2012 Hawai‘i Conservation Conference

ABSTRACTS

What Difference Does 20 Years Make?
Reflections on Change, Innovation, and the Work that Remains

July 31 – August 2, 2012

Hawai‘i Convention Center, Honolulu, HI

Hawai‘i Conservation Alliance
Hawai‘i Conservation Alliance Foundation
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1-1 Working With the System: Lessons From Listing Insects Under the Endangered Species Act
Karl Magnacca

There is now an increasing focus on arthropod conservation in Hawai‘i, in recognition of their status as the largest component of native diversity. With more rigorous documentation of the rarity of many endemic insect species has come a push for listing of species under the Endangered Species Act. However, while listing species gains them legal protection, it can also introduce difficulties that make conservation management harder. Insects pose particular issues because their life histories are often poorly known, which makes species-specific management for recovery difficult, but many are impossible to study or even identify while alive. With the experience of the existing conservation bureaucracy geared towards plants and especially birds, adapting to the needs of insects poses new challenges. I review the experiences with insect species that have been listed and those that are in the pipeline, particularly the 30 Drosophila and Hylaeus species that make up the bulk of the listed or targeted species in Hawai‘i. Some traditional techniques, such as fencing important habitat to protect forests from ungulates, are applicable to insect conservation, while others need to be developed for specific needs. Ultimately, the human aspects - greater integration between researchers and managers, increased information sharing, and educational outreach among both conservation workers and the general public - may be the most important for expanding the effectiveness of insect conservation efforts.

1-2 Looking at the Big Picture: Conserving Arthropod Communities
Paul Krushelnynoky

Arthropods constitute a majority of the biodiversity in most terrestrial ecosystems. In addition, these animals typically play important roles in ecosystem processes such as decomposition, soil turnover and pollination, and form critical links in food webs. Native insects and their allies are therefore not only important entities to conserve in their own right, but they are also important for the functioning of native ecosystems. Conversely, invasive arthropod species not only threaten native arthropods, but can also disrupt and alter entire biological communities. How best to conserve native arthropod communities in Hawai‘i, however, has barely been investigated and remains poorly understood. I will discuss what is known about threats to native arthropods, patterns of invasion, results of some management efforts, and the information needed to develop effective arthropod conservation strategies. Successful protection of arthropods is likely to have implications for the conservation of other endemic taxa, from plants that rely on arthropods for pollination to birds that use arthropods as prey.

1-3 Using Diverse Research Programs Focused on the Wēkiu Bug (Nysius wekiuicola) to Improve Conservation Management Strategies in the High Alpine Ecosystem of Mauna Kea
Jesse Eiben

University of Hawai‘i at Mānoa, Honolulu, HI, USA
The wēkiu bug, *Nysius wekiuicola*, found only in the summit region of Mauna Kea on Hawai‘i Island, depends wholly on wind-blown, gravity deposited arthropod prey from much lower elevations. Due to its limited range, specific habitat requirements, isolated populations, and habitat destruction, the wēkiu bug has been the focus of targeted research for its conservation. This insect has delayed telescope construction in its elevation range, become acknowledged in the public eye as a uniquely Hawaiian creature deserving attention and protection, and has been the focus of extensive scientific research and monitoring projects. Investigations into ecological constraints, population growth indices, and population genetics, culminated in the recommendation of protecting a specific habitat comprising ~25% of the area in its elevation range. We demonstrate that in the process of gaining detailed knowledge into how this unique insect survives in this harsh tropical alpine environment, broader management advice is inherently provided to land managers. The wēkiu bug can progress through three generations per year, and has a potential reproductive rate similar to other non-alpine sister species, has migration barriers created by subtle changes in substrate, and is genetically depauperate. These newly discovered facts have caused the conservation management regime to change and better address the actual threats to the species and ecosystem. In Hawai‘i, where plant and animal endemism is among the highest in the world, there is a need to conserve these amazing species with special life histories, and this approach to management can be used more broadly for ecosystem conservation.

**How Molecular Phylogenetics Can Inform Conservation: Three Case Studies From Hawaiian Moths.**

Matt Medeiros¹, William Haines², Daniel Rubinoff²

¹The Urban School of San Francisco, San Francisco, CA, USA, ²University of Hawai‘i at Mānoa, Honolulu, HI, USA

Many groups of moths endemic to the Hawaiian Islands are in a state of taxonomic disarray; within any given genus the numbers of species and their distributions are often unknown, making conservation decisions especially difficult. Historic over-description, wing pattern polymorphism, and lack of adequate sampling are often to blame for these problems. Here we show how molecular phylogenetics in concert with recent collecting effort has been used to clarify taxonomic issues in three genera, with different lessons learned from each. A phylogenetic analysis revealed that in cave-dwelling *Schrankia* (Noctuidae), only a single species is found throughout caves on Maui and the Big Island, suggesting that the ability to disperse between caves has helped this species develop and maintain a large range, unlike many other cave-associated species, which are apparently restricted to individual cave systems. In *Thyrocopa* (Xyloryctidae), phylogenetic analysis revealed that several polymorphic species are more widespread than previously recognized, though other species in this group have likely suffered extinction within the last hundred years. Still other *Thyrocopa* species, alpine taxa, have very limited ranges and appear critically threatened with extinction. Finally, in *Hyposmocoma* (Cosmopterigidae), four new putative species from Kaho‘olawe have recently been confirmed using molecular phylogenetics, and their relationships with other *Hyposmocoma* provide clues to larval natural history. Assembling the full life histories of these moths will provide information useful to manage their populations, and understand why these moths have persisted on an island where much of the native biota has gone extinct due to habitat degradation.
1-5 Hawaiian Land Snail Biodiversity: Conservation Status of a Vanishing Fauna
Kenneth Hayes, Norine Yeung
University of Hawai‘i, Honolulu, HI, USA

The Hawaiian Islands support the world’s most spectacular radiation of land snails. These species have distinctive evolutionary, ecological and cultural legacies and play an important role in our understanding of land snail evolution in general and island taxa in particular. They provide key ecosystem services, e.g. litter decomposition and nutrient cycling, and are flagship indicator species for intact mid-elevation rain forest, key to watershed maintenance. Unlike many invertebrates, they leave behind shells providing a record of colonization and evolutionary events, allowing inference of historical processes. Taxonomically, the Hawaiian land snail fauna is disharmonic, with only 10 of the ca. 90 recognized land snail families. Estimates of the number of species ranges from 752 to 1461. However the real number is unknown as most have not been studied in a comprehensive systematic manner for almost a century. Despite this uncertainty, even the most conservative estimates indicate that Hawai‘i is an incontrovertible gastropod diversity hotspot. Even more spectacular is that >99% of the species are endemic, many to single islands. We have recently begun to undertake the monumental task of cataloging what remains of the Hawaiian land snail diversity, and placing that within the larger framework of their evolutionary origins. Preliminary data confirm that much has been irrevocably lost, but there also remains a great deal of cryptic diversity that can still be saved. We present an overview of what remains and offer suggestions for what information is needed to develop effective conservation strategies to save this biodiversity treasure before it vanishes.

1-6 Stabilization of Rare O‘ahu Snail Populations Using Predator Exclusion Structures
Brenden Holland¹, Vince Costello¹, Stephanie Joe¹
¹University of Hawai‘i, Honolulu, HI, USA, ²O‘ahu Army Natural Resource Program (OANRP), Pacific Cooperative Studies Unit, Honolulu, HI, USA

Island snails have fascinated biologists since the time of Darwin, constituting some of the major species radiations on oceanic islands, including Hawai‘i. Due to the onslaught of invasive predators, the race is on to save the perhaps 10-25% of native snail species remaining on O‘ahu. The most effective method for controlling predators and stabilizing critical habitat in situ is via predator exclusion barriers. In collaboration with researchers and resource managers from UH Manoa and USFWS, the OANRP has funded and designed one such structure in the Waianaes, with a second in the Koolaus under construction. The Wai‘anae project included emergency collection of Achatinella mustelina, placing them in the UH Tree Snail Conservation Lab, while design and construction were completed. During this two year period, the number of endangered snails held in the lab increased from 202 to 340, while OANRP biologists conducted intensive predator sweeps for Jackson’s chameleons and Euglandina rosea, outplanting of native host trees, installation of water catchment, removal of invasive trees and plants, installation of real-time monitoring technology, and testing of various novel predator barrier technologies. Finally, permits were obtained and a post release-monitoring plan was established and in February 2012, the structure was completed and the 340 native tree snails were transported from the lab and released inside the structure. In addition to the target species, we have also moved a number of other native snail taxa into the protected habitat from surrounding areas. If successful, this effort represents a new collaborative direction for land snail conservation in Hawai‘i.
1-7 An Update on the Development of the State of Hawai‘i Native Invertebrate Database: A New Resource for Managers, Researchers, Planners and the Public

