically sequenced and barcoded. The voucher specimens have all been accessioned and will be maintained at the Smithsonian, University of Florida, and the Bishop Museum. It has been two years since MarineGEO Ola i ke kai took place and we have successfully sequenced and barcoded specimens from the fishes, meiofauna, and bacteria groups. The other specimens are currently being processed and will be completed shortly. All resulting data were coalesced into a new data template for MarineGEO, designed with input from the National Museum of Natural History for compatibility, usable by all science units and our international partners, and which will provide a standard for all MarineGEO sites moving forward. Kāneʻohe Bay is a well-studied ecosystem, yet hundreds of new invertebrate and meiofaunal species were discovered, and its expected to produce over 50 new scientific publications. These data also have practical value in being critical to decision-making for state land managers to understand and maintain Kāneʻohe Bay's biodiversity.

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Enhancing Invasive Species Monitoring at Hawai'i's Airports

Leyla Kaufman[1,2]

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The rate of invasive species introductions in Hawai'i increased dramatically since the start of commercial air service to the islands. Invasive species cause severe effects in Hawaii's economy as well in its fragile and unique ecosystem. Mamalu Poepoe is a pilot program funded by the Department of Transportation for a five-year period, and aims to enhance surveillance of selected invasive species at airport facilities statewide. It brings together different agencies such as the Hawai'i Department of Health (vector control branch), Hawaii Department of Agriculture, the University of Hawai'i, Hawai'i Department of Land and Natural Resources. The program also partners with the different Invasive Species Committees (ISC's) island wide and the Hawai'i Ant Lab (HAL). Selected invasive species include the Coconut Rhinoceros Beetle (*Oryctes rhinoceros*), Africanized Honeybees (*Apis mellifera scutellata)*, invasive mosquitoes and invasive ants. Target species were selected due to the threat they present, they can be easily missed through current inspections, as well as the ability to set up feasible and time efficient monitoring protocols.

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

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Connecting with Hālau ʻŌhiʻa: A Bio-Cultural Way Towards Resilience

Kekuhi Kealiikanakaoleohaililani[1], Kainana Francisco[2], Kalena Blakemore[14], Mililani Browning[22], Monika Frazier[16], Linnea Heu[9], Lea Kaʻahaʻaina[5], Joe Kern[11], JoAnna Quitan Kern[16], Rachel Kingsley[17], Natalie Kurashima[3], C. Kalā Lindsey-Asing[11], Renee Pualani Louis[16], Sierra McDaniel[23], Becky Ostertag[18], Puaʻala Pascua[19], Cheyenne Hiapo Perry[12], Aimee Sato[20], Jermy Uowolo[11], Nāmaka Whitehead[3], Darcy Yogi[13]

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Intimacy, connection, and relationship—these are ineffable sentiments that often forget to find their way into our professional lives. So what is the practical relevance of increased connectivity to the world around us, and how do we cultivate that? Through continued practice of Hawaiʻi lifeway skills, participants in Hālau ʻŌhiʻa Hawaiʻi Stewardship Training have experienced that the potential for individual and collective resilience is proportional to our connections to people and place. We will discuss how resilience can be fostered and enhanced in our professions by expanding our knowledge and practice of Hawaiʻi lifeway skills. These skills allow us to explore and strengthen our relationships to the places and lives that sustain us. Through our journey we have engaged with our landscapes through the skill sets of hula-dance, mele-poetry and music, oli-chant, moʻolelo-storytelling, kuahu-shared focal point, koʻihonua-cosmology, and mea ʻai-food. A central function to all of these practices is that they create, enhance and strengthen our connections to ourselves, our families, our communities, our environment and our universe. In this presentation you will have the opportunity to interact with Hālau ʻŌhiʻa participants and learn how we have utilized specific Hawaiian lifeway skills to deepen our connections to, and heighten the resilience of our human, forest and ocean communities. Break out discussions will include relationship and resilience building activities that engage the whole person.

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Finding & Using Your Voice As a Platform for Conservation - A Nāhululeihiwakuipapa Emerging Professionals Workshop

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In the conservation field, effective communication is a vital skill necessary for sharing information with partners, building relationships, collaborating on projects, and educating stakeholders from all backgrounds and sectors. This skill is not exclusive to the conservation world and expanding our reach for tools and resources from other industry sectors, e.g., entrepreneurship/marketing, can provide us with valuable expertise and knowledge to further enhance our conservation efforts. As our conservation community evolves to include more diverse expertise from non-conventional conservation industries, its resilience to current and future conservation issues and our abilities to innovate creative solutions need to increase and diversify.

This two hour workshop is designed to empower emerging professionals to find their voice, further develop their communication skills, and learn how to use their voice as a platform to share, educate, and convey their passion for the work they do in conservation, while also recognizing this skill is applicable to everyday interactions. This workshop will feature a dynamic panel of effective communicators, from the conservation field and marketing/business industry, and a small group activity where participants will work collectively to develop a succinct message to pitch a solution/address a broad conservation question. This workshop will provide emerging professionals the opportunity to put into practice this skill with constructive feedback from panelists.

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A Progress Report on the Highest Priority Research and Management Actions for Conservation of Hawaiian Forest Birds

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Hawai'i's forest birds face a number of conservation challenges that will likely lead to the extinction of multiple species in the coming decades if not addressed. Known threats include habitat loss, invasive plants, non-native predators, and introduced diseases. Climate change is predicted to intensify these threats, adding urgency to finding tractable conservation strategies. In 2015, we assembled a group of >60 stakeholders to prioritize research and management approaches critical for the near-term conservation of Hawaiian forest birds. We identified nine strategic action items that will contribute to conservation of Hawai'i's forest birds. Here, we discuss these nine actions and summarize recent progress on the seven highest priority items including; implementing a disease vector control program, increasing disease immunity in forest bird populations, habitat protection, implementing predator controls, increasing populations through captive breeding and re-introduction programs, reassessing monitoring strategies and focusing on the most vulnerable populations found on Kauai Island. The threats facing Hawai'i's forest birds are not unique and these conservation priorities serve as a model for other imperiled communities around the world.

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Exclusion of invasive ants increases nest success of an endangered Hawaiian yellow-faced bee (Hylaeus anthracinus)

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Hawaii has a single group of native bees belonging to the genus *Hylaeus*. These 63 species are known as yellow-faced bees and most have experienced significant declines in range and population. In 2016, seven species received federal protection under the Endangered Species Act of 1973. Invasive ants are thought to have driven range reductions and population declines, especially at lower elevations where more invasive ant species occur. We evaluated the effects of invasive ants on nesting *Hylaeus anthracinus* using artificial nest blocks. The blocks were placed in pairs at 22 points within three sites on the north and east sides of Oahu. One block in each pair was treated with a sticky plant resin which prevented access by ants while the other block remained untreated. From December 2015 – December 2016 a total of 1,123 nests were monitored. Nests in treated blocks were more likely to produce at least one adult than nests in the untreated blocks. In untreated blocks, ants were the most common cause of nest mortality followed by lack of development, displacement by the competitor *Pachodynerus nasidens*, and pathogens. The invasive ant, *Ochetellus glaber* was the only observed nest predator, although the big-headed ant, *Pheidole megacephala* was also present. An increased understanding of the factors limiting Hawaii's yellow-faced bees will inform future conservation effects that may include use of artificial nest sites, translocations, and habitat enhancement that could include invasive ant control.

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From Data to Metrics to Action - Effective Conservation on Division of Forestry and Wildlife Lands

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The Division of Forestry and Wildlife manages almost a million acres statewide, including many important conservation lands and habitats. With limited funding and such a large land area, data gathering and analysis has been critical for the Division to identify which areas to prioritize for protective management. This presentation showcases some of the data that the Division has used for planning, such as species' ranges and landcover maps. The presentation will also discuss where the conservation community can assist with the major data gaps and the need for metrics to determine success. A case study of the Sustainable Hawai'i Initiative's 30% by 2030 Watershed Protection Goal will show how the effective conservation project's data has influenced policy and on-the-ground accomplishments. The Watershed Protection Goal was announced by Governor Ige in 2016, seeking to protect 30% of Hawaii's watershed forests by 2030.

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Challenges and Successes of Conserving Hawaii's Terrestrial Invertebrates: A Seven Year Update

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Hawaii's terrestrial invertebrate fauna comprises more than 6,500 native species, of which nearly 99% are endemic. Insects and land snails alone make up about 6,000 known species. Despite this incredible native biodiversity, invertebrate conservation discussions are often absent from management planning and the development of conservation actions. This is in part because the majority of these animals are small-sized and cryptic, making them difficult to detect, identify, and monitor. In 2012, a terrestrial invertebrate symposium was organized as part of the Hawaii Conservation Conference to discuss challenges (e.g. assessing population status and viability, evaluating phylogenetic relationships among species, tracking trends using historical collection records) and successes (e.g. captive breeding programs for rare invertebrates, reintroductions into restored habitat) in invertebrate conservation. Seven years later, are we still tackling the same conservation challenges? What advances have we made? What failures have we experienced? This symposium will cover a diverse taxonomic range of terrestrial invertebrates (i.e. bees, damselflies, butterflies, and snails), and provide updates on challenges (e.g. continued extinction of species), advances (e.g. increased capacity for captive rearing, rediscovery of "extinct" species, development of educational outreach conservation programs), and insights into the way forward. Our hope is that by continuing the discussion initiated in 2012 we can continue to make strides towards conserving the bulk of biodiversity, much of which is often forgotten in the stampede to conserve mammals and birds.

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Building Resilience through Partnership: The Hawai‘i Association of Watershed Partnerships’ Approach to Conserving Watersheds

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The Hawai‘i Association of Watershed Partnerships (HAWP) comprises ten Watershed Partnerships across five islands, and works collaboratively with public and private landowners who own and/or manage more than 2 million acres of vital watershed areas across Hawai‘i. While each of the individual Watershed Partnerships has their own management priorities based on their unique geographic and social contexts, there are many cross-cutting issues that by working together can be addressed more efficiently and successfully as a unified group. HAWP endeavors to promote knowledge sharing and technical expertise among its partners, communities and beyond; through such information exchange and collaboration, the HAWP framework builds resilience to the many types of changes we face in conservation – ranging from climate to political and socio-economic.

During this forum, HAWP will take a deeper look into four cross-cutting themes that provide founding pillars to successful, landscape-level watershed conservation across Hawai‘i : (1) Fencing, (2) Restoration, (3) Outreach and Education, and (4) Project Development. HAWP will present a brief overview on each theme that characterizes the breadth of techniques utilized by Watershed Partnerships across the State, along with unifying successes and challenges per our collective monitoring and evaluation. Overview presentations will be followed by participatory break-out sessions facilitated by Watershed Partnership Coordinators with expertise in each of the themes. Key findings from the break-out sessions will be presented prior to forum conclusion with more detailed notes circulated to all participants following the conference. The HAWP forum will promote knowledge-sharing, collaboration/networking, and resilience-building among conservation practitioners across Hawai‘i.

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Assessing Ungulate Populations in Forested Areas with Aerial FLIR Surveys: Results and Early Lessons

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The Nature Conservancy's Kaua'i Program has been developing survey methodology using contractor (KIA Hawai'i) with Forward Looking InfraRed (FLIR) cameras for locating pigs, deer, and goats from helicopter in heavily-forest management units where dense vegetation hinders the spotting of animals. In units which were nearly ungulate free, FLIR was used to locate incipient animals for targeted on-the-ground hunting. In unfenced and recently-fenced units, strip transects were conducted in the first two hours of daylight to calculate a baseline population estimate for the units using 100-meter wide transects from 250 feet high. Based on these initial findings, FLIR technology was effective to quickly survey heavily-forested, topographically-challenging watershed areas. The technology was most successful in locating and identifying animals through dense forest canopy from a downward angle, which limited its effective range. Population estimates had wide confidence intervals due to low target density but also provided some data on localized abundance within units. Aerial FLIR was found to be useful in locating incipient animal populations in the more open, gentler terrain of the summit region, and aided the removal of pigs. FLIR surveys have been a helpful and cost-effective addition to ground observations and game camera survey when planning adaptive management actions. Challenging weather and logistical considerations persisted, so having a variety of pre-planned flight options was ideal but did not completely eliminate difficulty collecting FLIR data.

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Urban ʻĀina: Nurturing Biocultural Connections Where We Live

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The Hawaiʻi Conservation Alliance maintains a focus on protecting our remaining native ecosystems, many of which are remote and difficult to access. Most Hawaiʻi residents (89%) live in urban areas, and do not have ready access to protected habitats of high conservation value. Yet, we regularly interact with nature in parks, gardens, farms, and yards --- spaces that often support a wide range of native and canoe plants, but are often characterized as degraded and invaded, with little to no conservation value. If we believe that intimate relationships with the environment are critical to taking care of Hawaiʻi and her native biodiversity, then conservation entities are missing opportunities by failing to engage the nature that most of Hawaiʻi encounters daily. Because of these omnipresent yet overlooked opportunities, we contend that urban centers represent a vast untapped pool of conservation allies, and that investing in urban conservation can cultivate a more engaged, expansive, relationship-based conservation community. This symposium asks whether a new paradigm is required, based on high-quality, comprehensive engagement of our urban areas, with the goals of enhancing ecological and cultural value, and ultimately transforming the built environment into expanding kīpuka of biocultural knowledge and practice. Urban green spaces often support the only nature known to our youth, and certainly the nature most accessible to our adults, meaning these areas are critical to conserving Hawaii's cherished biodiversity as well as strengthening ecological and cultural resilience.

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Green Passport: Improving the Visitor Experience and Protecting our Natural Heritage

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Hawaii's environment underpins our economy and culture, but receives less than 1% of our state budget. This chronic underfunding diminishes the visitor experience and depletes the very ecosystems that drive our economy. Thus, we are in a situation where the values of both the visitor and the conservation communities are aligned. Our forum at HCC will bring together the highest thought leaders in Hawai'i to consider how our sectors can work together to achieve real change. This includes aligning the tourism sectors' efforts in responsible tourism with the archipelago wide Aloha+ targets and the financing efforts that support them both. Our forum will build on an effort that has been supported by the Hawai'i Leadership Forum and thought leaders who have been engaging for over a year and a half in order to build momentum and consensus around this issue. We now aim to reach a larger audience and drive community ideas forward towards a wider platform. The format will be a very brief presentation followed by a highly interactive panel.

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Putting the Rs in Marine Wildlife Resilience with Response, Reporting, and Research

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Marine wildlife emergency response efforts are critical to the survival of sensitive and protected marine species. These efforts are often highly visible to the public, and typically necessary to support ongoing conservation and management needs. Data collected from stranded sick, injured or dead animals, and wildlife sightings in some cases, helps to build our understanding of population biology, ecology, and environmental and anthropogenic threats. While the purpose and outcome of emergency response efforts may on the surface seem clear cut, there are underlying objectives that define the reality for action, or in some cases, inaction. In this symposium we explore the many different aspects, lessons learned, and outcomes of marine wildlife emergency response and reporting. We will share how a foundation of data and information is obtained and used to inform decision-making, response, and management actions. Given that many marine species involved in strandings are culturally relevant, respect and inclusion of Hawaiian cultural practices and traditional knowledge must also be incorporated into response efforts. We will demonstrate how this strong foundation of knowledge and expertise enables and translates into the expression and growth of public-private partnerships, coupled within Hawaiian cultural perspectives, to support meaningful community-based stewardship. Like the ʻaʻaliʻi which requires a strong foundation to grow given extreme adversity, population resilience and perseverance of marine wildlife emerges from a strongly rooted foundation in knowledge, resources, and partnerships.

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Empowering Fishers to Lead: A New Approach to Creating Neutral Spaces and Informed Decision Makers for Complex Fisheries Issues

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Experienced fishers and managers in Hawai‘i will agree that efforts to create a statewide recreational (or non-commercial) marine fishing license in our state have been extremely divisive and have always failed. This topic, like many in natural resources, combines complex legal and financial factors with a history of mistrust. This combination can place resource users and managers on opposing sides of problems, as well as of potential solutions.

Since 2016, a small group of fishing leaders, experts, and managers have been working together to understand whether a non-commercial marine fishing registry, permit, or license system might be legally and financially feasible in Hawai‘i. More importantly, if such a system was feasible, what would a system look like that was designed and supported by informed fishers and other stakeholders?

This group engaged in co-discovery of complex legal and financial issues unique to Hawai‘i and evaluated experiences from other states. Along the way, the process offered a new approach to sharing fisheries management information and putting it to use for the benefit of the resources and the users.

In 2018, the group held statewide information exchanges. They created safe, neutral spaces for community members to share perspectives, recommendations, and concerns with each other and with decision makers, in their own voice.

This forum will provide a mini demonstration of these exchanges. Following the demonstration, a panel of fishing leaders, experts, and managers will discuss how best to engage fishers, the new approaches tested by this project, and lessons they learned from it.

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Science and Management of Rapid ʻŌhiʻa Death Part 1

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Current scientific investigations into Rapid ʻŌhiʻa Death (ROD) have rapidly increased our understanding of the disease and offered some solutions as to how to protect Hawaii's native forests. Physiological research has illuminated how the pathogens move throughout the tree. Fungicides injected into trees as a prophylactic measure may be one way to protect individual trees from infection. Entomological investigations into the variety and distribution of beetles attacking infected trees shed light on what management tools may work to control spread. Initially encouraging experimental results showing some resistance to the pathogens is being scaled up. Landscape scale ecological analysis of hundreds of positive samples across Hawaii Island can explain which forests are at high risk from Rapid ʻŌhiʻa Death and what endangered species found in these forest could be threatened. Both maps of ʻōhiʻa trees with ROD symptoms derived from remote sensing and on the ground sampling have shown a clear pattern of less Rapid ʻŌhiʻa Death in forests which are fenced and protected from feral ungulates. Taken together, these results indicate we will be able to manage native forests and protect the most important areas from Rapid ʻŌhiʻa Death.

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Traditional and Contemporary Approaches to Ahupua‘a Management in the He‘eia National Estuarine Research Reserve

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Designated in January 2017, the He‘eia National Estuarine Research Reserve (He‘eia NERR) in the ahupua‘a of He‘eia is a living laboratory that blends traditional and contemporary practices to restore a functional ahupua‘a. Ahupua'a restoration is essential to maximize ecosystem services such as cultural and biological biodiversity, thus promoting resilience in a changing world. The site partners of the He‘eia NERR engage in restoration activities ranging from removing invasive mangroves at the mouth of the stream to restoring an 800-year-old Hawaiian fishpond. The He‘eia NERR team leverages and coordinates these efforts by designing a research agenda that serves the community, piloting a training program for coastal decision makers, elevating existing education programs, and building stronger bonds among the partners locally and nationally. This symposium brings together research, restoration, and education programs from the He‘eia NERR to frame a conversation on how to understand, adaptively manage, and promote stewardship at the ahupua‘a scale.

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Shedding light on the Alakaʻi Plateau: habitat modeling for endangered honeycreepers

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The ʻAkikiki (*Oreomystis bairdi*) and the ʻAkekeʻe (*Loxops caeruleirostris*) are honeycreepers endemic to the island of Kauaʻi that have seen rapid population declines over recent decades. Once widespread throughout the island these species are threatened by vector-borne disease, climate change, habitat loss, and invasive predators. To efficiently target conservation efforts for these critically endangered birds, a better understanding of their preferred habitat is necessary. We developed predictive nest and occurrence maps at three spatial resolutions (10, 100, and 250m) using high resolution Light Detection and Ranging (LiDAR) data for the remaining range of these two honeycreepers, just over 60km2 of the Alakaʻi Plateau. The resulting maps will inform focused field work to ensure the resiliency of both the ʻAkekeʻe and ʻAkikiki with the potential to elucidate future areas for translocation of captive bred individuals. Field work between 2012 and 2017 yielded 88 nests and 3,607 occurrence locations for the ʻAkikiki and 22 nests and 1,581 occurrence locations for the ʻAkekeʻe. We then used maximum entropy modeling to measure the relationship of the locations of these points to nine LiDAR-derived environmental factors including elevation, slope, and canopy height. Our results show that suitable habitat for ʻAkikiki is driven mostly by elevation, whereas several variables such as canopy density and canopy height contribute notably to modeling suitable ʻAkekeʻe habitat. We plan to incorporate remotely sensed climate data in order to improve our model's accuracy at the 250 meter resolution and discuss further results.

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The Seedling Skirmish: The Effect of 'Ōhi'a and Strawberry Guava Plant Neighbors in Hawai‘i

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Native plant decline is, at least in part, attributed to the spread of non-native plants, especially in island plant communities that appear to be particularly vulnerable to invasive species. However, the role of neighboring plants in native plant displacement remains unclear given the lack of experiments designed to test neighbor effects explicitly. We experimentally investigated whether invasive plants impose neighbor effects on native plants as a potential mechanism underlying native species declines in Hawaiian forests. Neighbor plant effects were tested in a controlled greenhouse experiment using two ecologically important plant species in the Myrtaceae family: *Metrosideros polymorpha* (‘ōhi‘a) and *Psidium cattleyanum* (strawberry guava). Metrics of plant performance were measured as survival and growth of seedlings. Preliminary results indicate that strawberry guava is a stronger performer than ‘ōhi‘a with lower mortality rates and greater phenotypic plasticity. ‘Ōhi‘a exhibited positive neighbor effects in leaf number and height growth rates with both ‘ōhi‘a and strawberry guava neighbors. Likewise, strawberry guava exhibited negative neighbor effects in height growth rates with both ‘ōhi‘a and strawberry guava neighbors. These results will shed light on whether seedling neighbor effects may drive the displacement of ‘ōhi‘a by the invasive strawberry guava. Considering the foundational, ecological, and cultural role of ‘ōhi‘a in Hawaiian forests, this research may be of particular interest to conservation and restoration practitioners working to preserve and restore the native forests of Hawai‘i.

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New Zealand Department of Conservation's Pest Detecting Dog Programme

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In New Zealand dog/handler teams have been used successfully for conservation for over 40 years. The pest detection programme was started in 1997 to detect invasive animals for control or eradication, mainly on off-shore islands. We experimented with presence/absence monitoring, trap placement, locating invaders, and spread monitoring, and also created assessment standards. Additionally, any dog being worked on public conservation land or in the presence of protected species, now had to be certified under the Department of Conservation (Doc) Conservation Dogs Programme.

Today the Doc has a pest detecting dog programme with approximately 27 certified dogs and handlers working on a number of different introduced pest species (including rodents, mustelids, cats, and Argentine ants), that are used for conservation and bio-security projects around New Zealand. The programme is currently expanding to include invasive weeds and reptiles. In 2016 Doc sought and formed a corporate partnership with Kiwibank and ran a pilot for the use of full-time conservation dogs and handlers. This was hugely successful and led to the employment of 4 full-time dog handlers in 2017 - handlers had only ever worked part time before. This partnership has enabled a significant increase in the use of pest detecting dogs for bio-security for islands and the vessels servicing them, working to measures agreed between the Doc and Kiwibank. Full time handlers are also being used to provide education programmes in schools. The New Zealand programme is also being sought out to provide dogs, handlers and expertise for international eradication projects; supplying dogs and/or advice to Japan, New Caledonia and Australia, and dogs and handlers to Tasmania, South Georgia and the Orkney Islands.

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Development of a Rodent Bait with Slug-repellent Properties

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Since 1995 the Army's Natural Resource Program on O'ahu has been controlling rodents to protect native plants, invertebrates, and birds. Bait longevity and attractiveness are keys to successful rodent trapping. Our success is impeded when slugs interfere with bait intended for rodents. Slugs can consume all or a portion of the bait, make it less attractive to rodents via their slime, and large slugs can trigger the traps. Our goal was to determine whether food grade citric acid (5% concentration) added to bait would repel slugs while remaining attractive to rodents. We conducted several trials including: 1) a two-choice food experiment where captive slugs were offered both a test (5% citric acid added) and control bait, 2) a field trial comparing the catch success of rat (*Rattus sp*.) snap traps set with either the test or control bait 3) a field trial comparing bait longevity in Good Nature A24 traps 4) a lab trial evaluating whether wild-caught house mice (*M. musculus*) avoided the test bait. In the lab, we found slugs significantly preferred the control bait in the two-choice feeding experiment. In the field, snap trap success was unaffected by bait type and bait longevity was increased with the treatment bait. Finally, mice showed no aversion to the test bait in the lab. This indicates that the addition of citric acid can improve the longevity and attractiveness of bait thereby aiding rodent control programs.

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Greater than the sum of its parts: the role of public-private partnerships in building resilient marine wildlife populations through emergency response and rehabilitation

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Emergency response is a critical component of conservation of marine species like the endangered Hawaiian monk seal (*Neomonachus schauinslandi*). Response efforts save individual lives and enhance population numbers, and data collected from stranded sick, injured or dead animals, as well as wildlife sightings help to inform conservation management strategies. With finite resources and facing rapidly shifting threats, conservation organizations can enhance their impact through partnerships. The Marine Mammal Center opened Ke Kai Ola, a hospital and education center dedicated to conservation of the Hawaiian monk seal in 2014. The close collaborations between the government agencies National Oceanographic and Atmospheric Administration (NOAA) and the US Coast Guard, and the non-governmental organization The Marine Mammal Center illustrate the benefits of private-public partnership. In a region where remote or restricted access locations challenge the typical logistical requirements for response and rehabilitation, federal agencies enable logistics and permitting, while NGOs harness the passion of volunteers to drive rehabilitation and community engagement efforts that can magnify the ability of an organization to perform mission-driven work. Community-driven education programs ignite awareness in the next generation of conservationists. Public-private partnerships are key to large-scale conservation success, and critical to successfully navigate the challenges that human-wildlife interactions of an emblematic, endangered species can pose. Since 2014, this partnership has allowed for rehabilitation of nearly 2% of the entire Hawaiian monk seal population. This symposium presentation will reflect upon rehabilitation efforts, and demonstrate the importance of public-private partnerships in enhancing the resilience of this endemic Hawaiian species.

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Monitoring Rat Activity using Game Cameras

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The Army Natural Resources Program on O'ahu has been engaged in rodent control since 1995 using various traps and techniques. To determine management effectiveness, tracking tunnels have been used as an independent monitoring system following the model outlined in The New Zealand Department of Conservation's current best practices. Inked cards with peanut butter are placed inside of a tunnel on day one and the next day the card is removed. In an effort to reduce labor costs and increase sensitivity, the use of infrared game cameras were trialed. Sixty-two Spy Point Force 10 HD game cameras were set to view existing tracking tunnels and the two methods were compared for one year. This method is less labor intensive than tunnels because it removes the need for the second day of checking. This presentation will discuss results of this trial, highlight some successes and obstacles, and provide insight into the uses for this technique across the Hawaiian Islands.

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Spatial distribution of green sea turtle (Chelonia mydas) nests at French Frigate Shoals, Hawaii: Implications for carrying capacity?

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The Hawaiian green sea turtle population is functionally a closed population (i.e., turtles primarily breed, nest, and forage all within the Hawaiian archipelago). Ninety six percent of nesting occurs within one low-lying, remote atoll - French Frigate Shoals (FFS). Annual nesting surveys are conducted on two islands within FFS, East and Tern Islands. A previous study concluded East Island could successfully support increased nesting activity, however, the authors assumed turtle nests are randomly distributed. In 2017 and 2018, we collected GPS data on nest locations to determine if distribution was random. Using the nearest neighbor spatial statistic tool in ArcGIS, we found that nests on East and Tern Islands were significantly clustered. Using kernel density analysis, we found that 95% of nests on East and Tern Island were located within 35% and 8% of the total area, respectively, while 50% of the nests were located within 10% and 2% of the island areas, respectively. Our results demonstrate nesting females use only a small portion of the available area of each island. Research in other regions has shown nest location directly impacts hatching success due to differences in environmental conditions; a clustered nesting pattern may result in higher microbial activity within nests and an increased probability of turtles digging up other nests. The previous study estimated the nesting population at FFS was far below carrying capacity (1-2%). We incorporated a clustered distribution pattern into the models used to calculate nesting beach carrying capacity and found the population was at 16-22% carrying capacity. In the future we plan to further examine the relationships between environmental factors and nest locations.

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Invasive mangrove removal at scale: tracking ecosystem change during restoration at the He‘eia National Estuarine Research Reserve

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While beneficial for multiple ecosystem services in other parts of the world, mangrove in O’ahu’s He‘eia stream prevents native diadromous fish from moving upstream, reduces estuarine habitat for important marine fish species, and limits open space for native wetland bird species. Three native-Hawaiian-led community organizations have joined The Nature Conservancy and the National Estuarine Research Reserve system to lead the charge to clear more than 10 acres of mangrove in the last three years.

We report on data collected before and after the removal documenting the effects of the restoration on sediment loss, nutrient export, changes in soil carbon, and fish connectivity. Sediment was monitored using multiple methods, including the installation of six long-term relative surface elevation tables (R-SETs) has shown where the surface of the restored area is lowering or accumulating. Overall, sediment loss and additional nutrients were not observed after restoration. Soil cores revealed over three feet of leaf litter and organic matter has built up over formerly predominantly clay soils, while water quality sampling shows little long-term change at the stream mouth. Immediately after removal, shrub vegetation quickly re-colonized the restored wetland. We continue to monitor changes in fish, invertebrates and vegetation utilizing the newly opened estuarine area and cleared freshwater stream.

This talk will describe the restoration techniques used in He’eia estuary, and the results of the physical and biological monitoring during the restoration process.

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In the know. Can artificial intelligence interpret camera trap data from the Hawaiian forest?

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Wildlife cameras provide an unobtrusive means to monitor wildlife presence, abundance, and behavior. Yet despite their convenience in the field, evaluating large numbers of digital images can be time consuming for low frequency events. When study targets are too small or too cold to effectively trigger heat-based motion sensors, time-lapse data collection may be used, creating reams of absence-only data. The application of artificial computer intelligence to digital image datasets can greatly increase efficiency and reduce human workload. A recent study used computer vision models to reduce volunteer time reviewing camera trap data by 75%. In preliminary runs on data from Kaua'i, our deep neural network models fit using the Keras package in R and Google's Tensorflow correctly identified photos with rats or without rats with an accuracy of 97% and a loss of 11%. None of the 120 photos with rats and only 9 of 130 photos without rats were misidentified in the training data after 50 epochs of training. Although the preliminary models "learned" well on the training set, they did not yet extrapolate with such high accuracy to entirely new camera view series. The work is ongoing. Here we describe our attempts to develop deep learning neural network models to review and sort camera trap data from GoodNature™ A24 rat traps in predator control grids in Hawaiian forests. These data will be used to modify trap placement (e.g., trap height, microhabitat etc.,) and enhance trap efficacy. Camera placement in the forest may also be a critical feature in capturing images that are more amenable to learning neural network analyses.

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Growing Resilience Together: Restoring the Haleakalā silversword and building natural resources stewardship through partnerships with Maui schools

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Haleakalā National Park (HALE) protects the Haleakalā silversword, or ʻāhinahina (*Argyroxiphium macrocephalum* ssp. *sandwicensis*), an endemic alpine species of ecological and cultural importance. Historically, *A. macrocephalum* was the predominant plant species of the alpine aeolian cinder desert ecosystem at HALE; past ungulate browsing, off-trail visitor trampling and climate change threaten the silversword's survival. Giving students the opportunity to help reintroduce ʻāhinahina at the Puʻu-ʻulaʻula summit allows them to develop a sense of natural resources stewardship, while restoring cultural, aesthetic, and ecological value and fulfilling the National Park Service (NPS) mission of protecting and preserving natural and cultural resources for future generations.

1,348 local students from sixteen public and private schools on Maui planted 2,271 ʻāhinahina in discrete population areas below Puʻu-ʻulaʻula. Students ranged in age from second grade to college, primarily targeting the fourth grade cohort of the agency-wide "Every Kid in a Park" campaign. Outplanting took place over three years (2016-2018) during the wet seasons of fall-winter-spring. Additionally, interpretive rangers and biologists provided educational talks about ecology, geology, and NPS resources protection work. The nursery volunteer program involves community volunteers who cultivate ʻāhinahina for these restoration projects, further encouraging community investment in natural resources stewardship.

Outplant survivorship is estimated at 70% (pending final monitoring results). Through this partnership with schools for ecological restoration, 56 new populations of ʻāhinahina have been bolstered towards species resilience. Involving students and community volunteers in this work builds capacity towards the next generation of collaborative stewardship at HALE.

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Detector dog helps discover the first confirmed Band-rumped Storm Petrel colony in the Hawaiian Islands

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We utilized a detector dog as part of a multi-method approach to confirm the presence of a Band-rumped Storm Petrel (BSTP) colony at Pōhakuloa Training Area on Hawai'i Island. A seabird project leader worked with a Springer Spaniel and his handler to search roughly 4 km^2 of 'a'ā and pāhoehoe lava fields at over 2000 m elevation. This project targeted one species, the Band-rumped Storm Petrel, a cryptic species which visits land nocturnally and spends its time at sea or in underground nest cavities. The detector dog was rewarded for identifying potentially active underground nests as well as BSTP carcasses. The dog searches were part of a collaboration of projects which all played a role in successfully confirming active BSTP nests. Acoustic monitoring determined areas of high BSTP activity, where researchers then conducted night vision surveys. Night vision surveys enabled researchers to lead the detector dog to high priority areas to search. Remote video surveillance confirmed BSTP presence at locations indicated by the detector dog. Challenges that needed to be overcome include rough terrain, large search area, and the cryptic nature of the target species. This project demonstrates that in order for the detector dog to succeed, the dog handlers need to understand the target species and environment.

