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Using Community Group Monitoring Data To Measure The Effectiveness Of Restoration Actions For Australia's Woodland Birds

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Before conservation actions are implemented, they should be evaluated for their effectiveness to ensure the best possible outcomes. However, many conservation actions are not implemented under an experimental framework, making it difficult to measure their effectiveness. Ecological monitoring datasets provide useful opportunities for measuring the effect of conservation actions and a baseline upon which adaptive management can be built. We measure the effect of conservation actions on Australian woodland ecosystems using two community group-led bird monitoring datasets. Australia’s temperate woodlands have been largely cleared for agricultural production and their bird communities are in decline. To reverse these declines, a suite of conservation actions has been implemented by government and non-government agencies, and private landholders. We analysed the response of total woodland bird abundance, species richness, and community condition, to two widely-used actions — grazing exclusion and replanting. We recorded 139 species from 134 sites and 1,389 surveys over a 20-year period. Grazing exclusion and replanting combined had strong positive effects on all three bird community metrics over time relative to control sites, where no actions had occurred. Effectiveness of grazing exclusion (when not combined with replanting) improved over time in terms of bird abundance but not species richness or community condition. Control sites with continued grazing and no replanting showed declines in species richness and bird abundance over time. Future monitoring programs should record details of site management history and effort (e.g. frequency, area) and include control sites without management actions so that the effectiveness of conservation actions can be evaluated.

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The Status of Resources in the Papahānaumokuākea Marine National Monument

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The Papahānaumokuākea Marine National Monument is a biologically, culturally and historically significant place in the Hawaiian Archipelago and a UNESCO World Heritage Site. The Monument encompasses the Northwestern Hawaiian Islands and is the largest protected area in the United States. Place-based conservation has been ongoing for over 20 years. Native Hawaiian practitioners consider Papahānaumokuākea to be one of the last remaining ʿāina momona. The Monument supports predator dominated coral reefs, is vital habitat for 23 threatened and endangered species, home to 14 million nesting seabirds and supports an exceptionally high percentage of species found nowhere else on earth.

Ten years of information have been recently evaluated to assess the condition and trends of the physical environment, habitats, living resources and historic and cultural resources of the Monument. Transdisciplinary approaches are utilized to conduct these assessments using descriptive and applied scientific, archaeologic and traditional research. Resource abundance and habitat quality will be discussed. This management assessment provides recent information on Monument resources in addition to shedding light on the impacts of recent natural disasters and discoveries. There will be discussions on the status and trends of: physical habitats, Hawaiian Monk Seals, green sea turtles, marine biodiversity, terrestrial and marine non-indigenous species, and Native Hawaiian resources.

SPEAKERS:

1. Introduction: Jonathan Martinez and Athline Clark

2. Habitats: Keo Lopes

3. Sea Turtles: Marylou Staman

4. Monk Seals: Thea Johanos

5. Terrestrial Non-Indigenous Species: Cynthia Vanderlip

6. Marine Biodiversity: Randy Kosaki

7. Marine Non-Indigenous Species: Brian Hauk

8. Native Hawaiian Resources: Kalani Quiocho

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Improving Bird Surveys in the Kaʻū Forest

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Most abundance estimates for Hawaiʻi forest birds are produced using point transect distance sampling. This method uses standardized counts recording the distance to each detected bird. The average density of each species is then estimated and multiplied by the habitat area to calculate abundance. The Kaʻū forest, on the slope of Mauna Loa volcano on Hawaiʻi Island, is the largest native forest in the state and home to eight native forest bird species, including three endangered and one threatened species. The forest is under management by the U.S. National Park Service and the State of Hawaii Division of Forestry and Wildlife, and in 2019, both agencies coordinated to conduct a simultaneous survey of their management units to produce a comprehensive estimate of Kaʻū forestʻs bird populations. We improved trends assessment using bootstrap regression methods which indicated that in the Kaʻū forest two endangered species (ʻakiapolaʻau (*Hemignathus wilsoni*) and Hawaiʻi ʻakepa (*Loxops coccineus*)) are in decline while the ʻalawī (*Loxops mana*) population is increasing. Surveyors recorded the local vegetation characteristics, allowing us to include site-level habitat information (such forest moisture category, canopy height and dominant undergrowth species) not previously used to estimate Hawaiʻi bird abundance. Both historical and contemporary descriptors of vegetation and the forest structure were used to improve density estimates. The effect on estimated abundance was moderate (< 10% difference) but we identified important covariates and methods to continue to improve future bird surveys in Kaʻū and elsewhere in Hawaiʻi.

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Actions for Future Abundance: Investigating Perceptions of Coral Reef Health and Pro-environmental Behavior among Coastal Users in West Maui, Hawai‘i

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Coral reef ecosystems in Hawai‘i are under threat from global and local stressors, including rising ocean temperatures, overharvesting, pollution, and ocean-based recreational activity. Hawaiian reefs adjacent to large population centers, like West Maui's once abundant, life-sustaining Nā Papalimu O Pi‘ilani reef, now show significant signs of human impact. Despite important links between coastal user activity and coral reef health, the social and psychological factors that influence human behavior in nearshore environments are not well-understood. What motivates individuals to take pro-environmental action to protect coral reefs? And how can communities effectively promote respectful reef etiquette among coastal users? We investigate these motivating questions by drawing from theories and methods in conservation psychology. Through a partnership between the community group Polanui Hiu, The Nature Conservancy, and Stanford University, we conducted an in-person survey of 300 coastal users in West Maui, an area popular for ocean-based recreation. We collected information on individual coastal users' 1) reef-based activities, 2) perceptions of reef health, 3) social-psychological indicators (such as place attachment and self-efficacy), and 4) pro-environmental behavioral intentions. Initial results indicate that residents have more knowledge of coral reef health and more place attachment than visitors. Subsequent analyses will identify variables that predict pro-environmental behavior. The findings will provide community partners with insight into coastal user groups to target outreach and education and to assess support for future fisheries management efforts. We anticipate that the study will promote safer, sustainable human-reef interactions, which may facilitate the return of marine life in West Maui.

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Teens Creating Conservation Innovations: Students Share Their Hawaiʻi Youth Sustainability Challenge Projects

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The Hawaiʻi Youth Sustainability Challenge (HYSC) helps students develop innovative solutions to the conservation challenges they identify in their schools and communities. In the 2019-2020 school year, Kupu and Kokua Hawaiʻi Foundation (KHF) are providing project grants, mentorship, and training to students in grades 10-12 from across Oʻahu. This smaller, more localized cohort allows the program to invest more deeply into project teams. Student projects promote ʻai pono, investigate air and water quality issues, use automation and tech to improve aquaponics and food waste systems, and design environmentally-friendly products and packaging. Each of these projects seeks to improve the community and achieve real change on a local level. Projects will be conducted throughout Spring 2020 with the support of mentors from Kupu and KHF. All student teams will also engage in Lā Hoʻohui ʻIke: A Day of Gathering Knowledge to provide them with peer learning and additional training to help ensure successful project implementation, develop collaborations across projects, and build personal toolkits that can help them in their work now and in the future. During this forum we will share the successes and failures of the new program model, and 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 Hawaiʻi. The forum also provides an opportunity for intergenerational learning, and will help aspiring students build a network they can draw from moving forward.

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Ola ka ʻŌlelo: Applying ʻŌlelo Hawaiʻi in Conservation Research and Management

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Around the world, there is growing recognition that Indigenous languages play a central role in supporting and maintaining biocultural resource abundance and diversity. Moreover, Indigenous Peoples know that Indigenous languages are an essential means to access, engage, and weave transformative and ancestral knowledge systems for solutions-based conservation and community well-being. Here, we present a bilingual symposium building upon a highly rated 2019 inaugural panel conducted entirely in ʻŌlelo Hawaiʻi (Hawaiian Language), which explored the interface of language, culture, and biocultural stewardship in Hawaiʻi. In this symposium, which will primarily include ʻŌlelo Hawaiʻi presentations with simultaneous English language translation, we will expand upon the 2019 session by providing additional concrete examples of the ways in which research, management, and stewardship are enhanced by ʻŌlelo and Moʻomeheu Hawaiʻi (Hawaiian Language and Culture). Our diverse collection of presentations from conservation professionals across the islands include an overview of the evolution of Hawaiian cultural integration at the Hawaiʻi Conservation Alliance (HCA) together with a series of case studies on research and management projects representing multiple disciplines and areas of expertise. We will conclude the session with a presentation on the essential role of allies in enhancing the application of ʻŌlelo and Moʻomeheu Hawaiʻi in conservation and resource management. Collectively these presentations are intended to demonstrate solutions-oriented pathways to advance conservation action and meaningful collaborations. Resulting discussions from this session will serve to inform future discussions on cultural values and practice in conservation, including tangible next steps for the Hawaiʻi Conservation Alliance.

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How can social capital boost participation in biodiversity-related behaviours?

emma church[1]

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Australia's biodiversity is under threat, with more than 1,700 Australian species and species groups at risk of extinction. There is increased recognition that communities have a strong role in protecting biodiversity: the Australian Biodiversity Strategy (2010-2030) calls for 25% increase in the number of Australians participating in biodiversity conservation. Social capital – connected networks characterised by trust, reciprocity and shared norms – may offer important resources for influencing individual action to realise these conservation goals (Pretty & Smith, 2004). However, there is uncertainty about the influence of social capital on stewardship behaviours. In this study we are used quantitative social surveys to identify what motivates people to adopt conservation behaviours and how one's social environment, namely social capital, influences likelihood of adoption of conservation behaviours. We surveyed a community sample (n=2800) of New South Wales, Australia, representative by age, gender and bioregion. Thus, we were able to identify behaviours more attractive to less engaged people, and factors that enable or constrain uptake of behaviours, revealing 'footholds for intervention' to be tested experimentally and in the field. This allows us to understand how to promote conservation engagement in different types of social groups, including those with few social connections. These results can assist practitioners to tailor programmes to different stakeholder types to maximise engagement and participation in conservation behaviours.

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Connecting communities for waterway stewardship: A tale of two rivers

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Urban coasts and waterways provide a range of ecosystem services that are highly valued by society. However, around the world human activities are transforming these ecosystems, leading to poor water quality, habitat degradation and loss of biodiversity. Our research explores ways to tackle these issues by increasing the reach of community stewardship programs. A mixed methods evaluative case study was conducted to understand the impact of two such programs on the relationship between social capital and the stewardship of local urban waterways. More specifically, this study examines i) what strategies motivate people to adopt a stewardship ethic and stewardship actions and; ii) how building social capital influences uptake of environmental stewardship. The first case study is a co-design of an ecological restoration was done to enhance the natural elements of an urban creek and to make it easier for the community to enjoy its surrounds through improved accessibility. The second case study is a 'change makers' program that connects like-minded people to work together to create new projects that positively impact the river and its communities. Our research findings are relevant to organisations that work with community members to promote conservation across Australia. These results will assist practitioners to tailor programmes to different stakeholder types to maximise engagement and participation in conservation behaviours.

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The Challenges of Managing Conservation-reliant Species

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Hawai'i and the Pacific Islands are epicenters of species imperilment. There are more than 500 imperiled species in Hawai'i and most of them are *conservation-reliant*: they face threats that cannot be eliminated but only managed, and the management may be needed for a very long time. As climate change pushes more species toward extinction, the queue of conservation-reliant species will continue to grow.

This reality poses a fundamental challenge to conservation, both locally and globally. Resources for conserving imperiled species are already inadequate and the long-term demands of conservation-reliant species will further strain conservation resources and societal support. We need to ask ourselves if we can save all biodiversity, and if so, how will we do it? Conservation efforts will need to be prioritized, acknowledging the long-term costs of conservation reliance while incorporating the social and cultural context as well as science. To address this challenge, conservation, management, and the societal commitment to conservation will need to change.

In this symposium speakers will discuss the implications of conservation reliance for the management and conservation of imperiled species in Hawai'i, and the opportunities for application of lessons learned in Hawaiʻi to global conservation. We will emphasize the ecological, cultural, social, economic, and legal challenges faced in dealing with conservation reliance, as well as lessons learned from management successes and failures. We will conclude with a discussion of ways forward.

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Lessons learned addressing storm and urban runoff in an urban environment

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East Honolulu is one of the most urbanized regions in the State of Hawaii. Not surprisingly in an area with so much pavement and development, storm and urban runoff have significantly affected water quality in Maunalua Bay. Mālama Maunalua's (MM) mission is to restore the health of Maunalua Bay, and a major component of that work is to address the runoff that is affecting it. Since its inception, MM has attempted numerous methods for addressing this issue, and as a result has learned many lessons on what works, what doesn't, and what could be a better way forward. This talk will focus on many of the recent efforts MM has undertaken to address the problem, and the lessons learned. The projects include:

- Planting trees;
- Deploying rain gauges and stream gauges;
- Utilizing volunteer and student help in identifying hot spots;
- Leading a multi-partner effort to educate and motivate the public;
- Planning the utilization of oysters for bioremediation;
- Studying resident perceptions of green infrastructure and water quality;
- Sharing the results of a 180-point water quality study from 2019.

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Looking Towards the Future: How to Improve Species Conservation in the 21st Century

Loyal A. Mehrhoff[1]

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Conservation reliant species require continuing management intervention to prevent their extinction. The concept of conservation reliant species provides a lens through which conservationists can better understand the species and ecosystems they manage and, importantly, the societal context that species find themselves in. It helps us think about how landscape-level management must integrate with species-specific management, how short-term management decisions affect future management options or costs, and what general strategies could be employed to restore all species in an area. It does not inform decisions on which species to save; that is a values decision. But, it does highlight the importance of planning for and allocating resources for reoccurring management actions – potentially far into the future. Hawaii has over 500 endangered species, more than any other U.S. state, and many of these species are currently conservation reliant. Some Hawaiian species have been managed for over a century and still require significant species-specific conservation efforts to keep them from extinction. Saving Hawaii's unique plants and animals will not only require long-term increases in conservation funding, but also a concerted effort to minimize the number of conservation reliant species by: (1) focusing on invasive species prevention and eradication strategies, (2) undertaking landscape conservation efforts that have long-term viability, (3) expanded species-specific migration efforts to adapt to a changing climate, and (4) the adoption of a more biodiversity-friendly society.

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Quantifying the Seed Dispersal Pressure of *Clidemia hirta* on Native Fruiting Plants

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Owing to species extinctions and introductions, changes in the species composition of mesic forests have dramatically altered seed dispersal functioning on the island of Oʻahu. Many native plant species depend on this dispersal function. *Clidemia hirta*, an invasive fleshy fruited shrub, is highly consumed by many frugivorous birds and therefore may negatively affect dispersal of native fruiting plants. To quantify the dispersal pressure of *C. hirta* on native plants, we will experimentally remove *C. hirta* fruits in a Before-After-Control-Impact paired plot design and monitor visitation and frugivory over a period of six weeks. Visitation and fruit consumption will be quantified using game cameras. Bird abundance and diversity will be monitored using points counts. Vegetation cover, fruit abundance, and diversity will be monitored along transects. Based on previous observations, we predict that rates of visitation and frugivory will be greater for non-native fruits than for native fruits and that among native fruits, P*ipturus albidus* will be the most frequently visited. Experimental plots with *C. hirta* removed will receive lower rates of visitation and frugivory overall; however, this difference will be reduced in plots with high fruit diversity and abundance. We expect a clear skew towards visitation and frugivory of invasive plants will be apparent in our system. We anticipate management recommendations should focus on planting diverse and productive native fruiting species alongside the current invasive species removal to ensure high visitation, and therefore increased seed dispersal.

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The influence of meal size and gut transition time on the detection of kiwi DNA in predator faeces

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Predation by introduced mammals is the leading cause of decline for many of New Zealand's native avifauna. It is therefore important to have effective methods of studying predator-prey interactions. Previously, evidence of predation had relied on visual observations or gut content analyses - an expensive and invasive method as animals must be caught and necropsied. Here, we evaluate a non-invasive, faecal-DNA-based approach for evaluating prey consumption. To date, it is poorly known how gut transition time, meal size and laboratory treatments such as DNA extraction procedures affect the success of prey DNA detection in vertebrate scats. To fill these knowledge gaps, we conducted a feeding trial in which captive stoats (*Mustela erminea*) were fed a small, medium and large meal of kiwi meat (*Apteryx* spp). DNA was extracted from all scats produced for the following 7 days and trace amounts of kiwi DNA were amplified using a targeted probe-based assay. The effects of meal size and time since consumption on DNA detection were investigated, with large meal size revealed to have a positive effect on prey DNA detection. Finally, we field-tested this tool to establish its practicality as an environmental sampling technique. The present study is one of the first to examine targeted detection of a single prey species using environmental DNA techniques. Overall, the ability of this non-invasive approach to detect kiwi DNA in predator scats suggests that it will be useful for monitoring the impacts of predators on at-risk kiwi populations and other threatened prey species

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The concept of conservation-reliant species and implications for species conservation

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Eighty-four percent of the endangered species in the United States, more than 400 of those in Hawaii, are conservation reliant and face the prospect of extinction from threats that cannot be eliminated, only managed, This management may be needed for a very long time regardless of the legal status of the species if extinction is to be avoided. As climate change and invasive species push more species toward extinction the queue of conservation-reliant species will continue to grow and the economic, cultural and political context in which we practice conservation become increasingly complex. This makes our task of conserving species and their habitats more difficult forcing us to make decisions about which species should be conserved, for how long, by whom, and to what end: preventing extinction or promoting recovery? To meet these new realities transformative changes are needed in management practices, conservation funding, level of public trust, and the scale at which management actions are taken.

In this presentation we will describe conservation reliance and illustrate its spectrum from extinct in the wild to thriving in the “wild” with human support. We will also describe tools used to manage conservation-reliant species and to build stronger conservation partnerships. Lessons learned from more than five decades of managing conservation-reliant species in Hawai‘i will be described and how that knowledge can help us find ways to provide greater management transparency and increase trust among conservation practitioners in their efforts to create landscapes where imperiled species can coexist with humans.

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Re-examining Morphological Differences Between 'Alae 'ula and Mainland Common gallinules

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The `alae `ula (Hawaiian gallinule, *Gallinula galeata sandvicensis*) is an endangered subspecies of the Common gallinule currently endemic to the islands of Kaua`i and O`ahu. Island subspecies like the `alae `ula are often the subject of significant conservation efforts and expenditures, and it is important to know what morphological, genetic, and ecological traits make them unique. While the genetic differences between `alae `ula and mainland gallinules have been explored, the literature on how `alae `ula physical differ from their North American cousins is scant and contradictory. Differences in morphology are typically the result of consistently different selective pressures, which in turn may necessitate specific different conservation and management strategies. We live-captured and measured >250 'alae 'ula across all major breeding sites on O'ahu, compiled unpublished field data on Common gallinules, and measured museum specimens of both subspecies. We compared mean tarsus length, facial shield length, wing chord, and body mass across all datasets and a meta-analysis of reported values in the literature. We found that `alae `ula had significantly longer tarsi and facial shields, shorter wing chord, and larger body masses than their mainland conspecifics. Some of these traits are associated with incipient flightlessness, which is characteristic of island birds in the rail family, but also may result from selection due to aggressive antagonistic interactions with conspecifics and other species in territorial disputes over limited freshwater wetland habitat. This study highlights the unique morphology of `alae `ula and presents a novel hypothesis for the ecological differences which drive these patterns.

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Estimating Bird Density from Single Automatic Passive Acoustic Recorders

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Abundance is a fundamental metric of management and conservation. Accurate and precise estimates are required for defining and evaluating management actions and assessing recovery programs. Distance sampling is a widely used method for estimating animal density. Standard bird surveys involve human observers searching for species visually and/or aurally. For each bird detected, the distance is recorded so that a detection function can be estimated. From it, an estimate of density follows. Passive acoustic monitoring methods were recently developed for estimating density using arrays of recorders. Here we describe the use of distance sampling from a set of passive acoustic recorders to which distances of recorded sounds cannot be measured directly. The signal strength of the detected bird songs or calls is converted to distances via a calibration exercise. We illustrate the methods using a survey to estimate the density of a Hawaiian forest bird (Hawai´i ´Amakihi; *Chlorodrepanis virens*) on the island of Hawai´i, USA. We validated our approach by comparing the obtained density estimates to human observer-based traditional point-transect distance sampling. Overall density estimates from recorded signals were lower than human-based estimates, but 95% confidence intervals overlapped. This study presents a simple but effective protocol for estimating animal density using a set of single automatic acoustic recorders for collecting large-scale and long-term information on animal populations, particularly for rare species and remote areas that are difficult to access. Our protocol may easily be adapted to other sound-emitting terrestrial animals. We conclude with some ideas for future work in this area.

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Population Genetic Structure of Ryukyu long-furred rat *Diplothrix legata* in Okinawa Island, Japan

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Ryukyu long-furred rat (*Diplothrix legata*) is an endemic species of Japan that lives only in northern Okinawa Island, Amami Oshima and Tokunoshima, and is the largest rodent in Japan. In the northern part of Okinawa Island, the number of native rare species has been reduced due to the invasive mongoose (*Herpestes auropunctatus*) released in the first half of the 20th century. In recent years, the removal of mongoose has progressed, and the number of rare species has been recovering. The rat have also experienced a decrease and recovery in population due to mongoose. In this study, to clarify the loss of genetic diversity and the effect of subpopulation due to a decrease in the past population of Okinawa Island population, we clarified genetic diversity and structure. We developed primers for PCR at 10 microsatellite loci for Ryukyu long-furred rats on Okinawa Island. DNA was extracted from the muscles of individuals who died in traffic accidents in the island from 2000 to 2018, and the genotype of 62 individuals was determined using these primers. As a result, the heterozygosity of the population was 0.59 (expected value) and 0.51 (observed value). This was higher than the stable population of Amami rabbits (*Pentalagus furnessi*, 0.54, 0.40) on Amami Oshima Island, another small island mammal. In addition, the results of the bottleneck test indicated that the past few generations did not experience excessive bottlenecks. As a result of Bayesian clustering analysis, the estimated population was K = 1, and no subpopulation structure was observed. On the other hand, the effect of isolation by distance was observed, suggesting that the population maintained a genetic equilibrium. From the above results, it is considered that the genetic diversity and genetic structure of the rat are hardly affected by mongoose, and a genetically healthy state is maintained.

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Multiple Sources of Evidence for Density Dependence in the Endangered Hawaiian Stilt (*Himantopus mexicanus knudseni*)

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Hawaiian stilts (*Himantopus mexicanus knudseni*) are an endangered subspecies of the Black-necked Stilt endemic to the Hawaii. Their dynamics are poorly understood but essential for their management and conservation. Density dependence, the relationship between population abundance and reproductive success, is a key endogenous driver of population behavior with large implications for waterbird conservation in space-limited protected Hawaiian wetlands. We tested for density dependence in Hawaiian stilts using two independent data sources: a 30-year time series of annual estimated range-wide abundance, and two 15+ year time series of nesting data. We compared nonlinear density-dependent and density-independent population model fits to our time series data, using both frequentist and Bayesian state-space approaches. Across both approaches, density-dependent models best fit observed population dynamics, with lower AICc and cross-validation statistics compared to density-independent models. Among density-dependent models, a conditional model in which density-independent dynamics occur below a population size threshold (~850-1000 birds), and then density-dependent dynamics occur above that threshold, performed best across all model comparisons. Our analysis of reproduction data revealed a strong negative effect of local adult density on nest success in one protected area where few alternative breeding habitats are available, but no such effect at another site with many adjacent alternative habitats. These highly consistent results imply that increased management on Hawaii's few remaining wetlands will not be sufficient to boost their numbers for downlisting, and that additional wetland area must be acquired, restored, and managed to reach population goals for this endangered subspecies.

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Assessment of Coral Reef Community Restructuring Throughout Bleaching and Recovery Using Environmental DNA in Hawaiʻi

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Coral reefs support the most diverse assemblages of marine life on Earth, yet are declining due to local and global stressors. Rapid and widespread monitoring is essential for tracking ecosystem responses, but assessment of coral communities traditionally relies on time consuming visual surveys and estimates of coral cover, the percentage of substrate occupied by living corals. The analysis of environmental DNA (eDNA) offers fast and efficient insights into the abundance and distribution of species, and we have previously demonstrated that visual estimates of coral cover are highly correlated with the abundance of coral eDNA on reefs in Hawaiʻi. Using a relatively simple, rapid, and replicated PCR-based metabarcoding approach, we investigate the effects of coral bleaching on the community structure of reef-associated invertebrates throughout thermal stress and recovery. Environmental DNA surveys were conducted before, during, and after the 2019 bleaching event at four field sites on Oʻahu. Taxa were targeted using universal primers for the mitochondrial Cytochrome c Oxidase subunit I gene (COI), which is designed to amplify marine metazoans. Our findings suggest that invertebrate communities undergo reshuffling throughout the 2019 bleaching event, with overall reductions in eDNA reads from corals and other cnidarians, and increases in eDNA signatures from poriferans (sponges). However, long-term monitoring of baseline eDNA signatures is needed to determine seasonal variation of reef taxa. Given its broad applicability and ease of use, eDNA metabarcoding can provide complementary analytical support for biomonitoring and management initiatives tracking changes on coral reefs in response to climate change and other disturbances.

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Identifying the genetic mechanisms underlying resistance or tolerance to avian malaria in Hawaiian honeycreepers

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Inflated extinction rates among Hawaiian honeycreepers (subfamily Drepanidinae) due to avian malaria (*Plasmodium relictum*) and its mosquito vector (*Culex quinquefasciatus*) showcase how introduced diseases can decimate naive ecosystems. Most honeycreeper species only persist in high-elevation refugia from disease, where temperature limits development of both mosquitoes and parasites. As climate change raises global temperatures we may see a rapid loss of these avian refugia. ‘Amakihi (genus *Chlorodrepanis*), are the only honeycreepers that remain at high densities in low-elevation areas where malaria prevalence is high. Experimental infections revealed different low-elevation ‘amakihi populations have evolved separate immune strategies (tolerance vs. resistance), while high-elevation populations remain highly susceptible. The genetic mechanisms underlying these immune strategies are largely a mystery. Therefore, we propose to experimentally infect a previously unexamined low-elevation population of Hawai‘i ‘Amakihi to determine how genomic and transcriptomic profiles differ between survivors and fatalities of malaria infection, how these profiles differ from those of a high-elevation population we previously tested, and what genes are associated with immunological responses. RNAseq results from previous high-elevation ‘amakihi experiments showed that transcriptomic profiles of birds that succumbed to malaria infection differed from survivor and control birds. Differential gene expression analysis identified 421 genes that constitute these transcriptome-wide differences, the gene families of which we are currently investigating to assess the biological processes underlying recovery from infection. Elucidating the genes associated with immunological adaptations to avian malaria may be important for developing gene-based conservation strategies for our remaining 17 species of Hawaiian honeycreepers.

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Ant species diversity, distribution and community composition in different forest types in Papua New Guinea

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New Guinea (NG) is a highly hotspot of ant diversity in the world. Previous studies in NG and elsewhere have provided important scientific information about effects of elevation, sampling approaches, stratification and forest succession important for ant species richness and composition. However, our knowledge of ant's ecology should also include the impact of forest disturbance combined with altitudes to understand the processes that maintain such high species diversity. We used tuna baiting and hand collection methods to investigate diversity and community composition of ants in 16 sites all across Papua New Guinea-in both disturbed and pristine forest, ranging from 28 to 2700 m asl. We found 176 of ants from exposing 320 tuna baits and 72 hand searched plots. Baiting samples were strongly dominated by few common species whilst hand searched plots captured more-rare species. Chao 2 estimator for both methods predicted under-sampling of local community. As expected, ant species diversity and richness significantly decreases with increasing elevation. Forest disturbance exhibited much smaller effect on the ant species composition than elevation, and its effect was not significant using multivariate randomizations. The unexpected high species richness in disturbed sites are driven by the fact that we sampled undisturbed communities at all elevations, while we did not sample disturbed communities at the high elevations (>2000 m). Hence, future studies shall sample more sites, ideally balancing for an equal sampling effort per disturbance stage and elevations.

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On the path to carbon neutrality: a Hawaiʻi carbon land use opportunity assessment

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Hawaiʻi is the first state in the nation to commit by law to 100% renewable energy and net negative decarbonization of the economy by 2045. Technology and information requirements for achieving these goals are significant. However, national-level greenhouse inventories and land-use change decision support tools are inadequate for the local to regional scale planning required for Hawaiʻi's island environment. A critical missing piece is a land-use information layer specifically developed to support wall-to-wall GHG management opportunities across the range of natural and working lands in Hawaiʻi. To maximize landscape-scale sequestration rates, we propose to work with stakeholders to develop a land-use classification map optimized for climate change mitigation at the Hawai´i scale. By assessing current statewide options for climate-smart landscapes that: (1) account for lands devoted to agriculture and development; (2) identify marginal and recently abandoned lands, agroforestry, and climate-smart pasture and crop production; and (3) respect the diverse conditions that shape land-use decision making. The outcome will be a land classification map and first-order resource assessment to evaluate challenges and opportunities for achieving current legislative mandates and support future related policy and programs. As a result, this project outcome will support Hawaiʻi's GHG Sequestration Task Force objectives of improving inventories and facilitating the development of quantitative tools needed for planning and implementing land-based climate action.

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How Does Capacity Development Translate into Conservation: An Evaluation of the Pacific Islands Managed and Protected Area Community

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In 2019, the Pacific Islands Managed and Protected Area Community (PIMPAC) completed an internal evaluation of its capacity development efforts since 2005 to better understand to what extent its activities translated into conservation. A logical model including inputs, outputs, outcomes and impacts was developed to inform the survey design. Data was collected by a desk top review of budgets, reports and strategic plans and over 50 in-person interviews of partners from across the Pacific who have been participants in training activities for the following topics: management planning, conservation action planning , socioeconomic monitoring, marine biological monitoring, fish market monitoring, terrestrial biological monitoring, enforcement, climate change adaptation, monitoring management effectiveness, ecosystem approach to fisheries management, and strategic communications/behavior change. The results indicated that given PIMPAC's limited budget and staff and large geographic scope, it has been successful in building capacity in a broad range of topics, providing skills that are being used in jobs focused on conservation, influencing changes of fisheries regulation and the abilities' of officers to enhance enforcement. Survey results also showed that the perceived current capacity for all training topics was identified to be between 5-6 or "moderate" on a 0-10 scale. Additionally, for all training topics, it is perceived that if PIMPAC did not exist, the current capacity would be statistically lower by 2-3 mean rating points. Results also revealed opportunities for improvements. Evaluations of capacity development programs are rare. This evaluation helps better understand the linkages between capacity development and conservation.

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Spatial dynamics of an endangered amphibian, *Ranoidea raniformis*, within heavily modified landscapes.

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In increasingly fragmented landscapes the ability for amphibians to adapt to changing environmental conditions is critical for their local persistence. In order to establish the capability of the endangered frog, *Ranoidea raniformis*, to sustain itself across heavily modified landscapes in northern Tasmania, we surveyed 89 independent anthropogenic ponds three times. Ponds were located within commercial timber plantations and active grazing landscapes. We employed N-mixture models in order to determine the influence of seven variables, from a pond localised scale to the macro landscape level, on the occurrence and abundance of *R. raniformis*. Detection probability was also accounted for, examining six potential factors. Site occupancy was low with *R. raniformis* only reported at 13 ponds. The primary determinant for both site occupancy and abundance, with a negative influence, was the %-cover of commercial plantation within the surrounding landscape. The amount of proximate remnant woodland was positively related to occupancy. This result indicates that within modified regions *R. raniformis* persistence is determined primarily by landscape-scale habitat composition rather than localised site-specific variables. This response is most likely due to *R. raniformis* life-history characteristics relying on the availability of both available waterbodies to facilitate spring/summer breeding and adjacent native woodland for over-wintering and foraging. Plantation blocks commonly saw native woodland pushed to the periphery of the commercial stand, leaving interior ponds isolated. This result has implications for the conservation needs of this species with the current policy-based prioritisation of pond-condition failing to account for the concurrent need for proximal native vegetation.

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Agriculture as a Tool for Conservation: Aspects of Root Competition in High Diversity Agroecosytems in Hawaiʻi

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High diversity agroecosystems provide refugia for native pollinators, preserve soil health, and limit agricultural runoff while producing similar yields to conventional agriculture. Replacing conventional monocultures with high diversity agroecosystems can positively impact conservation efforts in the Oceanic region, but underground competitive dynamics in these systems are poorly understood, limiting their adoption. We examined root competition between breadfruit (*Artocarpus altilis*) and māmaki (*Pipturus albidus*) to determine the impact of underground competition and how prior establishment influences that competition. Plants were grown in 50-gallon pots and outplanted in three sets of establishment treatments: māmaki first, breadfruit first, and both at the same time. We measured growth, nutrient uptake, and vertical root allocation to examine aspects of competition between breadfruit and māmaki. Our results indicate that Breadfruit was negatively impacted by competition while māmaki grew more under competition. Prior establishment enhanced māmaki's growth response and breadfruit growth was enhanced by simultaneous establishment. Nutrient uptake for breadfruit was inhibited by competition, while māmaki positive growth response can be attributed to its more aggressive nutrient uptake strategy. These results suggest that māmaki resilience in diverse agroecosystems can be improved by early outplanting during orchard establishment while interspecific competitive stress on breadfruit may be alleviated through nutrient management. These findings are the first steps toward developing improved orchard establishment protocols for both agroecosystems and novel reforestation efforts using these plants.

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Linking Monitoring Data to Conservation Management Through Triggers for Action

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Conservation interventions should ideally occur during the early stage of decline, when the species or ecosystem is still in relatively good condition. However, action is often delayed whilst monitoring data is gathered to reduce uncertainty around the extent of the decline. This can result in more significant intervention being required at a later date, and has resulted in several species being monitored to extinction. Decision triggers are a mechanism to initiate timely management responses, and combine agreed intervention points and actions that may help prevent continued unwanted declines. However, current applications are restricted to systems with robust monitoring data. We developed a method for setting decision triggers for managing threatened species which can be used in the absence of robust monitoring data. The method involves expert elicitation; practitioners are asked to assign trigger points and associated actions along hypothetical species decline trajectories. They then estimate the impact of those actions on the population based on their knowledge of the species. Trigger points and actions can then be updated as more data becomes available. We tested the method by interviewing 14 practitioners who manage threatened taxa in New Zealand. We found that species' life history traits, epistemic uncertainty and decision-maker risk preference were important factors when setting decision triggers. The rate of decline did not influence decision-making, suggesting that trigger points are consistent across decline trajectories. Our approach will promote proactive management through *a priori* setting of points of intervention and actions, ensuring conservation interventions are timely and effective.

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“Kanaloahe’ehaunawela: A coastal management report developed with Oiwi perspectives in marine ecology to inform stewardship

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Kamehameha Schools has tasked the Edith Kanakaole Foundation with creating a report that will aid in the creation of coastal management policies. The intention of this report is to develop a framework in which to understand the environmental phenomena and natural processes that occur in our coastal environments from an ‘Ōiwi (Native Hawaiian) perspective with the goal of making informed stewardship decisions utilizing kupuna (ancestral) knowledge. This methodology known as Honuanuiakea is a combination of Papaku Makawalu and grounded theory, in which a group of marine ecological experts (Marine scientists, microbiology experts, oceanographers, fishpond practitioners, voyaging, etc.) convened to dissect and analyze kupuna oli (chants) and kaao (stories), and discovered the encoded environmental and biological observations in the oli and kaao. These then went on to become coastal management recommendations categorized in the three foundations of Papaku Makawalu. This presentation will share some of these recommendations along with the process in how these recommendations were formulated by the collective professional practitioners.

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The Influence of Leaf Characteristics on Litter Arthropod Communities in a Hawaiian Lowland Wet Forest

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Forest leaf litter provides rich habitat for arthropods, but litter characteristics important to arthropods are expected to vary among plant species. Leaf nutrient content and phenotypic traits such as size, shape, and thickness influence the habitat and may explain why arthropod communities differ in space and time within litter of different plant species. To assess this relationship, we deployed mesh bags filled with single-species litter onto lowland wet forest plots within the Liko Nā Pilina restoration site on Hawaiʻi Island. Litterbags were collected after 1 and 6 months to identify arthropods that colonized the bags and leaf decomposition rates. Litter from beneath the canopy of each species was also collected and arthropods extracted using Berlese funnels. Arthropod morpho-species richness ranged from 17–35. Differences in arthropod communities among plant species were driven primarily by nutrient content. Carbon, nitrogen, phosphorus, and leaf water content were the principal variables driving arthropod diversity and abundance. Litter mass remaining after 6 months ranged from 18% to 77%, with k constant values ranging from 0.573 to 3.43. Microhabitat temperature under plant litter was not significantly associated with decomposition rate nor differences in arthropod communities.

Occupying several trophic positions, arthropods are essential elements of forest floor ecosystems. In restoration, careful selection of plant species can influence arthropod communities and sustain a diverse food web from the bottom up. A rich and diverse arthropod community may enhance the long-term ability of a forest to cycle nutrients and shelter other important species.

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Kua, Lako, Moʻo: Three basic pathways exploring indigenous biocultural perspectives in Hawaiʻi

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Biocultural conservation wields the relationships between a culture and the natural world. Hawaiian biocultural frameworks are complex but can be initially explored by examining the worldview elements that link native species and ecosystems to 1) the pantheon of Hawaiian gods, to which all elements of the environment were associated 2) the rich material culture and ethnobiological applications that emerged from centuries of life in the islands, and 3) the emergent oral traditions that weave species and ecosystems into everyday life, ethics, and sustainable existence. Examples out of traditional Hawaiian sources describing these three elements are offered, indicating their significance to an emerging integrated approach for transforming conservation in Hawaiʻi via indigenous perspectives that can be applied anywhere people have forged long-standing relationships with their environments. These sources are held in an amazing archive of intellectual, ethical and spiritual Hawaiian knowledge recorded by the world's largest printed archive of an oceanic indigenous culture: the 1.5 million pages of Hawaiian language newspapers becoming increasing available as a source of ʻike Hawaiʻi.

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Mai loko mai o ka pō: The growth of Hawaiian cultural integration in HCA and HCC

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Although since 2010 the Hawaiʻi Conservation Alliance has explicitly expressed goals to integrate Hawaiian knowledge, values and practices into conservation, the path toward cultural integration began in the last decades of the 20th century. In a brief oral introduction the evolution of the annual Hawaiʻi Conservation Conference is told, even from its days prior to being sponsored by the Hawaiʻi Conservation Alliance, starting from a small group of mostly agency-based conservation practitioners to its current incarnation of over a thousand participants reflecting a wide range of conservation and cultural interests. This transformation will be discussed in terms of gradual shifts in paradigms, and conscious and directed efforts to include and integrate more and more aspects of Hawaiian language, culture, values, and practices via the Hawaiian Culture Subcommittee of HCA. This presentation will be the first offering of a panel discussion on the growth of ʻōlelo (language) and moʻomeheu (traditional practice) in the enhancement of conservation research, management, and stewardship of the mea ola makamae o Hawaiʻi nei.

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Malo‘o ka Lani, Wela Ka Honua: Living Well Within Our Water Budget When The Sky Is Dry and The Earth Is Parched

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Hydrological resources are foundational to the fabric of Hawaiian ecosystems and communities. Understanding how Hawai‘i’s first inhabitants stewarded resources during periods of drought in such an isolated geography provides diverse insights into how society can prepare for, adapt to, and even mitigate the impacts of drought events across sectors. This project relies on an interdisciplinary research approach to address drought issues in Hawai‘i, with relevance across the Pacific Island region. We conducted a preliminary search for drought conditions, such as lack of water, and impacts, such famine and death, in historical Hawaiian ethnoecological resources: ‘Ōlelo No‘eau; Hawaiian Planters; translated chants and stories; and Hawaiian language newspapers. Methods included detailed review of drought references and the identifying of relevant themes. Initial findings identify short term, generational, and inter-generational droughts and dry spells that span from location specific to island wide events. General lessons gleaned include naming water sources for times of drought/abundance, the need to travel for food resources to old lands, misconduct of people leading to arid and prolonged harsh conditions and note of an abundant land during times of famine. Historical analysis of Hawaiian literature resources provides insights to how drought was perceived, broken, dealt with, impacted social order, and observed. Contemporary drought efforts aim to inform managers of indicators and environmental phenomena experienced communities look for, respond to, and how drought shapes resilience to place. ‘Āina Momona in arid locations takes cultivation of observation and interdependent survival to live well within a limited water budget.

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Relationships for ʻĀina Aloha: A Pilot Cooperative Project of the Puʻuwaʻawaʻa Community Based Subsistence Forest Area

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The Puʻuwaʻawaʻa Community Based Subsistence Forest Area (PCBSFA), is an informal collaborative stewardship arrangement formed in 2018 within the Puʻuwaʻawaʻa State Forest Reserve, North Kona, Hawaiʻi Island. The PCBSFA pilots community-based design and is currently implementing a plan for the transformation of 84-acres of pasture-land into native dryland, mixed-mesic, and historical dryland agroforests. This effort was a response to dramatic changes in land use and climate change on the summit of Puʻuwaʻawaʻa and a desire by lineal descendants to steward these landscapes. Led by multi-generational community leaders who are supported by non-profit and agency organizations, the PCBSFA operates by consensus-based decision making. Here we present our vision of a vibrant and engaged community, applying our skills, strengths, service, and aloha to maintain a bio-culturally diverse and productive presence within this ʻāina aloha of Puʻuwaʻawaʻa. The PCBSFA is the first community managed forest area project on lands managed by DLNR DOFAW in the Hawaiian islands. To date, we have: (i) fenced 84-acres; (ii) hosted ʻohana meetings resulting in a traditional knowledge-based, community-driven planting list; (iii) established the support of the Puʻuwaʻawaʻa Advisory Council; (iv) created resource documents, and (v) hosted five Kupu Hawaiʻi Youth Conservation Corps teams to support restoration and management activities in Puʻuwaʻawaʻa. Successful relationship building has made it possible to weave traditional knowledge with reforestation intentions providing knowledge holders access to lands thus increasing the capacity of agencies to mālama ʻāina. This community-led model has applications to expand ʻĀina Momona approaches.

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Meta-Barfcoding: DNA-Barcoding of Barf Yields Insights into Seabird Foraging Ecology

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Morphological identification of digested prey remains from a generalist forager can be a challenge, especially to species level. DNA techniques, whereby prey is sequenced and matched to large public nucleotide sequence databases, are increasingly being used to augment traditional morphological identification. We used a DNA approach that we call "meta-barfcoding" to identify highly-digested prey items from Christmas shearwater (Puffinus nativitatis) regurgitations from Kure Atoll. This technique uses high-throughput-sequencing to bulk-process barfs, targeting the cytochrome c oxidase subunit I (COI) mitochondrial gene. We processed 92 regurgitations collected from 2009-2017 to get an overview of the seabird's contemporary diet. The meta-barfcoding technique identified 87 unique taxa from 29 families of fish and squid. The identified prey items spanned a diverse range of taxa, including families that are reef-associated, pelagic-oceanic, and mesopelagic. Rare species (occurring < 5% of the samples) constituted 66% of the species richness. Overall, 81% percent of the families detected in the contemporary diet were previously documented in historical Christmas shearwater diets from the Northwestern Hawaiian Islands dating back to the 1970s (Harrison et al. 1983). Our results not only provide new details about the foraging ecology of this species, but we hope that our successful use of the COI region in identifying a wide range of taxa from highly digested seabird regurgitations will encourage other researchers to use this technique to identify low-quality prey samples.

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Ask and you shall receive: a coral-safe dive briefing reduces SCUBA diver contacts with reefs

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Coral reefs are a critical resource for the culture and economy of the American territory of Guam, but the island's coral reef resources are increasingly imperiled by climate change, particularly bleaching caused by rising seawater temperatures. Severe bleaching events in 2013, 2014, 2016, and 2017 have caused mass mortality of corals and made evident the critical need to reduce local stressors to protect the future of Guam's reefs. An estimated 300,000 people scuba dive on Guam's reefs annually, but the impacts of these divers are unknown. This study tests a low-effort approach to reducing diver impacts by using a coral-safe diving reminder. A single-sentence coral-safe diving reminder delivered as part of the standard pre-dive briefing was highly effective in reducing both accidental and intentional contacts with reef. Divers who received a coral-safe diving reminder made 72% fewer contacts with the reef, and about 60% fewer contacts with live corals specifically, than divers who did not receive a reminder. Predictors of high-impact divers were identified, including camera users, gloves users, visiting divers, large groups, and poor buoyancy control. This study may allow diving professionals to identify potential high-impact divers and reduce their impact through increased supervision.

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Understanding Social-Ecological Resilience: The Dynamics of Post-Cyclone Agroforest Recovery in Fiji

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The detrimental impacts of global change are particularly severe in Oceania, where extreme weather events, such as cyclones, are projected to increase in frequency and intensity. Cyclones play key roles in shaping the structure and composition of forest systems, and the human communities that rely on them. This may have implications for agroforests which are critical sources of food, water, and medicine, and conserve high levels of biodiversity. In 2016, Fiji was impacted by the strongest cyclone recorded in the Southern Hemisphere, category-5 Cyclone Winston. However, no research exists on how agroforests in the Pacific Islands recover after cyclones of this magnitude, or the significance for food security.

We examined how Cyclone Winston damaged agroforest trees and affected the diversity and richness of crop cultivars, and of domesticated and native tree species, over a five-year period. We collected data on plant composition, diversity, and resource use pre- and post- cyclone, in 50 agroforests across four districts. To contextualize these findings, we also conducted interviews about management decisions post-cyclone that impact biodiversity and nutrition.

We found few changes in agroforest tree species richness and composition post-cyclone, but large variation in the richness and composition of key crop cultivars across time and space. Tree damage and recovery was also influenced by land management practices and species identity. These results further our understanding of social-ecological resilience of agroforests in the face of uncertainty, and can help inform nature-based adaptive solutions to climate change impacts effecting agrobiodiversity and food security.

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The National Ecological Observatory Network in Hawai`i: open data to understand Hawai`i's changing ecosystems

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The National Ecological Observatory Network (NEON; www.neonscience.org) was conceived as an instrument to examine and understand the interactions between life and the environment at the scale of an entire continent over the course of a generation. Funded by The National Science Foundation, and operated by Battelle Memorial Institute, NEON finished construction of all 81 fields sites in 2019 and will now provide 30 years of open access ecological data to better understand how U.S. ecosystems are responding to climate change, land-use change, and invasive species. The comprehensive data, spatial extent and remote sensing technology provided by NEON will enable a large and diverse user community to tackle new questions at scales not accessible to previous generations of ecologists. The Pacific Tropical eco-climatic region of NEON (Domain 20) is represented by a field site in the Pu`u Maka`ala Natural Area Reserve on Hawai`i Island. Here, NEON has constructed a 105' instrumentation tower for continuous climate and ecosystem monitoring, as well as an array of forest plots to collect data about multiple facets of our unique ecosystem. NEON staff will provide an overview of the NEON sampling design in Hawai`I with examples of available data sets and how to access and use the data. The insights gleaned from NEON data and tools may inform decisions at the national and community levels that will impact natural resource management and human well-being for generations to come.

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Nā Kilo ʻĀina: Building Communities of Conscious People of Place to Support ʻĀina Momona

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In addressing abundant biocultural diversity within our natural ecosystems, we recognize the need to include people in our efforts towards ʻāina momona through strengthening the abundance and productivity within our social ecosystems. Through consciously including the "healing journey" of an individual person, family, and community, we support our people in recognizing their purpose and role within the broader community and the necessary collective contribution and investment to ecosystem health and abundance. Nā Kilo ʻĀina (NKA) is an initiative whose ultimate goal is ʻĀina Momona: abundant and thriving communities through developing and strengthening communities of conscious people of place. This initiative focuses on a collective journey of health based on the natural and social environment and the co-dependent relationship needed for both to thrive. The health of our environment is a direct reflection of the health of our people and vice versa. Through various branches of NKA, we are able to address 'people' needs while building the capacity of our people to address the needs of a productive watershed and holistic ecosystem health. We will share the development of the important components of NKA and the various branches that have grown out of this original initiative ranging from watershed monitoring tools to community and outreach programs. Participant and community partners will also share their own personal journeys of ʻāina momona and the impacts NKA have had within their lives, families, and community. We hope these strategies will support our collective journey addressing abundance and productivity with the intent to thrive.

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A Key to Restoring Threatened Hawaiian Forests and Supporting Sustainable Forestry Efforts Resides with Endemic ʻIliahi Species

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Santalum species, including the endemic Hawaiian ʻiliahi, are ecologically distinct as hemiparasitic trees requiring suitable hosts for survival. Reforestation and sustainable forestry of degraded ʻiliahi sites, therefore, may require supporting diverse and abundant plant communities. Our project aims to improve the survival and establishment of planted seedlings by better understanding resource allocation between ʻiliahi and native host species. We present two experiments being implemented with the goal of integrating results into current stewardship strategies. The first experiment uses a 3-pot design to isolate parasitized roots. Isotopically enriched or depleted water and nutrients (nitrogen and carbon) will be used to trace and quantify resource movement from the host. It is hypothesized that water and nitrogen are important resources acquired by ʻiliahi from hosts, but it is unclear whether carbohydrates are also exchanged. The second experiment utilizes overstory gaps in existing koa (Acacia koa) stands in order to underplant ʻiliahi. In addition to diversifying initial plantings, established koa may increase the probability of planted ʻiliahi making early, and abundant, hemiparasitic connections. For both experiments, morphological and physiological measures are used to identify parasitic connections to host plants and understand the drivers and effects of resource transfer for the ʻiliahi seedling and the host. These results will help improve efforts to restore functionally compatible, abundant, and robust forests.

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Biocultural outcomes of agroforestry restoration using a co-design, functional trait-based approach

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Unprecedented conversion of native ecosystems to intensive agriculture has prompted parallel calls for increased forest restoration and regenerative agriculture. Biocultural restoration of traditional agroforestry can simultaneously achieve both goals; however, how to transition fallow land to multi-functional systems remains a critical challenge. In collaboration with a community-based non-profit farm restoring ʻāina momona in Heʻeia, Oʻahu, we initiated a long-term experiment on fallow land with 100% non-native plant cover using before-after-control-impact design. We asked, how do species mixes designed for erosion control and early successional facilitation, through a co-design, functional trait approach, affect 1) plant survival, plant growth, and understory cover and 2) sediment retention? 3) How do cultural services, yields, and costs vary between species mixes? We selectively thinned the canopy, cleared the understory, and planted, tagged, and monitored over 1000 individuals of 20 species (19 native and Polynesian introduced) in five 12m x 15m plots and thirty 2m x 2m subplots per restoration scenario. We monitored pre-clearing, at planting, and six-months and one-year post-planting. Plots planted with a species mix selected for early successional facilitation had significantly faster growth rates and significantly greater understory cover of outplants than plots with a species mix selected for erosion control services. However, survival of trees and shrubs was the same in both scenarios. Soil root length density, a proxy for sediment retention, was not significantly different. Both scenarios produced plant material for harvest within one year of planting. Over 700 community members have volunteered, producing intangible benefits including enhanced connection to place.

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Urban ʻĀina: Restoring Abundance Where We Live

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The Hawaiʻi Conservation Conference (HCC) has increasingly embraced ʻŌiwi knowledge-practice-belief systems – from hosting entire sessions on ancestral methodologies to the conference format. Adapting the HCC to demonstrate the fundamental importance of these ʻŌiwi systems has greatly enriched Alliance conversations about the conservation and management of Hawaii's precious natural resources in natural terrestrial, nearshore and marine systems. However, relatively little focus has been on built environments where people spend most of their time. These missed opportunities are notable as most Hawaiʻi residents (89%) live in urban areas. While the biocultural stewardship of diversity has been written about widely, especially in indigenous and rural communities, applications in multicultural, urban environments have rarely been explored, including in Hawaiʻi. This symposium features urban social-ecological systems as pivotal for increasing capacity in conservation and restoring ʻāina momona. This symposium begins to unravel the questions: What does biocultural stewardship and conservation look like in an urban context? Why is it important? Although 'urbanism' and 'indigeneity' are often seen as opposite ends of a continuum, we offer a vision for urban biocultural stewardship that demonstrates how Indigenous and local knowledge offer solutions to our urban challenges. Through sharing work that features ʻōiwi knowledge-practice-belief systems in areas where we live, we offer a vision for future urban conservation work, based on our observations that urban, biocultural stewardship practices in Hawaiʻi are already showing the potential to transform the built environment into functioning landscapes that sustain us physically, emotionally, psychologically, culturally and spiritually.

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Using Humpback Whale Male Chorusing To Accurately Monitor The Temporal And Spatial Variation In Relative Abundance During The Breeding Season In Hawai‘i

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Understanding how a species utilizes its environment and how that use varies in response to natural and anthropogenic factors often plays a key role in the successful conservation of that species. The Hawaiian archipelago represents the principal breeding and calving grounds for North Pacific humpback whales (*Megaptera novaeangliae*), a population that was decimated by commercial whaling but removed from its endangered status by NOAA in 2016 following evidence of recovery to presumed sustainable levels. However, reports of fewer humpbacks present in Hawai‘i starting in the same year prompted efforts to continue long-term monitoring of the spatial and temporal patterns of humpback whale habitat use. Most long-term monitoring efforts with humpbacks in Hawai‘i have employed single methodological approaches including aerial or boat-based surveys and shore-based scans. The current study examined whether overall levels of humpback whale male song chorusing, the dominant source of low-frequency (0-1.5 kHz) energy in the marine soundscape during the breeding season, could be used to accurately track variations in the relative abundance of humpbacks off west Maui by comparing levels recorded across four consecutive breeding seasons to the results of shore-based scans for whales in the same area. By combining acoustic monitoring with visual land-based surveys, we found a strong positive correlation with humpback presence off West Maui, indicating that whale chorusing can be used as a proxy for relative abundance. Combining these methods, we were able to document trends in annual abundance and also examine spatial and temporal patterns of whale distribution in the study area.

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Understanding the role of plantations in the abundance of an arboreal folivore

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Forest cover is decreasing globally, primarily due to the conversion of forest to agricultural landscapes. In contrast, the area under plantation forestry is increasing by up to 3 million hectares per annum. For wildlife occupying landscapes where native forest is the dominant land cover, plantations generally represent a lower value habitat; however, plantations established on land formerly used for pasture, may benefit wildlife by providing temporary forest habitat and increasing connectivity. This study investigates the influence of landscape, site and climatic factors on koala population density in south-west Victoria where there has been extensive plantation establishment. We conducted koala surveys and habitat characteristic assessments at 72 sites across three habitat types: plantation, native vegetation blocks, and native vegetation strips. We detected higher mean koala density in plantation sites (0.85 per ha) than in either native block (0.68 per ha) or native strip sites (0.66 per ha). We found five covariates of koala density, and using these variables we spatially modelled koala abundance and discuss factors that are key in determining large-scale distribution and density of koala populations. We provide a distribution map that can be used to identify high priority areas for population management as well as habitat of high conservation significance for koalas. This information facilitates the linkage of ecological theory with the on-ground implementation of management actions, and may guide conservation planning and resource management actions to consider overall landscape configuration as well as the spatial arrangement of plantations adjacent to remnant forest.

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Indigenous Agro-ecosystems as Habitat for Endangered Hawaiian Waterbirds

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Approximately 15% of wetlands have been lost across Hawaiʻi since the industrial era, with ~44% of the total loss occurring in coastal areas, contributing to the listing of Hawaiian waterbird species as Endangered. However, the height of historical waterbird populations corresponded with the height of Hawaiian social-ecological systems due to the ability of indigenous flooded-field systems (*lo`i*) to provide foraging and nesting habitat. We aimed to understand the relationship between waterbird life cycles and management cycles within the agro-ecosystem as a means to assess the potential of *loʻi* restoration to contribute to waterbird recovery. Our 2019 observations revealed *ʻaeʻo* (*Himantopus mexicanus knudseni*) and *ʻalaeʻula* (*Gallinula galeata sandvicensis*), both disturbance-adapted species, partitioned the *lo`i* habitat temporally and spatially according to managed succession within the agro-ecosystem, which mimics the disturbance regimes these waterbirds evolved in. This means these flooded-field systems have the potential to contribute to waterbird recovery, and our observations of multiple successful fledging events of both *ʻaeʻo* and *ʻalaeʻula* within *loʻi* habitat supports this notion. Results from this study are important for informing management decisions regarding both *loʻi kalo* and waterbird populations and may help influence policies that allow waterbird populations to once again thrive alongside human populations.