Cynthia King1, James Parham2
1State of Hawai‘i DLNR-DOFAW, Honolulu, USA, 2Bishop Museum, Honolulu, USA

A fundamental limitation to implementing invertebrate conservation in Hawai‘i is the lack of available information relating to native invertebrates. What is even more concerning is that existing data are not organized or easily accessible to researchers, managers, environmental planners or members of the public. In order to effectively manage our native invertebrate species, DLNR-DOFAW should be able to identify and prioritize invertebrate conservation needs for species and habitats of greatest concern across the state. Historically, however, there have been no means by which to accomplish this objective. To address this long-term deficiency, DLNR-DOFAW is currently funding the development of a native invertebrate database which will centralize and integrate historical and contemporary invertebrate collection and survey records. The database is both an ecological and a geographic (GIS-compatible) database, and will house data related to species distribution, abundance, survey/collection methods, habitat-level characteristics, ecological interactions with other species, as well as permit, collector, and museum accession information. Once completed, this database will not only be utilized by DLNR-DOFAW to inform resource management, but will be made available to the public. Security features will be put in place to protect locations of threatened or endangered species, and data which have not yet been released for publication. Our expectation is that once invertebrate data are publicly accessible, they will be more widely referenced in research, resource management, environmental planning, and education, consequently raising awareness of the need for the conservation of native invertebrates.

1-8 Conservation genetics and geographic population structure in eight species of Hawaiian leafroller moths (Omiodes: Crambidae)

William Haines, Daniel Rubinoff
University of Hawai‘i at Mānoa, Department of Plant and Environmental Protection Sciences, Honolulu, USA

Although arthropods comprise the bulk of Hawaiian biodiversity, little is known about their population structure related to geography and ecology, making it difficult to prioritize species or populations for conservation. Using mitochondrial DNA sequences, we explored genetic diversity and population structure in eight endemic moth species in the genus Omiodes (Crambidae), including both common and rare species, some of which have been extirpated from islands where they historically occurred. Analyses of Molecular Variance (AMOVA) and Isolation by Distance (IBD) revealed dramatically different population structure among species; some species had high genetic structure, with populations isolated on specific islands, while others showed no genetic structure across their extant range, presumably due to frequent dispersal among islands. Species with high host specificity, especially those relying on native host plants, tended to have higher genetic isolation and smaller range sizes, while generalist species capable of feeding on non-native plants tended to have high gene flow among islands, and broader historical ranges. This suggests that specialist species (e.g. O. antidoxa, O. monogramma) may be more prone to extinction, and local populations should be considered to be evolutionarily significant units worthy of protection. However, some species (e.g. O. continuatalis, O. monogona) that have high genetic diversity and no evidence of geographic isolation throughout their current range have experienced past island extirpations, suggesting that
even widespread, vagile species are not immune to extinction. *Omiodes* moths can be successfully reared in the laboratory, and reintroductions may be possible, with careful consideration of these results.

### 1-9 Trends in Research and Conservation in the Past 20 years of the Hawai‘i Conservation Conference

**Daniela Dutra Elliott¹, David Duffy², Megan Laut³, David Elliott⁰**

¹University of Hawai‘i, Botany Department, Honolulu, HI, USA, ²Pacific Cooperative Studies Unit, University of Hawai‘i, Honolulu, HI, USA, ³US Fish and Wildlife Service, Pacific Islands Fish and Wildlife Office, Honolulu, HI, USA

The 20th anniversary of the Hawai‘i Conservation Conference gives us a unique opportunity to examine the past two decades of research presented. We looked at all abstracts written from 1993 to 2011 and examined how conservation and research trends changed over time in the conservation community. We identified relevant keywords and used frequency analysis to detect trends, which displayed a continuous increase in abstract numbers, culminating in 2011 with a 4.5 fold increase when compared to 1993. Results indicate a broadening of geographical scope and topics of research. In the early years the bulk of the research presented was conducted exclusively in Hawai‘i, but over time it has broadened to encompass the Pacific and link to other regions, such as Latin America. In recent years, human dimensions of conservation such as traditional knowledge and global warming have emerged. Initially, abstracts focused on species and programs updates and less on basic and applied research which have increased significantly over time. In recent years, there were more studies on the community level (e.g. food webs, ecosystem dynamics) and interspecific interactions (e.g. pollination and seed dispersers), as well as more theoretical studies using, for example, prediction models (for global warming and endangered species). The analysis of trends revealed important changes, including major shifts in species emphasis for research on both native and alien species, as well as a reorientation of geographical focus within Hawai‘i. These trends will be discussed and we will highlight gaps in knowledge that can be addressed in the future.

### 1-10 Haleakalā’s Native Wildlife: A 20-year Spot Check

**Cathleen Natividad Bailey, Joy Tamayose, Raina Kaholoaa**

Haleakalā National Park, Maui, Hawai‘i, USA

Haleakalā National Park began aggressive feral ungulate and introduced predator control in the 1980's. To determine effects of management, the Park has been monitoring populations of Hawaiian goose (nēnē), Hawaiian petrel (ʻuaʻu) and forest birds since 1988, and have been collecting observations of Hawaiian bat (ʻōpeʻapeʻa) and Hawaiian monk seal. Twenty years of data shows that habitat recovery has been beneficial for native wildlife species. The Haleakalā nēnē population is static and the ʻuaʻu population from 300-400 nesting pairs to over 3,000 nesting pairs. Data on forest bird populations, ʻōpeʻapeʻa and Hawaiian monk seal is currently being analyzed and will be presented at the conference.

### 1-11 The Last 20 years on Kaho‘olawe.

**Paul Higashino, Lyman L. Abbott, James Bruch, Lopaka White**

Kaho‘olawe Island Reserve Commission, Wailuku HI, USA

Haleakalā National Park began aggressive feral ungulate and introduced predator control in the 1980's. To determine effects of management, the Park has been monitoring populations of Hawaiian goose (nēnē), Hawaiian petrel (ʻuaʻu) and forest birds since 1988, and have been collecting observations of Hawaiian bat (ʻōpeʻapeʻa) and Hawaiian monk seal. Twenty years of data shows that habitat recovery has been beneficial for native wildlife species. The Haleakalā nēnē population is static and the ʻuaʻu population from 300-400 nesting pairs to over 3,000 nesting pairs. Data on forest bird populations, ʻōpeʻapeʻa and Hawaiian monk seal is currently being analyzed and will be presented at the conference.
Over the last 20 years on the island of Kaho‘olawe, a new plant genus (*Kanaloa*) was discovered; feral goats (*Capra a. hircus*) were eradicated, the Kaho‘olawe Island Reserve Commission (KIRC) was created to protect a terrestrial reserve of 116km² (45mi²) and a marine reserve 233km² (90mi²) in area; the US Navy conveyed deed of ownership back to the State of Hawai‘i and now the KIRC controls access to the island; and 200ha were planted with 200,000 native plants consisting of 20 different species using over 3000 volunteers. As a result, native plant cover has increased, the amount of bare soil has decreased and rates of soil erosion are less in areas with restoration. Today, volunteer trips with a cultural component continue to reestablish native dry forest plant species in the summit area of the island, and facultative and obligate plant species are being re-introduced into two wetland areas. The development of a Faunal Restoration Program is occurring and Hawaiian seabird habitat is being improved. There remains 39km² (15mi²) of hard pan which will require many decades to restore. However, future funding will be needed to continue the conservation activities of the last 20 years by the KIRC.

**1-12 Restoring a Hawaiian Nation Through the Restoration of Kaho‘olawe**

*Michael Nahoopii*

*Kaho‘olawe Island Reserve Commission, Wailuku, Hawai‘i, USA*

There are few places left in today's Hawai‘i where one may go to learn about being Hawaiian; Kaho‘olawe is such a place. In working for the return of Kaho‘olawe, many of the current generation rediscovered what it means to be Hawaiian. Restoring the island devastated landscape and protecting its vast ocean resources will provide a place and a purpose for a new generation of Hawaiians to be trained in the rights and responsibilities of “kahu o ka ‘aina,” or stewards of the land. It will provide a place for the Hawaiian and those who wish to be more Hawaiian to experience the intimate connection to the land and the sea. Thus Kaho‘olawe, as envisioned in the motto “Kukulu ke ea a Kanaloa,” will be a cultural learning center where traditional cultural and spiritual customs, beliefs, and practices of the Hawaiian people will be manifested in the physical work of restoration and stewardship. The vision statement of the KIRC is “The kino of Kanaloa is restored. Forests and shrublands of native plants and other biota clothe its slopes and valleys. Pristine ocean waters and healthy reef ecosystems are the foundation that supports and surrounds the island. Na po‘e Hawai‘i care for the land in a manner which recognizes the island and the ocean of Kanaloa as a living spiritual entity. Kanaloa is a pu‘uhonua and wahi pana where Native Hawaiian cultural practices flourish. The piko of Kanaloa is the crossroads of past and future generations from which the Native Hawaiian lifestyle spreads throughout the islands.” It is through this approach on Kaho‘olawe that conservation, restoration and stewardship is the mechanisms for today's and tomorrow’s generation of Hawaiians to learn and embrace a fuller understanding of their past, their environment and their nation.