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Genetic ancestry of feral pigs on O'ahu

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Pigs (*Sus scrofa*) across the Hawaiian Islands have a complex history – established with Polynesian colonization and shaped over time by global exploration, trade, and agriculture. Our objective was to describe the ancestry of contemporary feral pig populations on O‘ahu to elucidate the genetic effects of past introductions and help inform current and future conservation decision making. Genetic samples were collected from 238 feral pigs culled across O‘ahu as part of population control efforts and subsequently genotyped at 29,375 loci. Genotypes of O‘ahu pigs were then compared to a comprehensive reference set of *Sus scrofa* comprised of 2,516 individuals that represented 105 domestic breeds and 25 wild boar populations sampled across the world. O‘ahu feral pigs were most strongly associated with historic European breeds followed closely by a diverse genetic group distributed throughout south and eastern Asian, demonstrating the influence of ancestral Polynesian pigs on contemporary populations. To further clarify the influences of European versus Polynesian ancestry, the reference set was reorganized into two ancestry groups representing Asian and European lineages. O‘ahu feral pigs were more closely associated with European lineages (55%) than Asian lineages (45%), suggesting introductions over the past 240 years have begun to dilute and displace Polynesian ancestry. Quantify the influences of past and ongoing gene flow from domestic pigs into feral populations will help local stakeholders identify appropriate management action. Continued genomic research will allow us to understand how gene flow from domestic pigs has altered the phenotype and ecological niche of contemporary feral populations.

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Scent discriminating canines as an additional tool in the fight against ROD

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Rapid 'Ohi'a Death (ROD) is a disease that has caused mortality in more than a million *Metrosideros polymorpha* ('Ohi'a) trees on Hawai'i island and it appears to be spreading to other islands in the state. Land managers and agencies need accurate and field deployable diagnostic tools for early detection and response to trees and materials carrying the fungal pathogens *Ceratocystis lukuohia* and *Ceratocystis huliohia* known to cause ROD. Here we investigate the ability of trained canines to discriminate and identify the volatile (scent) signature of *C. lukuohia* and *C. huliohia* in 'Ohi'a trees and organic materials. To initially imprint canines with the scent, we used an innovative canine training aide technology known as Controlled Odor Mimic Permeation Systems (COMPS) to safely permeate volatiles from materials containing *C. lukuohia* and *C. huliohia* to canine training aide materials without exposing it to pathogenic fungal spores. We report preliminary results of canine detection efficacy trials with COMPS training aides and 'Ohi'a trees inoculated with *C. lukuohia* and *C. huliohia* pathogens. Succesful canine detection of *C. lukuohia* and *C. huliohia* was observed in single and double blind tests with both training aides and inoculated seedlings. These early findings suggest that scent discriminating canines can effectively detect ROD in 'Ohi'a trees and other materials . However, more work needs to be done to evaluate both the limitations and utility of this approach under a range of environmental and forest conditions.

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Time-series monitoring of the microbial food web within Kāneʻohe Bay and the surrounding open ocean

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Marine systems are sustained by the organic matter released through light-driven primary productivity of phytoplankton. Coastal environments in Hawaiʻi support elevated primary productivity and biomass across trophic levels, including that of heterotrophic bacteria, benthic reef-building organisms, and fish. In 2016, a monthly time-series sampling across ten stations spanning Kāneʻohe Bay and the adjoining open ocean, including sites within the Heʻeia National Estuary Research Reserve (HeNERR), was established. This research provides a baseline of primary productivity and other oceanographic measurements, phytoplankton diversity, and microbial community composition for comparisons over time and space. Our time-series sampling provides the Heʻeia community with information to evaluate how land and resource-use practices, such as the removal of invasive mangroves in the Heʻeia wetland and stream, influences the base of the marine food web. Similarly, our research will inform the Heʻeia community on the impacts climate change may have on the size, biomass, and productivity of phytoplankton, which will greatly influence the food web dynamics in Heʻeia fishpond and in adjacent reef waters of Kāneʻohe Bay. Currently, climate change is predicted to increase surface ocean temperature, decrease trade winds, and increase stratification in the nearby open ocean, which will likely reduce the nutrients available for phytoplankton in coastal waters. This shift to a nutrient-deplete system is likely to impact the productivity of phytoplankton and may limit their key role in supporting the functional food web of the healthy coral reef and fishpond ecosystems that the HeNEERS strives to conserve.

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Pahu Manamana o Umi - Decoding ancestral structures through Papaku Makawalu

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Papaku Makawalu is the Native Hawaiian comprehensive method of investigation of the Hawaiian Universe through 3 areas of study. Papahanaumoku includes all entities that go through a generative cycle and are separated upon birth from its originator. Examples of this process are man, birds, fish, bees, trees and so forth. Papahulihonua possess deep understanding of all the natural elements of the earth such as fresh and salt water, volcanism, land, soil make up, ocean and currents. Papahulilani intellect includes all natural celestial and atmospheric activities.

This document records the investigation of the structure Pahu Manamana o Umi or the Star Instrument of Umi. The site is located on Mauna Loa at approximately the 8000‘ elevation. The Pahu Manamana is a site of star alignments. It is considered unique in that there are few on the main islands. The Pahu Manamana and other sites were deconstructed through the lens of Papaku Makawalu. This method carefully decoded the algorithm of the site revealing intriguing information regarding sacred sites, star alignments, volcanic substrates, and extensive ancestral knowledge through experimentation and observation. The impetus for investigation directions, which is the case for all of the objects of study through Papaku Makawalu are the chants.

This forum will introduce the Papaku Makawalu method using this study of Pahu Manamana o Umi. The team will then use chant excerpts to train the participants in the use of Papaku Makawalu. Thereby, conservationists will have an ancestral tool to observe their places of study.

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Ecological and Native Dryland Forest Restoration on the Island of Kahoʻolawe

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The Kahoʻolawe Island Reserve Commission (KIRC) is reducing erosion and near-shore sedimentation and restoring dryland forest habitat at a 15 hectare Project Site in the Hakioawa Watershed on Kahoʻolawe. Using Best Management Practices (BMP's) established on Kahoʻolawe over the last 20 years, a combination of gabions and wattles are being used to outplant 10,000 native plants in irrigated corridors along the contours. Methodology includes soil erosion control features (gabions and wattles) that are installed in conjunction with native plants on irrigation. Gabions are rock filled baskets placed in stream beds and wattles are rolls of geotextile that capture sediment and provide reclaimed soil for outplanting. Monitoring includes vegetation plots (relevés) to record changes in plant species presence and cover, measuring soil erosion rates and measuring stage (height) in Hakioawa Stream during flash flood events. Permanent photo points with drone images 15 meters above the ground have been established to capture changes in vegetation over time. Plantings in irrigated corridors are increasing native plant cover and decreasing bare soil. Soil erosion control features decrease the velocity of overland sheet flow, while capturing soil and improving habitat in the near shore ocean environment. Native dryland forest restoration through the use of BMP's also improve habitat for native animals such as the endangered Hawaiian Yellow-faced Bee (*Hylaeus spp.*) and Hawaiian Hoary Bat (*Lasiurus cinereus semotus*). Finally the KIRC Restoration Program imparts an environmental, geographic and cultural education of Kahoʻolawe to the volunteers who contribute the workforce of 3000 hours to the project.

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Species Distribution Models used in Conservation Planning: Examples from the Pacific Islands

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Species distribution modeling and range modeling are widely used and well documented ecological tools. Unfortunately, these modeling methods are not often incorporated into negotiations and conservation planning for endangered species. We present two examples of how these models, developed by the Pacific Islands Fish and Wildlife Office, were successfully incorporated into negotiations and helped foster beneficial outcomes for endangered species. The first example uses a simple range model to help establish habitat protection for a listed Guam forest bird that is extirpated in the wild. The next example used species distribution models to identify landscape-scale recovery habitat for 30+ plant species. In both examples, the species models established an objective framework for discussions with landowners on conservation planning. The Pacific Islands Office is also using these same analytical methods to develop landscape-level management strategies needed to assist in the recovery of threatened and endangered species throughout the FWS Pacific Islands ecoregion.

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Why Wait? Initial Response of Nearshore Fishery Resources of Ka‘ūpūlehu, West Hawai‘i to a 10-year Fishing Moratorium

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The coastal fishing grounds of Ka‘ūpūlehu, Hawai‘i were long renowned for their abundance of fish, lobster, octopus, and limpets, but coral cover and fish abundance declined concurrent with vehicular shoreline access. In 2016, the Ka‘ūpūlehu Marine Life Advisory Committee developed, championed, and petitioned the State of Hawai‘i to enact a 10-year rest period from harvesting for intertidal and coral reef fish species along 3.6 mile of coastline to allow resources to recover to a level that can support sustainable harvest for years to come. The Ka‘ūpūlehu Marine Reserve was established by Administrative Rule. The community calls this fishing moratorium, “Try Wait.” Today, both trained community members and scientists monitor intertidal and coral reef habitat and species to track changes over time. While it is expected that many of the benefits will take several years to accrue, after only two years of rest, many valued resources are showing surprising signs of recovery. At several monitoring sites surveyed, both ‘opihi and faster-growing fish species (e.g., parrotfishes and wrasses) have increased substantially from levels recorded prior to implementation of the Ka‘ūpūlehu Marine Reserve. Slower growing species such as surgeonfishes have not increased as much, relative to adjacent areas, though are still showing signs of increasing in number and size. There is also evidence suggesting some spillover of fish from the Reserve into adjacent areas, where fish populations also appear to be stable or increasing, albeit at slower rates, relative to pre-2016 baselines. While preliminary, these results offer encouraging evidence that the rest period is working to both restore the resources of Ka‘ūpūlehu and provide benefit to nearby fisheries and aspects of these findings may raise new questions about how to manage coastal and marine resources for maximum productivity.

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Characterizing the Link Between Coral Reef Habitat Complexity and Fish Assemblage Structure Using 3-Dimensional Reconstruction Techniques

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Scleractinian corals are ecosystem engineers that support marine organisms by providing habitat, refuge, and sustenance. Habitat complexity is often associated to reef fish metrics of abundance, richness, and diversity, but is traditionally quantified using 2D techniques that do not capture entire reef systems. This study characterized the relationship between structural habitat complexity and fish assemblages by utilizing novel 3-dimensional (3D) reconstruction and analyses at a reef-system scale. During a 2017 NOAA cruise to the Northwestern Hawaiian Islands, the pristine reefs of French Frigate Shoals were surveyed for fish and habitat parameters along 30-m transects at 31 locations. Structure-from-Motion photogrammetry surveys allowed for 3D reconstruction of reef habitats, which were analyzed for 11 habitat complexity parameters using ArcMap, and annotated for benthic coverage using CoralNet. Fish species diversity was positively related to many surface complexity parameters, exhibiting the strongest relationship to 3D surface area complexity (3DSAC). 3DSAC positively related to coral coverage, coral genus diversity, tabulate *Acropora*, and encrusting *Porites*. Trophic-level examinations found corallivore abundance best related to rugosity; herbivore richness best related to slope; and invertivore richness best related to surface-area to planar-area and curvature. These results illustrate that increased 3D surface complexity, driven by coral coverage and diversity, provides the opportunity for niche habitat specialization at both assemblage and trophic levels. The relationships identified implicate that conservation and management efforts should focus on the resiliency of coral diversity at a genetic and morphological level, in order to preserve the ecological service that corals provide to fish assemblages.

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Ola ka ʻŌlelo: A Hawaiian Language Session on Language and Culture in Conservation

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Wahi a kūpuna, i ka ʻōlelo nō ke ola a i ka ʻōlelo nō hoʻi ka make. I loko nō o kēia makahiki kauʻāina o nā ʻōlelo ʻōiwi, e hoʻoholo ana mākou i pānela ʻŌlelo Hawaiʻi i mea e hōʻike aku ai he ʻōlelo ola kēia, a he waiwai nō i ka pōʻaiapili mālama ʻāina. E noi ana mākou i mau ʻelele o nā lālā mālama ʻāina like ʻole o ka Paeʻāina e kūkā kamaʻīlio ai no kā lākou hana, a pehea i kia ai ko lākou manaʻo ma o ka ʻōlelo, moʻomeheu, me ka ʻike kuʻuna Hawaiʻi. Kono ʻia ke anaina nānā e kaʻanalike a kūkākūkā pū me mākou ma o ka ʻike aku, ʻike mai.

Ancestral teachings tell us that language is an enabling factor of our ability to prosper. Like the ʻaʻaliʻi, language revitalization has become a way to demonstrate strength and resilience. In this, the 2019 UN Year of Indigenous Languages, we will convene a Hawaiian Language panel to celebrate our ancestral language and culture, to demonstrate their important role in conservation efforts, and to situate ancestral teachings in present-day conservation contexts. Panelists from various conservation groups across Hawaiʻi will share about their work and ways language and culture have guided and shaped their efforts. Through large group discussions, we will create opportunities to share and discuss together with audience members experiences, lessons learned, and recommendations for future action. We welcome all to attend. Simultaneous translation will be provided for those who require support.

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West Hawai‘i Coral Reef Communities After a Catastrophic Loss: Signs of Recovery, Resiliency and Continued Declines Following the 2015 Coral Bleaching Event

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Corals in West Hawai‘i suffered catastrophic mortality following the most intensive coral bleaching event on record for the state beginning in July 2015. Recovery will depend on numerous factors including the ability of surviving corals to regrow, the availability of open benthic substrates (maintained by surrounding fish and invertebrate communities), and the successful settlement and survivorship of coral recruits. DAR’s long-term benthic monitoring program used standardized image analysis to document catastrophic loss in coral cover from 2014 to 2016 across 26 monitoring sites. Post-bleaching coral mortality was estimated for nearly half of the live coral population at mid-depth reefs (averaging -49.7 % loss), with greater losses estimated for certain species (> 90 % loss for *Pocillopora meandrina* and *Porites evermanni*). Benthic cover was reanalyzed in spring 2017 and signs of limited coral regrowth were noted at 7 sites from 2016 to 2017, with stabilization occurring at 6 sites and continued coral cover loss at 13 sites. Coral recruitment to experimental terracotta tiles (deployed at 6-month intervals) has been monitored since 2004 at 8 fixed monitoring sites and settlement data suggests strong seasonal variability with relatively low coral recruitment in West Hawai’i compared to other areas. Benthic monitoring data was also analyzed to compare the availability of appropriate coral settlement substrates post-2015. Reef substrate composition was associated with reef fish and invertebrate communities, including both corallivore and herbivore abundance. Results from DAR’s reef monitoring program are used to help guide management strategies to promote reef recovery and resiliency into the future.

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The Hawai‘i Conservation Alliance’s Effective Conservation Program and Hawai‘i Conservation Status Report

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Conservation of Hawai‘i’s natural biodiversity in terrestrial and near-shore marine ecosystems relies on a combination of legal protection, habitat and species management, and information collected for monitoring or research. These efforts are also dependent on strong stakeholder support and awareness of conservation issues by the general public. While many agencies, private landowners, and organizations have implemented conservation efforts on the lands or waters under their jurisdiction, it is recognized that some amount of integration of these actions across ownership boundaries could further enhance conservation effectiveness at both island-wide and state-wide levels. The Hawai‘i Conservation Alliance is comprised of 26 member organizations, all having important resources or roles for conservation in Hawai‘i. In this symposium we will present examples of relevant conservation planning and management actions that are being conducted by members of the Alliance. These and other similar efforts are being linked into an integrated terrestrial and nearshore marine conservation planning and management program, called the Effective Conservation Program (ECP), facilitated by the Hawai‘i Conservation Alliance. The ECP allows for enhanced capacity and efficiency for addressing expanded conservation issues and needs at the state-wide level. Additionally, the integrated conservation database developed as part of the ECP is being used to support the Alliance’s Community Snapshot program, as well as the development of a Status of Hawai‘i Conservation Report.

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Humane Response Decision Making For Compromised Hawaiian Monk Seals, Sea Turtles and Cetaceans (Whales and Dolphins) in Hawaii.

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The NOAA Fisheries Service, Pacific Islands Regional Office (PIRO) leads a regional Marine Animal Response Network in Hawai'i. This network would not be possible without the collaboration of federal and state government partners and NGO partners. Each year this network responds to scores of marine wildlife in need of intervention to promote individual and population level survival. Cases can range from entanglements of humpback whales in marine debris and actively fished gear, dolphin strandings on coastal beaches, Hawaiian monk seals with superficial, or ingested fish hooks, to sea turtles with severe papilloma infections, all of which may impact the animals' survival in the wild without human intervention. Decision making by veterinarians, expert staff, and community stakeholders involve risk assessments that consider both human responder safety and animal welfare. Risk assessments evaluate the level of threat to the individual animal, as well as environmental considerations, permitted authority to respond, the complexity of event, and the resources and skill level appropriateness for the event. Further considerations include population impacts that may lead to unusual mortality events and a more global or ocean basin view of decision making at the population level. In all of these events, how the network responds from an adaptive management perspective informs future response efforts and a resiliency that works to benefit the animals and communities involved in a stranding event. This presentation will provide an overview of marine animal response efforts and how decisions are made to respond to the taxa that PIRO is mandated to protect.

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The Hawai‘i Conservation Alliance’s Effective Conservation Program: a tool to assess the status of conservation in Hawai‘i and to support additional priority conservation actions at the state-wide level

James D. Jacobi[1]

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The Hawai‘i Conservation Alliance’s (HCA) Effective Conservation Program (ECP) is designed to integrate terrestrial and near-shore marine conservation data, as well as planning and management actions, into a statewide effort to help address conservation needs at the island-wide and state-wide levels. The ECP database assimilates conservation related data from HCA member organizations and uses that information to facilitate biodiversity management at the landscape level and across jurisdictional boundaries, as needed. This integrated approach provides the geospatial data needed to support the HCA’s Community Snapshot project. It is also being used as the basis for assessing the status of conservation in Hawai‘i as a whole and for identifying additional priority conservation actions needed beyond those currently undertaken by the HCA member organizations. The planned production of a Status of Conservation Report for the Hawaiian archipelago will also be described, relying on information from the ECP database and contributions from HCA member organizations.

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Scoping with SeaSketch: A Public Engagement Process for the Marine 30x30 Initiative

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In 2016, Governor Ige announced the Sustainable Hawai‘i Initiative, which calls upon the Department of Land and Natural Resources’ Division of Aquatic Resources (DAR) to effectively manage 30% of Hawai‘i’s nearshore environment by 2030, known as the Marine 30x30 Initiative. To achieve this goal, DAR plans to lead a public engagement process to create a statewide network of marine managed areas to rebuild and sustain productive nearshore fisheries, coastal resilience, and cultural and social benefits. This forum will introduce the Roadmap to 30x30 – DAR’s plan to achieve effective management, of which a marine managed area network is a key component; outline the Marine 30x30 Initiative scoping process designed to create opportunities for broad stakeholder engagement; and introduce the interactive mapping tool, SeaSketch, through a hands-on tutorial. DAR intends to use SeaSketch in the 30x30 scoping process to engage stakeholders with the visual exploration of data to collect stakeholders’ opinions and ideas and analyze user-generated ideas with the best available science. The audience will experience first-hand how stakeholders can generate proposals representing a range of perspectives in an easy-to-use map interface. This forum will provide participants with an understanding of how DAR and partners intend to use SeaSketch during the Marine 30x30 scoping process to collaboratively design a network of marine managed areas for Hawai‘i, and how this tool could be used for other community-driven initiatives.

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Scaling-up restoration to protect Hawai‘i Island birds from the spread of invasive diseases and habitat degradation due to climate change

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Hawaiian forests have become severely degraded and many bird species have become extinct or endangered due to human activity, yet threats from invasive species and climate change continue to grow. Forest birds are vulnerable to the spread of mosquito-borne avian malaria into upper montane habitats due to climate warming. Additionally, the keystone tree species, ‘ōhi‘a (*Metrosideros polymorpha*), is threatened on Hawai‘i Island by disease (Rapid ‘Ōhi‘a Death - ROD) and other factors. Although forest bird conservation largely depends on mitigating the effects of climate change and ROD in ‘ōhi‘a-dominated watersheds, restoring bird populations in subalpine habitats offers another conservation option. All extant Hawai‘i Island forest birds were found historically in subalpine habitats, where ‘ōhi‘a is uncommon and transmission of avian malaria will likely remain low for decades. The iconic subalpine bird, palila (*Loxioides bailleui*), provides a starting-point for scaling-up restoration from species to community levels and from local to landscape levels. At the species level, the palila can be restored using a metapopulation approach whereby birds respond to different habitat conditions at multiple sites. Restoration can be scaled-up to the metacommunity level by facilitating dispersal and seasonal movement between sites; increasing the diversity of interspecific interactions through species reintroduction; reintegrating seabirds and other non-passerines into the regional bird community; and enhancing ecosystem services by bolstering nectarivore and frugivore populations. Watershed management programs provide a model for restoring bird communities at large geographic scales and across management jurisdictions, but conservation leadership and sustained funding are critical to success.

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Lessons learned from data-limited stock assessments of coral reef fish in Hawaii

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In recent years, the Pacific Islands Fisheries Science Center has been involved in generating stock assessment analyses for coral reef-associated fish populations around Hawaii and other Pacific Islands. This effort has proven challenging given the high number of exploited coral reef species, limited resources, and the quality and availability of data needed to support these analyses. To address some of these challenges, fishery scientists have focused on length-based mortality assessment models coupled with an innovative tool to generate missing life history parameters related to growth, longevity, and maturity, with the goal of determining the status of these stocks and generating management information required by federal law. This general approach was applied to 27 reef fish species in Hawaii, with results showing that 11 out of 27 species were likely experiencing overfishing in Hawaii according to reference points set by federal managers. Surgeonfishes and parrotfishes were the families most likely to experience overfishing, while goatfishes generally were not. Typically, species experiencing overfishing were the ones with long lifespans (i.e., surgeonfishes) or highly targeted (i.e., jacks, snappers). We present here an overview of this stock assessment approach, including solutions found to address some of the data challenges. We also present the results of applying this approach to Hawaii reef fish and discuss ideas to improve future data-limited stock assessments.

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Enhancing Native Species Resilience Through Effective Management of Aquatic Invasive Species

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Increasing native species resilience to disturbances that may shift the ecosystem balance must include managing any invasive species that are present. The State of Hawai‘i Department of Land and Natural Resources Division of Aquatic Resources’ Aquatic Invasive Species (AIS) Program works to prevent, manage, and control invasive species in marine and inland waters of Hawai‘i that are causing or could cause environmental, economic, or human health impacts. The AIS Program was developed to concentrate specifically on AIS because they pose significant threats to Hawai‘i’s native ecosystems as well as residents and visitors. The need for a coordinated statewide approach to address AIS issues was identified in the 2003 AIS Management Plan, which has been revisited and updated December 2018. The current AIS Management strategy is composed of four central pillars to achieve this goal: Pre-Border Prevention, Border Protection, Post-Border Management, and Outreach and Education. Within each pillar, there are specific objectives and associated actions that will be taken to effectively manage the impacts of invasive species, therefore enhancing Hawai`i's native ecosystem resilience. These objectives have been prioritized into an action strategy by program staff and participants in the 2018 AIS Steering Committee Workshop. The focus of this presentation is intended to identify the current status of the AIS Program and some of the actions that will be taken to meet these objectives over the next five-years.

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Physical Characteristics of Streams Which Increase Ecosystems Resilience To Salvinia molesta

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In 2017, community members reported a dramatic increase of *an invasive freshwater fern (Salvinia molesta)* on the Kilauea River on Kaua'i. *S. molesta* is an invasive fern which, under optimal conditions, creates thick floating mats in freshwater habitats and can overgrow entire bodies of water, as was seen in Wahiawa in 2002. Since it was reported, the DAR Aquatic Invasive Species Team has determined the distribution of the invasive fern island-wide using a new sampling method, environmental DNA (eDNA). Using eDNA, Kilauea and Kapa'a streams were identified as having the only confirmed populations of *S. molesta* and visual surveys were used to determine its density and inland extent. The initial visual survey was conducted on Kilauea stream a week prior to the heavy flooding event of April 2018 and over 50% of the banks were covered with *S. molesta*. The follow-up survey in August showed that *S. molesta* population had decreased to less than 20% coverage. Strong water flow and periodic flooding provides natural resilience to this invasive species on stream systems. However, the recent survey in February 2019 on Kilauea revealed a slow recovery of the *S. molesta* population. This monitoring series suggests that the management actions, such as manual removal, should target periods where *S. molesta* populations are naturally lower for the greatest chance of success. Successful island-wide management is only possible if *S. molesta* is contained to these stream systems and is not allowed to spread to additional watersheds.

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New Tools and Resources for Enhancing Urban and Community Forestry

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Urban and community forests are working for us every day, capturing stormwater and carbon, cleaning our air and drinking water, and providing us with energy savings. The US Forest Service is charged not only to help communities maintain and improve these forests and their benefits, but also to educate the public about the important role they play in our public health and well-being. These goals resonate strongly in Hawai‘i where organizations and agencies are seeking holistic ways to incorporate trees into dialogues on resiliency and adaptation to climate change.

New tools and resources are available to help quantify and manage the benefits of trees, and to engage communities in strengthening connections with trees. This presentation will highlight research-based resources including: iTree inventories, the Urban Forest Management Toolkit, Stew-Map, and iNaturalist. Case studies from Hawai‘i, American Samoa, and Guam will be tied to existing grant opportunities (e.g. Landscape Scale Restoration, Youth Conservation Corp, Citizen Science, and National Urban and Community Advisory Council) to provide a complete picture of how organizations of any scale can bring these resources to bear in their communities. The audience will walk away with key contacts for grant opportunities, links to in-depth trainings, and examples of how these tools have been utilized in neighboring communities.

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Applying Effective Conservation in Priority Setting in Hawai‘i

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Effective Conservation is an approach to setting priorities for conservation actions. It involves analyzing a combination of: 1) Conservation Targets, 2) Protective Designation, 3) Active Management, and 4) Stakeholder Involvement and Support. When all four are in place, we optimize our efforts to protect and manage biocultural resources, by recognizing their importance, preventing and mitigating threats, and ensuring long-term support of stakeholders. When key elements are missing, or only weakly attended to, the chances of long-term failure of our efforts increase, or our efforts are not optimally applied. Although the approach makes logical sense, conservation efforts frequently fail to ensure that all of the elements are given proper attention. Hypothetical examples of the nature of these insufficiencies are briefly presented, along with a few real world cases. This is because there are many complexities in assessing each of the four factors. The Hawai‘i Conservation Alliance has created an Effective Conservation Program (ECP) to help optimize its combined approach to partnered conservation efforts in Hawai‘i. We invite interested organizations and projects to learn more about ECP and apply its principles to their work.

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Evaluating the Efficacy of a Reef Restoration Strategy Using a Photomosaic Method

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Coral reattachment is the transplantation of coral fragments to a new location to restore ecosystem services and resources, prevent alternative stable states, and/or improve reef resilience. The Division of Aquatic Resources' Aquatic Invasive Species team launched a pilot project in Spring 2017 to investigate reattaching corals of opportunity as an addition to our toolbox for reef restoration and resilience. Two coral species, *Montipora capitata* and *Porites compressa*, were used in this study. Monitoring was carried out using "photomosaic" methodology, which was developed by the Scripps Institution of Oceanography and consists of stitching together a series of photos in a software program called Agisoft. ArcGIS was then used for image analysis using a protocol adapted from partners at National Oceanic and Atmospheric Administration Ecosystem Science Division. This presentation will discuss preliminary findings and future direction and application of this tool.

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Sharing Data in a Multi-Agency Collaboration: Managing Rapid ʻŌhiʻa Death in Hawaiʻi

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Rapid ʻŌhiʻa Death (ROD) is a complex forest health issue that has called the attention of many researchers and land managers across the state and beyond. This includes employees of several state and federal agencies, local and out-of-state universities, and non-profit organizations. One positive that has come from this serious disease is that it brings so many of us together to better steward the forests. This multi-agency collaboration benefits from consistent communication in order to support each other's progress towards finding solutions. Communication needs include sharing experiences and ideas for developing and continuing projects, finding opportunities and matching schedules for joint field efforts, and facilitating data exchange. Sharing sensitive data in a secure setting is an integral part of this process. Esri's ArcGIS Online (AGOL), along with mobile apps Survey123 and Collector, provides data sharing capacity and the ability to stay updated in the office and out in the forests. AGOL is a virtual host for our ROD sampling and lab results database. AGOL facilitates our participation in the U.S. Forest Service Digital Mobile Sketch Mapping (DMSM). AGOL allows us to incorporate a wide range of management and research data from a variety of sources, including natural resources, infrastructure, and derived products from advanced imaging technology. We continuously strive to improve and develop new applications with these mobile apps. This presentation outlines and provides examples of how we incorporate data management into ROD planning and actions in support of healthy ʻōhiʻa forests.

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Creating Innovative Tools for Supporting the Community of Stewards Who Care for Our Lands and Waters: Using Spatial and Network Data from the The Stewardship Mapping & Assessment Project

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Come learn about the data collected by the Stewardship Mapping & Assessment Project (STEW-MAP) and share your thoughts on how it can be used to collaboratively create resources for the public that build on existing platforms and address community priorities.

Across the Hawaiian Islands, there are many community and other non-governmental groups that care for marine and terrestrial areas. These groups are vital to the well-being of our communities, landscapes, and seascapes, but our ability to collectively affect positive change may be inhibited because there is little information about the type, extent, and connectivity of their engagements. To improve our understanding of local stewardship we asked: 1) What are the motivations and goals of stewardship groups?; 2) Where does stewardship occur?; and 3) How are stewardship groups connected?

We conducted surveys with organizations in Kona and Koʻolaupoko Districts on Oʻahu and North Kona and South Kohala of Hawai'i Island. We found a diverse range of motivations and goals, and sizes and locations of stewardship areas, indicating the complexity of the community of stewards. We present our spatial and social network results that identify areas of concentrated efforts and potential gaps in stewardship. We are committed to creating an online geospatial database of stewardship in the project areas; however that is only one potential use of the data. We invite you to share your ideas about how to create resources to support stewardship communities that care for our ʻāina and kai.

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Biocultural Restoration in Hawaii

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Biocultural restoration is an approach that incorporates both humanity and its connections to nature in a larger effort to restore the health, function and resilience of both land- and seascapes. Recently, a special issue in the journal *Sustainability* focused on biocultural restoration in Hawaii. Articles in the special issue range in focus from the theoretical, to philosophical, to applied aspects of such an approach to restoration. This special issue provided a venue for publications by demographics that are historically under-represented in science. Once completed, it became recognized as the largest collection of scientific publications by native Hawaiian authors. It also had the majority of its authorship was by women, and included two papers that were exclusively authored by women, making this special issue a historic milestone in science. This symposium will feature presentations by contributors to the special issue, but will also be open to other relevant research and/or projects.

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Hey Computer, Find that Plant!

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Small Unmanned Aerial Systems (sUAS) can quickly and efficiently collect cm-scale video and imagery, but the need for manual assessment of the resulting imagery by trained analysts creates a bottleneck that limits the utility of these data for the detection and identification of targeted plant species over large areas. Here we present results from a new automated computer vision (CV) classifier for the detection of *Miconia calvescens* DC and other species of interest, built upon a convolutional neural network using Tensorflow. High resolution imagery datasets, collected from dozens of individual sUAS fights at varying altitudes and lighting conditions, were used to train the computer to consistently recognize leaf characteristics of target plant species. These algorithms were then applied to directories of raw geotagged imagery to identify targets of interest that met a minimum confidence threshold. Real-world coordinates of the identified targets were then estimated from image EXIF and XMP metadata and trigonometric functions. The final output is a single file of targets, their estimated confidence values, and geographic coordinates, which can be used to direct subsequent operations (e.g. intervention, monitoring, etc.). Our current CV classifier can process ~200 images per hour, reducing the processing bottleneck and freeing analysts to examine a much smaller number of curated images. Although overall accuracies of the CV classifier still fall below those of human analysts, the system continues to improve and provides an increasingly powerful supplement to existing image processing workflows.

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Disease Biology of the Ceratocystis Fungi Involved in Rapid ʻŌhiʻa Death

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Rapid ʻŌhiʻa Death (ROD) is a complex of diseases caused by two new species of phytopathogenic fungi, *Ceratocystis lukuohia* and *Ceratocystis huliohia* I. Barnes, T.C. Harrin. & L.M. Keith. These fungi have been associated with an outbreak of ʻōhiʻa (*Metrosideros polymorpha*) tree mortality on Hawai'i Island and recently on Kaua'i. Although both causal agents of ROD, observations suggests substantial variation in rate of decline and symptom development between trees infected with *C. lukuohia* and *C. huliohia*. In order to better clarify the effects of these two pathogens in their host, inoculation experiments were conducted. Results from these experiments indicate that *C. lukuohia* and *C. huliohia* causes two distinct diseases, which differ in their rate of spread within the host, colonization patterns and symptom progression. A formal description of these diseases is underway. The results of these experiments will provide a better understanding of the biology of ROD and support improved management strategies.