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Assessing the Limitations of Conventional Predator Control in Maui Nui: Re-envisioning the Protection of Unique Seabird Habitat

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Maui Nui Seabird Recovery Project and Auwahi Wind Project work to improve the population of endemic, endangered ʻUaʻu (*Pterodroma sandwichensis*) on adjacent state land parcels bordering Haleakalā National Park. We evaluate seasonal breeding success using game cameras at ʻUaʻu burrows, and deploy traps strategically in response to predator activity on cameras. Data from seven field seasons show an increase in active ʻUaʻu burrows as well as higher reproductive success rates resulting from management actions. Our collaborative trapping efforts have been effective in suppressing predation rates even while the colony expands across management areas, though there are still limitations.

Although local predator abundance is comparatively low, feral cats (*Felis catus*) and small Indian mongoose (*Herpestes auropunctatus*) freely traverse the slopes of leeward Haleakalā. Camera data suggest predators are capable of targeting ʻUaʻu burrows during peak breeding season. We show how incorporating new trapping techniques and technology such as leghold traps and cellular-enabled cameras can improve capture rates temporarily; nevertheless we expect any reactive predator control strategy to remain limited to near-term predation suppression, due to the behavioral patterns and large home ranges of invasive predators. A more landscape-level approach that incorporates community involvement outside of seabird nesting areas is needed to address the behavioral ecology of pervasive predators throughout the islands. More collaborative predator control partnerships are needed to produce sustained and widespread restorative effects, allowing seabird colonies to function as a major vector for pelagic nutrients, contributing to the abundance and resilience of biocultural resources.

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Assessing ʻŌpeʻapeʻa (*Lasiurus semotus*) Habitat Use and Occupancy in the Helmano Wilderness Area, Central Oʻahu

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ʻŌpeʻapeʻa, the Hawaiian hoary bat (*Lasiurus semotus*), is the only extant, native, terrestrial land mammal in Hawaiʻi. It has been listed as endangered under the Federal Endangered Species Act since 1970. Despite this level of protection, there are large gaps in scientific understanding of this species' ecology. This is especially true on the island of Oʻahu, where the population is thought to be the smallest of the main Hawaiian Islands. To better inform land management decisions, we examined how ʻōpeʻapeʻa utilize habitat in a diverse, 650 ha portion of Helemano Wilderness Area (HWA), located in central Oʻahu. We deployed ultrasonic acoustic detectors for one to two-week periods at 80 sites across four habitat types (grazed grassland, ungrazed grassland, grazed evergreen forest, and ungrazed evergreen forest) from December 2019 to March 2020. Results from 672 detector nights indicate that while ʻōpeʻapeʻa detections are low, they are present in all four habitat types, with the highest detection rate in grazed grassland associated with domestic cattle. The naïve occupancy rate determined by the number of detections across habitats was 35 percent. A single species, single-season occupancy model examining habitat type, total nightly rainfall, and month found no significant differences between occupancy of the different habitats. However, the detection probability was negatively impacted by nightly rainfall. Results from this study provide a baseline for HWA to monitor occupancy trends over time to support ʻōpeʻapeʻa conservation.

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Challenges and opportunities in shifting diets towards pelagic fish: Case study of Palau

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Limiting reef fish consumption may be a necessary element of sustainable seafood provisioning strategies in Pacific island countries and territories. One much-discussed strategy is to shift consumption towards pelagic fishes. Per capita reef fish consumption in PICTs is amongst the highest worldwide, and tourism numbers in the region have increased dramatically in recent years, adding pressure on already stressed reef ecosystems. We examine the challenges and opportunities of shifting to a more pelagic-based diet in the Pacific Island nation of the Republic of Palau. Palau attracts over a hundred thousand tourists per year, far more than its ~21,000 residents. Palauans depend on reef fishes for nutrition and social customs, yet face depleted reefs. Alongside state and national efforts to protect nearshore habitats and sharks, the recently enacted Palau National Marine Sanctuary (PNMS) will severely limit pelagic fishing in its exclusive economic zone. We employed surveys, interviews, and value chain analysis to examine current supply and consumption volumes, consumption preferences, and the food supply chain. We found that small-scale fishers provide the majority of reef fish, while nearly all pelagic fish catch is from foreign fleets and will likely decline due to the PNMS unless there are policy changes. Tourists will eat more reef fish as pelagic fish prices increase, however, they are willing to pay more for local and sustainable pelagic fish. Based on these results, we present potential pathways to successfully shift consumption away from reef fish without undermining dimensions of food security or causing other unintended consequences.

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Scientific Advances in Understanding Rapid ʻŌhiʻa Death

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Scientific research into Rapid ʻŌhiʻa Death (ROD) in the past year has improved our understanding of how the disease moves and ways managers can interrupt the spread and protect our native forests. Remote sensing images combined with detailed and repeated plot inventories have shown that forests that are protected from feral animals have far lower levels of disease. Multiple images captured by sUAS (drones) over time have enabled researchers to closely follow patterns of mortality in selected forest stands and come up with estimates of overall ʻōhiʻa mortality. Analysis of hyperspectral imagery can indicate which trees have ROD before visual symptoms appear. A system that allows researchers to keep track of suspected, confirmed, and visually symptomatic ROD trees allows for landscape-level analysis of disease patterns. While it is known that frass produced by ambrosia beetles carries spores of *Ceratocystis*, the fungus that causes ROD, research has also shown that beetles can directly transmit the disease. Research is also underway on methods to deter beetles from attacking living but infected trees or logs on the ground. Because inter-island movement of infected ʻōhiʻa logs risks moving the fungi that cause ROD, improved methods of treatment of ʻōhiʻa wood have been developed, some of which have already been approved by the Hawaiʻi Dept. of Agriculture. Ongoing trials of the possibility of injecting protective fungicides into living trees have yielded mixed results depending on the environment. Restoration plantings of ʻōhiʻa in infected forests indicate that seedlings are not initially succumbing to ROD.

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Community Guide to Land Conservation in Hawai‘i

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Land in Hawai'i has special meaning - ‘āina or land (that which feeds us) supports all life – both physical and spiritual, and connects us to our culture, past, and ancestors. Land conservation in Hawai'i is unique, blending culture, conservation, biology, and history for a brighter future. The Hawaiian Islands Land Trust and The Trust for Public Land will be joined by community partners the Ala Kahakai Trail Association and Ke Ao Hāli‘i to unveil a recently completed Community Guide to Land Conservation in Hawai‘i, which explores how land conservation can build community resilience, conserve biocultural resources, and support healing land and local communities scarred by past divisions and disconnections. The guide includes practical information about public funding sources, transaction structures, communications with private landowners, methods of community based management and stewardship, and best practices of working with non-profit land trusts to achieve community goals of ‘āina momona, avoiding litigation or protests. The Ala Kahakai Trail Association and Ke Ao Hāli‘i will share their stories and perspectives, their visions of Ola Ka ‘Āina Momona: Managing for Abundance, and audience members will have an opportunity to explore/investigate land conservation options for their own communities. While the guide is targets communities in Hawai‘i seeking to protect land and bio-cultural resources, the concepts of community driven and collaborative conservation are applicable to all. This guide was made possible through the generous support of the Castle Foundation.

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Analyzing Habitat Change of Remote Atolls Using High Temporal Satellite Imagery

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Lalo (French Frigate Shoals) is an atoll in Papahānaumokuākea Marine National Monument (PMNM) located near the center of the Hawaiian Island Archipelago. In October 2018, Walaka, a category 5 hurricane crossed PMNM devastating some of Lalo's vital habitats for sea birds, green sea turtles, numerous endemic species, and the critically endangered Hawaiian Monk Seal. Most notably, East Island, historically observed to be ~11 acres, had been reduced to almost nothing. This project investigates the loss and subsequent recovery of these islets by analyzing monthly satellite images of Lalo. The surrounding areas of these islets, the Gins, East Island, Shark Island, Tern, and Disappearing Island were classified into "Land", "Submerged Sand", and "Hard Substrate" (i.e. coral reef) for a duration of one year after Hurricane Walaka. Results indicate that East Island began reaccumulating its land mass and grew to approximately 33% of its original area during the first 3 months after Walaka. By determining which areas were hardest hit and which areas are recovering, the most influential drivers of these changes can be deduced. Criteria like spatial orientation, storm proximity, bathymetry, and other factors can be modeled to determine the leading cause of the observed changes. This type of study is only possible due to the revolutionary constellation of satellites from the company, Planet. Analysis like these will help managers effectively respond to storm events within PMNM and other remote areas. With an expected increase in storm ranges due to climate change these tools will prove to be invaluable.

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Biodiversity and Resilience on Lānaʻi

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Lānaʻi is Hawaiʻi's sixth largest, but smallest publicly accessible inhabited island. Sitting in the lee of Maui, Lānaʻi's relatively small size, low rainfall, scarcity of resources, and general isolation bring the connection between sustainable land management and community health into sharp relief. Unfortunately, the native habitat of the island bears lasting scars of degradation from non-native ungulates and other invasive species introductions, as well as unsustainable ranching and agricultural practices beginning in the 1870s. Through the 1900s, many species disappeared outright, including the endemic Lānaʻi ʻalauhio (*Paroreomyza montana montana*; Lānaʻi creeper), Lānaʻi kāhuli (*Partulina crassa*; tree snail), and honohono (*Haplostachys munroi*; Munro's mint). Without consistent surveys, others were thought to be extirpated, existing only in chants, stories, writings, and museum collections. Despite the losses, we now know that Lānaʻi is still home to spectacular island-endemic flora and fauna, and significant populations of endangered plants, snails, and seabirds. The persistence of these native species and populations is due largely to past community members, naturalists, and conservationists who valued the uniqueness of Lānaʻi and worked to protect it as best they could. Current management focuses on protecting biodiversity and ecosystem function, remediating past damage, strengthening the connection of the community to the land, nurturing future leaders, and building a future of sustainable resilience and abundance for the land and the people who call it home. This symposium will explore some of the recent discoveries (and re-discoveries) on Lānaʻi, conservation successes, education and engagement efforts, and future large-scale partnership initiatives towards these goals.

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Hawaiian Bird Ethnosystematics and Implications for Modern Conservation

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What is the Hawaiian traditional system of bird naming and classification and how can it inform modern conservation? Fragments of a Hawaiian system of taxonomy and nomenclature of native birds can be pieced together through the writings of three scholars, David Malo, Kepelino Teauotalani, and Robert Perkins. Anthropologists have long used ethnosystematics (the systems used by a culture to cognitively order the world around them) to analyze cultural perspectives and world view. In 2019 the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services produced a media release of a report outlining the serious and rapidly growing decline of biodiversity on Earth. Notably, lands controlled by indigenous peoples were found to be degrading at a measurably slower rate than in other places, suggesting that indigenous ideas and perspectives have significant relevance to the field of conservation. While more attention has recently been given to Native Hawaiian customary land management practices and their relevance to modern conservation, not much is known about the specific ideas and perspectives of historical Native Hawaiians in managing native birds. Though there is a dearth of ethnographic information on land management related to birds, ethnosystematics provide an opportunity to learn more about this subject. Analysis of the writings of Malo, Teauotalani, and Perkins reveals a highly utilitarian emphasis in Hawaiian ethnosystematics, which suggests that an emphasis on the utility of Hawaiian birds in conservation might be pertinent.This presentation is based on research for a paper recently submitted for publication to *Ethnobiology Letters*.

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Investigating the decadal effects of SST change on Hawaiian Intertidal Communities

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Increasing sea surface temperatures (SSTs), largely driven by anthropogenic climate change, have been documented across the globe. Long-term monitoring of marine communities has revealed increased thermal stress due to elevated SST, which can result in substantial shifts in species' ranges and relative abundances in as little as a decade. These shifts are usually directed latitudinally—organisms migrate towards the poles to stay within their thermal tolerance limits.

Hawaiian intertidal habitats have been largely understudied. This is especially concerning considering that the archipelago provides little opportunity for poleward latitudinal migration in response to increasing SST, resulting in the greater potential for Hawai'i's intertidal organisms to reach the limit of their thermal tolerances. To our knowledge, no prior study has used satellite-derived SST data to assess possible temperature-driven changes in intertidal communities on a local, regional, and archipelago wide scale in Hawai'i. Preliminary analyses indicate annual mean SSTs have risen 0.68˚C across the archipelago from 2007–2019, with the variance between yearly minimums and maximums increasing by 0.77 ˚C. By leveraging data from a citizen-science intertidal monitoring project (*OPIHI*) in combination with satellite-derived SST measurements dating back to 2007, this work aims to elucidate the possible effects of SST change in Hawaiian intertidal algal and invertebrate community diversity, abundance, and distribution over time. Projected increases to global SST, in conjunction with Hawai'i's geographic isolation, warrant further investigation on how intertidal communities may be affected by SST change in order to improve management efforts in the face of a changing climate.

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Managing conservation reliant species through predator exclusion fencing and landscape level control

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Islands make up 5% of earth's land mass yet are home to 80% of extinctions and support 40% of currently endangered species. Invasive species, particularly introduced mammals, are one of the primary threats to island ecosystems and are responsible for two-thirds of island extinctions in the past 400 years. Controlling, or eradicating predators is one of the highest conservation value actions that can be undertaken on an ecosystem level, particularly for vertebrates. While predator eradications have been feasible on some islands, on larger inhabited islands, landscape level predator control, or fencing are used to control invasive species. Predator-exclusion fencing capable of excluding all mammalian pests ranging in size from mice to large ungulates has been used extensively in New Zealand and Hawaii. Here we present data comparing outcomes from a range of projects undertaken by Pacific Rim Conservation from an eradication on an island wide scale (Mokuauia), to localized fencing and eradication (Kaena Point, Kilauea Point) for seabird conservation and landscape scale predator control (Wailupe Valley for the protection of Oahu Elepaio). Across all scenarios, survival and reproductive success of native bird species increased dramatically, and in sites without native bird species present, translocation was pursued. While fencing and predator control are long term investments, in many cases they are the only viable option to create or maintain stable populations of certain species in the absence of island wide predator eradications thus creating conservation reliant ecosystems requiring a long term commitment once the action has been under taken.

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Managing conservation-reliant species under the Endangered Species Act: case studies from Hawaii and the mainland

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Under the U.S. Endangered Species Act, determinations as to whether to list or delist a species must be made “solely” on the basis of the best available science, and also “after taking into account those efforts” by the state fish and wildlife agencies to conserve those species. However, listing status does not necessarily align with the assessments of organizations such as NatureServe or the IUCN Red List, and degrees of biological imperilment do not reflect the allocation and prioritization of resources. Given the scale of the extinction crisis, chronic funding shortfalls, and the political rhetoric of many in Congress about the Endangered Species Act’s low rate of recovery — currently between 2-3% of all listed species — there are legitimate debates about who and how conservation reliant species should be managed.

This presentation will compare mainland listed species to their analogs in Hawaii. Specifically, it will assess the conservation of Kirtland’s and Golden-cheeked warbler to Hawaii’s listed songbirds. Further, the presentation will assess the conservation of grizzly bear — charismatic megafauna — with the monk seal and humpback whale. If a state agency — or even private entity — is willing to carry on necessary conservation activities indefinitely in Hawaii for a particular endangered species, could (and should) that species be delisted so conservation resources can be focused elsewhere? Given that Hawaii is home to one-third of all listed species, but receives less than five percent of all federal funding for conservation, consideration of conservation reliance is of paramount importance.

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Patterns of niche contraction identify conservation management priorities for declining mammal species

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Northern Australia is currently experiencing a rapid decline in mammal abundance, with the importance of various drivers being vigorously debated. However, despite the relevance and strength of ultimate and proximate causes of species declines being difficult to determine with certainty, practical conservation management can be informed by quantifying the environmental conditions that contribute to species persistence within a landscape.

We utilised a niche reduction approach to examine the relationship between declines in the spatial distribution and environmental niche of nine species, focusing on critical weight range mammals of the savanna woodland assemblage in the Northern Territory. First, we compared historical and contemporary records of species occurrences to quantify changing spatial patterns and niche characteristics through time. We then created and stacked ecological niche models to identify refuge environments across a geographically vast landscape.

We found that most species had greater declines in niche hypervolumes than range size, with considerable variation between species in the ratio of these two measures. A general shift towards areas of lower fire frequency, lower maximum temperature, higher vegetation cover, higher rainfall, and higher minimum temperature was observed. Areas identified for high conservation priority include the Cobourg Peninsula, the Darwin region, East Alligator River, and parts of the Tiwi Islands.

Investigating niche change can (1) improve understanding of processes involved in species declines, (2) improve status evaluations of threatened species, (3) help identify refuge conditions and locations in which threat impact is mediated or tolerated, and (4) suggest broad management goals to improve population persistence.

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Malama Pouhala - Empowering Youth in Conservation

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In the middle of Waipahu lies a native Hawaiian bird sanctuary, Pouhala Marsh. This place is hidden within its urban streets, and for many years have been used as a dump site of trash. Through the conservation efforts of the City and County of Honolulu and the State of Hawaii, Pouhala Marsh has been reclaimed and now thrives with the return of many native wetland birds and plants. To keep the efforts of restoration going, Waipahu High School has taken on the task of educating their students about this area, conducted scientific surveys, and worked in the clean up and planting of native plants. The students have also taken it a step further by learning what they could from the experts of the area, then sharing their knowledge with others through a program we call "Malama Pouhala". For the past two years, we have invited the surrounding elementary and intermediate schools to Pouhala Marsh on a field experience which was conducted by students of Waipahu High School. There, the high school students lead sections based upon the history of the area, the birds, the plants, and the water quality. The goal is to educate and share knowledge about the importance of maintaining a wetland ecosystem. Finally, the high school students organize and lead a restoration event at Pouhala Marsh on a Saturday. The community is invited as we help to clear the area of invasive plants and plant native plants which were cultivated in the greenhouse at Waipahu High School.

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Monitoring Cultural Ecosystem Services with Place-Based Indicators in West Hawaiʻi.

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Human well-being is intertwined with cultural ecosystem services, or the non-material benefits that people receive from the environment such as sense of place, spirituality, identity, and social relations. People care for and value cultural ecosystem services in diverse and complex ways. Although difficult, understanding this complexity is crucial for successful resource management. The West Hawaiʻi Integrated Ecosystem Assessment, a National Oceanic and Atmospheric Administration program, sought to identify place-based indicators of cultural ecosystem services, which are critical to human well-being. During 2018-2019, we conducted 31 in-depth, semi-structured interviews with community members in West Hawaiʻi who are involved in marine conservation (via paid and/or unpaid positions). Community collaboration was an essential part of this work to ensure that indicators were relevant and appropriate to West Hawaiʻi communities. In addition to identifying indicators, our results distinguished which cultural ecosystem services were discussed frequently and the “bundled” manner in which interviewees discussed them. We also highlight emergent themes from interview data, including the concept that human well-being depends not only on abundant ecosystems, but also on the opportunity for reciprocity between people and place. Our results provide strength to arguments that cultural ecosystem services cultivate and foster connections between people and place. This reciprocal relationship with the environment is prevalent in Hawaiʻi, however, it is not commonly integrated into resource management. Next steps for this work include working with communities and resource management to determine which indicators should be prioritized, and setting up long-term and systematic methods to collect primary monitoring data.

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Native Forest Birds on the Brink: *Wolbachia* to the Rescue?

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Native forest birds in Hawai‘i are in steep decline, with avian malaria identified as a key contributing factor. A warming climate is facilitating the expansion of disease-carrying mosquitoes into higher elevations – the last refugia for these species. In a race against extinction, a multi-agency partnership is exploring the use of an Incompatible Insect Technique as a form of mosquito birth control to suppress mosquitoes in forests used by these endangered birds. In this symposium, we review the major components of the program and describe efforts to date.

Presentations will provide updates on the current status of native forest birds in Hawai‘i; review the prevalence and distribution of avian malaria in Hawai‘i; identify knowledge gaps and describe a proposed model for landscape-level mosquito control; report on mosquito distribution and avian malaria in forest bird habitats on Kaua‘i and Maui; explain how *Wolbachia*, a naturally-occurring bacteria, can be used to suppress mosquitoes in the wild; outline a proposed strategy and challenges to a successful outcome; and discuss the process for community engagement.

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Evaluating Management Strategies for Invasive Rose-ringed Parakeets (*Psittacula krameri)* in Kaua`i

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The rose-ringed parakeet (*Psittacula krameri*) is among the most invasive bird species worldwide. Of the three Hawaiian Islands with introduced rose-ringed parakeet populations - Kaua`i, O`ahu, and Hawai`i Island – Kaua`i has the largest and most problematic parakeet population. Rose-ringed parakeets were introduced to Kaua`i in the 1960s. The population initially remained relatively small but began growing in the early 2000s and was estimated at 6,800 individuals in 2018. This population is causing agricultural damage by foraging on fruit and grain crops. The parakeets congregate nightly in large roosts in urban areas, causing disturbance through loud vocalizations and threatening human property and health through droppings. To address this problem, we are estimating the current rose-ringed parakeet population size and the efficacy of two population reduction strategies. We will evaluate whether parakeet-specific feeders can be used to deliver baits to parakeets while preventing access by non-target species. Monitoring a roost culling effort from March – June 2020, we will evaluate number of birds taken per unit of effort, age and sex ratio of birds taken, and how varying levels of effort could be projected to influence future population size. We estimated the 2020 population to include ≥10,500 parakeets. By repeating this population estimate in 2021, we will estimate current annual population growth. These studies will be incorporated into an integrated pest management plan to reduce the invasive rose-ringed parakeet population and related impacts on Kaua`i.

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Water, ecosystems, and people: insights from the ‘Ike Wai project on the Pu‘uloa (Pearl Harbor) and Hualālai aquifers

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Flows of water (wai) both affect and are affected by biodiversity conservation actions from mauka to makai. Water and ecosystems, in turn, closely link to people through connections to cultural practice, local economies, and human health. In this symposia, we explore linkages between land, water, and people from mountain to sea as illuminated by the ‘Ike Wai project in the Pu‘uloa (Pearl Harbor) and Hualālai aquifers. The ‘Ike Wai project is a 5-year interdisciplinary research collaboration on groundwater science, management, and sustainability in Hawai‘i, and is funded by the National Science Foundation's EPSCoR program. Topics in this symposium include: biocultural restoration of groundwater dependent ecosystems; links between forest conservation and culturally valuable springs; effects of future land management and climate change on groundwater sustainable yield; insights from mo‘olelo and Hawaiian language newspapers; and improving understanding of flows of water from mauka to makai ecosystems through microbial and geophysical techniques. Through our collective work, we demonstrate the importance of applied, interdisciplinary place-based collaborative research in helping to more holistically manage land and water for thriving communities.

Presentation order. Please note that Kiana Frank‘s abstract will not be presented due to her sick leave.

1. Pi‘ilani Smith - **Informing research through Hawaiian language Nūpepa: Examples from the ‘Ike Wai Project**

2. Kimberly Burnett (presenter), Ahmed Elshall, Christopher Wada, Aida Arik, Aly El-Kadi, Clifford Voss, Leah Bremer -- **Incorporating groundwater dependent ecosystems into groundwater management: Sumida Farm in Pu‘uloa (Pearl Harbor) Aquifer, O‘ahu**

3. Alan Mair (presenter), Kolja Rotzoll, Scot Izuka - **Impacts of land-cover change on water resources in Hawai‘i—what we know and what we don’t know yet**

4. Leah Bremer (presenter), Ahmed Elshall, Christopher Wada, Aly El Kadi, Clifford Voss, Jade Delevaux, Kimberly Burnett - **Benefits of watershed conservation for groundwater sustainable yield in Pu‘uloa**

5.Henrietta Dulai (presenter), Catherine Hudson, Trista McKenzie, Brytne Okuhata, Diamond Tachera, Aly El-Kadi --**The sources, composition, and coastal effects of submarine groundwater discharge in West Hawaii.**

6. Veronica Gibson (presenter), Leah Bremer, Kimberly Burnett - **Linked ecological, cultural, and socio-economic values of groundwater dependent ecosystems in Kona, Hawai‘i.**

7. Mathew Lucas (presenter), Ryan Longman, Jared Mclean, Sean Cleveland, Thomas Giambelluca, Jennifer Geis, Abby Frazier, and Gwen Jacobs - **Hawaiʻi Climate Data Portal (HCDP): An online tool for accessing historical and near real-time rainfall and climate data products**

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Aloha ʻĀina Fellowship: Restoring ʻĀina Momona

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Based on Molokaʻi, ʻĀina Momona is a native Hawaiian nonprofit dedicated to achieving environmental health and sustainability through restoring social justice. In 2017 we started the Aloha ʻĀina Fellowship, a program that takes emerging leaders on island and trains them in skills connected to culture, natural resource management, and civic engagement, exploring what it means to be an "aloha ʻāina" today. Our forum will be a facilitated panel discussion with our staff that run the program, as well as selected program participants. Panelists will discuss the ways we integrate ʻike kūpuna or ancestral knowledge as a fundamental basis for modern conservation, education, and leadership. We will share our method of planning for the future by looking to the past for answers, giving examples of how our cultural innovations can lead us into a sustainable future and help us restore damaged lands. Panelists will highlight our culturally informed, place-based approach to work that addresses modern day conservation capacity needs on Molokaʻi, and combines conservation work with civic engagement. The forum will include a breakout session for small group discussions with the audience based on one of our four primary program areas: wai (fresh water and it's just allocation), ʻai (sustainable food and agriculture), ʻāina (land and natural resources), and ea (social justice). The forum will end with the group coming together to discuss how these areas are connected and integral to managing for abundance in Hawaiʻi.

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A Tale of South Pacific Islands: Optimizing Biodiversity Conservation Plans Using Fisheries, Ciguatera and Pearl Farming

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Biodiversity, ciguatera, reef fisheries, mariculture and tourism are all important factors that co-occur in lagoons of the Pacific Ocean islands. In particular, ciguatera poisoning is a health threat and an environmental constraint that reef fishers have to deal with: it constitutes a socio-ecological trait for many islands. In tens of exploited lagoons, mariculture and specifically pearl oyster farming are significant both spatially and economically. However, none of these activities have been integrated into any Pacific island marine conservation plan in response to local managers' needs for mitigating conflicts among lagoon uses.

Taking Mangareva Island (French Polynesia) as a pilot site, we designed conservation scenarios aiming at protecting biodiversity, while minimizing costs for multiple users. First, we mapped biodiversity with ground-truthed habitat maps as surrogate of biological diversity. Second, we mapped costs by collecting spatial and quantitative data through local knowledge on ciguatera and fishing activity, with 41 map-based interviews, along with spatial data on pearl farming concessions provided by the local fishery services.

Lastly, we compared several scenarios of spatial conservation prioritization using Marxan software. Specifically, we evaluated the impact, in terms of overall costs, of adding a cost layer dependent on ciguatera. Conflicts between pearl farming activities and biodiversity were also measured for different conservation objectives.

Results highlight that specificities for Mangareva island cannot be generalized to other islands, and demonstrate that collecting and using local socio-economic ecological information relevant to communities and managers, such as ciguatera or pearl farming can be helpful for day-to-day conservation.

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Integrated landscape planning for species at risk

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The Department of Land and Natural Resources, with its federal, state, and NGO partners, is engaged in long range efforts to ensure sustainable biodiversity in Hawaii. Integral to this mission are the protection and recovery of species that are threatened, endangered, or otherwise imperiled throughout all or parts of their natural ranges. With more than 600 conservation reliant species at risk, effective planning is essential to success. However, while these species overlap extensively across the landscapes of conservation reserves that contain habitat essential for their recovery, most of the plans available for this work are traditional endangered species recovery plans that focus on only one or a few species. The disparate nature of this planning framework presents challenges to managers seeking to implement cost effective actions that maximize multi-species outcomes. The purpose of this project is to develop a systematic planning strategy that, 1) integrates traditional, population-level recovery planning into a multi-species framework at landscape scales, 2) identifies the habitat that is essential for recovery, 3) employs decision tools to prioritize work sites, and 4) prioritizes species-specific actions and multi-species actions within those sites to maximize benefits per cost. We employed this approach using a subset of species at risk on Maui to identify the most important areas to conduct landscape management such as fencing and ungulate control, locations and specific actions necessary to prevent extinctions and recover species, and measures of success that facilitate monitoring and adaptive management of species at risk.

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Engaging in the Political Process to Support ʻĀina Momona - A Nāhululeihiwakuipapa Emerging Professionals Workshop

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This workshop will focus on how to engage with the political process here in Hawai'i. Participants will hear from panelists currently involved in affecting change through policy and civic engagement. They will also learn how our actions and diligence, as citizens, are important to shaping the future we wish to see in Hawai'i, and beyond. Breakout sessions will teach participants about how to find and interact with their representatives (at all levels of government), hold decision makers accountable, find public meetings, and follow and influence legislation. Together, we can leverage our voices to create representation that is truly responsive to the needs of our communities and 'āina.

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The Micronesia Challenge: Conserving Ecosystems in the Islands of Micronesia

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In 2006, the Chief Executives from the Republic of Palau, the Republic of the Marshall Islands, the Federated States of Micronesia, the Commonwealth of the Northern Marianas and Guam committed to the Micronesia Challenge (MC): an agreement to effectively conserve at least 30% of the near-shore marine resources and 20% of terrestrial resources across Micronesia by 2020. The Micronesia Challenge was founded on decades of work by Micronesian communities, governments, and non-governmental organizations to raise awareness and strengthen the capacity across the region to sustainably manage natural resources and conserve biodiversity including the establishment of the MC endowment sustainable financing mechanism. It has also since inspired similar regional initiatives in the Caribbean, Western Indian Ocean and Hawai'i. The MC spans more than 20% of the Pacific Island region, encompassing an enormous, invaluable richness of biological and cultural diversity. Importantly, it emphasizes the connectivity of the region and the need to address problems across borders, bringing together nearly 650,000 people from over 2,000 islands and five political jurisdictions in the commitment to conserve the region's life-sustaining ecosystems for future generations. To gauge effectiveness of the MC, three Measures Groups were formed: Marine, Socioeconomic and Terrestrial. This presentation, presented by the MC Terrestrial Lead will showcase the successes and accomplishments of the work across the region to effectively manage resources at the regional, national, municipal and community levels to 2020 as the region looks to a new iteration of the MC going forward.

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The Decolonization of Terrestrial Resource Management and Conservation in Pohnpei, Federated States of Micronesia

Roseo Marquez[1]

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Pohnpei, in the Federated States of Micronesia, has a long history of colonial influence. From the Spanish, to the Germans, to the Japanese and to the Americans, the impacts of colonization affected all aspects of Pohnpeian ways of life including traditional resource management and conservation. Presented by a Pohnpeian terrestrial conservationist, this talk will discuss colonization and the impacts of change on traditional practices for conservation of terrestrial ecosystems including forestry and agricultural systems. It will examine pre-contact practices, colonial agendas and their influence on policy and management, outline the impacts of such practices and conclude with stories of empowerment through a recent resurgence in traditional agoforestry and conservation practices on the island. Focus will be on how local resource managers are finding ways to provide livelihoods, conserve their ecosystems and build resilience to the impacts of climate change through the integration of traditional ways of knowing with modern conservation tools. From the perspective of a Pohnpeian resource manager who works for a regional organization that promotes the needs of Micronesians, this talk will share a personal narrative of the effects of colonization and how it impacted the survival of Pohnpei's terrestrial resources through a history of colonization and how the people of Pohnpei are working to decolonize their experience and conservation practices.

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Education and Management for Rapid ‘Ōhi‘a Death

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Although Rapid ‘Ōhi‘a Death has been detected in all four counties of Hawai‘i, only Hawai‘i Island and Kaua‘i have detections of *Ceratocystis lukuohia*, the more virulent of the two pathogens that cause the disease, whereas O‘ahu and Maui have had detections of *Ceratocystis huliohia*, a less virulent pathogen that may predate the introduction of *C. lukuohia*. The disease has also occurred in different forest types on each island. Partners working on the different islands, including the Division of Forestry and Wildlife, the Invasive Species Committees, and the Watershed Partnerships, have therefore developed different approaches to monitoring, management, and outreach. Small unmanned aerial vehicles (drones) have emerged as an important tool in detection and monitoring as well as in research. New technology may even lead to use of drones to sample suspect trees in inaccessible locations. Management has focused on sampling suspect trees and felling confirmed diseased trees in areas of incipient outbreaks so as to limit the spread of the disease. Outreach programs have concentrated on raising awareness of the importance of ‘ōhi‘a and in contacting key groups of stakeholders who are most at risk for unintentional movement of the fungi. Outreach staff have collaborated with social scientists to develop effective programs to get forest users to change behavior and improve bio-sanitary practices. One outreach program is the statewide ‘ōhi‘a seed banking effort, which has trained hundreds of citizen scientists in identification of ‘ōhi‘a and proper ways to collect and store seeds.

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Factors Influencing the Distribution of the Pueo, or Hawaiian Short-eared Owl

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One native raptor, the Hawaiian short-eared owl, or pueo (*Asio flammeus sandwichensis*) occurs across all the main Hawaiian Islands. Considered an ancestral guardian and once prevalent, the pueo is currently state-listed as endangered on O'ahu. A potentially limiting factor for owls is prey availability. Models of predator-prey relationships assume a direct correlation between prey capture and prey density. However, habitat characteristics may impact the effort necessary to detect and capture prey. In this study we determined whether pueo presence was more closely associated with vegetation structure, prey biomass, or a combination of these factors. We used a random stratified design to select twenty-six sites across an elevational gradient on Maui. At each of these sites we conducted surveys for pueo and its potential prey items (rodents, birds, and insects). Pueo (N=11) were detected across a range of vegetation characteristics, but were most often seen in mid- to high elevation where bird and relative total prey biomass were low. Vegetation height influenced the detectability of pueo; thus, individuals may be using forested areas more frequently than originally thought. The occupancy models do not clearly identify whether vegetation structure (height/cover) or prey biomass are driving distribution but rather, suggest a combination of factors, and potentially others that were not accounted for in this study such as competition or predation risk, influence pueo distribution. Further research investigating tracking of individual pueo, impacts of pueo predators, and seasonal variation in prey abundance, is needed to manage for the abundance of this species.

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Using landscape genetics to enhance the mana associated with kaitiakitanga of Northland Brown Kiwi

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Northland Brown Kiwi (*Apteryx mantelli*, the kiwi species that occupies the North Island of Aotearoa New Zealand) populations are declining and there are concerns from local iwi (Maori tribe), hapū (Maori subtribe), and DOC (Department of Conservation) that these populations are inbred. Inbreeding in populations as small as these can be catastrophic due to the reduction in both genetic and biological diversity leaving them incapable of adapting in times of change. As species, and more importantly taonga species, continue to decline in Aotearoa, Landscape genetics provides a promising approach that might help to identify evidence for local adaptation and inform translocations of individuals to start new populations or add to existing ones.

Our project investigates the potential of Landscape genetics and the genetic makeup of kiwi distributed across Northland with a focus on Ipipiri (the Bay of Islands). The project was spearheaded by two hapū in Ipipiri, Ngati Kuta and Te Patukeha, due to the concerns they have for kiwi in their tribal area and wanting to exert their role as kaitiaki (guardians). Kaitiakitanga is guardianship of a natural resource and is one of the most important aspects of this project. Due to the connection that Māori have to the world and the environment kaitiakitanga is integral in ensuring longevity and survivorship of taonga species such as kiwi. Whakapapa in its simplest essence is genealogy. However, when we look at whakapapa in a Māori context it includes the concept of connectivity. This indicates that not only lineage-by-descent but also relationships and networks that connect people and things together are important like a food web in an ecological context.

We are interested not only in the genetics and science that surrounds kiwi conservation but also how mātauranga māori (traditional knowledge) can be intertwined with western science. In this presentation I will briefly introduce my PhD research, discuss the scientific methodology and how working with Māori has enriched this project.

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Collaborative Partnerships for Effective Marine Management

Kerrie Littlejohn[1]

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In the main Hawaiian Islands, our everyday activities threaten the marine resources that support many of our livelihoods. Finding a balance between our needs, the needs of nature, and protecting the rights of future generations will require strong collaboration between place-based management efforts and government agencies tasked with managing marine ecosystems and resources.

The purpose of this forum is to convene collaborators from Hawai`i and the Pacific to explore how partnerships can facilitate collaborative management and serve as a bridge between government and community groups. It is widely acknowledged that successful management areas require robust community engagement, but how do we go about achieving effective partnerships for true co-management? Discussions from this forum will inform the Hawai`i Marine 30x30 Initiative. 30x30 planners are actively looking to communities and partners to engage in long term collaborative management, and welcome new approaches to ensure that Hawai`i can effectively manage its nearshore waters.

This forum will feature a panel consisting of: a local leader involved in community-based marine management, conservation organization representative(s), community network representatives, and experienced collaborative partnership experts from other regions in the Pacific. The forum will be moderated by the Division of Aquatic Resources. Ideas generated by participants in breakout discussions will be synthesized into a report to help inform the implementation of Hawai`i's Marine 30x30 initiative.

Participants will be invited to break out into small groups to make recommendations to the 30x30 Initiative on relevant partnership themes such as governance, funding, organization, and stakeholder engagement.

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World Ecosystems in crisis - how habitat-loss and inadequate protection threatens representative biodiversity

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A combination of habitat conversion and inadequate protection threatens our planet's biodiversity with an extinction crisis. By analyzing the recently defined terrestrial World Ecosystems using a modified version of the IUCN's threatened ecosystem criteria, we found that 582 (24.3%) of the 2394 ecosystems are in crisis (high conversion and low protection), with 95 (7.6%) vulnerable, 95 (7.6%) as endangered and 80 (6.4%) as critically endangered. When estimated by percent of terrestrial area threatened, these numbers are higher with over a quarter (25.5%) of the terrestrial world in crisis, of which 9.4% is vulnerable and 16.1% is either endangered or critically endangered. One of the advantages of using the World Ecosystems is that the four components that make up the dataset - landform, climate regime and landcover subdivided by Wallace's bioregions - can be used to explore spatial variability in the global distribution of the ecosystems in crisis. For example, we found the Chinese, Indo-Malay and Oriental bioregions contained the highest percentage of crisis ecosystems with over 40% of their ecosystems in crisis, and globally, grasslands and forests are over 34% in crisis. Understanding this ecosystem crisis is crucial for sustaining the planets remaining biodiversity and will require stronger national commitments to include habitat representation in future conservation spatial plans. Leveraging existing global initiatives such as the UN Convention of Biological Diversity and Sustainable Development Goals to help highlight the importance of representation in protection will be critical in this endeavor.

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Mapping Individual Coconut Palm (*Cocos nucifera*) Trees in Urban Honolulu Using Deep Learning and Very High Resolution Remote Sensing Imagery

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There is a critical need for a methodology to improve efficiency and reduce the cost of collecting tree inventories in time for urban forest managers to effectively respond to threats. Coconut palms (*Cocos nucifera*) are important ornamental and agricultural trees in Hawai‘i. Coconut rhinoceros beetle (CRB) (*Oryctes rhinoceros*) has had severe impacts to coconuts and other palms on other Pacific Islands, such as Guam and Palau. The spread of CRB is currently being monitored by state agencies through traps and public reporting, however there are no data on the number and locations of coconut palms in the state. In this study, we develop a methodology to map coconut palms by integrating deep learning and high spatial resolution remote sensing imagery in urban Honolulu. The deep learning framework we tested include YOLO (You Only Look Once) and Faster R-CNN (Faster Region-based Convolution Neural Network). A ground truth dataset of over 3,000 geolocated individual coconut palm trees has been developed to train and test the deep learning algorithms. The tree mapping results are assessed using precision and recall, which are based on true positives, false positives, and false negatives. Our automatic tree mapping methodology particularly benefits disadvantaged and isolated communities as they are often more vulnerable to urban forest threats and do not have access to resources to conduct traditional tree inventories.

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Learning through Conservation: The role and impact of internships, fellowships, and other learn-by-working models in Hawai‘i conservation

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How can an internship foster empowerment in addition to employment? How can a host organization balance focused internship work with holistic support and perspectives on ahupua‘a restoration? The goal of this interactive session is for participants to reflect on the variety of internship and fellowship models that exist in the conservation field in Hawai‘i, and collectively assess their impacts on student career pathways and on Hawai‘i's conservation goals. In particular, we will examine the impacts of the current pandemic to conservation internships in Hawai‘i. A short panel discussion will set the stage, featuring representatives from organizations with a wealth of experience running or hosting internship programs. During the opening remarks, participants will be allowed to submit questions for the panelists, and “upvote” questions that they would like to prioritize. During the Q&A, the moderator will keep stack and call on participants who wish to comment and share from their own experiences. This forum will help to identify the shared values, models, and collaborative structures for internships that have emerged as successful over the last fifteen or more years, and strategize as a group about how to build upon them in the current challenging environment.

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Stabilizing Lānaʻi's Endangered Hawaiian Petrel Colony and Building a Lifeboat for Recovery

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The island of Lānaʻi is home to an important nesting colony of endangered ʻuaʻu, or Hawaiian petrels (*Pterodroma sandwichensis*). The colony had been presumed extirpated multiple times over the last century, but managed to persist in the face of habitat loss and invasive predators. Efforts by multiple partners in the last 5 years have mapped the distribution of the ʻuaʻu colony using passive acoustic recorders and in-person surveys, finding activity rates and nesting in some of the highest densities observed for this species across its Hawaiian range. As multiple colonies were located, a standardized monitoring program began to assess threats, reproductive success, and response to management efforts. High levels of depredation by cats and rats were initially observed, so a landscape-level predator trapping network was put in place that now protects nearly 600 acres of Lānaʻi Hale with over 100 cat traps and over 700 self-resetting A24 rat traps. In response to that protection, ʻuaʻu reproductive success more than tripled from 2016 to 2019, going from ~25% to 79%. Moving forward, seabird conservation on Lānaʻi continues to improve, with multiple new analyses being undertaken to map remaining habitat, analyze the pattern of loss to invasive species, and prioritize protection and restoration efforts. A new predator-proof fence is also under construction within the core breeding area which will create an 80+ acre predator-free refuge, thus helping to ensure a future for Lānaʻi's ʻuaʻu.

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Understanding Baseline Soil Carbon Stocks at a Biocultural Agroforestry Restoration Site in He‘eia, O‘ahu

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To create and sustain systems of ‘āina momona, symbiotic relationships between people and place are required, and biocultural restoration can facilitate this. Traditional agroforestry systems are widespread around the Pacific and were important agricultural systems in pre-contact Hawai‘i. In Hawai‘i, there is growing interest in restoring biodiverse agroforestry systems for multiple benefits, including native species restoration, food production, cultural connection to place, and increased ecosystem services including carbon sequestration. In this study, we collaborated with a community based organization, Kāko‘o ‘Ōiwi, and the He‘eia National Estuarine Research Reserve to establish a soil carbon baseline prior to the biocultural restoration of an agroforest designed for cultural, ecological, and economic benefits. Soil carbon is the most significant terrestrial carbon pool and has important implications for the broader health of the soil and land. Yet, how restoration affects soil carbon remains poorly understood particularly for agroforestry systems. To establish a baseline from which change can be detected over time, we sampled a total of 48 1-meter soil cores (divided into 5, 20-cm increments) from one control and two agroforestry treatment plots using a gridded design to capture spatial heterogeneity. We analyzed data using the Equivalent Soil Mass Method, and found the mean soil carbon across each of the plots ranged from 128.1 ± 8.3 Mg C ha-1 to 152.2 ± 5.6 Mg C ha-1. Heterogeneity of carbon was observed laterally and vertically throughout the profile. Over time, this case study will provide the first dataset of soil carbon storage with agroforestry restoration to better understand the potential role this type of restoration can play in land-based carbon sequestration locally. In Hawai‘i, this is the first in-depth case study of potential change in carbon stocks concurrent with restoration, and the first to evaluate change from a novel, invaded forest, to an agroforest.

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Evaluating new technology for rodent management in Upper Limahuli Preserve

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Invasive rodents pose significant challenges to conservation of native forests as well as the ecosystem and cultural services they provide. Typically, site-level rodent control requires a great amount of staff effort. Increasing advances in remote management technology and greater availability of technological tools has the potential to improve monitoring and capture rates while minimizing staff effort and impact on the landscape. Each new tool, however, must be thoroughly evaluated for a given site before it is adopted. In this presentation, we share results from trials of two relatively new technological tools for rodent management in remote field areas.

First, we evaluate the use of trail cameras for monitoring rodent activity. Game cameras were previously used to view movements of feral cats, barn owls, or native seabirds. In this trial, staff also noted daily rodent presence per camera. This information was compiled into a monthly site occupancy rate. During the trial, this method was used along with quarterly ink card monitoring. The trial concluded that game cameras give better temporal resolution with minimal effort and likely have fewer false negatives.

Second, we evaluate the use of automatic lure pumps compared to static lures within Goodnature A24 automatic-resetting rodent traps. These scent-based lures are designed to automatically release a portion of bait at regular intervals, with a goal of maintaining fresh bait for longer periods of time. The trial concluded that automatic lure pumps neither increased capture rates nor decreased staff effort compared to the previously used static lures.

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An Investigation into the Possible Introduction of the Venomous Box Jellyfish, *Alatina alata*

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During the 1980's, a stinging cubozoan began washing up frequently along Waikīkī's shoreline. These monthly aggregations of this box jellyfish, currently recognized as a single circumtropically distributed species, *Alatina alata,* are associated with the lunar cycle, occurring consistently between 8 and 12 days after each full moon. In spite of the serious hazard posed by monthly mass sting events, little scientific attention has been focused on the biology of this species and whether it is native to the region or introduced. Over the course of 12 monthly influxes, 150 box jellyfish were collected along Waikīkī beach and mtDNA cytochrome *c* oxidase I (COI) were amplified. Sequences were then compared between *A. alata* found in Australia, Saipan and Bonaire to determine the likelihood this species was introduced to Hawaiian waters. Preliminary results indicate shared haplotypes with Australia species as well as very low genetic diversity between Bonaire populations; genetic diversity which is unprecedented for naturally dispersed marine species separated by continental barriers. We suggest there is a strong possibility that this species has likely been inadvertently introduced to Hawaiian waters which opens the door to additional possible venomous cnidarian introductions

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Regulation and Enforcement Effectiveness of Natural Resources on O‘ahu, Hawai‘i

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The State of Hawai‘i’s Department of Land and Natural Resources (DLNR) implements rules and regulations to enhance, protect, conserve, and manage the unique and limited natural, cultural, and historic resources of the state. Natural resource extractors and users alike access Hawai‘i’s unique geography for recreation, subsistence, and collection; among other activities. The Division of Conservation and Resource Enforcement (DOCARE) is tasked with upholding the rules and regulations set forth by the State through education, observation, investigation, and the issuance of citations for confirmed violations. The division struggles with time spent enforcing these rules and traditional police duties such as parking, traffic, and domestic violations. This challenge, among many, has led to the division not perceiving themselves as effective in meeting their mission statement. I developed a 2014-2018 geospatial database of observations and investigations on the island of O‘ahu, which contains about 67% of Hawai‘i’s residents and spans 4250 km^2. I then assessed annual, district, and seasonal trends in investigation and observation intensity (activity per km^2). I also used in-depth interviews with DOCARE officers to enhance and situate geospatial findings into officer perceptions of effectiveness and daily routines. These results can assist DOCARE in understanding patterns of officer activity and contribute to their ability to more effectively allocate their limited resources to support and conserve Hawai‘i’s natural resources. Additionally, the division can better understand the enforcement hotspots of the island, temporal trends of perceived violations and monitoring efforts, and challenges that are limiting DOCARE in their ability to reach effectiveness.

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Evaluating Protection Strategies for an Invasive Plant Species: *Miconia calvescens*

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The choice to shift among invasive species management strategies depends on ecological, biological, and economic conditions that vary by species, location, and stage of invasion. Typically, as time and area invaded increases, economic returns to management shift away from prevention and eradication, and towards species containment and/or asset protection. This is the case for Miconia calvescens (M. Calvescens) in the East Maui Watershed, (EMW), where the species was introduced to a private nursery and botanical gardens 50 years ago, and subsequently escaped and spread throughout the forests of East Maui. While ground management efforts have been continuous since the early 1990's, this research focuses exclusively on the efficacy and impact of aerial herbicide ballistic technology (HBT) management efforts. We use a 25-yr management data set identifying the location and time of each M. calvescens individual eliminated to develop a spatiotemporal spread model, and use information on treatment costs and potential avoided damages to assess the relative benefit-cost ratio of a management strategies such as inaction, containment, and asset protection, under a number of EMW-informed biological and economic parameters. The primary goal of the research presented is to develop an operational methodology for evaluating biological and economic outcomes of containment and asset protection management strategies for M. calvescens in East Maui.

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Social Tipping Points in Marine Resource-Dependent Hawaiian Coastal Communities

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Hawaiʻi represents a social-ecological system (SES) in which human well-being is tightly linked to coral reef resources. As external stressors cause ecosystem declines, the ability of coastal communities to meet social, economic, and cultural objectives is reduced. Threats such as climate change, overfishing, and pollution induce ecological declines (e.g. reduced biodiversity and coral reef habitat complexity), leading to declines in social conditions (e.g. amount of fish caught, tourism revenue). Social declines may reduce employment, economic profitability, and community resilience. Ecological regime shifts, a customarily non-linear shift from one ecological state to another (e.g. coral-macroalgal phase shifts), are well-studied, but little is known about whether marine resource-dependent communities exhibit similar social shifts. Through indicator development and SES modeling, we identify social tipping points, or thresholds, by defining the relationship between reef status and societal functioning. Indicators in five domains, Economic, Cultural, Social, Health, and Safety & Security describe Hawaiian coastal community functioning. A spatially-explicit ecosystem model, Atlantis, is used to predict thresholds among distinct social regimes (e.g. high v. low economic profitability) dependent on reef resources. Threshold identification can support conservation efforts by pinpointing where management interventions effectively prevent unfavorable social shifts and sustain high resource provision. Modeling enhances predictive capacity for the Hawaiian SES, advancing conservation towards mutually beneficial relationships between coral reefs and the people that depend on them. Our methodological framework may be scaled up to coral reef-associated SESs globally, and the associated principles may be applied to other resource-dependent SESs, e.g. logging or mining communities.

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Trends in Native Hawaiian Waterbird Abundance in Relation to Environmental Factors and Management at James Campbell National Wildlife Refuge

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Located on the North Shore of Oʻahu, James Campbell National Wildlife Refuge (JCNWR) is home to one of the few remaining coastal wetland habitats on the Island of Oʻahu, and is actively managed to promote the recovery of endangered Hawaiian waterbirds. Monthly visual surveys help staff monitor the numbers of Hawaiian Coot (*Fulica alai*), Hawaiian Gallinule (*Gallinula geleata sandvicensis*), Hawaiian Stilt (*Himantopus mexicanus knudseni*), and the Hawaiian Duck (*Anas wyvilliana*) in the refuge. The two main goals of this project are 1) to analyze JCNWR waterbird survey data from multiple years for long term trends in waterbird numbers and 2) to use statistical models to better understand how environmental factors (e.g. rainfall, cloud cover, and wind) and management activities (e.g. predator control and vegetation management) are influencing waterbird numbers at JCNWR. Understanding the long term trends in the numbers of these endangered waterbirds and the influence of environmental variables and management actions will help JCNWR staff plan what future management actions are undertaken and when, as well as aid staff in better accounting for the influence of environmental variables on waterbird survey results. Our efforts to restore Hawaii's natural wetlands through predator control, vegetation management, and data analysis helps recover native waterbird populations on Oʻahu.

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Habitat fragmentation restricts pollinator assemblage and decreases pollen quality in a threatened insect-pollinated Proteaceae

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The anthropogenic fragmentation of natural habitats is now at unprecedented levels. *Conospermum undulatum* is endemic to southwest Western Australia, a global biodiversity hotspot. Significant fragmentation of remnant patches is likely to constrain the reproduction of this species by altered plant-pollinator interactions and expression of inbreeding depression. In 2017 we collected data from 12 populations looking for differences in reproductive output and pollinator assemblage. In 2018, we set up a pollination experiment to test for pollen limitation (PL) and inbreeding depression.
We found the reproductive output to be affected by population size, isolation, and floral display. Small fragments showed a less diverse pollinator assemblage compared to larger populations, with the most active visitor species missing. Results indicated that both PL and genetic factors prevent the development of seeds. We found that hand cross-pollination produced a ten-fold increase in seed production compared to natural pollination. By using pollen sourced from different populations we found that small patches produced 50% fewer seeds than what they are able to produce via inter-population breeding due to the combined effects of PL and reduction of compatible mates. Our results suggest that fragmentation may result in patches that are too small and isolated to be attractive for pollinators and to allow long-term population viability. Outcomes of this research will inform recovery plans to enhance the future persistence of *C. undulatum* by means of improved awareness of factors that constrain both its reproduction and its adaptation ability over the long-term.

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Many hands together: a multi-pronged approach to endangered seabird habitat preservation in Upper Limahuli Preserve, Kaua’i

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Effective preservation of endangered plants and animals requires numerous concurrent activities. On Kaua’i, managing for endangered seabirds Ua’u (*Pterodroma sandwichensis*) and A’o (*Puffinus newelli*) involves ongoing predator control, habitat preservation, and long-term standardized monitoring. We use Upper Limahuli Preserve as a case study in effectiveness of this multi-pronged approach in partnership with multiple organizations. Since 2011, staff from the National Tropical Botanical Garden (NTBG) have implemented adaptive predator control and habitat management, while the Kaua’i Endangered Seabird Preservation Project (KESRP) have focused on seabird monitoring utilizing multiple monitoring techniques.

We show data from both teams over this eight-year period, including predator activities and capture rates, invasive weed densities, as well as seabird reproductive success rates, call rates, and depredation rates. Predator control activities have evolved along with technological advances. Rodent management using automatic-resetting traps has drastically reduced black rat activity and burrow visitations, while rates of seabird depredation by black rats has declined. Overall, reproductive success rates and call rates for both seabirds have increased over time, and population simulation models indicate that ongoing management confers a direct benefit to endangered seabird populations.

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Reforestation of Degraded Lands in Micronesia

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The American-affiliated Pacific Islands of Guam, the Marianas, Palau, and the Federated States of Micronesia suffer from seasonal droughts and widespread wildfires. Grasslands replace forests in burnt areas and are prone to subsequent fires. Soil from eroding burnt areas covers nearby coral reefs, threatening fisheries and local people's livelihoods. Forestry agencies and communities in the Pacific have been working to break the grass-fire cycle through reforestation programs in degraded areas and community outreach and engagement programs. With technical help from the USDA Forest Service Reforestation, Nurseries, and Genetic Resources program and the University of Hawai‘i, local forestry agencies have improved seedling production and quality by switching to growing seedlings in forestry containers with potting mix rather than in poly bags with soil as is typical in tropical nurseries, installing irrigation systems, and broadening the species mix of seedlings by including an array of native species in addition to pan-tropical trees. Because reforestation sites often include soils with very different characteristics, reforestation programs have begun soil testing to determine where increased levels of liming and fertilization are necessary. Because most fires are human caused, agencies are working with local communities to change local perceptions about wildfire. Having school groups and local community groups plant trees gives them ownership of reforestation efforts. The improved technologies and increased community engagement have resulted in greater success in reforestation of degraded lands in the western Pacific.

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Re-imagining conservation translocations to enhance resilience in freshwater biota

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Conservation translocations promise to build species and ecosystem resilience, including those that weave diverse ways of knowing and seeing the world. Yet few studies to date have been led or co-led by Indigenous peoples or local communities, nor consider how Indigenous knowledge systems can inform conservation translocation decisions—particularly for legally unprotected or under-prioritised biota such as indigenous freshwater fish and invertebrates. In Aotearoa New Zealand, as scientists, practitioners and mana whenua (those with authority over the land), we are co-developing approaches that weave Western science—namely, genomic data—into mātauraka Māori (Māori knowledge systems) to enable more nuanced conservation translocation decisions for freshwater species. For example, mātauraka Māori describes extensive translocations of kēkēwai (freshwater crayfish; *Paranephrops zealandicus*) along traditional travel routes around Te Waipounamu (the South Island), and evidence of these management practises are also observed in preliminary genomic data. We are using these combined data to inform contemporary management to re-establish kēkēwai for sustainable customary harvest, including the selection of appropriate source populations for translocation. Beyond kēkēwai, we envision that approaches that centre Indigenous knowledge, practices and values will enhance conservation translocation decisions and lead to more resilient biocultural heritage both in Aotearoa New Zealand and beyond.