**1-13 A Legacy of Enhancement: The Benefits Accrued From 15 years of Monk Seal Recovery Efforts**

*Charles Littnan¹, Jason Baker¹, Albert Harting², Thea Johanos-Kam¹, Tracy Wurth¹*

¹NOAA Fisheries PIFSC, Honolulu, HI, USA, ²Harting Limited, Bozeman, MT, USA

A primary objective of NOAA’s Hawaiian Monk Seal Program is to mitigate sources of mortality to increase monk seal survival and recovery. Here, we summarize results from an analysis of interventions undertaken from 1995 - 2010 and their impact on the monk seal population. We identified and characterized a number of handling event types that likely or definitely resulted in increasing the survival of a seal (e.g., disentangling seals from nets,
dehooking, or reuniting mothers and pups) and focused primarily on those interventions that addressed high-risk situations (n = 614). Of these handled seals, there are 124 seals currently surviving, including 69 females. Throughout the lifespan of the handled seals there were 198 known births, with 56 of those descendents still alive including 25 females. Extending one additional generation, there were another 2 known births with 1 of those still alive. Combining all 3 generations gives 686 total seals, with 181 still alive including 94 females. Applying a correction factor to the known pup production, we estimate approximately 204 seals currently involved or descended from handled seals. In concert, the presence of NOAA and other field staff, their handling interventions, and the reports generated from a thirty-year presence in the NWHI, has provided an important safety buffer (at least 18%) for the population. This is particularly important during a period of stress for the NWHI population and may prove critical to the species in terms of their ability to weather the current storm.

1-14 Celebrating 40 Years of Clean Water Success!
Robin Knox
Water Quality Consulting, Inc., Kihei, Hawai‘i, USA

Water pollution and disturbance of aquatic and terrestrial ecosystems threatens water quality, drinking water supply, aquatic life, and the function of ecosystems. Celebrating the occasion of the 40th anniversary of the Clean Water Act, this paper examines the past successes, current challenges, and future direction of Clean Water Act programs in Hawai‘i. The presentation will focus on the relevance of Clean Water programs to watershed planning and conservation of coral reefs. The audience will gain an understanding of how state, federal and local clean water programs can work together effectively with conservation efforts to manage water quality from Mauka to Makai. Viewed from the ecosystems analysis perspective of Clean Water programs, the interconnections of diverse societal concerns including wastewater disposal, polluted runoff control, water supply, flooding, soil and water conservation, control of invasive species, and restoration of native ecosystem become readily apparent.

1-15 Koa Forest Recovery over 33 Years on Mauna Loa
J. B. Friday¹, Paul Scowcroft², Travis Idol¹, Sarah Knox¹, Holli Tidwell¹
¹Department of Natural Resources and Environmental Management, College of Tropical Agriculture and Human Resources, University of Hawai‘i at Mānoa, Honolulu, HI, USA, ²USDA Forest Service Pacific Southwest Research Station, Institute of Pacific Islands Forestry, Hilo, HI, USA

The Hawaiian forest can be resilient in the face of disturbance in the absence of woody invaders. In 2001 and again in 2011 we inventoried an unmanaged secondary koa forest at Kamehameha Schools’ Keauhou Ranch on the windward side of Mauna Loa. The degraded native forest regenerated naturally after logging and clearing in 1978. In 2001 we found that 12 native woody species had re-established: Acacia koa, Myoporum sandwicense, Metrosideros polymorpha, Coprosma sp., Ilex anomala, Cheirodendron trigynum, Myrsine lessertiana, Melicope sp., Vaccinium calycinum, Pipturus albidus, and Broussaisia arguta. No alien wood species invaded the site. Total stand basal area was 30 m²/ha, of which 26 m²/ha were koa. Myoporum sandwicense (naio) was the most common tree, at 1049 stems/ha, while there were 988 stems/ha of koa. A decade later (2011) koa continued to dominate the forest canopy despite ongoing density-dependant mortality, which is typical of single cohort stand of shade-intolerant trees. Koa basal area increased 19% to 31 m²/ha while koa density decreased 27% to 724 stems/ha.
Naio remains the most common tree with 861 trees/ha. All other species found in 2001 are still present and comprise a slightly larger share of the forest basal area than in 2001 (18% vs 14%). We also calculated koa volumes in cubic meters and board feet per hectare based on log lengths and upper log diameters. Our results serve as a guide to landowners wishing to restore koa forests both for biodiversity and timber production.

CONCURRENT SESSION 2: JULY 31, 2012

2-1 Application of Agricultural IPM Philosophy and Procedures in Conservation Management.
Mark Wright
University of Hawai‘i at Mānoa, Honolulu, HI, United States Minor Outlying Islands

Agricultural Integrated Pest Management (IPM) developed during the past four decades in large part through concern for reducing environmental impacts of pest management in agriculture. IPM requires the integration of mutually compatible techniques for pest suppression. Application of IPM aims to manage agri-ecosystems for scarcity (of pests) and abundance (of beneficial organisms). There are substantial contributions that may be made to conservation management by applying and IPM-based philosophy to the management of invasive species, while simultaneously addressing the need to minimize impacts on desirable species, and to increase their abundance and diversity. Key concepts that will be addressed include population sampling techniques applied to invasive- and indigenous species; determining “thresholds” for invasive species in natural systems; benefits and concerns associated with biological control of invasive species, and interactions among management options directed at achieving widely different outcomes.

2-2 Biological Control Supporting Conservation Programs in Hawai‘i: The Erythrina Gall Wasp Project
Leyla Kaufman1, Juliana Yalemar2, Cynthia King3, Mark Wright1
1University of Hawai‘i, Honolulu, Hawai‘i, USA, 2Hawai‘i Department of Agriculture, Honolulu, Hawai‘i, USA, 3DLNR, Honolulu, Hawai‘i, USA

Invasive species can cause severe impacts on native species and ecosystems. The practice of biological control has been mainly used to fight invasive species in agricultural settings but has also been instrumental tool for conservation efforts. The Erythrina Gall Wasp biological control project is the most recent example of a successful program against an invasive wasp that threatened the endemic wiliwili, Erythrina sandwicensis. The gall wasp arrived to Hawai‘i in 2005 and severely impacted all wiliwili populations in the islands. In 2008, a biological control agent, Eurytoma erythrinae, was released against this invasive species. Results from post-release monitoring indicate that E. erythrinae is successfully controlling gall wasp populations at most sites, and surviving wiliwili trees are recovering from gall wasp damage. Post release monitoring continues in order to determine the impact that E. erythrinae will have on the species’ long-term viability.

2-3 Integrating Biocontrol into Management of Strawberry Guava
M. Tracy Johnson
USDA Forest Service, Volcano, HI, USA
Although the history of classical biological control of weeds in Hawai‘i and around the world provides many examples of dramatic, problem-solving success, more often biocontrol agents function in the context of a combination of management tools. Integrating use of multiple tools is a challenge that Hawai‘i’s resource managers and scientists face together. Successful application of biocontrol to the problem of strawberry guava (*Psidium cattleianum*) invasion will depend on such an integrated approach. The Forest Service biocontrol program intends to partner with management agencies across the state to demonstrate the safety and effectiveness of the recently released agent *Tectococcus ovatus* for slowing the spread of strawberry guava in native forests, and develop strategies for combining the biocontrol with other approaches for restoration of degraded areas.

### 2-4 Biological Control and the Native Hawaiian Conservation Ethos

**Darcy Oishi¹, Samuel Gon²**  
¹Hawai‘i Department of Agriculture, Honolulu, Hawaii, USA, ²The Nature Conservancy of Hawai‘i, Honolulu, Hawai‘i, USA

Classical biological control is one of the earliest forms of invasive species management utilized in Hawai‘i. Its history dates back to the reign of King Kalākaua when he brought famed entomologist Albert Koeble to Hawai‘i to protect the Kingdom’s budding agricultural industries. King Kalākaua was deeply concerned about what we now call invasive species, any organism that disrupts the delicate balance between organisms in a living system. Classical biocontrol involves the same form of intimate knowledge of the relationships organisms have on each other and how they impact each other in a system that typifies the native Hawaiian conservation ethos. It involves determining what organism exists in a biologically linked fashion to target pest. Such organisms are then carefully examined to ensure that link does not affect other species. As a result, classical biological control seeks to re-establish the balance between organisms, and by extension the system as a whole-an approach that is fundamental to both the view of disease and of land care management. Utilizing the recent impacts of an invasive insect on wiliwili and the systemic impacts of strawberry guava on native forest ecosystems, we will examine how classical biological control "fits" into the Hawaiian conservation ethos.