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Pollination Biology of Hawaiian Lysimachia (Primulaceae)- Evidence for Moth Pollination in the Flora of Hawai‘i

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In Hawai‘i, plant-pollinator mutualisms are often disrupted by habitat destruction, extinction, and invasive species. This potentially contributes to the decline of both plants and pollinators. In order to expand our understanding of plant-pollinator relationships in contemporary Hawaiian ecosystems, the pollination biology of endemic *Lysimachia* was investigated. The Hawaiian radiation of *Lysimachia* (Kolokolo Kuahiwi) includes seventeen endemic species that originated from a single colonization event. Many of these species are now rare and endangered. Hawaiian *Lysimachia* are typically sprawling shrubs, and have flowers that range in color from greenish-purple (*Lysimachia kalalauensis* Skottsb.) to white and maroon (*Lysimachia iniki* K.L. Marr). Results of this study suggested that Hawaiian *Lysimachia* have evolved floral traits indicative of moth pollination. This was confirmed through field observations, where in total nine different moth taxa were observed visiting flowers of three species of *Lysimachia* during the evening and night. Moth visitors, the majority of which were non-native, accounted for 75% of total floral visitation observed. Hand-pollination trials with *Lysimachia glutinosa* Rock provided further evidence that Hawaiian *Lysimachia* have evolved xenogamous breeding systems, and therefore are most likely reliant on pollinators for seed production and regeneration. Efforts aimed at restoring *Lysimachia* in the wild should consider how moth diversity and abundance might affect the success of reintroductions. High rates of fruit set observed in wild populations of *Lysimachia* indicate that although most floral visitors observed were non-native, the diversity of moths found in Hawai’i may confer some resilience to plants pollinated by these visitors of the night.

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The ʻŌhiʻa Legacy Initiative; A Grassroots Effort to Return ʻŌhiʻa to Urban Hawaiʻi

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ʻŌhiʻa trees (*Metrosideros polymorpha*) are the backbone of the Hawaiian forest, and once ranged from the top of the mountains to the sea. However, large-scale human development has resulted in many areas throughout the historic range being now devoid of ʻōhiʻa trees. In 2017, the ʻŌhiʻa Legacy Initiative (OLI) completed an initial pilot project which targeted residents of Mānoa Valley. This project resulted in the local population of urban ʻōhiʻa being increased by over 200%, plus the creation of an urban inventory that can be expanded to assess populations statewide. With additional community projects in the works, OLI has shown that local communities can be successfully engaged and are receptive to taking part in large-scale urban tree repatriation projects.

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Using the Hawaiian Footprint to Inform Biocultural Restoration and Future Sustainability in Hawai‘i

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Pre-Western-contact Hawai‘i stands as a quintessential example of a large human population that practiced intensive agriculture, yet minimally affected native habitats that comprised the foundation of its vitality. An explicit geospatial footprint of human-transformed areas across the pre-contact Hawaiian archipelago comprised less than 15% of total land area, yet provided 100% of human needs, supporting a thriving Polynesian society. A post-contact history of disruption of traditional land use and its supplanting by Western land tenure and agriculture culminated in a landscape less than 250 years later in which over 50% of native habitats have been lost, while self-sufficiency has plummeted to 15% or less. Recapturing the ‘āina momona (productive lands) of ancient times through biocultural restoration can be accomplished through study of pre-contact agriculture, assessment of biological and ecological changes on Hawaiian social-ecological systems, and conscious planned efforts to increase self-sufficiency and reduce importation. We discuss the impediments to such efforts and the modifications required to implement biocultural restoration today.

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Troubling Declines in Maui's Endemic Honeycreepers: 2017 East Maui Hawai'i Forest Bird Survey

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The Hawai'i Forest Bird Survey represents the longest continuous dataset on native bird populations and has provided critical insight into the trends in bird populations over time. The most recent survey in 2017 covered the largest area of East Maui since the original surveys in 1980 and included areas that had not been surveyed for decades. This allowed for a more precise estimation of the global population size of three Maui endemic species. In 1980, the Kiwikiu (Maui Parrotbill; *Pseudonestor xanthophrys*) population was estimated at 261–835 (95% CI) individuals in 50 km^2 in east Maui. While alarmingly low, mean population size appeared to be somewhat stable at ~500 individuals from 1980–2000. However, the most recent survey estimated 44–312 individuals in 29 km^2 of native forest. Similarly, total abundance of 'Ākohekohe (*Palmeria dolei*) was estimated at 1,193–2,411 individuals, the lowest estimate yet for the species, and the species has declined >50% in the past two decades. Maui 'Alauahio (*Paroreomyza montana*) have also declined by 50% in the same time period, from a high of 195,000–225,557 individuals in 1997 to 88,502–106,954 in 2017. Perhaps most worrying is that these species are declining in reserves where the habitat is largely protected from damage caused by ungulates and the vegetation community has rebounded. These honeycreepers face a number of threats including mammalian predators and disease. Without additional management tools, such as broad-scale vector control to reduce the threat of disease, we may soon see additional extinctions of Maui's honeycreepers.

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Potential Heat and Chemical Treatments of Ceratocystis-Infected ‘Ōhi‘a Wood

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Rapid ‘Ōhi‘a Death (ROD), caused by the fungi *Ceratocystis lukuohia* and *Ceratocystis huliohia* I. Barnes, T.C. Harrin. & L.M. Keith is responsible for widespread mortality of ‘ōhi‘a (*Metrosideros polymorpha*) trees on Hawai’i Island and to a lesser degree on Kaua’i. The fungi can remain viable for months to years after tree death. This is problematic as ‘ōhi‘a wood is valuable and used as decorative posts and poles in island homes and architecture. The inadvertent use and movement of *Ceratocystis*-infested wood is a potential pathway for transport to new areas free of disease. To combat this, the Hawaii Department of Agriculture enacted a quarantine regulation requiring all ‘ōhi‘a plants and parts (including wood) be screened and deemed free of *Ceratocystis* before transport. To date, no treatment exists for *Ceratocystis*-infested ‘ōhi‘a wood. To strengthen this biosecurity effort, heat and chemical treatment methods were tested to eradicate the ROD pathogens in diseased ‘ōhi‘a wood. In two studies, an evaporative dry kiln was used to heat 2.4 m long *C. lukuohia* or *C. huliohia*-infected ‘ōhi‘a wood poles to a core temperature of 60°C for 60 minutes and then assayed for fungus survival by carrot baiting. Viable *Ceratocystis* was recovered from 92% of samples prior to heat treatment and 0% from kiln heated wood. In addition, the use vacuum steam heat treatments and low-cost borates is under investigation. The results of these trials will inform regulators of improved biosecurity treatment options to reduce the risk of spreading ROD to new, disease free areas.

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Hawaiian Honeycreeper Conservation in Light of Gut Microbiota

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Symbiotic microbes provide key health benefits to a host through processes such as dietary supplementation, boosts to host immune system, increased pathogen resistance, or tolerance to environmental perturbations. Proper functionality of all above processes is particularly essential when considering the conservation of an endangered species. 'Akikiki (*Oreomystis bairdi*) and 'akeke'e (*Loxops caeruleirostris*) are critically endangered insectivorous forest birds on the island of Kaua'i. Both are subjected to a suite of introduced threats and currently only occupy a small (54km^2) region of their previous range. An animal is not just an animal, but rather a symbiotic relationship between a host and its microbial inhabitants. This project explores an overlooked, but potentially critical component of effective species conservation; the gut microbiome. I analyzed the gut microbiome of both species as 1) they relate to one another, 2) they are affected by spatial and temporal processes, and 3) how they relate to life history traits. I collected fecal samples from birds in the wild as a non-invasive way to explore the gut microbiome. Samples will be analyzed through amplicon-based sequencing of the 16S rRNA gene to determine bacterial diversity and composition. Establishing this baseline understanding of host-microbiome patterns in wild 'akikiki and 'akeke'e is crucial for understanding how factors such as habitat degradation and captive breeding may have negative consequences on the functionality of the gut microbiome in Hawaiian birds

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Eco-engineering, eco-mimicry and other applications of indigenous resource management to maximize ecosystem services and address issues of sustainability in Hawai‘i

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‘Eco-mimicry’ is a form of eco-engineering that utilizes a deep understanding about the structure and function of ecosystems in a particular place to design cultural landscapes that solve complex problems, and allow for complex human societies to exist without sacrificing the key ecosystem services they depend on for survival. In a challenge to the notion that humans are intrinsically destructive to nature, eco-mimicry can actually — and has been used to — increase key ecosystem services such as abundance of food and clean water, good air quality, and robust biodiversity. The Hawaiian social-ecological system was originally designed using eco-mimicry as a means to maximize key ecosystem services in order to sustain a large human population, and did so in a way that did not irreparably compromise the integrity of the natural processes it was built on. The 20th century saw a massive shift away from the management strategies and philosophies associated with the Hawaiian social-ecological system, which is an era correlated with diminished ecosystem services, declining habitat, and an increase in endangered species. We will present a broad synopsis of how eco-mimicry is utilized in the design of the Hawaiian social-ecological system, and within that context discusses strategic management of key ecotones and biomes in terms of resilience and food security. It explores how reviving such an approach – to restore the health of social-ecological systems – can address issues of sustainability in the 21st century.

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Wiliwili and the War of Wasps: A Controlled Release of the Biocontrol *Eurytoma erythrinae* to Increase Viable Seedset of *Erythrina sandwicensis*.

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After the successful release of the Eurytoma parasitoid wasp (*Eurytoma erythrinae* Gates and Delvare) to diminish the devastating effects of the Erythrina gall wasp (*Quadrastichus erythrinae* Kim*)* on native wiliwili (*Erythrina sandwicensis* O. deg*)* trees in 2008, an overall stabilization in tree health has been observed and a natural ebb and flow for both wasp species occur throughout the year. In the wiliwili subpopulation of Waikōloa, Hawai`i, *Q. erythrinae* populations increase drastically during wiliwili reproductive periods prior to an influx in *E. erythrinae* resulting in extensive impact and damage of inflorescences and subsequent seed development across the area. In an effort to bridge the gap between academic research and logical practices for land managers, the staff at Waikōloa Dry Forest Initiative (WDFI) have undertaken a small-scale study to captively breed and release Eurytoma parasitoid wasps at first sign of gall wasp activity. Releases took place during this critical reproductive period with the expectation that timed release of *E. erythrinae* could decrease the rate of growth for *Q. erythrinae* populations; limiting their damaging effects and thus increasing available seedset for *E. sandwicensis*. The study followed ten inflorescences from twenty individual wiliwili with and without inoculation of *E. erythrinae* and assessed gall wasp infestation levels bi-weekly from flower bud to mature fruit. Results and conclusions of this study are currently being processed and will be presented at this conference. Additionally, WDFI will share their experience utilizing limited staff and budget to push forward use of biocontrols and advancing conservation efforts in Hawai`i.

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The Rain, Pain, and Gain: Development and Potential Applications of Automated Real-Time Gridded Rainfall Maps for Conservation and Natural Resource Management

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Since its completion, the online Rainfall Atlas of Hawai‘i has provided a high spatial resolution climatic baseline, and together with the temporally explicit monthly rainfall map product have proven critically important for a variety of resource management and conservation issues across Hawai‘i. In particular, detailed knowledge of current average and past changes in spatial patterns of rainfall has facilitated the protection of ground and surface water resources, management of invasive species, protection and restoration of native species and ecosystems, assessment of landscape and site level risk from disease, fire, drought and flooding, and has aided in planning adaptation and mitigation of the future effects of climate change. However, even with several updates, the current month-year rainfall maps extend only to 2012 meaning these gridded rainfall products lack the ability to inform real-time management responses. Because of the known utility and value of these spatiotemporal rainfall products for current natural resource and conservation applications, we have developed an automated system for near-real-time creation of month-year rainfall maps and provide a continuation of the high resolution rainfall products previously produced. We outline our basic workflow and the many rainfall based products that will be made available through a dynamic cloud-based data portal, including active station data, downloadable spatial grids, and an interactive web-map. Finally, several potential applications of this real-time spatial rainfall and derived products examples will be demonstrated to help Hawai‘i land and ecosystem managers start to understand how this real-time place-based knowledge can be beneficially integrated into their management strategies.

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Characteristics of effective Marine Protected Areas in Hawai‘i

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The State of Hawai‘i established its first legislated Marine Protected Area (MPA) in 1953 and today there exists a patchwork of spatial marine management strategies along a range of sizes, with varying levels of governance, enforcement, and effectiveness. Approximately 12% of waters within the 50 m depth contour and 5% of waters within State jurisdiction (≤ 3 nmi) have some form of marine management. No-take areas make up < 0.5% of nearshore waters and combined with highly protected areas account for 3.4% of this habitat. Most of the existing MPAs are small, with a median area of 1.2 km^2 (CI – 0.2-8.1). Twenty-five datasets, representing 1,031 individual surveys conducted throughout Hawai‘i since 2000 were used to compare fish assemblage characteristics amongst a subset of MPAs using a regulation-based protection classification scheme. Fully and highly protected areas had significantly greater resource fish biomass compared with areas with intermediate, or low protection. High human population density adjacent to MPAs had a negative influence on fish trophic structure within MPAs, while remote MPAs harboured higher fish biomass. Complex and heterogeneous habitats were important contributors to MPA effectiveness. Long-term monitoring of select MPAs showed mixed and complex trajectories. Resource fish biomass increased after the establishment of the Hanauma Bay MLCD in 1967 but plateaued after ~ 15 years, followed by changes in assemblage structure from fish feeding and invasive species. The Pūpūkea MLCD, established in 1983, was expanded 7-fold in 2003 and showed dramatic increases in resource fish biomass following increased protection. This information is critical to improving effectiveness of existing MPAs, helping inform ongoing efforts to implement a network of MPAs statewide, and aiding in the development of comprehensive statewide marine spatial planning.

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Restoration of an urbanized ahupua`a within Ko`olaupoko

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Urbanization and associated sprawl has affected the moku of Ko`olaupoko on the island of O`ahu. One of the ahupua`a, He`eia, within this moku is approximately 50% urban in its lower elevations, including Windward Mall, the H-3 interstate highway, and several subdivision developments. Adjacent to this development is a wetland and estuary that is currently being restored by Hawaiian non-profit organizations. The He`eia National Estuarine Research Reserve (HeNERR) was established in 2017 as a collaborative endeavor between the National Oceanic and Atmospheric Administration (NOAA) and the University of Hawai`i at Mānoa to support ahupua`a restoration efforts, and to monitor the effects of such a restoration approach on ecosystem services. HeNERR's official site partners include Kāko`o ʻŌiwi, Paepae o He`eia, Ko`olaupoko Hawaiian Civic Club, Ko`olau Foundation, Department of Land and Natural Resources (DLNR), and Hawai`i Community Development Authority (HCDA). We will share about the restoration work supported by HeNERR, efforts to revive mauka-to-makai thinking, as well as the monitoring and other research efforts that are ongoing. Highlighting efforts to restore urban ahupua`a, such as those in He`eia, have yet to be realized, but are important aspects of biocultural restoration in the name of sustainability, resilience, and cultural revival.

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Prey Biomass and Availability as Factors Influencing the Distribution of Pueo

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Raptors provide critical ecosystem services as the top-down regulators of the systems in which they occur. Only one native raptor, the Pueo (Asio flammeus sandwichensis or Hawaiian Short-eared Owl), provides these services across all the main Hawaiian Islands. Considered an ancestral guardian and once common on these islands, the Pueo is currently state-listed as endangered on O‘ahu, with declines attributed to habitat fragmentation and nest predation. In this study we determined the number of Pueo the Hawaiian Islands could support based on available prey biomass (small mammals, passerines, and insects) and determined whether their hunting locations were more closely associated with vegetation height, prey biomass, or a combination of these factors. Although vegetation height was positively correlated with prey abundance, Pueo hunting observations were positively associated with prey biomass and negatively associated with vegetation height. Overall, accessibility to prey was of greater importance than biomass in the selection of hunting sites. Although high prey biomass across these systems suggests the Hawaiian Islands could support large populations of these owls, environmental variables such as vegetation structure, perch sites and land use, as well as increased mortality due to anthropogenic causes may constrain this raptor’s population size. An increased understanding of the Pueo will lead to strength and persistence of the population across the state of Hawai‘i.

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IDENTIFYING SEABIRD COLONIES AND NEAR-ISLAND DISTRIBUTIONS AT SEA TO INFORM POTENTIAL OFFSHORE WIND ENERGY DEVELOPMENT SURROUNDING THE MAIN HAWAIIAN ISLANDS

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The Hawai‘i Clean Energy Initiative and renewable energy goals are the most progressive in the nation, with a goal of 100% clean energy by 2045. Currently, the Bureau of Ocean Energy Management and other federal, state, and local resource managers lack comprehensive, quantitative data to map seabird colony locations and breeding population sizes throughout the main Hawaiian Islands (MHI). In addition, the at-sea movements and habitat of breeding seabirds throughout the MHI have been poorly studied until recently. Through a collaborative effort spanning multiple agencies and organizations, we collected four years (2013-2016) of at-sea movement data on breeding seabird species across multiple colonies in the MHI. Currently, we also are working on a comprehensive atlas of breeding seabirds in the MHI that will support (1) environmental risk and impact assessments of renewable energy development to seabirds at colonies and in adjacent high-use offshore waters, (2) reference data to measure population trends, and (3) informed place-based conservation and restoration actions for species potentially affected by renewable energy development. In addition to informing offshore wind energy planning, these complementary studies build capacity to inform additional environmental management and conservation related to seabirds in the MHI.

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Fishery Resilience through the eyes of Fishers

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Where are the fishers? And what do they think of management? While a common question for aquatic resource managers working in communities throughout Hawaii, there is usually little to no follow through from management, nor are there opportunities provided for open discussion and engagement. This has resulted in barriers between communities and government and created an atmosphere of mistrust. The Department of Land and Natural Resources (DLNR), Division of Aquatic Resources (DAR) has taken an innovative approach using a traditional method of engaging fishers through a fishers working group. While working groups are traditional methods, most times the make-up of the groups are all in support of the same ideas. The DAR fisher working group, however, is made up of representatives from all sectors of fishing, from different islands, and usually have varying perspectives on similar issues. The working group allows fishers the opportunity to voice issues and concerns, as well as engage in face-to-face discussion with resource and project managers where valuable feedback is shared with DLNR. These are the thoughts and perspectives of fishery resiliency through the eyes of Hawaii's fishers.

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Stable Isotopes Reveal Food Web Dynamics for Native and Invasive Mullet Species in He‘eia Fishpond

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Our Project In Hawaii’s Intertidal (OPIHI) is a year-long undergraduate science internship program for students based on O‘ahu. The goal of the program is to collaborate with researchers and community groups engaged in the study and management of Hawaii’s coastal ecosystems, as well as to mentor the next generation of community ecologists by engaging them in authentic, place-based research. This year, one of the student research groups focused on describing food web dynamics in two mullet species, one native and one invasive, at He‘eia fishpond (a collaboration with Paepae o He‘eia and the University of Hawai'i at Mānoa). Restoration of the traditional Hawaiian fishpond, or loko i‘a, brings hope for raising a culturally significant food source in the face of climate change and increased concerns over food security and resilience. OPIHI students used stable isotope analysis of fish tissue from native striped mullet, *Mugil cephalus* (‘Ama‘ama), and invasive Australian mullet, *Osteomugil engeli* (kanda), from different size classes to assess competition and food-web dynamics. Preliminary results suggest that *M. cephalus* and *O. engeli*, although both microherbivores, may not directly compete, as they prefer different locations in the pond. However, restoration efforts should carefully consider how modification of the freshwater flow may alter microalgal community structure, potentially creating an advantage for *O. engeli* over native mullet. By immersing students in place and field-based research experiences, the OPIHI internship is aiding in the management of a culturally significant species by creating close connections between the students, the community, and Hawaii’s ocean environment.

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Tracking Hawai‘i ‘Amakihi (Chlorodrepanis virens wilsoni) in Nakula Natural Area Reserve on East Maui: home range estimation and evaluation of techniques for upcoming Kiwikiu (Pseudonestor xanthophrys) conservation translocation

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Nakula Natural Area Reserve (NAR) has been selected as the first release site to establish a second population of the critically endangered Kiwikiu (Maui Parrotbill, *Pseudonestor xanthophrys*) on leeward Haleakalā, Maui. Kiwikiu in this area will be fitted with radio transmitters to track their movements post-release. All locations have inherent challenges with respect to tracking birds. As a part of preparations for the Kiwikiu conservation translocation planned for fall 2019, we needed to test telemetry tracking capabilities across the landscape. To do this, we monitored another Hawaiian honeycreeper, the Hawai‘i ‘Amakihi (*Chlorodrepanis virens wilsoni*), one of the most common native birds in Nakula, as a test subject for how we will track released Kiwikiu later in the year. During spring 2019, we color-banded and attached radio transmitters on a total of 10 ‘Amakihi, using Lotek PicoPip Ag379 trackers using leg loop harnesses. Transmitters lasted an average of 50 days, allowing us to track, re-sight and take detailed observations of ‘Amakihi. We used all independent GPS point observations to estimate the home range of all tracked ‘Amakihi using minimum convex polygons and kernel density estimators. Learning more about habitat use and home ranges of native birds will shed light on the distribution of important habitat attributes in the fragmented Nakula forest. Additionally, this exercise will allow us to determine the limitations of radio-tracking capabilities in Nakula and make any necessary modifications before the translocation of Kiwikiu to the site.

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Coming in High and Hot: A novel appraoch to ungulate control utilizing UAS and thermal technologies

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As Unmanned Aerial System (UAS) technology continues to grow and improve, the ability of resource managers to utilize this technology for various management activities radically improves as well. The Nature Conservancy has been using UAS technology for several years focusing on mapping and monitoring vegetation. The Conservancy has also utilized thermal imaging technology to identify ungulate presence via helicopters. Both technologies, used for very different applications, have proven extremely useful in helping guide management decisions. The landscape of hunting and technology is changing with the advent of UAS and thermal cameras. Now that these two technologies can be combined, they are being used by TNC's Maui Forest Program to effectively aid in ungulate control activities. UAS technology paired with a thermal imaging camera can now be used to spot game, plan hunting strategies, and assist hunting efforts in real time.

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Correlation of He‘eia Fishpond plankton community abundance and distribution in response to environmental conditions

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Hawai‘i currently imports about 90% of their food. To improve Hawai‘i’s food security and sustainability, advancements need to be made in local food production systems. Native Hawaiian fishponds (loko i‘a) are historically important systems of aquaculture, with fish production relying on several different conditions. Nutrient concentrations and physical factors influence the composition of plankton communities which are an essential part of the fishpond foodweb. This project examines the relationship between physical and geochemical parameters and plankton communities within He‘eia fishpond. Between November 2018-February 2019, we measured physical parameters and collected discrete water samples from 14 sites within He’eia Fishpond and 2 end member sites in He‘eia Stream and nearby reef. Water samples were analyzed for dissolved inorganic nutrient concentrations and direct cell counts of autotrophic and heterotrophic plankton were taken. In general, heterotrophs dominated the freshwater sites whereas autotrophs dominated the marine sites within the fishpond. The relative abundance of diatoms, the primary food source for juvenile fish, was relatively low (3-8%) with the highest abundance in the sites adjacent to and in He‘eia Stream. These data indicate that continued restoration of He‘eia Fishpond and the nearby wetland may increase brackish conditions and increase the ratio of diatoms. Our research provides a better understanding of the complex relationship between plankton productivity and physicochemical parameters. Since plankton are the base of fishpond food webs, we assume knowing the abundance of phytoplankton in the fishpond will enable fishpond stewards to calculate potential fish yield and identify conditions that promote maximal fish productivity.

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Challenges & Successes in Providing Accessible Restoration Opportunities in Urban Koʻolaupoko

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Hui o Koʻolaupoko (HOK) is a non-profit whose mission is to protect ocean health by restoring the ʻāina: mauka to makai, focusing specifically in Koʻolaupoko Oʻahu. In many urbanized island communities, a leading threat to water quality, ecosystem and community health is land-based pollution resulting from an abundance of impermeable surfaces, habitat alterations, and introduction of non-indigenous flora and fauna. We address these problems by focusing on community-based riparian restoration and low-impact retrofit projects (green streets and rain gardens). This presentation will highlight challenges and successes HOK has encountered in addressing needs of communities across the urban to rural spectrum. As a non-landowning organization, partnerships with community stakeholders and wiling landowners provide the locations for our work. With their support, HOK has created and maintains highly visible restoration projects such as Heʻeia Estuary Restoration, Kaha Garden, Popoiʻa Street, and many rain gardens that serve as accessible outdoor classrooms for youth and adults. These projects offer a multitude of opportunities for citizens to interact with nature and develop their own sense of aloha ʻāina but they also come with the challenges of maintaining an easily accessible public space. Interpretive signs designed by community youth are vandalized weeks after installation, county departments don't have the capacity to assist with imperative infrastructure upgrades, and any imaginable household item is dumped on top of native plants, again. However, HOK holds the belief that an increase in urban green spaces and continued environmental outreach will combat these challenges and strengthen community resources, networks, and resilience.

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Changes in Predator Activity and Hawaiian Petrel Reproductive Success in Response to Landscape-level Predator Control

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The island of Lānaʻi is home to an important nesting colony of endangered Hawaiian petrels (*Pterodroma sandwichensis*). A growing landscape-level predator trapping network has been implemented to protect the colony from depredation by non-native rats and cats. Over 3 years, the trap network has grown to include 140 cat traps over 17+ km of trails in an approximate 250m x 1km spacing, and over 750 Good Nature A24 automatic rat traps covering ~180ha of nesting habitat in spacing ranging from 50x100 m to 50x50 m depending on the topography. With this protection, rat visitations to camera-monitored petrel burrows in proximity to A24 traps decreased, as did cat visitations and depredations of petrels by rats and cats. From just 2016 to 2018, Hawaiian petrel reproductive success nearly tripled, from around 25% to nearly 80% across the colony. Since the initial trapping network expansion, we are now starting to look spatially at the instances of predator sightings and depredations within the colony to inform potential modifications to the trapping grids to improve protection. This work protects one of the densest nesting concentrations of Hawaiian petrels, and supports the recovery and resilience of the species in the face of climate change and continuing development on other Hawaiian islands.

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Minimizing Mortality of Hawaiian Hoary Bats at Wind Farms

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There are currently at least 11 operating wind energy projects in Hawaii. Wind energy is an important – and growing – component of the State of Hawaii's efforts to reduce its carbon footprint. An anticipated future increase in wind projects and unexpectedly high rates of mortality of endangered Hawaiian hoary bats has become a serious concern. This concern has been complicated by our inability to accurately estimate island-wide bat populations or to document that compensatory mitigation techniques like habitat restoration can fully offset bat mortality associated with the operation of wind turbines. When it is difficult to confidently assess a project's impact on an endangered species and to simultaneously lack a reliable off-setting mitigation technique, it becomes especially important to look at ways to minimize the amount of mortality that a project causes. A review of the literature on turbine-related bat mortality found 14 attributes of wind project siting, equipment, and operational methods that are correlated with differences in bat mortality. A recommended suite of more bat friendly attributes may greatly reduce the number of endangered bats killed at both current and future Hawaiian wind projects.

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The Hawai´i Law Fellows Program: Expanding Capacity for Environmental Resource Management

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The Hawai´i Law Fellows Program is a collaboration between the Environmental Law Program at the University of Hawai´i's William S. Richardson School of Law and the Department of Land and Natural Resources (DLNR) to provide recent law school graduates with experience working in environmental resource management and to provide added capacity for DLNR in addressing legal issues as they arise. Legal fellows work closely with DLNR staff to help effectively communicate agency needs to the Attorney General's office, provide guidance on overlapping jurisdictional issues and agency responsibilities, and form a network between divisions that provides increased communication and coordination. Fellows also provide support for the Division of Conservation and Resources Enforcement (DOCARE) and Hawai´i's environmental courts.

The success of the Hawai´i Law Fellows Program has garnered interest in using the program as a model to increase environmental resources management capacity in other Hawai´i state agencies as well as jurisdictions throughout the Pacific Islands, Caribbean Islands, and mainland United States. Please join Professor Denise Antolini and the legal fellows in a panel discussion about the structure of the program and how this program can be adapted in other jurisdictions followed by breakout sessions where the panelists can discuss their specific focus in more detail with interested members of the audience.

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The Use of Scent Discriminating Canines for the Early Detection and Management of Plant Diseases

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The invasive redbay ambrosia beetle (*Xyleborus glabratus*), first detected in Savannah, GA in 2002, carried with it a fungal partner (*Raffaelea lauricola*). The pair have led to one of the most devastating new plant diseases in recent times affecting laurel trees (Lauraceae). It is estimated that in excess of 500 million trees have succumbed to laurel wilt disease. Having spread to the state of Florida, this devastating disease has also affected the agriculturally important avocado (*Persea americana)*. Symptoms of this disease, a vascular wilt, are the rapid browning and wilt of the canopy and the darkening of the xylem tissue. These symptoms, once visible, result in the rapid death of the tree within 4-6 weeks. However, prophylactic systemic treatment with propiconazole (Tilt®, Syngenta, Wilmington, DE) can protect the trees from the disease for approximately 12 months. This study evaluated the novel approach of using scent discriminating canines (*Canis familiaris*) trained on the volatiles of laurel wilt pathogen as a proactive, early detection management tool for grove owners. This presentation will discuss the success, special considerations, difficulties and challenges associated with canine detection, with respect to laurel wilt disease. In addition, the results of a canine trial in Hawai'i and the potential of using scent discriminating canines for the detection of *ʻŌhiʻa* trees afflicted with Ceratocystis *sp*. (Rapid 'Ōhiʻa Death (ROD)) is presented.

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Citizen Science: Utilizing iNaturalist to Report Aquatic Invasive Species in the State of Hawai‘i

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Citizen Science can be a powerful tool, from contributing to peer reviewed and published articles, to informing natural resource management decisions. In areas with limited staffing and resources, citizen science can supplement data gaps. Early detection of Aquatic Invasive Species (AIS) and documenting their distribution is crucial to AIS management which contributes to the resilience of aquatic ecosystems. In 2017, the State of Hawai‘i's Aquatic Invasive Species Team sought to increase community reporting of potential AIS utilizing iNaturalist. iNaturalist is an online crowdsourced recording tool and identification system for organism occurrence, that is free to join. The “State of Hawai‘i: Aquatic Invasive Species” (SH: AIS) project was created in iNaturalist which allows citizens to document and upload observations of introduced aquatic species in Hawai‘i to the project. By April 2019, there were 234 observations made by 65 citizens that were added to the project. The introduced aquatic species recorded in the project and their relevance to management will be discussed.

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Combating the Ongoing Threat of Aquatic Alien Species Through Ballast Water Risk Analysis

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Hawai‘i relies heavily on the shipping industry to import most consumer goods into the State. As a result, ship-borne vectors account for up to 78% of alien algae and invertebrate species into the State. One of the ways ships can transfer alien aquatic species is through their use of ballast water. To provide stability, ballast water is taken onboard by a ship when offloading cargo. The water is then carried to a new port and discharged when on-loading new cargo. If the ballast water is discharged untreated, it may introduce aquatic invasive species as well as pathogenic diseases that could destabilize natural ecosystems and incur negative human health and/or socioeconomic impacts. Currently, an estimated 346 marine alien algae and invertebrate species are established in the State—the highest number of species compared to the rest of the United States. The Department of Land and Natural Resources, Division of Aquatic Resources (DAR) is developing Hawai‘i’s Ballast Water and Biofouling Biosecurity Program in order to strengthen Hawai‘i’s aquatic biosecurity through performing vessel biosecurity risk assessments, monitoring, and compliance implementation for approximately 1,000 vessel arrivals with over 10% discharging in State waters annually. This poster will focus on how DAR is assessing and managing the risk of aquatic alien species introductions through ballast water requirements, the method of quantitative risk assessment and future plans of action to ensure compliance.

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Coral Reef Restoration Through Invasive Algae Management in Kāneʻohe Bay and the Waikīkī MLCD

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Despite various environmental stressors, Kāneʻohe Bay contains some of the highest coral cover on Oʻahu and serves as a nursery ground for many native juvenile fish and invertebrates. Fast growing alien invasive algae has smothered many reefs throughout the Bay. This phase shift from healthy coral to an algae dominated environment has severely degraded the reef and lead to a loss of ecosystem function. Since 2007, the Division of Aquatic Resources (DAR) has carried out invasive algae control efforts in the Bay using a combination of mechanical removal and biocontrol, effectively reducing invasive algae cover bay-wide whereby currently only biocontrol is needed to keep algae levels low. In addition to continuing management in Kāneʻohe Bay, DAR has begun a multi-year biocontrol project to raise and outplant native sea urchins (*Tripneustes gratilla*) within the Waikīkī Marine Life Conservation District (MLCD). A preliminary snapshot (SNAP) assessment was performed on the restoration area within the Waikiki MLCD to determine hotspots of invasive algae. These invasive algae hotspots will be prioritized within the MLCD for treatment with sea urchin biocontrol.