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Successful Planting Of *Metrosideros polymorpha* (‘Ōhi‘a) Is Possible In Forest Sites With Active *Ceratocystis* (Rapid ‘Ōhi‘a Death) Infections

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Rapid ‘Ōhi‘a Death is a newly emerging disease caused by the fungal pathogens *Ceratocystis lukuohia* and *C. huliohia. Ceratocystis* has killed at least half a million ‘ōhi‘a (*Metrosideros polymorpha*), a tree that is foundational to the landscape and Hawaiian culture. An added challenge for many managers is the fact that forests across Hawai‘i have exotic species in the understory, and loss of the ‘ōhi‘a canopy could cause conversion to exotic-dominated forests. One way to alter this trajectory would be to plant ‘ōhi‘a in *Ceratocystis*-affected forests, yet it is unknown whether seedlings would survive. In addition, ‘ōhi‘a seedlings succumb to a variety of stressors besides *Ceratocystis*, including competition from exotic plants and disturbance from feral ungulates. To better understand causes of planted ‘ōhi‘a mortality, we implemented a factorial experiment at the Keaukaha Military Reservation in Hilo, Hawai‘i in which we planted ‘ōhi‘a seedlings under *Ceratocystis* positive and negative adult ‘ōhi‘a and crossed these treatments with weeding invasive species and fencing from feral ungulates. We monitored seedlings for one year and tested all dead seedlings for *Ceratocystis* infection. Results showed that unfenced seedlings were three times more likely to die than fenced seedlings, and unweeded seedlings were over five times more likely to die than weeded. Importantly, none of the 51 dead seedlings tested positive for *Ceratocystis*, indicating that the disease was not a factor in mortality. We conclude that successful planting of ‘ōhi‘a is possible in *Ceratocystis*-affected forests but fencing from ungulates and clearing exotic species remain important to ensure survival.

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Excluding Mammalian Predators Increases the Reproductive Success of an Endangered Native Hawaiian Waterbird

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Fencing that excludes entire taxonomic groups has become increasingly popular in island systems worldwide and can prevent the depredation of endangered waterbird eggs and chicks by rodents, cats, and mongoose. However, exclusion fencing does not prevent avian, aquatic, and amphibious predators which may experience predator-release. Thus, there remains a knowledge gap regarding the potential gains in reproductive success. We compared the reproductive success of Endangered Hawaiian Stilts (*Himantopus mexicanus knudseni*) nesting within a mammal-exclusion fence to breeding pairs in a nearby wetland where trapping is the sole means for removing invasive mammals. We hypothesized that reproductive success would be greater for breeding pairs inside the exclusion fence.We used game cameras to monitor nests inside and outside the fence. Cameras recorded the number of eggs laid and the number of eggs hatched. A significantly greater proportion of eggs hatched per nest inside the mammal-exclusion fence ($\bar{X}$ = 0.83±0.07SE) than the site without fencing ($\bar{X}$ = 0.34±0.09SE; t_{26} = 4.37, P < 0.001). Clutch sizes inside the fence were also greater ($\bar{X}$ = 4.0±0.0SE) than the site without fencing ($\bar{X}$ = 3.67±0.11SE; t_{20} = 3.16, p = 0.005). Greater clutch sizes inside the fence may suggest lower stress levels in breeding adults. Thus, exclusion fencing may be a useful tool to help recover endangered waterbirds by increasing clutch size and nesting success. As complete island-wide eradication of mammalian predators is not feasible at this time, Hawai'i's Endangered waterbirds are conservation reliant and predator management must be sustained for waterbirds to persist.

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Restoration through ‘Revegetation’ Aids the Return of Native Birds to Agricultural Landscapes

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Globally, many programs are committed to returning vegetation to agricultural landscapes, with documented benefits for conservation and production. ‘Revegetation’ efforts range from small farm-scale plantings, to larger timber plantations. But do such plantings facilitate the return of native species to agricultural landscapes, and over what time-frame? We combined a novel, whole-of-landscape design with longitudinal datasets to determine whether farm-scale revegetation in south-eastern Australia reverses patterns of avifaunal decline associated with vegetation clearing. We sampled birds within 800-ha study ‘landscapes’ (n=23) which encompassed gradients in the cover of two types of vegetation: remnant vegetation and revegetation plantings. Birds were systematically surveyed in each landscape in 2006/07 and in 2019. In 2006/07, landscapes with remnant vegetation contained 24% more ‘woodland-dependent’ bird species than landscapes with vegetation that comprised of revegetation plantings. Avifaunal assemblages also differed strongly between landscape types. By 2019, revegetation landscapes supported similar numbers of woodland species to remnant landscapes, the latter showing little change in richness over time. Further, the species-area relationship for restored landscapes with increasing vegetation cover matched (in reverse) that for remnant landscapes with decreasing cover and declining richness. However, the types of species returning to revegetation landscapes differed from those in remnant landscapes, with assemblage composition still differing in 2019. Revegetation in agricultural environments provides valuable habitat for native species and contributes to the return of birds to heavily-cleared landscapes. Nonetheless, retaining native vegetation is critical as these habitats cannot entirely be replicated by revegetation, at least in early decades post-planting.

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Stap i tambu! Traditional conservation methods in Melanesia

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Indigenous peoples represent less than 5% of the global population but manage ~40% of intact tropical primary forests. Many of the management practices of Indigenous peoples are prime examples of sustainable human-landscape relationships. Tambu areas are a well-respected conservation practice in Melanesian societies where a no-go zone is imposed on a section of forest or coral reef to preserve plants, animals and fisheries stocks. Tambus traditionally served dual processes: to fulfil customary obligations and to restock resources. Tambus have been promoted as a potential Melanesia conservation tool. However, the practice appears to be disappearing in many Melanesian societies, including on Manus Island, Papua New Guinea. Using structured questionnaires and semi-structured interviews we investigated the practice of tambu management on Manus Island in relation to a culturally significant species, the Admiralty cuscus - *Spilocuscus kraemeri.* We aimed to understand (i) local knowledge and hunting practices; and (ii) the structure, application and adherence to tambu management systems. Our preliminary results show that large proportions of men from all age groups hunt the Admiralty cuscus. All respondents were aware of tambu management, but many had not practised it. Respondents indicated that tambus were usually broken due to a lack of consultation with clan members, or a lack of cultural knowledge transfer. To improve compliance with tambu management we advocate that the process must follow existing cultural protocols to be respected, and that all clan members need to participate to ensure compliance and knowledge exchange.

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HCC2020-136 **Urban Conservation for East Honolulu**

Charles B. van Rees, Elizabeth Reilly, Geary Mizuno

undefined

The contrast between native habitat and adjacent suburban development in East Honolulu (Maunalua) is stark. Remnant populations of dryland and mesophytic native plant species may be found contiguous with human communities such as ʻĀina Haina and Hawaiʻi Kai. Vital habitat for the endangered native communities of ʻalae ʻula (Hawaiian common gallinule, *Gallinula galeata sandvicensis*) and opaeʻula (Hawaiian red shrimp, *Halocaridina rubra*) also exist in close proximity to these suburban developments. Livable Hawaiʻi Kai Hui sees East Honolulu as an opportunity to transform the landscape of suburban backyards, streetscapes, parks and schools to reflect both the original native plant communities and managed pre-contact Hawaiian landscapes. Our stewardship of the Keawāwa Wetland and Hawea Heiau Complex, (Hahaʻione Valley, Maunalua, East Oʻahu) includes planting native dryland plants and traditional "Canoe Plants" to strengthen our connection to Hawaii's unique ecological and cultural history, and extend Hawaii's legacy to our children and their descendants. A transformed landscape can also increase climate change resilience through increased wildfire resistance, improved rainfall retention and aquifer recharge, and reduced need for landscaping watering. In this presentation we share our work and lessons learned from engaging suburban community members, governmental agency partners, and neighboring landowners. We see this work as key for re-establishing traditional cultural connections to an important sacred site as well as restoring ʻāina momona. We also present our proposals to advance our vision of transforming the urban landscape.

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It Takes a Village: An Example of Urban Forest Restoration Process at Ala Mahamoe

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With the increasing need to restore fallow lands dense with invasive species, landowners are turning to partners and community members to be part of the process. Koʻolau Mountains Watershed Partnership (KMWP) is utilizing various stakeholders to restore an urban forest restoration area in Moanalua, Oʻahu known as Ala Mahamoe. Ala Mahamoe is owned by the State of Hawaiʻi Department of Land and Natural Resources (DLNR) and is found within the Honolulu Watershed Forest Reserve. The Ala Mahamoe Cultural Forest Project seeks to restore the five-acre dry-land forest to a more native-dominated system, to increase water recharge capacity. Through a series of steps including weed-mat, mulching, fencing, weeding, and strategic planting, over twenty native species are found on the site. Additionally, members of the community like Kahu (Caretaker) Roddy Akau, have collaborated to guide planting, and share the cultural history of Ala Mahamoe. KMWP is restoring the area without herbicide for the community and kūpuna (elders) to use resources for lāʻau lapaʻau (medicinal purposes). Strategic volunteer workdays have helped to control weeds and install planting. As part of the Grow Forest Hawaiʻi initiative, KMWP has installed over 1,200 plants at Ala Mahamoe with the kokua (help) of 890 volunteers. KMWP acts as a nexus and land steward to connect people to the land by facilitating opportunities to learn, teach, and collaborate on this long-term restoration project. In this talk, KMWP will present the process and lessons learned in the stages of planning for Ala Mahamoe Cultural Forest Project.

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E Ulu Ke Kai Momona: Cultivating Abundance in Heʻeia Fishpond

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Biocultural restoration of Heʻeia Fishpond (HFP) physical structures such as the kuapā and mākāhā is reestablishing the capacity to manipulate the aquatic environment through control of freshwater and seawater flux creating kai momona or fertile water. It is this mixture that promotes growth of phytoplankton, a significant food source for the fishes raised in loko iʻa. Marching alongside the restoration of physical structures is the effort to eradicate the invasive red mangrove (*Rhizophora mangle*). This woody tree is an alien species to the Hawaiian coastal ecosystem. First planted as a management practice for erosion control, mangroves have proliferated in the absence of complementary organisms present in their native range, degrading ecosystems and coastal structures such as the kuapā of loko iʻa. We compared physico-chemical parameters across three sampling periods corresponding to intensive removal of mangrove and biocultural restoration of the loko kuapā: 2007-2008, 2014-2015, and 2017-2019. We hypothesized that restoration work will have an effect on water quality. Though collection methods between sampling campaigns varied, the following trends are apparent: salinity decreased from 29.5 to 24.6 ppt and temperature decreased from 25.6 - 24.2 ℃ indicating greater freshwater influence and changes in circulation. Between 2007-08 and 2017-19 periods we see an improved ratio of dissolved inorganic nitrogen to phosphate (N:P) for phytoplankton growth (13.6 - 17.4). Taken together, this research is a snapshot of environmental changes that occurred during the ongoing biocultural restoration of Heʻeia Fishpond which could benefit future management of indigenous food systems.

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Cat Crisis – The Challenges of Protecting Native Wildlife from Feral Cats in Hawai‘i

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Feral cats (*felis catus*) are introduced predators that are found from the coast to the mountains in Hawai‘i. Cats resonate with humans, but they are having a profound impact on native Hawaiian wildlife. Hawai‘i’s avifauna has suffered an extinction crisis since humans arrived and 30 of the remaining 48 species/subspecies are listed as “threatened” or “endangered” by USFWS. These native birds evolved without mammalian predators and cannot adapt to the threat that feral cats pose; many are facing catastrophic levels of cat depredation. Waterbirds such as the ‘alae ‘ula - Hawaiian Common Gallinule (*Gallinula galeata sandvicensis*) and koloa maoli - Koloa Duck (*Anas wyvilliana*) are particularly vulnerable, along with seabirds such as the ‘ua‘u - Hawaiian Petrel (*Pterodroma sandwichensis*). The impact of diseases spread by cats is also serious. Toxoplasmosis (spread through cat feces) is an illness that has killed Hawaiian Monk Seals (*Neomonachus schauinslandi*) and Hawaiian Spinner Dolphin (*Stenella longirostris longirostris*). If conservation of our unique native species is to succeed, it is essential to reframe the issue of cat management to address the problem. In this symposium session, the speakers will examine the impacts of feral cats on native wildlife in Hawai‘i and propose solutions; show why ‘trap, neuter, release’ is ineffective, and look at alternatives; examine the legal issues surrounding cat control and the role of policy in reducing the impacts of cats; and discuss the socio-economic, cultural and political challenges conservationists face in dealing with this invasive predator, and how to overcome them.

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"I'll tell you what I want, what I really really want" - Identifying Conservation Priorities for Bird Habitat in Hawai'i

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Migratory Bird Joint Ventures are cooperative, regional partnerships located in the United States, Canada and Mexico. They support partners who work in bird habitat conservation. Pacific Birds Habitat Joint Venture (Pacific Birds) includes the Hawaiian and other Pacific Islands. In 2019, Pacific Birds carried out a prioritization exercise to assess where our conservation support would be of the highest value in Hawai'i. We created a matrix of the status, threats and conservation opportunities for all Hawaiian native birds. We then interviewed 60 conservation professionals across the state, asking what the priority focus should be for Pacific Birds. Thirteen options emerged from the analysis of the matrix and interviews; they provided a broad overview of avian conservation priorities across the State. A follow-up analysis was undertaken to reduce the options, which resulted in two potential focus areas: Hawai'i Wetlands, and Hawaiian Forest Birds. Using a 'Problem and Solutions Matrix', Hawai'i Wetlands was ultimately selected as the Pacific Birds priority focus for Hawai'i and will include endemic waterbirds, migratory waterfowl and shorebirds. The results will guide the upcoming work of Pacific Birds and, with our partners, help us facilitate 'Managing for Abundance' in wetland habitat over the next decade. We discuss the prioritization process as well as the range of conservation challenges in Hawai'i that the process illuminated. The results have a clear utility for scientists, decision makers and land managers who are deciding where and how to most effectively deploy the state's scarce management resources.

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Indigenous Practices Expand Waterbird Habitat under Rising Seas

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Increases in sustainable food production to meet growing population needs are sometimes in conflict with biodiversity goals, but sustainability practices based on social-ecological frameworks, such as Indigenous Resource Management (IRM), offer a window into simultaneous achievement of these objectives. Lo'i, or Hawaiian wetland agro-ecosystems, are social-ecological sub-systems that if restored under an IRM paradigm, have the potential to not only provide sustainable food systems, but simultaneously expand nesting habitat of endangered Hawaiian waterbirds. However, in Hawai‘i, as globally, sea level rise threatens the availability of both coastal food production and suitable nesting habitat for waterbirds. In this study we use existing data to model end of the century (2100): (1) area of potential existing Hawaiian waterbird nesting habitat likely to be lost due to sea level rise; and (2) area of potential waterbird nesting habitat that may be gained through restoration of lo‘i systems. We find that nearly 29% (1,983 ha) of potential waterbird nesting habitat may be lost to sea level rise. However, restoration of lo‘i systems using IRM practices could expand current wetland habitat, and potentially compensate for losses. Restoration of lo‘i increases the resiliency of both social and ecological systems; however, current policies may hinder progress towards managing natural resources within a social-ecological framework. Our study demonstrates an urgent need for both conservation actions and policies that are inclusive of both humans and waterbirds.

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Potential Fertility Targets For Mammalian Gene Drive Pest Control

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Despite intensive conservation efforts, Aotearoa/New Zealand's unique and endangered *taonga* (treasured) species continue to decline under the pressure of introduced mammalian predator species. CRISPR-based gene drive systems could offer an additional mammalian pest control technique that is species-specific, economically efficient and humane. Capable of propagating genetic traits through wild populations, gene drive pest control systems can be designed by specifically targeting fertility or biasing offspring sex ratios. Despite established theory and empirical gene drive experiments in insects, candidate genes for mammalian gene drive systems are yet to be formally identified. Our research aims to identify criteria and a list of fertility genes with sex-specific effects that could be targets in a mammalian gene drive system. We initially developed systematic criteria based on sex-biased functionality, tissue restricted expression and viable mouse knock-out models, which yielded 17 highly promising candidate genes. We have subsequently investigated for each of these genes: regions of genomic conservation and polymorphism in *Rattus norvegicus* (Norway rat) and *Rattus rattus* (Ship rat), genetic variation within the genes across ~90 Ship rat samples of different geographic origin across New Zealand, and gene conservation across the recent 200 Mammal alignment to predict potential utility of these gene targets. We anticipate that this research will contribute a critical component to the humane, safe and species-specific development of mammalian gene drive systems in the interests of island conservation.

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Restoring Nearshore Hawaiian Algae and Seagrass Habitat

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This symposium will highlight the various methods and lessons learned around the state of Hawaii for removing invasive algae species, facilitating the return of native algae, and assessing the health of the nearshore habitat. It will demonstrate how community, culture, technology, and science all play a part in restoring native nearshore Hawaiian habitat.

Over the past decade, Hawaii has seen a sharp increase in community groups, individuals, and government agencies working to remove invasive algae, and facilitate the return of native algae and seagrass. Invasive algae is prevalent throughout the state, pushing out native species, altering native habitat, degrading water quality, and impacting other marine resources. A multitude of methods have been tried to restore native habitat and species, such as incorporating mechanical and cutting edge methods, utilizing cultural methods and techniques, or mobilizing broad community support. The lessons learned from the various efforts can provide a blueprint for other regions and groups looking to remove invasives in their location, and facilitate the return of native species to restore vital nearshore native habitat.

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

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A natural enemy of invasive strawberry guava (*Psidium cattleianum*) was released in Hawaii in 2012. Since then, regular monitoring in demonstration plots has revealed the impacts of the expanding populations of the Brazilian leaf galling insect *Tectococcus ovatus*. Although the effects of biocontrol are different for the three common varieties of strawberry guava in these plots, all varieties show susceptibility to the biocontrol. Declines in fruiting, leaf cover, and stem growth are apparent after a period of sustained galling. In native forest sites across the state, *Tectococcus* also has been successfully established and is spreading on its own. Given the time lag of several years between establishment and measurable impacts from biocontrol, management of strawberry guava at a landscape scale will be accelerated by further efforts to artificially disperse *T. ovatus*.

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Striking a Balance with Goodnature A24's: Trapping Rodents while Excluding ʻAlalā (*Corvus hawaiiensis*)

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Small mammalian predator control for released ʻAlalā (*Corvus hawaiiensis*) has been ongoing since 2016 in Pu'u Maka'ala Natural Area Reserve on Mauna Loa, Hawai'i Island. The introduced mammals that pose predatory and disease threats to reintroduced ʻAlalā in this reserve include rats (*Rattus rattus, R. norvegicus, and R. exulans*), small Indian mongooses (*Herpestes auropunctatus*), and feral cats (*Felis catus*). Trap types for control of these mammals include conibear kill traps, live cage traps, Goodnature A24 self-resetting traps, and rat snap traps. Since 2016, the ʻAlalā Project designed and trialed excluders of various materials, set at different heights, to exclude non-target species, including ʻAlalā. Each excluder prototype for the A24 traps was trialed on the conservation breeding flock of ʻAlalā at the Keauhou Bird Conservation Center to ensure they were not able to be activated by ʻAlalā. A photographic summary of excluders and housings will be shown in this presentation. A comparison of cost, capture rate, and time to produce and install between the Goodnature "Blocker for A24" and our original project designed excluders will be discussed. This work is indicative of the balance often needed in conservation implementation, where habitat and species management must be coupled with non-target and threat minimization measures for the focal species, to achieve recovery of the species.

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The Potential for Restoration of Reed-Warblers in the Mariana Islands

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Island birds have experienced extremely high levels of extinction. Translocation, deliberately establishing populations of species outside of their known ranges for conservation purposes, is a common practice to ensure species persistence and refill lost ecosystem functions. Based on a 2012 taxonomic assessment, historically there were four reed-warbler species in the Mariana Islands. Between 2007 and 2010 we surveyed for three of these species on Saipan and Alamagan for *Acrocephalus hiwae*, Aguiguan (*A. nijoi*), and Pagan (*A. yamashinae*). The reed-warbler on Guam (*A. luscinius*) is extinct. Our results indicate that reed-warblers are extirpated from Aguiguan and likely extirpated from Pagan. Thus, only the Nightingale Reed-warbler (*A. hiwae*) now remains, and is restricted to Alamagan and Saipan. We estimated the global population at between 1,019 and 6,356 birds (95% CI; mean estimate 3,688), which has declined by more than 1,000 birds since the first quantitative surveys were conducted in 1982; *i.e.*, a 24% decline in 28 years. Restoration and protection of their habitat could benefit the Alamagan population, as would similar conservation efforts on Saipan. Reed-warbler translocations have occurred on other islands with great success. After suitable restoration of appropriate reed-warbler habitats on Aguiguan, Pagan, and possibly Guam, individuals from Alamagan and Saipan could serve as founder populations. Follow-up research is needed to determine the extent and habitat preference of *A. hiwae* if individuals are to be translocated to Tinian in the future, where an unknown reed-warbler species previously occurred.

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Ola Nā Kini: Growing Plants and People

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The Earth's population is becoming increasingly urban, which shifts ecological and social dynamics within our communities. This is also true in Hawai‘i, including the city of Kapolei (‘Ewa moku, O‘ahu) which is experiencing the fastest population expansion in the state, from 15,000 people in 2010, to a projected 165,000 people by 2035, representing ten-fold growth. Kapolei also comprises three Hawaiian Homestead communities, fostering a growing Native Hawaiian population. Within this urban context, Mālama Learning Center (MLC), a non-profit environmental education organization based in West O‘ahu, manages for abundance through the regeneration of native plants and natural communities in ‘Ewa, particularly in the uplands of Kapolei. The abundance of life is portrayed from MLC’s native plant nurseries; to outreach and education with students, teachers, and community volunteers; to the culmination at community outplantings and gatherings. In this presentation, leaders of MLC will describe Ola Nā Kini, our program that strives to heal the land, ocean, and multitude of life through engagement and education. Ola Nā Kini, a traditional Hawaiian phrase expressing life for the multitude, is a restoration program within a collaborative network of schools, partner organizations, and natural and cultural resource specialists. We will share how we grow plants and people through our outplanting method where plants are densely outplanted as a close-knit community by our engaged groups of students and volunteers. Together, we learn how to restore a land damaged by erosion, wildfires, and invasive species by also learning how to restore connection of people back to the land.

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E ʻIlau Mai Kākou: Working together to achieve ʻāina momona

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Co-management and collaborative stewardship efforts have increased in both importance and impact in protecting and conserving Hawaiʻiʻs natural and cultural resources. Beginning in the cultural renaissance of the 1970's and continuing through the socio-political activation in the 1990ʻs, individuals and communities in Hawaiʻi catalyzed conservation initiatives that ushered in a new era of Aloha and Mālama ʻĀina as we know it today. As Hawaiʻi grapples with the impacts of a climate crisis, strategies that incorporate multiple stakeholder perspectives and expertise have led to solutions that empower historically underutilized voices from communities of place and practice to drive positive change. Co-management as a conservation process and outcome reflects the beauty and uniqueness of Hawaiʻi and those who are committed to her care, exalts the intimate connection between people and place, and incorporates the reciprocal activities grounded in the Hawaiian cultural value of kuleana.

In this interactive session a panel representing the spectrum of co-management frameworks including formal designations, community-driven and descendant-led stewardship, and support networks, will share unique stories of mauka and makai stewardship across the pae ʻāina. Facilitated break-out group discussions co-led by panelist members will provide participants the opportunity to discuss topics relevant to collaborative stewardship in Hawaiʻi, as well those strategies and lessons learned by the conferenceʻs broader Pacific Island attendees. Through this workshop, participants will have the opportunity to learn and discuss the ideas and collaborative models of co-management, as well as begin to forge relationships with others across the region interested in community-led stewardship.

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An interface between Art and Science: Empowering the local Māori voice in a Graphical Representation of New Zealand's Biological Heritage (Flora & Fauna).

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New Zealand's biological heritage is in decline due to threats such as climate change and habitat destruction. New Zealand's biological heritage and the wider environment are critical to Māori world view and culture. Therefore, Māori have long advocated for greater engagement in efforts to reverse this decline. One negative outcome that can be associated with localized declines in biological heritage is a concomitant loss of local Māori language (dialectical) terms and growing use of standardised Māori terms. Replacing local dialectical terms also runs the risk of losing the associated mātauranga (knowledge) that is inherent in the meaning of these local terms for their unique flora and fauna. Retaining this bioheritage knowledge is considered important and could play a role in conservation efforts. This research project was co-created with a kaumatua (elder, person of status) from the Tūhoe-Tuawhenua region who was concerned at the loss of their own unique Māori names. The research aimed to provide a viable way to retain and empower local indigenous bio-heritage terms via the creation of a static visual educational resource for Tuhoe-Tuawhenua youth displaying the forest vegetation of the Tūhoe-Tuawhenua. The plants in the final resource are identified by their local Māori term and their corresponding scientific name. Depicting ecological accuracy in the artwork was a specific requirement of the kaumatua and created some unique outcomes in how the artwork formed. This manuscript discusses the approaches used in this research and includes an analysis of its successes as well as its wider global applications.

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Using Native Oysters to Improve Water Quality and Clarity in Kāne'ohe Bay, O'ahu

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Over 90 water bodies in the State of Hawaiʻi are “impaired” under Federal standards for water quality. Every day, polluted runoff from urban, agriculture, and cesspools contaminate water resources and threaten public health. Hawaii has a culture deeply rooted in the ʻāina and the sacredness of the resources that the ʻāina provides. Native bivalves were once abundant and were a part of many ancient Hawaiian chants, songs, and legends. Sadly, their numbers have declined steadily over the last century. Waiwai Ola Waterkeepers has initiated a restoration project for native oysters (Dendostrea sandvichensis) that will serve to filter contaminants and restore habitats in the nearshore areas. In this pilot study, we placed juvenile oysters, obtained from the UH Hilo Pacific Aquaculture and Coastal Resources Center (PACRC), in cages at three sites in Kāneʻohe Bay. Oyster size, water salinity, and water temperature were made monthly at all three sites. Oysters grew a mean of 5.56 (± 3.7) mm over the three-month period, ranging in size from 11.72 - 14.86 mm initially to 15.8 – 22.4 (the values represent 20th and 80^{th} percentiles) after three months. Eighty-one percent of oysters placed in Kāneʻohe Bay in September survived across all three sites. Overall, the results of this pilot study indicate that the native oyster, Dendostrea sandvichensis, will survive and grow well in the coastal waters in Kāneʻohe Bay. In our future work, we plan to further explore the potential of restoring oysters at locations around the island to help clean coastal waters in Hawaiʻi.

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The Hunt for ROD Resistant ‘Ōhi‘a Genotypes: Updates from Disease Resistance Improvement Work for Restoring ROD Impacted Hawaiian Forest

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Covering more than a million acres, ‘Ōhi‘a lehua (Metrosideros polymorpha, ‘ōhi‘a) is Hawai‘i’s biocultural keystone. Natural resistance of Metrosideros species to Rapid ‘Ōhi‘a Death (ROD), a disease caused by two fungi of the Ceratocystis genus (C. lukuohia, and C. huliohia), is poorly understood yet represents the key to perpetuating ‘Ōhi‘a in Hawai‘i. To develop a landscape-scale understanding of wild-type ROD resistance in ‘Ōhi‘a, we: 1) created a protocol for sampling and propagating cuttings in the greenhouse that achieves an average of 11% (ranging from 0-80%) survivorship across individuals; 2) developed a Hawai‘i Island focused and remote sensing-based (Helicopter, Plane and Drone based analyses) methodology to support clonal propagation that identifies target survivor ‘Ōhi‘a (lone survivors surrounded by dead ‘Ōhi‘a) and randomly selected ‘Ōhi‘a lehua trees in adjacent alive or mostly alive ‘Ōhi‘a forest; 3) sampled 223 trees across Puna and Hilo districts, generating 10,098 cuttings; 4) developed a seed focused sampling plan for the State of Hawai‘i to screen ‘Ōhi‘a material; and 5) have propagated 340 seedlings from Kaua‘i and O‘ahu. Material is now available for disease screening, and in the coming 18 months, we will assess ‘Ōhi‘a disease resistance of propagated material. Identified disease resistant genotypes will form the foundation for: (i) efforts to model the potential impacts of ROD on ‘Ōhi‘a dominated native forests; and (ii) strategies for using putatively resistant material to restore ROD impacted forests previously dominated by ‘Ōhi‘a. This work will sustain the bio-cultural value of Hawai‘i’s landscapes.

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The Long Road Home: Integrated Floodplain Restoration For An Endangered Frog Species

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Declines and extinctions of amphibians is a significant threat to biodiversity in the Pacific region. *Litoria raniformis* (Endangered IUCN Redlist) was once widespread and abundant throughout south eastern Australia, but has since been severely impacted by water resource development, invasive fish and introduced disease. For the past two decades, floodplain water management has been used to restore wetland habitat for *L. raniformis* and other wetland taxa. We monitored frog breeding and population dynamics, along with a comprehensive set of hydrological, biochemical and biotic variables over a 12 year period to evaluate the success of management interventions and inform adaptive management. Active water management (principally through managed environmental water delivery) has made a significant contribution to increases in *L. raniformis* recruitment and abundance, and has also provided habitat for threatened and migratory waterbirds. The success of the program is underpinned by partnerships between water management agencies, communities and scientists who all play an active role in water planning and on-ground implementation. The development of ecological response models has provided much needed empirical support for adaptive management frameworks that has helped refine our understanding of the complex relationships between water management and long-term population viability, along with concurrent responses of other floodplain taxa.

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Connecting Islands Within an Island: Efforts to Build and Sustain Community Partnerships in Conservation at an Undergraduate University

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A critical component of managing for abundance is the connection of parties across communities and across sectors. These connections are particularly important for engaging individuals from a diversity of age and cultural groups. Even in geographically small regions, building strong collaborative partnerships can be difficult due to time constraints, cultural differences, and ‘tunnel vision’ on the part of the parties involve. The Island of Oahu, though small, hosts a diversity of entities that are passionate about conservation and resource management. Despite the small size of the island, building connections across these conservation communities can present a challenge. Here, I discuss efforts at Brigham Young University–Hawaii, a small undergraduate university with a largely international student body, to build collaborative partnerships with other members of the conservation community both in Hawai’i and across Oceania. I approach this issue specifically from the perspective of mentoring the next generation of conservation minded scientists and citizens, and involving members of the predominately Polynesian community of Lāʻie. I discuss several case studies in which collaborative efforts between students at BYU–Hawaii and members of the Ko’olauloa community, government and non-governmental conservation organizations, and non-profit land managers have resulted in transformational experiences for students and a boon for the collaborative partners.

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Stop Aquatic Hitchhikers: The Prevention of Aquatic Invasive Species Introduction Through Effective Ballast Water and Biofouling Management

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One of the most notable threats to marine ecosystem of Hawai‘i is aquatic invasive species (AIS). Vessel biofouling (accumulation of organisms that grow on the hull of ships) and ballast water (water taken up and released by vessels for stability during loading and unloading cargo), are responsible for almost 80% of AIS introductions to Hawai‘i. Invasive species that are transported by vessels have a potential risk to devastate the diverse and abundant flora and fauna of Hawaii’s marine ecosystems. The Division of Aquatic Resources’ (DAR), Ballast Water and Biofouling (BWBF) Program addresses these top AIS vectors primarily through risk assessments of reporting forms. These risk assessments enable DAR to prioritize inspections of vessels that pose a higher biosecurity risk. Through enforcing vessel reporting, compliance went from 50% in 2017 to 80% in 2019, which is a 30% total increase. There has been a slight decrease in high priority vessels from 2018 to 2019 as well as a slight increase of onboard ballast water treatment systems. These shifts may be attributed to effective monitoring techniques of real time data and active communication with vessel operators before or during their arrival to Hawai‘i. The next step is to validate the priority matrix to further develop the program, and continue to do risk analyses and vessel traffic monitoring to maintain our primary line of defense for AIS introductions attributed to arriving vessels.

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Quantifying summer zooplankton biodiversity and abundance to better understand trophic dynamics in He‘eia Fishpond, Kāne‘ohe Bay.

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Zooplankton communities play critical roles in coastal marine ecosystems, transferring energy from primary producers to fish. In Kāne‘ohe Bay, the largest coastal embayment in Hawai‘i, zooplankton communities are dominated by calanoid and cyclopoid copepods (holoplankton) species and larvae of other invertebrates and fish (meroplankton). However, zooplankton communities in Hawaiian fishponds remain undescribed, even as changes in mauka land-use, increased sedimentation, and invasive species impact these cultural sites. In summer 2019, we began initial descriptions of zooplankton diversity and community structure in He'eia Fishpond, hypothesizing that zooplankton abundance and diversity would be positively correlated with increased salinity and would be spatially distributed in locations more influenced by the oceanic influx. Zooplankton were sampled via weekly plankton tows between July 2 - 23, 2019, at high and low tides with sites selected along a gradient from fresh to fully marine waters. Strikingly, 97% of all zooplankton collected were holoplankton, with 99.7 % as marine copepods. In support of our hypotheses, zooplankton abundance varies spatially and tidally. During high tides, abundance of zooplankton at mākāhā increases with tidal amplitude and likely summer spawning events. Unexpectedly on July 23, adult Oithona sp. copepods collected from southern pond sites exhibited an unusual excessive polymicrobial ectomorphic growth, an apparently new copepod disease. Our findings enhance abilities to estimate fish productivity from Indigenous aquaculture, support on-going biocultural restoration efforts, present managers with a potential indicator to assess water quality, and finally, highlight the need for additional research on potential diseases that might affect zooplankton and other coastal upper trophic organisms in this important habitat.

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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 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. During the semester, surveys for nests were conducted between 6:30 and 9:00 a.m twice a week. Once a nest was located, students observed nesting behaviors from an unobtrusive location at a minimum distance of 10 m. Nesting locations were recorded and mapped using GPS. To communicate with the college's Auxiliary Services, a protocol was established to notify staff of the birds' presence. Data from the KCC campus is now shared with the larger White Tern Hui project. During the 2019-2020 academic year, five undergraduate students participated in the research, most of whom are working towards undergraduate degrees in biology or natural resources. Here the undergraduate researchers report on the most recent breeding season and the cumulative analysis of our multi-year monitoring of the KCC campus population. We also report on a series of unusual mortality events that occurred during fall 2019, indicating possible barn owl predation. The project continues to serve as an avenue for building capacity among local students for avian monitoring and survey techniques.

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Multiple Perspectives in Managing for Biocultural Abundance in the Ahupuaʻa of Puʻuwaʻawaʻa, North Kona, Hawaiʻi

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How do we manage for biocultural abundance in the leeward dry forests of Hawaiʻi where drought, wildfire, and invasive species have reduced our native dryland ecosystems by over 95%? In North Kona, the ahupuaʻa of Puʻuwaʻawaʻa is part of Kekaha wai ʻole, or “the land without water”, yet these water-limited lands have harbored an incredible abundance in the recent past. Described as one of the most botanically rich areas of all of Hawai`i by early botanists, Puʻuwaʻawaʻa still contains significant areas of dry and mixed-mesic forest that have immeasurable cultural and biological value. While these areas and values are threatened on many fronts, partnerships and collaborations across disciplines seek to conserve and perpetuate with the vision of returning to an abundant and thriving biocultural landscape once again. Here we present talks from multiple perspectives in order to build a rich foundation for our work; talks will include: 1) cultural knowledge, importance of place, and community co-management, 2) outreach and education for the next generation, 3) wildfire outreach, prevention and mitigation, 4) promoting abundant bird life, 5) managing data and reporting across a vast landscape, 6) managing sustainable hunting opportunities, and 7) protecting our rare and endangered species. We believe that by bringing together different approaches to conservation this will benefit both the natural communities as well as the human communities that live, work, interact with, and depend on this important place.

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Homeward Bound – Tracking Endangered Hawaiian Petrels on Lana'i

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The island of Lana'i is home to an internationally important breeding population of the endangered Hawaiian Petrel *Pterodroma sandwichensis*, a seabird endemic to the Hawaiian Islands. Breeding colonies on the island are concentrated in the uluhe-covered slopes on either side of the Lāna'ihale mountain. As light attraction and collisions with human infrastructure are two key threats to the species throughout their range, understanding the flight paths of birds at these colonies can be used to help in the planning process for any future development projects on Lana'i. In 2018 and 2019, we attached data loggers to breeding birds at burrows in multiple colonies throughout the core breeding area. We found that inbound birds followed two main routes to their burrows – either flying straight in from the south or following the south-eastern coastline in a northerly direction, eventually turning inland to the west. Inbound birds did not raft at sea before coming into land, nor did they spend time circling the colonies before landing at their burrows. Outbound flight paths showed a direct and dispersed pattern to the sea, with birds heading out in all directions between south-east and south-west, reaching sea level several kilometres offshore. None of the birds tracked flew over Lana'i City or the airport, regardless of inbound or outbound flight paths. The results suggest that birds use a combination of terrain and prevailing winds, particularly during homeward bound flight paths and that there are several key areas that the birds use when transiting to their colonies.

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Kaua'i as a Case Study for the Widespread Impact and Population-Level Effect of Feral Cats

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Kaua'i is home to a wide range of native and endangered bird species which are found from the lowlands up to the mist-enshrouded mountainous interior. All of these species face a wide range of anthropogenic threats, which in many cases are causing rapid population decline. The one threat they have in common is the feral cat *Felis catus*, a widespread, introduced predator to the Hawaiian Islands. We consider the impact of cats on native bird species on Kaua'i as a case study for the impact of this predator across the Hawaiian Islands. In particular, we focus on the impacts of cats on endangered seabirds (the Newell's Shearwater *Puffinus newelli* and the Hawaiian Petrel *Pterodroma sandwichensis*) in remote montane colonies. Seven colonies were considered, all of which now have large scale predator control and monitoring projects in place. Feral cats were found to be responsible for 35.6% of all depredations of the two species found between 2011 and 2017. Unlike rats (which were responsible for more depredations), cats targeted breeding adults as well as chicks. Burrows where adults were depredated were much less likely to be active in the following year and even less likely to initiate breeding. Cat depredations were recorded at all sites, regardless of how remote or inaccessible the sites were to humans. We consider the importance and challenges of introduced predator control at these colonies, the likelihood of colony extirpation if predator control was to cease, and discuss potential next steps to protect these endangered, endemic seabirds.

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Establishing a New Breeding Colony of the Threatened Newell's Shearwater on Maui

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The Newell's shearwater (*Puffinus newelli*) population has dramatically decreased in size and distribution in Hawaii, and the species is listed as threatened under the US Endangered Species Act (ESA) and critically endangered by the IUCN. Management, until recently, has been solely directed at caring for the remaining populations in the northwestern portion of Kauai. On West Maui, where the species is all but extirpated, a conservation initiative was undertaken to prove conservation benefits for the species under a Habitat Conservation Plan required by the ESA. In 2014, two ~1.8 hectare fenced management areas were constructed, and pigs, rats, mongoose, and feral cats were excluded. In addition, nest boxes were installed (50 each exclosure), vegetation was managed, and social attraction media (call playbacks and decoys) were instituted. Nest site visitation and activities are monitored using covert IR game cameras to document behaviors, visitation rates, breeding status, and reproductive performance. Visitation by seabirds started in the third year of social attraction, the first eggs were laid but did not hatch in years 4 and 5, and the first fledglings (n=5) were produced in year 6 (2019), from 20 occupied nests. Efforts were modified in several ways in 2019, and likely contributed to success. We examine the steady annual increase in nest site visitation and breeding success in the context of population modeling and discuss factors affecting the efficacy of social attraction toward establishing new nesting colonies, facilitating recovery capacity, and improving resilience to environmental change.

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Of ‘Ua‘u kani and Naupaka: Seabird Color Perception and Nesting Habitat

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‘Ua‘u kani (*Ardenna pacifica*) are indigenous seabirds that nest in burrows under naupaka and on hillsides on shorelines around Hawai‘i. On Kaua‘i’s south shore, birds returning to a colony at sunset frequently land on a road running through the colony and are subsequently hit by cars. Additionally, these birds must navigate densely packed native and introduced plants to locate their burrows. To investigate visual cues that may drive observed behaviors in this colony, visual contrast models were created using the PAVO R package. We investigated how objects in the colony compare visually and how ‘ua‘u kani vision may differ from an average bird. Physiological data on ‘ua‘u kani color perception were obtained from published literature. A spectrometer was used to collect reflectance data on five dominant plant species (*Megathyrsus maximus*, *Leucaena leucocephala*, *Telsosma cordata*, *Vitex rotundifolia*, *Scaevola taccada)* and three substrates (dirt, rocks, and the road). Results suggest ‘ua‘u kani perceive the road through the colony as visually similar to natural substrates in the area. Results also suggest ‘ua‘u kani have heightened color discrimination abilities among green plants compared to an average bird, especially naupaka. The ability of ‘ua‘u kani to discriminate naupaka above all other measured plants may be associated with the frequency of burrows dug near this plant. These species-specific visual models have powerful implications for management. These models allow for greater understanding of how birds perceive any object (i.e. outdoor lights against the sky/ground, wind turbines, and other environmental hazards), and management can adapt accordingly.

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A genetic database for improved detection of alien and native sponge species of Oʻahu

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Sponges are often unappreciated but serve key ecological functions in coral reefs. These functions can vary from primary producers or nutrient recycling in the food web that sustains biodiversity, to coral-killing invaders which wreak havoc on pristine reefs. Likewise, sponges are one of the most chemically bioactive organisms on the reef with biomedical potential. For example, Native Hawaiians used *ana* sponges to treat *ea* (human thrush). Despite their ecological and cultural importance in Hawaiʻi, sponges remain vastly understudied although it is widely known that some recent introductions have already become dominant in Kāneʻohe Bay. There are ~80 species of sponges in previous surveys of the Hawaiian Islands, and genetic resources exist for only ~30 of those species, despite the fact that sponges are notoriously difficult to identify to species without genetic tools. We sought to explore the biodiversity of coral reef and fouling community sponges found in Kāneʻohe Bay and Honolulu Harbor. Integrating genetics and taxonomy has already catalogued ~200 species of sponges, including new undescribed species, previously unknown introduced species, alien bio-eroding and phototrophic species that have the potential to outcompete native coral species in Kāneʻohe Bay. Emerging genetic early detection and monitoring techniques rely on well-curated sequence databases which are currently absent for Hawaiian sponges. Our work provides a foundation for accurate identification of Hawaiian sponges and the future use of promising technology, such as metabarcoding of eDNA of seawater samples, which is gaining popularity as an early-detection monitoring tool for managers to respond to alien invasive species.

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Natural Versus Non-Natural Bolus Matter in Black-Footed Albatross, *Phoebastria nigripes*, and Laysan Albatross, *Phoebastria immutabilis*, from Midway Atoll National Wildlife Refuge (NWR), Northwestern Hawaiian Islands (NWHI)

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Mōlī or Laysan albatross (Phoebastria immutabilis), and Kaʻupu or Black-footed albatross (Phoebastria nigripes), both indigenous to Hawaiʻi, are considered near-threatened by the International Union for Conservation of Nature (IUCN). Specifically, Midway Atoll NWR, managed by the United States Fish and Wildlife Service (USFWS), hosts the largest populations of these species. Both Mōlī and Kaʻupu are found on NWHI where 70% and 95% of breeding pairs, respectively. While the human disturbance at NWHI is minimal, the area receives significant amounts of floating marine debris due to Pacific Ocean currents, which affect open-ocean seabirds' foraging habits. Albatross boli (indigestible material thrown up by albatross chicks) collected at Midway Atoll NWR in 2019, and examined to determine their diets. We found that non-prey items (e.g. fishing line and plastic fragments) were present in all samples, contributing up to 24% of the bolus' weight. The Mōlī boli plastic items weighed significantly more, compared to the Kaʻupu (13% versus 2%, respectively, of total bolus weight). Additionally, Mōlī boli contained a significantly higher amount (69% of bolus weight) of non-prey items (natural, e.g. coral fragments and man-made, e.g. as plastics) than the Kaʻupu (52% of bolus weight). Furthermore, there were significant differences in the size of the ingested non-prey items between the two species. Plastic items found in the Mōlī, were larger than 2 cm versus the Kaʻupu where plastics less than 2 cm. These findings suggest that Mōlī or Laysan albatross might be more vulnerable to the effect of floating marine debris.

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Management challenges and successes in freshwater dependent ecosystems: connections among streams, wetlands, and estuaries

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Management of freshwater-dependent ecosystems (e.g., streams, wetlands, lakes, estuaries) crosses disciplines and resources (e.g., social-cultural, wildlife, vegetation, land, water), making coordination among stakeholders challenging. In Hawaii and US affiliated Pacific Islands, management decisions and associated research occurs at the federal (e.g., US Fish and Wildlife Service, US Army Corps of Engineers, US Department of Agriculture, Department of Defense, US Environmental Protection Agency, National Parks Service), state (e.g., Commission on Water Resource Management, Division of Aquatic Resources, Division of Forestry and Wildlife, Department of Health), and local (e.g., county, University of Hawaii, non-profit) levels. Because of the various and sometimes overlapping jurisdictions, responsibilities, and missions, making decisions in this complex regulatory space to affect real change at the species, habitat, or ecosystem level can be daunting. This symposium will bring together managers, scholars, and community members across a variety of disciplines to discuss challenges and successes of working in freshwater-dependent ecosystems and the how they could benefit from increased cooperation among agencies to improve the protection and restoration of aquatic, wetland, and estuarine habitats, their associated species, and the social-ecological systems dependent on them.

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Navigating complex regulatory space to improve the management of freshwater dependent ecosystems

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Management of freshwater-dependent ecosystems (e.g., streams, wetlands, lakes, estuaries) crosses disciplines and resources (e.g., wildlife, vegetation, land, water) with management decisions occurring at the federal (e.g., US Fish and Wildlife Service, US Army Corps of Engineers, Department of Defense, US Environmental Protection Agency, National Parks Service), state (e.g., Commission on Water Resource Management, Division of Aquatic Resources, Division of Forestry and Wildlife, Department of Health), and local (e.g., University of Hawaii, county, non-profit) level. Because of the various and sometimes overlapping jurisdictions, responsibilities, and missions, making decisions in a complex regulatory space to affect real change at the species, habitat, or ecosystem level can be daunting. However, cross-discipline and inter-agency synergies can support the conservation of important social-ecological systems, leveraging community support at the local level with institutional support at the state and federal levels. We discuss how multi-agency management is possible to improve the integration of bottom-up and top-down management across landscapes in order to protect and restore freshwater-dependent ecosystems and social-ecological services.

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Cultural and socioeconomic contexts of managing conservation-reliant species

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How do we generate societal support for managing conservation reliant species? By identifying species as conservation reliant, the purpose for engaging in conservation efforts may appear to be for the species' existence sake. At its heart, management of conservation reliant species is a people problem. If conservation efforts are to succeed scientists, managers, decision makers and stakeholders have to work together to cultivate a shared vision of how conservation can be integrated with societal and economic concerns at multiple levels. As an island society that at one time was 100% reliant on the effective ecosystem function and productivity, people were the nature-reliant species. What can we learn from the cultural and socioeconomic context that acknowledged the interdependence of abundant, thriving lands and people? Among Hawai'i's conservation professionals, there is familiarity with one aspect of traditional management practices which is frequently called the "kapu system." To more fully recognize the intention of those traditional management practices we need to understand the concepts of kapu and kānāwai, and how those translated into species and people management practices. We will also explore contemporary examples of management practices that are grounded in cultural and socioeconomic principles to elucidate approaches that could help address conservation needs in the context of Hawai'i's highly complex ecological and cultural environment to save and conserve conservation reliant species.

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Monitoring animal behavior and space use ensures minimal impact of research activities

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Research activities such as population surveys, animal tracking, and emergency interventions play an important role in the conservation efforts for the endangered Hawaiian monk seal (Neomonachus schauinslandi). However, these activities can also be invasive and potentially detrimental to the studied individuals. This study examined whether handling monk seals for research activities led to changes in the behavioral response to humans or in a seal's preferred haul-out location. We conducted our study on Laysan Island, where NOAA's Hawaiian Monk Seal Research Program performed daily surveys recording the seal's location on the island and degree of response to researchers' presence. We looked for changes in the degree of response, or in sectors used following instances of seals being handled for the application of research instruments. The most common response to human presence was classified as 'no disturbance', and this did not change significantly after a handling event (paired t-test; p-value = 0.1866). However, the proportion of days a seal spent in the sector they were handled in before the handling event did significantly decrease (from 16% to 2%; paired t-test; p-value = 0.002443). From these results it is shown that while handling events do not appear to induce an observable behavioral response in seals to the presence of humans, seals did tend to avoid sectors that they were handled in. Our study shows that research techniques can impact animal behavior and allow researchers to make a more informed decision on the costs and benefits of research procedures on this endangered species.

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Efforts to increase endangered yellow-faced bee populations using artificial nest blocks

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Hawaiian yellow-faced bees (*Hylaeus* spp.) are the only native bees in the islands. Many of the 60+ species comprising this important pollinator group are now extremely rare owing to habitat loss, habitat degradation, and predation and competition from invasive species. In 2016, seven *Hylaeus* species were formally listed as Endangered, the first bees to receive this designation in the U.S. Recent work developed an artificial nest block design that was readily adopted by the most abundant coastal bee species, *Hylaeus anthracinus*, while discouraging use by non-native bees and wasps and excluding predatory ants. We report here on an ongoing experimental study investigating how addition of these nest blocks and variation in floral resources affect populations of *H. anthracinus*. Nest blocks were installed at five coastal locations supporting populations of *H. anthracinus*: four on the island of O'ahu and one on the island of Maui. Nest block usage, flower abundance, and adult bee densities have been monitored since October 2018 and will continue to be monitored until October 2020 to learn whether bee numbers and/or distribution can be increased with nesting site augmentation, and if so, how floral resource limitation may influence this population recovery. Additionally, the nest block design enables the collection of unused pollen provisions and allows for the quantification of larval parasitism rates. The information collected is providing important insight into the bee's seasonal population fluctuations, pollination activities, resource needs, and mortality from parasitism.

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Mālama I Ke Kai: Community Action Guide for Coastal Abundance

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Across Hawaii and the Pacific, communities face increasing threats to life-giving marine resources. More than ever, communities are looking for solutions that empower themselves to take action via community-based management. The State, too, aims to effectively manage 30% of nearshore waters by 2030 for a more resilient future for Hawaii's residents. In keeping with the theme of the HCC and in alignment with all 6 conference tracks, the Maui Nui Network will roll out a new capacity building tool around community-based management called "Malama I Ke Kai: Community Action Guide." The Guide was developed and refined over ten years, based on our experiences and the simultaneous work of our colleagues across the Pacific. The Guide integrates fundamental and time-tested components of community-based management to help community groups organize and develop plans to restore marine resources using adaptive management. While some groups may choose to work independently, others may choose to pursue opportunities to collaborate with governments and other essential partners to implement their makai (ocean) management plans and achieve our shared goal of a healthy nearshore ecosystem with abundant resources –allowing all of us to continue to feed our families, enjoy clean and abundant nearshore areas, and perpetuate our way of life and livelihoods. The 1-hour forum will start with an overview, followed by community members sharing their stories about their kuleana in doing community-based work and what their experiences, advice and outcomes were from using the guide. We will wrap up with an interactive community panel Q&A/discussion.

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Refining methods to assess Hawaiian stream and estuarine fish diversity for collaborative monitoring

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The return of native fish is a critical bioindicator of abundance and ahupuaʻa health in Hawaiʻi. Comprehensive biodiversity assessments of native and non-native fish are therefore needed to understand impacts of restoration and changes in land use, especially in stream and estuarine ecosystems. Current methodologies vary widely due to the large differences in tidal changes, habitat that cause difficulties in visibility, catch-and-release methods, accessibility, and comparability between mauka (mountain) to makai (sea) sampling sites. The goal of this interactive forum is for participants to learn about the various methods currently utilized in streams and estuaries around Hawaiʻi to assess fish diversity, such as visual, catch-and-release methods, and eDNA metabarcoding surveys. The session will begin with a brief panel discussion featuring current monitoring methods on fish diversity around several watersheds in Hawaiʻi. Participants will then discuss in facilitated groups the current best practices and future recommendations for topics such as incorporating Indigenous knowledge, citizen science, and initiating eradication of invasive species while keeping capacity and resources in mind. Each small group facilitator will summarize thoughts to share with the larger group at the end. This forum aims to connect organizations and research groups interested in assessing fish diversity in streams and estuaries to assess abundance and watershed health, and forge collaborations for future efforts to achieve sustainability of ecologically fragile organisms in our estuaries.

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TAKING INVASIVE RODENT MANAGEMENT TO GREATER HEIGHTS

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Introduced rodents pose one of the greatest threats to biodiversity worldwide. The significant extinction risk for island endemic species in particular means that management of invasive rodents is a top conservation priority. Ground-based baiting systems are a common control method, particularly on human-inhabited islands where eradication is less likely. These methods can be effective in reducing numbers of ground-dwelling rodents, however, evidence demonstrates that rodents readily use other vegetation strata. This calls into question whether ground-based methods are effective in controlling entire rodent populations, or protecting vulnerable canopy-dwelling and -nesting endemic fauna. Using Norfolk Island – a small inhabited Pacific island – as a case study, we have investigated how introduced rodents move through their environment. Previous avian extinctions on Norfolk have been attributed to the presence of introduced rodents, and rodents are known to be a major threat to the remaining endemic species. To understand the effectiveness of rodent control, we argue that our focus must consider rodent activity in three dimensional space. We quantified rodent activity at the ground, mid-storey, and canopy level of three different vegetation types using a range of passive monitoring tools available to park managers, deploying them to all focal strata. Considerable rodent activity was detected across all three forest strata, indicating that the current ground-based baiting regime being used in the National Park likely targets a subset of the invasive rodent population. In systems where ongoing rodent control is the most feasible option, it is time to start thinking at greater heights.

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Managing for recovery of endangered species with the Spatial Monitoring and Reporting Tool (SMART)

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The human footprint has drastically reduced areas available for wildlife on islands and mainland in the Asia-Pacific region. The best chances for recovery of wildlife will be inside protected areas. To respond effectively to threats from invasive species, introduced predators and human encroachment, among others, managers need information on where threats are occurring and the capacity to address them quickly. Often, these solutions need to be implemented in remote places, with limited staffing and resources. In response to these fundamental needs, a broad partnership of conservation organizations developed the Spatial Monitoring and Reporting Tool (SMART). The 'SMART Approach' combines the SMART software with capacity building and a set of best practices, which have become the global standard for conservation law enforcement and protected area management, now implemented across more than 800 sites, 60 countries, and 115 government partners. SMART enables managers to take an evidence-based approach, utilizing information from a range of sources to assess their management operations, measure progress towards predefined targets, and improve protection and management at site level. SMART can also increase the management effectiveness at multiple scales, including deployment on a national scale as a unified management system. In this presentation, we provide an overview of SMART functionality and its applications for endangered species management by highlighting case studies from sites in PNG, Cambodia, Bangladesh and Russia where SMART implementation led to improved outcomes for wildlife through reducing threats and securing habitats. We emphasize how capacity building around SMART can both produce data relevant for recovering wildlife populations and empower managers and conservation practitioners to play leadership roles in collecting, analyzing and utilizing such data.

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Is Mitigation Translocation an Effective Method for Reducing the Rjsk of Collisions Between Mōlī and Military Aircraft?

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Wildlife-aircraft collisions (wildlife strikes) pose a serious risk to civil and military aircraft. Each year, mōlī or Laysan albatross (*Phoebastria immutabilis*) attempt to establish a breeding colony on the airfield at the US Navy's Pacific Missile Range Facility (PMRF) located on the island of Kaua'i, resulting in a hazard to safe aircraft operations at this facility. A long-term management program, with an emphasis on mitigation translocation (e.g., live-capture and translocation away from the area) of problematic individuals, has been conducted by USDA Wildlife Services. However, the efficacy of mitigation translocation as a non-lethal management tool is unknown, especially in island ecosystems. During 2018–2020, we conducted an experimental program to determine return rates of mōlī translocated from PMRF. Radio-tagged mōlī were translocated to release locations either 2 km or 45 km from the PMRF airfield during two time periods (early and late) within the mōlī breeding season (November to April). We monitored for the return of radio=tagged birds to PMRF using automated tracking units placed around the PMRF airfield, hand tracking, and examining all mōlī that were live-captured on the airfield during the breeding season. Preliminary findings of our study suggest mitigation translocation has value as a management method to reduce the risk of mōlī-aircraft collisions at PMRF.

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Cat Policy in Hawai‘i: Where We’ve Been and Where Need to Go

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Feral domestic cats (*Felis catus*) are among the world’s most harmful invasive species. The introduction of this species to Hawai‘i has resulted in predation on a wide range of native species and the transmission of zoonotic diseases (e.g., toxoplasmosis) leading to the deaths of additional native species. The close association of cats with people, however, has complicated control efforts and the implementation of policy solutions. We review the history of domestic cat policy efforts in Hawai‘i and identify challenges and solutions to reduce harmful cat-caused ecological impacts.