### 2-5 Two Decades of Ginger Abatement - Holding the Line

**Pat Bily**  
The Nature Conservancy, Hawai‘i, USA

This presentation will provide a synopsis of the IPM strategy for containing Himalayan ginger (*Hedychium gardnerianum*/kahili ginger) in The Nature Conservancy’s (TNC) Waikamoi Preserve on Maui. Strategies include decades of consistent manual control with regular volunteer efforts; chemical control trials to develop effective methods (supported by a HDOA Special Local Need Label for forest sites); huge efforts in eliminating pig disturbance, enhancing cultural control by allowing competition from native ferns and other intact layers; and support for biocontrol. Biocontrol activities include past field research with the *Ralstonia* bacterium and exploration in the Himalayas over the past 4 years (in cooperation with LandCare NZ) which has identified potential agents for further testing. These IPM strategies are regularly communicated to TNC volunteers, hikers, local students, garden clubs, and landscape associations to gain support, especially towards judicious use of chemicals in natural areas and biocontrol releases.
Identifying an Operational Niche for an Experimental Platform: A Case Study of Herbicide Ballistic Technology

James Leary
University of Hawai‘i at Mānoa, Kula, HI, USA

Herbicide Ballistic Technology (HBT) is a novel weed targeting platform designed to pneumatically deliver encapsulated herbicide projectiles with a unique capability to administer a lethal application to satellite weed targets with a 30-meter effective range and sub-meter accuracy. The original concept derives from challenging experiences in invasive weed management that are unique to Hawai‘i. The mission was to develop an advanced weed management tool for the benefit of stakeholders with conservation responsibilities in watersheds and natural areas. In order to accomplish this goal, the development strategy needed to evolve from customary efficacy validation studies (i.e. shoot plant...plant dies) into a regiment of controlled platform calibrations to measure performance of this novel technology under operational settings (i.e. Target Acquisition Rate, Operational Treatment Efficacy, Mortality Factor,...). Specifically, HBT has been best characterized as a platform integrated into aerial surveillance operations combining target detection with real-time target acquisition of remote satellite miconia (Miconia calvescens) populations. Feasibility and cost analyses are being implemented in a decision support process to determine optimal utility of the HBT platform that is largely based on target density. Finally, we speculate on biological control agent releases that are projected to provide measurable target population reductions with a discussion on how this could be used in adjusting resource allocations with a restructured management strategy.

The Gorse Project: Forestry Options for the Sustainable Management of Woody Leguminous Weeds

Nick Dudley, Aileen Yeh
Hawai‘i Agriculture Research Center, Kunia, HI, USA

Gorse (Ulex europaeus) is a noxious, spiny shrub species infesting the eastern flank of Mauna Kea on the island of Hawai‘i. Past control efforts include chemical, mechanical, fire, and biological control. In 2003, a series of forestry trials were installed as part of an overall sustainable management strategy for gorse control at Humu‘ula. Several types of forestry trials were installed including: (1) Native forest restoration; (2) Exclusion forestry where long-term cover will aid in exhausting the gorse seed bank; (3) Plantation forestry with fast growing species that out compete gorse; (4) Ornamental forestry. Tree species evaluated in the trial included Acacia koa, Cryptomeria japonica, Eucalyptus species, Pinus species, and Pseudotsuga menziesii. Prior to planting, each species was evaluated for risk of invasiveness. Tree species growth performance at year 1 is as follows: Acacia koa is the most desirable tree species for reforestation purposes at Humu‘ula. Average height growth rates of 1.5 m per year were reached. Eucalyptus spp. were the fastest growing tree species tested with height growth averaging over 2m per year. The conifers on the whole were the slowest growing trees species tested. These trials seek to expand existing IPM techniques for land managers for sustainable, long-term management of woody legumes.

A Holistic Approach to Ecologically Based Invasive Rodent Management

Katie Swift1, Peter Dunlevy2
1US Fish and Wildlife Service, Honolulu, HI, USA, 2USDA-APHIS-Wildlife Services, Honolulu, HI, USA
Rodent management is a vibrant field of study worldwide, with new research published frequently. Most of this research is focused on the protection of crops and human health; however, information on rodent behavior and ecology, the efficacy of control methods, and the development of new control techniques is transferable to native ecosystems in Hawai‘i. Ecologically-based rodent management (EBRM) has become the research-based standard used in agriculture globally, which if adopted in Hawai‘i should improve the effectiveness of rodent control for the protection of native species. It is a hierarchical process derived from IPM that employs a combination of procedures to decrease rodent damage on a resource to a target level. Techniques include altering the habitat where possible to reduce its potential to support rodents, high volume removal devices, barriers, and timing of rodent management. EBRM can be adapted for use in native ecosystems in Hawai‘i because regardless of the type of habitat they occupy, rodents are extremely adaptable yet predictable in their behavior. Their mobility and high reproductive output cause them to establish quickly in all areas that provide food, den sites and cover, whereupon they rapidly reach, and often exceed, the carrying capacity of the habitat. Therefore, when bait stations and traps remove a small number of individuals from a limited area, they are ineffective given these biological traits. Evaluating sites and proposed techniques within an EBRM framework at the beginning of the planning process will ensure that the methods selected have a high probability of achieving success.

2-9 Listing Species Under the ESA: U.S. Pacific Islands Conservation Actions.
Krista Graham
NOAA Fisheries Pacific Islands Regional Office, Honolulu, HI, USA

The listing of species as threatened or endangered under section 4 of the federal Endangered Species Act (ESA) provides protection and conservation benefits that may assist in the recovery of those listed species. Under the ESA, listed species are protected by Federal law from “take”, which means to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct. A recovery plan for each ESA-listed species is also developed, which includes recommended conservation measures. These plans must incorporate: a description of site-specific management actions necessary to achieve recovery of the species; objective, measurable criteria which, when met, would result in a determination that the species be removed from the list; and estimates of the time and costs required to achieve the plan's goal. Species may be delisted once they are recovered. Several marine species in the U.S. Pacific Islands have been petitioned for listing under the ESA: the Hawai‘i insular false killer whale; bumphead parrotfish; scalloped hammerhead shark; and 75 reef-building coral species. NOAA Fisheries has proposed to list the Hawai‘i insular false killer whale as endangered under the ESA and is currently developing the final listing rule. NOAA Fisheries has initiated status reviews and is evaluating the available biological information to determine whether listing is warranted for the 75 coral species, bumphead parrotfish, and scalloped hammerhead shark. The Hawaiian green sea turtle has been petitioned for delisting, and NOAA is reviewing the information to determine whether this action is warranted.

2-10 Critical Habitat Under the ESA: Pacific Islands Conservation Actions
Jean Higgins
NOAA Fisheries, Honolulu, HI, USA

Habitat loss, alteration and degradation are often the greatest threats to fish and wildlife nationwide. In developing the Endangered Species Act (ESA), Congress recognized that habitat...
protections would play a key role in recovering fish and wildlife that face extinction. Accordingly, “critical habitat” was established under the ESA, to characterize and safeguard the natural resources and areas that animals and plants need to recover. Safeguards for critical habitat are specific to actions that are funded, permitted, or carried out by federal agencies; however, the designation of critical habitat plays an important role in educating local, state, and federal planners about the importance of specific natural resources and areas. Additionally, these designations provide a foundation for stewardship of natural resources that support the recovery of the nation's fish and wildlife that are at risk of extinction. The State of Hawai'i has a large amount of designated critical habitat for ESA-listed terrestrial wildlife and plants; however, in 2011 the Hawaiian monk seal (*Monachus schauinslandi*) became the first marine mammal to have critical habitat proposed for the main Hawaiian Islands following a petition that NOAA Fisheries received from nonprofit organizations in 2008. The expansion of critical habitat for the Hawaiian monk seal would safeguard natural resources and areas throughout the Hawaiian Archipelago from poorly planned growth and development and on a project by project basis, provide conservation for one of Hawaii’s rare and at risk species.