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Ensuring long-term survival of Papahānaumokuākea Marine National Monument's three endemic songbirds through monitoring, habitat management, and translocation

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The Papahānaumokuākea Marine National Monument is home to three federally Endangered songbirds: Nihoa Millerbird, Nihoa Finch, and Laysan Finch. Self-sustaining populations of each species on at least two islands that are resistant to ocean inundation are required for long-term survival. The successful translocation of Nihoa Millerbird and Laysan Finch to low-lying islands has significantly reduced their extinction risk. Millerbirds translocated to Laysan continue to flourish with increasing numbers and expanding range, while the source population on Nihoa continues to undergo substantial population fluctuations. Translocated Laysan Finches at Pearl and Hermes Atoll persist on one islet, Southeast, but the islet is experiencing wash-over events related to sea level rise, precluding long-term persistence. The Laysan Finch source population remains stable at ~10,000 birds, but annual monitoring has not occurred since 2011. Nihoa Finches remain confined to Nihoa, with a population from 200-500 birds (mean 360), thus translocation of this species is a conservation priority for USFWS and the Monument. Kure Atoll and Lisianski were identified as suitable options for a translocated population in a 2006-2007 structured decision-making exercise. However, Nihoa Finches are highly susceptible to avian malaria and mosquitoes, which vector this disease, were detected on Kure and persist on nearby Midway, making Kure and any of the main Hawaiian Islands unviable options. Lisianski has suitable habitat and food resources and current sea-level models indicate that habitat will be available for at least 150 years. The long-term survival of these three species requires: 1) Consistent annual monitoring, 2) management of threats, and 3) translocations to safe high islands and suitable low islands until mosquitoes can be controlled in the main Hawaiian Islands.

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Update on the Status of a Biological Control Agent Released for Strawberry Guava in Hawaii

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Impacts of a biological control agent for strawberry guava (*Psidium cattleianum*) have unfolded gradually since it was first released in Hawaii in 2012. Monitoring of the Brazilian leaf galling insect *Tectococcus ovatus* in demonstration plots, where populations have grown steadily over the last 7 years, reveals impacts on fruiting, leaf cover and stem growth. These sites also show differing effects on three common varieties of strawberry guava, but all varieties are susceptible to the biocontrol. In native forest sites across the state, *Tectococcus* also has been successfully established and is spreading on its own. Techniques for assisting dispersal of the biocontrol agent to new areas have been refined and simplified over time.

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Investigating the Role of Beetles in the Spread of Rapid ʻŌhiʻa Death: Status of Research

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Rapid ʻŌhiʻa Death (ROD) is a lethal, fungal-driven vascular disease that threatens the health of ʻōhiʻa (*Metrosideros polymorpha*) forests across the Hawaiian Islands. Identifying mechanisms by which the *Ceratocystis* fungi (*C. lukuohia* and *C. huliohia*) spread among trees is critical to managing the disease and understanding the resiliency of the forest to this threat, but are unknown. Wood-boring ambrosia beetles (Curculionidae: Scolytinae) are thought to play an important role in *Ceratocystis* dispersal because fungal propagules growing within tree tissues can be released into the environment via macerated wood (frass) produced by beetles during gallery excavation. From May 2018 to present we conducted studies addressing the role of beetles in the spread of *Ceratocystis*. From seven beetle species identified to attack ʻōhiʻa, we found that gallery density varied little along the tree trunk although larger species were more prevalent near the base of the tree, suggesting that spatial partitioning may occur among species. Frass production varied considerably within and among galleries, with the largest species producing 3–4 times more frass than the smallest species. Experiments culturing *Ceratocystis* from frass showed that viable fungi are produced along the entire length of the tree. Passive environmental samplers found windborne frass to be present across the vertical profile of the forest suggesting that wind may disperse *Ceratocystis* throughout a stand. Overall, our results suggest that the ambrosia beetle community attacking ʻōhiʻa consists of an assemblage of species that contributes to the release of *Ceratacystis* inoculum in a variety of species-specific ways.

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Potential application of Wolbachia-mosquitoes to break the disease cycle in Hawaiian forest birds at the landscape scale

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Hawai‘i’s native birds are extremely vulnerable to mosquito-borne diseases. There were 50 species of passerines in the main Hawaiian Islands before mosquitoes arrived, but only 21 remain today. Twelve of these are federally endangered or threatened, and IUCN lists 19 as vulnerable or worse. The remaining species are primarily restricted to high elevations where there is still some native forests, and cooler conditions limit the mosquito and disease prevalence. Increasing temperatures are allowing mosquitoes and avian diseases to invade these previously safe habitats, and will result in additional extinctions of these irreplaceable forest bird species. Standard chemical control methods are not appropriate on a landscape scale in Hawai‘i due to the non-target risks to the environment and public health. Incompatible Insect Technique, using a naturally occurring bacteria,*Wolbachia*, is a promising alternative that can reduce insect populations by interrupting their reproduction. This method has been approved by the US Environmental Protection Agency, and is already used in the US and worldwide to reduce mosquito populations and disease transmission, while enhancing public health and quality of life. Scientists and conservationists from the American Bird Conservancy, DLNR Division of Forestry and Wildlife, and US Fish & Wildlife Service are working with the University of Hawai‘i, Michigan State University, and other collaborators to develop a control tool that could work for Hawai‘i. This process involves engaging local communities and stakeholders about this technique’s potential application and the decision process, developing the tools, securing the permits and funding necessary to save Hawai‘i’s forest birds.

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Commonness and Rarity in Island Taxa: Examining Intraspecific Genetic and Ecological Differentiation of Kōpiko (Psychotria mariniana)

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In Hawai'i, there are eleven putative species within the *Psychotria* (Rubiaceae, Coffee family) genus. The Hawaiian *Psychotria* (kōpiko) exhibit various distribution patterns where some species are rare and narrowly distributed, such as the endangered *Psychotria grandiflora*, while others are widely distributed and found on the majority of islands. When congeneric species exhibit contrasting distribution patterns, understanding the drivers for commonness and rarity are important for conservation and management planning especially in the face of climate change. In an effort to understand factors contributing to rare species' distributions, we studied a widespread species, *Psychotria mariniana.* Rare species are inherently difficult to study, so examining a closely-related, but more common species can provide insight into the causes of commonness and rarity. We conducted a phylogenetic and population genetic analysis using field-collected and herbarium-sampled *P. mariniana* from six different islands. We inferred a species-level phylogeny using nuclear and chloroplast markers (i.e. ITS, ETS, matK, psbA, etc.) where different *P. mariniana* populations formed monophyletic groups, both within and among islands. These data provide evidence of inter-island and intra-island population structure. We aim to further analyze population genetics using 12-15 microsatellite loci to compare gene flow estimates, allele frequencies, and heterozygosity measures among all populations. These data, along with ecological data, aim to shed light on factors contributing to the success of *P. mariniana* to provide sufficient, beneficial information to Hawai'i's Plant Extinction Prevention (PEP) program regarding the conservation of the endangered *Psychotria.*

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IMPORTANCE OF UNGULATE-INDUCED WOUNDS IN TRANSMITTING THE FUNGAL PATHOGEN, CERATOCYSTIS, INTO METROSIDEROS POLYMORPHA (‘ŌHI‘A) TREES: FIELD PLOT- AND LANDSCAPE-SCALE EVIDENCE.

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Each year for the last 4 years, *Ceratocystis*-induced Rapid ‘Ōhi‘a Death (ROD) has killed tens of thousands of ‘ōhi‘a (*Metrosideros polymorpha*) trees. ‘Ōhi‘a is Hawai’i’s most abundant and important native forest tree species. Currently ROD mortality extends across more than 135 thousand acres of Hawai’i Island, and now occurs on all five of the island’s volcanoes, including Kohala. Previous research investigating impacts of related *Ceratocystis* species attacking other tree species elsewhere in the world have shown wounds to be critically important pathways for *Ceratocystis* spore access into trees, eventually leading to disease and mortality. *Ceratocystis* is characterized as a wound pathogen. Ongoing pathology studies of *Ceratocystis* and ‘ōhi‘a in Hawai’i confirm this. Here we present results from field plot and airborne, laser guided spectroscopy studies investigating whether or not wounds caused by ungulates increase the susceptibility of ‘ōhi‘a trees to ROD. We focused on sets of paired fenced (i.e., ungulate free) and unfenced (i.e., ungulates present) areas of Hawai’i Island where ROD is present. Both field-based and remotely sensed results indicated that fenced areas free or virtually free of ungulates exhibited lower levels of ROD infection and mortality compared to adjacent areas where ungulates are present and actively wounding ‘ōhi‘a trees. Results suggest the importance of disturbance agents such as ungulates in creating wounds that render ‘ōhi‘a trees, stands and forests substantially more vulnerable to ROD.

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Innovative Restoration Using Resilient Corals to Enhance Coastal Protection in Hawai‘i

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Coral reefs are one of the most diverse and threatened ecosystems that provide valuable services to our local communities, fish and wildlife. Reefs can dissipate up to 97% of wave energy caused by storms and buffer sea level rise impacts, providing coastal protection for an estimated 200 million people worldwide. However, it is predicted that only 10% of corals will survive past 2050 as ocean warming events become more frequent and last longer. This novel project will identify coral stocks that are more resilient to thermal stress, grow them in *in situ* nurseries, and propagate them in close proximity to their origin along the southern (urban) and eastern (suburban/rural) coasts of O‘ahu. *Montipora capitata* and *Porites compressa*, two of the main reef-building species in Hawai‘i, will be targeted at three sites: South Shore (Airport), Kāne‘ohe Bay and Maunalua Bay. Partners include National Oceanic and Atmospheric Administration (NOAA), Hawai‘i State Department of Land and Natural Resources (DLNR), Hawai‘i Institute of Marine Biology (HIMB), and a non-profit organization, Mālama Maunalua (MM). NOAA and DAR are specifically mandated to conduct coral restoration and have existing permits, while HIMB offers expertise on coral thermal stress tolerance, and MM will engage community members to enhance transferability. Outcomes will include a model for effective natural coastal protection for communities, fish and wildlife with best practices that can be scaled up across the State of Hawai‘i for greatest impact.

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Hui Loko Network: Working together on Hawai‘i Island to mālama Hawaiian fishponds and anchialine pools

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The Hui Loko network includes 24 different organizations of fishpond and anchialine pool managers, stewards, and practitioners on Hawai‘i Island. The network is comprised of Federal and State agencies, non-profits, private landowners, and cultural practitioners who share a collaborative approach to restoring and maintaining healthy ecosystems, outreach, education and perpetuating traditional practices. Through collective discussions, sharing of knowledge and ideas, and supporting each other’s projects by on ground joint labor forces, each network site has been able to achieve more. Habitat restoration within the Hui Loko network has focused on invasive species control such as poeciliids and tilapia (*Tilapia Oreochromis* spp.), seashore paspalum *(Paspalum vaginatum),* pickleweed (*Batis maritima)* and mesquite (kiawe, *Prosopis pallida*), and sediment removal. Habitat restoration and best management practices have resulted in an increase of native species such as endangered water birds like the Hawaiian stilt (ae‘o, *Himantopus mexicanus knudseni*), fish species such as the striped mullet (‘ama‘ama, *Mugil cephalus*), and endemic anchialine pool shrimp, ‘ōpae ‘ula (*Halocaridina rubra*). Community engagement through volunteer workdays and educational excursions strengthens community members’ connection to place and nurtures future stewardship of these unique ecosystems. Through building relationships and learning from one another, engaging our communities, and working together, our collective goal is be to resilient in the face of climate change and social pressures in the hopes that by restoring ecosystems we also strengthen communities.

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What We Can Learn From Fish: Integrating Behavioral Ecology and Coral Reef Conservation

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Coral reefs are threatened by habitat degradation and intensive fishing. Such changes may shift communities, impact reef productivity, and alter predation risk. We propose integrating behavioral ecology with current management techniques to conserve Hawaiian reefs and their species. We combine the ecology of fear and spatiotemporal habitat use to categorize reef habitats. This approach allows us to gain insight into coral reef quality from the fish's perspective and incorporates an assessment of ecological processes, such as predation. We hypothesize that core reef habitats will have high fish density and high foraging intensity, while reefs of inferior value to the fish will have low density and low foraging intensity. We selected patch reefs of varying quality in Kāneʻohe Bay, Oʻahu, Hawaiʻi and surveyed fish and benthic communities along with the foraging behavior of the abundant and widespread saddle wrasse (hinalea lau-wili, *Thalassoma duperrey*). Experimental food patches to quantified saddle wrasse giving-up densities (GUDs). When deployed at small spatial and temporal scales the GUD reveals costs of predation associated with foraging. Within reefs, fish did not have microhabitat foraging preferences. This suggests that predation risk is independent of microhabitat properties, and is instead a factor of overall reef properties. We classified Hawaiian reefs into categories of core, refuge, food for predators, and inferior habitat. The approach can supplement current assessment practices, inform the establishment marine protected areas, and serve to protect natural resources of Hawaiian people.

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Coping With The Stress: Physiological Differences In Reproduction Of Montipora flabellata Versus Montipora capitata

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Anthropogenic global warming is increasing ocean temperatures, causing sustained warming periods that stress corals in several ways, including their reproduction. If coral sexual reproduction is negatively impacted, this could reduce the pool of larvae and recruits to the reef ultimately limiting the population's capacity for adaptation. Therefore, monitoring and reporting of gamete quality is a useful metric to track the responses of corals to local and global stressors that otherwise look visually healthy. Recent observations in Kāneʻohe Bay suggest that while corals appear to be visually healthy, their sexual reproduction has been significantly impacted. Specifically, long-term monitoring of sperm motility for both *Lobactis scutaria* and *Montipora capitata* demonstrated approximately 50% loss of motility since 2013. Loss of motile energy whereby motility crashed after 30 min (previous years demonstrate robust motility for > 2 hr.) also suggests that no real reversal of these trends was observed in 2017, two years after the previous bleaching event. It is possible that these corals are experiencing sublethal impacts to their gamete development due to elevated temperatures that appear to last for years after a warming event. However, some corals in the bay might be coping with this increased thermal stress. Initial spawning observations of the coral *Montipora flabellata* in Kāneʻohe Bay revealed very high sperm motility with good duration during the 2017 and 2018 spawning season, while *Montipora capitata* maintained its observed downward trend of previous seasons.

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Can Depredated Endangered Hawaiian Water Bird Carcasses Explain Behavioral Patterns of Introduced Predators? A Case Study on Hanalei National Wildlife Refuge (NWR), Kaua‘i, Hawai‘i

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Hanalei NWR was established in 1972 to provide valuable feeding and nesting habitat to five endangered Hawaiian water bird species. These water bird populations are small (e.g., <3,000) and incredibly vulnerable to threats such as avian botulism C (*Clostridium botulinum*) and introduced predators such as feral cats (*Felis catus*). Avian botulism is a fast-acting neurotoxin that when ingested, quickly immobilizes and often kills birds. Areas with high levels of botulism may be used by introduced predators as a way of exploiting intoxicated birds. Preliminary analyses suggest habitat features may also facilitate predator access to these birds. In this case study we explore the relationships of habitat features on the levels of depredation on the refuge, and evaluate if carcasses can be used as an index of predator occurrence. We predict that areas where birds are more accessible to predators such as dikes, small farm fields and wetlands, and botulism “hotspots” influence bird carcass abundance. Obtaining this information may refine future hypotheses, improve our understanding of how introduced predators utilize the landscape, and how to better enhance protection of endangered birds on the refuge.

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Biocultural restoration of traditional agriculture: cultural, environmental, and economic outcomes of loʻi kalo restoration in Heʻeia, Oʻahu

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There are growing efforts around the world to restore traditional agricultural systems through a biocultural approach that emphasizes the links between cultural revitalization and ecological health. We collaborated with Kākoʻo ʻŌiwi, a community-based non-profit in Heʻeia, Oʻahu to understand the ways that loʻi kalo restoration contributes to linked community, ecological, and food production goals. Interviews with families participating in the ʻohana program described a suite of community and cultural benefits stemming from the process of restoration, including enhanced social connections, cultural (re)connections to place, and physical and mental well-being, which inspired their sustained participation. We additionally found that loʻi kalo restoration has the potential to reduce sediment delivery by ~ 38% to downstream social-ecological systems, including the fish pond (loko iʻa) and Kāneʻohe bay. In addition to the community and ecological benefits of kalo and other local food production, we found important potential economic benefits over time, particularly when restoration included the ʻohana program. In combination, our results demonstrate that a biocultural approach can support the social and financial sustainability of agricultural systems that provide multiple benefits valued by the local community and non-profit while also contributing to statewide sustainability goals.

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Kaua‘i: A Case Study in Rapid Response to Both Fungal Species causing Rapid ‘Ōhi‘a Death

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Rapid ‘Ōhi‘a Death (ROD) striking Kaua‘i surprised everyone, none more than the conservation organizations most poised to deal with rapid response. Both pathogens causing ROD were first detected on Kaua‘i in 2018, *Ceratocystis huliohia* was confirmed in three distinct locations and *Ceratocystis lukuohia* was confirmed in one location. The initial detection triggered a host of early detection and rapid response actions by a collaborative team of scientists and forest managers representing state, federal, and private organizations from around the state. This presentation will focus on rapid response efforts that the Kaua‘i ROD Advisory Committee developed, highlighting the present and future actions taken to understand, detect, predict, and respond to ROD on Kaua‘i. The inter-agency collaboration provides a case study of mobilization of an island community in response to a new invasive species.

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Hawai‘i Wildlife Crime Prosecutors Workshop

Keith Swindle, Justin Kollar, Marc Wallenstein, Carlton Helm, Danica Swenson, Ian Garrod

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The prosecution of wildlife crime in Hawai‘i is an important legal tool for addressing intentional or egregious human acts that harm marine and terrestrial species. Tragic stories of extreme wildlife crime in the news include shooting of Monk Seals, bludgeoning of Nēnē, slaughter of Laysan Albatross, harassment of Green Sea Turtles, finning of sharks, and downing of Newell’s Shearwaters. More common crimes that may initially seem manini but have a cumulative harmful impact on the entire ecosystem involve illegal fishing, coral theft, and dolphin harassment. This Workshop will bring together key members of the federal, state, and local enforcement chain - including prosecutors from Honolulu and Kaua‘i, a United States Fish & Wildlife Service (USFWS) special agent, a Division of Conservation and Resources Enforcement (DOCARE) State Department of Land and Natural Resources (DLNR) Officer and Academy Director, an Assistant US Attorney, and the DOCARE Law Fellow - in an effort to strengthen collaboration, communication, and cross-training. Panelists will discuss the widespread incidence of wildlife crime, investigative techniques, evidentiary challenges, prosecution options, judicial review process (including in the new Hawai‘i Environmental Court), dispositions, and alternative sentencing. Discussion will highlight efforts to boost wildlife enforcement capacity such as the recently established DOCARE Officer Academy. In the second half of the Workshop, participants will engage with the panelists in gathering evidence on, preparing a case for, and prosecuting a mock Hawai‘i wildlife crime before the panel. The goals of this workshop are to build a resilient network of wildlife prosecutors in Hawai‘i and to engage the conservation community in reporting and supporting the wildlife enforcement process.

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What's on Your Plate?: Land-based Pollutants in Hawaiian Reef Fishes

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As modern land use modifies coastal environments, sedimentation and runoff increasingly threaten coral reefs. In urban areas with high concentrations of pollutants, contaminants can be quickly transported onto the reef through groundwater discharge or surface runoff. Once on the reef, marine organisms that consume detritus may ingest these contaminants. In this study we explored the relationship between land use and reef fishes in Hawai'i by examining the concentrations of different metals in sediments and in the tissues of fishes spanning multiple trophic levels from sites on O'ahu (7 sites) and Kaua'i (3 sites). We particularly focused on species that are commonly targeted by fishermen. Tissue samples were analyzed for a suite of 21 metals using inductively-coupled mass spectrometry. Our results indicate that high levels of arsenic, which is likely a result of historic agriculture, are seen in sediment at several locations (e.g., Maunalua Bay and Hanapepe) and in some fish tissues. We also found high lead in sediment and fish from Kewalo. Sediment and fish samples from Maunalua also had higher thallium concentrations than other sites, and fish from Hanapepe appeared to have higher zinc and selenium concentrations than those from other locations. In the next year, we will work with interested community members and fishermen to continue to expand this research and to better understand the trophic pathways linking land-based pollutants and reef fishes. We hope our results will help communities and resource managers by providing information on the locations and species of potential concern.

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Urban ʻĀina: Community Driven Indigenous Urban Design

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Hoʻōla Hou Iā Kalauao is a Native Hawaiian non-profit that actively stewards approximately 2.5 acres of agricultural land on Oʻahu. Located in the middle of a dense urban core, in the ahupuaʻa (land division) of Kalauao, the farm shares boundaries with Pearlridge Shopping Center, parking lots, and some of Oʻahu's most congested traffic arteries. The farm gets its water from a natural spring that feeds traditionally cultivated Native Hawaiian crops. Approximately 35 varieties of heirloom Kalo (taro) are grown here along with other native plants. In addition to traditional foods for the community, this farm provides space for partnerships to grow as well. Over the past year graduate students from the University of Hawaiʻi at Mānoa Department of Urban and Regional Planning have created tools and processes to support growing of relationships between the farmer (Anthony Deluze), the landowner (Kamehameha Schools), and the kaiaulu (community). In this presentation, we share how the development and maintenance of pilina (connection) with kilo (observations) can foster both the preservation of ʻāina and the kaiulu in today's modern context and conditions. Though our process, we systematically inventory both tangible and intangible ecosystem services such as acreage of native habitat restored or ʻike (knowledge), and share results with the landowners, ultimately highlighting major inputs and outputs of the farm. In addition we create means to streamline day to day farm procedures, and hold space to support opportunities to grow pilina with ʻāina. Through our collaboration, we learn how indigenous practice seeds healthy ʻāina and how dependent they are on each others wellbeing. Furthermore, we restore the symbiosis that the Kupuna (ancestors) of this pae ʻāina developed with their living landscape and move towards the sustained abundance they fostered for millennia.

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Kia‘i Kanaloa

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Kia‘i Kanaloa is a network of Native Hawaiian cultural and religious practitioners from each island who acknowledge a genealogical relationship with and kuleana (commitment, responsibility) to cetaceans as akua (gods) and kinolau (physical body forms) of the ocean god Kanaloa. In the Kumulipo, akua Kanaloa and his kinolau are firmly established as important cosmogonic forces: “O ke Akua ke komo, ‘A‘ole komo kanaka. O ke ka‘ina a palaoa e ka‘i nei” “It is the god who enters, Not as a man does he enter. In the lead the whales proceed”.

As Kia‘i Kanaloa, we have been working closely with NOAA and DLNR to ensure that cetaceans, monk seals, turtles, and other kinolau of Kanaloa are afforded the respect due to them when they are in distress, stranded, injured, and/or have expired on our shores. Their peaceful transition to Pō (eternity) and honoring their remains is important to us. The oli of Kanaloanuiākea informs us of the important ecological and biological function of Kanaloa beings:

"Lana i ke kai, Lana i ka honua, Lana i ka houpo a Kanaloa." It drifts upon the land. It floats in the sea. It intermingles in the energy of Kanaloa. Participating alongside NOAA‘s marine response team, members of Kia‘i Kanaloa are committed to engage with palaoa and other kinolau of Kanaloa through kilo (Native Hawaiian observation methodologies) and pule. Indigenous knowledge, as demonstrated in these sayings, help us navigate our cultural protocols of interacting with these akua.

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Protective Effects Of Naupaka Kahakai Juice (Scaevola taccada) Against UV Radiation: An Alternative To Commercial Sunscreen Chemicals?

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Scaevola taccada or Naupaka Kahakai is a native Hawaiian plant that grows commonly in coastal areas. Indigenous knowledge suggests that the fruits of this plant contain UV absorbing compounds. As such, the fruits of this native plant could potentially help reduce the use of commercial sunscreens on Hawaiian reefs. Indeed, repeated exposure to commercial sunscreen chemicals affects coral growth and recruitment in the long run, threatening Hawaii's marine wildlife. In this study, we will determine if the juice of the fruit of *S. taccada* can protect yeast from harmful UV radiation. The juice of the fruits of the *S. taccada* was collected by squeezing them through a sterile muslin cloth. After being centrifuged, the supernatant of the juice was collected. A nanodrop spectrophotometer was used to generate an absorption spectrum from the extract. The extract was filter-sterilized and added to *Saccharomyces cerevisiae* suspensions at a dilution of ½, 1/10 and 1/100. Suspensions were plated and then exposed to UV rays at 253 nm for 0 min, 0.5 min, 2 min, and 5 min. Absorption spectrum studies indicate that indeed Naupaka Kahakai fruits do contain sun-blocking properties, with a calculated Sun Protection Factor (SPF) as high as 20. However, the experiments performed using UVC rays (253 nm) indicated that plates exposed to UV showed no signs of viability. Nevertheless, more experiments will be performed in the future using reviewed protocols and different methods to support or disapprove the original hypothesis.

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Building Resilience by Building Leaders: Cutting-Edge Environmental Law & Policy Research from Hawai'i's Law Students

Richard Wallsgrove[1], TBD 1 [law student to be selected by members of HSBA Environment, Energy, & Resources Section in May 2019] TBD[1], TBD 2 [law student to be selected by members of HSBA Environment, Energy, & Resources Section in May 2019] TBD[1], TBD 3 [law student to be selected by members of HSBA Environment, Energy, & Resources Section in May 2019] TBD[1]

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Each spring, second-year law students at the University of Hawai‘i at Mānoa’s William S. Richardson School of Law are required to write a scholarly paper based on in-depth research. These students are creating a strong foundation for careers as environmental leaders, while analyzing issues at the cutting edge of law and policy in Hawai‘i and the Pacific. This year, students are analyzing issues—and proposing solutions—across a wide swath of questions that impact our ability to improve resilience. For example, in the wake of Kaua‘i’s 2018 flooding disaster, what are the legal and practical implications of waiving environmental regulations for repairs completed during an emergency proclamation? With rising tensions around judicial and executive decisions about development on Mauna Kea, what are the long-term implications for the constitutionally guaranteed public trust? As rising seas force us to retreat from the shore, what do the latest federal cases tell us about the limitations on land use conditions? In collaboration with practicing lawyers from the Hawai‘i State Bar Association Environment, Energy & Resources section, three top student papers will be selected to present their findings at the Hawai‘i Conservation Conference. What can tomorrow’s leaders teach us about today’s conservation challenges and opportunities?

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Being a Maka‘ainana In an Urban World

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As Hawaii becomes more urbanized, it is also becoming more difficult to engage the cultural practices, knowledge systems and values passed down through generations. Landscapes change, concrete covers the majority of our living areas, and what we once knew as fishing grounds and lo‘i are now displaced by sea walls and suburbs. The effects of Hawaii becoming more urbanized however, can be compared to a natural event that occurs often in the state: lava flows. Rock covers everything drastically changing the landscape, but what remains are the kīpuka. Just as these kīpuka begin the regrowth process in baron lava fields, as do our urban kīpuka generate inspiration and innovation in our urban landscapes. As a graduate student at the University of Hawai‘i at Mānoa, I have been able to visit some urban, biocultural kīpuka’s [such as Mokauea, Lo‘i Kalo Park, Kalauao, and Ho‘oulu ‘Āina.] and have seen first-hand their remarkable effect on Hawaii’s youth and on the land. As life begins cracking through the urban lava field, our job as maka‘ainana is to first kilo, observe and learn from our ‘āina; then, we must ho‘okō ke kuleana, or fulfill our responsibilities to steward ‘āina. This talk aims to give a better understanding of what we kilo in our urban ‘āina, and what our kuleana is as kanaka after our ‘āina has changed so drastically. The lava field is fresh, and the seeds have been planted; now it is up to us to decide what this new landscape will become.

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Using Automated Data Analysis to Monitor Whale Populations Around the Hawaiian Islands

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Hawaii is home to over 15 different whale species. More commonly, you will find species such as the Short-Finned Pilot whale, Dwarf Sperm whale and Beaked whales. The winter months from November to May are a very special time for Hawaii. Over 10,000 humpbacks migrate from the summer feeding grounds in Alaska to breed, birth, and nurse their young in the warm waters of the Hawaiian Islands. However, humpback whale count has declined by 50-80% over the past four years. Maintaining diversity in whale population ensures the maintenance of genetic diversity in whale species, making them resilient to environmental changes. The goal of our research is to study and track whale counts using automated data analysis. For computers to conduct an automated data analysis on an audio recording, they first need to be converted to a spectrogram. Audio samples were recorded by our community partner, the ALOHA Cabled Observatory (ACO). A spectrogram is a visual representation of the audio spectrum of frequencies in a sound recording over a given amount of time. Within the spectrogram are formants, which are amplitude peaks in the frequencies of a complex sound. The computer was programmed to differentiate formants to distinguish between different whale species, and therefore able to produce an automated count of each species, based on their respective formants. For future research, we will correlate whale count and migration patterns to rising ocean temperatures. We will also implement the use of active noise cancellation to mitigate ship noise around the Hawaiian Islands.

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Marketing Invertebrate Conservation in Hawai‘i: Principles, Audiences, and Strategies

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Invertebrates comprise a significant proportion of terrestrial biodiversity in Hawai‘i, are crucial in maintaining healthy native ecosystems, and are an important component of Hawaiian culture and the resilience of the Islands. Public awareness and perception of native invertebrates is critical to the support of scientific research and conservation efforts focused on these organisms. Adopting principles from the marketing and science communications fields, I discuss opportunities and strategies for enhancing public perception of Hawaiian invertebrates and native biota in general. I focus on audience identification, messaging strategies, multimedia workflows, and results from a previous communications campaign about Hawaiian micromoths. Based on those results, I then detail new strategies for a current communication campaign featuring Hawaiian land snails, flagging considerations that apply broadly to public awareness of biodiversity conservation in Hawai‘i.

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The Hawaiian Endemic `Āla`a (Planchonella sandwicensis) Represents Two Distinct Taxonomic Entities

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Understanding the taxonomic status of endemic Hawaiian species is an integral component of implementing conservation practices. Distributed in mesic and dry forests on six Hawaiian Islands, `Āla`a is an endemic Hawaiian tree currently recognized as *Planchonella sandwicensis* (formerly *Pouteria sandwicensis*). Due to morphological variations within *P. sandwicensis* there exists confusion about the potential taxonomic boundaries between populations of this species. To reevaluate the taxonomic status of *P. sandwicensis* and provide a firm foundation for the understanding of the variations within the species we quantified morphological characteristics of 42 vouchers from across Hawai`i and generated a molecular phylogeny using ETS, ITS, and *RPB2* sequences. The phylogeny indicates that *Planchonella* in Hawai`i represents two well-supported clades differentiated by morphology and geography. One clade is distributed on Kaua`i, O`ahu, and Maui Nui and contains flat leaves, greenish petals, long pedicels, and purple fruits. The other clade is distributed on all islands and contains leaves that are flat or rolled, greenish or yellowish petals, short pedicels, and yellow fruits. The purple-fruited clade corresponds to *P. sandwicensis* while the yellow-fruited clade corresponds to the type material of *P. spathulata*, currently in synonymy with *P. sandwicensis*. Morphology of *Planchonella spathulata* is very variable across its range, even within islands like Maui, but there is no molecular or morphological support for additional subdivision of the species. It is our hope that this reevaluation of Hawaiian *Planchonella* will establish a strong foundation to support the understanding of species differences within this genus to inform future conservation efforts.

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Habitat use of the Hawaiian hoary bat on Maui

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The foraging ecology of the Hawaiian hoary bat has been poorly characterized and lack of information is hampering efforts to develop effective recovery plans. We used acoustic surveys to describe how bats used the landscape, and although acoustic studies on this species have been conducted on several of the Hawaiian Islands, no long-term, widespread studies have previously been conducted on Maui. We used the Generalized Random Tesselation Stratified survey design to select acoustic sampling sites across nine habitat types covering a ~30,000 ha study area. Calls were recorded for three nights in each habitat and rotated five times (round) every other month for five sampled months for a total of 223 deployments. We analyzed the impact of three environmental variables: 1) habitat type; 2) elevation; and 3) temperature; as fixed effects on bat activity, with the round number as a random effect. We applied generalized linear mixed effects models with the package glmmPQL to account for overdispersed count data and used a negative binomial distribution with a log link. Bat activity (minutes with bat calls) was highest in grasslands, gulches and low-intensity developed habitats and lowest in forested habitats, although feeding buzz data could not be explained as an independent variable. A combination of structural features and resource availability likely drive habitat use. Our data has substantial implications for management decisions and demonstrates this species' foraging flexibility in non-native habitats as well as the need for caution when applying acoustic data from habitats among different islands in Hawaii.