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Invasive Seaweed Removal and Native Limu Restoration in He‘eia Fishpond

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Located along the shores of Kane'ohe Bay on O‘ahu, He'eia Fishpond encloses 88 acres of dynamic brackish water that is home to a diverse population of aquatic plants and animals, both native and introduced. Paepae o He'eia was founded in 2001 to mālama He'eia Fishpond while restoring the ponds ability to serve as a farm for primary estuary productivity (plankton), a nursery for juvenile marine species, and a holding and growing space for herbivorous reef fish. Presenting a significant challenge to this goal are several species of invasive seaweed that blanket the pond floor and account for thousands of pounds worth of unwanted biomass. Our invasive seaweed control and removal efforts began about fifteen years ago when we relied solely on volunteer labor to remove invasive seaweed by hand. While the education and outreach impact was significant, our ability to make serious headway in controlling the seaweed was limited. In 2019 and 2020, thanks to the support of project partners, our team employed the "Super Sucker" strategy, developed by The Nature Conservancy and DLNR-Department of Aquatic Resources, to increase our rate and area of removal within the fishpond. We tailored the strategy, originally created for the reefs of Kane'ohe Bay, to meet our specific fishpond needs and methods. We will present the results of our nine-month long invasive removal along with the progress made on our native limu restoration.

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Exploring Pathways and Opportunities for Community-Based Forest Management in Hawai‘i

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Top-down, agency-driven approaches to resource management in Hawai‘i limit the ability of local communities to fully engage in natural resource stewardship, which is an integrated part of Hawaiian lifeways and traditions. A growing interdisciplinary movement calls for integration of place-based knowledge and local practices into resource stewardship in Hawai‘i through community-based approaches. This research explores the underlying conditions for successful implementation of community-managed forests (CMF) in Hawai‘i, with a focus on how specific landownership arrangements and assemblage of actors influence the collaborative resource management process and outcomes. Through semi-structured interviews and participant observation, this exploratory research explores the following questions: (i) how can lessons learned from international and national collaboratively managed forests, as well as community-based marine systems in Hawai‘i be applied to the development of CMF in Hawai‘i? and (ii) what are the pathways and opportunities for the development and successful implementation of CMFs in Hawai‘i? Our initial results suggest that, while there is community and agency-level interest in community-based forest management in Hawai‘i, there is not yet a clear path toward co-management on public lands. Our results highlight the value of applying lessons learned from the Community-Based Subsistence Fishing Areas in Hawai‘i, which share historical, socio-cultural, ecological and economic contexts and provide insight into factors that will likely impact successful development of CMF Hawai‘i.

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Using Forest Inventory Data to Monitor Changes of Vegetation, Invasive Species, and Pig Damage in the Pacific Islands and Hawaii

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Forests across the Pacific are currently facing many threats. Disturbances are trending to be larger and more frequent throughout the region. Understanding and reporting on forest changes is a high priority for land managers in the Pacific Islands.

The U.S. Forest Service Forest Inventory and Analysis (FIA) program has measured forests in the U.S. affiliated Pacific Islands (American Samoa, Guam, Republic of Palau, Commonwealth of Northern Mariana Islands (CNMI), Federated States of Micronesia (FSM), and Republic of the Marshall Islands (RMI)) since 2001 and recently completed a full remeasurement of these surveys. The Hawaii FIA inventory began in 2010 and is currently being remeasured. FIA data can provide a baseline for trends and change.

The data collected from these inventories were evaluated for changes in the understory vegetation cover, tree, and invasive species. The understory vegetation cover for most of the islands did not change substantial. However, CNMI showed a significant increase in understory vegetation cover and Guam had a decrease in understory vegetation cover that can be linked to tree damages and pig disturbances. Across the surveyed Pacific Islands, Guam has the highest percent of forest land disturbed by pigs (9.8%, sampling error 1.8%). The species richness was highest in Palau and lowest in RMI. Species richness increased significantly in FSM and CNMI, while Palau observed an increase of endemic tree species.

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NiU NOW! The Tree of Life, an Untapped Resource for the Future

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Cocos nucifera L. (Arecaceae), **niu** within moana-nui-ākea, flourished around the equator building kinship with humanity by supporting nourishment, shelter, food and medicine, while enriching all aspects of living. This presentation will share cross-cultural insights on rediscovery of the **niu** remedy that stands in our backyards! The current "fruitless coconut tree" found throughout our urban environs is the overused exotic iconic symbol of tropical islands now labelled ‘ornamental’ in Hawai‘i. The true **niu momona** (flourishing coconut palm) is embedded within island Indigenous cultures telling their stories of who they are -- *Hawai'i is no exception!* The **niu** is a vital source of our collective and cultural emergence as well as our resilience. It supports the livelihood and life of over one hundred million people around the world, and it holds centuries of cultural understandings not always aligned with modern botanical research. Throughout Oceania, stories of niu as the "first tree” to come and the “last tree” to stand after natural disasters, helps us re-establish a working relationship that guides us through these global changes. The **niu** is an untapped resource for the climate that has already *changed.* It is vital for Island food security and needs to be engaged with ancient knowledge practices currently seeking expression.

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Making a Beach Cleanup "Count" Through Citizen Science

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The Coastal Marine Debris Monitoring Program (CMDMP) was created by Pacific Whale Foundation in 2015 to encourage members of the public to become citizen scientists through marine debris monitoring and removal efforts. The program distributes cleanup kits, consisting of an upcycled bag and a data sheet, throughout Maui which provides a simple and effective way for the public to become engaged in local conservation efforts.

Through returned data sheets, we track details on the type, amount, and location of debris on Maui. These data can then be used to prioritize outreach programs and campaigns designed to focus on mitigation and prevention of problematic debris items. To date, the CMDMP has collected information on over 84,000 pieces of debris and engaged more than 600 citizen scientists in critical monitoring and removal efforts. With data on ~70,000 plastic items including nearly 23,000+ cigarette filters, these data are used to determine the effectiveness of current policy (e.g. Maui County’s tobacco use ban), while working to guide future legislation by providing data that speaks to the detriments of plastic debris (e.g. single-use plastics ban).

The willingness of citizens to actively participate in conservation is demonstrated through this program, and can be encouraged by providing easily accessible methods and actions. The CMDMP is helping us better understand Maui’s debris trends and can be scaled and replicated throughout the main Hawaiian Islands. In an era of limited funds and abundance of passion, citizen science programs such as this are an effective way of collecting data while safeguarding coastal resources.

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Importance of NETwork Weaving: New Engagement Together, Working On Restoration Kuleana Solutions

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Working in conservation in Hawaiʻi, we often feel like we are in a race against time. Community-based non-profit organizations need to wear multiple hats on a day-to-day basis to make discernable progress, often times resulting in siloed work. This solution-oriented and interactive session will feature non-profit mālama ʻāina organizations spanning across Hawaiʻi who are part of the Community Restoration Partnership (CRP) of the Hawaiʻi Community Foundation (HCF). Through their support, this cohort style approach weaves together multi-agency collaboration inviting innovation to flow and shared capacity to grow amongst the CRP network. These community leaders will briefly share highlights of their environmental restoration work and strategies that engage community expertise and build pilina (relationships and connection) within communities to strengthen their agency. They will also share about their experiences in navigating around challenges familiar to organizations that have admirable goals, but lack the experience, funding, and time to reach them. After these presentations, session attendees will break into small groups where presenters will facilitate group discussions on successes and challenges faced within their own work, potential solutions, and how others in the small group can offer support to each other to further build everyone's capacity for conservation in Hawaiʻi. The small groups will reconvene to learn from each other, emphasizing the importance of networking and building partnerships in conservation that help to build capacity in this field as, I haʻaheo no ka lawaiʻa i ka lako i ka ʻupena (the fisher may be well proud when well supplied with nets).

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Developing methods to spatially represent social values in Hawai'i

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Maps are an important tool used by managers to communicate and visualize the biological and geophysical features of a place. However, the information included or excluded on maps can reinforce existing power dynamics and inadvertently silence voices. There are increasing efforts to develop maps that spatially represent social values as a means to communicate what community of a place finds important and what their needs are. However, those aspects that are more difficult to articulate and measure may be some of the values that are most important to people yet because they are not represented or known they can get left out of decision-making processes and traded off. We aim to better understand social values and the emotional depth and significance connected to these values as well as how they may be spatially represented. This facilitated workshop will gather the perspectives from individuals of varying backgrounds to understand their emotional connection and perceived significance of various social values as well as their mappability. We will start with an overview of various social values and a framework addressing the various levels of intensity these values may be perceived as. Participants will then join small groups to discuss their perceptions of what levels the various social values belong in as well as how they could be mapped. This workshop can aid in a better representation of community priorities and in elevating voices and values that may previously have been misrepresented.

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Contextualizing the social-ecological outcomes of coral reef fisheries management

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Marine protected areas (MPAs) have emerged as a valuable tool in biodiversity conservation and fisheries management. However, the effective use of MPAs depends upon the successful integration of social and ecological information. We investigated relationships between the social system structure of coastal communities alongside biological data describing the status and trends in fish communities around Yap, Micronesia. Traditional marine tenure made Yap an ideal place to investigate the underlying principles of social-ecological systems, as communities own and manage spatially-defined coastal resources. Analysis of social survey data revealed three social regimes, which were linked to corresponding gradients of ecological outcomes. Communities with decentralized decision-making and a preference for communal forms of fishing had the greatest ecological outcomes, while communities lacking any form of leadership were linked to poor ecological outcomes. Interestingly, communities with strong top-down leadership were shown to have variable ecological outcomes, depending on the presence of key groups or individuals. We last investigated whether social perception could successfully predict the status of fish assemblages within non-managed reefs. Several biological metrics of fish assemblages within non-managed areas were significantly predicted by a gradient of human access, suggesting social perception could not predict the growing human footprint over the study period. These findings highlight the potentially overlooked role that community-oriented decision-making structures and fishing methods could play in successful conservation efforts and the limitations of perception data. Policies that promote communal marine resource use offer a novel approach to improve fisheries management and promote social-ecological resilience.

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Who decides what counts?
Honoring diverse cultures values in environmental policy frameworks on Hawai'i Island.

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Numerous examples illustrate growing attempts of policy makers to incorporate and consider diverse cultural values in decision-making processes. Representatives of indigenous communities have been invited to consult and inform the process and to share aspects of their traditional ecological knowledge, cultural values and world views. Prevailing colonial power dynamics, along with limited available tools to authentically engage and communicate diverse value systems in policy, have led to increasing criticism, concluding indigenous voices to be insufficiently represented, appropriated or to be overlooked. Remarkably few studies have been designed to focus on how to integrate and honor indigenous cultural values in environmental policy. Thus, the extent to which indigenous world views have been captured through available policy tools and how they ultimately influenced policy outcomes is still poorly understood. This study investigates whether the methods used in Cultural Impact Assessment's (CIA's), as part of broader land development permitting processes, resonate with deep held cultural perspectives and understandings in native Hawaiian communities. Through an interdisciplinary and community-engaged research design, we explore how the way CIA's are currently conducted can be amended to more effectively capture diverse perspectives about relationships to the land, and rightfully incorporate the role of native Hawaiian intangible cultural values. This study critically analyzes the politics of environmental knowledge production in an indigenous context and considers the role of alternative approaches to the study of human-environment relations in land use policy decision-making processes.

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Queensland Longhorn Beetle (*Acalolepta aesthetica*) in Hawai‘i: Invasion Status and Key Unknowns

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The Queensland Longhorn Beetle (*Acalolepta aesthetica*) is an invasive insect established on Hawai‘i Island. The species has not been documented as invasive elsewhere or problematic within its native range, but members of its family are major pests whose larvae bore into wood and can cause extensive damage to trees. An adult Queensland Longhorn Beetle was first reported from the Puna District in 2009, and observations suggest that the invasion may be ending its lag phase. Data are suggestive of increasing abundance, spread, and impacts, but our understanding of the beetle's ecology and distribution is extremely limited. The species poses challenges for both detection and control, with the most prominent sign of an infestation being sap and frass extruding from the host tree, potentially followed by host dieback. The species has a wide host breadth, and host trees include culturally important kukui (*Aleurites moluccanus*) and ‘ulu (*Artocarpus altilis*) as well as economically important species including cacao (*Theobroma cacao*), citrus (*Citrus* spp.), and avocado (*Persea americana*). Prominent among the unknowns is whether native tree species will be susceptible to this emerging invader. An increasing awareness of this invasion among conservation practitioners can help document new populations and hosts and characterize impacts to socio-ecological systems.

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Habitat Suitability Modeling and Conflict Analysis of Game Mammals and Native Plants on the Hawaiian Island of Lānaʻi

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Introduced ungulates cause agricultural damage and degradation of native biodiversity throughout Hawaiian ecosystems. The ability to effectively manage game species for specific conservation objectives is often limited by the scientific understanding of their distribution and abundance. This is especially true in Hawaiʻi where introduced game mammals are poorly studied and have low value relative to native species in other states. The Hawaiʻi Interagency Biosecurity Plan has identified ungulate control as the single most expensive invasive species problem in the state largely because of costly barriers necessary to separate areas managed for sustained-yield hunting from those where ungulates have been eradicated. Long-term solutions that are being considered to reduce annual management costs will include land use prioritization modeling with stakeholders to protect native threatened and endangered species from extinction, minimize ingress, and to facilitate both population control and sustained-yield hunting. We modeled the habitat suitability and ecological associations of European mouflon sheep (*Ovis musimon*) and axis deer (*Axis axis*) on the island of Lānaʻi using intensive aerial survey and environmental data that included climate, vegetation, and topographic variables. Both species are habitat generalists showing little affinity to particular plant species or communities. Findings suggest that removal of a substantial portion of the more abundant axis deer population may lead to an increase in abundance and distribution of mouflon without containment. Resulting spatial models of game mammal habitat suitability will be employed to inform land use prioritization analyses and to help resolve long-standing conflicts between native species conservation and sustained-yield hunting.

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Noah’s Ark has an unwanted predator onboard

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Kaua‘i is a ‘Noah’s Ark’ for endangered bird species, hosting most of the world population of koloa maoli (Hawaiian Duck), ‘alae‘ula (Hawaiian Common Gallinules) and ‘A‘o (Newell’s Shearwater). These birds face heavy depredation, due to the presence of outdoor cats on the landscape, particularly those in ‘feeding colonies’ and from trap-neuter-release programs. As carriers of diseases such as *toxoplasmosis*, cats also present a serious health risk, as their feces infects Hawaiian Monk Seals and dolphins, causing miscarriage, birth defects and even death.

As we lose parts of the North West Hawaiian Islands to climate change, Kaua‘i will become more important for migratory birds including mōli (Laysan Albatross) and ua‘u kani (Wedgetailed Shearwater). These birds are important in the story of Hawai‘i and play a pivotal ecosystem role. They provide critical connections between land and sea in story and daily life. It is imperative to protect them from depredation.

Cat control has become a highly politicized issue. A grass roots group, Kaua‘i Wildlife Coalition, has been working on a solution. This talk seeks to answer the question, “How do we protect wildlife, human health, and the wellbeing of cats?” and documents the socio-political and cultural work going in Kaua‘i to that end (successes and failures). It will address current county, state and Humane Society policies and look at what changes are needed to protect native wildlife. The process of obtaining support from decision makers, private landowners and local people will also be explained. The conclusions are relevant across the Hawaiian Islands.

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Productivity and Carrying Capacity (PACC) of Hawai‘i’s Intertidal Fishery to Support ‘Āina Momona

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Over the past decade of intertidal monitoring, our research team has identified critical gaps in research to develop adaptive management strategies for Hawaii’s unique wave-dominated, rocky intertidal shoreline. From recent findings, we draw new hypotheses that focus on the effects of seasonal changes on patterns of reproduction, recruitment and productivity in rocky intertidal communities. The goal of our project is to develop a sustainable fishing model for ‘opihi (*Cellana* spp.) based on the environmental carrying capacity across Hawai‘i. PACC implements a mix of standardized and novel methodologies across shoreline types (boulder, bench, and sloped rocky substratum) across windward and leeward shores in different seasons throughout the year to: 1) examine the effect of swell exposure on habitat size; 2) develop a practical method for determining ‘opihi growth rates and age; and 3) measure species reproductive output in relation to major environmental drivers such as temperature. We expect that habitat size grows and shrinks according to seasonal swell patterns. Varying shoreline types sustain different population structure and distribution and affect total ‘opihi biomass and reproductive output. Reproduction is correlated with size, however, growth rate and age-at-length will differ by habitat and season. PACC aims to identify optimal habitat for a productive intertidal fishery and re-establish productive ecosystems as a fundamental strategy of traditional Hawaiian resource management. The outcomes include creating spatial and temporal management strategies/tools and supporting stakeholder decision-making towards ‘āina momona, abundant and productive communities of people and place.

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Fostering Real-Time Climate Adaptation: Analyzing Past, Current, and Forecast Temperature to Understand the Dynamic Risk to Hawaiian Honeycreepers from Avian Malaria

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Based on environmental tolerances of the sporogonic stages of *Plasmodium relictum* parasite and its vector, *Culex quinquefasciatus*, we examined the long-term weather trends for three high value, forest bird refuges (Alaka‘i Wilderness Preserve on Kaua‘i, Hanawi Forest Reserve on Maui, and Hakalau Forest National Wildlife Refuge on Hawai‘i Island) to understand the temporal and site-specific differences of temperature-driven suitability for localized avian malaria transmission. Our results not only show differences in the suitability for transmission across elevation, but also different levels of vulnerability to avian malaria transmission with any additional projected increase in temperature. We also analyzed temperature trends from 1990 across the landscape to better understand patterns of potential disease transmission beyond site-specific locations. Lastly, by linking current site-specific weather data to real-time weather forecasts, we developed a real-time avian malaria warning system to assist managers in identifying conditions when vector control is most needed at these three selected study sites. This online tool determines when conditions are likely to be suitable for local development of *P. relictum* and *C. quinquefasciatus* at Alaka‘i, Hanawi, and Hakalau. This tool illustrates how managers can incorporate climate and current weather patterns into current decision making without having to consider the uncertainties of long-term climatic and ecological projections.

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Applying an invasion framework to build a tracking system for non-native island floras: a case study of challenges and solutions in Hawai‘i

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Islands are plant invasion hotspots, some having more non-native than native species. Many plants are recent arrivals, leading to concerns that their full spread and impacts are not yet realized. Given that islands host extraordinary numbers of endemic and threatened species, invasion tracking schemes are urgently needed to understand the complex, species-rich but data-poor scenarios typical of islands. We apply Blackburn et al.’s framework (2011) for categorizing invasions to the non-native plant checklist for Hawai‘i and discuss potential uses and complications. Data deficiencies and ambiguities required lumping recommended categories to align with Hawai‘i’s available data; nonetheless, this coarser categorization describes invasion phases relevant to managers and could provide the basis for an effective tracking system. However, the framework does not accommodate uncertain invasion statuses, which prevents clear categorization of species that exist outside of cultivation but are not definitely naturalized. These instances may consist of “casual” species that never form self-sustaining populations, but could also include recently introduced species that have not yet spread. In response to this obstacle, we explore the relationship between scores from “likelihood of spread” components of the Hawai‘i-Pacific Weed Risk Assessment (compared to “likelihood of impacts” components) and analyze its application for predicting naturalization. We conclude that this predictive tool is a promising supplement to on-the-ground monitoring for data-deficient elements of a flora. Finally, we describe how implementing a version of the explored framework may increase response potential for invaders not known elsewhere and could facilitate species prioritization by informing impact and control feasibility assessments.

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The future of Hawai'i's native forests in the face of Rapid ʻŌhiʻa Death: Field plot and landscape-scale analyses.

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An estimated 350 million ʻŌhiʻa (*Metrosideros polymorpha*) trees live in the Hawaiian Islands, with 83% of them found on Hawai'i Island. A tall canopy-dominant with dense wood, ʻŌhiʻa trees account for nearly 17 million metric tons of aboveground forest carbon across Hawai'i. Rapid ʻŌhiʻa Death (ROD), caused by fungal pathogens *Ceratocystis lukuohia* and *C. huliohia*, continues to threaten ʻŌhiʻa forests statewide. Here we report results from our ʻŌhiʻa mortality monitoring network of 250 forest plots. Plots containing one or more trees infected with *C. lukuohia* exhibited annual mortality rates averaging 10%. Mortality rates were variable and dependent on site and stand characteristics (e.g., stand age, lava substrate, ungulate activity, and climate); mortality rates were near zero for some stands and 45% in others. Young, small stature ʻŌhiʻa stands exhibited lower mortality rates than older, larger stands. This was likely due to smaller, younger trees being less prone to wounding or occurring on lava flows with lower incidences of wounding. Mortality rates were relatively high in low elevation areas with high mean annual temperatures, and relatively high in areas with mean annual rainfall values between 2030 and 4060 mm. Further, high densities of invasive plants, such as strawberry guava, currently inhibit natural regeneration of ʻŌhiʻa in many forested areas, particularly those at lower elevations (i.e., < 1000 m asl). Considering the increasing occurrence of *Ceratocystis*-induced mortality, both wound management and invasive plant management are critically needed to protect extant ʻŌhiʻa forests and to promote ʻŌhiʻa reproduction where substantial mortality has occurred.

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Management Thresholds for Coral-Reef Stressors: Evidence Synthesis for Informed Action

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Local management action to address land-based stressors on coral reefs can improve reef health and mitigate the effects of globally increasing sea surface temperatures. Coastal development and runoff lead to sedimentation, which directly impacts coral demography and the ecosystem services that coral reefs provide. Decision making for reef resilience in the face of global and local stressors requires information on thresholds for land-and sea-based management action. In response to needs identified by managers of Hawaiian and Pacific coral reefs, we conducted a systematic literature review and meta-analysis that explored the effects of both deposited and suspended sediment on corals to identify stressor thresholds. We compiled a global dataset that spanned three oceans, over 100 coral species, and a range of field- and lab-based approaches. Across studies, we compared coral responses to sediments of terrigenous versus marine provenance with deposition and turbidity levels ranging from 0 to 1000 mg/cm^2/day and 0 to 5000 mg/L, respectively. Our review of manipulative experiments quantified a diversity of responses by coral larvae, juveniles, and adults, including behavior, physiology, growth, and mortality. We contextualize these results with observational studies that explored the consequences of episodic flooding, upstream development, mining, and dredging. We have recently undertaken additional meta-analyses for common co-stressors on coral reefs, including eutrophication, pollution/contaminants, light attenuation, and freshwater discharge. Results from these analyses will disentangle the additive and synergistic effects of multiple, local stressors on coral reefs, while providing managers with the information necessary to prevent damage to these valuable, yet fragile, marine ecosystems.

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Importance of Local and Indigenous Knowledge for Urban Biocultural Stewardship

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This presentation introduces the context and framework for the symposium **Urban ʻĀina: Restoring Abundance Where We Live.** While Indigenous and local knowledge-practice-belief systems are increasingly appreciated and written about for their contributions to conservation and natural resource management in Indigenous and rural contexts, there has been little acknowledgement of their relevance to multicultural, urban environments, including in Hawaiʻi. Hawaiʻi-based cultural practitioners and scholars are leading an exciting dialogue by demonstrating how ʻōiwi knowledge-practice-belief systems can operate in the built environment. Featuring these applications can help to more fully realize the full potential of kinship-linked, place-based stewardship models in urban settings. Drawing from research and practice in Hawaiʻi, New York, and beyond, this presentation advances the discussion that the Urban ʻĀina symposium sparked last year and it sets the stage for us to begin to unravel the following questions: What does biocultural stewardship and conservation look like in an urban context? Why is it important to consider these strategies? How can we create novel spaces of exchange and co-learning among diverse practitioners including local stewards, Indigenous people, public agency resource managers, educators, artists, and other practitioners? We conclude by articulating a new paradigm to grow conservation capacity, one that is based on high-quality, comprehensive engagement of our urban areas, with the goals of enhancing ecological and cultural value, and ultimately restoring the function of our urban areas to bring about biocultural abundance.

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Valuable Lessons on Productivity and Perspective that Drive Research to Support ‘Āina Momona: A Message from Hawai‘i's Intertidal Shoreline

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Over the past decade, our team has been conducting intertidal monitoring along Hawai‘i’s wave-exposed shorelines to address community concerns on sustainable harvest of ‘opihi (*Cellana* spp). Working alongside numerous schools and organizations, we have learned valuable perspectives on productive shorelines, and how they relate to the larger goal of thriving communities. Through integrating institutional research, traditional knowledge systems, end-user (i.e. fisher) engagement, and outreach/education, our team has developed a unique research approach - made possible through the contributions of these multiple perspectives, considerations, and relationships. This journey has allowed us to create a platform that is inclusive of various knowledge systems to address the needs of our people and our environment. Building on recent research, our understanding of place changes by season and across multiple landscapes. We have developed an approach to look at different habitat types and environmental influences on the carrying capacity of our intertidal fishery. Striving for a productive and sustainable fishery, our latest discussions have led us to identify management strategies that involve bottom-up and top-down initiatives. We believe sharing our journey is valuable, and will encourage a more inclusive conversation to evolve management and conservation to truly support ‘āina momona, abundant and productive communities of people and place.

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Climate-dependent demographic shifts of a threatened endemic Hawaiian plant: current trends and future scenarios for the Haleakalā silversword

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Past work has identified Haleakalā silverswords (ahinahina, *Argyroxiphium sandwicence* subsp. *macrocephalum*) as a clear example of a native Hawaiian species being impacted by ongoing climate shifts. While higher elevation populations at Haleakalā's rim have remained mostly stable, lower elevation populations have reversed a trajectory of management-led recovery and steeply declined in recent years. Compared to most plants in Hawai'i and the broader Pacific, Haleakalā silverswords have an enviable collection of demography plots describing species recruitment, growth, and mortality for over 35 years. In this research we integrated these unparalleled demographic data into comprehensive models to explore the Haleakalā silverswords' past, present and future responses to climate change and variability. In doing so, we offer an unprecedented look at the underlying demography of the species, from basics such as variability of individual longevity across populations, to the complex population-specific demographic responses to changing and variable climatic conditions. We further used our models to project ongoing population trends 20-30 years forward and to tease out the relative importance of climate variability to the long-term persistence of silversword populations on Haleakalā.

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Ka Pilina o nā Hāʻukeʻuke: A Study of the Genetic Connectivity of the Culturally Significant Sea Urchin (*Colobocentrotus atratus*) in Hawaiʻi

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Over-harvesting marine invertebrates is a growing problem in Hawaiʻi. One such invertebrate is the intertidal marine urchin species *Colobocentrotus atratus*, or Hāʻukeʻuke. Hāʻukeʻuke are used in Hawaiian medicines to treat certain skin ailments and are currently harvested for consumption, fish bait, and other commercial uses. In traditional times, management of resources were done within an ahupuaʻa (land division), and therefore, were regulated by the people within each ahupuaʻa. Today, regulations are done by a state entity and most living resources have very generalized regulations (e.g. minimum size requirements). Harvesting for hāʻukeʻuke is not currently regulated. In order to ensure populations of this important living resource are not lost, we must understand the population structure of Hāʻukeʻuke. This study reports the genetic population structure of Hāʻukeʻuke, from four main Hawaiian islands. Based on mitochondrial cytochrome oxidase subunit 1 (mCOI) sequences, genetic differentiation among sampling sites were uniformly low (pairwise F_{st} = 0.01 to 0.08). In contrast, also using mCOI sequences, an Exact Test of Population Differentiation revealed that none of the populations are drawn from the same gene pool, and that the populations are not freely interbreeding. Thus, any massive loss of individuals from a population (such as over-harvesting) would have major impacts for the remaining individuals on that island. Therefore, current regulations and management plans for this organism do not encompass the complexity of the different populations in Hawaiʻi. We recommend these results on Hāʻukeʻuke population structure be used to inform better management practices for this important cultural living resource.

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Managing a Living Metacollection of the Critically Endangered Kauaʻi Hōlei [*Ochrosia kauaiensis* H. St. John (Apocynaceae)].

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Once occupying an expansive endemic range in mesic and wet forests on Kauaʻi*, Ochrosia kauaiensis* H. St. John (Apocynaceae) is currently limited to approximately 150 mature individuals in the wild. In 2018, the taxon was assessed using the International Union for Conservation of Nature Red List criteria as Critically Endangered. Ongoing threats include non-native plant displacement and invasive animal habitat destruction. Seed predation by rats has halted natural regeneration. While research to assess therapeutic alkaloid applications is limited, pre-contact cultural uses of the four Hawaiʻian Hōlei taxa is documented. The *ex situ* Living Collection of *O. kauaiensis* at the National Tropical Botanical Garden (NTBG) is representative of remaining sub-populations in Hanakāpīʻai, Hoʻolulu, Keālia, Limahuli, Pōhakuao and Waiahuakua. Having recalcitrant (unorthodox) seeds, all 88 documented wild seed collections by NTBG since 1988 have been propagated in a metacollection maintained across six institutions and agencies in three states. Four additional institutions and herbaria share specimen and genetic resources. Recently, wild monitoring and collection efforts have increased due to grant funding and inter-agency collaboration. Re-collection and monitoring of over 140 plantouts in *ex situ* collections and *inter situ* restoration areas continue to increase due to Geographic Information Systems improvements and inventory capacity building. Additionally, database improvements have streamlined nursery propagule tracking and access to horticultural care. Future multi-partner conservation strategies are challenged to expand exclosure re-introduction efforts and safeguard wild Kauaʻi Hōlei habitat via invasive species management and predator proof fencing.

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Development and Implementation of the Suspect Rapid ʻŌhiʻa Death Trees Management Tracking System

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A key factor in improving our understanding of Rapid ʻŌhiʻa Death (ROD) behavior is monitoring our efforts to support thriving native forests. A typical workflow for us is to identify ROD-symptomatic ʻōhiʻa (*Metrosideros polymorpha)* trees, visit and sample the ʻōhiʻa to confirm ROD presence, and then follow-up with research and/or management actions. Multiple methods for data collection, storage and sharing are already in place for each part of this workflow. Furthermore, different individuals from different agencies often contribute to a given individual tree's management. With all the discrete parts, keeping this organized and tracked efficiently is a challenge. While communicating about ways to overcome this challenge on the island of Kauaʻi, a comprehensive data system to track ROD activities and support field operations was identified as a key need for operating this workflow. Through effective communication and field testing we successfully developed and implemented a management tracking system using Esri ArcGIS Online and Collector app. Esri is the worldwide leader in geospatial technology, and provide great tools for mapping, navigation and data analysis. This presentation focuses on the details of the tracking system we created, and the benefits of using Esri software to support ROD management.

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A Critical Exploration of Ecosystem Restoration, Feral Pig Management, and Wild Harvest in Hawai‘i

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Managing for ‘āina momona, described as a state of biocultural resource abundance, requires understanding the multiple values, perspectives, and practices associated with our natural and cultural resources. Yet navigating these diverse perspectives in management and stewardship can require trade-offs across social, cultural, and ecological dimensions, as has been the case with feral pig management and wild harvest in Hawai‘i. In many instances, values and perspectives come to light in response to pending or past management actions, yet there are limited opportunities for proactive discussions and exchange to enhance our capacity for effective resource stewardship. Moreover, as decision-makers around the world develop global policies and assessments on the sustainable use and harvest of wild species, these high-level negotiations reveal a pressing need for critical dialogue with local-level resource managers, stewards, and caretakers. In this session, we will create an interactive and respectful setting to discuss diverse values, priorities, and needs surrounding native ecosystem restoration and wild boar harvest in Hawai‘i. Using breakout sessions and interactive polls, we will support participants as they share and exchange perspectives, and reflect on pathways forward for local sustainability. We will also briefly explore available forms of information spanning multiple disciplines and knowledge systems. Ultimately, we hope to support future opportunities to meaningfully acknowledge and incorporate multiple forms of evidence in ecosystem protection, restoration, and wild harvest decision-making.

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Evidence-Based Conservation for Australian Woodland Birds: A Systematic Review

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Many of the woodland bird species of sub-tropical and temperate Australia are declining. Twenty-three functionally important species have experienced severe declines over the past 35 years and 40 species are listed as threatened under national or state legislation. These birds are threatened by multiple threats, including habitat loss, degradation and fragmentation, grazing, agricultural intensification, changing fire regimes, loss of structural complexity of vegetation, and competitive exclusion by hyper-aggressive native birds. Despite this we still do not have an overall picture of which management actions are most effective at improving woodland bird abundance, species richness, and other ecological responses. Using a systematic review, we reviewed over 600 papers, and summarised the scientific evidence from 184 studies on the effectiveness of >20 possible interventions. The actions most frequently studied were remnant habitat retention, replanting, fire management, grazing management, and retaining woody debris. This review will give practitioners and policy makers in Australia and across the Pacific an understanding of which actions would work best to conserve threatened birds. Our review also highlights key knowledge gaps, as we found very few studies on nest box installation, weed control, artificial tree hollow creation or feral predator control – despite all these actions being commonly implemented. Given current investment into revegetation, stewardship programs and other conservation initiatives, there are ample opportunities for this review to help focus and guide the future management and research of threatened birds.

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Teaching Change: Collaborations between scientists and educators enhance place-based education

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Teaching Change is an educational partnership that was launched in 2012 to introduce students to native ecosystems, the threats they face, and what is being done to manage those threats, with the overall goal to inspire the next generation of environmental stewards and leaders in Hawaiʻi. *Teaching Change* relies on strategic partnerships between non-profit organizations, state and federal government land managers and scientists, and K-12 and University educational institutions to provide local students and teachers with educational opportunities in interdisciplinary themes of biocultural resource management. Our programs emphasize human-nature connection (i.e., connection to place) by engaging students in place-based, hands-on education. We focus on how partnerships between scientists and educators lead to the implementation of place-based educational programs designed to improve environmental literacy. Using a new partnership between *Teaching Change* and the National Ecological Observatory Network (NEON) as a model, we discuss how this collaboration is developing a program that connects educators with the conservation community to enhance place-based learning for local youth. Through this partnership, classrooms will be exposed to Puʻu Makaʻala Natural Area Reserve, the cutting-edge technology and field methods being employed there, and large sets of climate data that are collected in this local ecosystem. Educators will learn how to incorporate this real-time, high quality and publicly accessible data utilized by NEON scientists locally and nationally into lesson plans for their students via outdoor, immersive experiences. Finally, we discuss how these experiences help to develop a connection to place for both students and teachers.

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Feasibility of Using Reactive Oxygen Species in Controlling the Invasive Seaweed, *Avrainvillea lacerata*

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Overgrowth by algae continues to be a top concern for coral reef managers worldwide, by putting many biocultural coastal resources at risk. *Avrainvillea lacerata*, or leather mudweed, is particularly aggressive smothering corals and seagrasses. This seaweed has spread to form substantial mounds to cover many acres on the southern and eastern shores on O'ahu. Despite previous experiments, no biological agent successfully controls this seaweed. Efforts in Maunalua Bay have proved successful in removing total biomass via manual removal by volunteers. However, there remains substantial potential for regrowth from the perennating basal holdfast that is embedded in sediment, which is hard to remove fully through manual removal alone. Thus, this project examines the novel application of intracellular reactive oxygen species, administered as hydrogen peroxide (H_2O_2) into the basal attachment of *A. lacerata* in sediment. Treatments of H_2O_2 solutions were used to test the effect of peroxide concentration on photosynthesis, water quality, and benthic community composition. Overall and as an effect of treatment concentration, photosynthesis rates were reduced throughout the seaweed. Dissolved oxygen was elevated at the site of reaction but community composition, including epiphytic and adjacent algae, was unaltered by the H_2O_2 treatments to *A. lacerata*. Training requirements, equipment costs, and volunteer hours will be discussed for overall practicability of implementation.

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Responses of Ambrosia Beetles and *Ceratocystis lukuohia* to to Disease Transmission in ʻŌhiʻa

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Rapid ʻŌhiʻa Death (ROD), fostered by two fatal vascular diseases of ʻōhiʻa (*Metrosideros polymorpha*), is continuing to spread on the islands of Hawaiʻi and Kauaʻi. Our understanding of the diseases has increased greatly over the past few years, but fundamental questions remain unanswered. Frass extruded by wood-boring ambrosia beetles appears to be the primary mechanism by which propagules of disease-causing *Ceratocystis lukuohia* and *C. huliohia* are released from infected trees into the environment. Our objective is to understand interactions among infected ʻōhiʻa, ambrosia beetles, and frass containing *C. lukuohia*, the more virulent of the two species. To address this question, we inoculated healthy ʻōhiʻa with *C. lukuohia* at several locations and tracked the timing, abundance and species composition of beetles attacking infected trees every 1–2 weeks for more than eight months. We also identified the prevalence of viable *C. lukuohia* within frass. Beetle attack rates were quantified by uniquely marking frass-producing galleries discovered during each site visit. Frass produced from a subset of galleries was collected on each date using frass traps secured around gallery entrances. We found that the beetle species attacking trees varied among sites and most attacks were initiated once trees showed symptoms of infection (e.g., yellow or brown leaves). Furthermore, individual galleries produced frass containing viable *Ceratocystis* for at least five months. Results from this ongoing study suggest that ʻōhiʻa infected with *Ceratocystis* remain a threat for at least five months due to prolonged attack by ambrosia beetles and sustained fungal viability within the tree.

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Ten Years of Success from Active Management and Restoration Efforts on Terrestrial Non-Indigenous Species in the Papahānaumokuākea Marine National Monument

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Kure Atoll is the State of Hawai'i's most significant seabird sanctuary providing habitat for 18 seabird species, and numerous protected species. Kure Atoll, is part of the Papahānaumokuākea Marine National Monument and lies 2,200 km northwest of Honolulu and is highly vulnerable to the effects of climate change. The State of Hawai'i is committed to prioritizing management objectives to reduce the potential for habitat loss and improve the island's resiliency. Management priorities include invasive plant eradication, native plant establishment, and reclaiming habitat on the interior of the island. Eradication programs were initiated in 2010 with intent to eliminate the atoll's most destructive species. Native plant propagation and establishment has complemented these efforts by replacing invasive species with soil-stabilizing native plant communities. Seabird colonies have increased significantly since these management actions were established but during the last decade declines have been documented in the black-footed albatross (*Phoebastria nigripes*). Monitoring data indicates that black-footed albatross reproductive success is declining in the preferred nesting habitat along the beachfront where increased storm frequency and intensity have been documented. Management options to provide resiliency for the future of Kure wildlife are ongoing and include improving high-island nesting habitats which once supported thriving seabird and Laysan duck colonies, and have experienced extirpation. It is critical to continue to maintain robust wildlife populations on Kure Atoll until species appropriate habitat can be secured. These long-term goals will take decades to complete, requiring management to act now.

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Resilience and Change: Natural Regeneration of Threatened and Endangered Plants at Kaʿūpūlehu Dryland Forest

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Tropical dry forests are among the most threatened ecosystems globally. In Hawaiʻi, dry forest restoration initiatives have emerged over the past two decades, focusing on removing invasive species, and outplanting thousands of threatened and endangered species. Despite these large efforts, we have little knowledge of whether restored populations will be self-sustaining into the future, including in the context of climate change.

We focus on a biocultural restoration initiative, the Kaʿūpūlehu Dryland Forest on Hawaiʿi Island, where cultural ecology, outreach, and stewardship are deeply integrated. Using a collaborative approach, we draw on nearly two decades of observations combined with six years of demographic monitoring to address: 1) Are threatened and endangered species regenerating naturally? 2) Is this regeneration sufficient to ensure viable populations, now and under increased drought projected with climate change? 3) Which management interventions can most effectively address bottlenecks?

Over 6 years, we documented >1000 naturally regenerated keiki, from 11 species of threatened and endangered species. Recruitment and survival varied across species and were significantly positively correlated with annual rainfall. Stochastic demographic models indicate that restored populations of some species, including maʿo hau hele (*Hibiscus brackenridgei s*ubsp. *brackenridgei*) and kauila (*Colubrina oppositifolia*) are projected to be self-sustaining under current conditions and in the context of increased probability of drought. For species with low recruitment, our models combined with on-the-ground management experience, pinpoint interventions with potential for impact now and under future climate change. Overall, our results provide insight on managing dry forest plant populations in the context of uncertainty.

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Maui Gingervitis: An Increasing Problem

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The Nature Conservancy of Hawaii's Maui terrestrial program works with partners to collaboratively identify, control and map Himalayan Ginger, *Hedychium gardnerianum,* throughout Maui. Control efforts have a significant impact in slowing the spread of this highly invasive plant; however, effort must be greatly increased to keep it out of intact native forest areas. Himalayan ginger has become the greatest invader in our Waikamoi Preserve on East Maui, despite intensive efforts to control this pest across 1,000 acres of the preserve over 30 years, during which 500 of those acres were extensively swept and treated at 5-year intervals. Conservation groups working on ginger are currently resource limited and are approaching their capacities to successfully suppress or contain this weed, thus efforts to find additional tools for Integrated Pest Management (IPM) and to collaborate and leverage results need to be ramped up. A potential obstacle that we'll address is the expiration of the Special Local Needs registration in October 2021 for the herbicide, Escort XP, used in the preferred method of treatment. Questions also remain about how to best control individuals on cliff faces and in areas too sensitive to sweep through with ground crews. Results of herbicide ballistic technology (HBT) field and lab trials will be discussed, including the potential for a new formulation to be registered. Additionally, new technologies are increasing the efficacy of remote sensing and surveying, and we may be able to employ drone technology and aerial surveying soon if resources allow.

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Toxoplasmosis impacts on native birds in Hawai‘i & the Pacific, and the human health effects

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Hawaii has one of the highest numbers of endangered birds per capita in the United States. Losses are attributed mainly to habitat loss and invasive predators. Of these predators, feral cats feature prominently and can have two adverse impacts: predation and pathogen pollution. In the latter case, feral cats are responsible for dissemination of the parasite Toxoplasma gondii through their feces. The infectious stage in the feces (oocysts) is very resistant and can persist for many months in the environment affording ample opportunities for native birds to get exposed. T. gondii was partially responsible for extirpation of Hawaiian crows from their native range and has also killed native geese, coots, ducks, and red footed boobies. The parasite has also killed many colored fruit doves in American Samoa. Finally, T. gondii is a zoonotic disease that could cause fetal malformation in humans. Because cats are not native to Hawaii, and because T. gondii can only exist in the presence of cats, toxoplasmosis is a manageable disease. Keeping cats away from wildlands would go a significant way to helping recover Hawaii’s rare and endangered birds.

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Impacts of Water Releases on Instream Habitat and Biota in Waimea River, Kauai using the High Definition Stream Survey (HDSS) and High Definition Fish Survey (HDFS) Techniques

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Requested by the State of Hawaii, Commission on Water Resource Management (CWRM), the Division of Aquatic Resources (DAR) staff performed High Definition Stream Surveys (HDSS) and High Definition Fish Surveys (HDFS) associated with trial flow releases from the Waiahulu and Koaiʻe diversions on the Waimea River, Kauai. Primary objectives were: 1) documentation of the species within the study reach; 2) documentation of instream habitat at the diverted and restored flow rates; and, 3) estimation of change in suitable habitat for native species in response to increased flow rate. A backpack-mounted HDSS system captured geo-referenced video of 1.6 miles of stream channel habitat conditions at three different flow rates and the HDFS system documented species occurrence. HDSS video output was classified for habitat type (riffle, run, and pool), water depth and ʻoʻopu nōpili habitat suitability. The HDFS video was reviewed for the presence of aquatic animals and their relative abundance. We observed marginal gains in habitat suitability between diverted and partially restored flow conditions and a more rapid gain between partially restored and fully restored flow conditions. Results showed that a stream flow of approximately 6.5 mgd or greater was necessary to achieve improved habitat for ʻo'opu nōpili. These instream habitat benefits would likely continue through downstream reaches and possibly within the stream mouth estuary as well. The HDSS and HDSFS approaches provided better documentation of instream flow changes, and were completed more quickly, with lower man-power and for a lower cost than our traditional transect-based approach.

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‘Ano‘ano Momona: Five Years of Seed Banking for the Future of ‘Ōhi‘a

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With Rapid ‘Ōhi‘a Death (ROD) threatening our native forests, a proactive step we can take is to collect seeds from wild ‘ōhi‘a trees and store them in seed banks for future restoration. Hawai‘i Seed Bank Partnership (HSBP) research shows that ‘ōhi‘a seeds stored under seed bank protocols can remain viable for at least 18 years. These banked seeds are used for current or future reforestation efforts, and for research into potential resistance to ROD. The ROD Seed Banking Initiative is an ongoing project that expands capacity for collection and banking of ‘ōhi‘a seeds across all islands. In 2016, the HSBP developed a statewide seed collection strategy for ‘ōhi‘a. Since then we have been scaling up by training volunteers how to collect and handle ‘ōhi‘a seeds, without doing harm to forests, using methods that protect seed viability and ensure conservation value. As of 2020, HSBP facilities have banked collections from well over a thousand ‘ōhi‘a trees, representing 13 different ‘ōhi‘a taxa, from 46 seed zones across 6 main islands. Since 2017, we have held over 35 workshops on 5 islands and trained >600 people how to collect ‘ōhi‘a seeds and submit them to seed banks. Participants have included conservation professionals and interns, cultural practitioners, students and teachers, hikers, and other nature enthusiasts. The ROD Seed Banking Initiative is ongoing in 2020, providing conservationists and scientists with seeds for future restoration and research, while educating and empowering the local community to contribute to citizen science and conservation.

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To Minimise the Risk of Extinction for Threatened Populations Both Genetic and Demographic Factors Must be Considered

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A range of decision-support tools are available to identify management options that minimise the risk of extinction for threatened species. These tools often focus on how to buffer populations against demographic and environmental factors that are important for minimising extinction risk. Despite clear links between genetic factors and extinction risk, genetic factors are often ignored when evaluating alternative management options. An example of this is deciding whether to allocate resources to protect a single large or several small (SLOSS) populations. The SLOSS debate is generally framed in relation to the relative risks to population persistence of environmental versus demographic stochasticity. Protecting one large population can minimises the extinction risk associated with demographic stochasticity. While protecting several small populations can spreads the risk of catastrophe across populations. Our goal was to address how genetic risks could be included when evaluating whether to invest resources into one large or several small populations. Using the design of fenced conservation reserves in Australia, we demonstrate the loss of genetic diversity from populations under two scenarios - one large versus two small reserves. Our results show, that when genetic risks are considered, one large population performs better than several small. However, when environmental factors make it desirable to spread risk across multiple populations, resources need to be allocated to translocate individuals among fenced sites (i.e., metapopulation management). Without considering the loss of genetic diversity, the long-term persistence of fenced populations could be compromised. We show that failing to consider genetic risks to populations could generate solutions that compromise the long-term persistence of fenced populations.

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‘Ano‘ano Momona: How Hawai‘i Seed Bank Research Can Empower Plant Conservation and Ecosystem Restoration

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Seed banking is gaining traction across Hawai‘i and worldwide as a key strategy for conservation, restoration, and climate resilience. It will only become more critical, especially in Hawai‘i with its high biodiversity, endemism, and vulnerability to ecosystem threats. Members of the Hawai‘i Seed Bank Partnership (HSBP) have banked seeds of native Hawaiian plants successfully for 25 years, despite observations that some seeds lost viability in frozen storage. A new study published in 2019 was the first to analyze long term research from three HSBP facilities. We investigated seed storage behavior in the Hawaiian flora to optimize storage conditions and recommend re-collection intervals (RCI) to maximize viability of stored seeds. Using 20+ years of data, we tested freeze-sensitivity for 197 species and calculated RCIs for 295 species. We identified four families (Campanulaceae, Cyperaceae, Rubiaceae, and Urticaceae) and four genera with seed freeze-sensitivity and six additional genera with likely freeze-sensitivity. Storage longevity was variable, but 195 species had not yet reached RCIs at most recent viability tests (ranging from 1 to 20+ yr), 123 species had RCIs >10 yr, and 45 species had RCIs <5 yr – highlighting the importance of monitoring viability over time and using seeds before they expire. Freeze-sensitive storage behavior is more widely observed in Hawai‘i than any other regional flora, and yet 40 freeze-sensitive species maintained viability at 10+ years in refrigerated storage. This research can be immediately applied to practice in Hawai‘i, empowering land and species managers with a powerful decision-making and planning tool for conservation.

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Restoration of Hawaiian Tropical Dry Forests: A Biocultural Approach

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Stemming from the theme of "Ola Ka 'Āina Momona," we present research on biocultural restoration efforts of dry forests in Hawai'i. Dry forests once represented the greatest species diversity among Hawaiian forest types and are within or near the social ecological zones of wao kanaka (human habitation zone). We have lost over 90% of Hawaiian dry forests and despite the growing recognition for biocultural approaches, there has been little evaluation of the social - ecological outcomes of a biocultural approach to restoration. We focus on a collaborative study with two biocultural dry forest restoration projects, Ka'ūpūlehu and Auwahi. We used semi-structured interviews and surveys with volunteers and dry-forest caretakers to address: What are the motivations for implementing biocultural restoration projects?, How are biocultural restoration projects impacting both the kaiaulu (human community) and kaiaola (ecosystem) of dry forests? and, What are successes and challenges of a biocultural approach? Our results revealed some of the deeply rooted motivations for a biocultural approach including: sense of kuleana (responsibilty) from lineal descendants and caretakers that have been hānai-ed (fed/fostered) by place, collaborating with place and people, and enhancing connections between people and place. We also found that many of the aspects of forest restoration that volunteers identified as most important to them, overlap with those defined by caretakers. Our results highlight that conservation and restoration efforts must recognize that the kaiaulu has and should continue to have a relationship with the kaiaola of dry forests.

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Hawai'i Island Reef Fish Diversity And Abundance In Eight Reef Systems Off Of Northwest Hawai'i Island Between 2009-2019

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The worldwide concern for deterioration of coral reefs and associated fish due to human activities has led to increased monitoring of these systems. Climate change in the form of warming sea surface temperatures has increased the frequency of bleaching events. The recovery of the coral and associated fish assemblages is impeded by increasing nearshore use by people and shoreline development resulting in poor water quality on the reefs. Both warming oceans and poor water quality are thought to have been contributing to the declining health of coral reef ecosystems in Hawai'i. Long-term data are critical for understanding trends and supporting effective ecosystem management. To meet this vital information need, the Seattle Aquarium began performing annual SCUBA video surveys of coral reef ecosystem health at eight sites off the west coast of Kona, Hawai'i in 2009. The Seattle Aquarium conservation team monitors reef fish diversity and abundance, coral cover, and coral bleaching annually inside and outside of protected areas or Fish Replenishment Areas (FRA). The main objectives of this project are to (1) document trends in fish and corals over time and between sites, (2) understand the changes in coral health by assessing percent coral cover and bleaching events. Here we report the first analysis of fish population trends over 11 years in 8 sites off of the west coast of Hawaii with significant results between the most common species between sites and years. We will also discuss changes in fish assemblages post coral bleaching event and coral recovery post bleaching.

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Remote Trap Monitoring: So Many Traps, So Little Time

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Invasive predators pose significant risks to entire ecosystems - especially delicate communities of native species on islands. On the Hawaiian island of Lānaʻi, predators such as feral cats and rats threaten rare and endangered species including kāhuli (tree snails; *Partulina variabilis* and *P. semicarinata*), ʻuaʻu (Hawaiian petrels; *Pterodroma sandwichensis*), hala pepe (*Pleomele fernaldii*), and hāhā (*Cyanea lobata*). Therefore, reducing predators across the landscape benefits multiple species. The response to predator control can be dramatic; for instance, in areas with cat and rat control on Lānaʻi, ʻuaʻu reproductive success has increased three-fold over just 3 years. Though effective, trapping across Hawaiʻi's montane landscape requires considerable resources. While Good Nature A24 self-resetting traps provide efficient *rat* control with 2-3 staff visits/year (compared to single-kill snap traps), landscape-level *cat* control using live traps challenges staff capacity. Live trapping traditionally requires frequent monitoring by staff to ensure quick, humane response times to captures of both target predators and bycatch species. New remote sensing tools provide an alternative to in-person field checks. We deployed multi-link mesh network Cuddeback Cuddelink™ camera systems that provide several benefits over telemetry and cellular trail-cameras. A Cuddelink 'home' camera connects up to 15 additional cameras on a single cell plan, allows use across areas with variable cellular coverage, and provides daily visual confirmation of each trap's status. Our cost/benefit analysis comparing the Cuddelink system to daily, manual, in-person monitoring show a savings in reduced staff hours that far exceeds the cost of setup, use, and maintenance of the camera system.

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He Lala au no ku'u mau kumu, Me He Hoa 'Aina La (I am a branch of my teachers, as a steward)

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I am a lala, branch, of my teachers. I follow in an uninterrupted succession of hoa 'aina, stewards, who care for, are fed by and assume an inherited love of my homelands in the North Kona district of Kekaha-wai'ole. The kumu or teachers, I speak of are two-fold, but bear the same name, Kupuna. The first Kupuna I refer to are my relations, people of my parent and grandparent generation who have taken me by their side to walk the lands of our ancestors and the transfer of knowledge unfolds like pages of chapters in books and maps recorded in their minds are spoken, their voices resound in my ears and I recognize these people, kupuna, as one of my greatest teachers. The land itself, the trees, the rocks, the meandering lava rivers, familiar winds, the oceans, and nutrient rich waters, attributes of my homeland are the second kupuna I acknowledge as my teachers. Many kumu, sources of knowledge, to learn from, I must be the learner I am intended to be. Ancestors voices now carried on wisps of wind or the seemingly barren 'lavascapes,' I listen. These sources I speak of reveal answers I seek, direction I request and actions I carry out in the workings of malama 'aina in ancestral spaces and places. I look to these kumu, trees, these sources as I, in the present, ground my roots, outstretch my branches and grow my trunk as one day I will become the tree my branches speak of.

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Ungulate-Free Status-3 years and Counting at the U.S. Army Garrison, Pōhakuloa Training Area

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Non-native ungulates (sheep, goats, and pigs) are a serious threat to native species and ecosystems in Hawaii. At Pōhakuloa Training Area on Hawaii Island dryland habitats support 26 threatened and endangered species, some exceedingly rare and most of which are negatively affected by non-native ungulates. There are 15 ungulate exclusion fence units at PTA totaling 138 km in length and they protect 15,092 ha of native habitat. Fencing is a conservation measure to protect this species at a landscape level and is a requirement of the 2003 and 2008 Biological Opinion issued to U.S. Army Garrison, Pōhakuloa Training Area (USAG- P). Since 2017, all 15 fence units have been ungulate-free. To maintain the ungulate-free status of the fence units USAG-P staff developed an ungulate-free management action plan to include: 1) incidental sighting reporting, 2) camera surveillance monitoring, 3) fence line inspections, 4) Judas animal monitoring (telemetry tracking collar), and 5) aerial surveys. If any of these 5 actions provide evidence of an ungulate ingress, then removal operations are implemented. Ungulate removal operations include 1) live trapping, 2) ungulate drives, and 3) professional shooting. Since 2017, there has been 5 ingress events and 16 ungulates were detected and removed.

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Weaving Mātauranga Māori and Western science to characterize adaptive variation in a critically endangered freshwater fish

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Conservation translocations have become an invaluable conservation management strategy for many threatened species in Aotearoa New Zealand and beyond. Kōwaro (Canterbury mudfish; Neochanna burrowsius) is a critically endangered freshwater fish with a highly fragmented distribution across the Canterbury region. Conservation translocations have been attempted to enhance species recovery, but - to date - there has been little regard for the potential disruption of locally adapted populations. There is a growing interest in using a conservation genomic approach to characterize adaptive variation to identify appropriate source populations for translocation. However, characterizing adaptive variation in under-studied freshwater species is challenging, in part because relevant ecological data - collected using Western science approaches - are often lacking. However, other knowledge systems may provide even more holistic ecological data. Indeed, kōwaro are a taonga (treasure) to Ngāi Tahu (local Māori tribe), and the tribe holds extensive records from the 19th century containing mātauranga (including traditional ecological knowledge) that has been passed down from tūpuna (ancestors). Here, we weave this mātauranga into a genotype–environment association study that includes present day ecological data and whole genome resequences for kōwaro populations across their contemporary range. In addition to informing the conservation management of a threatened freshwater taonga, our research contributes to the growing number of studies that demonstrate the power of using a two-eyed seeing approach in conservation.

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Near-daily reconstruction of tropical rocky intertidal sea-surface temperature from 'opihi (*Cellana sandwicensis*) shells to infer their life-history

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Measurements of life-history traits can reflect an organism's response to environmental conditions. In wave-dominated rocky intertidal ecosystems, studying grazing benthic invertebrates are often constrained by hazardous working conditions. Recent research demonstrates mollusc shells to be high-resolution, oceanographic climate proxies for sea-surface temperature (SST), as well as archival records of growth. However, prior to this study, no molluscan climate proxy has been calibrated for the tropical rocky intertidal environment – a zone influenced by fluctuating SST, mixed tides, trade-wind patterns, and heavy surf. We report the first near-daily, spatio-temporal climate proxy for SST in the tropical rocky intertidal environment by coupling secondary ion mass spectrometry (SIMS) analysis of oxygen isotopes with the sclerochronology of 'opihi (*Cellana sandwicensis*), a native limpet with significant commercial and bio-cultural value. We also develop a method for reliable interpretation of seasonal growth patterns using physical growth features, and, based on the number of oxygen isotope cycles in the shell record, estimate longevity of this species to be 5 years. This study provides a robust approach to explore both rocky intertidal climate and life-history traits for the conservation of 'opihi.