**2-11 Take Reduction Under the MMPA: U.S. Pacific Islands Conservation Actions**  
*Jayne LeFors*  
*NOAA Fisheries Pacific Islands Region, Honolulu, HI, USA*

The U.S. Marine Mammal Protection Act (MMPA) prohibits the “take” of marine mammals, with limited exceptions, where “take” is defined as “to harass, hunt, capture, or kill, or attempt to harass, hunt, capture, or kill any marine mammal.” The MMPA authorizes the prescription of regulations with respect to the taking and importing of marine mammals to insure that such taking will not be to the disadvantage of those species and population stocks. The law also requires development and implementation of “take reduction plans” to reduce incidental take of marine mammals in commercial fisheries. Recent efforts by NOAA Fisheries in the U.S. Pacific Islands use the MMPA’s take reduction authority to address the conservation of two marine mammal species that are facing very different threats. False killer whales (*Pseudorca crassidens*) are incidentally taken by Hawai‘i-based commercial longline fisheries at an unsustainable rate; and Hawaiian spinner dolphins (*Stenella longirostris*) are being subjected to take and harassment by tourism vessel operations and by individuals who attempt to swim with or closely approach the dolphins. This presentation gives a brief overview of how take reduction under the MMPA conserves and protects marine mammals, and provides details on efforts by NOAA Fisheries to minimize or reduce the take of these species. Specifically, this presentation describes the development of a Take Reduction Plan to reduce incidental mortality and serious injury of false killer whales in Hawaii’s commercial longline fisheries, and development of regulations to minimize human-caused disturbance and disruption of behavioral patterns of Hawaiian spinner dolphins.

**2-12 Conservation Benefits of the Dolphin SMART Program in Hawai‘i**  
*Laura McCue*  
*NOAA Fisheries Service, Honolulu, HI, USA*

The Dolphin SMART program is a unique, voluntary, recognition and education program for tour operators whose mission is to promote environmental stewardship of wild dolphins in coastal waterways and aid in dolphin conservation by reducing human activities that may cause dolphin harassment. This program provides conservation benefits for dolphins and participation...
incentives to tour businesses who agree to voluntarily follow program criteria. The mission is accomplished by members engaging in and conducting responsible viewing and advertising practices, as well as educating guests on the importance of responsible viewing for dolphin conservation. Another facet to Dolphin SMART is the Proud Supporter program. Dolphin SMART Proud Supporters are local businesses that do not conduct dolphin viewing but support the program mission. Proud Supporters help raise public awareness for Dolphin SMART by teaching the public the importance of booking with a Dolphin SMART business to aid dolphin conservation. The Dolphin SMART program was first implemented in the Florida Keys in 2007 as a pilot project. Since then it has expanded to Alabama in 2008, the Southwest coast of Florida in 2010, and most recently in Hawai‘i in 2011. Here in Hawai‘i we currently have Dolphin SMART operators on the islands of O‘ahu and Kaua‘i. The program also plans to expand to Maui, the island of Hawai‘i and other areas within the Pacific Islands Region as needed.

2-13 Local, State, and Federal Regulatory Structures
Jonathan Scheuer
Hawaiian Islands Land Trust, Hawai‘i, USA

This presentation will review current efforts at private land conservation in Hawai‘i, using a historical contextual approach to differentiate past and current conservation efforts, challenges, and opportunities. It will describe the various players and stakeholders in different land conservation efforts, past and current legal and fiscal mechanisms used to conserve land, and delve into different ways that success at land conservation can be measured from multiple perspectives. It will pay particular attention to the emerging use of conservation easements to protect conservation values in land and the challenges and opportunities that emerge when these efforts are viewed in the broadest context of land conservation in the islands and the multiple kinds of values that can be protected in conservation efforts.

2-14 Legal Aspects of Conservation Easements
Gregory Hendrickson
The Law Offices of Gregory D. Hendrickson, Kealakekua, HI, USA

This portion of the presentation will focus on the important legal considerations required as part of a conservation easement transaction. These issues include the nature of the legal land interest, what organizations qualify to hold the conservation easement, and the importance of defining the conservation purpose of the transaction. Additionally, the discussion will consider tax, title and other real property issues.

2-15 Acquisition Strategies: Fee Interests versus Conservation Easements
Dale Bonar, Scott Fisher
Hawaiian Islands Land Trust, Hawai‘i, USA

This session will examine the pros and cons of pursuing the acquisition of fee title or conservation easements on lands with significant conservation values. The decision about the best tool for permanently conserving such lands depends on a variety of issues, including landowner vision and goals, management requirements, costs of acquisition and ongoing management, capacity of the organization to manage and/or enforce, availability of funding, and potential partners in conservation of the property. We will discuss the methodologies we utilize.
to evaluate these (and other) issues, decide whether and how best to approach each project, and prioritize the efforts to acquire their permanent protection.

2-16 Direct Acquisitions Versus Brokering Lands to be Held by Other Conservation Entities
Lea Hong
The Trust for Public Land, Honolulu, Hawai‘i, USA

History of voluntary land conservation efforts in Hawai‘i by The Trust for Public Land (over 40,000 acres), its partnerships with federal, state, and county agencies and other NGOs, and the establishment of local state and county public funding sources for land conservation.

2-17 State-related Funding Sources for Acquisition of Conservation Lands
Sheri Mann, Molly Schmidt
DLNR, Division of Forestry and Wildlife, Honolulu, Hawai‘i/O‘ahu, USA

Over the last decade, recognition of the need for land acquisition (both for conservation easements and fee simple acquisitions) as a strategic tool to address Hawaii’s conservation challenges has resulted in a variety of public funding sources at the County, State, and Federal levels. The DLNR, Division of Forestry and Wildlife (DOFAW), acts as a conduit for several federal programs, that allow these funding sources to pass through and be directed toward Hawaii’s resource needs and protection priorities. DOFAW also manages the State source of conservation land acquisition funding, the Legacy Land Conservation Program, as well as coordinates with several of the county sources of land acquisition funding for the protection of Hawaii’s resources. In this segment we'll provide a brief overview of the funding sources available through DOFAW and elsewhere.

2-18 Assuring the Perpetual Management of Conservation Values
Trae Menard
The Nature Conservancy, Hawai‘i, USA

This session will examine the challenges of managing lands “in perpetuity” and discuss the short-term and long-term issues that have to be considered both before and after acquisition of conservation lands. Such issues include identification of management practices, adaptive management plans to deal with unavoidable climatic change, costs and funding opportunities, and identifying appropriate partnerships for carrying out the identified practices.

CONCURRENT SESSION 3: AUGUST 1, 2012

3-1 Examination of Feeding Ecology of Corallivorous Fishes to Assess Impact of Health in Coral Reef Ecosystems
Trisha Soares, Misaki Takabayashi
University of Hawai‘i at Hilo, Hilo, HI, USA

Coral degradation due to disease is increasing as a result of anthropogenic impacts affecting coastal marine environments. Here, corallivores were used as an indicator of health status in coral reef ecosystems on Hawai‘i Island. Fish surveys combined with tissue sampling of corallivores (damsel, butterfly, and parrotfish) were conducted to compare biochemical signatures as a proxy for fish diet at five sites of varying coral health status. Stable isotope
analyses ($\delta^{13}C$, $\delta^{15}N$) were used to examine impacts of coral health on corallivorous diets. Fish abundance was significantly higher ($p<0.001$) at the healthiest coral site (Pohue Bay, 213.8 ±10.9 SD) and lowest where corals were most impacted (Wai opae, 120.8 ±13.6 SD). Similar trends were identified in obligate (butterflyfishes) and facultative (damselfishes) corallivores (Pohue Bay, 21.3 ±5.7 SD, 164.5±40.6 SD, respectively) and (Wai opae, 7.5, ±3.1 SD 13.0 ±3.2 SD, respectively). However, the opposite relationship was identified between coral health and facultative corallivore (parrotfishes), which had highest abundance at site with the most impacted corals (Pohue Bay, 5.5 ±2.4 SD, Wai opae, 10.6, ±5.9 SD). Species richness was not significantly different between sites in any fish family. Stable isotope analysis identified differences in the signatures of fishes found in healthy and unhealthy areas and will be discussed further. Corallivorous fish populations exhibited differences in abundance and species richness in areas of varying coral health. Stable isotope analysis may be a valuable tool available for examining relationships between coral reef inhabitants and their ecosystem.

3-2 A Multidisciplinary Approach to Restoration and Sustainability of Midway Atoll’s Shallow Reef Habitats.

Donald Potts1, Kristin McCully1, Wendy Cover2, Anne Warner1

1University of California, Santa Cruz, Santa Cruz, CA, USA, 2Fagatele Bay National Marine Sanctuary, American Samoa, USA

Because Midway Atoll has been extensively modified by engineering activities over the last century, it is now difficult to determine which ecological communities and conditions prevailing before modification. The coral *Porites compressa* is rare over most of the reef, except in the deepest part (~25 m) of the lagoon where patch reefs are dominated by large colonies of live *P. compressa*. These patch reefs are probably relics of a much more widespread community and may be the best representatives on the pre-disturbance reef. To evaluate past and present conditions, and to evaluate the potential for these patches to serve as sources for recolonization for other parts of the lagoon, we: A) explored coral recruitment and survival, and predation on coral transplants at several sites; B) documented the distribution, settlement and growth of pearl oysters (*Pinctada* spp.); C) collected >300 sediment and rubble samples throughout the lagoon to identify the major frame-building species today and in the past; and 4) initiated measurements of reef accretion, reef erosion, and sediment movement. Initial results will be integrated and interpreted, and potential management strategies indicated.