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Efficacy of the Initial Community-based Subsistence Fishing Area at Hā‘ena, Kaua‘i

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The Hā‘ena community in collaboration with the State of Hawai‘i’s Department of Land and Natural Resources established the first Community Based Subsistence Fishing Area (CBSFA) in 2015 in Hā‘ena, Kaua‘i. The goals of this biologically and culturally managed area is to support fishing and gathering for subsistence, religious and cultural purposes in a sustainable manner through effective management practices of local community and State management. Part of the evaluation of the efficacy of the management plan includes annual biological surveys and strategic environmental and physical monitoring by the Division of Aquatic Resources and the Coral Reef Ecology Lab along with ongoing community monitoring. The monitoring results show a statistically significant increase in abundance, biomass, piscivores, and food fishes since baseline surveys in 2013/14 inside the CBSFA as compared to outside the boundaries. The fully protected Makua Pu‘uhonua reported a significant increase in large size fishes and seven species of food fishes. These preliminary trends may indicate the effectiveness of community management. In addition, long-term monitoring of corals shows a decline following the 2014/15 bleaching event. More recently, changes in the biological populations have been detected since the massive April 2018 flood event including a significant decline in urchin populations. The role of the community in these efforts have proven invaluable.

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DLNR‘s Limu Restoration and Resilience Initiative

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Historically in Hawai‘i, limu were a consistent facet of a simplistic yet nutritious diet. Variety in land based food items were limited relative to the variety of options in the sea, which added to the appeal of these marine botanical species. Hawai‘i's people have continued to use algae in a similar fashion to their root cultures. However, there are some uses that have been developed in Hawai‘i's modern multicultural setting. Granted that limu still holds a place of importance in modern Hawai‘i, many believe that it is underutilized and thus underappreciated. Therefore, the Division of Aquatic Resources would like to make a concerted effort to broaden the utilization and appreciation of limu in Hawai‘i. One of the ways to address the under-utilization of limu is to provide communities with more opportunities to harvest limu, whether it be for consumption, medicine, or other cultural use. We hope to enhance these opportunities via limu restoration and resilience projects. Activities may include environmental characterization beneficial to limu growth, habitat restoration, out planting with seed rocks and limu leis, translocation, removal of competing alien algae, and benthic monitoring. At this point in time we have identified two potential sites on O‘ahu to conduct such efforts, He‘eia and ‘Ewa Beach.

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A Functional Trait Approach to Agroforestry Design for Biocultural Restoration in He‘eia, O‘ahu

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Sustaining biodiversity while meeting human resource needs is a critical challenge. This is especially true in Hawai‘i where over 25% of native plants are threatened or endangered and high labor and land costs make forest restoration economically challenging. Multi-story agroforests, however, can both conserve biodiversity and produce culturally and economically valuable products. Agroforests were widespread in Hawai‘i prior to European contact, yet relatively few remain today. While interest in biocultural restoration of agroforests is growing, designing systems that incorporate indigenous and local knowledge and produce a suite of valued ecosystem services remains challenging. Plant functional traits may facilitate the design process by serving as a tool to predict the connections between plants and ecosystem services; however, few studies have combined a functional trait approach to agroforestry design with explicit inclusion of cultural values. To help fill this gap, we tested a participatory functional trait design process with a community-based non-profit to identify species of high cultural and/or economic importance that would also provide 1) erosion control and 2) successional facilitation services. Of 110 candidate species, we selected eight different native and introduced species for each species mix and four species to include in both mixes. We then established a restoration experiment at Kākoʻo ʻŌiwi with the two species mixes using before-after-control-impact design where we will investigate differences in plant growth, survival, and soil carbon over time. We discuss some of the opportunities and challenges involved in a participatory design approach and describe the early stages of a long-term restoration experiment.

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Coastal Dune Restoration via Biomimicry Sand Collection Systems

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The James Campbell National Wildlife Refuge (JCNWR) is located on an alluvial plain on northern windward O‘ahu, exposed to constant winds and waves. It is subject to environmental pressures that may exacerbate coastal erosion with changing climate conditions, like increased storm activity and rising ocean levels. The restoration of the coastal dunes at James Campbell NWR has been recognized as essential to protecting the inland portions of the refuge, including the brackish and freshwater wetlands as well as an installed predator-proof fence, which encloses seabird colonies and seabird translocation efforts. In addition, a developed dune ecosystem would benefit native Hawaiian flora found only in that environment, such as the endangered *‘*ohai (*Sesbania tomentosa*). Ecologically, these dunes provide structure and complexity to the environment, supporting a more biologically diverse landscape and allowing different plant species and their commensals to utilize different topographical areas and gradients. This pilot study consisted of drone mapping and of a sand collection system. The mapping provided a way to analyze conservation threats and analyze the study area. The collection system utilizes wooden shims which function as biomimicry for native plants, creating sand-trapping matrices and protecting outplants from some of the damaging environmental effects of wind and salt spray, allowing for accelerated sand accretion, dune stabilization and revegetation. The results were so far inconclusive with little sand buildup, owing perhaps to seasonal differences in littoral sand movement and a shortened time frame of data collection.

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10 years of conservation in Upper Limahuli Preserve

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The National Tropical Botanical Garden's conservation program in Upper Limahuli Preserve is a case study in long-term ecological conservation in a remote wet montane forest. This 400-acre hanging valley contains naturally occurring populations of 254 native plant taxa, 213 of which are Hawaiian endemics. Upper Limahuli is also home to Hawaiian forest birds and breeding colonies of endangered ground-nesting seabirds `A`o (Newell's Shearwater, *Puffinus newelli*) and `Ua`u (Hawaiian Petrel, *Pterodroma sandwichensis*).

Despite the rugged topography and sheer cliffs, which provide some protection against many environmental pressures, the Preserve has changed over the roughly 25 years of management. It is vulnerable to encroachment by invasive plants such as Australian Tree Fern (*Cyathea cooperi*) and Himalayan Ginger (*Hedychium gardnerianum*) and depredation pressure by feral cats (*Felis catus*), rodents (*Rattus spp*.), and Barn Owls (*Tyto alba*). Natural disturbances such as Hurricane Iniki and recent landslides create more canopy openings and opportunities for further ecosystem change.

In the past ten years, the conservation program in Upper Limahuli Preserve has grown from small, intermittent camping trips for invasive removal and seed collection to a multi-agency collaboration with a year-round dedicated conservation team. A variety of projects have focused on rare plant collection and propagation, invasive plant removal, and predator control. By taking advantage of new technologies and continually tailoring techniques to the needs of the landscape, the overall conservation program has advanced significantly over the course of a decade.

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Sunscreen Use Assessment in Hawai‘i Prior to the 2021 Chemical Ban

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In an effort to increase coral reef resilience, the state of Hawai‘i passed legislation banning the sale of sunscreens containing certain chemicals (oxybenzone and octinoxate) demonstrated to be harmful to coral reef ecosystems, starting in January 2021. While this ban influences what sunscreens can be sold in the state, visitors to the islands can still bring in sunscreens containing these chemicals. Thus, it is critical to educate the public about the ban and the impact of certain chemicals on coral reefs, as well as to understand the impact that the ban is truly having on sunscreen use in areas where coral reefs are present. In order to better understand the state of sunscreen use and beach-goer awareness prior to the ban going into effect, we surveyed beach goers on Oahu (Waikiki and Hanauma Bay) and Hawai‘i Island (Kahalu‘u and Waialea) about their sunscreen use. Surveys covered the following topics: 1. People’s sunscreen use and preferences; 2. People’s awareness of the dangers to coral reefs of certain chemicals in sunscreens and reef-safe sunscreen alternatives; 3. If people are aware, where they learned this information; 4. People’s willingness to switch to alternative types of sunscreen if they are not already using reef-safe sunscreen options. When possible, surveyors also inspected sunscreens that beach-goers were using to determine whether they contained the banned chemicals. Here, we present the outcomes of these surveys for each location, as well as potential implications for public outreach and information dissemination regarding chemicals in sunscreen.

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Potential Changes in Infiltration in Hawaiian Forests Caused by Climate Change and Invasive Species

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Precipitation in Hawai‘i’s upland areas provides needed water to people and ecosystems. Once it reaches the ground, rain can either run off and contribute to water flow in streams, or it can infiltrate into the ground and provide water for plants and recharge aquifers and groundwater. The exact route that water takes is controlled by many factors, including the duration and intensity of rainfall, topography, soil properties, and vegetation. Limited existing research indicates that plant composition and land use may cause differences in local infiltration. How will rapidly expanding invasive plant species and, conversely, local conservation efforts, impact water resources into the future? In this project we attempted to do the first landscape-wide assessment of the importance of these factors on infiltration across forested areas that account for the majority of rainfall across the state. To do this we deployed 38 paired plots in fenced/unfenced and native/invaded areas along moisture and substrate age gradients within forested areas across Hawai‘i and Kaua‘i islands. At these plots we characterized forest structure and soil characteristics to assess the vegetation-mediated impacts of invasives and broader environmental variation on soil infiltration. While we expected moisture and substrate age-mediated differences in infiltration between fenced vs ungulate damaged areas, and in native vs invasive dominated areas, differences in infiltration were often complex, unexpected and scale-dependent.

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At the Confluence of Invasives and Climate: Building a New Community of Practice

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Terrestrial and aquatic ecosystems in the Hawaiian Islands are being transformed by two large-scale, landscape-altering threats: invasive species and climate change The goal of this forum is to hold a facilitated, interactive dialogue about building a new community of practice (CoP) in the Hawaiian Islands that works at the intersection of invasive species management and climate change adaptation. The objectives of this CoP would be to (1) identify new research lines of inquiry, informed by managers, examining the interactions and synergies of invasive species and climate change impacts on land and in the ocean, and (2) develop novel management strategies and actions to these combined threats, and strengthen existing approaches that are showing early signs of success. The forum will begin with brief overview presentations about the state of invasive species and climate change research and management in Hawai'i, then segue into a facilitated discussion with audience members to explore what a CoP might look like, how it would be organized, who would participate, etc. We encourage students, community resource managers, and seasoned professionals to join the forum!

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Rapid ʻŌhiʻa Death "Lab in a Suitcase" Diagnostic Training

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The recent discovery of fungal pathogens (*Ceratocystis lukuohia* and *C. huliohia*) that cause Rapid ʻŌhiʻa Death on Kauaʻi Island has led to an awareness that local ROD response teams may benefit from having the ability to use on site molecular diagnostic tools for these diseases. Researchers at USGS-PIERC have developed a portable, field compatible molecular diagnostic test to facilitate fast turnaround of results for on-site management. The test uses isothermal recombinase polymerase amplification technology to identify both *C. lukuohia* and *C. huliohia* in DNA extracted from beetle frass or wood samples. The entire assay including DNA extraction can be performed in less than 90 minutes on up to eight samples, including necessary controls. The workshop will include a brief lecture, an introduction to standard pipetting techniques, methods for sample collection and preparation, DNA extraction of samples, and isothermal DNA amplification using a portable fluorometer. Hands-on training in groups of up to 4 individuals will run 6 hours, including a 1-hour lunch break. Registration will be limited, with priority to individuals from management organizations and response teams with a need for this capability. Previous lab experience is helpful but not necessary.

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Hotspot Distribution of Black Rats in a Montane Mesic Forest

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Invasive black rats (*Rattus rattus*) are found throughout the Pacific islands in a wide range of habitats, posing serious threats to native species. We investigated rat demography and habitat associations to help managers develop effective conservation strategies. We used capture-mark-recapture techniques to investigate the distribution of rats in montane mesic forest in the Mauna Loa Strip section of Hawai‘i Volcanoes National Park during four trapping sessions from 2015 to 2017. Four paired plots (300 x 300 m) were established, with two each at high (1700–1830 m) and low (1220–1340 m) elevations. Basket traps were placed at 50-m intervals in each grid for a total of 49 per plot. We identified 681 marked individuals from 1285 total captures (5595 trap-nights). Of 305 rats captured more than once, only 19 were caught >12 months apart, indicating an approximately annual turnover rate of the population. Capture frequency was normally distributed at all plots except one where rat density was relatively low and 22% of traps never caught a rat. Although ≥95% of traps on the other plots caught rats, captures of marked individuals overall varied widely (0–15 per trap) during the 3-year period. This suggests that the density of rats, and therefore the intensity of their impacts, varies at a very fine spatial scale in some habitats. Targeting hotspots of rat activity could help managers allocate their limited resources strategically.

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Molecular Markers for Detecting Rapid ʻŌhiʻa Death-associated Ambrosia Beetle Species from Frass

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Ambrosia beetles can be extremely invasive and have been associated with diseases worldwide, which may be attributed to their haploid-diploid biology and symbiosis with their ambrosia fungi. Most ambrosia beetles bore tunnels into stressed or dead trees, planting their symbiotic fungi in the xylem and remaining to feed and reproduce in the gallery for as long as conditions remain suitable. These beetles have recently been associated with the spread of Rapid ʻŌhiʻa Death (ROD) in Hawaiʻi, and knowledge of their life-history, community composition, and capacity to spread the disease have become essential. Unfortunately, species-level identification of these beetles can be difficult due to subtle differences in their morphological characteristics in addition to requiring excavation from trees. To facilitate species identification from frass and the beetles themselves, we designed species-specific molecular markers for ambrosia beetles associated with ROD in Hawaiʻi. Importantly, molecular-based identification of beetles from their frass can provide host-tree information whereas traditional lure-based trapping does not. This tool has potential be used with high throughput sequencing or mass Sanger sequencing to identify beetle species from frass collected directly from galleries on trees across the Hawaiian Islands. Identification of ROD-associated ambrosia beetle species that produce viable inoculum is critical to the development of proper management strategies.

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In the Weeds: Mapping Change, Managing for Resilience Utilizing Stream Weed Surveys for Rapid Assessment and Monitoring in Mauka Watershed Management Areas on Kaua‘i

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Managing the biocultural resources of native forests for resilience in the face of climate change and invasion from introduced species is complex and often requires novel approaches. Quantifiable metrics of forest health and habitat change are extremely valuable for conservation prioritization and as measures for effective management actions. Streams may serve as corridors of ingress for habitat-modifying weeds like strawberry guava (*Psidium cattleyanum*), Himalayan ginger (*Hedychium gardnerianum*) and Australian tree fern (*Cyathea cooperi*) and thus also as indicators of looming changes in habitat health. Anecdotal detection of these and other weed species along the streams of the Alaka‘i Plateau has been common, though no systematic sampling had been conducted. To aid on-going watershed protection work, The Nature Conservancy’s Kaua‘i Forest Program collected detailed baseline information for streams across newly-fenced and planned fenced areas. Field staff conducted thorough surveys of ten stream stretches totaling 26.8 kilometers of linear stream corridor. Analysis of individual weed species was completed in ESRI ArcGIS using the kernel density tool and a 20-meter buffer to spatially delimit weed density along streams. Results showed a general pattern of decreasing weed densities with increased elevation along the streams. This provided repeatable metrics that can be used to measure habitat changes by area, evaluate management actions, and the analysis illuminated areas of high density for immediate weed control work by field staff. In addition to the area-specific results, this presentation will focus on providing the field methodology and analysis steps required for implementation by practitioners with similar projects.

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Examining the Effect of Helicopter Noise on Bird Assemblages in Hawai'i's Protected Natural Areas

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Anthropogenic noise has adverse effects on birds, including decreased breeding success, increased flushing behavior, and changes in vocalization patterns. The avifauna in Hawai‘i is among the most threatened in the world, and helicopter noise in Hawai‘i’s forests could be another stressor native birds face in addition to disease, habitat loss, and non-native species. The number of helicopter overflights in Hawai‘i Volcanoes National Park (HAVO) is one of the highest in the National Park system, but the effect of helicopter noise on native birds within the park has not been assessed. Our primary objective was to determine if helicopter noise affects the acoustic behavior of native birds within protected natural areas. We placed automated acoustic recorders in three forested areas that are subjected to helicopter traffic from air tours, two in HAVO and one in the Upper Waiakea Forest Reserve on the Island of Hawai‘i. We addressed the following questions: 1) Does the vocalizing behavior of birds change as the power of helicopter noise in an audio recording increases? 2) Do birds sing less after a helicopter overflight than before the helicopter overflight? And 3) does the response to helicopter noise differ by species? We found that native and non-native birds respond to the maximum power of helicopter noise, and the response differs by species. Our results demonstrate impacts of anthropogenic noise on native bird habitat and may serve as the foundation of an air tour management plan that considers potential effects of air tours on native forest birds.

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Just Add Cameras: Collecting Useful High-Resolution Imagery During Helicopter Operations

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Helicopters are a regular, important, and expensive component of large-scale conservation and invasive species efforts in Hawai‘i, commonly used in remote, ecologically important areas for digital mobile sketch map surveys, invasive plant mapping and control, ungulate control campaigns, and the delivery of supplies and personnel. Over these same areas, there is often a deficit of available high-resolution (<10 cm) imagery, despite improvements in small unmanned aerial systems (sUAS), fixed-wing manned aviation, and satellite systems. Here we present work exploring the benefits and challenges of adding consumer-grade (digital single-lens reflex (DSLR) and GoPro) camera systems to acquire useful imagery during planned conservation helicopter operations in Hawai‘i. Examples include results from invasive species surveys and control operations within Hawai‘i Volcanoes National Park, and surveys for rapid 'ōhi'a death on Hawai‘i and Kaua‘i islands. Collectively, these missions resulted in valuable imagery covering >10,000 hectares. Adding camera systems to ongoing conservation helicopter operations greatly increases the value of these missions, as the resulting high-resolution georeferenced imagery provides an objective record that can be used in a variety of ways. Important considerations include flight safety, camera positioning, image processing, and integration into mission objectives.

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The Hawaiian Koʻa Card: A Coral Health Assessment Tool for Coral Reef Resilience and Bleaching Occurrence in the Hawaiian Islands

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Coral reefs are the foundation to our social, cultural, and economic life in Hawaiʻi; however, these reefs are currently being threatened by many local and global impacts including increasing temperatures. The recent severity and extent of bleaching events pose a significant threat to the integrity of this unique ecosystem. Therefore, we developed a coral health reference card, The Hawaiian Koʻa Card, to assess and quantify coral bleaching and educate the community about its impacts to Hawaiʻi. To accurately quantify the change in color during bleaching, controlled laboratory studies followed by field validations and surveys were conducted. Colors presented on the Koʻa Card have been linked to physiological state and health (e.g., symbiont density, chlorophyll levels, photosynthetic performance) of common coral species in Hawaiʻi. The Koʻa Card provides provides a technical solution to inform and improve management of our nearshore resources through collaborative monitoring efforts by community members, researchers, and managers on a state-wide scale, which will assist in determining management efficacy, identifying resistant regions and species, establishing baselines and focus areas, and developing and exceuting rapid response plans.

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What We Learn from Responding to Stranded Sea Turtles and Monk Seals in Hawai`i

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Responding to stranded sea turtles and monk seals is an important part of our duty to help Hawaii's marine animals in need. In addition to improving individual animal welfare, Federally-permitted stranding response activities provide myriad broader benefits to science, conservation, and the community. While strandings do not necessarily represent the entire population at large, they can help us identify threats to these threatened and endangered species at local, regional and population-wide scales. Stranding investigations enhance our scientific understanding of the causes of morbidity and mortality, and can serve as an early warning system for the detection of new threats. Among green sea turtles, top causes of stranding include entanglement in fishing line, nets or other gear, fibropapillomatosis, shark attacks and boat strikes. Strandings have been an essential tool in detecting toxoplamosis in Hawaiian monk seals, which is the leading disease-related cause of mortality in the species. Stranding response presents opportunities for collecting samples that supplement long-term datasets on baseline population health, life history, foraging, and genetics, and they augment sample archives that can be used for emerging questions of conservation concern. In addition to identifying causes of mortality, post-mortem investigations offer unique hands-on opportunities to better understand the anatomical and physiological adaptations that exist in these species. In all, stranding response offers a wealth of opportunities to learn not only about seals and sea turtles but also Hawaii's marine ecosystem as a whole, and this knowledge is an important asset to the communities that depend on it.

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Rapid ‘Ōhi‘a Death Mortality Trajectories in Varied Environmental and Management Settings

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Native forests across Hawai‘i Island, and now also on Kaua‘i, are experiencing ‘Ōhi‘a (*Metrosideros polymorpha*) mortality associated with rapid 'ōhi'a death (ROD). Following the initial expression of visible symptoms, infected trees defoliate over weeks to months, with defoliation speed and severity related to the pathogen species, either *Ceratocystis huliohia* or *C. lukuohia*. The primary objective of our study was to track spatial and temporal patterns of ROD mortality on an individual tree basis under different environmental and land-use regimes (upper and lower elevation forest reserves and ranching sites) to gain insights into effective management and the resilience and future outlook of affected forests. From 2016 to the present, we collected monthly cm-scale resolution imagery via small unmanned aerial systems (sUAS) and manned helicopters, and extended our time-series back to before the outbreak via available aerial pictometry. Molecular analysis by real-time PCR was used to confirm the presence of *Ceratocystis* spp. in wood samples from selected symptomatic trees. The expression of ROD varies across study sites, with ungulate-free areas typically displaying lower mortality levels. In some locations, overall mortality is >30% of the local ‘Ōhi‘a forest, reaching 100% mortality in localized patches. A secondary objective was to determine if early detection of ROD infection is possible from the spectral signature of leaf reflectance. Repeat laboratory spectral measurements of inoculated 'ōhi'a seedlings and derived vegetation indices revealed modest early detection gains (<5 days) over detections based on visible symptoms alone. This laboratory work is being expanded with sUAS spectral measurements of inoculated 'ōhi'a trees in the field.

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A Seal-Eyed View of the Underwater Habitats of the Hawaiian Archipelago

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Understanding how animals interact with their environment can reveal ecological needs and provide insights for managing healthy populations. In the effort to recover endangered Hawaiian monk seals, it is important to understand how seals use their under-water habitat and what factors influence foraging effort and ultimately survival. Emerging technology has produced instruments that streamline the process of collecting data from seals in the marine environment, making it possible to record video footage along with data on depth, location, speed, and other movement parameters for a foraging seal. We deployed multi-sensor cameras to record metrics related to foraging habitats, such as depth and bottom type, as well as metrics related to individual foraging behavior, such as foraging trip distance and dive depths. The seals studied ranged in age from yearling to adult, and they occupied divergent habitats including French Frigate Shoals in the Papahānaumokuākea Marine National Monument (n=3) and Molokai in the main Hawaiian Islands (n=4). In this presentation, we will share foraging videos from these areas across the archipelago and describe differences in the foraging conditions encountered by monk seals in the monument versus the main islands. We found differences in foraging effort between locations, with seals from French Frigate Shoals traveling further for foraging trips and diving deeper than seals from Molokai. We also found behavioral differences according to age, with younger animals making more exploratory movements and more frequent prey chase/capture attempts. These differences in foraging behavior provide clues to the mechanisms that may drive differential survival across age classes or geographic locations.

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Management Implications of Submarine Groundwater Discharge on Coral Reef Metabolism in Maunalua Bay

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The challenges of coral reef management continue to increase from compounding stressors, with some studies predicting the total loss of reefs in the next century. Submarine groundwater discharge (SGD) has been identified as a significant source of nutrients to nearshore reefs in Hawai'i, although there is conflicting evidence regarding the impacts of SGD on reef metabolism, particularly the dynamics of net community calcification (NCC) and net community production (NCP). This study investigates how reef metabolism is influenced by SGD across a spatial mixing gradient in Maunalua Bay on O'ahu by examining the change in total alkalinity (TA) as a function of dissolved inorganic carbon (DIC) over 24h cycles at Black Point and Wailupe. We test the hypothesis that the delivery of nutrients by SGD alters community metabolism to reduce the specific calcification of reef communities by increasing proportional algal biomass. Tidal and seasonal interactions are examined to assess potential trends in reef metabolism. This study highlights the need to understand the impacts of submarine groundwater discharge (SGD) on coral reef metabolism as this knowledge can aid in assessing coral susceptibility to ongoing climate change and support management decisions that will conserve remaining reefs.

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Beginning to Re-establish a Palila Population on Northern Mauna Kea

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Prior to human contact, Palila (*Loxioides bailleui*) were found in dry forests on at least three islands, Kaua'i, O'ahu, and Hawai'i. However, their range dramatically contracted after humans arrived, and now this endangered honeycreeper is only found in a single population on the southwestern slope of Mauna Kea. The species regularly bred on the northern slope of Mauna Kea in the 1960s, and a series of releases and translocations from 1997–2009 created a temporary population there. Conservationists are renewing the efforts to re-establish an additional population to reduce the impacts of climate change and natural disasters, such as drought and fire, on the single remaining population. Following additional years of forest protection, habitat restoration, and intensive predator and ungulate removal, the habitat at the Pu'u Mali Restoration Area appears suitable to attempt to re-establish a second Palila population. A collaborative effort between multiple conservation organizations and agencies conducted an initial release of 30 Palila, bred at the Hawaiian Endangered Bird Conservation Program's Keauhou and Maui Bird Conservation Centers. This soft-release effort began in Spring 2019 and has been studying the role of pair bonding on initial settlement behaviors and monitoring post-release survival and dispersal. The effort also examined environmental factors such as māmane fruiting phenology and rainfall as important factors for influencing the establishment success of the new Palila population. This is the first in a series of Palila translocations, and future efforts will rely on moving wild birds from the southwestern to northern slopes of Mauna Kea.

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The View from Above: Aerial Approaches for Detection and Control of Ants, Plants, and Birds

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Efforts to control target invasive species in remote locations are frequently complicated by habitat and slope conditions. To overcome these challenges, the Maui Invasive Species Committee (MISC) now uses aerial platforms, including full-scale helicopters and unmanned aerial systems (UAS) in areas where sustained ground efforts are not feasible, practical or safe. A dense infestation of little fire ants (Wasmannia auropunctata) has become established in East Maui and is not accessible by foot. To implement control, MISC, in partnership with the Hawai‘i Ant Lab, has developed a helicopter-based aerial-broadcast platform to deliver a baited gel containing a non-toxic insect growth regulator. MISC continues to utilize Herbicide Ballistic Technology (HBT) to protect high-value watersheds from incursions of Miconia calvescens. The presentation will provide an update on current regulatory requirements and considerations for using HBT in Hawaii. A population of mitred conures (Psittacara mitratus), which nests on vertical sea cliffs on Maui’s north shore, once numbered in the hundreds. Previous control efforts have reduced the population to approximately 18 individuals. Surveys to locate nest sites using ropes (rappelling) had limited success due to the complexity of the cliff area. MISC and partners are now using unmanned aerial systems equipped with forward-looking infrared radiometer (FLIR) technology to locate nest sites of the remaining birds. Through the use of aerial tools, MISC and partners continue to gain new insights and improve strategies for these target species and hope to inform future approaches on a wider spectrum of taxa in the Hawaiian Islands.

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Diverse Partners and Approaches Lead to Greater Resilience of Dry Forest Restoration Projects

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Endangered Hawaiian dry forests are increasingly threatened by non-native pests, wildfire, and climate change which may lead to an increase in the intensity and duration of drought effects. In addition to accelerating threats, funding for restoration work continues to be limited. In order to restore dry forest habitats that are resilient to intensified future changes, a diversity of partnerships and approaches are required that leverage scarce resources, mobilize volunteer efforts, and utilize new technologies to assist with natural resource planning. Here we detail 9 years of effort at Pu`uwa`awa`a Forest Reserve in North Kona to meet these increasing threats through partnerships, volunteers, and the use of new technologies to better understand and manage our dry forest ecosystems. First we will discuss diverse partnerships and collaborations between Pu`uwa`awa`a and community groups that have led to the planting of over 25,000 native dry forest plants, some on the brink of extinction. Second, we will review how our partnerships and collaborations have led to new solutions to problems to help advance conservation goals. Finally, we will discuss the use of new technologies including UAS photos and surveys, remote sensing and mapping, and watershed modeling to help us understand where species are on the landscape. These approaches and partnerships have been key to successful conservation and natural resource planning and work aimed at creating resilient self-perpetuating restoration communities at Pu`uwa`awa`a, and we hope they can serve as a model for conservation programs elsewhere in Hawai`i and the Pacific.

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The Effects of Atrazine on the coral Pocillopora damicornis

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Corals reefs are currently threatened by compound effects of human and non-human induced stressors. Runoff containing sediment and toxicants used on land is one of the issues plaguing reefs in Hawai‘i. Atrazine, a restricted use herbicide, was the most commonly found pesticide in the streams that flow in to the ocean around Hawai‘i according to the 2014 Department of Health Water Quality Assessment. *Pocillopora damicornis* colonies were collected from from Kāne‘ohe Bay for use in atrazine exposure experiments. Coral nubbins were exposed to either filtered seawater (FSW), FSW with dimethyl sulfoxide (DMSO, used to dissolve atrazine), 1 ug/L atrazine, or 10ug/L atrazine to analyze whether atrazine impacts coral health at ecologically relevant concentrations. There was slight bleaching in atrazine exposed corals after a week-long exposure. Liquid Chromatography-Mass Spectrometry (LC-MS) protein analysis showed 225 upregulated and 66 downregulated proteins in the 10ug/L concentration of atrazine vs the DMSO control. The 1ug/L treatment had a similar response with 127 upregulated and 42 down regulated proteins shared with the higher concentration. Western blot analysis also showed greater expression of detoxification enzymes in the atrazine exposed samples. These results indicate that atrazine has an effect on corals at the molecular level at low concentrations. The identification of coral toxicant thresholds are necessary in order to monitor the health of Hawai‘i’s coral reefs. The development of specific coral biomarkers will allow scientists and managers to diagnose coral health before a mortality event. Management of local stressors will increase resilience of coral reefs in the context of climate change.

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Evaluating Landscape-scale Conservation in the Face of Climate Change: The Pacific Islands Climate Change Cooperative

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“Landscape-scale conservation” has become a common term in conservation biology – emphasizing the importance of planning at scales that encompass ecological processes and species migrations, and address large-scale environmental threats – but formal frameworks for evaluating the effectiveness of landscape-scale conservation have remained rare. Recognizing the need for collaborative responses to large-scale environmental stressors such as climate change, the U.S. Department of the Interior began developing a network of Landscape Conservation Cooperatives (LCCs) in 2009. As one of these twenty-two LCCs, the Pacific Islands Climate Change Cooperative (PICCC) was established with the charter purpose of assisting those who manage native species, island ecosystems, and key cultural resources in adapting their management to climate change for the continuing benefit of the people of the Pacific Islands. Guided by a diverse steering committee of land/resource managers, the PICCC serviced a vast area across Hawai‘i and the U.S. Affiliated Pacific Islands. This paper presents key findings from our attempt to evaluate PICCC’s achievements between 2009 and 2018. Based on interviews and a survey, we describe the foundational conditions from which the PICCC set out to establish a landscape-scale conservation framework, the challenges it faced, its goals and achievements, and derive transferable lessons from the experience for any conservation community working with limited resources across large expanses of land and ocean. The research underlying this presentation serves as a record of the unique landscape-scale conservation and climate adaptation approach that was developed by the PICCC’s steering committee and partners over the course of the collaboration.

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Hoa‘āina of Hā‘ena: the story of an ‘ohana-driven organization's journey towards ‘Āina Momona in Hā‘ena, Kaua‘i.

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Hui Maka‘āinana o Makana (Hui) is a non-profit organization established and governed by ‘ohana of Hā‘ena on the island of Kaua‘i. Like the a‘ali‘i, with strength and persistence, these ‘ohana have withstood strong and ever changing winds of change in their rural community. The mo‘olelo (history) of this organization speaks volumes to the trials and successes of Hā‘ena’s lineal descendant’s perseverance to be the hoa‘aina (companions) within their ahupua‘a. In the face of constant change the unique history of this ‘ohana-driven organization highlights their processes to be flexible like the ‘a‘ali‘i, building relationships and capacity within their community. These stories shed light on the accomplishments the Hui have had through the stages of growth which include: 1) building co-management relationships with the State, 2) establishing the first community-based subsistence fishing area, 3) facilitating a community-driven marine monitoring program, and 4) creating a pathway through programs and internships that target future generations of the Hā‘ena community. The goal of this session is to share these stories through a range of perspectives and experiences in the hopes that these lessons will resonate with other communities who are becoming hoa‘aina within their place. Kupuna and makua will share the challenges and successes of their journey while incorporating the voices of the next generation. This collective and generational expertise will provide attendees with an opportunity to learn from the often unheard/untold story of Hui Maka‘āinana o Makana‘s journey to ‘Āina Momona (a thriving and productive people and place).

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Viability Testing of Rapid ʻŌhiʻa Death (ROD) Found On Ambrosia Beetles and Their Frass

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Ambrosia beetles (Curculionidae: Scolytinae) are hypothesized to play an important role in the spread of the fungal pathogens *Ceratocystis lukuohia* and *C. huliohia* that cause Rapid ʻŌhiʻa Death in Hawai'i. The beetles may directly spread the disease between trees by transferring viable fungal propagules attached to their bodies or indirectly through propagules attached to macerated boring material (frass) that is released into the environment during their excavation of reproductive galleries. We reared beetles in the laboratory from portions of freshly cut ʻōhiʻa that were infected with *C. lukuohia* or both *C. lukuohia* and *C. huliohia,* and contained active beetle galleries. To date, seven ambrosia beetle species have been reared from infected ʻōhiʻa (*Metrosideros polymorpha*) trees on Hawai'i Island. We employed a variety of culturing techniques to investigate the overall viability of *Ceratocystis* propagules on ambrosia beetles and their frass that emerged from ʻōhiʻa. We successfully cultured *C. lukuohia* and *C. huliohia* from frass collected throughout the length of naturally infected ʻōhiʻa trees but have yet to confirm the presence of viable propagules on the emergent beetles. We were able to culture *C. lukuohia* from ambrosia beetles allowed to walk on live fungal colonies growing in the lab suggesting that beetles may be capable of directly transferring propagules. We are continuing to investigate the role of ambrosia beetles in the transmission of *Ceratocystis* focusing on beetles and frass collected from emergence traps in the field.