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Forest Stewardship Program and Conservation Capacity

Building Opportunities in the Marshall Islands

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The Republic of the Marshall Islands (RMI) is a collection of 29 low-lying coral atolls comprising 1,156 islands and islets located four hours by air south west of Hawaii in the Pacific Ocean. Despite its attractive scenery, RMI faces many challenges especially when it comes to food security. Recent data revealed 91% dependency on imported foods. Efforts to increase agricultural production are frustrated by strong winds, salt spray, inundation, prolonged drought and other climate related issues. In addition, the soil condition is generally sandy and poor in quality. The Forest Stewardship Program has been established to advocate forest conservation and diversity and to propagate and distribute traditional and exotic fruit bearing trees in five urban atolls. Since 2015, the Program has shown positive results including four nursery facilities, 12 school garden and demonstration sites, planted and distributed more than 1500 fruits trees and trained more than 500 young people and 30 land owners on tree planting, soil management and forest conservation. To build future capacity the Forest Stewardship Program in partnership with the Ministry of Natural Resources & Commerce and the College of the Marshall Islands have trained 15 student interns in 300-hour practicum and research tracks in food production, forest management and conservation techniques.

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Status and trends of Honu, or green sea turtles (Chelonia mydas), in the Papahānaumokuākea Marine National Monument

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Residing in the most geographically isolated island chain on the planet, the Hawaiian green sea turtle population was recently designated as a Distinct Population Segment (DPS) under the U.S. Endangered Species Act. One of 11 global DPSs, the Central North Pacific population is a "closed" population, with almost no movement of individuals into or out of the region. For 45 years, the population's primary nesting habitat on the islets of Kānemilohaʻi or French Frigate Shoals in the Papahānaumokuākea Marine National Monument has been monitored by NOAA Fisheries' Marine Turtle Biology and Assessment Program. This long-term tagging study has produced a wealth of information about the status and trends of Hawaiʻi's nesting females. For example, the data indicate that approximately 96% of the population nests at French Frigate Shoals, with >50% occurring on the islet called East Island ("East"), and a 3.2% annual increase in nesting female abundance on East over several decades. There remains, however, limited data to assess this population's resilience to the potential effects of climate change. Currently, our research foci are (1) determining where mating and nesting will occur following the erosion of East Island following the impact of Hurricane Walaka at the end of 2018, (2) hatching success, (3) incubation temperature (for hatchling sex-ratio), (4) genetic sampling (for operational and breeding sex-ratios), and (5) satellite telemetry with fine scale habitat use sensors (for internesting behavior and foraging connectivity). Results from these projects serve as the foundation for understanding the population's resilience to climate change.

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Recent Projects Show the Utility of Molecular Data and Community Science in Understanding Hawaiian Macrofungal Diversity

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Mushrooms are an important yet understudied component of Hawaiian biological diversity comprising endemic species, recently established alien species, popular edibles, deadly poisonous mushrooms, and species that have broader ecological impacts such as facilitating native plant growth or non-native plant invasions. Despite the usefulness of molecular data to identify mushrooms, fewer than 50 Hawaiian macrofungal species had any molecular data available in online DNA repositories prior to 2018. In four recent projects, we collected mushrooms and generated new DNA sequences in order to shed light on their identity and origin. Using both traditional academic research and community science initiatives, combined, we generated approximately 170 new DNA sequences for 140 unique species throughout the Hawaiian Islands. Approximately 50 community scientists participated in this work, enabling us to cover larger areas over longer periods of time and engage interested community members. We found that several species attributed to known taxa are likely misidentified, many Hawaiian taxa have no representative sequences in DNA repositories, and several additional deadly poisonous fungi occur in the islands than previously known. We also identified at least five species that were previously unknown to science. Overall, our work illustrates the need for a better understanding of macrofungal taxonomy for the purposes of conservation and understanding the biological diversity found in the Hawaiian Islands, and argues for the incorporation of community science and molecular data as a model to build capacity towards this goal.

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Student Scientists Provide Evidence of Successful Community-led Restoration of Hawaiian Bay

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Maunalua Bay, HI has been adversely impacted by industrialization and the introduction of the invasive algae species Avrainvillea amadelpha (AA). In hopes of restoring Maunalua's health, the community group Mālama Maunalua (MM) was formed, with the primary focus of removing the AA invasive algae. In 2009, a $3.4 million grant was given to MM via the American Recovery and Reinvestment Act (ARRA) supporting the 'Great Huki' in which 75 full-time workers were hired to remove over 3 million lbs. of algae. To maintain the progress ignited by the ARRA funding, a volunteer program was established. Students from Kapi`olani Community College (KCC) have participated in the program through their classroom, collecting quantitative data on the removal effort. Our work analyzed ten years of data, collected by twenty classes of KCC students, for patterns and long-term trends in algae composition. Results show a dramatic reduction of the invasive AA in the bay, with coverage decreasing from 85 to 23 percent within the ten years, while native populations increased by 25 percent. Findings show that the effort to reduce the invasive species has been an overwhelming success. The legacy of the ARRA grant has been sustained by the community and has led to a complete transformation of the bay. The improvements within the bay exemplify a new approach to ecological restoration, one in which it is understood that there are no quick fixes and consistent, prolonged community-based efforts must become the new standard.

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What is That Thing? Quantifying Behavioral Responses of Nēnē to a Novel Non-lethal Hazing Method

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Conflict situations between humans and wildlife are difficult to mediate, especially when state and federal Threatened and Endangered (T&E) species are involved. Finding solutions that resolve the conflict while simultaneously conserving or even benefitting the wildlife is an important challenge. Nēnē or Hawaiian geese (*Branta sandvicensis*) inhabiting and nesting at the Hōkūala Resort pose a serious risk to safe aircraft operations at Līhu'e Airport on the island of Kaua'i. Due to the unique nature of the human environment, as well as the presence of 5 other federal T&E species, a novel non-lethal hazing program was developed and employed at the Hōkūala Resort beginning in late June of 2019. A key component of this program is the use of border collies. As nēnē did not evolve with mammalian predators, hazing with dogs is a truly novel stimulus. Concurrent with the hazing actions, we are collecting detailed information on the behavioral responses of the nēnē, including alert distance and flight initiation distance. Preliminary findings suggest nēnē become hypersensitized to the hazing activities, increasing the efficacy of the method. We found no evidence of negative impacts on the other federal T&E species present at the Hōkūala Resort. Early indications from this effort suggest non-lethal hazing using border collies might be a valuable tool for use in managing other state and federal T&E species involved in conflict situations.

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Ancient Birds and Modern Technology: Tracking Nēnē Throughout Their Annual Cycle

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The cultural significance of native Hawaiian avifauna, in historical times through the modern era, cannot be understated. Concurrent with changes in human society, the landscape has undergone substantial changes through time, especially within island ecosystems. Today, some native Hawaiian birds have adapted to habitats that are heavily influenced by humans (e.g., urban areas). The nēnē or Hawaiian goose (*Branta sandvicensis*), the state bird of Hawai'i, is an excellent example. However, for wildlife professionals to effectively manage for sustainable or even increasing populations of nēnē, information regarding the movement patterns and habitat use of these birds throughout their annual cycle is needed. As part of a larger effort, we live-captured 10 adult male nēnē and fitted them with cutting-edge GPS-capable telemetry units in June of 2019 near Līhu'e on the island of Kaua'i. We documented the survival, seasonal movement patterns, and habitat use of these nēnē for a one-year period (through one annual cycle). Our preliminary findings confirmed that collisions with vehicles is an important source of mortality for nēnē. During the breeding season, selected nesting sites within urban and suburban habitats that are highly influenced by human activities. During the flocking season (non-breeding period), 9 of 10 nēnē moved to an agricultural landscape away from human settlements. The information learned from this study will be valuable to wildlife managers when identifying habitats and specific areas important to nēnē conservation.

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Kaua‘i Rapid ‘Ōhi‘a Death: Facing the Unique Challenges of Preventing the Spread of ROD on Kaua‘i

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Symposium: Education and Management for Rapid ‘Ōhi‘a Death

Tracking number: HCC2020-414

Both strains of Rapid ‘Ōhi‘a Death (ROD), C*eratocystis lukuohia* and C*eratocystis huliohia*, were discovered on the eastern side of Kaua‘i in 2018. During the first year after the discovery of ROD, Kaua‘i DOFAW and Kaua‘i Invasive Species Committee (KISC) focused on 1) outreach efforts; and 2) determining the disease distribution range through aerial surveys and on-the-ground sampling of suspect trees. During this initial phase, efforts were made to build capacity including hiring and training staff. Since 2018, education with thousands of residents has been conducted; and the current range has been determined to include low land wet valleys on much of the eastern side of the island, as well as pockets on the south and north sides of the island. This presentation will discuss ROD’s current status and management, highlighting the challenges and discoveries that are unique to Kaua‘i. As we enter phase two, our management focus is felling trees, especially near the periphery of the current known distribution range and in the areas closest to Kaua‘i’s most pristine native forest. We are also working with various interdisciplinary, mostly Hawai’i Island based, scientists to determine the most effective modes of management and to grow the understanding of both strains of ROD. This includes developing an efficient data management system, and collecting drone and aerial imagery for long-term measuring and monitoring of the disease. Future management will be shaped according to new findings through working with these scientists.

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How to slow a snail: quantitative evaluation of rosy wolfsnail (*Euglandina rosea*) barriers

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Euglandina rosea was introduced to Hawai'i in 1955 to control agricultural mollusk pests. A generalist predator, *E. rosea* proved adept at finding prey in native forests, where it contributed to the decline and endangerment of endemic snail species. *Achatinella mustelina* is an endemic, endangered species of tree snail found only in the Wai'anae Mountains of western O'ahu. Our program (Army Natural Resource Program on O'ahu) maintains five predator-proof enclosures on O'ahu to protect *A. mustelina* from threats, including *E. rosea*. An electric barrier and two physical barriers (an angle and a copper cut-wire mesh) are employed to prevent *E. rosea* incursion. Unfortunately, the discovery of *E. rosea* crossing the angle and the observations that a snail placed directly on the copper cut-wire mesh could cross, has led us to reevaluate the experiments that led us to adopt these methods. Additionally, *E. rosea* has been found several years after construction inside two of the five enclosures with all three barriers in place. Here we describe our development of a repeatable method for testing the efficacy of snail barriers relative to a meaningful control. We carried out this work to better evaluate the ability of current barriers to exclude *E. rosea* as well as to test new prototypes. Given the importance of enclosures to the survival of *A. mustelina*, the enormous cost they require to build and maintain, as well as our plans to build more, it is wise to make certain they really *are* predator proof.

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Hawaiian monk seal population update: signs of a fragile recovery

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Total range-wide abundance of Hawaiian monk seals is about 1400 seals. Although the current population estimate is similar to last year's, the overall trend remains positive, with numbers growing 2% per year since 2013. Most seals (about 1100) reside within Papahānaumokuākea where vital rates are conducive to population growth at all subpopulation sites except Pearl and Hermes Reef (PHR). However, some trends are concerning. Juvenile survival is critical to monk seal recovery, and all sites except Lisianski I. have shown recent declines in this metric. French Frigate Shoals (FFS) has seen major changes with the loss of two important pupping islets in 2018; one inundated by tides and the other washed away by Hurricane Walaka. In 2019, these islets reappeared as small unstable sandbars. Loss of safe pupping habitat makes young pups vulnerable to shark predation and drowning, and nursing pup survival declined dramatically at FFS. Conversely, post-weaning survival of pups at FFS has increased in recent years. After subpopulations at Laysan Island, PHR, Midway and Kure Atolls experienced several years of high juvenile survival, leading to varying degrees of population growth, these subpopulations started experiencing poorer survival 2–5 years ago. Multiple interventions are conducted each year to increase survival, including disentangling seals caught in marine debris, rescuing seals entrapped in crumbling infrastructure, and translocating pups from areas of high shark predation to safer areas. These and other program activities designed to identify and mitigate threats continue to contribute significantly to recovery at both the individual seal and population levels.

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Subterranean Biodiversity and Food Web Complexity on the Island of Hawai’i

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The subterranean biodiversity and food web complexity in lava tubes on the Island of Hawai’i have been surveyed over the past five years, with specific focus on lava tubes on the south-western side of Mauna Loa in 750-1500 year-old flows. Arthropod community assemblages were predominately associated with roots that penetrate the passages, and we documented numerous undescribed species. We used stable isotope ratio analyses to assess ecosystem dependency on roots as nutrient sources, particularly in the context of food web structure and niche specialization, and verified root identity using molecular barcoding. The roots, confirmed to be from the native ‘Ohi'a lehua tree (*Metrosideros polymorpha*), had ∂^{-13}C compositions ranging from ca. -24‰ to -29‰, depending on elevation. The carbon isotope compositions of arthropods were comparable to the roots, as expected if roots serve as the primary nutrient source. ∂^{-15}N compositions of arthropods were generally enriched relative to roots, suggesting the presence of at least five trophic levels. Cave-adapted planthoppers that feed directly on ‘Ohi'a, however, were slightly depleted in ∂^{-15}N relative to roots, likely due to bacterial endosymbiont contributions to host nitrogen because sap is a poor nitrogen source. Although the colonization history of Hawaiian lava tubes is not well understood, the arthropod diversity within these relatively isolated ecosystems are clearly linked to the age and health of the Ohi'a forests on the surface. More efforts to conserve subterranean habitats are needed to protect ‘Ohi'a roots, which will increase the health of surface forests as well as protect these unique ecosystems.

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Advancing Locally and Culturally Attuned Monitoring and Reporting

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Advancing conservation and natural resource management for abundant biocultural diversity ultimately relies on local actions, even when sustainability frameworks are designed at global (e.g., UN Sustainable Development Goals), regional (e.g., Framework for Resilient Development in the Pacific), and sub-national scales (e.g, the Aloha+ Challenge State of Hawaiʻi 30x30 Commitments). Identifying and evaluating locally and culturally attuned goals and priorities is a promising pathway to support meaningful local actions and to effectively plan, manage, and monitor for future sustainability across generational timescales. In this interactive workshop, we will share a set of outreach materials that provide tools and techniques to enhance monitoring and reporting efforts through the use of locally and culturally attuned metrics and indicators. We will guide participants through a series of criteria to assess monitoring and reporting metrics, including a set of prompts to evaluate the applicability of existing indicators to local and cultural contexts, and steps to modify or create new indicators as necessary. We will also highlight ways that these tools and resources have been useful to inform sustainability planning and policy across local to global decision-making scales. Ultimately this workshop is expected to enhance monitoring and reporting efforts by focusing on ways to create and adapt indicators when developing versatile, long-term plans for sustainability. The workshop will provide information useful to advance cultural values, practice, and capacity in conservation and is especially relevant for individuals engaged in sustainability strategic planning and reporting in the Pacific.

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Mauka to Makai: Investigating the Viability of Using Green Infrastructure to Reduce Polluted Storm Water Runoff into Maunalua Bay

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Rapid and ongoing urbanization has severely altered the natural hydrology of watersheds, leading to increased overland flow and pollutant loading into riparian and coastal ecosystems. This is exacerbated in areas such as the Hawaiian Islands which have naturally short and steep drainage basins and are subject to flashy torrential rains. Our region of interest is Maunalua Bay (the Bay), located on the southeastern coast of the Island of O‘ahu. The watersheds surrounding Maunalua Bay have undergone extensive development since the 1950's, and approximately 50% of land-use in the region is now urban. These impervious surfaces have increased the volume of storm water runoff that transports high loads of harmful pollutants and fine sediment material directly into the Bay's waters, impairing water quality. Negative impacts to this degradation include reductions in marine biodiversity, fisheries production, and recreational activities; most notably the shift in reef community structure from coral dominated to one dominated by invasive algae. To address this, Mālama Maunalua and the Bren School of Environmental Science & Management (Bren) partnered to explore the viability of using green infrastructure to reduce peak flow volumes of land-based pollution entering the Bay. We employed the Environmental Protection Agency's Storm Water Management Model 5.1 (SWMM) to model the hydrology of the Maunalua Bay Region and simulate a baseline of polluted storm water runoff. To identify suitable areas for green infrastructure placement, we utilized the GreenPlan-IT toolkit developed by the San Francisco Estuary Institute. The simulated baseline runoff and sediment pollutant loading results facilitate identification of priority areas for watershed managers to target restoration efforts. We then investigate reducing storm water loading through implementation of green infrastructure in target areas. Our preliminary results show areas of high runoff ratios relative to surrounding areas within the watershed. Further analysis will include sediment pollutant loading, mitigation via green infrastructure, and cost considerations for implementation. In addition to increasing the understanding of how to manage polluted storm water runoff in the Maunalua Bay Region and other Hawaiian communities, this project can help to inform other island nations whose natural resources are increasingly threatened by storm water runoff associated with urbanization.

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The Impact of Gaps and Biases on New Uses of The IUCN Red List

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The International Union for Conservation of Nature's Red List of Threatened Species (The IUCN Red List) has become the world's most comprehensive information source on the global conservation status of animal, fungi, and plant species. Countries, governmental agencies, and conservation organizations around the world are increasingly relying on the published IUCN Red List assessments to develop conservation policies and priorities. Additionally, a plethora of new uses of the IUCN Red List are emerging from funding agencies including IUCN Red List assessments as one their evaluation criteria, to research using meta-analysis of Red List data to address fundamental and applied questions in conservation science. However, the last update of the IUCN Red List included assessments of 112,400 species representing only a fraction of the world's biodiversity today. Furthermore, the included assessments are significantly biased in regional and organismal cover. Terrestrial systems and in particular forest ecosystems are better covered than other environments, and there is also a strong bias towards animals, rather than plants or fungi. For example, the about 38,600 plant species currently assessed represent only about 10% of the worlds known plants. These extensive gaps and biases may significantly impact both conservation priorities, funding, and the new uses of the data for understanding global patterns. Focusing on the example of the Flora of Hawai'i, this presentation will review the gaps and biases and new uses and discuss the limitations and challenges as well as explore the importance of filling gaps and addressing biases through the continuous strive to extend the species coverage of the IUCN Red List.

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Changes in Mosquito Distribution and Avian Malaria Prevalence in Kīpahulu Valley, Haleakalā National Park

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Recent declines in native forest bird abundance in East Maui suggest avian malaria is encroaching on remaining critical bird habitat.To determine if disease transmission has increased, we re-surveyed sites in Kīpahulu Valley to compare mosquito distribution and malaria prevalence with an earlier study conducted in 2002. Sites were located along an altitudinal gradient ranging from 760 m to 1950 m above sea level (asl) and similar field methods and lab analyses were conducted for both studies. In 564 trap-nights we collected 115 *Culex quinquefasciatus*, the vector of avian malaria, from six of the seven sites ranging from 760 m 1430 m asl. We did not capture adult mosquitoes at our highest site located at 1,950 m. Malaria parasites were detected in *Culex quinquefasciatus* from four of the six sites where mosquitoes were collected. For sites where malaria was detected, infection rates in dissected mosquitoes ranged from 7 % at 915 m asl to 50 % at 1430 m asl. These results differed greatly from the 2002 study, when no mosquitoes were detected above 915 m asl and the prevalence of avian malaria below 900 m was 3-4%. While larval mosquitoes were detected in streams below 900 m during the 2002 surveys, high water events limited larval surveys in 2019 and no larval *Culex quinquefasciatus* were detected. These preliminary findings provide strong support for the idea that malaria transmission has increased in both altitudinal range and intensity and is likely playing a key role in recent forest bird declines.

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Can you have your cake and eat it too? Using non-native ungulates to protect threatened native ecosystems and provide a perpetual, sustainable hunting program

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Tropical dryland forests are the most threatened ecoregion in Hawaii. At Puʻu Waʻawaʻa and Puʻu Anahulu, anthropogenic use for agricultural livestock production across 150 years irreversibly changed the vegetative composition of the area. Conversion of the native forest to a pasture grass dominated system was the catalyst that substantially altered the natural fire cycle. Today, 73% (~75,000 acres) of the area is non-native grasslands/non-native forest. Wildfire is the greatest threat to the ~16,000 acres of the remnant dry land forest and the 15 species of threatened and endangered plants found therein. Though they continue to be a threat to native forests, grazing ungulates now present the most efficient and cost effective opportunity to protect these systems from the greater risk of catastrophic loss due to fire. The development of a Habitat Conservation Plan in Puʻu Waʻawaʻa and Puʻu Anahulu aims to protect and restore the native forest through an integrative approach to natural resource management. This plan combines fencing and removing ungulates from the highest quality habitat with sustainable public hunting strategies to manage ungulates populations at levels that can effectively reduce fire fuel loads outside of the fences to protect and restore the system on a whole.

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Exploring the environmental factors influencing Toxoplasma gondii infections in Hawaiian monk seals

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Toxoplasmosis is a top threat to Hawaiian monk seals (*Neomonachus shauinslandi*) in the main Hawaiian Islands where seal habitat overlaps with substantial human and cat populations. As the only host in which the parasite *Toxoplasma gondii* can complete its life cycle, cats are the sole source contaminating the environment with infectious oocysts which can then runoff into the marine environment, threatening marine mammals. To better understand the dynamics of *T. gonii* infection in Hawaiian monk seals, we examined monk seal toxoplasma cases in relationship to cat distribution, rainfall patterns, and hydrology on the island of Oahu. We estimated the distribution of outdoor cats based on previously conducted public cat ownership surveys, and documented feral cat colonies. Using a nutrient delivery hydrology model (InVESTR NDR), we mapped the expected intensity of oocyst runoff for each of Oahu's watersheds. There was only weak correlation between estimated cat density and toxoplasma cases in monk seals, with several cases occurring adjacent to watersheds with lower cat density. Using a case-control study design, we compared the odds that toxoplasmosis cases versus non-diseased strandings (controls) occurred shortly after a large rainfall. We found that toxoplasma cases were 12 times more likely than controls to occur after heavy runoff events. Together these results suggest that even in areas with moderate to low densities of outdoor cats, frequent rainfall delivers sufficient oocysts to infect Hawaiian monk seals. With infectious doses as low as a single oocyst, any contaminated runoff constitutes a serious risk to Hawaii's endangered monk seal.

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South Kohala Coastal Partnership: Managing for Abundance

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The State Division of Aquatic Resources and Coral Reef Working Group identified South Kohala as a priority area for the Hawaiʻi Coral Reef Strategy to implement action to reduce anthropogenic impacts to the reef. The South Kohala Coastal Partnership was established through the guidance and collaboration of community members, associations, organizations, resource managers, state and federal agencies and is guided by the South Kohala Coastal Action Plan (SKCAP). In 2012, partners worked together to develop the SKCAP with ridge-to-reef management strategies for the South Kohala priority area that extends from the northern boundary of the Kawaihae ahupuaʻa to the southern end of ʻAnaehoʻomalu Bay.

The SKCAP is used to help guide conservation work to protect and restore the coastal and marine food resources, coastal wetlands, coral reef ecosystems, native reef herbivores, native reef predators, and community kinship and stewardship. Over 70 participants and experts from over 30 agencies and organizations contributed to the development of the SKCAP. The participants of the planning process identified the following six strategies: community partnerships, community co-managed areas, fisheries management, sediment reduction, invasive species, and additional threat analysis to help reduce impacts to the conservation targets. The participants are part of the South Kohala Coastal Partnership and are committed to helping with the implementation of the South Kohala Conservation Action Plan.

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Botanizing on Lānaʻi: Rare Plants, Weed Eradication, and Biosecurity Updates

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Despite current threats from ungulates, weeds, and climatic factors, and years of unsustainable ranching and agricultural practices, native-plant dominated habitat still persists on Lānaʻi, which is home to 21 federally threatened and endangered (T&E) plant species. These plant species have global significance as some are the last individuals of their species, and others represent significant proportions of the remaining plants in the wild. Thanks to work with partner agencies, surveys on Lānaʻi continue to reveal new T&E plant locations for species such as *Canavalia pubescens* (ʻāwikiwiki), *Abutilon menziesii* (koʻoloaʻula), and *Cyanea gibsonii* (hāhā). Multiple ungulate-proof exclosures provide protection for T&E plants, including a recently constructed 2-acre exclosure that protects a remnant koʻoloaʻula population. Additionally, we plan to build a new exclosure in 2020 to protect a *Bidens micrantha* subsp. *kalealaha* population. Construction of the exclosures, along with active management inside the units via weed control and outplanting, serve to protect extant T&E plant species to increase population numbers and overall abundance of these rare and beautiful species. In addition to rare plant work, several incipient weed species are targeted for eradication on Lānaʻi, with plans to continue to expand the target species list in coming years. Lastly, multi-partner, coordinated biosecurity efforts continue to prevent successful island invasion by coqui frogs, little fire ant, coconut rhinoceros beetle, hala scale, and other pests to keep Lānaʻi a safe place for native species recovery into the future.

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Restor(y)ing Ancestral Abundance in Kalihi Valley

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Kalihi is diverse in land use and culture. On the edge of the residential zone in Kalihi Valley, community-engaged multi-partner stewardship is restoring 100 acres of native upland forest. These state lands are named Hoʻoulu ʻĀina, to grow the land and to grow because of the land. Each year, thousands of volunteers come together around forest, food, knowledge, spirituality, and health co-creating reciprocal healing – ʻO ka hā o ka ʻāina ke ola o ka poʻe, the breath of the land is the life of the people. For indigenous peoples, conservation as connection with the natural world is life. From this essential relationship evolves cosmologies, communal strategies and values like kuleana (privilege/responsibility/right) proven effective in sustaining wholeness generationally. ʻĀina (land) is not "resource" but kin, family, ancestor, self. All life forms, whether a single cell of our body, all beings big or small, ocean, wind or rock, are fractals of the one. Familial connection to land common to all Pacific cultures means caring for the forest as our grandmother. The climate crisis compels us now to tell a different story about conservation, beyond tree planting, the food pyramid, and how new technologies will save us. We must renew the ancient story of wholeness that our ancestors told, to restore the intimate relationship between people and land back into balance and resilience. Presenters will explore the concept of restor(y)ing ancestral abundance, sharing how community members stand in collaborative love, care, and protection for that which feeds us physically and spiritually.

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An integrated approach to long-term wildfire resilience of both people and place

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Wildfire is an issue across Hawai‘i and the Pacific with broad and long lasting consequences, impacting municipal, natural, cultural, and community resources. This is particularly true in the Pu‘uwa‘awa‘a area, where fire risk is high and the resources that need protection are highly valued. This presentation will highlight the historical and recent collaborative efforts taken by residents, natural resource managers, and emergency responders toward wildfire preparedness, prevention, and risk reduction in the area. A combination of methods (e.g., Asset Based Community Development, Nonviolent Communication and Appreciative Inquiry) were used to facilitate and support community-determined (grassroots) and public-private partnership efforts toward wildfire prevention and safety. These methods are resulting in an engaged and proactive citizen group taking the lead on neighborhood efforts in partnership with an adjacent state neighbor (DOFAW) who is currently building a program on state lands that follow their priorities and interests. Supporting and empowering integrated, community-driven efforts through project assistance and certification opportunities leads toward long-term resilience of both people and place along with broader wildfire protection for both residential and wildland areas.

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Efficacy Tests Of Commercial Fungicides Against Rapid ʻŌhiʻa Death In Vitro And By Trunk Injection

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Rapid ʻŌhiʻa Death (ROD) is an emerging disease that is killing large expanses of ʻōhiʻa forests that comprise much of the Hawaiʻi forest ecosystem. As of early 2020, more than 180,000 acres in all districts of Hawaiʻi Island have been affected, with mortality in certain areas ranging from 5 to 95 percent. The disease has recently been detected on Kauaʻi, Mauʻi and Oʻahu. Systemic fungicides are useful in management of laurel wilt disease in avocado orchards and of oak wilt in *Quercus* species in the eastern USA. The potential for their use in managing *Ceratocystis*-caused diseases associated with ROD was investigated. Laboratory and field experiments were conducted to evaluate fungicides and two intravascular injection methods for their ability to inhibit fungal growth and suppress ROD development in ʻōhiʻa, respectively. Radial growth rates of *C. lukuohia* and *C. huliohia* were determined on fungicide-amended 10% V-8 agar in vitro. Effective growth inhibition was achieved with 100 ppm propiconazole and thiabendazole. Macro- and micro-infusion methods were used to inject propiconazole (14.3% a.i.) into healthy ʻōhiʻa one month prior to challenge inoculation with *C. lukuohia* in field sites at two different elevations. Tree canopy evaluations for ROD symptom presence were conducted monthly during the 14 or 26 month-long experiments. Results suggest that environment and ʻōhiʻa variety play an important role in effectiveness of field tree treatments.

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Kāhuli on Lānaʻi Hale, a Brief Introduction to Land Snails on the Island of Lānaʻi and the Efforts to Save Them From Extinction

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Over 750 species of land snails have been described from the Hawaiian Islands, representing one of the most spectacular radiations in the world. Remarkably, 99% of these species are single-island endemics. Unfortunately, due to habitat alteration and introduced predators, it is estimated that half of this diversity has already been lost, and 100 additional species, across islands, may be facing imminent extinction within the decade. Until recently the island of Lānaʻi has been largely overlooked, with only a few surveys focused on the large endangered tree snails in the genus *Partulina*. However, recent rediscoveries of species and populations thought to be extinct have brought to light the potential for land-snail conservation on the island. We will discuss the current and historical distribution of land snails on Lānaʻi, with a focus on conservation actions, and the partnership approach between state, federal, and private entities, being used to protect the remaining species. In particular, Lanaʻi now has two predator-proof enclosures, or pā kāhuli, that have the potential to serve as exciting tools for maximizing protection of the remaining endemic species and safeguarding genetic diversity.

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Exploring Innovative Control Options for the Caribbean Corkscrew Anenome in Kāneʻohe Bay

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Introduced aquatic species can negatively affect native ecosystems and native species abundance in our nearshore habitats. Effectively managing this threat includes rapid response to new reports of non-native species, exploration of control options, and eradication where feasible. In early 2019, the Division of Aquatic Resources' (DAR) Aquatic Invasive Species (AIS) Team rapidly responded to a novel report for Hawaiʻi, the Caribbean Corkscrew Anemone (*Bartholomea annulata*) in Kāneʻohe Bay. The distribution investigation showed *B. annulata* were present throughout 21% of the 0.325 km2 surveyed, extending a minimum planar distance of 3.9 km throughout Kāneʻohe Bay. Different management options were considered for control of the alien anemone. Two new control techniques were pilot tested on *B. annulata* in partnership with the United States Geological Survey (USGS) and the United States Fish and Wildlife Service (USFWS). The first technique involved funneling heated seawater to spot treat the anenomes. The second technique was direct application of a caustic paste comprised of a biodegradable polymer, calcium carbonate and sodium hydroxide. The heat treatment yielded a mortality rate of 33-71%, while the paste treatment yielded a mortality rate of 60-89%. This pilot study assessed the feasibility of these control methods on *B. annulata* in Kāneʻohe Bay and expanded the AIS management toolbox.

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Malama ‘Āina and Capitalism: A Survey of Ecotourism Practices and Preference in Hawai'i

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Ecotourism provides the promise of generating financial stability for conservation, empowering local communities, and creating meaningful experiences for tourists. However, the application of ecotourism often falls short because of innate flaws within its system. The Hawai’ian Islands represent a top ecotourism destination, with the island of O’ahu alone receiving upwards of 10 million visitors a year. While a boon to the local economy, the increased visitation to O’ahu has the potential to degrade natural resources, which could, in turn, threaten the collapse of O’ahu’s ecotourism industry and ecosystems. To better understand the current state of O’ahu’s ecotourism sector, we conducted a comprehensive review of the industry to evaluate opportunities to bring ecotourism in line with the needs of conservation and local communities. We surveyed operators to determine the extent to which they met the requirements for an industry sustainability certification program and their participation in conservation based activities. Additionally, we used a choice experiment survey based on recommendations from conservation professionals to interview tourists and local residents about their preferences for biodiversity, ecotourism related activities, and hotspots. While many of the surveyed operators met the criteria for certification, 40% of operators did not participate in any form of conservation-based activities. Interestingly, the majority of individuals viewed sustainability certification as important. We also discovered an untapped ecotourism market on O'ahu for natural features such as native vegetation. Collectively, our results highlight several means by which ecotourism operators could improve their contribution to managing Hawai’i’s natural resources for abundance.

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Changes in forest structure and nesting behavior of Hawaiʻi ʻelepaio over 25 years

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Long term ecological studies are valuable for detecting changes over time. We compared forest composition and Hawaiʻi ʻelepaio (*Chasiempis sandwichensis*) nest site selection over a 25-year period in Hawaiʻi Volcanoes National Park (HAVO). We found that both forest composition and ʻelepaio nest tree characteristics changed over time, suggesting a response to habitat restoration efforts. In 1993–1994, Sarr et al. (1995) studied Hawaiʻi ʻelepaio nest site selection and forest structure in mesic montane forest recovering from ungulate damage along Mauna Loa Road in HAVO. We returned to the same location in 2016 and used similar methods to compare ʻelepaio nest site selection (tree species, tree and nest height, and DBH). We repeated the same point-center-quarter method to quantify forest composition (tree density, relative abundance, height, and DBH) in 2019. Twice as many nests were found in aʻaliʻi (*Dodonaea viscosa*) as in koa (*Acacia koa*) in both time periods. Our measurements suggested that heights of nests and nest trees were greater for aʻaliʻi and koa in the earlier study, but DBH of non-nest trees trended upward for both species over time. Overall tree density was 0.16 trees/m^2 earlier and 0.26 trees/m^2 later. Koa relative abundance was 0.53 trees/m^2 earlier and 0.45 trees/m^2 later, but aʻaliʻi remained constant over time at 0.47 trees/m^2. The relative abundance of māmane (*Sophora chrysophylla*) was not recorded earlier but was 0.08 trees/m^2 in 2016. Our results suggest that changes in forest structure may affect nesting behavior, but in ways that are not necessarily simple or consistent.

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Monitoring rodent populations before and after installation of Goodnature A24 traps within Upper Manoa Valley, Kauai

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Upper Mānoa Valley (UMV) is a 78.6 ha valley located on the north side of Kaua'i, in the protective subzone of the State Conservation District. Within UMV, a population of federally listed threatened Newell's Shearwaters have been detected with the use of song meters and ground surveys conducted by the Kaua'i Endangered Seabird Recovery Program (KESRP). The survival of this population is dependent on protection from non-native vertebrate predators that are ubiquitous throughout the Hawaiian Islands. Through the use of monitoring game cameras, several of the major predators to native seabirds have been detected within UMV, including feral cats (*Felis catus*) and rats (*Rattus rattus and R. exulans)*. Implementation of predator control activities in UMV is an important conservation measure for increasing breeding success rates and promoting the survival of these native seabird species, both within UMV and nearby seabird habitat.

As part of predator control efforts within UMV, a series of Goodnature A24 rat and mouse traps were deployed in late 2017 to suppress rodent populations. Rodent presence was monitored prior to (2015-2017) and after trap deployment (2017-2019) with game cameras. Results indicate that deployment and maintenance of Goodnature A24 rodent traps significantly decreased rodent presence at the site.

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Hawai`i Island ROD Surveillance, Monitoring and Management Update

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On Hawai`i island, land managers and research partners continue to refine Rapid `Ōhi`a Death (ROD) early detection and rapid response means and methods to locate and suppress new infestations, and track the growth, spread and intensity in known infestation areas. Through adaptive management, this program has identified a suite of best management practices and has been instrumental in developing research questions to better understand ROD. Aerial mapping and tracking activities and methods, current management strategies such as felling, tarping and monitoring, and collaboration on the use of helicopter-mounted camera systems and sUAV (drone) imagery, adding higher efficiency and effectiveness to field search efforts, will be discussed. Lessons learned on Hawai`i island are fully transferable; since the 2018 detection of ROD on Kauaʻi, tools and workflows developed on Hawaiʻi Island have been employed on Kauaʻi to manage infestations and craft outreach and communication campaigns. These lessons can and are being 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 broad inter-agency collaboration with a wide variety of stakeholders across the state.

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White Syndrome: Insights from a decade of coral disease monitoring in Guam

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Predictive modeling of coral disease requires a robust understanding of disease drivers that can be developed through long-term in situ observations of coral disease. We explore the utility of longitudinal datasets for improved forecasting of coral disease. Beginning in 2009, fifteen coral communities at five sites on the island of Guam were monitored approximately quarterly resulting in a decade-long coral health dataset. Using these data we investigate potential drivers of the coral tissue loss disease White Syndrome including colony-scale biology, local ecology, thermal stress, ocean color, and local history of prior bleaching. We find evidence of several factors associated with White Syndrome, including strong evidence that larger-than-average colonies experience greatly increased disease risk regardless of coral species. In addition, we identify multiple associations of the disease with ecological factors at the colony and community scale, and draw attention to a negative association with short-term heat stress. These results are used to produce a predictive model of White Syndrome risk at the colony-scale across multiple species, highlighting the value of long-term monitoring efforts for management of coral disease throughout the Pacific.

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Changes in the Condition of Physical Habitats in Papahanaumokuakea in the Past 10 Years

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Terrestrial and marine physical habitats are dynamic. Natural processes of sediment accretion and erosion as well as calcification and erosion have continued to occur in the Monument, which directly provide the physical properties, rugosity, and the variety of habitats that support a diversity of species. In addition, there is relatively low calcification rates and available calcification minerals to support rapid growth of calcareous organisms in Monument waters. Extreme weather events have also significantly altered the physical habitats of the critically endangered animals which reside here. The complexity of habitat change within the monument is compounded by the former construction and altercation of islets by the US military building barracks and airfields, creating non-natural erosion and accretion rates. As climate change brings on raising sea levels and an increase in sea surface temperature, shoreline change is projected to fluctuate more and be subjected to more frequent storm events reaching these higher, northern latitudes like that of hurricane Walaka. Shoreline erosion, coral reef calcification, and ocean pH levels need to continue to be monitored over the coming years to be able to evaluate the impacts that climate change will have on this critical habitat.

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Long-term studies of ‘ua‘u kani (Wedge-tailed Shearwater, *Ardenna pacifica*) reveal population trends and inform protective management strategies

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Seabirds are excellent indicators of the health of coastal habitats. The ‘ua‘u kani (Wedge-tailed Shearwater, *Ardenna pacifica*) is one of the most abundant indigenous seabird species throughout the Hawaiian Islands, making it an ideal study species. In Maui Nui, mark and recapture data for this species dates back to 1999. Currently, volunteer-driven banding events occur semiannually. The data shows that the colonies at Hawea and Mo‘omomi – which benefit from both long-term predator control and habitat restoration – are rapidly growing in size while Kama‘ole III and Ho‘okipa remain more static. Interestingly, however, adult survivorship among the four colonies is equivalent. Although most ‘ua‘u kani return to their natal colony, some emigration does occur, primarily from the islet of Molokini. As such, the offshore islets - which are free from the pressures of predation - are likely acting as source populations and therefore maintaining the adult population of the islands. Provided these findings, we hypothesize that the variation in growth rates at the colonies is instead influenced by a differential in reproductive success. After monitoring a scattered selection of active burrows at Hawea, Mo‘omomi, Kama‘ole III, and Ho‘okipa, we determined that the rapidly growing colonies have higher chick fledge rates. Ultimately, all of our findings emphasize the importance of both habitat restoration and predator control. Protective management can have rapid and positive effects on individual colonies and long-term impacts on the stability of the larger population. These efforts are critical as seabirds contribute greatly to the biodiversity of coastal ecosystems.

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Demystifying conservation translocation guidelines, beginning with inter-specific hybridisation

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Conservation management strategies for threatened species - exemplified across Oceania - generally seek to prevent extinction and enhance recovery. The IUCN SSC Guidelines for Reintroductions and Other Conservation Translocations were established to assist decision-making, however, implementation of these guidelines by conservation practitioners can be impeded due to uncertainty regarding genetic concerns associated with small populations, intra- and inter-specific hybridisation, and taxonomic uncertainty. Here, we seek to clarify the guidelines related to anthropogenic inter-specific hybridisation, or the interbreeding between distinct species. Of particular concern are conservation translocations that move threatened species to areas where they may hybridise with closely related species. In these situations, inter-specific hybridisation may compromise the genetic distinctiveness of the threatened species, and at its most extreme result in extinction-by-hybridisation. Genetic tools - and more recently conservation genomic tools - can be used to assess the risk of inter-specific hybridisation prior to translocation, but confusion regarding the most appropriate actions remain. We are conducting a systematic review of the relevant literature to test the hypothesis that when genetic markers indicate strong differentiation between hybridising species, introgressive hybridisation is less likely to occur, and the probability of detecting cryptic introgression with genome-wide markers will be low. We will then use these data to generate a decision tree to assist conservation practitioners during the assessment of inter-specific hybridisation risk, providing greater certainty around this challenging aspect in the conservation translocation guidelines.

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The Unexpected Role of Streams in the Conservation of 'Alae 'Ula (*Gallinula galeata sandvicensis*)

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‘Alae ‘ula (Hawaiian common gallinule, *Gallinula galeata sandvicensi*s) are among Hawaii’s most endangered endemic waterbirds, having been extirpated from all main islands except for Kaua‘i and O‘ahu, and likely numbering below 1000 individuals. The restoration and protection of freshwater low-elevation wetlands is largely credited with preventing their extinction, and they now persist almost exclusively in managed wetlands that are isolated from one another by urban (O‘ahu) and forest or rural (Kaua‘i) land cover. This study integrates simulation research on population viability and the potential effects of sea level rise on ‘alae ‘ula habitats on O‘ahu with a landscape genetics analysis to evaluate the importance of stream and other lotic water habitats in the population connectivity and long-term conservation of ‘alae ‘ula. Our findings indicate that, on O‘ahu, streams, drainage canals, and other linear water features may reduce long-term extinction risk of ‘alae ‘ula by permitting population connectivity and emigration from habitats lost to sea level rise. Sea level rise within the next 50-100 years may eliminate habitat which currently supports 40-50% of O'ahu's 'alae 'ula population, restricting them to small, isolated wetland habitats which support small numbers of individuals. Connectivity and dispersal will be essential for the viability of these habitats. Community management of privately owned wetland habitats and shared riparian zones will be an essential part of ensuring population connectivity and viability for the O'ahu 'alae 'ula population. Interdisciplinary collaboration between wetland managers, conservation biologists and traditional land managers would make great contributions to this type of initiative.

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Understanding changes in space and time in the distribution and relative abundance of *C. quinquefasciatus* on Kaua'i

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Mosquitoes pose a threat to Hawai'i's native forest birds as vectors of avian malaria. The situation is particularly dire on Kaua'i, which is lower in elevation than the other Hawaiian Islands that still have relatively intact native avifauna. Consequently, we have been studying the abundance, distribution, and seasonality of the malaria-carrying mosquito, *Culex quinquefasciatus*, at mid and high-elevation sites on Kaua'i. In 2011-14, we surveyed adult mosquitoes at two sites, one in the core and one in the periphery of current forest bird range. To survey adults, we used CO2 and gravid traps, and to survey larvae we collected water in dip cups from standing water on transects along stream margins and upland areas. In 2018-19, we repeated the core site surveys and added six new sites at 2500-3000' around the Plateau. Results suggest that 1) mosquito numbers increased over the decade; 2) core habitat is largely mosquito-free from January-July, but not other months (48 adults were captured over just seven trap nights in August); and 3) sites within 4km of core habitat contain high densities of mosquitoes as early as April. Most adult mosquitoes were caught in CO2 traps and very few larvae were found, suggesting among other possibilities that mosquitoes are immigrating into the study area. We will validate these results with additional surveys this fall. Understanding the distribution, relative abundance, and seasonality of *C. quinquefasciatus* in Kaua'i will help lead to safe, effective, and cost-efficient mosquito control techniques for use across the state.

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History, Pressures, Status and Response: a Look Back at the Last 10 Years of Place Based Management in the Papahānaumokuākea Marine National Monument

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The Papahānaumokuākea Marine National Monument was established in 2006 by presidential proclamation, was named a World Heritage site in 2010 and was most recently expanded to 582,578 square miles in 2016 making it the largest protected area in the Unites States and second in the world. The Monument provides habitat to a diversity of terrestrial and marine species and holds a rich cultural significance to Native Hawaiians. Numerous pressures have have historically impacted the Monument including fishing, vessel hazards and groundings as well as military use. These legacy pressures have lasting impacts on particular fish stocks, contaminants and debris, entrapment hazards to wildlife and disturbances to the coral reefs. Climate change, non-indigenous species, marine debris and natural disasters have been the most significant pressures across the past 10 years and are ongoing. The remote location and size make the Monument a special place but also makes it challenging to assess resources freqently enough to interpret changes over time. However, co-managing agencies together with partners and communities have been able to address many pressures with targeted research and management responses. Responses include: detailed research and characterization, active restoration of terrestrial landscapes, removal of non-indigenous species and contaminants, removal of marine debris and buoy groundings, and a suite of preventative regulations. The following presentations will introduce the current status and trends of resources over a period of ten years and will highlight: physical habitats, Hawaiian Monk Seals, green sea turtles, marine biodiversity, terrestrial and marine non-indigenous species and Native Hawaiian resources.

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Shifting the narrative: Conveying a message of hope in conservation at the advent of the Anthropocene

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For the past several decades the dominant narrative in conservation has been one that presents humans as inevitable threats to ecosystems and biodiversity, the ultimate proof of which is the global climate crisis and the dawn of the 6th mass extinction. With an ever-increasing human population, mainstream conservationists and popular media have defaulted to painting an apocalyptic picture of a dystopian future for our planet. This approach dashes all hope and tends to push conservationists deeper into despair with every extinction event, which only plays to confirmation bias and feeds into a self-fulfilling prophecy. The prevailing story has been one of hopelessness and fear. It is no wonder that it has been impossible to rally support from the masses and garner more allies in conservation efforts. As we acknowledge that this defeatist narrative has brought us to a dead end, how do we overcome our ecological grief and re-define ourselves with a message of hope? This panel discussion will feature leaders in conservation who successfully shifted the narrative about the realities in which we live, the work we do, and the future we can co-create. This new narrative focuses on resilience, the potential to foster such resistance and recovery, and the power to maintain preferred stable states. Join the conversation and help us to write a new story for the future of Hawaiʻi and our planet.

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I lama kū ka naʻauao kūpuna mai ke au kahiko mai (Wisdom from the ancestral past as our guiding light)

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In many ways, Indigenous Resource Management (IRM) is built on a conservation ethic, but from within a worldview that sees humanity and nature as a part of a single system rather than one that perceives humans as separate from nature. The same is true in Hawaiʻi. An example of this can be seen through the *moʻolelo* of the late *Kumu Hula* John Kaʻimikaua, which tells of the *ʻaha kiole* in the pre-*aliʻi* era on Molokaʻi. The *ʻaha kiole* analyzed problems and addressed solutions in resource management through the perspectives of eight realms between the heavens and the horizon. This approach to resource management led to the genesis of the *moku* system and ushered in an unprecedented era of abundance, peace, and prosperity. We will share contemporary stories of how these concepts are being applied in conservation efforts on various islands.

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Engaging Indigenous agency through collaborative management to achieve effective conservation in Hawai‘i

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Community-based collaborative management (co-management) is a pathway to engage both ‘Indigenous people and local communities’ (IPLCs) and government in effective conservation of biocultural resources, and associated habitats, within the context of a shared vision. In spite of existing international and regional policy on the matter, as well as notable successes at the local level, government agencies in Hawai‘i have failed to implement laws and policies that engage with IPLCs towards broad applications of community-based co-management. We propose that government agencies engage with forms of Indigenous agency as a means to more broadly apply collaborative management and achieve established conservation and sustainability goals. In order to do that, however, a better understanding of laws protecting Native rights and practices, as well as a recognition of various forms of Indigenous agency is needed. This paper articulates key forms of Indigenous agency that exist within Native Hawaiian culture, such as *kua ‘āina*, *hoa ‘āina*, and the interrelated values of *aloha ‘āina*, *mālama ‘āina*, *and kia‘i ‘āina*. Government agencies can engage with such forms of Indigenous agency as a way to de-escalate conflicts with IPLCs in areas of conservation and resource management, and as a pathway towards pro-actively engaging IPLCs in collaborative management. Doing so can help Hawai‘i to achieve its conservation and sustainability goals, and to contribute towards the fulfillment of global goals in that regard. This approach could also be transformative to scientific fields of research, such as conservation biology, by informing how research should be approached in places stewarded by IPLCs.

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Community Resilience following 2018 Kaua'i Floods

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With climate change, more typhoons, floods, fires, and other local-level ecological disasters threaten Hawai‘i communities and native ecosystems. In April 2018 the island of Kaua’i, an area long known as the wettest spot on earth, received 50 inches of rain in approximately 24 hours causing flooding across the island. Mud and debris from landslides uprooted vegetation, filled bays with sedimentation, and oversaturated soil, further increasing the chances and severity of future flooding events. Landslides closed the only highway, traveled by over a million tourists each year and isolated coastal communities. Community members and local nonprofits quickly organized to check on neighbors, evacuate tourists and reunite families by boat, deliver meals, conduct door to door assessments of family needs, staff medical teams, and clear storm debris. Less immediate actions included community coordination of home rebuilding and cleaning waterways to prevent future floods. One year after the floods, graduate students from the University of Hawai‘i at Manoa interviewed over seventy community members, including first responders, government officials, non-profit leaders, and flood survivors to document their experiences and learning. This year, an additional group of students continues to analyze the qualitative research collected. Some emerging lessons include the importance of strong local-level institutions and networks, neighbor-to-neighbor response, and local knowledge of changing ecological patterns such as historic stream paths. In the face of increasing climate-change-induced disasters, it is pivotal to promote long-term community resilience through community-led government-supported actions, local-level positions in proactive natural resource management, and rebuilding in anticipation for future events.

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Successful genetic integration of supplemented Tasmanian devils into a wild population

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Tasmanian devils have experienced an 80% population decline across the species range since the emergence of an infectious cancer, devil facial tumour disease, in 1996.Given the success of the captive insurance population that commenced in 2006, the wild devil recovery program was launched. This program aims to reintroduce devils from the disease-free insurance population into wild populations across Tasmania to perform demographic and genetic rescue. In 2016 a total of 33 devils from the insurance population, were released to one such wild devil recovery population at Stony Head, Tasmania. The current study aimed to determine whether supplemented individuals were successfully breeding with the incumbent population and contributing their genetic material. DNA was extracted from a total of 190 devils (33 release; 155 incumbent) and samples sent to Diversity Array Technologies for reduced representation sequencing, DArT-seq™. A total of 61 juveniles were trapped in the year following the release of which 34% were assigned to released and incumbent mixed pairings. Initial genetic diversity assessments showed a boost in observed heterozygosity, both neutral and functional, of the F1 generation post-release. These results confirmed that translocated devils can successfully integrate into an existing population and provided the STDP with essential information for devil conservation management.

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‘IKE - Informative Kits for Education: Preparing Hawai‘i communities for ocean acidification

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Ocean acidification (OA) is an emerging global change that may affect coastal communities by impacting marine life and ecosystems to which we are connected. Educational toolkits are used by the NOAA Ocean Acidification Program (OAP) to translate scientific research to the public to create an understanding of chemical trends, their potential biological and ecosystem impacts, and opportunities for human communities and industries to adapt to this change. A toolkit was designed for the NOAA Hawaiian Islands Humpback Whale National Marine Sanctuary (HIHWNMS) and the University of Hawai‘i at Mānoa Oceanography Department (UHM) to effectively educate audiences about OA. The toolkit was developed using concepts from cognitive-based communication strategies that proactively engage with, invoke understanding and empower audiences. The toolkit incorporated values from the Framework’s Institute as overlying themes for each module to effectively connect with and empower participants to be part of community-based solutions.The toolkit consists of four modules that include activities that identify the cause of OA, bring awareness to the change in carbon dioxide in the air and our ocean, show how OA impacts marine-life, and inspire action-based solutions. Pre-and post-surveys were used to evaluate the effectiveness of the toolkit and preliminary results from 4th and 5th graders suggest that the students exhibited an increased understanding from the activities. After evaluation and revisions, the toolkit will be distributed to HIHWNMS, UHM and other interested partners in Hawaii and is part of a larger effort to equip each US region with effective tools to communicate about ocean acidification.

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Restoring Wao Functions to our Urban Areas

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Over hundreds of years, Hawaiians constructed a sophisticated understanding of distinct biogeographic zones that run horizontally across the landscape. These are called “wao”. More than an ecological construct, wao established prescribed behavioral practices for human engagement with ʻāina in a way that preserved the natural cycles of the land and optimized generative abundance. From the large-scale loʻī terraces and coconut groves that dominated the wao kanaka to the water collectors (ōhiʻa, moss, etc.) of the wao maʻukele, each species and mineral was understood to contribute to the health of these islands. Over the last century, urbanization and its associated environmental changes have compromised the health and generative abundance of ʻāina.

This presentation examines the literature on wao and engages in the practice of makawalu to analyze Native Hawaiian kaʻao and ʻoli to inform an understanding of: 1) the function of each wao and 2) how we as makaʻāinana can contribute to restoring those functions in our own areas. My research concludes: as codified systems prescribing human-environment relationships at the landscape scale, wao are as relevant for urban residents today as they were for kūpuna of the past. Reclaiming and applying these systems to contemporary urban land use planning, where human-built and natural systems are integrated, has great potential to improve the health of our islands and restore abundance where we live.

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Wailua Ahupua'a Restoration Project *E malama Wailua Ahupua'a*

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Wailua Ahupua’a restoration project was founded by a small group of dedicated young adults born and raised in the Puna district of Kauai, the project’s mission is to restore personal relationships between the land and its people. It began with a dream, entranced by tales of self sufficiency and abundance in the paradise of what was old Hawai’i it became an insatiable urge to restore the land, not only to its former glory, but also using what we know now to create a modern natural utopia. Just the feeling of seeing indigenous farming and irrigation systems, clear corridors creating clean flowing streams free of debris, flourishing native species, and big harvests of mea’ai for all the people to take home is enough reward to keep our crew motivated for life. After restoration comes preservation, meaning once a place has been restored it must be continuously cared for in order to retain health as the presence of alien invaders still pose many threats to native flora and fauna. This means we must train the next generation to be caretakers and instill that responsibility or kuleana into their children and so on. Our project welcomes community members of all ages and skill sets, to mālama ’āina.

Some of our current kuleana include the restoration of watershed areas within the Lihue-Koloa Forest Reserve for cultural practices and native ecosystem protection management, including agroforestry, riparian restoration, invasive species removal, native plantings, aquaculture and horticulture of Kalo and other non-invasive plants, trash removal and environmental education.

In just 4 months we have successfully restored stream flow in the Uhauiole district, established lo'i systems, conducted invasive species removal, and native forestry restoration, we have also provided a place for people of the community to connect and learn from one another and the land.

Our end goal is to restore stream flow, and clean water systems, establish community food sovereignty and all-together, the Ahupua'a resource management systems from the mountains to the ocean.

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Pacific sheath-tailed bat: past, present, and future

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The Pacific sheath-tailed bat (*Emballonura semicaudata*) is a member of the Emballonuridae, an Old World bat family once common in Polynesia, eastern Melanesia, and Micronesia. It is the only insectivorous bat recorded .from a large part of this area. Sheath-tailed bats are small and brown, weighing approximately 0.2 ounces (5.7 grams). They roost communally in caves, overhangs, lava tubes or crevasses, and forage in forests on small insects (0.08–0.2 inches; 2–5 mm). They comprise four sub-species in the Pacific, two of which (*semicaudata* from Fiji and *rotensis* from the Mariana Islands) are now critically endangered. The best information suggests the *semicaudata* subspecies remains primarily on smaller islands in Fiji and has been extirpated from historically occupied areas in Samoa, American Samoa, Rotuma, Vanuatu, and Tonga. The *rotensis* subspecies persists only on the small island of Aguiguan in the Marianas. Threats include predation by nonnative mammals, disturbance of roost caves, habitat loss due to deforestation and overgrazing by ungulates, and stochastic events such as tropical cyclones. In this talk, we summarize the status of the Fiji and Mariana Islands subspecies of the Pacific sheath-tailed bat. We present results of a recent status assessment and predict future population trajectories based on growth or decline rates derived from the primary literature 15 years into the future and discuss the results. Without meaningful conservation interventions, quite beyond the status quo, we predict that both subspecies of the Pacific sheath-tailed bat will be extinct by 2035. Ongoing and proposed conservation efforts are shared.