3-3 Reading Between the Lines: Interpreting Public Support for Hawaiian Monk Seal Recovery

Rachel Sprague, Jennifer Metz, Jeff Walters

NOAA Fisheries Service Pacific Islands Regional Office, Honolulu, HI, USA

Hawaiian monk seals (*Monachus schaunislandi*) are critically endangered: only ~1,100 individuals remain and the species is declining across most of its range. However, a small population in the main Hawaiian Islands (MHI) has been increasing in recent years. While encouraging, this growth creates new and diverse management challenges, including increased frequency of interactions with humans, and in some cases, misperceptions and animosity toward seals. Recent NOAA proposals for monk seal recovery have further highlighted disparate public viewpoints. We evaluated public opinions toward monk seal recovery from multiple sources. Many official comments on federal proposals expressed resistance to recovery actions or seals in the MHI (e.g., ~60% of the most frequent comments (N=793) on a Programmatic Environmental
Impact Statement). It may be tempting to view these comments as representing lack of public support for recovery of monk seals. However, random sampling provides a different outlook: 90% of public perception survey respondents (N=382) believed that protecting monk seals is important because they are unique to Hawai‘i, and ~40% believed that monk seals are not protected enough (N=200). This may reflect differences in how the public perceives and supports regulatory processes, as opposed to endangered species themselves, though we still observed some similarities in misperceptions between the sources. Ultimately, successful conservation will depend on public support and the willingness of humans to find compromises and coexist with wildlife. NOAA is working toward better ways of communicating science and creating positive messages to connect endangered species recovery with community values outside of regulatory processes.

3-4 Investigating Diet and Foraging Behavior to Explain Divergent Population Trends in the Hawaiian Monk Seal
Maire Cahoon¹, Charles Littnan², Ken Longenecker³
¹Joint Institute for Marine and Atmospheric Research, University of Hawai‘i at Mānoa, Honolulu, HI, USA, ²Pacific Islands Fisheries Science Center, NOAA Fisheries, Honolulu, HI, USA, ³Bishop Museum, Honolulu, HI, USA

Diverging trends in population abundance of endangered Hawaiian monk seals (Monachus schauinslandi) are apparent between the Northwestern Hawaiian Islands (NWHI) and the main Hawaiian Islands (MHI). The smaller MHI seal population is increasing, has higher juvenile survival, and seals appear to be in better condition overall relative to the NWHI. It has been hypothesized that diet and prey availability may be driving these trends. This study combines fecal analysis and satellite tracking for the first comprehensive study to define MHI monk seal foraging ecology and investigate what factors related to prey or foraging behavior explain regional trends. Prey remains from feces and regurgitates (n=120) were identified to the lowest possible taxonomic level. No striking differences in diet were detected between the MHI and NWHI seals. Satellite-linked dive recorders were opportunistically deployed on 18 seals between January 2004 and June 2008. Average tracking duration was 3.6 months. Relative to the NWHI, most dives were shallower and shorter, between 0 - 20 m and 98% of dives were less than 10 minutes. Foraging trip durations were shorter, lasting on average 3.8 d ± 0.27. Home-ranges were smaller, and generally very restricted (310.29 km² ± 45.69) with animals showing high fidelity to particular regions of their island of residence. The incongruity in body conditions of seals between locations likely indicates differences in foraging behavior and habitat use such that MHI seals appear to be investing less time for foraging resulting in a positive energy balance.

3-5 Examining the Role of Macroalgae in Promoting Sea Turtle Tumors
Migiwa Kawachi¹, Kyle Van Houtan², Celia Smith¹
¹Botany Department, University of Hawai‘i at Mānoa, Honolulu, HI, USA, ²Pacific Island Fisheries Science Center, National Oceanic and Atmospheric Administration, Honolulu, HI, USA

Since the 1980s, the tumor-forming disease fibropapillomatosis has been a conservation concern for the green turtle (Chelonia mydas). However, as green turtle populations in Hawai‘i and elsewhere have steadily increased, the disease received less attention. A recent epidemiological analysis in Hawai‘i showed that rates of the disease vary locally, at the spatial scale of individual watersheds. The results of this study linked the disease to land-based nutrient sources and to
invasive macroalgae, which forms the diet for green turtles. The study hypothesized that coastal eutrophication affects turtle tumors by elevating the amino acid arginine in their forage. Arginine is an important building block for herpes viruses - the cause of the tumor infections. To test these ideas, we conducted nutrient enrichment experiments in laboratory and collected macroalgae from the nearshore waters of O‘ahu and Maui. We analyzed the bulk stable isotope contents and the amino acid profiles and compared the results between high and low nutrient treatments. Our experiments show nutrient inputs increase photosynthetic rates and promote tissue growth. Interestingly, algae collected from known eutrophic sites in Hawai‘i have both elevated $\delta^{15}N$ and arginine, compared to samples from the same species from nearby, non-impaired locations. (Any differences between native and non-native or invasive species are so far not detected.) This confirms that macroalgae may play a mechanistic role in promoting fibropapilloma tumors, and furthermore suggests that anthropogenic factors affecting water quality are important to the management of this disease and to sea turtle populations.

3-6 Innovation in Hawaiian Odontocete Research, Changes in Management, and Work that Remains: Pantropical Spotted Dolphins as a Case Study
Sarah Courbis¹, Robin W. Baird³, Frank Cipriano², Deborah Duffield¹, Marc Lammers⁴
¹Portland State University, Portland, OR, USA, ²Genomics/Transcriptomics Analysis Core San Francisco State University, San Francisco, CA, USA, ³Cascadia Research Collective, Olympia, WA, USA, ⁴Hawai‘i Institute of Marine Biology, Honolulu, HI, USA

Over the last 12 years, studies of the life histories and population dynamics of odontocetes in Hawai‘i have provided a fresh understanding of these species and their place in Hawai‘i’s marine ecosystems. Studies using photo-identification, genetics, and tagging have begun to show that toothed whale species distributed around the Hawaiian Islands often have island-associated populations, some of which are local to specific island regions within the archipelago. As a result, NOAA Fisheries has recognized separate stocks within several Hawaiian odontocete species: false killer whales, spinner dolphins, and common bottlenose dolphins, with insular false killer whales under consideration for listing as Endangered. We will present an overview of recent improvements in our understanding of Hawaiian odontocete movement patterns and population structure and use pantropical spotted dolphins found near the inhabited Hawaiian Islands to illustrate how population genetics is applied to population structure questions and how it can inform management decisions. Better insight into the interplay between gene flow, diversity, and dispersal is necessary for understanding effects of natural events and anthropogenic activities on populations and designing appropriate management and conservation actions. Genetic results suggest there are at least three demographically isolated populations of spotted dolphins between O‘ahu and Hawai‘i Island that should be recognized as separate stocks and managed accordingly. We celebrate these research success stories and their influence on how odontocetes are managed in Hawai‘i, and conclude our presentation with thoughts on what remains to be done, including some directions recent acoustical research has taken.

3-7 The Hawai‘i Fish Habitat Partnership: Cooperative Aquatic Resource Conservation in Hawaii’s Inland and Coastal Marine Waters
Gordon Smith
Pacific Islands Fish and Wildlife Office, U.S. Fish and Wildlife Service, Honolulu, Hawai‘i, USA

The Hawai‘i Fish Habitat Partnership (FHP) consists of a diverse group of partners that plan and coordinate aquatic habitat restoration projects statewide. Partners include state and federal...
resource agencies, watershed groups, landowners and researchers. The Hawai‘i FHP seeks to cooperatively develop and implement habitat conservation projects to benefit native aquatic life in streams, estuaries, anchialine pools and nearshore marine habitats through the support and participation of government agencies, non-governmental organizations and communities. The Hawai‘i FHP is a locally-driven working unit of the National Fish Habitat Action Plan and is one of 17 recognized partnerships that have formed nationwide. Strategic priorities of the Hawai‘i FHP include reducing habitat impacts due to stream water withdrawals, reducing impacts of human-made instream barriers that obstruct migration of native diadromous fish and invertebrates, support for watershed restoration programs that reduce water quality impacts to adjacent coral reef ecosystems, technical assistance for habitat assessments, and maintaining cooperative relationships that can assist on-the-ground aquatic habitat conservation on public and private lands. The partnership is currently provided funding and technical support for more than fifteen aquatic habitat restoration projects; these include the Waipa Stream Restoration Project on Kaua‘i, Māhuahua ‘Ai o Hoi in the He‘eia watershed on O‘ahu, and four anchialine pool restoration efforts on the Big Island. Future project support will be directed to restoration projects that foster increased resiliency of aquatic ecosystems.