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Preserving Coral Reef Biodiversity Using Cryopreservation

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Coral reefs are declining globally due to warming sea surface temperatures, ocean acidification, and a suite of local stressors. It is imperative that coral populations and biodiversity are maintained before they are lost. Cryopreservation has been used effectively for many years to preserve other wildlife species and their genetic diversity. Our lab uses cryopreservation techniques to preserve the genetic diversity of coral species around the world. Currently we are able to freeze coral sperm and larvae and have banked over 30 species globally, including 3 Hawaiian species. However, after the consecutive bleaching events in 2014 and 2015, our team documented a significant decline in reproductive success in the Hawaiian corals we study. Our existing conservation methods (freezing sperm and larvae) depend on corals producing high quality reproductive material, and this decline has forced us to explore other important cryo-conservation methods. Corals are able to asexually propagate from small fragments that have been broken from the parent colony. We are developing techniques to freeze these micro-fragments of adult coral, which if successful, would decouple conservation efforts from sexual reproduction and its very limited window of opportunity, allowing cryo-conservation of corals to be year-round and to work with species which are problematic due to location or unknown reproductive timing.

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Developing and Implementing Indicators on Connections Between People and Place

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The importance of connections between and across people and place is a key commonality and means to enable strength and resilience in the face of change here in Hawai'i and in Indigenous and local communities around the world. However, for a number of reasons, managers and policymakers around the world struggle to incorporate these concepts and related metrics into management plans and sustainability policies across local to global scales. During this presentation we discuss lessons learned through continued collaborations with Indigenous and local community members in the Pacific and internationally on metrics related to people and place, including an April 2019 practitioner gathering highlighting practical experience and lessons learned developing and implementing Indigenous-led indicators. We present takeaways from the gathering, together with highlights from complementary efforts, to describe successfully implemented sustainability management metrics on the connections between people and place as well as examples of implementation challenges and potential solutions. We conclude by describing how this information has informed preliminary work on a series of policy briefs for managers and policymakers interested in enhancing the local and cultural relevance and applicability of their reporting metrics. We have found that sharing these experiences and reflections creates and supports opportunities for community-to-community exchange. More importantly, we hope that sharing this information ultimately supports future action towards identifying metrics that are culturally appropriate, monitored in a way that is coordinated with and respect peoples' livelihood strategies and time limitations, and provide information that is relevant for local community decision-making in Hawai'i and beyond.

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Current Status of Coqui Frog (Eleutherodactylus coqui) on Maui and an Overview of Approaches to Control

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The Maui Invasive Species Committee (MISC) continues to utilize an integrated pest management approach to control coqui frogs (*Eleutherodactylus coqui*). Monitoring of known infestations and detection of incipient populations is ongoing, with 53 single frogs removed and 4 new populations (five or more calling coqui in discrete locations) found in the 2018 calendar year. Of 29 historic populations, 19 are now considered eradicated, supporting MISC's use of an effective approach to removal. However, biological, environmental, and operational challenges related to control have put MISC at a crossroads. With limited resources, MISC has updated its approach to containing this invasive species by utilizing smarter tools and technology, focusing on high-risk expansion zones, and most importantly, empowering organized community groups to perform coqui control to supplement MISC efforts.

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Scent Detection Dogs as a Tool for Species Monitoring and Impact Study at Renewable Energy Sites

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In the United States, scent detection dogs have been successfully deployed at renewable energy sites to help monitor and record the operational impact on migrating and resident birds and bats for over a decade. Dogs are vital tools in this effort, as they can make detection without human characteristic inferring bias.

In the projects, dogs were trained to detect and locate species including pallid bats, Swainson's hawk, burrowing owl, American peregrine falcons, white-tailed kite, and loggerhead shrike. (At wind farms on Oʻahu, Maui and Hawaiʻi islands, dogs are utilized to detect species including Hawaiian hoary bat, Wedge-tailed shearwater, and Hawaiian petrel.)

Typically, a well-trained scent detection dog team can successfully find 80-90% of all possible targets, which far surpasses the detection rates of human surveyors without a dog. The higher detection rate achieved through canine surveys provides a more accurate take estimate of monitored species, which may in turn better inform the take permitting process and efforts to prevent or mitigate wildlife mortality.

The presentation will share different training and assessment standards as well as testing methods that are applied to specific survey sites in California (Mojave, Leemore and Livermore), and how they could be improved or further standardized across nationwide renewable energy projects to optimize bird and bat detection. As more wind and solar farms are constructed to support renewable energy, it is important to improve the monitoring to comply with incidental take permits and understand the impacts to wildlife in Hawaiʻi, Pacific and mainland.

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Shifting the Balance in a Lowland Mesic Forest on O‘ahu: Maximizing the Native Acacia koa Seed Bank

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Working with the Hawai‘i Division of Forestry and Wildlife (DOFAW), we have built a partnership that allows Kapi‘olani Community College (KCC) students to work alongside community members restoring a two hectare exclosure in Wailupe Valley constructed by DOFAW. Our team has established a transect grid to document current forest composition as a baseline for comparison prior to invasive species removal and establish removal comparison plots to determine the most efficient restoration techniques. This past spring, we targeted invasive species removal in 10 x 10 m plots with high potential of carrying a seed bank of native Acacia koa and adjacent plots with similar topography and species demographic for comparison. We hypothesized that newly sprouting Acacia koa seedlings will indicate the existence of a fertile seed bank with potential for enhanced restoration of the native habitat. Prior to removal, we monitored tree species in both the removal and control plots. Everything >1 m height was measured for diameter at breast height (DBH), and everything <1m was counted. We calculated basal area [$BA=\pi(DBH/2)^2$] and summed for each species. We cleared removal plots of invasive species using manual hand removal methods. Through continued post-removal monitoring, we have observed that in the removal plots Acacia koa seedlings have sprouted and thus far are thriving in the newly cleared canopy. Our results demonstrate that these seed bank targeted methods of extraction in conjunction with community involvement allow for a potentially reproducible model for holistic native forest rehabilitation.

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Prioritizing fire management, conservation and stakeholder trust over a large landscape at Pu‘u Wa‘awa‘a, Big Island

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Conservation in Hawaii must contend with the complexity of both ecological conditions and the values of people who use the landscape. The 15,000 ha Pu‘u Wa‘awa‘a (PWW) Forest reserve on leeward Hawai‘i Island holds some of the largest tracts of native dry forest which have been heavily impacted by fire and ungulates. PWW is managed by the Hawaii Division of Forestry and Wildlife (DOFAW) who also serve a diverse community of recreationalists, hunters, and ranchers. Multiple options can address the threats to native ecosystem integrity, yet each comes with trade-offs in terms of stakeholder support. The objective of this study was to quantify these trade-offs to understand how and where different management alternatives contribute to native species protection and maintaining stakeholder trust. We applied a structured decision making framework that incorporated the variation in cost and outcomes of each management alternative across the PWW landscape with respect to fire risk, native species protection and how alternatives build or erode user group trust. We ran optimization models to identify the type and location of management alternatives under various budget constraints and scenarios that prioritize different outcomes (e.g. rancher values vs. endangered species protection). Our results indicate that stakeholder interests and fire risk reduction can be maximized at lower cost than conservation objectives, and, unsurprisingly, that maximizing native species reduces trust among hunters and ranchers. However, the models also identified alternatives that balance these interests and provide a transparent method for DOFAW to inform and justify their decisions with stakeholder groups.

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THE EVOLVING THREAT OF RAPID 'ŌHI'A DEATH (ROD) TO HAWAI'I'S NATIVE ECOSYSTEMS AND RARE PLANT SPECIES

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'Ōhi'a has been dying across large areas of Hawai'i Island mainly due to two fungal pathogens (*Ceratocystis lukuohia* and *Ceratocystis huliohia*) collectively known as Rapid 'Ōhi'a Death (ROD). Here we examine patterns of positive detections of *C. lukuohia* as it has been linked to the larger mortality events across Hawai'i Island. Our analysis compares the environmental range of *C. lukuohia* and its spread over time through the known climatic range and distribution of 'ōhi'a. We further modeled the potential distribution of *C. lukuohia* across the Hawaiian Archipelago to estimate the risk of ROD to other islands. Given the potential for *C. lukuohia* to alter the structure of 'ōhi'a dominated forests, we used our projected potential distribution of *C. lukuohia* to assess the risk of ROD to threatened and endangered plant species across Hawai'i. Analyses show this fungal pathogen generally encompassed the core, but not the extremes of the climatic range of 'ōhi'a. We also found evidence that protecting habitat by fencing out introduced feral ungulates reduces the incidence of the disease likely by reducing physical damage caused by these animals to 'ōhi'a trees, a precondition for *Ceratocystis* infection. Our distribution models indicate that there are highly suitable areas for the disease across the archipelago. Many native plants are likely vulnerable to these types of large 'ōhi'a mortality events: of 234 endangered native plant species considered, 122 (52%) have more than half of their range within current and expanding *C. lukuohia* suitable areas. Given the ongoing spread of *C. lukuohia*, we developed a dynamic web portal to host our results online, where models and analyses are updated to provide managers with a useful tool to help monitor and assess the risk of *C. lukuohia* as it continues to spread.

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Investigating the Relationship between Microplastic Sinks and Sea Urchin Density on Kaua'i

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Microplastics in the ocean have become a major environmental concern. There is concern that microplastics have entered the food chain and will impact biodiversity. Kaua'i's coastline has intertidal habitats which host many important species such as sea urchins. Tidepools have limited circulation so they may be sinks for microplastics. Bottom feeders living in tidepools like sea urchins might be affected by the accumulation of microplastics.

I examined sediment samples from four tidepools in southeast Kaua'i. In each pool, I measured total tidepool volume and conducted a sea urchin survey – visually identifying the number of urchins from 3 species. All samples and data were collected once from each tidepool. The control sediment sample was taken in the open ocean about 50 feet from the shoreline. I then used a home-made sediment-microplastic isolation unit (SMI) to separate out the microplastics from the samples. A zinc chloride solution was used as the separation medium. I then ran a correlation analysis on the number of microplastic strands per sample to the density of sea urchins (urchins/cubic meter) of all four pools.

The analysis found that tidepool samples contained more microplastics than the control sample. This indicates that tidepools collect and hold microplastics. The correlation coefficient of -0.67 shows a weak negative correlation between the microplastic concentration and sea urchin density. This may indicate that increased microplastic concentration has an impact on sea urchin density in tidepools. What happens in tidepools is an indicator for what may happen ocean-wide as microplastic pollution continues.

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The Return of the Naturalist: A Forest Bird Field School Takes Flight in Hawai‘i

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The endemic forest birds of Hawai‘i are marvels of evolution yet threatened by disease, habitat loss, and predation - all threats exacerbated with climate change. Monitoring and managing their populations, especially in changing environmental conditions, require reliable data collected by trained observers. Over the last few years, during forest bird surveys on Hawai‘i Island, we observed a lack of “primary” observers trained to identify all forest birds by sight and sound. The de-emphasis of natural history in conservation biology and the reduction in field training courses at universities has led to a shortage of trained observers. Currently, conservation programs and land managers lack sufficient capacity to train forest bird monitors. To address this lack of capacity, we offered a “Forest Bird Field School” on Hawai‘i Island in January 2019. This intensive, week-long course included field-based training on forest bird identification and survey techniques; small group mentoring; and discussion and interaction with experts in the field of Hawaiian ornithology, cultural history, and forest bird conservation. 16 locally based participants, from a wide range of backgrounds, completed the course. Eight participants earned “primary” observer status and eight students advanced their identification skills considerably. Through developing and improving emerging biologists’ naturalist skills of observation and identification, we hope to not only sustain the capacity to conduct future forest bird surveys but also to revive the importance of natural history in Hawaiian conservation biology.

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Mapping and prioritizing vegetative fuels management projects to reduce fire risk across Hawaii State

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The area burned annually by wildfire in Hawaii has increased fourfold in recent decades. Reducing the hazard posed by vegetative fuels is one of the few management actions that can directly reduce fire risk. In 2015, Hawaii Wildfire Management Organization's (HWMO) Technical Advisory Committee, comprised of over 35 fire and natural resource experts across the state, discussed Hawaii's lack of consolidated landscape-level information on vegetative fire fuels treatments. HWMO therefore prioritized this issue due to its importance toward furthering activities to protect natural resources and communities from wildfire. Funded by State Grant-in-Aid and US Forest Service grants and in collaboration with University of Hawaii Wildland Fire Program and the Hawaii Division of Forestry and Wildlife, HWMO coordinated workshops to develop island-by-island vegetative fuels management maps. The project used participatory mapping with land stewards, land managers, and agencies to identity both existing and desired fuels reduction activities in order to: 1) Improve ability of landowners and land managers to plan projects and secure funding for vegetative fuels management efforts; 2) Identify and communicate vegetative fuels management needs and priorities; 3) Enhance communication among partners, neighbors, and funders by providing visual aids and a collaborative workshop process; and 4) Maximize fire protection by using resources for highest shared priorities. In this presentation, we describe the fundamentals of hazardous fuels identification, the process and lessons learned in creating these maps, and discuss how the workshops illustrate the diversity of valued resources and highlight the areas that participants prioritized for future fuels management work.

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Āhua Reef Wetland Restoration

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Āhua Reef wetland serves to integrate conservation, community and the navy's mission. By strengthening this section of land we are providing a standard for future restoration efforts and creating safe habitat to help the endangered Ae'o (Himantopus mexicanus) population thrive. Āhua Reef is a 4-acre coastal wetland with adjacent mudflats and nearshore reefs located at the mouth of Pearl Harbor on Joint Base Pearl Harbor-Hickam. Comprehensive conservation efforts in this area are targeted at building a resilient ecosystem that increases storm water retention, boosts coastal strength and increases waterbird nesting habitat. Several acres of invasive red mangrove (Rhizophora mangle), pickleweed (Batis maritima) and kiawe (prosopis pallida) have been removed, which allows native species to survive and flourish. Volunteer events to restore Āhua Reef serve as a platform to educate and converse with local community members regarding all projects undertaken Navy Natural Resources ranging from invasive species management to wildlife conservation. These include: Brown Tree Snake (Boiga irregularis) trap monitoring, Naio Thrips (Klambothrips myopori) surveys, Coconut Rhinocerous Beetle (Oryctes rhinoceros) mitigation, Green Sea Turtle (Chelonia mydas) Nesting surveys, Native Oyster Restoration, Pueo (Asio flammeus sandwichensis) surveys and waterbird monitoring. Before restoration efforts started at Āhua Reef, few birds visited the area. With the removal of invasive alien plants, predator trapping and restriction of domestic pets, Ae'o are now residents in the area. Their neighbors include kōlea (Pluvialis fulva) and 'Auku'u (Nycticorax nycticorax). Ongoing work at Ahua Reef represents long-term conservation work that is directly improving habitat quality for endangered waterbirds.

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Restoration of 'Aina Malo'o on Hawai‘i Island

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Before European contact, Native Hawaiian agriculture was highly adapted to place and expressed a myriad of forms. Although the iconic lo‘i systems (flooded irrigated terraces) are often portrayed as traditional Hawaiian agriculture, other forms of agriculture were, in sum, arguably more important. While pockets of traditional agricultural practices have persevered over the 240 years since European arrival, the revival of indigenous methods and crops has substantially increased since the 1970s. While engagement in lo‘i restoration and maintenance has been a core vehicle for communication and education regarding Hawaiian culture, it does not represent the full spectrum of Hawaiian agriculture and, on the younger islands of Hawai‘i and Maui in particular, does not accurately represent participants’ ancestral engagement with ‘a ̄ina malo‘o (dry land, as opposed to flooded lands). These “dryland” forms of agriculture produced more food than lo‘i, especially on the younger islands, were used to produce a broader range of resource crops such as for fiber, timber, and medicine, were more widespread across the islands, and formed the economic base for the powerful Hawai‘i Island chiefs who eventually conquered the archipelago. The recent engagement in the restoration of these forms of agriculture on Hawai‘i Island, compared to the more longstanding efforts to revive lo‘i-based cultivation, is challenging due to highly eroded knowledge systems. However, their restoration highlights the high level of place-based adaptation, demonstrates the scale and political landscape of pre-European Hawai‘i, and provides essential elements in supporting the restoration of Hawaiian culture.

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Preserving Ancient and Historic Trail Systems in Hawai‘i Through Community-Based Stewardship, Descendant Kuleana, and Ancestral Indigenous Knowledge

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Hawai‘i Island is composed of a network of ancient and historic trails of cultural and historical significance which traverse ahupua‘a throughout the Hawai‘i Island coastline and connect communities from mauka to makai. In alignment with our mission to perpetuate the legacy of our ancestors, the Ala Kahakai Trail Association (ATA) is committed to connecting, reconnecting and enhancing the connections of families and communities with ancient and historic ties to the trail. In recognition of this ancient trail system, a 175-mile corridor within the trail system was designated as the Ala Kahakai National Historic Trail. The National Park Service and ATA support management strategies emphasizing the preservation of natural and cultural resources within the trail corridor, while honoring traditional values and practices with protocols and respect for Hawai‘i - past, present and future. This presentation will identify the benefits of utilizing ancient trails as a natural resource management tool with emphasis on community-based management and provide opportunities for discussions on how educational outreach and trail stewardship efforts are aligned with the conservation goals of Hawai‘i. Trails provide a physical link to natural resources, facilitating access intended for collaborative landscape protection, resource management and educational outreach. Incorporating trail systems into natural resource protection strategies will encourage communities to enhance and maintain positive relationships with the natural environment while mitigating human impacts on natural resources. In the face of change we must strengthen the stepping stones that we intend future generations to walk upon, ensuring resiliency in current and future conservation efforts.

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Development of optimal survey methods to provide reliable estimates of game bird populations on Hawai‘i Island

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Hunting of game species is a culturally, socially, and ecologically important activity across the Hawaiian archipelago. Today, 16 introduced game bird species can be hunted in the Hawaiian Islands during designated hunting seasons. Mauna Kea Forest Reserve and Game Management Area and Kapapala Ranch (both on the island of Hawai‘i) are managed by the state of Hawai‘i Division of Forestry and Wildlife. Game bird populations in these areas are understudied, and a better estimate of their population size is needed, both to inform hunting regulations and evaluate conservation actions. To address these concerns we (1) designed and tested game bird survey methodologies with and without the use of dogs; (2) estimated game bird population sizes in each reserve and (3) compiled and analyzed game bird harvest data from 1986 to 2018 on all of Hawai‘i island. Line distance sampling gamebird surveys were carried out with and without dogs in both hunting units in 2018. No differences in detection rates were found for Kapapala among survey methodologies but detection rates were higher with dogs at Mauna Kea. Hunting dogs can significantly increase encounter rates in locations with high vegetation and low observer visibility. The harvest numbers suggest that hunter success is location and species-dependent.

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Finding Resilience in Muliwai: Do estuaries of Hawai‘i Need a Baseline State?

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Our expectations are that resilient ecosystems will return to a baseline state after disturbance. In other words, resilience of an ecosystem is measured against its ability to reestablish itself to a pre-disturbance state. However, and in many ways counterintuitively, resilient ecosystems do not always recover to a baseline. An alternative approach to assess resilience of an ecosystem is to gauge its capacity to adapt to changing conditions while continuing to perform core ecological functions.

Estuarine ecosystems can contribute to our understanding of resilience because their established communities are adapted to hourly, daily and seasonal shifts in salinity, pH, temperature, turbidity, light attenuation, and other stressors that occur within compressed habitats. Estuaries perform important ecological functions, such as nursery areas for juvenile fish; erosion protection and retention of soils; improving water quality; and sequestering of excess nutrients. On the other hand, estuaries are deeply impacted by changes linked to the anthropogenic alternations of the global environment, including sea level rise as well as changes in precipitation, temperature, and salinity. Here we will present a conceptual model of core ecological functions linked to resilience in muliwai based on four years of monitoring 10 sites throughout Hawai‘i. This conceptual model will be applied to assess and document extant conditions of muliwai at a Statewide level over the next three years.

Importantly, understanding resilience in muliwai will inform restoration and reconstruction efforts of this coastal ecosystem formed by marine, freshwater, terrestrial and atmospheric interactions.

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Division of Aquatic Resources is Improving Data Management of Aquatic Resources by Providing Tools to See a Bigger Picture

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Division of Aquatic Resource (DAR) staff collect, store and interpret a range of data to monitor and manage hundreds of species, both native and invasive, in aquatic ecosystems that include streams, estuaries, anchialine pools, wetlands, rocky intertidal and coral reefs. In addition to resource conservation monitoring, DAR also collects and manages data on resource extraction (i.e., recreational fishing efforts). Here we will discuss how these data have been managed and used to date, where the division is doing as we evolve our data management to single, multiuser, centralized database, and how this approach can support multiple scale initiatives, from Community-based Subsistence Fishing Areas (CBSFA) to 30 by 30 Marine Management, to improve both aquatic resource conservation and recreational fishing experiences.

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Partnerships and Community-based Stewardship Supports Marine Wildlife Resilience in Hawai‘i

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Nearshore coastal fisheries are a documented threat to sea turtles and monk seals in Hawai‘i and an impediment to population recovery. Interactions with gillnets are typically lethal, and hook-and-line fishing gear can cause entanglement, flipper amputation, and death; resulting in approximately 200+ strandings per year. To address this threat and empower fishermen with relevant guidance, it was necessary to build community-based stewardship while promoting co-existence between fishermen and protected marine species. A multi-agency partnership coupled with community participation has established a *Fishing Around Seals & Turtles* (FAST) program to promote responsible recreational fishing and community engagement. FAST serves as a platform to disseminate information and best-practice guidance – developed as a result of stranding data – to reduce the frequency and adverse effects of accidental interactions. These best-practices include barbless circle hooks, guidance to improve survivorship, and reporting. Through FAST, Hawai‘i’s fishermen are becoming empowered to contribute to ongoing conservation efforts. Importantly, we anticipate that the resulting open and honest communication between fishermen and government partners will provide the foundation to support community stewardship and marine wildlife resilience into the future. This presentation will provide an overview of key messaging, best-practices, and lessons learned given the challenges related to the status of marine wildlife populations, the logistical constraints of raising awareness and responding to wildlife emergencies in a multi-island state, and fishing practices that are deeply embedded in Hawaiian culture.

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Translating Specimen Data into Conservation Action

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Bishop Museum has the world's largest collection of Hawaiian plants and animals - around 4.5 million specimens. This material, which is beiing actively databased and georeferenced, forms the core of the Hawaii Biological Survey (HBS), a state-designated program based at the Museum to compile a complete inventory and to document the occurrence and status of all plants and animals of Hawaii - native and non-native, terrestrial, marine and freshwater - and to maintain reference collections of these organisms. The Museum is currently updating its HBS species checklists and is developing plans to provide web-based spatial information resources and utilities for use by natural resource managers. The Museum also holds around eight million specimens from Papua New Guinea (PNG). It has combined data from this material with data from other museums to develop a national biodiversity information system to help assess conservation options in PNG. The lessons learned from this effort, which provides a model demonstrating the use and importance of specimen data for conservation planning, are being incorporated into the HBS.

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Of Mantas and Men: Understanding the Intersection of Hawai‘i's Reef Manta Ray and Its Growing Tourism Industry

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In 2014, the Hawai’i state legislature passed House Concurrent Resolution 170 (HCR 170) urging the Department of Land and Natural Resources (DLNR) to manage the Kona manta viewing sites and address overcrowding, safety, and liability concerns. DLNR made a thorough analysis of the popular Kona manta viewing sites and decided to implement mooring buoys, limited use permits, and a suite of accompanying regulations. This study examines proposed updates to Hawaii Administrative Rule §13-256 and the Kona manta viewing sites management plan in comparison to (1) “charismatic megafauna” marine tourism elsewhere (e.g. sharks, rays, and marine mammals), and (2) public perceptions surrounding these sites. Using methods from Chung et al. 2019 to systematically rank management tools at similar sites and a qualitative analysis of forty stakeholder interviews, my study will evaluate the likely effectiveness of the regulations. After more than thirty years of unconstrained manta viewing tourism, proposals for management have included everything from the status quo (no regulation) to complete closure. DLNR’s task is to identify which of the many regulatory options should apply to these unique places. The success of the program will depend not only its ability to address the concerns of HCR 170, but also to advance DLNR’s mission to protect and conserve Hawaii’s natural resources.

Chung, A., Oliver, T., Gove, J., Gorospe, K., White, D., Davidson, K., & Walsh, W. (2019). Translating resilience-based management theory to practice for coral bleaching recovery in Hawai ‘i. *Marine Policy*, *99*, 58-68.

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Native Forestry: A new model for sustaining conservation

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The necessity for ecological restoration and biodiversity conservation is intensifying but funding for this work is often inconsistent a threat to the long term viability of conservation efforts. Attempting to embody the resilience of a‘ali‘i which is captured in this year’s conference theme: *He ‘A‘ali‘i Ku Makani Au*, resource managers are exploring new management models which provide the stable funding needed to achieve native ecosystem restoration goals. This panel will showcase four innovative native forestry projects which have developed new financial and ecological models for koa (*Acacia koa*) and ‘iliahi (*Santalum paniculatum*) ecosystem restoration on Hawai‘i Island at Keauhou, (Ka‘ū), Hōkūkano and Hāmākua. Experts in land management, forestry and conservation will share about these projects, their respective roles, and how each contribute to the overall project success. An example of one project is the effort at Hōnaunau where harvest of koa from an area heavily impacted by grazing and feral ungulates is used in the production of high value instruments. The project, while still in its formative years, has provided economic capital to increase ecological restoration within Hōnaunau Forest, most recently through providing funding to plant 5,000 native trees.

This session is hoped to stimulate proactive conversation around finding practical and appropriate financial solutions for land managers throughout the state. To best achieve this, an interactive discussion featuring the panelists will be held following the presentations allowing the audience to dive deeper into the social, political, and ecological challenges each project has faced.

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Overcoming challenges in seed production of Bonamia menziesii, a critically endangered and Hawai'i-endemic vine.

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In the comprehensive seed bank of the National Tropical Botanical Garden, only 4 wild collections of seed exist for *Bonamia menziesii*, totaling less than 100 seed. The most recent collection was made in 2001 because the wild plants on Kaua'i are no longer setting fruit. Insect predation and pollinator loss are some factors contributing to the rapid decline of this species in the wild; these are issues common to many plant species in Hawai'i. For years, our nursery specimens of *Bonamia menziesii* have flowered consistently but failed to set fruit. In September of 2018 we began hand pollination to encourage fruit set. During our initial attempts to produce seed we hit several hurdles, from learning proper pollination technique to preventing abortion of fruit. Our goal is to prevent extinction of *Bonamia menziesii* by producing viable seed for both storage and propagation. Methods of fruit production investigated on our ex-situ collections include hand pollination, open pollination, and utilizing physical barriers to prevent insect predation. We have had 60+ fruits on multiple vines, but are still determining factors that contribute to the production of viable seed, including banking seed, sending seed to Lyon Arboretum for micropropagation and direct propagation. Understanding both the needs of our endangered species and the species-specific threats they face is critical for improving our restoration populations. Our successes and failures will inform conservation plans for this and other endangered Hawaiian species.

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Hunting in Paradise: hunting and harvest data on Lāna'i 2014-2018

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Axis deer (*Axis axis*) have been hunted on Lāna'i for almost 100 years. Since the 1950s, Hawaii's Department of Land and Natural Recourses, Division of Forestry and Wildlife has leased and managed 30,000+ acres of Lāna'i as a Game Management Area (GMA). Various land owners have managed deer on the remainder of the island with different philosophies depending on agricultural mission at the time. Since 2012, management of hunting outside the State GMA has fallen to the Wildlife Control Staff with Pūlama Lāna'i (PL) which is the land-management and property asset company for the island's majority ownership. Though the GMA and PL hunting areas effectively share the same herd, their seasons, tag fees, bag limits and other management parameters are very different. For instance, rifle hunting occurs year-round in PL hunting areas but with low daily numbers of hunters (~1-10 per day), whereas hunting occurs for only 9 weekends in the GMA but with high densities of hunters (175+ per weekend). We set out to 1) compare the different strategies for deer management and hunting in these two areas; 2) review hunter and harvest data collected between 2014 and 2018 in both areas; and 3) assess the management implications of this data to better manage ungulates on Lāna'i. The data shows a steady increase in hunting pressure. However, the hunting success rate, has remained approximately the same across both the PL and GMA managed areas. The hunting pressure as it stands, has not curtailed the growth of the herd.

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South Maui Coral Reef Cleanups: Saving One Polyp and Turtle at a Time

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Numerous human-caused threats are accelerating the decline of our Hawaiian coral reefs. Derelict fishing gear and trash ("marine debris") entangles, hooks, chokes, sickens, and crushes coral plus reef dwellers. Since this debris persists in the ocean environment for many years, careful removal lessens these often-unseen impacts. Our small Turtle Team (2-12 trained people) conducted 279 surveys from Mā'alaea to Mākena, South Maui, in 2018. Marine debris was opportunistically collected during these surveys that lasted ~1-2 hours depending on ocean conditions. Everything was collected by freediving with scissors and wire cutters, and then transported on customized floats. Once ashore, items were photographed, sorted into categories and quantified. Not including the fishing line/rope, the number of other items removed per survey ranged from 0 to 366 (mean= 52.2 ± 72.1 SD). A total of 119,340 ft of fishing line/rope plus 15,198 items (2,379 pounds) were collected: 1,950 hooks, 5,820 weights (1,088 pounds), 3,123 swivels, 450 bobbers/lures, 497 leaders, 1,832 pieces of plastic trash, and 1,526 pieces of other trash. Items were either recycled, upcycled, re-used, trashed, or kept for art/educational purposes. During these 2018 surveys, our team de-hooked and/or disentangled 48 green sea turtles (*Chelonia mydas*). These cleanup and rescue activities show the prevalence of this issue in South Maui, which is known for its ecologically significant and beautiful coast. Statewide solutions: more community involvement, education, responsible fishing practices, and litter control plus extended producer responsibility.

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Training dogs to detect imported fire ants

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DRAFT In this investigation, detection dogs are trained and used in identifying red imported fire ants, *Solenopsis invicta* Buren, and their nests. The methodology could assist in reducing the frequency and scope of chemical treatments for red imported fire ant management and thus reduce labor costs and chemical use as well as improve control and quarantine efficiency. Three dogs previously trained for customs quarantine were retrained to detect the scents of red imported fire ants. After passing tests involving different numbers of live red imported fire ants and three other ant species--*Crematogaster rogenhoferi Mayr, Paratrechina longicornis Latreille, and Pheidole megacephala* F.--placed in containers, ajoint field survey for red imported fire ant nests by detection dogs and bait traps was conducted to demonstrate their use as a supplement to conventional detection methods. The results prove detection dogs to be most effective for red imported fire ant control in areas that have been previously treated with pesticides and therefore containing a low density of remaining red imported fire ant nests. Furthermore, as a complement to other red imported fire ant monitoring methods, this strategy will significantly increase the efficacy of red imported fire ant control in cases of individual mount treatment.

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Management of Rapid ʻŌhiʻa Death on Hawaiʻi

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Rapid ʻŌhiʻa Death (ROD) is a fungal disease causing mass mortality to the keystone forest tree species in Hawaiʻi. The potentially devastating impacts to native ecosystems and watersheds are a top concern for land managers throughout the state, and have prompted a multifaceted interagency response. On Hawaiʻi Island, collaboration and information sharing between land managers and ROD scientists has led to the development of an Early Detection-Rapid Response (EDRR) program to locate and suppress new infestations. Through adaptive management, this program has identified a suite of best management practices and has been instrumental in the development and testing of key research questions to better understand ROD. Management strategies such as felling, tarping and monitoring will be discussed. The lessons learned on Hawaiʻi Island are fully transferable; for example with the 2018 detection of ROD on Kauaʻi, tools and workflows developed on Hawaiʻi Island have been employed by Kauaʻi land managers to better manage infestations and conduct outreach and communication campaigns, and these lessons learned can be shared more broadly across the State. In this talk we will present the latest approaches to detection and management of ROD, and share some of the successes and challenges of maintaining a broad interagency collaboration with a wide variety of stakeholders across the State.

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I Paʻa Hou i Kalou: Visualizing Bio-Cultural Restoration of Loko Wai and Loʻi Kalo in Waialeʻe, Oʻahu

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Waialeʻe, Oʻahu harbors diverse yet little-studied cases of Hawaiʻi's unique natural resources, Kanaka ʻŌiwi (native Hawaiian) use of those resources, and the complex histories and contemporary issues that surround them. Of particular note is Kalou, a 2-acre loko wai (freshwater fishpond) situated within the present-day 20-acre Kalou Marsh, which was formerly used as loʻi kalo (taro pondfield). Although the majority of present vegetation there is non-native, endangered, endemic Alae ʻUla (Hawaiian Gallinule) and Alae Kea (Hawaiian Coot) have consistently been observed at Kalou Marsh over the past year. At present, the University of Hawaiʻi owns 135 acres in Waialeʻe, including the majority of Kalou Fishpond and Kalou Marsh, and is currently seeking to relinquish management this property. Given this context, here I review 19th and 20th century ʻŌlelo Hawaiʻi (Hawaiian language) and English primary archival documents to describe the traditional wetland agroecosystem of Kalou. I combine knowledge of this reference system with that of subsequent landscape and demographic changes, baseline observations of Kalou's present state, current community and stakeholder sentiments gathered through a recent visioning workshop series, and projections of future climate change and sea-level rise. Ultimately, I synthesize these diverse lines of inquiry via geospatial analysis techniques to illustrate how historic, contemporary, and projected future contexts can inform resilient bio-cultural restoration of Kalou, regardless of management entity.