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Rapid Response and Distribution Investigation of the Caribbean Corkscrew Anemone, a novel introduction to Hawaiʻi

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A report of Caribbean Corkscrew Anemone (*Bartholomea annulata*) in Kāneʻohe Bay near Heʻeia Harbor was made to the Division of Aquatic Resources (DAR) Invasive Species Team in early 2019. This triggered a rapid response protocol with the goal to verify presence, evaluate distribution and consider management options for the species which has never been documented in Hawaiʻi before. An effective response to newly identified non-native species is critical to increasing the chance of successful management. Our Team has had a long history of managing invasive species in Kāneʻohe Bay and have seen firsthand how they can dramatically impact its abundant waters. The initial response involved a site inspection, taking photographs, and live specimen collection to send to taxonomic experts to verify its identity. Following the confirmation of the species, the immediate area was surveyed for the distribution and density of the anemone. The distribution extended far beyond the reported area requiring a faster survey method where presence/absence was noted instead of density. The distribution surveys showed *B. annulata* was present on 21% of the 0.325 km^2 surveyed, extending a minimum planar distance of 3.9 km throughout Kāneʻohe Bay. Concurrently, a literature review of the species was conducted to evaluate life history, ecological characteristics, and history on invasion elsewhere. An efficient rapid response effort allows for a baseline of distribution and can inform possible control efforts.

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Investigating Regime Shifts in Northwest Hawai'i Island Coral Reef Systems

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The Northwest coast of the Big Island of Hawai'i was heavily impacted by the 2014-2017 global coral bleaching event, which was estimated to have disturbed 75% of coral reefs worldwide. Consecutive bleaching events in 2014 and 2015 were observed at various sites along the coast, which can lead to regime shifts from coral dominated systems to macroalgal dominated systems. Changes in fish community are likely attributed to a combination of increasing sea surface temperature, shifts in functional group, changes in water quality and a mixture of management regimes. Video transect surveys were conducted annually (typically in January-February) from 2009-2020 in eight sites along the West coast of Hawai'i Island. Fish were identified to 120 different species which make up functional groups of predators, secondary consumers and herbivores (further separated into browser, grazer, and scraper categories). A generalized linear model was developed to identify key environmental variables that influence changes in functional groups. This project aims to inform the 30x30 conservation initiative, by identifying key environmental variables that influence changes in fish community structure along the Northwest coast of Hawai'i. Healthy nearshore reefs are vital for ecosystem services such as contributing to local economy, food resources and cultural significance. Maintaining diversity and abundance of these systems is a priority to management, community members, and those who are invested in encouraging these systems to thrive.

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Beach Conservation Threatened by Shoreline Hardening and Sea Level Rise

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Loss of sandy beaches threatens cultural resources and identity, community resilience, ecosystem health, and tourist-based economies. Shoreline hardening, which is the construction of hard structures to prevent property erosion, is the main cause of beach loss. Sea level rise is expected to cause more beach loss, which may rapidly occur depending on management practices. Identifying beaches at risk to current and projected shoreline hardening provides important data for resource managers to implement sustainable practices that protect beaches. Using a sea level rise erosion hazard zone model, we identified the risk of new shoreline hardening for O’ahu, Hawai’i and found that current management practices must change immediately to ensure beaches are sustained. Today, hazardous erosion issues are addressed as they occur property by property. We recommend returning to indigenous methodologies by conducting proactive, place-based, and holistic practices that include all stakeholders of those places to reduce degradation of the environment and safeguard the future resilience of the coastal community.

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Endangered Ae‘o (Hawaiian Stilt; *Himantopus mexicanus knudseni*) Reproductive Success and Juvenile Habitat Use

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Recent studies on endangered ae‘o (Hawaiian Stilt; *Himantopus mexicanus knudseni*) indicate that habitat variables, such as vegetation height and proximity to water, do not have significant impacts on hatching success. However, ae‘o chicks leave the nest within hours of hatching, and characteristics of nearby habitat may impact predation risk, and thus, fledging success. In this study, we examined hatching success and habitat use of recently hatched chicks in the Marine Corps Base Hawai‘i - Kāne‘ohe Bay (MCBH-KB). Motion-activated cameras were used to determine the number of eggs laid and nest fate. Visual observations and VHF radio transmitters were used to track movements of chicks at least 7 days old. Chicks were tracked daily for the first 7 days and then 2-3 times per week thereafter until fledging at 24-28 days old. Minimum convex polygons were generated for 8 tracked chicks with at least 15 relocations each. Out of 150 eggs observed in the 2019 nesting season, 32% (n = 48) hatched. Of the hatched eggs, 17 chicks were observed after leaving the nest area, and excluding chicks with unknown fates (n=4), 54% (n = 7) successfully fledged. Pre-fledglings that were radio-tagged (n = 8) were observed foraging and resting in multiple habitat types, and median home range size was 0.46 acres. Low reproductive success may be due to predator pressure. Reducing the density of predators and maximizing available habitat is critical for improving ae‘o reproductive success and managing for abundance.

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Examining coral community composition and 3D habitat structure on shipwrecks located in Apra Harbor, Guam

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The island of Guam has a storied history of maritime activity associated with wars and naval training. In Guam's waters, shipwrecks are the most prevalent underwater cultural heritage (UCH) sites, with over 60 documented. The purpose of this study was to conduct a comprehensive assessment of the coral reef community composition and 3D habitat structure on shipwrecks and the adjacent undisturbed coral reef area. Characterizing coral communities is an important component of ecological monitoring as the architectural complexity of corals creates the foundation of the habitat and profoundly influences overall ecosystem functionality. Using innovative structure-from-motion (SfM) photogrammetry, we created high-resolution underwater 3D reconstructions of the benthic habitat with spatial accuracy at the centimeter scale, allowing for precise quantification of coral community composition, coral colony characteristics, and 3D structural complexity. With these results, we are able to accurately assess how the benthic composition on shipwrecks compares to its adjacent reef, improving our understanding of how these shipwreck structures are influencing the ecology of coral reefs on the island of Guam. The large spatial habitat maps created by this study provide important baseline information for detecting change and developing effective management strategies to protect and preserve Guam's coral reefs.

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Honuaola: Caring for Lānaʻi's Biocultural Landscape

Shelly Preza[1], Benjamin Ostrander[2]

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Ola ka ʻāina, ola ke kanaka. Indigenous people understand that when the land thrives, so do its people. In traditional times, native Hawaiians learned to live within the wealth and limitations of their natural environment in order to ensure abundance for present and future generations. Our work on Lānaʻi aims not only to conduct conservation activities with this idea in mind but also to connect our community back to the land that sustains us. In this talk, we will present they ways that the partnership between Pūlama Lānaʻi and the Lānaʻi Culture & Heritage Center has helped to foster relationships between members of our community and their biocultural landscape. We will share stories of our educational outreach through the years, focusing in particular on the engagement of youth at the Waiaʻōpae Fishpond restoration and on the Lānaʻi Culture & Heritage Center's E ʻIke Hou iā Lānaʻi summer cultural literacy program. Cultural and community-based stewardship practices are essential to the long-term success of projects occurring on ʻāina ʻōiwi, and we, as stewards, understand that the conservation of the natural landscape cannot reach its full potential without the acknowledgment of the biocultural landscape too. By creating opportunities to connect with our ʻāina, we hope to build capacity with our island youth as future leaders in our community, helping them to grow up with a deep sense of place and to be able to share these stewardship values with their families, peers, and greater community.

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Empowering Mangrove Protection by Pohnpei Communities in the Era of Sea Level Rise

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Multiple stressors threaten Micronesia's island shorelines, including the fringing mangrove forests that protect the shoreline and offer many ecosystem services. Threats include climate change impacts such as rising seas and changing storm patterns, as well as local disturbances like dredging, pollution and construction. There is a pressing need to increase the long-term resilience and adaptive capacity of Micronesia's mangrove resources for the benefit of the communities that depend on them. A multi-phased, collaborative project has been assisting communities in Pohnpei, Federated States of Micronesia, where mangroves surround and protect the island, to assess their vulnerability to impacts on mangroves, and develop and implement protective measures that reflect scientific projections of change in these forests. Communities around the island developed assessments of the vulnerability of mangroves, and the vulnerability of the community's socio-ecological links with their forests. All communities reported moderate to very high vulnerability, and developed key actions required to reduce threats and enhance mangrove health. To provide critical data to guide management and protection, studies of carbon stocks, forest health, sediment accretion rates, and sea level trends, and projected changes were coordinated by the Micronesia Conservation Trust and conducted by the US Geological Survey, US Forest Service, and University of Tasmania, with the assistance of The Nature Conservancy, the US Fish and Wildlife Service, and the Conservation Society of Pohnpei. This presentation will present the results of these studies, proposed adaptation actions at the community and state level, and the potential for this work to be expanded across Micronesia.

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Strengthening Conservation Capacity through the Kai Kuleana Network.

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The Kai Kuleana network is composed of communities that are focused on building capacity to protect coastal and marine ecosystems on the leeward coast of Hawaii Island. Community leaders from the network will share capacity building techniques that have led to successful improvements in fisheries management, outreach and education to increase understanding of respectful behaviors, pono fishing, deepen relationships within communities and strengthen stewardship practices. The Kai Kuleana network's function is to support each community by providing an opportunity to share challenges and identify solutions. The network approach is place-based to ensure solutions are customized to fit the context of each community. The Kai Kuleana network will share the process, successes and challenges of building capacity within each community, including governance, staffing, training, education, resource monitoring and civic engagement.

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Testing for consensus among global biodiversity indicators

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Our world is experiencing the sixth mass species extinction, a phenomenon expected to have serious implications for human well-being, and which affects islands and continents differently. Policy makers rely on biodiversity indicators to identify when and where nature is changing so they can mitigate further loss. Currently, there are multiple global-scale biodiversity indicators in play. Each indicator conveys change in different, but related components of biodiversity, such as species richness or population size. Many indicators share an implicit assumption that they have some relationship to extinction risk. This is illustrated by their use in measuring progress toward global species extinction targets under the Convention on Biological Diversity (CBD) and Sustainable Development Goals (SDGs). The relationship between most global biodiversity indicators and extinction has not, however, been explicitly tested, putting policy-makers at risk of making ill-informed decisions, and species at higher risk of extinction. We investigated the relationships between biodiversity indicators, and between indicators and extinction risk. We developed a database of species extinctions in each of the world's terrestrial ecoregions, then tested ecoregion scores of biodiversity indicators (including the Biodiversity Habitat Index and the Red List Index) for correlation with recorded extinction and risk rates. We also investigated whether correlation between metrics varied by geographic region. We found some indicators are more reliably correlated with extinction rates than others, and that consensus between indicators varies by region, which we discuss in the context of Oceania. Our findings have implications for upcoming negotiations on the CBD's post-2020 framework and monitoring strategy.

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Using Forest Inventory and Analysis Data to Better Understand Distributions of Native and Non-native Tree Species and Invasive Plants Across the Hawai'ian Islands

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Long-term monitoring data is necessary to understand the impacts of invasive species on forested ecosystems. The U.S. Forest Service's Forest Inventory and Analysis (FIA) Program began a systematic forest inventory on the Hawaiʻian Islands in 2010 to understand structure and health. Initial measurement data show tree stem densities, basal area, and biomass varied greatly among the Hawaiʻian Islands. Hawaiʻi Island supported the largest number of tree stems over 5 inches and the greatest basal area and carbon mass per acre, while Lanai had the lowest amount within each category. *Metrosideros polymorpha,* (ʻŌhiʻa lehua) is the dominant tree on Hawaiʻi and Maui, covering about 57% and 48% of their forests, respectively. *Psidium cattleianum* (strawberry guava) is the most abundant non-native species on every island, covering about 122 thousand acres. *Clidemia hirta* (kosters curse) and *Schinus terebinthifolius* (Brazilian pepper-tree) are the second (38 thousand acres) and third (25 thousand acres) most frequent non-native species across of all of the Hawaiʻian Islands. Strawberry guava is the dominant tree on Kauaʻi (50%) and Lanaʻi (35%), whereas *Leucaena leucocephala* (haole koa) is the dominant tree on Oʻahu, covering 18% of the island. Data from plot re-measurements in 2019 documented recently dead ʻŌhiʻa trees present on 58 of 80 plots, of which 6 plots had trees infected with *Ceratocystis lukuohia*– the causal agent of Rapid ʻŌhiʻa Death. Forest inventory data provide useful information for land managers to better understand forest composition, dynamics, and health across the Hawaiʻian Islands.

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Incorporating Groundwater Dependent Ecosystems into Groundwater Management: Sumida Farm in Pearl Harbor Aquifer, O‘ahu

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Groundwater management policies around the world increasingly seeks to protect groundwater-dependent ecosystems. This includes human uses tied to natural spring discharge that is important for these linked systems. There are few examples of practical tools to balance human groundwater use with ecological water demand related to spring discharge. Using a simulation-optimization framework, we directly incorporate a spring discharge constraint into the analysis of sustainable yield for operationalizing groundwater policy in the state of Hawai‘i. We use Sumida Farm on the island of O‘ahu, a spring discharge-dependent watercress farm with historical, cultural, and ecological significance, as a case study to highlight the importance of incorporating linked systems into groundwater management. This research provides decision makers in Hawai‘i with information regarding the trade-off between groundwater withdrawal and spring discharge, which is connected to multiple benefits, including historical and cultural values and biodiversity conservation targets in line with codified state beneficial use protections.

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The Micronesia Conservation Trust: Supporting Micronesian Communities in Conservation (Success Stories)

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This talk will present a case study of a sub-regional organization working to support and empower communities across the region with a mission to ensure that people and communities are at the center of conservation efforts. The Micronesia Conservation Trust (MCT) is a regional organization based in the Federated States of Micronesia (FSM) serving the FSM, the Marshall Islands, the Republic of Palau, the Commonwealth of the Northern Marianas and Guam. Since 2006, MCT's has been acting as an effective bridge between the international conservation community, development partners, and our Micronesian communities and governments. As this bridge, MCT works to deliver efficient funding, insightful conservation and resource management practices, financing expertise, partnership access to on-the-ground stakeholders, and support continuing improvements in measuring and sharing results. MCT is also a key partner of the Micronesia Challenge, a regional agreement to effectively conserve at least 30% of the near-shore marine resources and 20% of terrestrial resources across Micronesia by 2020. This presentation will share how MCT brings in external resources and provide localized technical support directly to communities and the people who rely on ecosystem services for their livelihoods and survival and conclude by highlight success stories from across the region. This presentation will serve as a case study of how the people of Micronesia, through the establishment of organizations such as MCT, are taking the lead and ensuring their needs are met with regards to support and assistance for conservation.

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Restoring Pilina of Place through Nā Kilo ʻĀina

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In the Nā Kilo ʻĀina (NKA) program, ʻĀina is identified as the/our sustenance which feeds us on all levels of health (physical, mental, emotional, spiritual). The initiative of Nā Kilo ʻĀina focuses on the collective journey of strengthening relationships of place. NKA provides a unique learning system which highlights the reciprocation of healthy natural environments and communal social dynamics. Utilizing the richness of ʻŌlelo Hawaiʻi, Nā Kilo ʻĀina (NKA) emphasizes specific themes which influence the development of community-based curriculum. Throughout our NKA programs, ʻŌlelo Hawaiʻi is used as a tool to bring value and perspective to the place, the community, and the practice of kilo (observing with all senses). Likewise, Inoa Hawaiʻi (Hawaiian names) are emphasized to describe the function and purpose of place, flora, and fauna. In community gatherings through our NKA programs; past and present memories of kilo are shared and in turn participants learn many different components that make up our communities. Through observations and lessons of moʻolelo, pilina (interaction with place) grows and encourages participants to contribute to the continuation of moʻolelo of place. Through stewardship efforts within NKA programs and the perspective of ʻŌlelo Hawaiʻi, we can make the best decisions to mālama ʻāina if we build and value our relationship with people and places. ʻŌlelo Hawaiʻi within Nā Kilo ʻĀina supports conservation efforts through building a network of observers grounded in Hawaiian perspective to continually strive and maintain ʻāina momona.

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Drought in Hawaii - Natural Resource Managers' Knowledge and Perspectives

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Natural resource managers in Hawai‘i face increased challenges due to climate change, and effective collaboration between managers and scientists can lead to more relevant science and better climate adaptation. Climate change will increase the frequency and severity of drought in Hawai‘i, exerting greater impacts on the state’s unique landscapes, ecosystems, and species. Land managers often rely on prior experience to respond to drought, but as drought regimes change more information is needed to guide management planning and actions which will protect the health and abundance of Hawaii’s ecosystems.

The Hawai‘i Drought Knowledge Exchange (DKE) pilot project is bringing together land management organizations and climate/drought researchers in the social and physical sciences to collaboratively develop and answer drought management questions in a process of knowledge co-production. As part of this effort we conducted interviews with natural resource managers to identify the drought information sources managers currently use, the biggest challenges they face during drought, and gaps in drought information and resources. This presentation will share a summary and synthesis of interview responses, which will help guide the DKE’s efforts to build a Learning Network of collaborative, multi-directional stakeholder relationships, and to co-produce relevant, manager-accessible information that will help reduce the negative impacts of drought on Hawai‘i’s landscapes and sustain their capacity for abundance into the future.

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Dry forest habitat for Hawaii's native birds

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Dry forests on the leeward (western) sides of the Hawaiian Islands once supported some of the most diverse avian communities in the islands, but today only scattered remnant forests still support native bird communities. On Hawaii Island, several dry forests support important populations of native birds, and can play an important role in efforts to save Hawaii's forest birds from extinction. Species such as the Iiwi, the iconic honeycreeper recently listed as threatened with extinction, is apparently thriving in Hawaii Island dry forests, and reintroductions of the Alala are scheduled for dry forest sites in coming years. Additionally, efforts to increase the ecological service birds provide to forests include the planned reintroduction of the Omao thrush, a frugivore important for seed dispersal, back into dry forests they once occupied. Therefore, ongoing efforts to protect and restore these valuable dry forests are critical for the long-term viability of Hawaii's unique avifauna.

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Roosting Ecology of Endangered Tree-roosting bats on Okinawa Island: Implications for Bat-friendly Forestry Practices

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Managing species for abundance is challenging when little is known about them. The Ryukyu tube-nosed bat (*Murina ryukyuana*; Endangered) and Yanbaru whiskered bat (*Myotis yanbarensis*; Critically Endangered) are tree-roosting bats endemic to the Ryukyu Archipelago, Japan. Despite both species being considered threatened by deforestation, the habitat requirements of these species remain mysterious. To inform sustainable forestry practices and conservation management, we identified day-roosts by radio-tracking both species in the subtropical forests of Okinawa's Yambaru region. Naturally low capture rates were increased using an acoustic lure. *Mu. ryukyuana* roosted primarily in understory foliage, using tree cavities more often for maternity roosts. *My. yanbarensis* roosted almost exclusively in cavities along streams through old-growth forests and showed less variation in roost site characteristics. Average roost height for both species was low (~3 m), but *Mu. ryukyuana* maternity roosts were significantly higher than non-maternity roosts. We also report the first maternity roosts of *My. yanbarensis*. Small maternity colonies and low roost fidelity suggest that both species require many roost sites. The less flexible roosting preferences of *My. yanbarensis* may explain its striking rarity, but further research is required to confirm this. We recommend forestry practices adopt the following guidelines: 1) reduce understory thinning, 2) preserve forests along streams, 3) promote greater tree cavity densities by protecting old-growth forests, and 4) refrain from cutting between April–July when bats are pregnant or lactating. Our results will be provided to local forestry and inform conservation planning concerning Yambaru and Amamiguntō National Parks.

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Using innovative methods to identify a new breeding colony of the Endangered ua'u (Hawaiian Petrel, Pterdroma sandwichensis)

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The Hawaiian Petrel, or Ua'u, is an endangered seabird that breeds in burrows in remote montane regions of Hawaii. Spending most of their lives at sea, these birds are cryptic in their terrestrial habits, returning to land at night and breeding in remote and often inaccessible areas

On Hawaii Island, ua'u were first detected in modern times on Kohala mountain by employees of the Natural Area Reserves System in 2011-2013. While working in the Lahomene Unit of Puu O Umi NAR they heard ua'u calling.

In 2013, Kauai Endangered Seabird Recovery Project sent staff to Kohala mountain where they confirmed the presence of ua'u through auditory surveys. From there, NARS staff deployed song meters around locations where birds were heard to determine hot spots of activity. After two years of remote sensing, night surveys were conducted using night vision and infrared binoculars. Visual confirmation further narrowed down localized activity, but ground searches during the day for burrows were unsuccessful. In 2017 and 2018, NARS and KESRP staff captured 5 adult petrels (using a combination of lights, playback and mist nets) flying over the main study site and attached GPS tags before releasing them. High resolution tracks were obtained for two of the tagged birds, and in the fall of 2019 NARS staff followed one of the tracks directly to an occupied burrow. This was the first burrow found in Kohala in contemporary times. We also discuss future management efforts, focused on predator control and burrow monitoring, to protect this newly-discovered population.

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Effectiveness of Predator Removal Programs for the Protection of Endangered Seabirds on Kauai

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Hono O Nā Pali (HONP) Natural Area Reserve is an important breeding site for the federally threatened Newell's Shearwater (*Puffinus newelli*), the federally endangered Hawaiian Petrel (*Pterodroma sandwichensis*), and the federally endangered Band-rumped Storm-Petrel (*Oceanodroma castro*). Breeding colonies of these seabirds elsewhere on the island of Kauaʻi face threats from anthropogenic sources such as light pollution and power-line strikes. While the colonies in HONP are relatively unaffected by anthropogenic threats given the lack of human habitation and infrastructure on the northwest coast of the island, they do face predation from a variety of invasive predators. The terrestrial predators that have been documented depredating seabirds in HONP colonies are feral cats (*Felis catus),* black rats (*Rattus rattus)*, and feral pigs (*Sus scrofa).* The colonies in HONP are within an ungulate proof fence as of 2014, and thus are protected from further pig predation. However, the site remains open to rodents and cats and thus ongoing trapping efforts are necessary to control those predators. Predator control activities were implemented in 2014 and have expanded every year since. Seabird reproductive success at all sites increased once predator control operations were in place and depredations by all terrestrial species decreased significantly. Seabird depredation rates were also found to be negatively related to predator control effort for both cats and rats. This work highlights the importance of controlling introduced predators at endangered seabird colonies and shows that with effective and adaptive predator control programs in place, seabird colonies are able to persist and recover.

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Biocultural Conservation - A Portal to Agency Transformation

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This talk examines lessons learned, obstacles encountered and outcomes achieved by the USDA Forest Service's Institute of Pacific Islands Forestry (IPIF) in our effort to honor a 2010 commitment made by Hawaii's conservation community to increase engagement of biocultural stewardship. IPIF has been able to achieve some positive outcomes because of three important factors: (i) the sustained and nurturing mentorship of Native Hawaiian kumu – our catalysts for change; (ii) the hiring of Native Hawaiian professionals – our foundational voices of place; and (iii) the expanding of our scope of work to include Native Hawaiian stewardship trainings, biocultural research, and research that address knowledge system integration, biocultural methodologies, and decolonization. These are our building blocks of personal and professional growth. ʻŌlelo Hawaiʻi has been central to each of these facets but also to illuminating barriers: IPIF as a Federal Agency has insufficiently grappled with engaging the colonial footings of Western knowledge, the legacies of our history, and the multi-layered epistemological biases that can thwart progress. While academic literature is useful in framing justice driven processes, actual change has required the building of relationships striving for reciprocity and trust, approaching professional and personal growth with intellectual and emotional creativity, and cultivating practices that seek to reconcile egregious historical wrongs that remain largely "under the radar" of mainstream USDA Forest Service life. In sharp contrast to piece meal or trial by error approaches, the ʻŌlelo Hawaiʻi based ritual, oli and hula shared with us has provided a deeply structured approach to change, growth and transformation.

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Effect of Fragmentation and Isolation on Fish Utilization of Bleached Coral Reef

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Coral reefs are being affected by warming oceans and coastal development, which cause bleaching and fragmentation. The mechanisms are well understood but less is known about how fish utilize bleached and fragmented reefs - a knowledge gap that prevents stewards from integrating the ecological value of bleached and fragmented reefs into planning. Knowledge of how the size and location of bleached and fragmented coral reef influence fish usage could better inform effective conservation or restoration of reef resources. To these ends, we used a naturally occurring study system at Waialea Marine Life Conservation District (MLCD) in the Moku of Kohala, Hawai'i island, which includes 11 bleached coral islands of different size and proximity to main reef areas. For each island, underwater videography paired with direct measurement of fish abundance, richness, evenness, and diversity, and of island physical characteristics were used to test hypotheses about island size and proximity to main reef areas. Bleached coral islands were found to hold significant ecological value to diverse assemblage of fish, which continued to use the bleached fragments for habitat purposes despite a near complete absence of live corals. Corallivores made up a small part of this assemblage, and we observed little coral foraging. For small but not large fragments, diversity decreased with distance from main reef areas. The fish diversity of large islands was constant and high across distance from main reef, suggesting that large reef areas can better support diverse fish assemblages than small reef areas. This finding provides practical insights for designing the size and spacing of reef restoration projects.

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Status and Trends of Marine Biodiversity in the Papahānaumokuākea Marine National Monument

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The status of marine biodiversity in the Papahānaumokuākea Marine National Monument (PMNM) is assessed as good, based on a review of existing literature and unpublished data. The waters of PMNM are home to an abundant array of corals, algae, invertebrates, and fishes. Levels of endemism are known to increase with latitude, and shallow coral reef fish assemblages at the northern end of PMNM are composed of over 60% endemic species (compared with ~25% in the main Hawaiian islands). 57 species of stony corals, 372 species of macroalgae and two seagrasses have been recorded from the PMNM. Recently, dozens of undescribed species of algae have been collected from mesophotic coral ecosystems (MCEs, deep coral reefs between 50 and 100+ m) of the Monument. 338 species of fishes have been recorded from the NWHI including several new species from MCEs. MCE fish assemblages are characterized by globally significant levels of endemism, with 100% endemism documented at 90-100 m at Kure Atoll. The invertebrate fauna of PMNM is understudied. Over 600 species of macroinvertebrates have been recorded from French Frigate Shoals alone, with more than 250 species reported as new records. There are insufficient data on biodiversity to identify a temporal trend, and thus expansion of basic characterization remains a significant management priority. Recent threats to biodiversity in the Monument have included severe damage from Hurricane Walaka to unique *Acropora* spp. coral reefs at French Frigate Shoals, and a major bloom of an invasive red alga at Pearl and Hermes Atoll.

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Applications of ungulate spatial ecology to achieve conservation and hunting objectives

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Introduced ungulates have costly impacts to agriculture, native ecosystems, and urban environments. Their impacts cut across trophic levels and range from disturbing soil composition and biogeochemistry to direct predation or consumption of threatened flora and fauna. Management of ungulates is a top priority throughout the Pacific. However, very little is known about their distribution and abundance. Furthermore, government mandates and community advocacy for viable public hunting programs complicate the type and location of optimal management actions. In this study, we explored how understanding the spatial ecology of these species may inform conservation decisions while maintaining and potentially improving the quality of public hunting areas available. We created distribution models of species relative abundance using data collected during two seasons (fall and spring 2018) on the island of Maui. These data were collected using remote camera traps and systematic disturbance surveys for three ungulate species: feral pigs (*Sus scrofa*), feral goat (*Capra hircus*), and axis deer (*Axis axis*). We found that incorporating our distribution models with existing spatial data on threatened plant communities highlighted new areas of potential concern for conservation management intervention, as well as optimal locations for hunting. This type of approach allows managers to prioritize management actions based on the perceived threat from ungulates while also identifying areas where increasing hunter access might benefit conservation objectives and the hunting community.

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An Overview of the Current Distribution and Population Status and Recent Trends of Hawaiian Honeycreepers, Major Threats and Challenges for Recovery

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Our Hawaiian forest birds are in crisis. Sixty-three percent of Hawaii's endemic birds have already gone extinct. Twelve out of 21 remaining Hawaiian forest bird species are federally threatened or endangered. Invasive predators, habitat loss and habitat degradation from invasive plants and ungulates have had profound impacts and still remain major threats. However, the most imminent threat for honeycreeper species is disease spread by invasive mosquitoes, of which the most devastating is avian malaria. Six endemic Hawaiian honeycreeper species-ʻAkikiki (*Oreomystis bairdi*), **ʻ**Akeke**ʻ**e (*Loxops caeruleirostris*), Kiwikiu (*Pseudonestor xanthophrys*) , **ʻ**Akohekohe (*Palmeria dolei*), Palila (*Loxioides bailleui*) and ʻAkiapōlāʻau (*Hemignathus wilsoni*)-have fewer than 2000 individuals remaining. A seventh species, ʻIʻiwi (*Drepanis coccinea*), was recently listed as federally threatened, with avian malaria listed as a primary threat. Further, climate change is predicted to increase the current range of mosquitoes into areas that are currently mosquito-free and thus harbor the last remaining populations of these honeycreeper species. Here I summarize our most current Hawaiian forest bird estimates, recent trends and distributional changes from recent forest bird surveys, and highlight the imminent plight of these species. I also present the efforts that forest bird recovery projects are undertaking to sustain the current populations through conservation breeding and translocations, habitat restoration, predator control, and ungulate fencing and control. However, we need to address mosquito-borne disease at the landscape level soon to avoid additional extinctions of Hawaiian honeycreepers.

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Examining the seascape of compliance in U.S. Pacific island fisheries

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Noncompliance is a major threat to marine social-ecological systems. Recent noncompliance research has focused on illegal, unreported, and unregulated (IUU) fisheries and capacity shortfalls in marine protected areas (MPAs), but less work has assessed other aspects of noncompliance. Although there is wide recognition of the role of noncompliance in governance failures, the academic literature on compliance rarely acknowledges the connections between governance processes, compliance activities, and management outcomes. Likewise, scholars often highlight instrumental approaches that include law enforcement tools, instead of a diverse suite of non-instrumental interventions that encourage voluntary compliance through education, outreach, and targeted behavior change. We sought to understand the seascape of compliance across the United States Pacific islands region, an area of 5.83 million km^2 that includes Hawai'i, American Samoa, Guam, the Northern Mariana Islands, and one of the world's largest MPAs. The region includes commercial, subsistence, and non-commercial fisheries, and a diversity of cultures that rely on them. To examine compliance, we employed a qualitative approach, including an extensive review of historical and archival data sources, an analysis of the fisheries management literature in the region, and 29 expert interviews. While the literature highlighted the importance of enforcement, experts called attention to multiple factors that affected compliance, such as capacity, governance processes, and a lack of data. Although several fisheries may benefit from an increased enforcement presence, we argue that non-instrumental and governance approaches can complement enforcement and should be part of an integrated compliance approach both in the region and worldwide.

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USE OF SPECIALIZED NO-KILL BEE VACUUM TO REMOVE HYMENOPTERA NESTS FROM HAWAIIAN SEABIRD BURROWS

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Federally endangered Hawai'ian Petrels (Pterodroma sandwichensis) and federally threatened Newell's Shearwaters (Puffinus newelli) nest in the remote sea cliffs of Kaua'i's north shore, specifically within the Hono o Na Pali Natural Area Reserve (HONP NAR). These long-lived species reproducing in the HONP NAR face threats from a variety of island-wide sources including power line strikes, light attraction, invasive mammalian predators, and several species of bee and wasp. Bees and wasps pose a specifically devastating threat, as they nest in the burrows of seabirds, and have been documented having stung birds to death upon the bird returning to their burrow. Control of hymenoptera nests in HONP NAR is a key element to seabird protection and management, however such management in remote native ecosystems presents a variety of challenges. The management cannot use insecticides, must be portable, and require no external power source. We have created a fully functional prototype vacuum that is capable of capturing a hive with few to no casualties, which can then either be translocated or destroyed. After the colony is safely removed from the burrow, the burrow is ready to be used again by seabirds in the future. Bees and wasps nesting in seabird burrows is a new observation, and this equipment gives us an opportunity to get out ahead of this threat to the endangered seabird species before the problem grows.

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E Ho‘i Na Keiki Oki Uaua O Nā Pali: Home Go The Resilient Children of the Pu‘uwa‘awa‘a and Pu‘uanahulu Hills

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Indigenous and local knowledges are providing insights into the design and practice of reforestation across the rural-urban gradient, including ancestral lands and our contemporary places. Lineal descendants of North Kona are working to formally return as active stewards to what is now the Pu‘uwa‘awa‘a Forest Reserve, a landscape where their ‘ohana have resided for generations. The Pu‘uwa‘awa‘a Community Based Subsistence Forest Area (PCBSFA) is an innovative collaboration that envisions a vibrant and engaged community that applies the communities skills, strengths, commitment to service, and aloha to maintain bio-cultural diversity within this ‘āina aloha of Pu‘uwa‘awa‘a. Successful relationship building has made it possible to weave traditional knowledge with reforestation intentions providing knowledge holders access to lands thus increasing the capacity of agencies to mālama ‘āina. The PCBSFA is the first community-based forest subsistence area of its kind in Hawai‘i, and is designing and beginning to implement a plan to transform 84-acres of fire prone grass into native dryland, mixed-mesic, and historic dryland agroforestry. Grounded on our palapala pilina relationship document, the PCBSFA relies on consensus-based decision-making that is led by multi-generational community leaders with non-profits and agency organizations playing supportive roles. Where communities are committed to reinvigorating the resilience and abundance of ‘āina aloha even within highly urbanized environments, the PCBSFA offers a new approach and perhaps a model for relationship building and decision-making among lineal descendants, agencies, and NGOs.

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Connecting land to sea through stream water quality: Developing common methods for monitoring stream water quality to improve management actions that reduce soil loss to coastal ecosystems

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Freshwater stream water quality is an important indicator of stream health and connects mauka watersheds to makai resources. Maintaining healthy watersheds is increasingly a goal of marine planners who want to improve the resilience of coral reef ecosystems to global threats. Increasingly, projects are being implemented to curb non-point source pollution sources due to ungulates, poor agriculture practices, legacy agriculture practices and wildfire. However, projects are not being monitored using common protocols and quality assured methods to obtain data that can compare how effective the installed best management or land management practices are. To identify which management efforts have the greatest improvement on water quality, and to be able to compare the effectiveness of different projects to reduce sediment, it is important to have standardized methods to evaluate upstream-downstream changes.

This talk will first summarize the current methods being used at the county, state and federal levels to monitor for turbidity and total suspended sediment in Hawai'i's streams. We will then present possible options for standardized monitoring that can be adopted by non-profit partners and government agencies and discuss which protocols have consensus and can be adopted more generally.

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The Power of Partnerships and Place: Engaging Kapiʻolani Community College Undergraduates in Community-based Restoration in Maunalua Bay

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Partnerships between community-based groups and colleges are effective ways to teach science through real-world experiences, provide meaningful community service for students, and generate valuable citizen science data. In the Fall of 2009, Kapi'olani Community College (KCC) initiated an innovative, collaborative partnership with Mālama Maunalua (MM) to address student learning, data collection needs, and community engagement by involving KCC undergraduates in the Environment and Ecology Lab (BIOL 124L) in removing invasive algae at Paiko in Maunalua Bay. Each semester, students learn to identify local algal species, monitor species distribution, analyze data, and present their findings to MM staff and the larger community. The collaboration provides students with an opportunity to learn ecological monitoring techniques and cultivates stewardship through hands-on learning. Nearly two-thirds of the KCC campus falls within the watersheds of Maunalua Bay, and class pedagogy emphasizes the importance of place and community action to address environmental challenges. KCC Students have removed over 16 tons of invasive algae, and the monitoring dataset now spans over 10-years, documenting positive changes in algal biodiversity, especially reduction in the target removal species. The semester-long interaction with MM professionals and community members offers KCC students a richer lab experience, deepens community ties, and broadens career perspective. The majority of students reported good or great gains for both course content knowledge and community connection. Our partnership can serve as a model to both engage undergraduate college students in science and generate much-needed data through citizen science.

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Place-Based Conservation Planning: A Forum to Help Identify and Prioritize Resource Needs and Guide Decisions for State-Funded Acquisition of Private Land

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As an island state with limited space, Hawaiʻi relies on strategic management to ensure that resources—from critical watershed and coastal habitat to areas of significant cultural or recreational importance—will not be abused or destroyed. The Hawaiʻi Department of Land and Natural Resources (DLNR) is mandated to plan for the acquisition of land that protects resources for public benefit. DLNRʻs Legacy Land Conservation Program (LLCP) applies a place-based conservation approach to identify, prioritize, and conserve lands that hold exceptional, unique, threatened, and endangered resources. LLCP works collaboratively with grantees who represent a wide range of conservation needs, selected through a competitive grants process. Identifying and comparing place-based resource values and conservation needs is a crucial component of LLCP's selection process, enhancing communication, collaboration, and equity for grantees and the communities that they serve.

During this forum, LLCP staff will describe the public process for evaluating locations and allocating funds for land acquisition. Then, participatory break-out groups will evaluate sample applications from previous awards, such as Kānewai Spring (Oʻahu), Waikapuna (Kaʻū, Hawaiʻi), Puaʻahala (Molokai), and Upper Kūkaiau Ranch (Mauna Kea, Hawaiʻi). These staff-facilitated sessions will aim at (1) identifying and assigning value to place-based resource qualities and (2) applying these findings to improve the planning process that guides LLCP land acquisition. Groups will present key findings from the break-out sessions prior to forum conclusion and LLCP will circulate detailed post-conference notes to all participants. This place-based conservation planning forum will promote collaboration and knowledge sharing among conservation practitioners across Hawaiʻi.

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A course-based undergraduate research experience resolves taxonomic uncertainty for oyster aquaculture and confirms the presence of *Ostrea stentina* in Hawaiʻi

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Course-based undergraduate research experiences (CUREs) are designed so that whole classes work to address a research question that is of interest to an identified community (*e.g.*, local; industry). In January 2019 we began implementing a pilot CURE to resolve the taxonomic identification of an unknown oyster of interest for the local aquaculture industry. Phenotypic plasticity in oysters makes them difficult to identify based on morphology alone, but their identities can be resolved using genetics. For this project, a class of undergraduate and graduate students at the University of Hawaiʻi at Hilo used DNA barcoding to verify the identities of known and unknown specimens from Oʻahu and Hawaiʻi. Students discovered that most of the unknown samples belonged to the *Ostrea stentina/aupouria/equestris*species complex. Phylogenetic analysis placed Hawaiʻi *Ostrea* alongside samples from China, Japan, and New Zealand, grouping them within the recently classified western Pacific *O. equestris*. This study expands the known range of *O. equestris* by providing the first verification of its occurrence in Hawaiʻi. To continue with this work, a new cohort of students began genotyping specimens from additional locations in January 2020, with a goal of better understanding the distribution of *O. equestris* in Hawaiʻi as well as verifying additional unknown species. Commercial oyster aquaculture in Hawaiʻi is being developed to address multiple purposes, including food production, environmental mitigation, and pearl farming. Course-based undergraduate research experiences offer one solution for solving knowledge gaps while helping to train the next generation of researchers and managers.

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Informing Biodiversity and Conservation Research through Hawaiian Language Nūpepa: Examples from the ʻIke Wai Project

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Hawaiian Language Nūpepa (newspapers) are a treasury of knowledge that document and provide insight to practices, traditions, and knowledge of old Hawaiʻi. With a mission to ensure Hawaiʻi's water security through research, education, and community engagement, the ʻIke Wai Project looks to our nūpepa as a foundational element of our research. To further local community and project member's understanding of wai, the Hualālai and Puʻuloa aquifers of Hawaiʻi and Oʻahu Islands were selected for their historical connection to wai and their distinctly different environmental and urban conditions. Nūpepa have enriched our understanding of wai by revealing environmental and biological characteristics, attributes, and a host of effective conservation management practices that are unseen to modern research practices and findings. Nūpepa have both reinforced research findings and/or informed us of different approaches to take. Most important, the knowledge uncovered in the nūpepa has been critical to our successes with the community. A number of community members have expressed that without the outreach efforts of the the Institute of Hawaiian Language Research Team (IHLRT), they would not have participated with the ʻIke Wai project. Furthermore, translation compilations by the IHLRT have been ʻIke Wai's most impactful gift to the community for their participation. This talk will discuss the ʻIke Wai method of approaching nūpepa for information relevant to the project's research, and will share two "storymaps" of the ʻIke Wai study sites developed by the project team.

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Habitat Use of Pueo (*Asio flammeus sandwichensis*) in Hawaiʻi

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Short-eared owls are a globally distributed species experiencing significant annual declines. Most short-eared owl research originates from temperate and continental systems where short-eared owls are described as vagrant grassland specialists. In Hawaiʻi, the endemic pueo subspecies (Hawaiian short-eared owl; *Asio flammeus sandwichensis*) inhabits an extremely different ecosystem composed of isolated and heterogenous subtropical islands. We aimed to describe seasonal migration and habitat use patterns of pueo in Hawaiʻi, where we hypothesized that pueo exhibit higher site fidelity, fewer nomadic movements, and utilize a broader range of habitat types than their continental counterparts. In this study we deployed VHF transmitters on four pueo captured on leeward Oʻahu. Transmitters lasted for 3-months with one harness failing prematurely and one mortality, likely due to collision with a communications tower, leaving two with greater than 50 relocations. Throughout the duration of the study pueo did not exhibit migratory behavior and maintained stable home ranges averaging 482 acres. Pueo were found roosting almost exclusively in patches of forest and foraging in mowed fields with some observations of foraging near human structures. These results suggest that pueo are less vagrant and utilize a broader range of habitats than their continental counterparts. The non-migratory status of pueo indicate that conservation of habitat at scales of about 500 acres are appropriate and habitat use results suggest the importance of forested and open habitat. These findings will help guide conservation actions that will allow pueo populations to thrive across the Hawaiian Islands once again.

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Land-based Pollutants in the Reef Fishes and Sediment of Maunalua Bay, O‘ahu

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In heavily modified coastal environments, habitat degradation has led to sedimentation, runoff, and an increasing concentration of pollutants on coastal reefs. In Maunalua Bay, O‘ahu the presence of anthropogenically derived chemicals, such as pharmaceutical compounds and nutrients, has been validated through numerous previous studies. Little work has been done, however, to examine how these pollutants may be affecting the fish species that are commonly targeted by fishermen, which has important implications for human consumers. In this study we build upon past work examining metal concentrations at sites around O‘ahu and Kaua‘i to look more specifically at a range of inorganic and organic pollutants in fish tissues, algae, and sediment from Maunalua Bay. We are working directly with local fishermen to collect the samples that we are using for this study to ensure that the sampling accurately reflects species that are commonly consumed. Sediment samples were collected at stream and harbor outflow areas spanning from Kahala Stream to the Hawai‘i Kai Harbor. We are collaborating with colleagues at NOAA, Conservation International, Mālama Maunalua, and UH Mānoa’s OPIHI Internship Program and have been working together with community members and students throughout the research process. Because of the breadth of the work that has been done in Maunalua Bay, including a recent extensive water quality study, we are able to contextualize our findings to contribute to a comprehensive understanding of how pollution in Maunalua Bay may be affecting reef fishes and the humans that consume them.

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Distribution of Avian Malaria in Native and Non-native Forest Bird Communities Across Hawai‘i

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Habitat destruction, introduced predators, and diseases have decimated the diverse, endemic native forest bird community of Hawai‘i. In particular, avian malaria, vectored by the introduced *Culex quinquefasciatus* mosquito, has caused dramatic declines and extinctions in many native bird species that are highly susceptible to the disease. Traditionally, avian malaria has been absent from forests above ~1,500 m where temperatures are too cool for growth of mosquitoes and the malaria parasite. However, increases in local temperatures from global warming appear to be allowing the disease to move into higher elevation forests. In order to understand the distribution and prevalence of malaria compared to historical studies, we collected and analyzed over 2000 blood samples from avian communities at varying elevations across the main Hawaiian Islands from 2019–2020. Prevalence varied widely by species and location, and provides important insights into the distribution of disease and which species are important for transmission. We will present the results by site, and evaluate associations with elevation, precipitation, temperature, and species. Understanding environmental correlations of disease prevalence is important to help mitigate anthropogenic impacts associated with invasive species and climate change, specifically with addressing the challenges associated with species translocation.

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Discovery of a new red limu with invasive traits at Manawai, Papahānaumokuākea Marine National Monument

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The Papahānaumokuākea Marine National Monument (PMNM) is one of the largest marine conservation areas in the world, and supports a high diversity and abundance of native marine flora and fauna. Manawai, or Pearl and Hermes Atoll (PHA), is located in the northern reaches of PMNM, and contains over 1100 km^2 of pristine reef. In 2015, small patches of an unknown red limu, or alga, were noted at PHA. By July 2019, expansive mats of this new alga in the genus *Chondria* were found at PHA from 1 to 21 m depths. The algal mats smothered native corals and limu, becoming unattached in shallow water and abrading benthic assemblages. The alga was observed from the edge of the back reef to fore reef, but was not observed within the lagoon interior or at mesophotic depths. Stable isotope analyses of tissue $\delta^{15}N$ ranged from 2.2-3.4‰, suggesting its distribution was not influenced by anthropogenic or shore-based processes (like seabird guano) during the time period of collection. However, the %N in algal tissue ranged from 0.95-2.75%, with the highest concentrations at northern sites, suggesting enrichment by other processes may be occurring. This alga with invasive traits poses a serious threat to coral reefs in the Pacific given its high abundance, mat-forming morphology, and fragmentation potential. Additional studies on its reproductive phenology, physiology, growth, and removal efficacy are needed to assist in the management and containment of this new species with invasive traits.

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Honuanuiakea: Paa ke kahua o na kapu a kanawai i ka hana loko ia (Honuanuiakea: Reestablishing kapu and kanawai in loko ia practice)

Kalaionamoku Kanakaole[1]

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Honuanuiakea is a facilitation process that leads a selected group of experts through specific traditional Hawaiian chants and stories to interpret and analyze with the goal of utilizing the groups expertise to produce specific kanawai (guidelines) and kapu (rules) on how our practice, research, and projects should interact with our natural resources. The information collected through this facilitation is recognized as kupuna data or ancestor knowledge that has been coded in the form of mele (song) that has been composed through generations of environmental observation. For this presentation, this process was conducted with fishpond and marine ecology experts to determine kapu and kanawai for the practice of loko ia (fishpond).

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Metabarcoding of fecal samples to determine foraging ecology of two insectivorous honeycreepers

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The Hawaiian honeycreeper lineage is one of the quintessential examples of adaptive radiation. The extreme geographic isolation of and habitat diversity within the Hawaiian Archipelago has resulted in a lineage whose members are believed to occupy distinct dietary niches. Prior dietary analyses on Hawaiian honeycreepers have relied on non-molecular techniques, specifically through morphological identification of prey fragments in fecal samples and visual observation of prey consumption. These methods introduce inherit bias in the types of prey identified, specifically favoring large-bodied species with thick exoskeletons. Using a novel molecular metabarcoding technique, I have sequenced DNA in bird fecal samples to identify consumed prey while minimizing previously mentioned biases common in prey species detection. This current project will determine the degree of dietary specialization and overlap in two strictly insectivorous Kauai endemic species, the ‘akikiki (*Oreomystis bairdii*) and the ‘akeke’e (*Loxops caeruleirostris*). Preliminary analyses of their fecal microbiomes, which are known to be greatly influenced by diet, indicate that the two species have very distinct microbiomes. This suggests that despite occupying overlapping home ranges and maintaining insectivorous diets, there may still significant separation in dietary specialization. Understanding the dietary composition can improve our understanding of the functions involved in the ecosystem as a whole. This is especially important for endangered species, like the ‘akikiki and ‘akeke’e, because it may aid in identification of critical habitat for protection or restoration and a clearer understanding of the cause for their decline in the first place.

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Evaluating Policy of the United States Intended to Reduce Vessel Strikes to Large Cetaceans in the Pacific

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Vessel strikes are one of the leading human induced threats to cetacean conservation, especially large whale species that are particularly vulnerable to injury or death from vessel collisions. In areas where increased shipping activity coincides with seasonal migration, foraging, and breeding; such as the ports of O‘ahu, San Francisco area, and inland waters of Washington, the potential for cetacean-vessel interaction increases significantly. In efforts to address this threat to species biodiversity, the Marine Mammal Protection Act, Endangered Species Act, and localized progressive monitoring and modeling have been utilized to reduce vessel strikes from occurring within domestic waters. Despite these efforts, estimated and reported collisions involving large cetaceans have significantly increased throughout the Pacific. Federal and state policy, reported collision statistics, and current primary literature show that data discrepancies and knowledge gaps relating to underreported vessel strikes limit conservation efforts. The presentation will provide recommended initiatives to inform conservation efforts are recommended through the improvement of vessel strike data accuracy, increased implementation of at-sea monitoring, and the improvement of ship strike mortality modeling. Place-based management and policy implementation pertaining to Hawai‘i specific populations, regional traits, seasonality, and vessel classification will allow for a better chance of reducing vessel strikes and developing a more sustainable relationship with the cetaceans that hold such a cultural significance to Hawai‘i.

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Redefining Ecosystem Based Management Units in the Hawaiian Archipelago Using Pooled RADseq Approaches

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Restriction site-associated DNA (RAD) sequencing allows for the identification of genetic markers, spanning a genome. This is a cost-efficient method for surveying population differentiation to obtain a high-resolution view of population structure and determine boundaries of gene flow in non-model organisms. Differentiation between pools of individuals can be used to infer boundaries when spatial patterns are present (vs differentiation uniformly distributed between populations). Using few genetic markers, Toonen et al. 2011 identified boundaries to gene flow across the Hawaiian archipelago in dozens of species. Here, we evaluate the value of using pool-seq as a genome-wide single nucleotide polymorphism approach to assess genetic differentiation among populations. Pooled sequencing (pool-seq) reduces cost per sample when surveying many individuals and may be particularly well suited for gathering population genetic information across many individuals and broad geographic areas. However, analyzing pooled data remains computationally challenging and unstandardized. Several programs have been developed specifically to handle pool-seq data, unfortunately, most still require heavy formatting or programming skills. Using a ToBo lab developed pool-seq pipeline (AssessPool) we identified differentiated loci to compare population structure for a subset of five species used by Toonen et al. 2011 across the Hawaiian Archipelago. Pool-seq approaches grant the statistical power to identify genetic differentiation at a finer resolution than previously assumed. Understanding how genetically distinct populations are has widespread implications for ecosystem-based management practices, and pool-seq approaches allow for a cost-effective approach to further evaluate multispecies regions in the Hawaiian Archipelago.

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Removal of Non-native Predators on A Navy Base to Conserve Native Species

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The Pacific Missile Range Facility (PMRF) is a relatively small U.S. Navy installation with sites ranging from sea level to mid-elevation (roughly 1524m). PMRF and a Pacific Cooperative Studies Unit (PCSU) Project jointly manage the natural resources of the base. Utilizing the installation and the immediate surrounding area are 17 threatened and endangered (T&E) species: birds, plants, insects, mammals (Hawaiian Monk Seal (*Neomonachus schauinslandi*), Hawaiian Hoary Bat (*Aeorestes semotus)*) and Hawaiian Green Sea Turtle (*Chelonia mydas*). One strategy to manage for these species' safety, wellbeing, and abundance is to control introduced predators such as feral cats (*Felis catus)*, rats (*Rattus* sp.), and Barn Owls (*Tyto alba)*. These introduced predators reduce local populations of native species and impact global populations as well. The PCSU Predator Control Team reduces and removes introduced threats to T&E species. Since 2017, when the partnership between PCSU and PMRF begam, over 275 cats have been removed from PMRF, reducing predation and the threat of *Toxoplasmosis gondii*. Evidence has been found that at least one cat has consumed an endangered Hawiian Gallunile (*Gallinula galeata sandvicensis)*. More than 100 rats have been incidentally caught in feral cat traps and in Goodnature traps. We are currently working to implement a Barn Owl removal project to protect not only T&E species, but also Migratory Bird Treaty Act species, such as Wedge-tailed Shearwaters. The mission of the joint project between PCSU and PMRF is to increase our abilities to more effectively protect native species present via control of non-native predators.

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Moʻolelo and Management: A Review of Hawaiian Literature towards Culturally Competent Place-Based Stewardship

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Papahānaumokuākea is the remote region of the Hawaiian archipelago that was recognized as a ritual center of power for Hawaiian belief systems which has become a Marine National Monument. This exploration was conducted to answer the question: how does the traditional role of these places translate into and/or inform management now? This presentation is a review of an exploration into a series of moʻolelo (epic, story, narrative) to further examine the cultural history of Papahānaumokuākea, more specifically, Kuaihelani, in an effort to further inform the means by which cultural, place-based management are incorporated within the area. This research is an effort to reinforce the concept of cultural continuity across various ʻāina to battle the discursive narratives that have ultimately led to a disconnect from place which has left ample room for mismanagement of place and its resources. The cultural practices, values, and wahi pana (storied places) that are found within the Hawaiian language texts build a foundation of understanding of the cultural history and therefore, the role and importance of these places within conservation efforts and the broader Hawaiian worldview. When compared to the contemporary history and methods of conservation, the implementation of Hawaiian language sources has the potential to serve as a part (if not a majority) of a cultural competence metric of management that can be applied both system wide as well as in a specific place.

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Subterranean Biodiversity of the Island of Hawai'i: Insights Into the Evolution and Diversification of Cave-adapted Planthoppers

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Island lava tubes harbor arthropod community assemblages with complex food webs based on nutrients provided by roots from the native 'Ohi'a lehua tree (*Metrosideros polymorpha*). These sensitive ecosystems represent hotspots for understudied biodiversity. To date, 74 troglobiont species have been described from across the main Hawaiian Islands. Of these species, 44 have been documented on the Island of Hawai'i, where we focus on understanding subterranean biodiversity in the context of community assemblages from different volcanic flows. Cave-adapted species of several genera found in lava tubes from multiple volcanic systems (e.g., Kīlauea, Mauna Loa, Hualālai), indicate that either similar species assemblages evolved independently over time, or that there are complicated routes of dispersal among flows from these separate volcanoes. Bioinventories documented significant range expansions for previously described species, and revealed new cave-adapted species, including undescribed and cryptic cave-adapted planthopper species (Cixiidae) that feed on sap of 'Ohi'a roots inside the lava tubes. Based on preliminary genetic work, we find evidence for distinct and divergent planthopper populations across lava tube systems found in different aged flows. The planthoppers harbor obligate microbial partners that provide to the hosts essential amino acids and vitamins that are lacking from the nutrient-poor food source. Therefore, as keystone species, planthoppers are an important trophic level in the subsurface ecosystem, and understanding their biodiversity is critical for conservation efforts of these unique subterranean ecosystems, which also include conservation and protection of Ohi'a forests on the surface.

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Working Together for Clean Water: Developing a Pathway to Integrate Community Feedback for a Successful Hawai‘i Cesspool Conversion by 2050

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Hawai‘i’s water is impacted by 88,000 cesspools discharging approximately 53 million gallons per day of raw sewage into groundwater and nearshore systems, threatening tourism, human health and coral reef health across the State. In 2018 Hawai‘i Legislature passed Act 132 to support the conversion of all cesspools by 2050 to mitigate impacts to groundwater, human health, and marine ecosystems. Act 132 established a cesspool conversion working group whose purpose is to develop a long-range comprehensive plan for cesspool conversion across Hawai‘i. Due to the geology of each island there is no “one size fits all” solution and each island has individual hurdles to overcome in order to reach the 2050 goal.

Homeowners and community members will be the most impacted by the transition. In 2019, the Coral Reef Alliance (CORAL) developed *Working Together for Clean Water: A guide to help Nonprofit Organizations and Community Groups prepare to transition from cesspools to improved residential wastewater infrastructure*. This collaborative session will engage stakeholders from each island who are interested to support the 2050 initiative in a successful transition to secure Hawaii's drinking water and coral reefs. We will guide participants through a facilitated discussion to gather questions and concerns around wastewater impacts and cesspool conversion and implementation by island. CORAL’s goal is to integrate session feedback into a final tool of the *Working Together for Clean Water Guide* which will be shared with the State of Hawai‘i Cesspool Conversion Working Group to address community concerns, of which CORAL is a member.

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(re)Establishing **Pilina**: Understanding the Relationship Between Communities and ‘Alae ‘Ula.

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Kānaka (native Hawaiians) have lived under the guiding principles of pilina (relationships), mālama (to care for), and ‘āina momona (abundance) which encourage reciprocal relationships with the environment. Pre-contact, these principles were common in daily life in traditions such as wetland agroecological practices of lo‘i. Lo’i are irrigated terraces that range from patches of mature kalo to fallow patches with only mud. These are important because they may expand the available habitat for the endangered ‘alae ‘ula (Gallinula galeata sandvicensis, Hawaiian gallinule). Pilina between ‘alae ‘ula and kānaka has been documented through the appearance of this manu (bird) in ka’ao (myths), mo’olelo (stories), mele (songs), and ‘olelo no’eau (proverbs). The ‘alae ‘ula have served as omens, place descriptors, knowledge keepers, and ‘ai (food). This study used grounded theory to explore themes that arose from (1) archival research and (2) interviews with lo’i farmers to understand the historic and current relationships between community members and an endangered species. Understanding how the meaning of the ‘alae ‘ula‘s presence and voice has evolved over time will help to guide management decisions for the recovery of this endangered species.