3-8 Long-term Monitoring of Native Fish in Waikolu Stream, Kalaupapa National Historical Park, Moloka‘i, Hawai‘i
Anne Farahi1, Anne M.D. Brasher0
1National Park Service, Hawai‘i National Park, HI, USA, 2USGS Water Science Center, Moab, UT, USA

The National Park Service has begun long-term monitoring of fish (Awaous guamensis, Sicyopterus stimpsoni and Lentipes concolor) in Waikolu Stream on Moloka‘i. Abundance and distribution data collected along a longitudinal gradient in 2009-2010 are compared to data collected from 1992-1994. All of these species have an amphidromous life cycle; eggs are laid in the stream, larvae hatch and wash out to the sea, eventually returning to a stream where they settle and grow to maturity. Water diversions can prevent downstream dispersal of larvae and upstream migration of post-larvae. Between the two sampling periods fish populations of all three fish species appear relatively stable in lower stream reaches; however, in the upper reaches there has been a marked decrease in abundance of Sicyopterus stimpsoni and Lentipes concolor. This decrease is observed most notably after the first diversion dam. This decrease over 16-17 years could indicate potential long-term effects of water diversion on native fish and snail populations.

3-9 Pearl Oysters (Pinctada) of Midway Atoll (Northwestern Hawaiian Archipelago)
Kristin McCully, Donald Potts
University of California, Santa Cruz, Santa Cruz, CA, USA

Pearl oysters (Pinctada spp.) may be an important component of coral reef ecosystems due to their community interactions, water filtering capacity, and potential for bioremediating nutrient and heavy metal pollution. Two species, P. margaritifera and the smaller P. radiata, have been reported previously from the Hawaiian Archipelago. Adult P. margaritifera are extremely rare at Midway Atoll, with only 13 located in 6 years of extensive bivalve surveys and other field work. Genetic analyses, using the nuclear ITS1 and mitochondrial COI markers, have identified most 2010 and 2011 Pinctada recruits on Midway Atoll as a third species, P. maculata, previously undocumented from the Hawaiian Archipelago. A population matrix model for the genus
Pinctada has been developed and parameterized using field measurements of recruitment, survival, and growth of *P. maculata* on Midway Atoll, survival and growth of adult *P. margaritifera* on Midway Atoll, and published data on distributions, abundances and size-distributions of *Pinctada* species from other locations. This model is used to project population sizes and dynamics of both *P. margaritifera* and *P. maculata* for several Hawaiian localities and to explore the impacts of possible management options.

### 3-10 The Hawai‘i Wetland Joint Venture: Statewide Partnership for Wetland Conservation and Waterbird Recovery

**J. Rubey**  
*Hawai‘i Wetland Joint Venture, Hawai‘i, USA*

The Hawai‘i Wetland Joint Venture (HWJV) is a partnership of federal, state, local government, non-profit organizations and local parties who are working together for the recovery of coastal wetland habitats for endangered endemic waterbird species. These species include the koloa, moorhen, coot, stilt, laysan duck and nēnē. This talk will cover the origin of the National Habitat Joint Ventures and expand to the more recent state representation of the HWJV. The HWJV is the state arm of the Pacific Coast Joint Venture covering the western coast of the continent. In Hawai‘i, the work of the various HWJV partners contribute to all aspects of recovery including: collaborative planning; research; site protection, restoration, & management; training & networking; and educational outreach. This talk will cover the role the Joint Venture plays here in Hawai‘i, it’s history, the challenges faced, site conservation actions and partner projects, and plans for future habitat protection and collaboration.

### 3-11 Importance of Federally Protected Coastal Wetlands to Hawaii’s Endangered Endemic Waterbirds

**Jared Underwood, Mike Silbernagle, Mike Nishimoto, Kim Uyehara**  
*USFWS, Honolulu, HI, USA*

Hawaii’s coastal wetlands are inhabited by five endangered endemic waterbird species. These include the Hawaiian coot (‘alae ke‘oke‘o; *Fulica alai*), Hawaiian duck (koloa maoli; *Anas wyvilliana*), Hawaiian stilt (ae‘o; *Himantopus mexicanus knudseni*), Hawaiian moorhen (‘alae ‘ula; *Gallinula chloropus sandvicensis*), and Hawaiian goose (nēnē; *Branta sandvicensis*).

Declines in all species have been attributed to loss or modification of wetland habitats, predation by introduced predators, avian diseases, drought or diversion of water limiting water availability, and historic overhunting. Systematic semiannual population counts have been conducted across the state over the last several decades. During the same time period, a minimum of monthly population counts have occurred on various federally protected coastal wetlands around the state. We explored these data to assess current status and trends for each species on statewide and localized scales. We also explored the importance of the federally protected coastal wetlands and their management on the overall and localized status and trends. We found that on a statewide scale, most species have rebounded from historic lows and over that last 25 years have steadily increased. We also found that management actions on specific federally protected coastal wetlands have benefited the species on the local scale and may have contributed to statewide population increases. Using these analyses we are able to inform current conservation efforts and increase the chances of recovery for these species.
3-12 Recovering Hawaii’s Endangered Waterbirds: the Role of the Kaua‘i National Wildlife Refuge Complex
Mike Mitchell, Kim Uyehara, Chadd Smith
Kaua‘i National Wildlife Refuge Complex, Kilauea, HI, USA

The Kaua‘i National Wildlife Refuge Complex has greatly expanded their wetland restoration efforts at both Hanalei and Hule‘ia sites in recent years. The increase in viable functioning waterbird habitat has resulted in dramatic increases in waterbird species seen on the refuge as evidenced by semi-annual waterbird counts. But unexpected perturbations such as botulism can heavily reduce bird numbers as well. Kaua‘i is home to the most genetically intact population of *Koloa maoli* (Hawaiian duck); but this waterbird species is now severely threatened due to hybridization with feral mallards. Both the successes and challenges faced at the Kaua‘i National Wildlife Refuge Complex have been significant. This talk will provide an overview of both restoration successes and management challenges within the context of bird population changes and trends seen over the years.

3-13 Wetlands of Maui-Nui - Complexities of Management in View of Stasis and Change
Fern Duvall
DLNR, Forestry & Wildlife, Wailuku, Maui, HI, USA

The Maui-Nui Islands of Lana‘i, Moloka‘i, and Maui provide eleven important wetlands for endangered waterbird refuge and recovery. Review of the current status and past history of wetland management of the major wetlands illustrates both stasis and more recent innovation providing insights into possibilities and varying recovery potential provided to the three endangered waterbirds found on Maui County. Management of the wetlands of Maui-Nui has not historically followed any standardized coherent management paradigm, but rather has been dictated and often remains complicated by the location of the wetland, its ownership, and the roles and jurisdiction of the wetlands’ managing entity. Wetland management on Maui-Nui is multi-faceted and is formulated and performed by Federal, State, County, as well as private entities. Conflicting mandates of managing agencies, as related to surrounding land tenure, and land owners continue to complicate the future recovery potential for Maui-Nui waterbirds. In contrast, changing interest and expertise from national organizations, has generated new and increased funding sources, and dollars available for work in Maui-Nui wetland management. While conflicting issues urgently need resolution, the recent more holistic and cooperative approaches to ordering, prioritizing and funding wetland management, have nonetheless expanded horizons over the past twenty years, such that the outlook for future successes seem possible.

3-14 Management of Kaua‘i Coastal Wetland Plant Communities with Prescribed Grazing to Enhance Habitat for Endangered Hawaiian Waterbirds.
Lex Riggle, Gregory Koob, Tom Runyon
Natural Resources Conservation Service, Lihue, Hawai‘i, USA

The Natural Resources Conservation Service (NRCS) has a long history of working with farmers, ranchers and land managers to address many kinds of resource concerns. Located only slightly inland from Kauai’s eastern coast, the Kawaihau Wetland Restoration Project was the first USDA Wetland Reserve Program (WRP) perpetual easement in Hawai‘i. The area includes about 40 acres of brackish water wetlands and mudflats, 20 acres of freshwater marsh, and more
than 40 acres of riparian and upland buffer. In 2011, a unique management alternative was initiated to convert a six foot tall impenetrable *Urochloa mutica* stand to a more desirable community structure for endangered Hawaiian Waterbirds. Working with a local rancher, goats are now grazing and maintaining much of the area in a seral habitat type. Habitat alterations by low impact, well-managed goats have greatly expanded the area available to endangered waterbirds and have resulted in a dramatic increase in Hawaiian duck sightings. Additional benefits provided by the rancher include predator control and informal population monitoring. As energy costs continue to increase, affordable management alternatives should be evaluated for all wildlife habitat types. Agreeing and committing to landscape goals by diverse interests contribute much to habitat development and endangered species recovery.