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Resilient Hawaiian Communities Initiative – He ʻaʻaliʻi kū makani au

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The Resilient Hawaiian Communities (RHC) initiative was a two-year effort with the goal of strengthening the resilience of two Native Hawaiian communities to the effects of environmental change and variability. This initiative was funded by the U.S. Department of the Interior and co-led by staff from the U.S. Fish and Wildlife Service, Department of the Interior's Office of Native Hawaiian Relations, National Park Service Pacific Islands Office, and Ka Huli Ao Center for Excellence in Native Hawaiian Law at the University of Hawai'i Mānoa. The two communities that participated in the RHC Initiative are the Kailapa Community Association on leeward Hawaiʻi Island and Waiehu Kou Phase III Association on windward Maui. Both communities used a variety of approaches, including huakaʻi (field trips and site visits), to engage their residents, surrounding landowners, and other interested parties throughout 2018. At the end of the initiative they produced written community resilience plans that provide roadmaps for future adaptation activities. This poster provides a brief overview of the RHC initiative then delves into the specific issues and solutions identified by Kailapa and Waiehu Kou III as they move forward in building resilient Native Hawaiian communities. The poster also provides links to resources developed by the communities such as videos, climate syntheses, and other products.

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Mapping Marine Debris using A.I. Machine Learning

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Coastal ecosystems are under constant threat from marine debris, yet our understanding of amount and composition as well as the patterns and rates of accumulation on our shorelines is limited in scale and scope. Better management of marine debris on our shorelines requires better tools for mapping, measuring, and monitoring. While it's relatively easy to collect imagery, analyzing such large volumes of data can be very slow and subject to errors/bias, thus making it difficult for rapid marine debris detection and response.

Using machine learning, we are automating the analyses of different types of images: aerial (manned aircraft) ortho-imagery for mapping debris densities and identifying regional hotspots; ground-level (smartphone) photos for real-time debris detection for quick assessments in the field before/after beach cleanups; UAS (drones) photos for quantifying small items. We are also developing online platforms to engage citizen scientists and serve coastal resource managers and community groups. We are building upon baseline data and lessons learned from a previous mapping effort of the main Hawaiian Islands (http://arcg.is/29tjSqk). These comprehensive, precise measurements of the quantity, location, type, and size of macro-debris in a wide range of shoreline types are an excellent source of training, test, and validation data to evaluate different machine learning algorithms. The project is working to achieve the greatest impact after being awarded a Con X Tech Prize in 2018.

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Liko Nā Pilina Experiment: Lessons Learned in a Path Towards Restoration Sustainability

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The Liko Nā Pilina project is a hybrid restoration experiment that evaluates tradeoffs among invasion resistance, carbon sequestration, native species regeneration, and labor costs. Native and non-native species combinations were chosen based on functional trait properties; treatments test combinations of species whose traits are more dissimilar (complementary) or similar (redundant), and slow and moderate carbon turnover rates. Five years after clearing and planting, we summarize the major lessons learned. First, there may be a tradeoff between fast growth and reproduction. The Moderate Redundant treatment has the fastest relative growth rate and highest survival, leading to the greatest carbon accrual, while the Slow Complementary treatment has the greatest number of species and individuals fruiting. Yet, despite these differences, there is no difference among treatments in invasive plant cover or recruitment of native and outplant seedlings. Species differences can have outsized effects on the treatment results, and small microtopographic differences in terrain can have measurable influences on tree growth and seedling recruitment. Adaptive management led to modifications of the weed removal practices and installation of electric fences that reaped large rewards by reducing by labor and costs up to 85% in the last two years. Overall, the hybrid restoration strategy is an improvement over invaded lowland wet forest in terms of ecosystem services, but the exact species mixes may be less important than originally hypothesized, at least over this five-year time scale.

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Bridging Spatial Data and ‘Ōiwi Worldview for Biocultural Stewardship with Kamehameha Schools

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Kamehameha Schools (KS) is the largest private landowner in Hawai‘i, with holdings of over 364,000 acres. These lands include one fifth of Hawai‘i’s watershed forests and provide habitat for over half of Hawai‘i’s endangered species. KS stewards native ecosystems to preserve natural and cultural landscapes and enhance the resource base for traditional practices, inspiration and identity for its beneficiaries. Stewardship areas are prioritized based on landcover, biodiversity, risk and strategic criteria to select viable projects with returns that align with KS’ five values (Education, Community, Culture, Economics, and Environment) and its educational mission. KS uses culturally grounded approaches and spatial data at multiple scales, including the translation of western spatial data tools from ‘ōiwi (indigenous Hawaiian) perspectives, to inform prioritization, tracking, and adaptation of stewardship, all while maintaining data sensitivity. With its small staff and limited funding, KS has relied on a largely collaborative model of stewardship to both leverage resources and expand the scope of conservation management across ownership boundaries.

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Mapping Biological Soil Crusts with Small Unmanned Aerial Systems

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Biological soil crusts are communities of photosynthetic microorganisms that grow over bare soil in arid and semi-arid ecosystems and are known to increase soil stability. Despite their potential to mitigate erosion, the distribution of biocrusts in degraded drylands on Hawaii Island is unknown. We mapped biocrusts in the Kawaihae watershed, a semi-arid landscape prone to erosion, using imagery collected by small unmanned aerial systems (sUAS) at three spatial resolutions (1.15, 2.05 and 2.80 cm/pixel). Using a pixel-based methodology, we produced classifications with overall accuracy ≥90% at all three resolutions. As biocrust development is associated with increasing soil stability, we also explored this relationship in the Kawaihae watershed. We identified 3 different biocrust levels of development (LOD) and conducted soil aggregate stability testing at all development levels. We found that there is a significant increase in soil stability between soils without surface biocrusts (LOD score of 0) and those with biocrusts at any development level (LOD 1-3). Higher-developed biocrusts imparted greater soil stability than less-developed biocrusts, but the impact on soil stability reached a ceiling beyond biocrust LOD 1. Our project provides a biocrust mapping methodology that can be used by researchers and land managers globally and insight into the role of biocrusts in erosion prevention in the Kawaihae watershed and similar arid/semi-arid landscapes.

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Overcoming Seed Dormancy in Propagation of Endangered Abutilon menziesii (Malvaceae)

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Abutilon menziesii (Malvaceae) is an endangered, endemic Hawaiian plant species found within dry shrublands on O‘ahu, Lana‘i, Maui and Hawai‘i Island. *Abutilon menziesii* seeds were thought to exhibit physical dormancy, which can be broken by scarifying the seed’s water-impermeable seed coat. However, several Hawaiian seed banks have observed that fresh seeds scarified immediately before sowing often rot. Thus, we hypothesize that this species may instead exhibit combinational dormancy – both physical and physiological dormancy – which may be broken by allowing seeds to sit on growth media for an extended period of time before scarifying. To test this hypothesis, we designed a delayed scarification experiment with eight treatments: immediate scarification; scarification after one, two, three, four, five or six months; and an untreated control. For this experiment, we used seeds stored in dry, frozen conditions for approximately 17 years, and scarified by lightly nicking the seed coats with a scalpel. Preliminary results suggest that seed bank storage breaks physiological dormancy of *A. menziesii* seeds so that physical scarification stimulates germination, and that delaying scarification increases germination rate. We are repeating this experiment with fresh seeds to solidify a germination methodology to be used by other entities that propagate this species for in situ restoration efforts. Given anecdotal evidence of low seedling recruitment in natural settings, determining how to break seed dormancy at ex situ facilities where seeds are less threatened by insect and fungal pests will give population managers greater flexibility as they work to conserve this endangered native species.

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Restoration of Native Low Elevation Windward Dryland forest in Kalaupapa National Historical Park

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Ka'uhako Crater, within Kalaupapa National Historical Park, is recognized for its representation of "low elevation windward dryland forest". Of particular interest are the 'Ohe makai-Hala pepe (*Reynoldsia-Pleomele*) forests on the southwest inner-slopes of the crater, and the Wiliwili-'Ohe makai (*Erythrina-Reynoldsia*) forests both within the crater itself and upon the crater rim. These plant communities are some of the few examples of such forests remaining on the Hawaiian Islands.

Repeat inventory assessment indicated a high rate of native tree loss (Wiliwili, 'Ohe makai, and Hala pepe), that was primarily attributed to a change in plant community within the canopy and understory; predominantly due to increased abundance of Java Plum (*Syzygium cumini*) and Christmasberry (*Schinus terebinthifolius*). Additionally, browsing by deer, rooting by pigs, and seed predation by rats had prevented the establishment of a younger native tree cohort, preventing natural regeneration of this fragile dryland forest.

Reducing problem alien vegetation, planting nursery-grown native stock, and removing feral animals has established new populations of native plants, bolstering this only remaining windward dryland forest on the island of Molokai. Indeed, stabilization strategies for maintaining Ka'uhako Crater indicate successful expansion of existing patches of native trees and shrubs.

The scarcity of 'Ohe makai-Hala pepe and Wiliwili-'Ohe makai forests across the state of Hawaii, as well as the presence of many special status plant species, emphasize the importance of retaining extant dryland forest within Ka'uhako Crater. These biological resources are key components of the natural and cultural heritage of the Hawaiian Islands.

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Shallow Water Resource Fish Surveys in West Hawai‘i Suggest Declines in Food-Fish Species.

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Shallow Water Resource Fish Surveys were conducted in West Hawai‘i from February 27 to April 24, 2018 at 72 sites from Lapakahi (North Kohala) to Manukā (Ka‘ū). The objective was to document the abundance of adult resource fish species in shallow water (2m to 6m depth) habitats where they are typically most abundant during the day. Sites were selected to include locations previously surveyed in 2009 using the same methodology. The total distance surveyed in 2018 was 15,380 m (50,459 ft.), for a total surveyed area of 76,900 m^2.

The biomass of parrotfish significantly increased from 2009 to 2018, but these differences were mainly driven by a limited number of sites and by two species, *Chlorurus spilurus* and *Scarus rubroviolaceus*. Three of the four of these sites were within managed areas: two in Ka‘ūpūlehu (no-take reserve) and one in a Netting Restricted Area. Despite this increase, the overall biomass of herbivores at the shallow water sites decreased by 48% from 2008 to 2018 largely driven by a decrease (-69%) in surgeonfish biomass. The abundance of key species of adult surgeonfish has steadily declined since 2008, most notably for *Acanthurus leucopareius*, *Naso unicornis*, and *Acanthurus achilles*. The most dramatic decline was observed for *Acanthurus achilles* abundance which decreased by 90% from 2008 to 2018. *Acanthurus achilles* were observed on 73% of transects in 2008 but only on 38% in 2018. These results suggest the need for targeted management to enhance conservation efforts and support the resiliency of declining species, particularly surgeonfish.

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Using Avenza Maps App to Improve Invasive Species Management Outcomes

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Successful invasive species control requires detailed mapping to delimit infestations and ensure thorough coverage in treatment areas. Recent advances in mobile mapping technologies enable the use of interactive georeferenced maps in the field to better locate individuals and document survey and control actions. Since 2017, Hawai'i Volcanoes National Park Natural Resources Management has implemented this technology through mobile app Avenza Maps™. The app allows users to download or create maps for offline use on smartphones or tablets. Custom maps can be built on computers using enterprise data, and seamlessly uploaded into the app for data collection in an offline environment. Compared to handheld GPS devices, Avenza enables increased functionality to mark features of interest, calculate area and distance, record tracks, and more easily export data. This app has been used to guide thorough ground sweeps for weeds such as banana poka and faya tree, or to more accurately record offset waypoints for silk oak and albizia detected during helicopter surveys. Teams have also used Avenza to assist with locating over 900 tree samples to map the distribution of Rapid 'Ōhi'a Death and also to keep infected tree management organized. Another intuitive use was the identification and control of a 3 acre incipient Little Fire Ant infestation. The use of the Avenza Maps app in offline environments has shown tremendous advantages over other data collection methodologies such as handheld data loggers or similar apps requiring a wireless connection, and has improved the efficacy of invasive species control operations in the park.

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Identifying and tracking indicators of success in biocultural restoration

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Building resilient ecosystems and communities in the Hawaiian Islands requires restoring complex systems that integrate biological and cultural elements. Identifying and tracking indicators of success in these biocultural systems is critical to understanding the long-term impacts of restoration efforts. However, developing effective indicators of success, especially in the context of a rapidly changing climate, is extremely challenging. This presentation will highlight insights and collaborative plans emerging from a partnership between the He'eia and Tijuana River National Estuarine Research Reserves that seeks to bring together researchers, restoration specialists, community stewards, and cultural practitioners to explore ongoing efforts and future opportunities related to the research, modeling, and monitoring of biocultural indicators. Topics of focus will include: (1) tracking climate adaptation actions to ensure community resilience, (2) incorporating cultural considerations in monitoring and evaluating ecosystem restoration efforts, (3) building a social-ecological modeling and monitoring community of practice leveraging NOAA's National Estuarine Research Reserve System, and (4) lessons learned from local and transnational biocultural restoration efforts.

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Manu o Kū of Diamond Head: Breeding Behavior of an Indigenous Seabird on the Kapiʻolani Community College Campus

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The Manu o Kū or white tern (***Gygis alba***) is an indigenous seabird, named the official bird of the City and County of Honolulu. The species is listed as threatened by the State of Hawaiʻi and is protected under the Migratory Bird Treaty Act. In Spring 2014, Kapiʻolani Community College (KCC) students initiated a Manu o Kū monitoring program on the campus which is now an ongoing undergraduate research project. Surveys for nests were conducted between 6:30 and 9 a.m twice a week. Once a nest was located, students continued to observe nesting behaviors from an unobtrusive location at a minimum distance of 10 m. Nesting locations were recorded and mapped using GPS. In order to communicate with the college's Auxiliary Services, a protocol was established to notify staff of the birds' presence. We also set up a live streaming webcam to expand the campus engagement and to obtain more detailed nesting information. Data from the KCC campus is now shared with the larger White Tern Hui project. During the 2018-2019 academic year, three undergraduate students have participated in the research, most of whom are working towards undergraduate degrees in biology or natural resources. The project continues to serve as an avenue for building capacity among local students for avian monitoring and survey techniques.

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Grazing as a Tool to Reduce Wildfire Risk at Pu‘u Wa‘awa‘a Forest Reserve

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The establishment of flammable invasive grasses in Hawaii has created a grass-fire cycle that promotes fire and eventually replaces native forest. Targeted grazing by livestock provides a potential tool to reduce grassy fuels and fire risk at large spatial scales. In Hawai‘i, cattle grazing can reduce invasive grass biomass, although little work has been done on implementation, and grazing in forests is controversial. Pu‘u Wa‘awa‘a Forest Reserve on Hawai’i Island contains one of the largest remnants of tropical dry forests in Hawai’i and is threatened by fire promoting invasive grasses. This study 1) develops alternative grazing scenarios at Pu‘u Wa‘awa‘a that maintain a conservation focus; 2) examines how indigenous Hawaii grazing practices developed by paniolo, or Hawaiian cowboys, could be used as a land management tool; and 3) examines values of Hawaii residents as they relate to different dry forest fuels management strategies. Research suggests that cattle grazing can reduce fire risk, but would likely not be economically feasible for paniolo, who practice their trade primarily as a cultural heritage, not as a business. Results could aid land managers and policy makers in making better informed decisions and provide a model for other fire prone areas in Hawai‘i to utilize.

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Coordinating Education and Training Programs at the Ahupua‘a Scale

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The designation of the He‘eia NERR created a unique opportunity to weave together independently initiated education and outreach programs into a more collaborative learning community. The impact of aligning programs at the ahupua‘a scale will be far reaching. Organizations in He‘eia NERR provide educational experiences for more than 6,000 students per year and engage a variety of professional audiences, including natural resource managers, policymakers, and cultural practitioners, whose ideas and actions influence estuaries statewide. He‘eia NERR staff conducted interviews and surveys to determine current strengths and needs in education and training programs within the ahupua‘a. We highlight current education programs, present the results of the needs assessment, and discuss initial steps to address priority issues that emerged.

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Two Years Down, Eight to Go: Progress on Implementing the 2017-2027 Hawaii Interagency Biosecurity Plan

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The Hawaii Interagency Biosecurity Plan was released in January 2017 and provides a comprehensive analysis of gaps relating to Hawaii's preborder, border, and postborder biosecurity systems. The Plan describes a broad set of policy, process, and resource actions needed to address those gaps, and places those action items on a 10-year timeline that leads to a 2027 vision of a more resilient, biosecure Hawaii. The agencies and partners needed to implement these actions are spread across a network of invasive species and biosecurity experts at HDOA, DLNR, UH, DOH, and other entities. The Hawaii Invasive Species Council is committed to tracking progress on implementation across participating agencies and partnerships over the 10-year life of the plan. As we've passed the two-year mark for implementation, what progress has been made? What biosecurity legislation has passed, and which bills have failed to make traction? What new lines of research have opened? Are we keeping pace with implementing the 2027 vision? Staff from the Hawaii Invasive Species Council intend to provide this progress report as the second of 10 annual presentations at the Hawaii Conservation Conference to ensure that the conservation community remains informed and engaged as implementation progresses.

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Watershed Snapshots—a biocultural approach to understanding and promoting healthy communities through place-based conservation and management

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Over the last 15 years, the Hawai`i Conservation Alliance (HCA) has championed the Effective Conservation Program (ECP) as a way to optimize partnered conservation efforts in Hawaii. One of the four major components of ECP is active stakeholder involvement and support. The Watershed Snapshot project is a method to holistically assess the health of watersheds in Hawai`i and help inform and guide community-based conservation actions based on the communities' knowledge, values and priorities. This tool, called 'Community Watershed Snapshot' is not limited to measures of biodiversity and habitat health. It includes metrics for the health and well-being of both culture and community. This process actively engaged 3 communities — Hā`ena (Kaua`i), Maunalua (O`ahu), and Hau`ula (O`ahu). The pilot phase in these 3 sites was well received and a practitioner guidebook was developed to share and improve the lessons learned from the 3 pilot communities. Launched in 2018, "How Healthy is Your Ahupua'a: HCA Community Watershed Snapshot Guidebook" was produced to open access for communities interested in pursing co-management. We are now poised to scale up and support interested communities across the State in collaboration with the E Alu Pū Network (a network of communities engaged in co-management efforts) as a way to unify community-based conservation, management and evaluation. Our presentation will give an overview of the consultation process history, highlight examples of community-produced educational products, and the current evolution of using this approach as a model for future expansion among communities ready to implement holistic ridge-to-reef management efforts.

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Crabbing & Connectivity: Science for Sustainability

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Hawaiian fishponds, or loko i‘a, are ancient aquaculture systems that are models of sustainable aquatic resource management based on long-term experience from traditional Native Hawaiian havest practices. An estimated 350+ fishponds provided food security for ancient Hawai‘i, but by 1901 only 99 remained in production, and most of those were abandoned by mid century. Reclamation efforts, beginning in the 1970s, have resulted in the rejuvination of 38 actively managed fishponds across the State. Fishponds are being adapted to modern human population needs, because functional fishponds contribute to improved food security. In this study, we seek to examine culturally and economically important crab fishery species to ask two primary questions: 1) Are fishponds self-seeding or well-connected to the surrounding coastal waters, and 2) What are the traditional management practices for our species, and can those still work today? To find whether fishponds are self-seeding, we will use genetic sequence data to estimate fine-scale patterns of dispersal and exchange between fishponds, adjacent coastal waters, and nearby islands for each of these species. In order to address merging traditional and modern management practices, we investigate traditional fishing and combine it with modern collection data (assessments and abundance estimates) to propose a sustainable crab fishery model that may be tailored to fit manager preferences.

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Foraging ranges of the Hawaiian hoary bat on Maui

Dave Johnston, Kristin Jonasson, Brad Yuen

The foraging ecology of the Hawaiian hoary bat has been poorly characterized and lack of information is hampering efforts to develop effective recovery plans. Previous research has been conducted on foraging ecology in continuously wet temperate forests on Hawai‘i island but may not apply to the drier slopes of Haleakalā on Maui. We outfitted 16 bats with radio-transmitters to characterize their foraging ranges. Bats were tracked for three to seven nights before transmitters were lost. Foraging ranges (95% kernel) were large, ~13,600 hectares (ha) or 7% of the island and “core use areas” (50% kernel) were ~3,700 ha or 2% of the island. Ranges are likely underestimates because bats were tracked for a short timeframe and because bats routinely moved out of range (e.g., over the ridge of Haleakalā Crater). Current U.S. Fish and Wildlife Service guidelines recommend 16 ha of forested habitat to support one Hawaiian hoary bat based on core use area sizes from Hawai‘i Island. Our data has substantial implications for management decisions and demonstrates the need for caution when applying data from different climate zones.

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Native Hawaiian alpine shrubland and a resident endangered seabird population exhibit resilience following ungulate exclusion

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Feral ungulate grazers are responsible for extensive damage to Hawaiian ecosystems through grazing of native plants, trampling of soil, and dispersing invasive weeds. Management of forest reserve lands often includes protecting sensitive areas with ungulate-proof fencing and removal of animals. Ungulate exclusion was completed on the leeward slope of Haleakalā in the Kahikinui Forest and Nakula Natural Area Reserves in 2014. We expected to see an increase in vegetation coverage and relative abundance of native plant species in response to the release from grazing pressure. We also expected a positive response from the resident ‘ua‘u (Hawaiian petrel, *Pterodroma sandwichensis*). ‘Ua‘u burrows are commonly trampled by browsing ungulates, and native vegetation is known to infulence their habitat selection.

We conduct annual vegetation surveys in permanent 10x10m plots distributed randomly within the fenced area (n=55). Native species diversity is increasing (4% mean increase). Most significantly, native coverage and diversity is consistantly greater than non-native species ($p<0.001$). The number of active ‘ua‘u burrows and ‘ua‘u fledging success also continue to increase.

The resiliency of the native alpine shrubland vegitation contributes to its successful regeneration. Some native shrubs are not prefered by ungulates and provide cover for rapid recovery of the community when grazing pressure is removed. Non-native grasses outcompete native grasses, which recover more slowly than shrubs; however, overall native species composition across the landscape is robust. We conclude that excluding ungulates from unique high-elevation habitats in Hawai‘i is a straight-forward method for significantly impacting endemic species at the community level.

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Science and Management of Rapid ‘Ōhi‘a Death Part 2

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New methods of treatment of ‘ōhi‘a logs infected with the pathogens that cause Rapid ‘Ōhi‘a Death (ROD), either chemically or by heating, can reduce the likelihood that the pathogens will move inter-island with wood products. Use of dogs trained to sniff out infected trees that are not yet symptomatic promises a useful tool to detect incipient outbreaks. Current on the ground management includes felling of infected trees, closing infected areas, and increasing bio-sanitary measures for all forest users. A statewide extension program has involved community members through an ‘ōhi‘a seed banking effort. The 2018 discovery of both ROD pathogens on Kaua‘i has provided a case study of mobilization of an island community in response to a new invasive species.

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Machine annotation of Puaiohi calls in environmental acoustic recordings

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Falling hardware costs has made large-scale passive acoustic monitoring of wildlife increasingly affordable in recent years. Wildlife conservationists and scientists have a variety of potential uses for bioacoustic data, but usually require accurate annotations as a first processing step. Manual methods for producing annotations of these recordings (using Raven, for example) are time consuming, tedious, and prone to human error. Using machine learning techniques to assist in this task has the potential to greatly reduce the costs associated with producing these annotations.

In this study, we employ a deep neural network to produce an automated annotation pipeline targeting the Puaiohi (M. palmeri). Puaiohi are a critically endangered songbird endemic to the Alakai plateau on the island of Kaua'i, Hawai'i, USA with an estimated population of only 500 remaining in the wild. They are threatened by multiple factors, such as climate change, habitat loss, and mosquitos carrying avian malaria. The call of the Puaiohi is particularly amenable to automatic detection, due to its simplicity and regularity.

Using a human-annotated dataset consisting of approximately 30 hours of forest environmental recordings, we trained a deep convolutional network to annotate environmental recordings. The automatically generated annotations feature accuracy and recall which are similar to a first-pass manual annotation. Using retail commodity hardware, the network can be trained in approximately 15 minutes and can annotate a new 15-minute sample in under a minute. This demonstrates the utility of machine learning approaches for targeted annotation of environmental recordings.

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Do the remains remain? Small animal decay in the Alakaʻi

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The introduction of rodents to islands poses a threat to native fauna, which often have no adaptation to defend their offspring or themselves. To combat predation of nests and brooding females, the Kauaʻi Forest Bird Recovery Project has deployed 425 Goodnature A24 rat traps at two field sites where high densities of native forest birds remain. Routine trap checks are conducted every 4 months to assess bait and trap function and count carcasses; typically we find 0-3 rat or mouse carcasses. We assume that traps kill more animals than indicated by physical carcass counts because 75% of traps have counters that record number of traps fire, and those counter tallies exceed the number of carcasses seen. Thus we hypothesize that some portion of carcasses are scavenged or decompose in between trap checks, which may include non-target animals. To test the hypothesis that we fail to detect some proportion of carcasses, we placed 30 non-native animal carcasses on transects in the trapping grid in early December 2018. Carcasses were surveyed every 10 days for one month, and monthly thereafter. As of late February 2019, 25 carcasses could be easily detected, suggesting that we are likely to detect most carcasses after 4 months unless they are scavenged. This study will also help us estimate time of death from other causes possibly disease.

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A software tool for producing annotations of prolonged audio recordings using machine learning and deep neural networks

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Prolonged passive acoustic monitoring of animals has recently become possible due to the affordability of automated recording devices. The information that can be extracted from these audio recordings is valuable for supporting scientists with a variety of research goals. However, large-scale processing of these recordings to extract desired information presents challenges. Conventional methods of manually annotating bird calls are time-consuming and prone to error. Methods that use machines to assist with the annotation pipeline would greatly improve the utility of passive monitoring programs.

We have developed a software package that streamlines the process of training deep neural networks to annotate environmental audio recordings for target sounds. The supervised learning process uses Raven-compatible selection tables to identify target vocalizations in the training data, and produces similar tables when annotating new recordings. Built-in models are capable of reaching human-like annotation accuracy on simple vocalizations and can be trained on commodity hardware in minutes. Customized network models can be easily added by users, if desired. Our software is provided as a Python package, and is available under an open source license.

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Precision Agroforestry Inventory Monitoring in the Marshall Islands using Small Unmanned Aircraft Systems

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Sustainable agroforest management requires accurate and spatially detailed forest inventories, which can be challenging and expensive to conduct in remote and isolated areas using traditional means. This project was a pilot study to determine the utility and efficacy of using small unmanned aerial systems (sUAS) to generate detailed forest inventory data in the Republic of the Marshall Islands (RMI). sUAS imagery was collected over a 135 hectare study area on Arno Atoll, RMI, from altitudes of 85 m and 150 m and used to generate orthomosaics, 3D point clouds, and digital surface and elevation models. Individual tree agroforestry metrics, including tree heights and crown diameters, were derived from these datasets and compared to field data collected from subplots within the study area. Over 20,000 individual coconut trees were identified within the study area, and we found good correlation between sUAS-derived metrics and ground based measurements of coconut tree height (r squared value of 0.83) and crown diameter (r squared value of 0.72). Juvenile trees in dense stands were not visible in the sUAS imagery, resulting in an undercounting of these resources. Our findings suggest that sUAS technology provides an effective and economic means of producing detailed forest inventory data in remote pacific islands, with the additional benefit of collecting valuable topographic data.

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The Pulelehua Project: Attempts to Expand Populations of Native Butterflies through Captive Rearing and Reintroduction Coupled with Habitat Enhancement

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Hawai‘i has only two native butterflies: the Kamehameha butterfly (*Vanessa tameamea*) and the Hawaiian blue (*Udara blackburni*). Although the Hawaiian blue appears to be comparatively resilient, the Kamehameha butterfly has suffered considerable range reductions, presumably due to habitat loss, predation by birds and ants, and other factors. The Pulelehua Project (operated by the Hawai‘i Department of Land and Natural Resources) attempts to reestablish Kamehameha butterfly populations through captive rearing and release. In 2017 and 2018, we completed three rearing cycles, releasing a total of 5,450 butterflies at five restoration sites in the southern Ko‘olau Range of O‘ahu, where the butterfly has been extirpated. Sites had been densely outplanted with the host plant māmaki (*Pipturus albidus*), and control methods for invasive ants were implemented, when necessary. After releases, we visited sites weekly to assess establishment by surveying all host plants for caterpillars or evidence of feeding. We found caterpillars at all release sites, indicating successful reproduction, but unfortunately we found no evidence of establishment beyond one generation. Our results suggest that reestablishing this butterfly is not as simple as providing a high density of host plants and protection from ants, though this approach may work in some areas. We continue to encourage residents to plant māmaki and protect it from predators, particularly in Windward communities, but we also encourage the widespread planting of ‘a‘ali‘i (*Dodonaea viscosa*), a host plant of the Hawaiian blue butterfly, which may be more likely to naturally colonize residential areas across a broader range of climates.

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An ‘Alalā Update: Data and Reflections from 18 Months Back in the Wild

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Since the fall of 2017, a population of reintroduced 'Alalā (*Corvus hawaiiensis*) have been living continuously in the Pu'u Maka'ala Natural Area Reserve on Hawai'i Island. Over 20 birds have been released, and have so far shown high survival (95%) as the world’s only wild-living group of 'Alalā. Intensive post-release monitoring has continued throughout this time, yielding insights into their social interactions, movements and potential breeding behavior. We reflect on our latest field observations of the released 'Alalā, and discuss what we have learned so far about the importance of pre-release training for release candidates. Finally, we will discuss tactics for monitoring and managing their movements, supplemental feeding, territoriality and foraging behaviors. The release and management of the species is the result of a multi-partner collaboration whose goal is to establish a self-sustaining group of 'Alalā within their known historical range, fulfilling their ecological and cultural roles. We assess progress towards our goals, and highlight important milestones on the path to 'Alalā recovery.

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Improving Captive Rearing Methods for the Endangered Orangeblack Hawaiian Damselfly (Megalagrion xanthomelas)

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The orangeblack Hawaiian damselfly (pinapinao, *Megalagrion xanthomelas*) historically occurred in lowland aquatic habitats throughout the high Hawaiian Islands. The introduction of nonnative fish for mosquito control reduced this once common species to a few disparate populations. On O‘ahu, *M. xanthomelas* rests on the brink of extirpation, with one remaining population known, and the species was federally listed as endangered in 2016. The Hawai‘i Department of Land and Natural Resources began a program to rear and release immature *M. xanthomelas* in November 2018 with the intent to establish additional populations on O‘ahu. Initial captive rearing methods yielded a very high survival rate of naiads (immature damselflies) prior to release, but naiad coloration was noticeably lighter than that observed in the wild, and the reasons for this difference were unclear. We tested the effects of diet supplementation and substrate variation (color and composition) on naiad developmental rates and exoskeleton coloration in captivity. When the standard diet (brine shrimp) was supplemented with a diversity of freshwater zooplankton, naiads developed more rapidly, but coloration was not strongly affected. Naiads reared against dark-colored substrates were noticeably and significantly darker than naiads raised against light backgrounds, and more closely matched the color of wild naiads. These results will be used to modify existing rearing methods to better replicate natural naiad development in the laboratory. Such efforts are essential to maintaining the resilience of all endemic pinapinao in the face of ecological change.

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Captive Rearing of the Orangeblack Hawaiian Damselfly (Megalagrion xanthomelas) and Reintroduction Attempts on O‘ahu

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The orangeblack Hawaiian damselfly (*Megalagrion xanthomelas*) was historically one of our most widespread endemic damselflies (pinapinao), but is now restricted to small, scattered populations on several islands. Habitat destruction and the widespread introduction of mosquito fish (Poeciliidae) are thought to be the primary causes of decline in this species and other pinapinao. On O‘ahu, only one population of *M. xanthomelas* is known, confined to an approximately 100 m stretch of stream at Tripler Army Medical Center (TAMC), and the species was federally listed as endangered in 2016. Several translocations of this species have been attempted in the past, but none have successfully established. In November 2018, we began a captive rearing program for *M. xanthomelas* at the Hawai‘i Department of Land and Natural Resources arthropod captive rearing facility, with the goal of establishing additional populations on O‘ahu. We collected vegetation containing damselfly eggs from TAMC, hatched naiads (immature damselflies), and reared them in the laboratory. Naiad survival rates in captivity were very high (94%). When naiads reached their final developmental stage, just before becoming adults, we released them into fish-free habitats. After releases, reintroduction sites were surveyed for adult damselflies weekly. As of May 2019, we had released 404 individuals into a stream in Wai‘anae Kai Forest Reserve, and are in the process of releasing a second cohort in artificial ponds at Lyon Arboretum in Mānoa Valley. Here we will present the results of post-release monitoring at these reintroduction sites and assess the establishment of new populations of *M. xanthomelas*.