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Hawaiʻi Drought Knowledge Exchange

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Recent severe El Niño-related drought events and long-term drying trends have negatively impacted landscapes, watersheds, and near-shore areas in Hawaiʻi. Climate variability, climate change, and drought will continue to impact natural resources as future projections suggest continued drying trends in Hawaiʻi, especially in leeward areas across the State. As novel climates emerge, particularly hotter and drier conditions, it is critical that scientists produce locally-relevant, timely, and actionable science products, and that managers are able to access them. While land managers are often tasked with utilizing the "best available science", they may be unaware of or unable to access available data products as there is no centralized, drought-focused information clearinghouse or formal mechanism to engage with scientists. Both managers and researchers have identified that a knowledge exchange process is needed for drought in Hawaiʻi to allow for formal collaboration between the two groups to co-produce drought data and products. To address this need, we established a new program to pilot a focused drought knowledge exchange process between the research community and resource manager user groups, thereby expanding the utility of drought-related products for resource managers. Through collaborations with three partners, we demonstrate how managers can take a more active role in the research process and how more timely and relevant drought-related tools that can inform management planning on different time scales. This project outlines the process for increased collaboration between scientists and managers, and demonstrates the benefits of translated, customized, co-produced drought and climate data products.

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Differential Change in Indigenous Versus Endemic Plant Cover Over Time Across Abiotic Gradients in an Invaded Hawaiian Landscape

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Endemic island floras are often vulnerable to anthropogenic disturbance and species invasions, and the Hawaiian Islands have a particularly high degree of endemism. Abiotic site conditions have also been shown to influence the invasion process. However, it is relatively unknown to what degree indigenous and endemic Hawaiian plant species are differentially affected by anthropogenic impacts across abiotic gradients in the long-term. We revisited 25 plots ($400m^2$) that were previously established in Kahana Valley (1978) and the Pahole Natural Area Reserve (1991) on the island of O‘ahu, Hawai‘i and visually estimated (Domin-Krajina cover-abundance scale) plant species cover. We measured slope, elevation, precipitation, and understory light availability using a clinometer, GPS, rainfall atlas, and light sensor bar, respectively. We analyzed the effect of these abiotic factors on the cover of endemic, indigenous, and non-native plant species in previous and current surveys, and the change in cover between surveys. Endemic species lost cover since previous surveys, while indigenous species cover increased, as did that of non-natives. Endemic species cover was positively associated with elevation and slope; change in endemic species cover was negatively correlated with precipitation. These results indicate that site accessibility and availability of precipitation were more important determinants of endemic cover than indigenous cover, and endemic species are more susceptible to decline. The disparity in cover change trajectories between indigenous and endemic species suggests that generalizations about natives as a single group may be misleading, and more intensive efforts may be required to maintain native endemic species in Hawaiian forests.

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Conservation Management Prioritization by the State of Hawaii Division of Forestry and Wildlife

David Smith[1]

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Resource managers face many decisions on how to allocate conservation efforts effectively. Among the considerations are conservation urgency, maximizing effectiveness of conservation actions, agency/staff capacity, and funding. The Hawaiʻi Division of Forestry and Wildlife (DOFAW) manages nearly one million acres statewide, including many important conservation lands and habitats. Efforts to keep currently listed native species of plants and animals from going extinct is an enormous challenge; expanding focus to include non-listed but conservation-reliant species makes this an even greater task. In this presentation the conservation strategies taken by DOFAW will be described, initially focusing on one of the most conservation-reliant species, the Alala, then expanding the discussion to conservation efforts focusing on multi-species conservation areas and conservation at the landscape level.

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Analyzing the microbiome of five macroalgal species from Oneʿula Beach, ʿEwa, Oʿahu

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Advances in high-throughput sequencing have allowed for microbiome studies on natural and artificial microbial communities permitting a deeper understanding of how microbes might be influencing or controlling host and biome health. The ocean represents the largest biome on earth, however, we've only begun to understand the diversity and function of microbial inhabitants, and know even less about their interactions with limu, or macroalgae. Macroalgae play an integral role in overall ocean biome health through the formation of habitat and in food web dynamics. Previous studies have focused either on the microbiome of a single algal species or a single algal species and its interaction with a limited number of microbes. This project aims to understand and provide baseline data on the microbial communities of five species of intertidal macroalgae. Representative species from the Chlorophyta (green), Phaeophyceae (brown) and Rhodophyta (red) phyla were collected from Oneʿula Beach at low tide in May 2019. Additionally, this collection included, diversity of calcification levels, morphologies of algae and both native and invasive species. From this collection, total DNA was extracted. Using universal bacterial primers, the SSU rRNA gene was amplified for high-throughput sequencing to elucidate the core and variable algal microbiome. This study will represent a great advance in our understanding of algal microbiomes and their connectivity. In particular, it will provide further insight in comparing native and invasive algal species in the intertidal, which may have a significant effect on overall ecosystem function and health.

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Ka wai ola: The living waters of Hawaii

Kiana Frank[1], Gwen Jacobs[1], Eric Attias[1], Leah Bremer[1], Kimberly Burnett[1], Gregory Chun[1], Henrietta Dulai[1], Niels Grobbe[1], Nicole Lautze[1], Jonghyun Harry Lee[1], Diamond Tachera[1], Brytne Okuhata[1], Sheree Watson[2]

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As researchers within the ‘Ike Wai project, we are building off the ‘ike (knowledge) and values of the Hawaiian people to restore and rebuild our understanding of wai (water) in the context of our time and our place as a data-driven mechanism to support the best decision-making, management and policy around the sustainability of water. This requires us to understand, just as our kupuna (ancestors) did, where the water comes from, where it goes, how resources are connected, what is the the impact of our management practices on the yield and quality of that water and the impact on the health of our ecosystems. We focus our interdisciplinary sampling efforts spanning from geophysics to microbial geochemistry across the region of Kona from the summit of Mauna Kea to the depths of Kahalu‘u bay to constrain and refine our understanding of submarine hydrology. Here, I will share integrated data across all our work in the context of ‘ike kupuna (ancestral knowledge) to frame and provide some high level answers to primary ‘Ike wai science questions, emphasizing what transdisciplinary/transepistimological research looks like, and best practices in water research with community. By examining mo‘olelo, mele, and oli of Kona through scientific lenses, we can begin to decode the insight left to us by our kupuna – bridging cultural and historical knowledge with contemporary knowledge systems – to better understand the relevance of these stories today and perpetuate the restoration, sustainability and resilience of our water resources.

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Ready, Set, EDRR (Early Detection and Rapid Response)! Application of WorldView-3 High Resolution Satellite Imagery for Landscape-level Remote Detection of Invasive Pines on Haleakalā.

Jonathan Marshall[1]

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Invasive pine trees (*Pinus spp.*) pose a significant threat to the diverse native ecosystems of Haleakalā National Park. Nearby established pine forests and recent fires have resulted in an influx of pine seeds into the montane East Maui region. Haleakalā National Park is home to scrubland and sub-alpine ecosystems that are crucial habitat for many endangered Hawaiian plants and animals. Control of newly established pine populations is vital to prevent competitive exclusion of essential native habitat. Due to the remoteness of this region, early detection is crucial for successful control. Traditional field and airborne reconnaissance methods often lack the ability to comprehensively detect remote incipient populations or are too expensive to use frequently. To improve detection capability, we examined the utility of WorldView-3 satellite images and software land cover classifiers to map pines across East Maui. This method relies on the ability to spectrally identify pines and also differentiate from surrounding vegetation types. We compared imagery from 2016 and 2019 to assess the presence of pine trees within conservation areas and to monitor ground and aerial control through mortality detection. Post-classification accuracy assessment and field surveys have verified an >80% agreement between detection and validation datasets. The results of this project provide a basis for adding a remote sensing component to invasive species management at Haleakalā National Park and will be used for improved prioritization of control efforts and to assist post-control monitoring.

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Managing, Sharing, and Using Biological Information: A Brainstorming Session on Information Needs in Hawai‘i with Natural Resource Managers and Hawai‘i Biological Survey (Bishop Museum) Scientists

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[1]Bishop Museum, Honolulu, United States, [2]U.S. Geological Survey, Hawai‘i National Park, United States

What information is needed to effectively manage native and nonnative organisms in Hawai‘i? How do we organize, share, and use that information? How can we do it better going forward? In 1992, the state legislature established the Hawai‘i Biological Survey (HBS) as a Bishop Museum program dedicated to compiling a comprehensive species checklist and maintaining a reference collection of all plant and animal species – terrestrial, freshwater and marine – native and introduced – within state boundaries. As a result, Hawai‘i is the only state with a complete species checklist. The Museum has also databased and georeferenced most of its collections from Hawai‘i – over five million specimens – and we are now ready to design new digital tools and services to make this information maximally useful to government agencies, conservation NGOs and other partners and stakeholders. With dedicated research staff in botany, entomology, ethnology, ichthyology, malacology, zoology, molecular biodiversity, and cultural resources, HBS has significant capacity to provide essential information to aid in native ecosystems management, the selection of protected areas, the restoration of degraded habitats and the detection and eradication of invasive species, agricultural pests, and species that pose human health risks. We want to learn how best to design our resources to meet stakeholder needs. This forum will involve small-group discussions facilitated by Bishop Museum curators with the aim of creating a framework to guide the development of HBS resources. This is particularly important now as we confront imminent existential threats to Hawai‘i’s unique biodiversity.

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Hawaiian Anchialine Ecosystems: Inventory Status, Restoration Efforts, Community Engagement, Policy Initiatives & Announcing the 5th International Symposium

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Estuaries exist at that critical aquatic intersection between fresh (wai) and saltwater (kai) systems. These highly productive transitional habitats (muliwai) provide essential habitat for various organisms (fishes, invertebrates, limu) and provide valuable resources, but also lie at the interface where threats from human activities and sea level rise converge. With only 1,000 known habitats worldwide, anchialine pools (loko wai ‘ōpae or kāheka) are abundant in Hawai‘i but relatively rare globally. A conservative estimate of anchialine pool complex counts statewide totals 580, however many were lost and several new pools were created during the 2018 lava eruption event in Puna. Scientists around the globe and in Hawai‘i have studied these unique anchialine ecosystems for decades. However, while our knowledge base on anchialine ecosystems continues to grow, we are in a race to apply best management strategies to protect these valuable ecosystems amid climate change and human impacts. Project collaborators will present a status update on the 2016 inventory conducted by state biologists, share ongoing restoration efforts happening within the community-based Hui Loko network (Hawai‘i Island fishpond and anchialine pool group), highlight policy initiatives to protect these fragile habitats, provide a summary of available local anchialine research, and introduce the 5th International Symposium on Anchialine Ecosystems (5ISAE) that is scheduled on Hawai‘i Island in late 2021. These symposia are held every three years and this 5ISAE event will be the first time this global community of anchialine scientists and explorers will convene in the Pacific Region (and in the USA).

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Abundance under threat: Securing seabird habitat in a changing world

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Rapidly rising sea level in response to global climate change imperils island ecosystems. The low-lying islands and atolls of Papahānaumokuākea are experiencing accelerated loss of habitat, with some models predicting a 25% decrease in land by the end of the century. Fourteen million seabirds representing 21 species make this the world's most abundant collection of tropical seabird colonies. It is expected that some species will relocate to suitable habitat on higher ground when faced with crowding, increasing disturbance from storm events, and ultimately, disappearing territory. Here we present the first account of a breeding colony of Red-footed boobies ('Ā, *Sula sula*) on Maui, established in 2018. Data from regular monitoring reveal that the colony is expanding. The arrival of 'Ā is exemplary of what is expected as seabirds search for new colony locations on high Hawaiian islands; however, suitable locations are limited. Threats such as introduced predators (rats, cats, mongooses) and nighttime light pollution pressure established populations and drastically decrease the probability of successful colonization. In order for seabirds to persist throughout Ka Pae 'Aina o Hawai'i Nei, appropriate habitat that can support a functional native coastal community must be identified and protected. We present and discuss current projects along with a selection of possible sites for future protection. We aim to demonstrate how site selection criteria assess positive impacts for immigrant and resident seabirds as part of a greater island ecosystem that includes native plants, invertebrates, off-shore biota, and people.

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Optimal Resource Allocation to Minimize Human Impact on Wedge-tailed Shearwaters Nesting in Beach Parks on O'ahu

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Increasing numbers of Wedge-tailed Shearwaters (WTSH) nesting on O‘ahu suggest that offshore islet restoration efforts are leading to population recovery, but nests in recreational beach parks may be more likely to experience nest failure due to nest collapse. Recent studies suggest visual barriers at nesting sites may be effective in decreasing the incidence of burrow collapse. However, limited funds are available for seabird conservation on coastal lands managed by the City and County of Honolulu Department of Parks and Recreation (DPR). In this study we used a portfolio approach to identify the optimal combination of sites for installation of post-and-rope visual barriers, given budget constraints, at DPR beach parks on the Windward side of O‘ahu. The number of seabirds potentially supported by each protected area was calculated using O‘ahu offshore islet WTSH population densities. The cost for each site was calculated based on materials, excluding labor costs.With an optimization approach, our model determined which combination of sites would protect the greatest number of nesting birds at funding points between $500 and $6,000. The output of this model will indicate, for a given budget, which sites at which to install post-and-rope fences to maximize protected WTSH nests. This research provides park managers with a simple tool that identifies effective allocation of limited resources to achieve a conservation objective. Secondarily, this research demonstrates a method by which managers may identify funding amounts that significantly increase outcomes per dollar spent, for use in grant applications or rebudgeting across conservation portfolios.

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Estimating Streamflow Availability for Ecosystem and Human Uses Where No Streamgage Exists, State of Hawai‘i

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In Hawai‘i, management of the surface-water resources for many streams is hindered by a lack of quantitative information on the availability of water during low-flow conditions. Competition for limited water resources for instream and offstream uses has led to conflict between parties with competing interests in beneficial stream-water uses. The Hawai‘i State Commission on Water Resource Management establishes instream-flow standards that quantify flows necessary to protect the public interest in the stream water with consideration for existing and potential water developments, including the economic impact of restricting such use. Knowledge of low-flow characteristics is fundamental to establishing reasonable and defensible instream-flow standards. Furthermore, the use of stream water for agriculture and municipal purposes, traditional and customary Hawaiian rights, maintenance of ecologic balance, aesthetics, and recreation are factors that play a role in planning and management decisions. This talk will describe an approach to estimate natural streamflow availability under low-flow conditions for sites where streamflow data are limited or unavailable. The implementation of StreamStats, a map-based web application, allows users to select a point of interest on a stream where low-flow information is needed. This is a robust approach that addresses the data needs of different stakeholders and will lead to improved understanding of surface-water resources in Hawai‘i.

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Application of Water-Budget Models to Evaluate the Effects of Forest Change on Water Resources in Hawai‘i: Information Needs to Reduce Model Uncertainty

Symposia ID HCC2020-196

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Water resources for ecologic, cultural, and socioeconomic needs in Hawai‘i can be affected by changes in forest cover. To evaluate the availability of fresh groundwater under changing land-cover conditions, accurate estimates of groundwater recharge are needed. Water-budget models have been developed by the U.S. Geological Survey for estimating the spatial distribution of recharge in island settings. These models are useful for estimating the impacts of land-cover change on recharge and can help to provide critical information for evaluating the benefits of and prioritizing watershed management and biodiversity conservation efforts. One example includes the *Hawai‘i Groundwater Recharge Tool* (http://recharge.ikewai.org), a web application maintained by the University of Hawai‘i through the ‘Ike Wai Gateway, which allows a user to quickly evaluate how changes in land cover affect recharge for the island of O‘ahu. Another example includes the application of a water-budget model to estimate recharge across the island of Maui for a set of plausible land-cover change scenarios developed by the Pacific Regional Integrated Sciences and Assessments program (https://doi.org/10.3390/rs11243048). These example applications rely on critical inputs needed by the models to characterize hydrologic processes such as evapotranspiration, fog interception, and surface-water runoff for different types of forest species. However, species-specific information across their habitat range (and potential range) is limited, resulting in uncertainty in recharge estimates. This talk will describe selected sources of uncertainty for quantifying land-cover change impacts on recharge using these water-budget models and suggested future data collection and analyses needed to reduce the uncertainty.

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New Insights into the Life History of the Endangered Orangeblack Hawaiian Damselfly (*Megalagrion xanthomelas*) Learned Through Captive Rearing

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The endangered orangeblack Hawaiian damselfly (*Megalagrion xanthomelas*) was historically widespread on all the high Hawaiian Islands until habitat destruction and the introduction of nonnative poeciliid fish diminished populations. On O`ahu, one population remains at Tripler Army Medical Center (TAMC). Intending to establish additional populations on O`ahu, our group developed captive rearing protocols for both immature (naiads) and adult damselflies. Little detailed information exists on the life history of Hawaiian damselflies, and none have been bred through a full generation in captivity. During our reintroduction efforts, we have filled several temporal gaps in the life cycle of *M. xanthomelas*, including egg development time (15 days) naiad development time (65 days), and adult life span (up to 70-80 days). Importantly, after emerging as an adult, this species takes about 21 days to sexually mature. Rearing experiments revealed that naiad coloration is significantly affected by substrate coloration, and naiads fed a diet that included a variety of freshwater zooplankton developed slightly faster than naiads fed exclusively brine shrimp. We found that *M. xanthomelas* eggs at TAMC were sometimes attacked by a parasitoid wasp (Mymaridae: *Anagrus* sp.), which has not been previously documented in this species. During our most recent round of rearing, naiads experienced high mortality that we suspect was caused by a currently unidentified pathogen. Infected naiads have been sent for sequencing, and rearing protocol was modified to stop pathogen transmission. Captive rearing has yielded a wealth of information about this rare species, allowing us to refine our rearing and release protocols.

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Community Q&A - Restorative Energy Justice in Hawai'i

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Restorative environmental justice aims to advance the environmental justice framework beyond its frequent focus on disparate environmental harms and health impacts. A restorative approach attempts to uncover the latent role of colonization in contributing to environmental harms, better understand complex issues related to communities' social and cultural connections to natural resources, and support ongoing work toward cultural and economic self-determination. Restorative *energy* justice faces the challenge of mapping this framework onto an energy landscape that is often focused on questions related to energy technologies.

As Hawaiʻi implements its energy transition, we find an opportunity to tackle this challenge directly. The policies driving this once-in-a-lifetime transition are imbued with restorative concepts and phrases such as "energy independence," "self-sufficiency," "indigenous energy resources," "community resilience," and "protecting the interests of future generations." To give life to these concepts, it is necessary to first consider communities with greater complexity, acknowledging specific cultural values, history, socio-economic power, and group needs and goals. The questions that matter are not always the questions being asked by scientists, lawyers, or conservationists.

This Forum is designed to bring community questions into the Hawaiʻi Conservation Conference dialogue. Interviews and social media submissions will be used to source community-derived video questions about the energy sector, renewable energy development, fossil fuel reliance, and justice principles. Those questions will be answered and debated by a panel of energy and policy experts, each tasked with applying a restorative justice lens. Participants in the Forum will also be given live opportunities to discuss questions with the panel.

616

Place Based Innovations – Creating and Refining Data Collection, Analytics, and Project Management for Dry Forest Ecosystems

Sam Aruch[1]

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Data management while less than exciting (for most of us) is a daunting yet necessary task for land managers. Many people that work in the conservation field just want to be outside. They don't want to collect and manage data. They struggle to find the balance between data that informs management and the required information to satisfy grants and deliverables. This often results in wasted time and energy to collect and report on information that neither informs or measures impact. The diversity of work performed, remoteness of environment, and variety of user level present even more of a challenge to collect and mange useful and relevant information. Over the last several years we have worked with 100s of mangers to develop a placed based project management platform. Our emphasis has been on developing user friendly tools and work flows to make data available in real time to workers as well as analytics to measure impact and change over time. These tools include the ability to map restoration areas, track the demographics and frequency of volunteers, track individual rare plants from wild collections into the nursery and back out into the field, manage and review camera trap data, and many other use cases critical to managing hundreds to hundred of thousands of acres at a time. In addition to data collection we have adapted and developed tools for analytics and grant reporting. Using Puʻuwaʻawaʻa as a dry forest case study we will discuss the suite of tools we have integrated, the challenges inherent in developing and implementing these initiatives for field projects, and share success stories of projects that have successfully been able to measure, map, and share their impact especially.

617

Invasive Species and Climate Change: Building a New Community of Practice

Heather Kerkering[1], Laura Brewington[2], Jeff Burgett[3], Joshua Atwood[4], Christy Martin[5]

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Ecosystems in the Hawaiian Islands are being transformed by two large-scale, interacting threats: invasive species and climate change. The East West Center, U.S. Fish and Wildlife Service, Pacific Islands Climate Adaptation Science Center, Hawaii Invasive Species Council, and Coordinating Group on Alien Pest Species are exploring the perspectives and needs related to the confluence of invasive species management and climate adaptation. Initial research indicates that invasive species managers are concerned about the impacts of climate change but are not satisfied with the knowledge or information currently available to address these threats.

This forum will serve as an interactive dialogue about building a new Community of Practice (CoP) in the Hawaiian Islands around this issue. The objectives of a CoP would be to (1) identify priority lines of research, informed by managers, to examine the interactions between invasive species and climate change; (2) develop management strategies and actions to these combined threats, and strengthen existing successful approaches; (3) create space for engagement and communication of lessons learned; (4) facilitate a network of resource managers and researchers; and (5) promote relevant research and develop effective information-sharing strategies. The forum will begin with overview presentations, including the results of a recent survey of invasive species managers in Hawaii and coordination efforts thus far, followed by a facilitated discussion to explore topics highlighted by the survey and next steps to building a CoP. We encourage new and seasoned practitioners, managers, and researchers to participate and take advantage of this networking and information sharing opportunity.

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A Friendly Collaboration Between Private organizations, Government agencies, Humans and Machines to Improve the Efficiency of Using Camera Traps for Threat Detection and Management in Hawaii’s Ecosystems

A Friendly Collaboration Between Private organizations, Government agencies, Humans and Machines to Improve the Efficiency of Using Camera Traps for Threat Detection and Management in Hawaii’s Ecosystems

Sam Aruch[1], Mari Reeves[2], Lisa "Cali" Crampton[3]

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Machine learning is all the buzz these days. Tools and methods are advancing faster than we can adopt them. The challenge is to harness these innovations and make them usable to the teams that perform conservation and resource management. Camera traps are a popular tool to study Hawaii’s ecosystems. A typical camera can collect 10,000 photos a month. Some managers have over 100 cameras in the forest. It can take hundreds of hours to review and sort photos. This creates a huge time burden for managers to review and assess these images. There is an important need to quickly, accurately, and efficiently review hundreds of thousands of photos. Using open source tools and feedback from the field, we have developed and adapted manual and machine learning pipelines to sort camera trap data, automate threat detection, quality control the results, and retrain the models. We will discuss the story of our collaboration, current results, use cases, and next steps including how to sustain the collaboration and continue to iterate and innovate on our work.

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Hoololi Aina: Changing landscapes -Challenges in Wildland Fire Management in the Face of Climate Change

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Climate change has been a key factor in increasing the risk and extent of wildfires in the Western United States, including Hawaii. Wildfire risk depends on a number of abiotic and biotic factors, including temperature, soil moisture, and the presence of trees, shrubs, and other potential fuel. These factors have direct or indirect ties to climate variability and climate change. Climate change causes forest and grassland fuels to be more dry, and has doubled the number of large fires between 1984 and 2015 in the western United States. The average area burned per year in Hawaii has increased 400% over the past century.

Research shows that changes in climate that create warmer, drier conditions, increased drought, and a longer fire season are boosting these increases in wildfire risk. For much of the U.S. West, projections show that an average annual 1 degree C temperature increase would increase the median burned area per year as much as 600 percent in some types of forests.

Once a fire starts—more than 98 percent of Hawaii wildfires are caused by people—warmer temperatures and drier conditions can help fires spread and make them harder to put out. This Forum will explore the ways that communities, land managers and wildland firefighters can be proactive in their approach toward an increasingly flammable future for Hawaii's ecosystems and how to meet the challenges that climate change will create in the wildland-urban interface and our forested watersheds.

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Using Long Term Aquatic Monitoring Data to Inform Management Decisions

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The National Park Service Pacific Island Network (PACN) Inventory & Monitoring Program collects monitoring data including water quality, animal distribution and abundances, and water levels in various aquatic resources such as streams, anchialine pools, and wetlands in national parks throughout the Pacific. The PACN includes 11 protected areas on the naturally and culturally rich islands and archipelagoes of Hawai‘i, American Samoa, Guam, and the Northern Mariana Islands. These data are indicators of ecosystem function and inform resource managers on the effectiveness of landscape level management practices. Some examples include detection of new invasive species, changes in water quality parameters over time and installation of new stream gauges to monitor water flow. These projects require cooperation from various organizations that span the state, federal, and private sector. Long term data collection assists managers in stewardship of these critical natural resources to preserve them for future generations. Here we present our methods, recent findings, and long-term objectives.

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Place-based Conservation As a Way of Building Strong Pilina Between People and the Environment

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[1]Pacific Cooperative Studies Unit, Honolulu, United States, [2]Napuu Natural Resource Management, Kona, United States, [3]DOFAW, Kona, United States

The botanically and culturally rich area of Kona ʻākau nests the home of Nāpuʻupualukinikini or Nāpuʻu, comprised of the ahupuaʻa of Puʻuwaʻawaʻa and Puʻuanahulu. This area is notable for its prominent landscape and the biocultural resources it provides within the dry region of Kekahawaiʻole. The introduction of invasive species amongst other things, has decimated the native dryland ecosystem of Nāpuʻu to a mere 2-5% remaining. Although much of the former native ecosystem has been lost, the current landscape still holds remnants of native biocultural diversity. Place-based conservation at Puʻuwaʻawaʻa is striving to restore the abundance of native biocultural diversity. The Outreach and Education Program of Nāpuʻu Conservation Project has been successful in connecting people to the landscape, sharing cultural practices and traditions, and restoring the native dryland forest of Puʻuwaʻawaʻa Forest Reserve. The program focuses on hosting community work days, educational service projects, and outreach events. Since 2016 over 300 groups have contributed their service by helping to plant more than 16,000 native plants of more than 60 different species. Puʻuwaʻawaʻa has also hosted four Bio-Cultural Blitz events and 13 Run for the Dry Forest events. Place-based conservation builds a strong pilina to place, fosters a sense of stewardship, and helps to build resilient communities. The community plays a key role in protecting the health of the forest, and it's with their participation and kōkua we see the vision of abundance becoming a reality.

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Midway Seabird Protection Project- A Multifaceted Rodent Eradication Project

Jared Underwood[1]

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The U.S. Fish and Wildlife Service plans to implement the Midway Seabird Protection project in the near future. Implementation of this project will protect the seabird population at Midway by removing invasive house mice from Sand Island, Midway Atoll National Wildlife Refuge. This removal is necessary to protect the largest colony of albatross in the world as well as 29 other species of birds that rely on Midway Atoll. On more than 500 other islands worldwide, invasive rodent removal campaigns have been successful and resulted in long-term benefits to native species with short-lived negative impacts to them from the eradication operation itself. The effort on Midway Atoll has many novel challenges including abundant non-target species, including on of the rarest ducks in the world, extensive infrastructure akin to a city built for 5,000 people, and a community of 50 people that live year round on the island. This presentation will update the conservation community on the status of this project. Focus will be on the challenges associated with such a complex project and creative and innovate methods that have been developed to deal with these problems.

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Improving Hawai'i's Genetic and Taxonomic Organism Inventory Using Autonomous Reef Monitoring Structures (ARMS)

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Part of maintaining Hawai'i's healthy nearshore reefs is promoting natural biodiversity and abundance. Aquatic Invasive Species (AIS) pose a threat to native ecosystems, thus understanding the distribution of non-native species is key to management. Harbors serve as the port of entry for introduced aquatic species as hull-fouling and ballast water are the primary vectors for marine introductions. In efforts to document species found in harbors and adjacent reef flats in Hawai'i's waters, the Division of Aquatic Resources' (DAR) AIS Team has begun a monitoring project that uses Autonomous Reef Monitoring Structures (ARMS). Twenty ARMS were deployed in May of 2018 in and outside of commercial harbors that included: Nawiliwili, Kaua'i; Kahului, Maui; Honolulu, O'ahu; Kalaeloa/Barbers Point, O'ahu; Hilo, Big Island. The first ARMS unit was pulled from Honolulu Harbor on August 12 and brought to the Bishop Museum for analysis and organism preservation. In collaboration with the Bishop Museum, DAR hopes to expand on the inventory of aquatic non-indigenous species and supplement genetic databases with confirmed taxonomic samples to better inform management.

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I Paʻa Hou i Kalou: Assessing the Potential for Biocultural Restoration at Waialeʻe, Oʻahu

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Given widespread historic landscape modification, current urbanization pressure, and projected climate change scenarios in Hawaiʻi, kīpuka (refugia) of biocultural resources which remain intact or possess high restoration potential are increasingly important to protect. Effectively doing so requires not only a thorough mechanical understanding of relevant Kānaka ʻŌiwi (native Hawaiian) resource management practices but a holistic understanding of the culture's worldview. This case study sought to develop such an understanding for Waialeʻe, Oʻahu by asking: 1) How can the natural and cultural resources of this place be understood through a contemporary Kānaka ʻŌiwi perspective? 2) What are the customary Kānaka ʻŌiwi resource management systems of this place? And 3) How might these customary resource management systems be restored? To address these questions, I utilized archival search, literature review, field methods, social approaches, and geospatial analysis. Key outputs include a comprehensive catalog of traditional place names and mythology; a characterization of customary land use practices including loko wai (freshwater fishponds), loʻi kalo (taro pondfields), and māla (diversified dryland agriculture); and a contemporary description of Kalou Marsh, which hosts the endangered endemic waterbirds ʻalae ʻula (*Gallinula chloropus sandwichensis*) and ʻalae kea (*Fulica alai*). This study suggests high potential for biocultural restoration at Waialeʻe; although the historic systems are not currently in active management, the natural resources necessary to support these biocultural systems remain relatively intact. In addition to assisting the biocultural restoration of Waialeʻe, this work stands to inform similar efforts at comparable sites.

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Using Geographic Information Systems to Model Sea Level Rise Refugia for Endangered Species

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Today, species numbers are dropping rapidly and more species are becoming endangered than ever before in human history. Therefore, it is important to protect earth's biodiversity in flora and fauna. Kauai is a hotbed of endemic species but is now threatened by something new: sea level rise. Sea level rise puts Kauai's critical habitats in harm's way – threatening the extinction of irreplaceable species. Using Geographic Information Systems (GIS) and free data available from the State of Hawai'i and the Federal Government, I determined which critical habitats are at risk from sea level rise. I created a GIS model to determine where climate refugia could be created on Kauai – the model examines sea level rise exposure areas and critical habitat and then factors in constraints like urban areas, ocean, other sea level rise areas, and elevation. This allowed me to identify potential refugia – or places the endangered species could migrate to. This model could be applied to the rest of Hawai'i and possibly the rest of the United States.

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TOXOPLASMOSIS IN HAWAIIAN SPINNER DOLPHINS

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Toxoplasmosis is becoming increasingly recognized as a threat to Hawaiian wildlife, including marine mammals. To date, fatally disseminated toxoplasmosis has been established as the cause of death in three Hawaiian spinner dolphins. One spinner dolphin death was reported in 1990 off of Mokuleia, Oahu. Two more recent spinner dolphin deaths have been investigated by the University of Hawaii Stranding Laboratory, one occurring in 2015 off of the Kona coast of Hawaii Island and the other in 2019 off of Waianae, Oahu. In the 2015 and 2019 cases, extensive diagnostic testing was conducted to better understand the type of toxoplasmosis infection and how this disease is impacting Hawaiian spinner dolphins. This included necropsy examination, histopathology, testing for *Toxoplasma gondii* by PCR in a suite of tissues from different organ systems, immunohistochemistry and genotyping. In both cases, *T. gondii* was found to be pervasive and was present in all major organ systems of the infected spinner dolphins. The type of toxoplasmosis that infected these spinner dolphins is represented by genotype #24, a genotype that has previously been described from feral pigs from Hawaii. Toxoplasmosis has not been detected in other whale and dolphin species inhabiting Hawaiian waters to date but the resilience of this parasite in the marine ecosystem makes it plausible that this parasite could be infecting additional whale and dolphin species. Felines are the definitive host for *T. gondii* but our understanding of how oocytes enter the marine food chain and infect spinner dolphins and other marine mammals is poor.

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Where We Are With ‘Alalā: the Ups and Downs of Reintroducing Hawaii’s Only Living Crow Species Back to the Wild

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The ‘Alalā, or Hawaiian Crow (*Corvus hawaiiensis*) is a federally endangered species which went extinct in the wild in 2002. A reintroduction effort has been underway since the fall of 2016, releasing ‘Alalā from conservation breeding facilities into the Pu’u Maka’ala Natural Area Reserve on Hawai’i Island. During that time, a total of 30 ‘Alalā have been released, making up the world’s only wild-living ‘Alalā. The released ‘Alalā have reached breeding milestones, yet have also faced numerous survival challenges. Intensive post-release monitoring has continued, yielding insights into their social interactions, movements, breeding behavior, and causes of mortality. We present data on the ‘Alalā released into Pu’u Maka’ala, their current status in the wild, and discuss what we have learned about planning and implementing future releases of this unique species. Finally, we will discuss tactics for monitoring and managing their movements, breeding behavior, supplemental feeding, and territoriality, in light of native and introduced threats and emerging challenges. The release and management of the species is the result of a multi-partner collaboration whose mission is to establish self-sustaining populations of ‘Alalā within their known historical range, fulfilling their ecological and cultural roles. We assess progress towards our goals, and highlight important steps on the path to ‘Alalā recovery.

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Assessing Social Networks to Better Manage for Abundance

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A wide diversity of community and civic groups engage in environmental stewardship, which sustains the wellbeing of Hawaii's social-ecological systems. An expanded understanding of how groups are connected could increase the effectiveness of stewardship, for example, by facilitating collaboration among groups or enhancing information exchange throughout networks. To this end, social network analysis is a valuable tool that can be used to assess the strength and complexity of organizational relationships in communities, identify new potential partnerships, leverage resources that can be shared, and remedy gaps in the network.

We applied social network analysis to better understand a community of stewards in Kona and Koʿolaupoko Districts on Oʿahu. The analysis is based on the results of a survey completed by 130 groups who engage in stewardship. The survey focused on group characteristics, types and locations of stewardship, and collaborations with other groups. Our results address the questions: 1) Who are the groups that broadly participate in stewardship and what are their motivations and goals; 2) How are these groups connected; and 3) Are there characteristics that are associated with highly collaborative groups?

We present examples of how social network analyses can be used to address pressing resource management questions. We also share how a group's characteristics, including their motivation, size of area stewarded, and age of group can predict how well connected they are and to which other types of groups they are connected. Our results can contribute to prioritizing resource management efforts and strengthening community capacity for place-based stewardship.

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Perpetuating ʻĀina Momona through Loko Iʻa Culture

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The Hui Mālama Loko Iʻa is a network across Hawaiʻi which includes over 60 fishpond and anchialine pool sites with more than 100 managers, stewards, and practitioners. The network is coordinated by Kuaʻāina Ulu ʻAuamo (KUA), and is comprised of non-profits, private landowners, cultural practitioners, and federal and state agencies who share a collaborative approach to restoring and maintaining these systems through community engagement, education and the perpetuation of traditional Hawaiian fishpond practices. Through collective discussions, sharing of knowledge and ideas, and supporting each others' projects in joint restoration efforts, each site is able to achieve more alongside their peers in the hui. The collective goal of the hui is to perpetuate ʻāina momona through loko iʻa culture.

In this workshop, kiaʻi loko (fishpond guardians and caretakers) will host virtual huakaʻi to share and teach key aspects of their management, such as environmental observation, fish monitoring, and fishpond infrastructure. Participants will learn indigenous approaches to science and resource stewardship in contemporary fishpond management.

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An Exploration of Historic and Contemporary Indigenous Urban Conservationism: Kipuka in Honolulu.

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The built environment strongly influences our ability to manage for abundance. The pressure Hawaii's large pre-contact population put on natural and living systems was mitigated via the "wao system," an ancestral conservation methodology which highly regulated practices in the different climatic zones ofahupua`a. This system, though greatly diminished post-contact, has become a powerful framework deployed by Kanaka Maoli planners in the articulation of a new Native urbanism that is concerned with the biocultural revitalization and conservation of the built environment and the green spaces within. When the Native population was forced to urbanize, specific urban cores became pockets of biocultural potency for these ancestral systems to radiate out of. Honolulu, as the urban center of the State of Hawai`i, is embedded with a wealth of these kipuka that support native and Polynesian-introduced vegetation and Hawai'i lifeways: 'Iolani Palace, Papakōlea, Hālau Kū Māna Public Charter School, Center for Hawaiian Studies; and Ka Waiwai, a Resiliency Hub curated by Waiwai Collective being key examples.

This presentation provides an opportunity to explore Honolulu's unique ingenious urban ecological biocultural heritage, with a careful eye to how our systems stressed the careful integration of people into living ecologies.

This presentation will also lift up the work of the Decolonizing Cities mini-conference. This year it will: question the current structures that limit integrated and whole systems planning; engage participants in hands-on activities to practice new ways of co-discovery and co-learning; serve as a prelude to an Indigenous Urban tour; and a closing meeting at Ka Waiwai.

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The Efficacy of the Wake Atoll Biosecurity Plan

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Prior to an attempt to remove two invasive rodent species from Wake Atoll in 2012, a basic installation biosecurity plan was written and implemented by the U.S. Air Force (USAF). Since the original biosecurity plan was somewhat rodent focused, in 2015 the USAF modified it to incorporate a broader array of interception tools and preventative measures, and a more detailed description of cargo flow for this site. This modified implementation plan, much like most implementation plans, has never been formally tested for efficacy. We attempted to evaluate the efficacy of biosecurity practices guided by the current USAF biosecurity plan for moving supplies via barge between Hawai`i and Wake Atoll. In Hawai`i, this included deploying interception tools in the cargo receiving and storage areas and assessing the condition of shipping containers to be loaded in and sent to Wake. Live animals were intercepted at all stages in shipping containers and cargo areas in Hawai`i and despite preventative measures, again in shipping containers received on Wake. Information shared during this presentation highlights the importance of biosecurity practices and how natural resource managers and pest control specialists can evaluate their efficacy. They can then use findings to make protocol changes aimed at reducing incursion risk and thus potential impacts to resources.

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Reframing Wahi Kūpuna: Research on the Physical Condition of Native Hawaiian Cultural Resources in Papahānaumokuākea and How it is only Part of the Story

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For more than a century, archaeological field studies on the islands of Mokumanamana and Nihoa, in the region now known as Papahānaumokuākea Marine National Monument (PMNM), were focused on mapping and documenting the physical condition of pre-contact Native Hawaiian archaeological sites, whose densities are among the highest in Hawaiʻi. The physical condition of these cultural resources has been impacted by multiple human and biophysical environmental disturbances including natural erosion, bioturbation by plants and seabirds, and the effects of climate change including more severe hurricanes. An assessment of the physical condition of these resources over the last 10 years will be presented. More recently there has been increasingly widespread recognition that the physical condition of cultural resources is only a part of their cultural integrity and heritage value. Innovative practitioners within the Hawaiian cultural resources management (CRM) community have led a resurgence in ʻŌiwi (Indigenous) institutions and methodologies and conducted (re)search on (k)new information and ancestral memories about the functions of cultural land- and seascapes. As PMNM celebrates 10 years as a natural and cultural World Heritage site and over two decades of protections, Hawaiian community leaders continue to be active agents of biocultural conservation and restoration in Papahānaumokuākea. A cultural paradigm shift driven by pae ʻāina (archipelago-wide) visions of ʻāina momona is occurring, transforming the way that PMNM co-managing agencies steward biocultural resources. This presentation provides a brief history of research on cultural resources, and several examples illustrating how the concept of cultural resources is (re)framed and implemented in PMNM management.

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3D SfM Photogrammetry and eDNA Methodologies for Assessing Coral Cover

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As coral reefs in Hawai'i are increasingly threatened by rising temperatures there is a need for new methodologies to accurately and efficiently monitor changes in coral cover, 3D structure, and diversity. Environmental DNA (eDNA) analysis is a fast and efficient method for understanding species distribution and diversity simply from processing water samples. This method has only been applied to coral reef communities once, revealing strong correlations in coral cover derived from visual estimates and eDNA analysis. We compared the coral cover derived from eDNA analysis with coral cover derived from high quality 3D models of the reef using Structure-from-Motion (SfM) photogrammetry. We amplified long fragments from 16S ribosomal DNA and cytochrome oxidase-1 genes and used primers to specifically amplify coral species found in Hawai'i. We investigated the relationship between coral abundance estimates from eDNA results and percent coral cover from high resolution 3D habitat maps. Our goal was to assess if the 3D habitat complexity of coral reefs in Hawai'i Island is driving biodiversity levels indicated by eDNA analysis. This study revealed the utility of the eDNA methodology for assessing coral cover, which will be valuable for monitoring and management of natural resources in Hawai'i.

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Determining symptomatic ROD phase duration from high frequency visible wavelength aerial imaging

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Beginning in 2016, the UH Hilo Spatial Data Analysis & Visualization laboratory has conducted monthly to bimonthly aerial surveys across eastern Hawaiʻi Island of native forest stands affected by rapid ʻŌhiʻa death (ROD) in different management and environmental settings. Repeat high-resolution (3-5 cm/pixel) visible-wavelength raw RGB imagery, collected via sUAS and helicopter platforms, is processed and used to generate geo-rectified orthomosaics and track the condition of every mature individual ʻŌhiʻa tree within each stand over time. We have found that ROD-infected trees typically go through a consistent sequence of visible decline, with their canopies progressing through four different stages: (1) chlorotic yellow, (2) bright reddish-brown, (3) post-peak drab brown, and finally (4) bleached white leaves, followed by complete defoliation. Better understanding the duration of these stages can assist in establishing appropriate monitoring schedules for the early detection of new outbreaks in high priority areas. Our results show that on average and across all sites, the chlorotic yellow stage lasts < 30 days, the bright reddish-brown phase lasts 57 (± 34), and the post-peak drab brown stage lasts 86 (± 55) days. Stage durations do differ across monitoring sites, suggesting that environmental variables may influence how quickly symptoms progress within an infected forest stand.

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The Symbiont That Could: Using *Wolbachia* to Reduce Disease Transmission in Hawai‘i

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Wolbachia is arguably one of the most successful parasites on the planet. An intracellular, maternally-inherited symbiotic bacterium, *Wolbachia* was first identified in 1924 from the common mosquito, *Culex pipiens*. *Wolbachia* occurs naturally in an estimated 60 percent of all insect species, including fruit flies, moths, dragonflies, and mosquitoes, such as Hawai‘i's non-native *Culex quinquefasciatus*, the vector for avian malaria and avian pox. In some host species, *Wolbachia* naturally induces a form of conditional sterility called cytoplasmic incompatibility (CI), which increases the relative fecundity of *Wolbachia*-infected females in the population. Subsequent research has shown that breeding and releasing male mosquitoes with a strain of *Wolbachia* that is incompatible with that found in wild females results in non-viable mosquito offspring. This discovery is being utilized globally in two different but effective management strategies, population suppression and disease inhibition, to address mosquito-borne human diseases such as malaria, dengue, and Zika. In Hawai‘i, a multi-agency partnership is working with mainland partners to develop a Hawai‘i-based *Culex quinqefasciatus*, transinfected with novel *Wolbachia* strain(s) (wAlbA and wAblB), as a potential biocontrol agent to help prevent the extinction of Hawai‘i's forest birds. This presentation will describe relevant biological characteristics of *Wolbachia,* review global applications and recent research, and consider technological challenges to its use in Hawai‘i.

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Maui Nui Wildlife Impacts of At Large Cats (*Felis cattus*) and the Failure of Trap Neuter & Release Programs

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Na manu kamaʻāina, native birds, both na manu kai and na manu ka wao akua, evolved over millennia without mammalian predators. Therefore they have no defenses or behaviors to protect themselves from the mammals that *Homo sapiens* brought to Ka Pae ʻĀina Hawaiʻi. While we do not have numbers for Hawaiʻi, in all of the United States cats alone kill approximately 2.4 billion birds every year making cat predation the largest human-caused mortality threat to birds. In this talk we will describe the pōpilikia of *Felis cattus*, the domestic cat, on previously abundant native Hawaiian wildlife. Feral cats exist in all areas of the islands, from urban to the most remote wilderness. Maui Humane Society estimated the cat population on the island of Maui to be 400,000. We will discuss the harsh realities of predation and the economic impacts of cats as predators of our native wildlife and identify the organizations working in Maui Nui to stem their depredation. Cats are the obligate host for *Toxoplasma gondii*, the Apicomplexa that causes Toxoplasmosis in mammals and some birds. Oocysts shed in cat feces survive in the environment for at least a year and are transmitting the disease resulting in deaths of ilio-holo-i-ka-uaua and nene. We will describe how the practice of Trap Neuter and Return (TNR) serves to maintain this disease in the environment and fails to reduce the number of cats on the landscape while leaving them free to predate our native wildlife.

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Race Against Extinction: Applying *Wolbachia* to Save Hawai‘i’s Forest Birds

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With climate change and increasing temperatures, disease-carrying *Culex quinquefasciatus* are expanding into the last refugia of Hawai‘i’s native forest birds. An effective, landscape-scale strategy is urgently needed to save these birds from extinction. *Wolbachia*-based mosquito suppression is successfully addressing the spread of mosquito-borne human diseases worldwide. These landscape-scale efforts are typically driven, managed, and funded at the national level, with projects occurring in relatively homogenous, urban or semi-urban areas. In contrast, the potential use of *Wolbachia* as an Incompatible Insect Technique in Hawai‘i would be the first conservation application of the technique, the first to occur in remote, often inaccessible, heterogenous forests, and the first to be locally driven.

This presentation will focus on the strategy and challenges to the successful release of *Wolbachia*-*Culex* in Hawai‘i, and its potential to save these birds. Successful deployment of the strategy depends on obtaining regulatory approval from appropriate State and Federal agencies and public support for the tool. Criteria development and a ranking process for initial trials and selecting larger area(s) for landscape-scale releases are also critical components. Mass rearing and delivery of *Wolbachia*-modified mosquitoes pose additional challenges. We will discuss the overall strategy of the multi-agency Steering Committee on Landscape-Scale Mosquito Control and outline relevant timelines and estimated costs for implementing this critical conservation action to save Hawai‘i’s forest birds.

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Cascading effects of Rapid ʻŌhiʻa Death on Hawaiian Forest Bird Communities

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The widespread and rapid mortality of ʻŌhiʻa lehua (*Metrosideros polymorpha*) as a result of Rapid ʻŌhiʻa Death (ROD), poses a serious threat to the diversity, structure, and function of Hawaiʻi's remaining native forests and the endemic plants and animals that depend on ʻŌhiʻa. ʻŌhiʻa is an important nesting substrate and food resource for both insectivorous and nectarivorous birds, and there is no substitute for the volume, geographic spread, and year-round source of nectar provided by ʻŌhiʻa. We used advances in recording technology and soundscape analysis tools to assess changes in bird communities in six forests across Hawaiʻi Island that varied in the percentage of ʻŌhiʻa mortality (20-95%). We used a paired design in each forest with four recorders in areas with ROD and four recorders in adjacent areas with less than 10% ʻŌhiʻa mortality (control areas). Contrary to our expectation we found higher soundscape indices values in ROD areas compared to adjacent control areas, suggesting a greater number of vocalizing animals (birds, crickets, frogs) in areas with increased ʻŌhiʻa mortality. However, differences in soundscape indices between paired ROD and control areas were driven by increased total vocalizations of non-native communities of birds and coqui frogs (*Eleutherodactylus coqui*) in ROD areas. In contrast, we found the total vocalizations of native bird species decreased in ROD areas compared to paired control areas. Overall, these results suggest a negative impact of ROD on native Hawaiian bird communities even in areas with low to moderate levels of ʻŌhiʻa mortality.

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Using Proteomics to Understand Coral Health of West Maui

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Local stressors are known to reduce coral resilience to bleaching from thermal stress events. A major local stressor on coral reefs is land based runoff. Land based runoff from urbanization has caused a decline in coral coverage and health off West Maui, especially at more stressed nearshore reefs. To evaluate the health of reefs of West Maui, 1 cm *Porites lobata* punches were collected at nearshore (higher stress) and offshore (lower stress) sites off Honokowai, and Wahikuli in April 2015, May 2017, and April 2018. Additional punches were collected from Olowalu in April 2017 at a nearshore and offshore site. Three corals from the same site were grouped in equal proportions for Liquid Chromatography-Mass Spectrometry (LC-MS) to identify proteins in each sample. Corals had unique protein expression profiles at each site, despite nearshore and offshore sites being less than 1 km apart. There is segregation by site (nearshore vs. offshore), location, and collection year. Corals from sites closer to land showed increased gene ontology enrichment in metabolism and vesicle coating across locations. Nearshore corals also had pathways activated for steroidal synthesis, which could be tied to detoxification. This data can be used to visualize the health of corals at sites along a gradient of anthropogenic impact. Proteomic analysis is a minimally intrusive way to diagnose coral health without using mortality as an indicator of stress on a reef. This method can be used to help managers understand the state of their reefs, and the factors causing stress on the reef.

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Mālama Pu‘uloa: Can a Community Clean Up a Superfund Site? Restoring Pearl Harbor to ‘Āina Momona

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Pearl Harbor, the largest estuary in Hawai`i, was historically `āina momona – a place of abundance. Today it contains a Superfund site, is surrounded by signs warning against the consumption of fish and invertebrates obtained from its shores and a shoreline choked with invasive mangrove. Environmental neglect and pollution both from marine and land-based sources has contributed to the decline of an area that historically supported a legendary marine fishery.

In response to environmental research and extensive site observations along the shoreline of Pearl Harbor, community members formed the 501(c)3 non-profit Hui o Ho`ohonua in 2015. This community non-profit, through its Mālama Pu`uloa (Care for Pearl Harbor) Program, has created a restoration momentum and is developing a set of approaches believed to be the basis for effective, long-term restoration of the area.

Hui o Ho`honua has focused these efforts at Kapapapuhi Point Park in West Loch, Pearl Harbor with a focal point on community participation in shoreline, Hawaiian fishpond, and stream restoration.

Notable progress has been in the removal of invasive mangrove and marine debris, the restoration of native vegetation, and the development of āina based education and community engagement programs. Important aspects of our approach include developing new regional partnerships with federal and state conservation agencies, local academic institutions, military volunteers and multiple `Ewa based non-profits.

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Kiln-Heating and Boron Dip Diffusion Treatments of ʻŌhiʻa Logs to Eradicate Viable *Ceratocystis* Fungi

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The fungal pathogens *Ceratocystis lukuohia* and *C. huliohia* cause rapid ʻōhiʻa death (ROD), where they colonize and disrupt water flow in ʻōhiʻa, leading to crown wilt and tree mortality. The thick-walled spores (aleurioconidia) of the fungi are "long-lived" in wood. Transport of such wood could result in long-distance movement of the pathogens and potential spread of ROD. ʻŌhiʻa logs are commonly used for structural support and decorative architectural features of buildings and other structures in Hawai`i.  Inter-island movement of such logs, however, was restricted by a state quarantine (Hawai`i Department of Agriculture, HDOA) following the discovery of ROD. Logs cannot be moved unless certified to be free of the pathogens by testing of wood samples or by HDOA-approved heat treatment. Heat and chemical treatments were tested for their ability to eradicate viable *Ceratocystis* within colonized logs. A vacuum kiln was used to heat 20 to 30 cm diameter logs (1.7 m long) to a target temperature of 56°C and held for 30 minutes.
Disk sections were assayed for viable *Ceratocystis* presence before and after heating. Also, in chemical trials, boron (disodium octoborate tetrahydrate, DOT) was used for dip diffusion treatment of pathogen-colonized ʻōhiʻa wood. Earlier laboratory bioassays had determined that a 10% DOT solution completely inhibits *Ceratocystis* growth and recovery on carrot baits. Depth of DOT penetration in short ʻōhiʻa stem sections and the chemical's effect on survival of the pathogens in log bolts were evaluated. Development of effective log treatments will strengthen Hawai`i's biosecurity efforts

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Bringing the outdoors closer to home: Indoor use of native plants to increase public engagement and support of conservation

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In the last two decades, the use of native Hawaiian plants in urban spaces has increased due to the growing awareness of invasive species issues and due to state laws which advocate native plants in publicly funded landscapes. While a number of native species have been successfully utilized in urban landscapes, lack of plant material availability and variety continue to be key constraints. Research on the indoor use of native Hawaiian plants, in particular, has been limited. To expand the use and promotion of native Hawaiian plants in urban living spaces and to increase awareness and public engagement in conservation, an ornamental horticulture research program was developed to study underutilized species for indoor use. The objectives of the program are: 1) to develop a germplasm collection of common/non-endangered native plants from across the state, 2) to evaluate and select ornamental forms and develop propagation techniques, and 3) to evaluate suitability of species for horticultural use (e.g. indoor plants). Propagation and indoor studies conducted in the past four years indicate the potential of Hawaiian *Peperomia* species as indoor plants. Currently, we have identified selections of two species (*Peperomia blanda* var. *floribunda* and *P. sandwicensis*) that are suitable for indoor conditions. Plant materials are currently being propagated for market testing as well as for distribution to interested nursery growers across the state. In the future, the program hopes to engage with conservation groups and agencies to develop a framework that supports conservation/restoration efforts in Hawaii through the sale of these plants.

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Abundances of Aquarium-collected Coral Reef Fishes in Protected and Open-access Areas of Oahu, Hawaii

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Since the 1930's, the collection and trade in marine ornamental fish has expanded to become an international industry with the potential for overexploitation and negative effects on coral reefs. The Main Hawaiian Islands are major exporters of ornamental reef fish and yet, outside of the well-managed Kona coastline of the Big Island, there are no published studies on the effects of ornamental collection on reef fish populations. On the island of Oahu, for example, there are few collection limits and less than 1% of its coastline is protected. Oahu does however maintain fish collection records and has one long-term well-protected no-take zone, Hanauma Bay, which has been closed to collection since 1967. Here we report on the abundance of aquarium-collected fish species from Oahu by comparing fish abundances in open collection areas to two protected locations within Hanauma Bay. Sixteen species were surveyed, including five endemics, using the visual belt-transect search method. Six species of reef fish – *Acanthurus triostegus*, *Chaetodon lunula*, *Ctenochaetus strigosus*, *Naso lituratus*, *Zanclus cornutus*, and *Zebrasoma flavescens* – exhibited significantly lower populations in collection areas. Decreases were observed in the four most heavily-collected species, three of which are not taken as food fish, suggesting that ornamental collection is primarily responsible for the differences in abundance. These findings indicate that the creation of additional protected areas on Oahu could both improve the status of reef fish populations and sustainability of the aquarium fishery.

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Benefits of watershed conservation for groundwater sustainable yield under climate change in the Pu‘uloa (Pearl Harbor) aquifer

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Groundwater in Hawai‘i is intricately linked to ecosystem conservation as watershed management can influence the amount and quality of recharge, which in turn, affects drinking water supplies as well as culturally and ecologically important groundwater dependent ecosystems, such as anchialine pools, fish ponds (loko i‘a), lo‘i kalo, and nearshore systems. In this study, we worked with watershed managers in the Pu‘uloa (Pearl Harbor) aquifer to develop future native forest conservation scenarios, including a no protection, a full protection, and a targeted protection scenario and modeled changes in groundwater recharge and sustainable yield using a groundwater simulation optimization approach. Sustainable yield estimates were then used to determine differences in groundwater replacement costs among forest conservation scenarios under two water demand scenarios in a context of a dry future climate scenario (Representative Concentration Pathway (RCP) 8.5 mid-century). We found that the level of forest protection had about half the influence of RCP 8.5 mid-century rainfall on groundwater recharge and sustainable yield. Specifically, full forest protection resulted in a 7-11% (8-12 million gallons per day) gain in sustainable yield compared to no forest protection, translating to substantial reductions in annual groundwater replacement costs. While more ecohydrological data are needed to reduce modeling uncertainties, this study demonstrates the potential links between mauka ecosystems and groundwater management in a context of a dry future climate, providing insight for water and watershed management and policy in Hawai‘i.