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Not gone yet, but we're not well either: an update on Hawaii's remaining land snails

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Hawaii supports a spectacular radiation of land snails, with more than 750 species. Yet, the real number of Hawaiian species is difficult to ascertain, since until very recently, most had not been studied in a comprehensive systematic manner for more than 60 years. Prior to 2010, it was suggested that 90% or more of Hawaiian land snails were extinct, but these estimates were based on partial surveys or research limited in taxonomic scope and failed to account for the many land snail species that failed to capture the public's fascination or be protected under the Endangered Species Act. More recently, surveys, molecular systematics, and revisionary taxonomic research facilitated by the invaluable land snail collection housed in the Bishop Museum, has revealed the large degree of error associated with earlier extinction estimates and uncovered previously undescribed species. Hawaiian land snails, instead of consisting of 75 or so species, number in the 100s, with many other previously considered extinct species awaiting to be rediscovered. In this presentation we provide an update on many of the families and offer our perspectives on how to proceed with saving what remains. The primary lesson from much of this work over the last decade has taught us some very clear lessons, primary among them is that public perception is critical to funding for biodiversity conservation and research, and that hope remains for much of the Hawaiian fauna, if we are all willing to take a slightly different approach to studying and appreciating it.

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The Ulu Lehulehu-Million ‘Ōhi‘a Initiative, Bringing ‘Ōhi‘a Back Into Our Everyday Lives

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The Initiative was born from the simple need to bring ‘ōhi‘a back into our yards, schools, parks, and everyday lives. Through the Initiative, 1000’s of trees have been planted by youth on Hawai‘i Island, and we have developed and teach school curricula and propagation methods to support the public’s desire for information and tools for propagating ‘ōhi‘a across Hawai‘i Island. We have reached over 1,835 Hawai‘i Island students through classroom visits, raised and
distributed over 1,200 ‘ōhi‘a seedlings to schools and community groups, and reached hundreds of thousands of citizens through presentations, public events, social media, and a Hawaiian Airlines in-flight educational video. Additionally, we have established and maintain an ‘ōhi‘a forest of 800 trees in the Kupua‘e ‘Ōhi‘a Common Garden, an effort to restore pasture lands to forest at the Hawai‘i Experimental Tropical Forest (HETF) in Laupāhoehoe.
The **Million ‘Ōhi‘a Initiative** is envisioned to be a multi-year initiative to plant one million ‘ōhi‘a trees statewide. The Initiative is now expanding our collective capacity for a million ‘ōhi‘a effort in Hawai‘i and ensuring the continued presence of this critical keystone species in Hawaii’s forests, parks, and communities. Our holistic program is designed to build and foster personal relationships to Hawaii’s native landscapes through tree planting, education and outreach, and citizen science, and will support the growth of local plant nurseries across the state.
Our program is dedicated to supporting local commerce through the purchase of ‘ōhi‘a seedlings
from existing and emerging providers of native Hawaiian plants.

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Restoring Seabirds in Hawai'i - Resilient Beings But Require Our Commitment To Recover

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Seabirds were once the most numerous animals in the Hawaiian Islands. The arrival of Homo sapiens resulted in displacement of the majority of them from their terrestrial habitats. Habitat change and introduction of mammalian predators has driven decline of seabird species. In 2006 Maui Nui Seabird Recovery Project and the state of Hawai'i, Division of Forestry & Wildlife went to Lāna'i to determine if there were Hawaiian petrel ('Ua'u, *Pterodroma* sandwichensis) remaining on Lāna'ihale. That exploration resulted in documentation of, what is perhaps, the second largest remaining population of the species. It was immediately apparent that predation, by feral cats (*Felis cattus*), was a serious problem. On the island of Maui, colonies of Wedge-tailed shearwater ('Ua'u kani, *Ardenna pacifica*) have been subject to predation by feral cats resulting in total reproductive failure in colonies where no predator control is performed. We engaged the community and the then owner of Lāna'i to build a feral cat "sanctuary" where animals were removed from the landscape and placed in a fenced enclosure. On Maui, community engagement in the form of a yearlong attempt at dialogue and stakeholder position sharing failed to bring the parties to productive resolution. The Maui Humane Society maintains a trap, neuter, & return policy that provides no relief to seabirds and other native and endangered species from feral cat predation. We explore the differences in the two situations and identify important elements of the Lāna'i experience that led to success and additional options for augmenting seabird's natural resilience.

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The Hunt for ROD Resistant ʻŌhiʻa Genotypes: Building the Foundation for a Disease Resistance Improvement Program for Restoring ROD Impacted Hawaiian Forests

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ʻŌhiʻa (*Metrosideros polymorpha*) is the most bioculturally important tree species in Hawaiʻi; it is the backbone of Hawaiʻi's native forests and watersheds covering more than one million acres statewide, and is a foundational element in traditional Hawaiian knowledge systems and cultural practices. ʻŌhiʻa has steadily disappeared from our landscape due to land-use change, invasive species, and disease, the most prominent being Rapid ʻŌhiʻa Death or ROD, representing a potentially devastating threat to the health of our forests statewide. ROD is a disease caused by two fungal pathogens, *Ceratocystis lukuohia* and *Ceratocystis huliohia*. In the face of ROD, quantifying the presence and strength of resistance for various genotypes of ʻōhiʻa to *C. lukuohia* and *C. huliohia* is critical. Preliminary research shows that there is wide variability in the susceptibility of ʻōhiʻa to ROD, and so there is a high likelihood of identifying resistant genotypes. To build a disease resistance "tool," we must screen ʻōhiʻa for resistance to ROD. The work involves: a) an expanded effort to sample diverse genotypes of ʻōhiʻa, from natural populations of *Metrosideros* species, in highly impacted stands (>80% mortality), and "ROD free" stands, b) challenging these genotypes through established disease exposure protocols, and c) identifying resistant material for further progeny testing and possible outplanting. This initial effort will form the foundation for innovative restoration efforts, and help to inform conservation actions that can lead to the restoration of ʻōhiʻa dominated forests impacted by ROD, thereby improving the ecological and cultural value of the landscape.

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Detection Dog Trained to Locate Multiple Threatened Species in New Zealand

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A canine was initially trained to locate whio/blue duck *(Hymenolaimus malacorhynchos*), an endemic, threatened waterfowl in New Zealand which are an indicator species of healthy waters. Whio are found in pristine rivers and streams that are often remote and difficult to access. As whio are crepuscular, human walk-through surveys were previously limited to early mornings and late evenings when birds were active on the river. However, the use of a canine increased the ability to survey for longer periods throughout the day by locating roosting and hiding birds thereby increasing accuracy as well as distance covered. This technique has greatly aided conservation management of whio across New Zealand by providing accurate results of short-term fluctuations and long-term trends. These skills for detecting whio by a canine have also been applied to other threatened species to assist with population monitoring as well as giving greater versatility for the working life of a detection dog. Key considerations when selecting multiple species for a detection dog to locate includes choosing target species that inhabit different niches to avoid overlap and to develop an understanding of the canine's indication behaviours. Through targeted training with the additional species, positive reward and utilising inherent hunting instincts, a canine detection dog has been able to be utilised for detecting a variety of cryptic and threatened species to aid conservation efforts in New Zealand. This canine has been certified to locate five different threatened species whio, kiwi (*Apteryx* sp.), seabird sp., weka (*Gallirallus australis*) and tuatara (*Sphenodon punctatus*).

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Engaging the community through ‘ōhi‘a seed collecting workshops

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A constructive way that the Rapid ‘Ōhi‘a Death outreach team has worked with local communities has been through conducting workshops on collecting ‘ōhi‘a (*Metrosideros* spp.) seed for seed banks, research into topics such as disease resistance, and local use. Participants learn to identify different ‘ōhi‘a species and varieties and how to collect and store seeds. Seeds are deposited in a network of local seed banks for future use in research or restoration, and participants may also collect seed for their own use. Being able to collect and save seed gives concerned community members a way to contribute actively and perpetuate forests threatened by Rapid ‘Ōhi‘a Death. In 2017-2018, the team from Lyon Arboretum, the Laukahi Hawai‘i Plant Conservation Network, and UH Cooperative Extension put on 15 workshops at locations on Kaua‘i, O‘ahu, Maui, Moloka‘i, and Hawai‘i Islands and trained 350 people in seed collection, including both private citizens and agency staff. Program staff and volunteer workshop participants subsequently banked 165 new ‘ōhi‘a seed collections at the Lyon Arboretum seed facility and 275 new ‘ōhi‘a seed collections at other neighbor island seed banks. Even for those folks who did not immediately begin collecting seeds, the workshop was valuable outreach and education, which they then continued to share with their family, friends, students, and other community members. Enthusiasm for the workshops has been high enough that a new round of workshops is being put on in 2019 with funding from the Hawai‘i Tourism Authority.

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Reproduction of the A'ama Rock Crab Grapsus tenuicrustatus in Hawai'i and Other Pacific Island Communities

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The rock crab *Grapsus tenuicrustatus* occurs throughout the tropics. It has long been a beneficial food source in many Pacific island communities. In Hawai'i this crab is known as A'ama and has both cultural and nutritional importance. Collection data has shown a notable decrease in catch per year. Similar concerns have been raised by agencies in French Polynesia. Government agencies lack the necessary information to effectively manage this recreational fishery. Although limited traditional knowledge about A'ama reproduction exists, there is almost no information in the scientific literature. Life history data is essential for successful management and conservation of these populations. This study investigated the reproductive periodicity, size at first reproduction, and fecundity of *Grapsus tenuicrustatus* in Hawai'i with additional information from some other Pacific islands. Crabs were collected monthly from December 2016 – March 2018 for a total of 1,235 individuals. Data collected included gender, carapace width (CW), presence/absence of eggs, and fecundity. Reproduction occurred throughout the year although it was most common from January to March. Large females (55-60 mm) were ovigerous 90.9% of the time and small females (26-30 mm), were ovigerous 30.6% of the time. Females less than 26 mm were not reproductively mature. Fecundity ranged from 20,200 to 76,000 eggs per female and was positively correlated with body size. These data can help guide managers in developing rules and regulations for this fishery.

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Ecosystem Effects of Sea Level Rise on Anchialine Pools in West Hawai'i

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Anchialine pools are groundwater fed coastal habitats that connect inland pools underground to the marine environment through porous rock. Hawaiian anchialine pools support endemic *Metabetaus lohena* and *Halocaridina rubra* ('opae'ula) as well as rare and endangered species of crustaceans, damselflies, birds, and gastropods. Introduced fishes, destructive land use, water pollution, water withdrawal, and senescence fueled by introduced vegetation destroy or degrade pools – these threats may be exacerbated by sea level rise. Potential impacts to anchialine pools due to coastal flooding were predicted and mapped for West Hawai'i at intervals between 2018 and 2080. Flood predictions incorporated field surveys of over 450 anchialine pools, in-situ measurements of groundwater levels, high resolution LiDAR-based topographic data, and risk-based estimates of flood magnitude and frequency that include probabilistic projections of future sea levels in the region. Combining groundwater and ocean levels in flood frequency projections enabled us to determine where future habitats will emerge, where current habitats will be lost, and where risks such as invasive fishes may spread as waters rise. Although 80% of the 509 current pools will be lost by 2080, over 1,000 new pools are projected to form inland. As flooding increases, introduced fish will disperse into new habitat unless action is taken to restore priority pools before they become connected. Managers, planners, and coastal community members worked with designers to create a web-based decision support tool to visualize and incorporate future sea level risk to coastal ecosystems into their plans and actions.

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What can we learn from whale and dolphin strandings? A mechanism to understand threats to Hawaiian cetacean populations and their resiliency

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Cetacean (whale and dolphin) strandings provide opportunity to investigate causes of mortality and contribute to an understanding of the biology and ecology of approximately 20 cetacean species that inhabit Hawaiian waters. The University of Hawai'i Stranding Laboratory relies on public reporting of dead stranded cetaceans throughout the Hawaiian Islands to mount stranding responses, conduct necropsies and collect and archive tissue samples. When stranded cetaceans are reported fresh dead, extensive necropsy examinations and organ tissue sample collections allow for DNA analysis, life history and diet information, diagnosis of infections, histological examination of tissues and evaluation of anthropogenic impacts. We have documented marine mammal diseases such as morbillivirus, toxoplasmosis and brucellosis. When categorizing known cause of death in Hawaiian cetaceans, the highest mortality rate is attributed to infectious disease. Other documented anthropogenic threats to Hawaiian cetaceans include marine debris ingestion, fish hook ingestion, entanglement in fishing gear and vessel strikes. A later stage of investigations includes examination of skeletal material for evidence of bone disease and/or signs of blunt trauma. Advanced scientific methods applied to archived cetacean tissues allow for new discoveries from past standing events. We assess causes of mortality and the population health of cetaceans in support of conservation and management efforts for native species. Documenting threats is also important in evaluating the resiliency of Hawaiian wildlife. Maximizing scientific information from stranded cetaceans is dependent on collaboration between stakeholders and local communities and forms the foundation of effective conservation strategies.

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Understanding Trends of Non-Native Invasive Vegetation for the Kawainui Marsh Restoration Project

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Kawainui is a vital pua in the lei of wetlands of Ko‘olaupoko, O‘ahu. Kawainui was considered the piko of Kailua and revered as ‘āina momona so succulent that the kānaka even ate of the lepo. Today the marsh is dormant and largely a forgotten landscape but continues to function as critical habitat for our native and endangered species, modern flood control, and as sediment filtration for millions of liters of wai entering Kailua Bay. The Hawai‘i Department of Land and Natural Resources (DLNR) currently manages Kawainui and have listed invasive plants as a top priority and impediment to restoration. To assist, my study answers the following questions: (1) How has the vegetation community of Kawainui changed? (2) What invasive plant species are currently present within the study site and how does the plant community vary? (3) What are the most effective and practical recommendations for invasive plant management and native plant restoration? First, I conducted a historical ecology analysis, which provided a timeline of social-ecological reference systems. Next, I completed a plant community analysis using randomized quadrat surveys of four cardinal plots for percent cover. The primary invaders included *Urochloa mutica*, *Pennisetum purpureum*, *Paederia foetida*, and *Commelina diffusa*. My final management recommendations report emphasizes the need for small patch invasive plant removal, restoration companion planting, and reengagement with kānaka. Long-term residual effects of intensive agriculture, invasive species introductions, and rapid urbanization speak to the dynamism of the system, resiliency of our persisting endemic fauna, and the uncertainty of Kawainui’s future.

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Act Now or Forever Hold Our Peace. Rapid Widescale Land Snail Extirpation and Extinction Calls for Immediate Emergency Intervention

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This presentation is a plea for partnership and a call to action, for we must act now or forever hold our peace. Recent catastrophic land snail declines, observed in wild populations across O'ahu and Maui, are heralding the end for many species. With the rate of declines observed, it is estimated that we are on the verge of losing most of what comprises 10 genera of land snail, approximately 100 species, within the next 1-10 years. In a rush to prevent extinction, the Hawai'i Department of Land and Natural Resources – Snail Extinction Prevention Program (SEPP), and partners across the state, are “manning the lifeboats” using novel techniques involving captive propagation, predator-proof fencing, translocation, and reintroduction to prevent loss. Here the grim status of wild populations will be reported, as well as descriptions of the current techniques being used in extinction intervention. To be effective, immediate conservation actions must occur across property boundaries on multiple islands. Anything less than a coordinated response will leave extinction on our collective hands.

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Citizen Foresters: Understanding the trees where we live to engage communities and catalyze stewardship

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Preserving and growing tree canopy in our urban and inhabited areas provides vital environmental benefits such as capturing water during storm events, lowering ambient heat, trapping air pollutants, increasing biodiversity, and preventing soil erosion. When a canopy change analysis study of urban Oʻahu revealed a startling trend of urban tree canopy loss (5% loss in over 4 years), public, private, and non-profit partners responded by creating the Hawaiʻi Citizen Foresters. The program trains and certifies volunteers as Citizen Foresters to inventory trees, collect data, and serve as tree ambassadors in their communities. Since 2016, over 100 trained volunteers have collected data on more than 7,000 trees. Citizen Foresters have not only initiated and taken on new community forestry projects, but have formed their own communities and strong social connections. Trees play a key role in strengthening communities' resilience to climate change. It is critical to connect people to the trees where they live and share the message that nature isn't something that "happens somewhere else." We have found that empowering community members to be active in the stewardship of urban trees and greenspaces, not only increases their own knowledge, and their capacity to support trees, but also builds social connections within their communities. Program staff and active Citizen Foresters will share the tools, methods, and innovative partnerships used to quantify the environmental impact of the trees around us and to build community stewardship of trees.

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Aloha ʻĀina Practices: Growing Trees and Youth in Urban Settings

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Aloha ʻĀina Youth Empowerment project is an ongoing project that engages ʻāina-based, indigenous, cultural practices to activate love and care of ʻāina, water, and life among Hawaii's elementary, middle, high school and the University of Hawaii-West Oahu students where they live and learn every day. This project aims to create a strong sense of local identity while addressing food security issues by activating and combining tropical agricultural practices that indigenous to islands of Hawaii and Sri Lanka to bridge ecological and cultural knowledge. The project engages youth with hands-on learning about land and plants, climate change mitigation knowledge, and skills that can be applied in their daily lives, with a focus on utilizing untended school lands in meaningful ways. The teaching pedagogies and practices include promoting students' understandings of Hawaii's seasons, annual rain cycles, plant varieties; how plants react to environmental and climate change; and how plants that have cultural and dietary value (e.g., tī, hala, kukui, ulu, niu, uala, and kalo) grow, mature, and produce. As students' knowledge of and engagement with plants in the built environment grows, so do their personal relationships with land and plants. These practices build a cohesive understanding of our surrounding nature as well as our current food system by integrating ancient with modern nutritionally-rich and well-balanced dietary knowledge

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Are future extinctions preventable? Living down our title as the "extinction capital of the world"

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The ongoing sixth global mass extinction is well documented, but what is less well understood is how to identify which extinctions are preventable, and more importantly, how to focus our efforts on preventing those extinctions. With 586 endangered species identified in the state of Hawai‘i, efforts to prevent extinction have not been commensurate to the crisis, largely due to a chronic lack of resources. We assembled a team of 19 endangered species experts to identify the federal, state, or IUCN-listed threatened or endangered species for which: (1) solutions to prevent extinction are known and technology exists today to implement at-scale; (2) solutions to prevent extinction have been identified, but technology is not available today, or is not available at a scale which would prevent extinction; (3) solutions to prevent extinction are unknown or unclear. We then compared threats and solutions across taxonomic groups to determine whether potential synergies may be gained through a regional approach to achieving recovery. Most threatened or endangered species in Hawai‘i, including 74% of 57 invertebrates, 88% of 493 plants, and 61% of 36 vertebrates have known solutions to prevent extinction that could be implemented today if resources were available. Many of these species face common threats, and efficiencies may be gained through multi-taxa approaches to conservation. In a world full of wicked problems, we wish to highlight the hope that remains for hundreds of species for which extinction may be prevented, and raise a call to implement known, timely and achievable actions toward this purpose.

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Securing the future of endangered Akekee through translocation from Kauai to a higher elevation island

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Mosquito-borne diseases, exacerbated by climate change, dramatically threaten most Hawaiian forest bird species, especially those on lower lying islands. The population of 'Akeke'e, a Kaua'i endemic forest bird, is currently less than 1000 individuals and has recently shown a greater than 90% decline. Under most climate change scenarios, no habitat will remain for this species on Kaua'i by 2100 unless this threat can be significantly abated. Landscape-scale mosquito control is several years off; some population trends project that this species could go extinct in the meantime. After four years of egg collection, the conservation breeding flock numbers only 10 'Akeke'e, due to difficulties finding nests and poor survival post-hatching. To prevent extinction of this species, we must consider translocation to other islands that have higher elevation habitat than is available on Kaua'i (e.g, Maui, Hawaii Island). The translocation plan will set a population size and trajectory for the translocated 'Akeke'e that can be factored into determinations of whether this species can be considered recovered. A well-developed translocation plan for 'Akeke'e can also serve as the model for other species who face threats that cannot be adequately addressed in the current range. This poster outlines the issues to be considered in translocating 'Akeke'e and steps by which to resolve them.

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Beyond Words – Exploring Media-Represention of Endangered Species

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The 21st century has brought about a variety of changes to Hawai‘i, and the ways tourists visit and interact with Hawai‘i’s natural resources has drastically changed over the past two decades. Hawai‘i’s need for natural resource protection has been consistently growing in an ever-globalizing world. Thus, this paper focuses on the potential negative effects of Hawai‘i wildlife tours’ media representations of endangered marine species, focusing onhow they are constructed through linguistic and extralinguistic resources. Further, it suggests how through the same channel of medium, there are ways to protect them.

To explore how media constructs wildlife tourism, this study builds on research of media-induced tourism, which empirically provesthat media has a significant effect on tourists’ decision-making processes regarding destinations and behaviors. Additionally, it draws on sociolinguistic research in tourism, which has examined representation construction through semiotic resources used in tourism media, including textual and extratextual features. This study further utilizes critical discourse analysis,with target data including a variety of media such as guidebooks, magazines and websites for tourists in several major tourist languages and two years of ethnographic research on tourists’ experiences in Hawai‘i wildlife tours.The analysis demonstrates that media for Hawai‘i wildlife tours tend to depict and encourage tourists to interact with these endangered species in close proximity, potentially harming them. Based on these results, this study also suggests ways to change to transform harmful representations into beneficial ones.

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Hawaii Forest Plant Gathering Practices & Implications: Na ke kanaka mahi ai ka imuonui

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Non-Timber Forest Products (NTFPs) play a critical role for communities in the United States and across the globe. NTFPs include a diversity of plants and plant parts - from fruit, flowers and leaves to bark, and other parts – as well as fungi. NTFPs provide materials for a multitude of uses, including food, medicine, housing, the arts, and ceremony. In Hawaii, NTFPs were used extensively and continue to be important to subsistence practices and/or make major contributions to cash economies. The purpose of this research is to assess in Hawaii what contemporary forest plants are wild harvested, why, and by whom as well as the social, ecological, and economic implications of wild plant harvest. Methods to identify key forest plant species and harvesters include interviews, the first analysis of Department of Land and Natural Resources plant permit database, surveys of markets and cultural events, including an online structured survey of plant harvesters across the islands. Results illustrate the importance of connection to place and practice, that conservation methods can be utilized while harvesting, that introduced species can play key substitution roles in contemporary practices, and Hawaiians are key harvesters with many others who engage and contribute to Hawaii forests. The kuleana, enduring burden and blessing, of forest resiliency sits between harvesters and formal social structures of management. Native species are still being harvested for subsistence, educational and economic purpose. This NTFP research informs future policy decisions affecting the cross section of contemporary cultural, economic, and conservation values of Hawaii forests.

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Healthy Soils Hawai‘i: Carbon Farming as a Tool of Resiliency

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Hawai'i has taken many pledges to lead the way to a more sustainable future. Specifically, Hawai'i's plan to be carbon neutral by 2045 and the added goal to double food production by 2020. Addressing climate change vulnerabilities and prioritizing local food development are both significant focuses, but many believe them to conflict. How can Hawai'i resiliently increase agricultural production without contributing heavily to climate change & carbon emissions? One solution is utilizing Hawai'i soils as carbon sinks. In both production and natural environments, carbon can be stored in the soils rather than the atmosphere, reducing carbon dioxide levels. Two strategies are utilized to emphasize carbon sinks. By creating carbon farm plans, we can focus efforts for developing farm management practices that act more as carbon sinks rather than emitters. Additionally, installations of best management practices that help sequester carbon can both increase food production and increase the carbon sink of farms evidenced through programs in California & Costa Rica. Through implementation on farms in Hawai'i and community outreach, Hawai'i can weave together sustainability and agriculture. Carbon farming is a tool to make Hawai'i more resilient and adaptable in the face of change. Healthy Soils Hawai'i (HSH) is a pilot project working with farms & ranches throughout Hawai'i to test the effect of best management practices and carbon farming. Modeled after a similar program in California, HSH is bringing together soil science, sustainable agriculture, carbon experts and our agricultural community to lead the way in carbon neutrality & food production goals.

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Ridge restoration and reef response: Impacts of invasive mangrove removal on nearshore coral reef

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The He‘eia watershed has been severely impacted by invasive species, including red mangroves (*Rhizophora mangle*). While mangroves are native to most tropical ecosystems, they have become invasive in Hawai‘i since introduction in 1902, appear to not serve the same critical ecosystem functions as in their native range. Mass removal of invasive mangroves and replanting of native riparian plants and lo‘i taro is underway since the recent incorporation of He‘eia into the National Estuarine Research Reserve System (NERRS). To better understand how these changes in the watershed may influence the nearshore coral reef, we established 24 permanent monitoring stations on the He‘eia reef flat where we assess marine fish populations, sedimentation levels, water quality, and coral reef condition before, during, and after restoration. Preliminary results indicate no significant change in rates of sedimentation or nutrient loading in coral-dominated areas since the start of mass mangrove removal. Monitoring of reef conditions provides baseline data for potential changes to the coral reef as restoration progresses, and presents a unique chance to study how mangrove removal affects nearshore coral reefs outside of the native range. The marine ecosystem data we collect complements research in the freshwater, fishpond, and terrestrial environments to allow for an ecosystem approach in understanding and managing the entire ahupua‘a while maximizing benefits to both natural and human communities.

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Reproductive Ecology and Population Genetics of Hawaiian Wiliwili, Erythrina sandwicensis (Fabaceae)

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Hawaiian dry forests are severely imperiled with little intact habitat remaining and many species which are rare and endangered. Wiliwili, or *Erythrina sandwicensis* (Fabaceae), is among the most iconic, resilient, and culturally significant dry forest trees. This research focused on the reproductive ecology, population genetics, and regeneration of wiliwili in order to provide useful, informative results for conservation management. Research questions included: 1) Which species visit wiliwili flowers, and could act as pollinators? 2) What is the effect of different pollination treatments on the number, size, and viability of wiliwili seeds and seedlings? 3) What is the genetic relationship among different island populations of wiliwili? and 4) Is wiliwili regenerating in the wild? Results from this study suggest that the majority of floral visitors to wiliwili are non-native species. Treatments involving cross-pollination were found to produce significantly more fruit and seeds than the control and other treatments. Few seedlings and saplings were found in any of the populations surveyed, indicating there may be limited recruitment in the wild. Genetic analyses found that island populations were distinct from one another. Despite the negative impacts of invasive species and habitat loss, restoration efforts are active in dry forests across the state, and wiliwili is proving to be quite resilient in the face of change. Efforts focused on restoring wiliwili should aim to increase seed-set by encouraging cross-pollination through the conservation of pollinators and by increasing the number of individuals in a population, and to expand the number of seedlings that survive to maturity by implementing grass control and fencing.

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From Local to Global – using the Watershed Snapshots to prepare for WCC 2020

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Over the course of the last decade, the Hawai`i Conservation Alliance (HCA) has been developing a tool to holistically assess the health of watersheds in Hawai`i. This tool, called 'Watershed Snapshots,' was not only limited to measures of biodiversity and habitat health, but was one that includes metrics for the health of both culture and community. This tool was piloted on three communities actively engaged with the HCA — Hā`ena (Kaua`i), and Maunalua (O`ahu), Hau`ula (O`ahu). The results were presented at the World Conservation Congress (WCC) here in 2016. One of the outcomes of WCC 2016 was the 'Hawai`i Commitments,' which sets forth a holistic approach towards community-engaged conservation efforts. As the HCA prepares to report back to WCC 2020 (Mersielle, France) about the status of our implementation of the Hawai`i Commitments, we will revitalize and update this tool to align it with the Hawai`i Commitments, and use it to evaluate 10 communities across the State in collaboration with the E Alu Pū Network (a network of communities engaged in co-management efforts). The symposium will include short presentations by those involved in this effort, and will be moderated by Chipper Wichman, a leader in the Hawai`i Delegation.

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Designating a State Snail for Hawai‘i

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Hawai‘i’s native land snail species are part of a diverse island radiation with more than 750 species and 99% endemicity. Unfortunately, about 70% of the fauna may be extinct, and some families consisting of only a few extant members. Only 5% of the fauna are protected under the Endangered Species Act, but realistically, nearly 90% of the should be. To promote awareness and the preservation of Hawai‘i’s land snails’ cultural and ecological significance, a State Senate bill to designate a state snail was written by two high school students from Kamehameha Schools. The bill was written and submitted in early 2019 in an effort to get *Laminella sanguinea*, a species from the last extant Hawaiian endemic family, designated as Hawaii’s state snail. Unfortunately, the senators to whom the bill was sent decided not to give it a hearing, and it failed to make it to the senate. However, we continue to be hopeful and are here to provide the community and public the background on the scientific and cultural importance of Hawai‘i’s land snails in an effort to garner support for this bill in 2020. We hope that the designation of a state snail will set a strong foundation for the continued conservation of Hawai‘i’s native invertebrates and the awareness of extinction crisis.

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Mongoose Population Assessment: Is there a breeding population on Kauaʻi

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In August of 2015, Kauaʻi Invasive Species Committee assembled an international panel of experts in the field of mongoose detection, tracking, trapping, and control methods to develop a Kauaʻi-specific program for the detection and control of mongoose. Since 2012 there have been 3 live mongooses captured on Kauaʻi. These captures reinforced the need for better biosecurity at our ports of entry and brought up the possibility of a breeding mongoose population on the island. Using information gathered at the 2015 meeting, a comprehensive Mongoose Population Assessment Plan was developed to survey the island by deploying baited tracking tunnels, at 500 meter intervals, along the main highway of Kauaʻi. The purpose of the survey was to detect the presence of an incipient population. The spatial configuration of the survey is based on the premise of sampling areas where mongoose are likely to occur and likely to go undetected. Three filters were used to establish the survey area: housing density, recent monitoring effort, and vehicle and cargo movement zones. The survey encompassed one year and was conducted quarterly. In total, 900 tracking tunnels were deployed and at the end of the year-long survey it was determined that there is no evidence of a breeding population of mongoose on the island of Kauaʻi.

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The Effect of Ungulate Fencing, Salt Spray, and Soil Type on the Coastal Plant Distribution and Abundance on the Kalaupapa Peninsula, Molokai

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On the Kalaupapa Peninsula, coastal salt spray vegetation transitions from shorter, predominantly native plants near the shoreline, to taller Christmas berry (Schinus terebinthifolius) further inland. This project examined the effect of feral animals, soil type, and salt on the distribution of coastal vegetation, using quadrant plant surveys and soil conductivity measurements, in two 100 hectare (250 acre) areas with, and without deer (Axis axis). Soil salt levels were determined to be similar across all soil types except for sand; lower readings for sand could be due to the prevailing wind patterns or soil drainage. Without deer, mineral and organic soil had larger percentages of plant cover, while the sand and mixed (sand and mineral) soil types had higher percentages of native species present. Comparing the impacts of deer on either sides of the fence, both native and non-native plant cover decreased when deer were present. In addition, the species richness for all plant life forms was lower. Four key plant species were selected in the grass, forb, or shrub life form categories. All experienced a decrease in average percent plant cover when deer were present. Based on these results, it can be concluded that deer are negatively impacting the coastal salt spray vegetation and species richness regardless of soil type. Deer are the strongest factor decreasing the diversity and abundance of native species. Fencing appears to improve plant cover when deer are not present, especially for native species which seem to grow abundantly in the sand. Fencing is the foundational solution to directing specific locations for restoration and conservation of native species in Kalaupapa Peninsula while removing ungulates and invasive species.

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Restoration strategies for out-planting at marginalized coastal leeward landscapes on Hawaii Island

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Native vegetative restoration projects on arid coastal landscapes can be difficult in the first year of development due to a host of environmental stressors and/or resource limits. Water availability and distribution is but one challenge to land managers; however, the dilemma is compounded by decades of soil erosion and the marginalization of the soils water and nutrient-holding capacity. It is well known that revegetating degraded landscapes can increase SOM, water and nutrient holding capacity and will reduce sediment run-off. However, typical to arid leeward ecosystems, high radiative exposure and climate change (i.e. extreme rain events and prolonged draught) increase attrition rates of undeveloped native species. Here we quantified growth rates of five native plant species – two under-story shrubs (*Sida fallax* and *Scaevola gaudichaudii*) and three tree species (*Cordia subcordata*, *Thespesia populnea* and *Calophyllum inophyllum*) as a function of three treatments: natural/installed shade, mulch, companion planting and a control that has no treatment. Holding water near constant, our findings suggest that between treatments not all species respond to shade, mulch or in proximity to a nurse plant. However, we did find with high certainty that two shrubs and one tree species react favorably to the treatments individually and interactively between multiple treatments. As a result, we suggest that future restoration efforts include at least mulching and/or partial shading of young saplings at or near the time of planting. Further, we propose that *T. populnea* and *S. gaudichaudii* are the most resilient candidates for the initial phases of a project.