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Characterizing vocalizations of the critically endangered Palila (*Loxoides bailleui*): cultural evolution?

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The story of decline in Hawai‘i’s native forest birds is analogous to that of the history of the native people of Hawai‘i. Displacement from ancestral lands, the onslaught of deadly disease, and the loss of cultural traits due to radical declines in populations continue to have lasting effects that thwart the persistence of natives in Hawai‘i. However, the loss of language users and tutors, and reduced complexity in vocal characteristics, may serve as the most significant indicator of a population’s changing culture. Birdsong is one of the best-known examples of a cultural trait in the animal kingdom. Changes in songs over multiple decades may be indicative of cultural evolution in action. This is the first longitudinal behavioral study to characterize vocal elements of the last remaining population of wild Palila (*Loxoides bailleui*), an endemic seed-eating finch, on Hawai’i Island. Less than 1,000 wild Palila exist today on Mauna Kea within an area of only 5% of their historical range. I will be analyzing audio recordings of birdsongs from a period of nearly 50 years (1974 to 2020). As this research is still underway, I predict to find a decrease in vocal complexity and song diversity, and thereby losses in cultural traits, from past to present as a result of Palila’s declining population. This work sets a baseline for the use of future acoustic research to further understand behavior as a guide for improved conservation and management of this critically endangered species.

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Understanding Local Pig Hunters' Values and Practices as a Way Towards Collaborative Management of Hawai'i's Pua'a (Feral Pigs; *Sus scrofa*)

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Feral pigs are highly invasive species that pose substantial threats to Hawai'i's environment, economy, and human health. Yet, hunting feral pigs is a common practice for Native Hawaiians and locals across the islands, which provides food, recreation, and perpetuation of culture. Feral pigs are managed by DLNR for both conservation (e.g. ungulate exclusion fences that protect upper native ecosystems) and recreation (e.g. hunting licenses for public hunting).
Hunters' knowledge and concerns regarding policy and managing pigs are often not prioritized into management decisions, resulting in conflict between hunters and state land managers. In this study, we aimed to understand the social-cultural values and practices of hunters relating to feral pigs and how their values and practices can enhance feral pig management and improve relationships between hunters and managers. We interviewed 30 pig hunters (in-person and phone) on Maui and O'ahu about hunters' values and practices around hunting, hunters' knowledge of pigs, perspectives on feral pig management, and recommendations. We transcribed interview recordings and used a grounded theory approach (MAXQDA Software) to group comments across interviews into emerging themes. Some important takeaways included: hunting for food, health, and peace of mind; respect for people, place, and practice; addressing the issue of access; need for transparency and inclusion in decision-making; and finding common ground. Our interviews informs DLNR's game management efforts by identifying common values, concerns, and management recommendations among hunters. This study encourages more discussions between hunters and managers toward possible collaborative management efforts that address both hunting and conservation goals.

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The Sources, Composition, and Coastal Effects of Submarine Groundwater Discharge in West Hawai‘i

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The ‘Ike Wai project collected information on the spatial distribution and temporal variability of nearshore submarine groundwater discharge (SGD) along the Kona coast in West Hawai‘i. Groundwater discharging along the shoreline is sourced from different parts of the island and accordingly it is enriched in various chemical solutes. Nutrient, trace metal, and pharmaceutical concentrations reflect the wide range of land use categories along flow lines from pristine to waste water affected areas. We will show analyses of spatial patterns of water sources and ages, groundwater composition with respect to nutrients, dissolved inorganic and organic carbon, trace metals and anthropogenic pollutants such as pharmaceuticals. The effect of SGD on coastal salt balance, nutrient composition, ocean acidification, and pollution from waste water will be discussed.

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Coral Reef Restoration using Native Sea Urchins (*Tripneustes gratilla*) for Biocontrol of Invasive Macroalgae

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In the 1970's several algae species were introduced to Kāne`ohe Bay as part of a study to promote a carrageenan industry. Over the next 25 years coral reef habitats in the bay became increasingly dominated by invasive macroalgae. In the early 2000's, the Division of Aquatic Resources (DAR), The Nature Conservancy (TNC), and Hawaiʻi Institute of Marine Biology (HIMB) proposed a two step solution to remove the seaweed: mechanical removal and urchin biocontrol.

Seaweed was mechanically removed by means of a diver operated suction pump, the 'Super Sucker'. An urchin hatchery was developed to provide native collector urchins, *Tripneustes gratilla*, for biocontrol. Patch reefs throughout Kāne`ohe Bay were surveyed and the reefs were ranked and prioritized based on invasive algae cover.

In 2018 the priority patch reefs were determined to be over 90% clear of invasive algae. Because of the lower invasive algae levels on the patch reefs, the Super Sucker is not currently used. The corals are recovering and urchins are used to spot treat invasive algae hotspots. Due to the success of *T. gratilla* as an invasive macroalgae biocontrol in Kāneʻohe Bay, DAR has expanded the sea urchin project to the Waikīkī Marine Life Conservation District (MLCD) for the control of *Gracilaria salicornia* (Gorilla Ogo).

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Prioritizing and Planning Conservation Actions in the Ahupuaʻa of Puʻuwaʻawaʻa and Puʻuanahulu in North Kona

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Successful conservation of Hawaiian landscapes and species require careful planning as well as detailed geographic data on both cultural and natural resources across the landscape. With diverse data sources, maps can be created that delineate areas most in need of protection from threats. However, because funding is often limited, planners must prioritize which areas and resources to protect first. Here we outline the results of an 18-year long process of data collection, planning, and prioritization at Puʻuwaʻawaʻa and Puʻuanahulu ahupuaʻa in North Kona. Initially, resource managers drew lines on maps in areas they were familiar with to prioritize protection; lines represented areas to protect native forest from ungulates. After 2002, botanists led helicopter, road, and foot surveys to determine plant locations, and maps were created showing locations of wild endangered individuals. Next, plant locations and range data were used to predict the presence and probability of endangered species in unsurveyed areas. In 2017, Wada et al. made maps predicting changes in landscape flammability and groundwater recharge under a current and future climate, both with and without restoration. Most recently, Carnegie Airborne Observatory used remote sensing data to map individual trees across the landscape. Pooling these data sources and products to prioritize protection, we ranked proposed fenced units based on a variety of metrics. We found that prioritization schemes generally fell into three categories, protection of existing forest, regeneration potential, and rare plant protection, and the different metrics often conflicted with one another due to variation in resources across the landscape.

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ʻAʻole ʻo kana mai ka hana i ka nae!

Puʻu Kukui Watershed Preserve & Kanaeokana Network of Hawaiian Schools

Pomaika'i Kaniaupio-Crozier[1,2]

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ʻO ka waiwai maoli o ka mālama ʻāina ka ʻike kuʻuna no ia ʻāina i loaʻa i loko o ka ʻōlelo a me ka moʻomeheu ʻōiwi. A pehea e mau ai ia ʻike kupuna i maʻa hou ai kākou me ka loli o ke aniau i kēia wā ʻānō? Pēlā nō kā mākou e hana nei, ʻo ia hoʻi ka hana pū ʻana me nā haumāna e ʻōlelo Hawaiʻi ana mai nā kula o Kanaeokana. ʻOiai he kahua paʻa ko lākou pākahi i ka waiwai o ka ʻāina i ko lākou ola, kūpono lākou e aʻo mai i ka waiwai o Puʻu Kukui nō hoʻi.

The true value of traditional resource management is the traditional knowledge that's found in the native language and culture. How do we preserve this ancestral knowledge so that we can adapt with the changes that are occurring now? PKW will respond to this query by sharing our current work with Hawaiian language speaking students from Kanaeokana Schools. While their foundation is firmly grounded in the value of ʻāina to their emotional, spiritual and physical well-being, they are perfectly poised to learn about the pristine value of Puʻu Kukui.

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The integration of ‘ike ku‘una and ecology in the collaborative design of a biocultural restoration agroforest on Pu‘ulani in He‘eia.

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Biocultural restoration is a kīpuka in conservation for the reclamation and integration of ‘ike ku‘una (ancestral knowledge) by kānaka maoli. Pu‘ulani, a biocultural restoration project in He‘eia, was conceived in a partnership between Kāko‘o ‘Ōiwi—a community-based non-profit committed to restoring ‘āina momona in He‘eia, and the University of Hawai‘i. Pu‘ulani is part of the 405 acres the community-based non-profit, Kāko‘o ‘Ōiwi, is actively restoring. The project, since its inception, has been led by ‘ike ku‘una and supported by its ability to inform conservation-related sciences. Over the past two years Pu‘ulani has been populated with an agroforest comprised of culturally valuable lā‘au lapa‘au, lei, and ceremony plants, selected for their value to the community and their specific mana in that space. The extensive species selection process considered both traditional understanding of the place and each lā‘au, as well as analyses of each plant’s ecosystem services. The result is a system that provides multiple values for Kāko‘o ‘Ōiwi, the He‘eia ahupua‘a, and the University of Hawai‘i. Pu‘ulani‘s proximity to urban areas increases accessibility for the community and kūpuna, thus elevating its capacity for community interaction and education. Additionally, collaborative research at Pu‘ulani informs plant functional trait research, as well as the capacity of agroforestry to sequester carbon, decrease erosion, and combat invasive weeds, actively integrating ‘ōiwi and western sciences. The vision for Pu‘ulani, reflected in the approach to species selection and system management, demonstrates practical and productive integration of ‘ike ku‘una and conservation knowledge.

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Hāʻena ʻĀina Momona: A 20 year review of an organization's journey towards managing for abundance in Hāʻena, Kauaʻi

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Hui Makaʻāinana o Makana (Hui) was established in 1999 by ʻohana of Hāʻena on the island of Kauaʻi. Hui has just celebrated 20 years of challenges and successes while continuing its mission "to protect and maintain the ʻāina and wisdom of our kupuna in Hāʻena," a storied-place famous in ʻāina momona. Hui members will candidly share the past 20 year journey, which has led the Hui to a curatorship of 15 acres of State Park land in Hāʻena, the first Community Based Subsistence Fishing Area (CBSFA), and a community-ʻohana organization navigating dynamic generational relationships while adjusting to contemporary social and economic pressures. As many communities are advocating to participate in the management and care of their geographic communities, the Hui feels that a sharing on the lessons learned and the road traveled would benefit all stakeholders; community, NGO, and government agencies alike.

Hui members will openly and honestly share the challenges and accomplishments they have had and the sometimes hard process of "grading themselves" along the way. The Hui will share data and findings from important milestones such as: 1) the first five-year review of the Hā'ena CBSFA, and 2) a 20 year summary of curatorship reports that have tracked the resources (monetary and in-kind) needed to understand how the Hui got to where they are today. This valuable story will be a realistic eye opener for other communities and organizations in understanding the complexities of embarking on this same journey of managing for abundance, ʻāina momona.

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Does the native green limu *Chara zeylanica* keep fresh and brackish waters clear

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Chara (‘onohi‘awa, or stonewort), is a genus of slightly calcified, native green limu, or algae, found in freshwater to brackish environments. In high abundance, *Chara* induces a clear water state via nutrient bioremediation (nutrient removal), by limiting sediment resuspension, and through allelopathic effects on bloom-forming phytoplankton. Thus, it holds great potential as a natural conservation tool for maintaining water clarity and limiting nuisance algal blooms in lakes and brackish lagoons. Unfortunately, knowledge of its ecology and physiology in tropical ecosystems, such as Hawai‘i, is generally lacking. The Wai Kai Lagoon in ‘Ewa, O‘ahu is a man-made, 21.8 hectare brackish (7.5-8 ppt) body of water with an average depth of 6 m. *Chara* naturally colonized the lagoon and currently covers up to ~90% of the soft lagoon bottom. Since 2013, monthly data on water quality parameters, water column irradiance, and *Chara* abundance, canopy height, and type of growth have been collected at 12 sites within the lagoon. Two seasons were determined based on annual patterns in precipitation, water temperature, and irradiance. Two-way ANOVA’s determined that while there was no significant difference in percent cover between seasons over the past 5 years, there were significant seasonal differences in *Chara* average height, new growth, and senescence depending on the year. These results will be used to inform the management practices of freshwater and brackish bodies of water, with the goal of conserving both natural and man-made habitats for native communities.

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Convergent melanism disguises the evolutionary identity of an endemic lizard surviving in a highly compromised insular landscape

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Remote oceanic islands have the potential to harbour distinctive and sometimes unknown biodiversity due to unique evolutionary processes that give rise to endemism. This diversity can be further masked in taxa that possess traits that are prone to parallel or convergent evolution, in which case molecular data may be crucial to revealing lineages that have yet to be discovered. We used DNA sequence data to verify the identity of two morphotypes of scincid lizard occurring in the Republic of Nauru, a remote island the west-central Pacific Ocean that has been decimated by more than a century of phosphate strip mining, repetitive bombing during World War II, and other anthropogenic insults. Our results indicate that the two morphotypes are ontogenetic variants of an undescribed species of *Emoia* that has been misdiagnosed due recurrent evolution of whole-body melanism. This species breaks a long branch of the phylogenetic tree that connects two geographically disparate taxa within the *Emoia atrocostata* species group, indicating that Nauru was a key stopover point during the range expansion of *Emoia* in the west Pacific region. The discovery of an undescribed vertebrate taxon on Nauru emphasizes the importance of preserving and restoring habitat on small, remote islands, and where endemism is likely to be high and unknown to science.

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Distribution and status of Oceania snake-eyed skink (*Cryptoblepharus poecilopleurus*) in Hawai'i with comments on additional US Pacific Islands

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Cryptoblepharus poecilopleurus (Oceania snake-eyed skink) has been considered one of the most wide- ranging skink species in the Pacific Basin. Range maps show it occurring from the Marianas in the northwest, Hawaii in the northeast to Easter Island in the southeast. Most maps illustrate this range as continuous and the large gaps in their occurrence in the Pacific Basin are not obvious. We have worked to better illustrate the known distribution of the species across this range and have tried to determine the current status of populations of the species across many of the remote islands within Hawai'i, the US Territories, and Remote National Wildlife Refuges. In some cases, population declines or extirpations were detected, but causes have not been established. Within Hawai'i our surveys have detected the first records from Oah'u proper in decades or longer and show increasing isolation of the relict populations detected. Recent genetic analyses support the idea that this widespread taxon naturally invaded most of this range and supports an early morphological assessment that what is referred to as *Cryptoblepharus poecilopleurus* may consist of several species. Specimens from the Marianas are distinct in color pattern from elsewhere in the Pacific and genetic data supports an independent origin of that taxon from other *Cryptoblepharus poecilopleurus* populations in the Pacific. The species is currently listed as Least Concern by the IUCN Red List. However, if further assessment shows that multiple taxa are represented across the range, then some could warrant higher conservation concern.

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Measuring How Fish Respond to Restoration of Estuaries on Maui, Hawaii

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For about a century most streams on Maui, Hawaii have been diverted. Recently, for selected streams water extraction practices have ceased. Restoration of freshwater in streams presented an opportunity to measure how marine and estuarine fish respond to increases in freshwater input to downstream estuaries. A study was initiated to measure how fish biodiversity, species distributions and tropic structure respond to restoration of estuaries using cast net sampling coupled with environmental DNA sampling (eDNA). For eDNA a total of 7 primers from 3 gene regions was used to measure operational taxonomic units (OTU). One restored estuary was compared to two estuaries that are downstream of diverted streams (control sites). Combining both methods, a total of 56 OTUs were sampled among sites. Only one species was detected using both methods and found at all sites, endemic *Kuhlia xenura*. Combining results from both methods, the restored estuary had 35 OTUs detected compared to 16 OTUs at one control site and 20 OTUs at the other. At the restored site three species were sampled using cast nets, with the same three also detected using eDNA. In contrast, cast net sampling at both control sites detected a total of 5 species not sampled by eDNA. Building on this approach an additional 3 restored estuaries have been added to the study and monitoring has been expanded to include sampling quarterly to record potential differences in recruitment of juvenile fish species between restored and impacted estuaries. Results indicate that fish in estuaries respond positively to restoration.

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Goodbye Paper, Hello Smartphone: Electronic Field Data Collection of Released ʻAlalā Using Survey123 for ArcGIS

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Accurate and timely data collection and sharing are important components for informing management actions to help ecosystems maintain abundance and thrive. For data collection and sharing to be effective, accurate, and efficient, the data collection interface must be easy for field staff, interns, and volunteers to use. Survey123 is a customizable mobile app that we use for documenting aspects of the ʻAlalā reintroduction in the Puʻu Makaʻala Natural Area Reserve. We have been collecting field data using Survey123 on a daily basis since 2017. For example, we record the forest layer in which ʻAlalā are observed, the species of plants that ʻAlalā are interacting with, and social interactions with other ʻAlalā. We share our experiences and discuss the benefits of Survey123 such as its ability to be used on any smartphone, customizable features, GPS data point collection, and its utility in facilitating consistent data entry across users. Survey123 has increased our efficiency compared to traditional paper and pencil data collection. We also share the challenges of Survey123 such as the cost and need to update each phone separately when revisions are made to each form. Survey123 has been a valuable tool to inform the management actions for the recovery of ʻAlalā in the wild. We recommend Survey123 for a diverse array of conservation projects that frequently collect and share data, particularly in conjunction with a GPS location.

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Resilience Takes Time: Assessing Results from 10 Years Protecting the Upper Watershed of Wainiha Valley on Kauaʻi from Australian Tree Fern Invasion Utilizing Aerial Innovation

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The diversity, function, and threatened nature of the massive watersheds on Kauaʻi's north shore are imperceptible amid the verdant valleys as viewed from the coast. The dramatic topography and unique plant communities capture, filter and channel staggering amounts of rainfall brought with the tradewinds. The connection between the near-shore environment, coastal community and the forests of the upper watershed are in plain view, and the challenges to maintaining the abundance and resilience of all three are interwoven. As coordinator of the Kauaʻi Watershed Alliance, The Nature Conservancy, along with public and private landowners has been working to protect the upper watersheds for over 10 years from priority invasive species including Australian tree fern (*Cyathea cooperi,* ATF). This presentation focuses on sharing lessons and techniques from innovation in landscape-scale imagery collection and analysis, the long-term results of precision aerial herbicide application and on-the-ground treatment efforts across a 3,600-acre management unit in the rugged headwaters of Wainiha Valley, and next steps in the region. Development of, and fundraising for, a novel approach to a remote threat led to a lengthy first treatment pass (2009-14). Kernel density analysis of imagery showed that succinct second (2015-17) and third (2018-2019) passes, along with targeted ground treatment efforts in accessible areas resulted in rapid reductions in the overall density of ATF from 1.4 to 0.9 ATF/acre. Most notably the maximum density was reduced from 7.9 to 2.1 ATF/acre, approaching our goal of suppressing this highly invasive species to less than 2 ATF/acre.

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Kaelepulu: Investigating an Impaired Estuary

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This investigation explored the impact of current Kaelepulu estuary management and its impact to the adjacent popular beach by addressing the questions: Is there an improvement water quality in estuary when open? Is there a change in water quality along beach when open? Is storm water runoff a factor? Can community based participatory research be used to garner a greater level of understanding of and care for this system? To address these questions, the following hypotheses were tested: If the berm is open and the estuary has exchange with the ocean, then the water quality in the estuary will improve and there will be negligible impact to the water quality along Kailua beach. If there is a greater volume of water exchanged, as measure temporally and through estuarine elevation changes, then overall water quality in the estuary will improve and there will be relatively no impact on the water quality along Kailua Beach. If community engages in the research process, then greater awareness of and attitudes towards stewardship of place will be garnered. The Pacific American Foundation's WIRED Program has been studying the area for several years engaging local students, community members, and the environmental firm, Oceanit. This investigation engaged WIRED's 6th -12th grade students and their school teachers to use the same well-established Department of Health protocols at eight sample locations evenly distributed along the beach and estuary. These techniques of data collection and analysis have been incorporated into schools' curriculum. Specifically, Temperature, DO, Salinity, Conductivity, pH, and Turbidity were measured. Water samples were collected to test for Nitrogen, Phosphorous, Chlorophyll, and Enterococcus. Water volume exchange was quantified. Participant pre and post surveys were conducted to assess changes regarding awareness of local environmental issues and engagement in and attitudes towards stewardship of place. To date not all results have been compiled however, principal component analysis determined enterococcus, salinity, and turbidity as the primary indicators of water quality. It appears that the opening of the berm does not significantly contribute to poor water quality along the beach and opening events also improve water quality in the estuary. Post participation surveys are still underway, however anecdotally, engagement in the research process appears to deepen connection and care to place.

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Diets of ‘Ae‘o (Hawaiian Stilt - *Himantopus mexicanus knudseni*) Chicks in Wetlands on O'ahu

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Recovery of endangered species is dependent upon maximizing reproductive success and minimizing mortality, but management actions aimed at increasing recruitment are often hindered by a lack of knowledge at critical life history stages. For example, the dietary preferences of precocial chicks may differ from nesting adults; thus, the optimal foraging habitat may also differ between these life stages. The Endangered Hawaiian Stilt (ae‘o - *Himantopus mexicanus knudseni*), a subspecies of the Black-necked Stilt, is considered a generalist forager, but little is known regarding prey selection in precocial chicks. In this study, stable isotope mixing models were used to estimate the contribution of potential prey sources to stilt chick diets in wetlands on O‘ahu Island, Hawai‘i. We found predicted contributions to be similar among potential prey items at a site with high prey diversity and the oldest and largest chicks. At three other sites, younger chicks appeared to select particular items from among available prey, including species in the orders Hemiptera (true bugs) and Araneae (spiders). Species in these orders were lower in biomass compared to other species available at each site, suggesting the chicks were selecting for these items from among available prey items. Hawaiian Stilt chicks may preferentially select certain prey items which are easy to handle and high in nutrients important to development, and likely diversify their diet as they gain dexterity and height. Our results may inform decisions for optimal habitat and macroinvertebrate management in Hawaiian Stilt nesting sites to maximize reproductive success and survival.

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Preventing Aquatic Species Introductions through Collaborative Partnerships in Hawai'i: A Case Study

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Ballast water and vessel biofouling are the top two vectors of aquatic species introductions into Hawai'i. They are responsible for nearly 80% of the 350 non-indigenous marine species currently established in Hawai'i. In late 2019, a shipping company voluntarily notified the Hawai'i Division of Aquatic Resources (DAR) that they would be acquiring a heavily fouled Mobile Marine Infrastructure (MMI) from out of state. Upon recommendations from DAR and Washington Department of Fish and Wildlife, the company cleaned the hull of the MMI prior to entering Hawai'i waters and allowed DAR's Ballast Water and Biofouling Team (BWBF) to survey the hull upon its arrival. The BWBF team conducted joint dive operations with the National Oceanic and Atmospheric Administration to survey the hull for alien species. A total of 21 samples representing at least 13 different species were collected and sent to Bishop Museum for taxonomic and genetic identification. It is these types of stochastic events that pose the greatest risk of carrying invasive species, and DAR co-managed this threat by relying heavily on their partnerships. The data will help build the eDNA database for Hawai'i, which will improve early detection capability. Furthermore, managing invasive species through prevention and early detection is most cost-effective, and this case study facilitated the development of an interagency response procedure. This event increased exchange of knowledge and resources, prompted standardization of methodologies and reporting, and increased capacity for the prevention of alien species introductions and protection of abundant marine resources in Hawai'i.

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Linked Ecological, Cultural, and Socio-economic Values of Groundwater Dependent Ecosystems in Kona, Hawai‘i

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Groundwater Dependent Ecosystems (GDEs), including submarine groundwater discharge influenced nearshore systems (muli wai), Hawaiian fish ponds (loko i‘a), and anchialine pools are prominent biocultural systems along the Kona coast. There is growing interest in the restoration and protection of these GDEs, and in ensuring that landscape and water management practices support these systems. In this study, we interviewed 16 GDE managers and lineal descendants to explore the multiple ways that GDEs are used, valued and cared, as well as current management strategies, historical and current threats, and desired futures. We found that GDEs are important spaces for cultural connection to place, social networks, and education through active participation in biocultural restoration. While few GDEs are currently utilized in the way they were historically for food production, water sources, and fishing practices, there is strong interest in reviving these systems for restoration of cultural practice associated with fishing and harvesting. Perceived threats to these systems include over-pumping and pollution of groundwater, pollution, introduced species, sea level rise, and urban development. Given their high cultural and ecological value, resource managers and communities are dedicated to addressing these threats through biocultural restoration practices and increasingly seek to engage in watershed scale planning and policy mechanisms to protect and restore these systems. Interviewees discussed the future of these systems in light of biocultural restoration, and the challenges presented with climate change and sea level rise, and increased number of visitors. These discussions presented some direction and novel innovations for future management of these systems.

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Understanding the Role of Avian Malaria in the Recovery of ʻAlalā

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Avian malaria is well known to be one of the most significant threats endemic forest birds in Hawaiʻi, particularly honeycreepers. However, only a limited number of studies have examined the impact of avian malaria on ʻAlalā. As a result, it is important to better understand the role of avian malaria, particularly for the recovery of ʻAlalā during the current reintroduction effort which began in 2016. We examined blood samples collected from ʻAlalā both in managed care at the Keauhou and Maui Bird Conservation Centers, and in the wild. Avian malaria was detected in five ʻAlalā in managed care, where disease transmission is reduced by enclosing each aviary with mosquito netting. We also detected avian malaria in three deceased ʻAlalā recently released into the Puʻu Makaʻala Natural Area Reserve, although avian malaria was not the primary cause of mortality in these three cases. These preliminary results and previous studies suggest that avian malaria is not as lethal to ʻAlalā compared to honeycreepers, however, this disease could play a role in limiting the recovery of ʻAlalā. As a result, avian malaria should continue to be monitored and considered during ongoing conservation management efforts of ʻAlalā.

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Managing for Abundance in the Wao Kele: Vegetation Monitoring and Recovery Following Non-Native Ungulate Removal

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Persistent management efforts over the past 10 years have led to the protection of important biocultural resources across more than 9,000 acres of montane and lowland wet forest and 60 acres of unique lowland bog from ecosystem-altering invasive species in the heart of Kauaʻi's watershed. As coordinator of the Kauaʻi Watershed Alliance, The Nature Conservancy, has conducted extensive monitoring and continues to refine surveys to investigate the effects of protection across a spectrum of non-native animal densities ecosystem types, including native-dominated and novel forests altered significantly by introduced plant species. Responses of specific forest resources were uneven across different ecosystem types, though general watershed quality improved across all protected areas. Important examples include an increase in understory from 25-36% in the most intact forest of the Alakaʻi plateau and recovery and stabilization of ground cover at the low-elevation bog at Kanaele where initial ground disturbance by ungulates averaged 21%, the worst effected plots rebounded within 8 years and native species make up 96% of ground cover in an area that could otherwise have been lost if left entirely unprotected. The 3,600-acre Wainiha Preserve, where highly invasive *Clidemia hirta* swept through the valley during the monitoring period, illustrates the potential for recovery of these novel ecosystems impacted more distinctly by non-native species. Monitoring data suggests that while understory and ground cover increases were driven by non-native species, native species still make up a relatively stable proportion in areas once badly degraded by feral pigs.

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

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The Orangeblack Hawaiian damselfly (*Megalagrion xanthomelas*) was once one of the most ubiquitous endemic Hawaiian damselfly (pinapinao) species. *M. xanthomelas* is now found in sparse populations across the state, its widespread decline due to habitat loss and the introduction of invasive species, especially predatory mosquito fish (*Gambusia* spp.). Once thought to be extinct on O‘ahu, in 1994 a single population was discovered at Tripler Army Medical Center (TAMC). The species was listed as endangered in 2016. Between 1998 and 2015, five unsuccessful attempts were made to translocate wild-caught damselflies to other O‘ahu sites. In 2018, the Hawai‘i Invertebrate Program (HIP) began a captive rearing and reintroduction program for *M. xanthomelas*. As of July 2020, HIP had released over 1,800 captive-reared naiads and adults at three O‘ahu Sites: streams in both Wai‘anae Kai Forest Reserve and Dillingham Military Reservation (DMR) and artificial predator-free ponds at Lyon Arboretum. At Lyon, oviposition was only observed at nearby lo‘i that were teeming with mosquito fish and not at the artificial ponds. The site is therefore considered inviable. At the Wai‘anae Kai site, oviposition was continually observed at the target stream, but second-generation adults were not observed. Due to a handful of environmental factors the site is now considered unsuitable for establishment. Reintroduction at DMR began in June 2020, and successful establishment has yet to be determined. The long-term success of *M. xanthomelas* reintroduction relies on identifying suitable sites that are predator free, isolated from potential sinks, and attractive for breeding.

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Hawaiʻi Climate Data Portal: An Online Tool for Accessing Historical and near Real-time Rainfall and Climate Data Products

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Climate data are critically important for a variety of land, water and conservation management issues across Hawaiʻi. Due to a lack of a central data repository, climate data access is limited despite some availability through individual researchers, and local, state, and federal agencies. Previous efforts to compile and publish statewide station observations and high-resolution gridded climate maps have been successful, however, the finite end dates of these projects leave a widening data gap in the most recent years. Furthermore, access and analysis of these highly important climate data has always required the use of GIS and other specialized software. Given the importance of these datasets for conservation efforts in Hawaiʻi, up-to-date, custom queryable, climate products are needed to understand climate influences on natural resources and to facilitate timely climate-informed management decisions. To address these challenges, the Hawaiʻi Climate Data Portal (HCDP) was created to capture, store, and provide access to real-time and historical climate data and products. The HCDP makes available 100 years of monthly and 30 years of daily rainfall maps and observations. This system currently includes an automated near real-time production of gridded rainfall maps and station observations. In the coming months this online platform will host an ever-growing suite of climate products including new variables and derived products useful for land and water management, available at several time steps. In this presentation, where and how to access custom place-based near-real time and historic climate data for the main Hawaiian Islands will be demonstrated.

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O‘ahu Rapid ‘Ōhi‘a Death Response, Sampling, And Considerations

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The initial detection of Rapid ‘Ōhi‘a Death (ROD) from the pathogen *Ceratocystis huliohа* on O‘ahu in July 2019, prompted a joint effort across multiple partner agencies. Hawai‘i Island provided the model of ROD response and methodologies used on O‘ahu. The O‘ahu Invasive Species Committee (OISC) and the Division of Forestry and Wildlife (DOFAW) led the response supported by the Ko‘olau & Waianae Mountains Watershed Partnerships (KMWP & WMWP), the Army Natural Resources Program (ANRP), and the Coordinating Group on Alien Pest Species (CGAPS). The response on O‘ahu has relied on aerial surveys to identify and locate potentially infected ‘Ōhi’a (*Metrosideros sp.*) trees utilizing Digital Mobile Sketch Mapping (DMSM) technology. Additionally, high resolution visible (RGB) imagery produced by aerial survey of approximately 30,000 acres of forest with support from the Spatial Data Analysis and Visualization Labs (SDAV) at the University of Hawai‘i at Hilo was analyzed to locate trees displaying symptoms of *Ceratocystis* infection and to establish a distribution of symptomatic trees. The resulting imagery allowed geolocation of high priority targets for ground sampling. The follow up work from both aerial survey methods has highlighted the utility of sUAS or drones in ROD response on O‘ahu. Additionally, the unique diversity of ‘Ōhi‘a taxa and endemism that occur on O‘ahu have led to interesting observations of ROD symptoms. Inconsistent symptoms and a high incidence of negative results from sampled trees indicate a need for more research on how to identify *Ceratocystis* infection and to tailor ROD response to O‘ahu’s ‘Ōhi‘a forests.

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Community Based Native Algae Restoration

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For the past 10 years, Mālama Maunalua (MM) has worked to restore the nearshore habitat of Maunalua Bay by removing invasive alien algae (IAA), and working to promote the return of native algae. The effort has relied heavily on community support. This talk will focus on the various efforts and lessons learned, including:

- Removing IAA through volunteers, and a vacuum system
- Transplanting native sea grass
- Scientifically monitoring progress, and what the science is showing.

Since starting the effort around 2010, MM has led over 13,000 volunteers, removed 3.5 million lbs of IAA, seen native algae slowly return to the nearshore areas, and witnessed changes in nearshore conditions.

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Community Connection is Key: Community Involvement Promotes Reduced Fire Risk at the Wildland-Urban Interface of Pu'uwa'awa'a

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The community of Pu'uanahulu is located in a wildland-urban interface on Hawai'i Island. This area is marked by a variety of historical disturbances resulting in invasive species monocultures, removal of dry forest, and loss of biodiversity. Sixteen native plants from the adjacent Pu'uwa'awa'a Forest Reserve are currently endangered with some species having fewer than ten individuals remaining in the wild. One of the most important threats to this community and ecosystem is wildfire. In order to reduce that risk, the Pu'uanahulu community, Division of Forestry and Wildlife, Hawai’i Wildfire Management Organization, and the Napu'u Conservation Project began working together in 2019 to address fire-related issues. The benefits of this cooperative effort protect the community from wildfires originating in the forest and the forest from fire risk originating in the community. In the last year, we have accomplished some important milestones. We have organized the first meetings and conducted a community hazard assessment. Community members organized a Firewise Committee to provide education opportunities and materials for their community and the public. They are creating a volunteer contact list and developing plans and activities intended to reduce fuel loads and create fire breaks reducing the risk of catastrophic fire. In addition, they are progressing the process needed to become a certified Firewise Community. This important cooperative work can serve as a model for community outreach and wildfire prevention state-wide, continue to cultivate a sense of belonging and responsibility, and restore and maintain the abundant biocultural diversity of this unique place.

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Southern House Mosquito (*Culex quinquefasciatus)* Ecology in Hawai‘i: Current Understanding, Knowledge Gaps, and Models to Support Effective Implementation of Landscape-level Vector Control

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Effective implementation of novel vector control requires detailed knowledge of mosquito ecology and population biology. Here we review our current understanding of the primary avian malaria vector in Hawai‘i, *Culex quinquefasciatus*, and highlight key knowledge gaps for landscape-level vector control within native Hawaiian forest bird habitat. Broadscale patterns of distribution and abundance are best characterized on the eastern flank of Mauna Loa on Hawai‘i Island, where *Cx. quinquefasciatus* abundance in mid-elevation forests exhibits seasonal population dynamics with peaks generally occurring September-October and at higher elevations from October-November. *Culex quinquefasciatus* in windward eastern Hawai‘i Island have been estimated to disperse on average 1.5km and up to 3km and exhibit genetic differentiation using microsatellite markers both across the main Hawaiian Islands and within Hawai‘i Island. In Hawai‘i, Cx. *quinquefasciatus* use naturally created terrestrial and stream cavities as larval habitat, reflecting landscape- and island- specific differences in topography and environmental conditions. Key gaps in our current understanding in the ecology of *Cx. quinquefasciatus* include current mosquito abundance at potential *Wolbachia*-transinfected mosquito release sites, adult dispersal and connectivity of natural mosquito populations, site-specific larval habitat ecology, and mating competitiveness, movement, and survival of mosquitoes from release sites. We conclude by discussing a modeling framework to estimate key parameters for landscape-level mosquito control and propose a *Cx. quinquefasciatus* population dynamic model to simulate mosquito suppression and compare effectiveness of alternative traditional and novel vector control implementation strategies, with the aim of effective localized population suppression of Cx. *quinquefasciatus* in forests where it is urgently needed.

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The Pacific Island Land Snail Biodiversity Repository (PILSBRy) Portal: Enhancing Research and Conservation Management of This Highly Endangered Fauna

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Pacific Island land snails (PILS) are important decomposers and nutrient cyclers, providing crucial terrestrial ecosystem functions in their native environments. There are over 6,000 PILS species, many of which are endemic to specific islands, mountains, or valleys. Most of these species are either endangered, extinct, or lack sufficient data regarding their population statuses. Biodiversity assessments, systematic revisions, and species histories are thus crucial in conservation planning and the preservation of PILS diversity. There are currently over 3.6 million PILS specimens housed in various museum collections across the United States. Over 2 million of those specimens are in the Malacology collection at the Bernice Pauahi Bishop Museum. The Bishop Museum, along with five other natural history museums, were awarded a National Science Foundation funded project titled “Advancing Digitization of Biodiversity Collections”. The project aims to digitize, compile, and mobilize PILS specimen information in these museum collections to a single portal. Digital access to PILS records across all collections will serve as a valuable, time-saving tool in PILS biodiversity and systematic assessments, as well as with conservation research for individual regions or species. Beyond lot records and taxonomic groupings, data will include specimen images, georeferenced locations, collectors’ notes, and genetic information. Easy access to accurate, reliable data is now necessary if we are to understand the evolution of PILS across the Pacific Islands, and to make effective decisions regarding their future. Here we present the Pacific Island Land Snail Biodiversity Repository (PILSBRy), highlighting information that will be made available via the portal.

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Natural Climate Solutions in Action: The Nature Conservancy's Improved Forest Management Carbon Project at Kona Hema Preserve, Hawai'i Island

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Restoring forests and improving the management of existing forests in Hawai'i will contribute significantly to the State's target of capturing more carbon than we produce by 2045, with the added benefits of protecting native ecosystems and tempering the climatic effects of reduced rainfall, increased temperatures and more severe weather. Managing and reforesting with native koa (*Acacia koa*), as well as other native tree species, will provide an opportunity for Hawai'i landowners to capture carbon and potentially participate in carbon markets, providing an alternative revenue source and incentivizing sustainable land management. Carbon markets permit companies to offset a portion of their emissions by purchasing carbon credits from landowners implementing actions like growing trees and protecting forests. The Nature Conservancy (TNC) is implementing an Improved Forest Management (IFM) carbon project to be certified with the America Carbon Registry (ACR) at its Kona Hema preserve on Hawai'i Island, which will be the first project IFM project in Hawaii. Working with the project developer TerraCarbon, we are conducting a forest carbon inventory to assess and verify the tons of carbon captured in Kona Hema with the intent to add partner landowners over the first five years of the 20-year project. It's estimated Kona Hema could provide 130,000 carbon credits over a 40-year period and will be sold on voluntary carbon offset markets. In addition to capturing carbon, keeping the forest healthy at Kona Hema provides fresh water while providing habitat for Hawaiian birds, plants and trees.

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Maunakea, kuahiwi ku ha'o i ka malie: Maunakea, standing alone in the calm - A Collaboration of Native Hawaiian Resource Managers

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Within the conservation community there are culturally grounded conservation managers on Maunakea that work with the public to further the mission to reforest the slopes, manage ungulates, and restore populations of native species. During one of the most controversial subjects in our time, land managers on the slopes of Maunakea have maintained their mission by working collaboratively with each other, including various partnerships, as well as inviting the public to participate in conservation initiatives that include native planting, bird counts, and removal of invasive species. This forum will provide Native Hawaiian managers in current positions at the Mauna Kea Watershed Alliance, Mauna Kea Forest Restoration Project, and Department of Hawaiian Home Lands ʻĀina Mauna Legacy Program to share how programs are persisting in these controversial times, how they work together, what the public has been able to support, and what projects the managers are looking to accomplish in the near future. The forum will facilitate a group exercise to provide understanding of restoration goals, along with an art exercise focused on the meaning and vision of Maunakea abundance has for participants past, present, and future. Maunakea has an impact on Hawaii Island, Hawaii, and the world. This forum seeks to identify how Maunakea conservation managers can resonate with these messages and also share with other conservation agencies how collaboration occurs in an area where conservation is the main issue in the media but attention to boots on the ground projects are sometimes overlooked.

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Effects Of A Long Term Fire Retardant On Native Hawaiian Flora

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The spread of invasive, fire-adapted grasses across Hawai'i has led to an increase in wildfires and has consequently sparked an interest in the possible use of long-term fire retardants (LTFR) for improved wildfire management. However, the impact of LTFR on native Hawaiian Flora has not been previously assessed. This preliminary ninety day study aimed to determine the effects of the LTFR, Phos Chek LC95A, on ten species of native Hawaiian plants that are commonly found in Oahu's Forest Reserves. Initial observations of the plants were taken before Phos Chek was administered foliarly at three treatment rates based on the Normal application rate of 5.5 gallons of water per gallon of Phos Chek. The compared treatments were applied at 2x (double strength) and .5x (half strength). A negative control was used where no LTFR was applied. Weekly observations included plant height, leaf health, and overall appearance. Most plants suffered leaf die off and browning after the treatments and some species, such as A'ali'i, 'Ōhi'a and Koki'o ke'oke'o, did not recover well from the initial foliar death. Plants that were sprayed with the highest LTFR concentration had the most extensive foliage die back. Despite the detrimental effects of Phos Check on some species used in this study, we concluded that partial mortality is a better option than the likely total mortality of plants in a fire event. The results of this study therefore support the use of Phos Chek as a potential tool for wildland fire response in native Hawaiian ecosystems.

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Focused Surveys for Endangered Maui Parrotbill and 'Ākohekohe at Haleakala National Park, 2018-2019

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Surveys conducted in 2017 failed to detect endangered Maui parrotbill (*Pseudonestor xanthophrys*) and 'ākohekohe (*Palmeria dolei*) within core rainforest habitat at Haleakalā National Park. To determine if these endemic Maui species are indeed absent from these core areas, we conducted intensive searches in 2018 and 2019. We also deployed song meters and initiated collection of arthropod species for baseline information. We confirmed presence of both bird species. Audio and visual detections of Maui parrotbill were noted between 1842-1946 m elevation in Kīpahulu Valley. Audio and visual detections of 'ākohekohe were made between 1645-2000 m elevation in Kīpahulu Valley and Manawainui. 'Ākohekohe detections appeared to follow seasonal changes in 'ōhi'a bloom. Important foraging plants for Maui parrotbill were found at all survey stations, signifying high habitat quality in these core areas. The lack of detections in 2017 may have been due to sampling technique since the variable circular plot method is not specifically designed to detect rare bird species. We did not detect Maui parrotbill and 'ākohekohe at lower elevations where they were found in 1992-2008 surveys, which suggests a decrease in range for these species. The range decrease could be due to changes in understory diversity in those lower elevations where dramatic increases in non-native, invasive plant species have occurred. Data from song meters is pending and could provide more location information on these rare birds to help guide management efforts. Analysis of arthropod species is also pending and could provide information on prey availability for Maui parrotbill.

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Coastal Sand Dune Restoration at James Campbell NWR

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Coastal sand dunes play an important part in Hawaii's beach system. Vegetated dunes trap windblown sand, store excess sand reserves, serve as natural erosion buffers and create an elevated berm and dense root system that may protect against storm and high wave events. In addition, coastal sand dunes provide essential habitat for many of Hawaii's native and endangered species. Unfortunately, over the past couple of hundred years, this precious ecosystem has been heavily impacted by invasive species, human development, and climate change. One of our new objectives at James Campbell NWR is to restore, protect and manage coastal dune/strand within the refuge to promote nesting and roosting habitat for 6 different seabird species, as well as protected habitat for endangered honu and the yellow-faced bee. In order to achieve this, we will be managing and assisting the establishment of native plant species as well as the eradication of invasive species. Our restoration project will begin with ten 10x10m experimental plots for which we will be testing out different restoration methods. Treatments for each plot will include one of these treatments or a combination of them: treating invasives with different forms of herbicides (ie. selective, non-selective, broadleaf, etc.), manual removal of invasive plants, and out-planting of native plant species. Plots will be mapped and surveyed periodically in order to monitor the results and success of each type of treatment. Knowledge obtained from the results of our experimental plots will be used to implement a comprehensive coastal dune restoration plan for the refuge and possibly other sites within the region.

Status of Alien Marine Species in the Papahānaumokuākea Marine National Monument

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The Papahānaumokuākea Marine National Monument (PMNM) is a marine protected area encompassing over 1.5 million km2 surrounding the Northwestern Hawaiian Islands (NWHI). PMNM has a permitting system in place in order to manage this pristine environment and limit alien species introductions. Over 400 species of marine non-indigenous/alien species are recorded in the Hawaiian Archipelago, but only 10-15% are known to be established in the PMNM. The PMNM marine alien species inventory project was created to combine alien alga, invertebrate and fish inventory records with recent surveys to produce a checklist of documented findings. The complex taxonomic nature of invertebrate fauna makes positive identification difficult and further taxonomic resolution may be possible from cataloged museum specimens resulting from previous surveys. Researchers have identified some species found in PMNM as cryptogenic species, meaning they may be either a native species or an introduced species, with clear evidence for either origin being absent. Our study found that there are potentially 61 non-indigenous species in PMNM. Of those species, 39 are established, 21 cryptogenic, and 1 which may be present but is not established. There are 2 cryptogenic species of red algae, 3 species of fish and 56 species of marine invertebrates. One of the cryptogenic red algal species has just been described as a new species, Chondria tumulosa. This species has recently been found to exhibit invasive-like growth characteristics at Manawai (Pearl and Hermes Atoll) as managers and researchers strive to identify biocontrol efforts and best management practices (BMPs) to prevent further spread.

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Managing Issues of Near-Shore Fisheries in Hawai‘i: A Policy Analysis of the State’s Marine Aquarium Fishery

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The impacts of the marine aquarium trade are heavily debated, as varying perspectives on the effects that the fishery poses exist. In this cost-benefit analysis (CBA), four policy scenarios were developed and analyzed. The method used for comparing across alternatives is the estimated Net Present Value (NPV), where quantitative costs and benefits are evaluated for each scenario, and the summed stream of costs are subtracted from the summed stream of benefits, which have been discounted to account for temporal differences. Major findings from this study suggest that the market structure of Hawai‘i’s marine aquarium fishery provides optimum conditions for economic leakage to occur, specifically due to the value added by out-of-state sellers of Hawaiian fish who realize a majority of the profits. Significant distributional issues are also observed across identified stakeholder groups. Due to the skewed market structure of this fishery, only a small number of stakeholders directly involved in the fishery (collectors, wholesalers, dealers) are receivers of any true benefit. Out of the four policy scenarios explored, a statewide aquarium collection ban, was identified as the most equitable and efficient option because it was the only option that yielded a positive net present value (NPV), and negatively impacted the fewest stakeholders overall. The recommendations from this analysis will be helpful for policy makers and resource managers as they consider addressing the social, economic, cultural, and environmental resource issues that Hawai‘i’s marine aquarium fishery poses.

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Exploring Partnerships to Expand Capacity for Environmental Regulation and Legislation in Pacific Island Jurisdictions

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The University of Hawaii's William S. Richardson School of Law and the National Oceanic and Atmospheric Administration (NOAA) have formed a partnership to build capacity for the development of environmental regulation and legislation in Pacific Island countries and territories. The history of colonization, status as trust territories, and recent independence of many Pacific Island jurisdictions has led to a clash between the imposition of central government law as passed down through colonial authorities and customary law which has governed natural resource regulation for centuries. In building environmental regulatory capacity in these jurisdictions, it is imperative that those drafting regulations not only have a formal legal education, but also an understanding of the unique history, culture, and legal framework of the specific jurisdiction. However, many Pacific Islands lack centers for formal legal education and rely on regulators educated in foreign countries. The William S. Richardson School of Law, in coordination with NOAA, has developed and is now offering a class on Pacific Island Environmental Legislative Drafting in which law students work directly with regulators in Pacific Island jurisdictions to develop environmental regulations and legislation. The goal of this class is to provide Pacific Island jurisdictions with drafts of much needed legislation and regulation while also providing an avenue for building future capacity in these jurisdictions by teaching students the intricacies of drafting environmental law and policy specifically tailored to Pacific Island jurisdictions.

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Legal Actions on Behalf of Future Generations

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This presentation aims to introduce the Hawai'i Conservation Alliance community to the Normandy Chair for Peace ("NCP"), an organization whose mission states that: "Before We Can Have Peace On Earth, We Must Make Peace With the Earth." The presentation title "Legal Actions on Behalf of Future Generations" mirrors the title of a book with an anticipated publication date of June 2020, representing the first in an ongoing series of publications by NCP. This interdisciplinary book explores a wide spectrum of evolving concepts that have been deployed as juridical tools for protecting future generations -- e.g., environmental justice, climate justice and protection of the Commons. The book further recognizes that we must constantly explore new ways of conceiving justice itself, examining the deployment of scientific, legal and other fields to varying degrees of success. As the newly appointed Deputy Ombudsman for Future Generations (Oceania Region), and lead for the NCP project on Indigenous Peoples, Local Communities and Future Generations, the presenter will invite the audience to bring their issues to the attention of the NCP.

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Bacterioplankton Response to a Stochastic Event in a Tropical Estuarine System

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Climate change is predicted to increase the frequency and intensity of tropical storms, harmful algal blooms, and pathogen outbreaks. However, the extent to which microbial community dynamics vary during climate forcing remains unknown for tropical, high-island, estuarine systems like Hawai‘i. For Pacific Island communities, water quality is an important tool for managing resources in a changing climate. The summer of 2014 was characterized by mild El Niño conditions resulting in high tropical storm frequency in the Central Pacific. At He‘eia Fishpond (HFP) O‘ahu, a coastal estuarine embayment constructed by Native Hawaiians, we captured the effects of Tropical Storm Wali, a precipitation event exceeding 15 cm in 24 hrs. Analysis of 16S rRNA amplicon sequences revealed microbial changes between pre-storm, storm, and post-storm conditions. Post-storm microbial assemblages more closely resembled pre-storm assemblages but sustained a fraction of storm-introduced groups. The introduction and sustained presence of clades containing fecal indicator species and opportunistic pathogens (Vibrio, Clostridium, Burkholderia, etc.) was detected during and following the storm event. Adequate water quality is essential to maintain a thriving and abundant HFP for the community. These results provided the first field evidence of microbial resilience following a storm event in a tropical estuarine environment in Hawai‘i and suggest potentially larger impacts to marine productivity, food web dynamics, and biogeochemical cycles.

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Community Engagement and the Use of Biotechnology for the Conservation of Hawai‘i’s Forest Birds

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A novel approach to avian malaria could help prevent the extinction of Hawai‘i’s endemic honeycreepers. The technology involves rearing and releasing male mosquitoes with a strain of *Wolbachia* bacteria to make the males reproductively incompatible with wild females. In Hawai‘i, cultural protocol requires asking permission before entering a home, hālau, or forest, with clear intention and sensivity to impact. The proposed release of *Wolbachia* mosquitoes will require seeking permission from the public, through authentic and sustained engagement among local communities and with a wide range of stakeholders. The community engagement process must address a number of challenges. Native forest birds are largely restricted to remote forests, making them and their plight unfamiliar to many residents. The *Wolbachia* approach has been used elsewhere in the world to combat mosquito-borne human diseases, but would be new to Hawai‘i. The window for preventing extinction is narrow, compressing the time scale for action. This presentation will describe the proposed community engagement strategy, including timelines and opportunities for input, with a focus on what it means to ask for permission.

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Mauka to Makai watershed restoration in West Maui to improve coral reef health and community resilience

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Land-based pollution from sedimentation is a key threat to West Maui's coral reefs, contributing to the decline in live coral cover by up to 50 percent in localized areas. A network of dirt roads once used for industrial scale agriculture runs across West Maui's mid slope region. During storms, they convey significant volumes of sediment into the streams which is then transported to the shoreline. These brown water events smother corals with sediment. To address this problem, the Coral Reef Alliance (CORAL), in partnership with the West Maui Ridge to Reef Initiative, is testing restoration practices along the road that run parallel to the stream gulches in Wahikuli watershed. Through use of plant-based sediment traps we are restoring the native ecosystems. Our restoration goal is to increase infiltration of stormwater across the landscape in order to reduce flow of sediment-laden water into stream gulches. Ultimately, we aim to develop a mauka to makai restoration solution that can be implemented along stream gulches from the Watershed Partnerships areas down towards the coastline in order to support effective management of nearshore reef habitat. We work with local partners and a team of volunteers to help us implement the restoration while providing an opportunity for community to reconnect with the land. In this session we will describe the practices we are using, share preliminary results of their performance in retaining sediment on the landscape and make recommendations for implementation of no development zones along stream gulches to protect coral reefs of Hawai`i.

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Ho‘oulu Hou: Student community collaborations to cultivate ‘Āina Momona in Hawai‘i

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Managing for abundant ‘āina and thriving communities requires training in holistic and collaborative approaches grounded in diverse ways of knowing. This forum will share student projects from The *Kū‘oko‘a: Sustaining Abundant ‘Āina & Resilient Leadership* initiative in an interactive format with multiple opportunities for discussion and interaction. This initiative is a collaboration of ten Native Hawaiian faculty across the University of Hawai‘i at Mānoa dedicated to enhancing community ability to care for ‘āina across the archipelago, who conduct research and teach courses related to sustainability and resilience grounded in Hawaiian knowledge. In this session, graduate and undergraduate students will share projects created in these courses, in small groups with opportunity for feedback and discussion. Projects include websites highlighting cultural and ecological resources of ahupua‘a the students come from, field classes supporting community efforts to care for significant places, and research to help in restoring bio-cultural resources across the Hawaiian islands. In addition to sharing their projects, students will reflect on their learning and how it has impacted their career paths in conservation. As collaborative and holistic efforts are becoming more widespread in natural resource and environmental policy-making processes, young people entering these fields require practical experience in applied and participatory research, community engagement, facilitation and collaboration across diverse groups. The efforts shared in this session are helping to equip a new generation of leaders, strengthen resilience of communities across the islands, build partnerships within and beyond the university, and cultivate pono decision-making regarding land and resources in Hawai‘i.

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Promise and Peril on Hawai‘i’s Edge: Management and Conservation on Lāna‘i

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Situated in the middle of earth’s largest ocean, Hawai‘i rests at the world’s edge. Sitting in the lee of Maui, Lāna‘i sits on Hawai‘i’s edge with its relatively small size, low rainfall, scarcity of resources, and general isolation. Hawaiians knew it as a land formerly haunted by ghosts, and even after the ghosts’ banishment by Kaululā‘au, few people lived there for long periods of time. The history of Lāna‘i post-1870 is defined by this isolation and near-complete land ownership by a series of single entities. These two attributes have offered relative benefits and detriments to the island’s natural resources. On the one hand, cumulative periods of nearsighted and exploitative ranching and agriculture land use has removed 95% of Lāna‘i’s historic native habitat and introduced damaging invasive species. On the other, periods of proactive land management led to the successful extirpations of non-native species such as goats and pigs. Lāna‘i’s isolation has also allowed it to outright avoid introductions of invasive species such as mongoose, little fire ant, coqui frog, and a multitude of weed species, and makes it more defensible against future introductions. In this talk we set the stage for the “Biodiversity and Resilience on the Island of Lāna‘i” symposium; reviewing how the promise and peril of the island’s isolation and land ownership history have impacted its natural resources, and how a series of new initiatives, such as the landscape level Kuahiwi a Kai project, will hopefully support Lāna‘i’s ecological resilience and the community that calls the island home.

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Forest Products to Create Abundance at Pu'uwa'awa'a

Irene Sprecher[1]

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Managing for abundance implies there is a rich and healthy system - one capable of supporting all the living and non-living things found within it. This means we not only have a wealthy ecological system, but one that can support people with vibrant social and strong economic systems. What does this look like as a forest is restored, and what opportunities do forest product development provide to sustaining abundance? Pu’uwa’awa’a Forest Reserve was established to support for multiple-uses, including recreation, rare species management, community engagement, preservation of cultural gathering rights, and research, among others. Forestry resource development is included as one of those multiple-uses but is of a lesser overall priority. As such, forest product management must be compatible with other goals, and benefit the management of the native forest. Since its establishment, Pu’uwa’awa’a has been an important place for forest products, including being one of the few places cultural practitioners can access and collect non-timber forest products specific to dryland forests. With the development and growth of forest product economic opportunities, both traditional models and new ecosystem services markets could play an important role in building and sustaining abundance at Pu’uwa’awa’a.

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Aerial control of little fire ants on Maui

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In 2019 the Maui Invasive Species Committee began aerial control of little fire ants (Wasmannia auropunctata) in Nahiku Maui using a gel bait matrix containing s-methoprene (brand name Altocid). The treatments (n=8) were done in succession, each spaced 6 weeks apart, in an effort to reduce the little fire ant density and population spread with the goal of eventual eradication. A custom-made, externally mounted tank and sprayer system designed for use with a MD 500 was utilized to administer the aerial treatments. In this presentation we discuss methodology, operational components, and preliminary results of little fire ant aerial control efforts on Maui to date.

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Progress on Implementing the 2017-2027 Hawai‘i Interagency Biosecurity Plan

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The Hawai‘i 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 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 Hawai‘i Invasive Species Council (HISC) 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 three-year mark for implementation, what progress has been made? What biosecurity legislation has passed, and which bills have failed to make traction? Are we keeping pace with implementing the 2027 vision? What gaps remain as opportunities for improvement in future years? Staff from HISC will continue to provide this progress report as the third of 10 annual presentations at the Hawai‘i Conservation Conference to ensure that the conservation community remains informed and engaged as implementation progresses.