3-15 Facilitating Partnerships: Hawai‘i Wetland Joint Venture and the Conservation Registry
Peregrine Edison-Lahm
*Defenders of Wildlife, West Linn, OR, USA*

The Conservation Registry is a free online tool for planning, tracking, mapping, and sharing environmental projects. The Hawai‘i Wetlands Joint Venture is a part of the Pacific Coast Joint Venture (PCJV), which has its own “portal” within the Registry. The PCJV portal is a landing page that highlights projects relevant to wetlands preservation. Many Hawai‘i projects have recently been included. The Hawai‘i Wetlands Joint Venture will use it in conjunction with the Hawai‘i Wetlands Information Network (WIN). The Conservation Registry: (1) helps organizations and landowners understand the context in which they are working; (2) helps people determine the degree to which actions are taking place within identified priority areas; (3) determines if projects are effectively conserving habitat for at-risk species; (4) aids policy-makers and investors in understanding where public and private money is being spent; (5) helps conservationists find partners, funding, and advice; (6) helps everyone learn from the successes and challenges experienced by others doing similar projects; (7) demonstrates that it is possible and useful to integrate information across jurisdictions and ownerships.

3-16 The Rare Plant Facilities: A Synopsis of the Current Situation
Adam Williams
*1Harold L. Lyon Arboretum, Honolulu, HI, USA, 2Division of Forestry and Wildlife, Honolulu, HI, USA*

Currently, rare plant propagation facilities include botanical gardens, mid-elevation nurseries, seed storage and micropropagation laboratories on Kaua‘i, O‘ahu, Maui Nui, and Hawai‘i Island. This talk aims to provide background information on the creation of these unique facilities and an overview of their current situation and status, with a particular focus on innovations and accomplishments over the last twenty years. The facilities’ mission is two-fold: to propagate, multiply and grow rare taxa for restoration efforts in-situ, and for germplasm storage ex-situ to provide for a “genetic safety net” to prevent species extinction and preserve genetic diversity. Within the Rare Plant Program almost every aspect of horticultural science is being applied to the conservation of the State’s threatened flora. By utilizing conventional nursery propagation techniques like cuttings, grafts, and airlayers, to less common in-vitro and aseptic methods, and ongoing research on native seed dormancy, long-term storage and germination, the program’s expert horticulturists provide an invaluable service to any conservation organization seeking to do restoration work.
3-17 Collaboration Leads to More Successful Restoration Projects
Patrice Moriyasu
University of Hawai‘i, Honolulu, Hawai‘i, USA

Volcano Rare Plant Facility (VRPF) is a plant propagation nursery that produces endangered plant species for conservation. 146 threatened and endangered species occur on the island of Hawai‘i. 24 of those are already considered to be extinct in the wild. Working closely with collectors from the Plant Extinction Prevention Program, Natural Area Reserve System, and Forestry, species are collected and tracked. Through various plant propagation methods VRPF works to increase plant numbers and to preserve genetic diversity. Further collaboration with Federal, State and private partners restore threatened and endangered plant species to appropriate habitat on the Big Island. Close collaboration between collectors, propagators and out plant coordinators has resulted in: more accurate tracking of species, maximizing founder representation, more successful propagations and increased survival of out plants.

3-18 Hawaiian Rare Plant Facilities: Growing the State’s Rare Plants: Collaborating to Protect Rare Plants in the Natural Area Reserves on Hawai‘i Island.
Lisa Hadway, Nick Agorastos, Kualii Camara
DLNR-DOFAW, Hilo, Hawai‘i, USA

The Hawai‘i Island Natural Area Reserves System manages eight reserves across the island encompassing nearly 95,000 acres. The program is part of the Department of Land and Natural Resources Division of Forestry and Wildlife, and was established in 1971 to protect representative examples of Hawaii’s unique ecosystems so that current and future generations may enjoy them. Our natural resource management responsibilities are vast, and this creates challenges in our abilities to commit all of the required resources to properly manage our reserves. One of the critical management actions of the Hawai‘i Island NARS program is to protect the rare and endangered plant species found in the diverse range of habitats protected under the NARS designation. Through essential collaboration with partners, some of which include the three Hawai‘i Island watershed partnerships, the PEPP, and the Volcano Rare Plant Facility, the Hawai‘i Island NARS program has had many successes introducing numerous endangered plants into the wild. Introductions into large, fenced, ungulate free tracts of habitat are the preferred methods to protect these species and provides for watershed protection as well. The Volcano Rare Plant Facility plays an integral role in the NARS rare plant program’s success. The presentation will review examples of our success and the challenges we face protecting Hawai‘i Island’s rare plant species.

3-19 Contributions of ex situ Seed Banks to Conservation of Rare or Endangered Plants
Christina Walters
USDA-ARS, Fort Collins, CO, USA

Germplasm banks are widely used to conserve genetic diversity of agronomic species and their wild relatives. Over the last two decades, experience with more common species has been used to support seed banking efforts of some of our most rare species. The resulting collaborations among Agencies, NGOs and scientists from diverse disciplines bring a richer understanding of seed biology as well as strategies to overcome some of the major challenges specific to seeds collected from wild populations. These challenges include small sample sizes, unknown germination requirements and undefined strategies to regenerate aging populations of seeds. New
techniques designed to non-invasively evaluate seed quality and predict seed responses to storage conditions will increase the capacity of ex situ germplasm banks to care for precious seeds. Improving seed quality and seed longevity is a major research effort for both cultivated and wild-collected seeds. Critical assessment of many paradigms about seed storage behavior (including the orthodox-recalcitrant dichotomy, optimum drying procedures and temperature effects) is required to move beyond misperceptions about seed banks’ efficacy in maintaining seed viability and forestalling genetic erosion. Extensive research on seeds from Hawaiian flora, conducted in collaboration with numerous partners, has revealed unexpected discoveries about post-harvest physiology that is also relevant to understanding anomalous behavior observed in some mainland species and seed collections. This research also demonstrates that current seed bank technology is applicable to Hawaiian flora and can be used to “buy time” as other conservation strategies are implemented.

3-20 Connections: Makai, Mauka, and Moʻokauaahu
Hannah Springer
1Kamaʻaina of Kekaha, Kona, Akau, Kailua Kona, HI, USA, 2Puʻuwaʻa’awa’a Advisory Council, North Kona, HI, USA, 3Kaʻupulehu Monitoring Committee, Kailua Kona, HI, USA, 4Kaʻupulehu Marine Life Advisory Committee, Kailua Kona, HI, USA, 5Hui Laulima O Kekaha Kai, Kailua Kona, HI, USA

From the time that the ancestors arrived on the shores of Hawaiʻi, we have been shaped by its seas and lands, that is, our world view, our approaches to problem solving, and our humor. In turn Hawaiʻi has been shaped by us, with ever increasing range and speed, according to our fancies, desires, and needs. Hannah Kihalani Springer will discuss her observations of and contributions to this dynamic, based on her life in the land of her ancestors, from the generation of Captain Cook’s arrival to the present.

3-21 Status and Trends of Dry Forest Avifauna
Richard Camp1, Colleen Cole2, Eben Paxton3
1University of Hawaiʻi at Hilo, Hawaiʻi National Park, HI, USA, 2Three Mountain Alliance, Hawaiʻi National Park, HI, USA, 3U.S. Geological Survey, Hawaiʻi National Park, HI, USA

Native Hawaiian birds have experienced catastrophic declines and extinctions, which has been particularly severe for dry forest populations. In many cases, remnant forest bird populations persist in wet and mesic forests while their dry forest counterparts are either gone or persist only as a relict population because these habitats have been heavily impacted by numerous factors and little intact dry forest remains today. For example, the Kona district on Hawaiʻi Island harbors a narrow mesic-wet, high-elevation forest and a broad, highly altered dry, low-elevation forest. Eleven species or populations in this region are extinct, six are rare, and only four are common. While all 10 extant species occur in dry montane forest, only five occur periodically in the dry lowlands. Bird trends in Puʻu Waʻa’a Forest Bird Sanctuary were predominantly decreasing, although Hawaiʻi ‘Amakihi was increasing, and ‘Io and ‘Apapane were stable. Similarly, many populations in sub-alpine dry woodlands on Mauna Kea have declined during the last century and trends of some species, most notably Palila, have continued downward in recent years. Bird populations in dry forests have declined due to activities of ancient Hawaiians and later Westerners, and dry forests seem particularly susceptible to invasions by alien species, which alters forest composition and structure and food webs. Ungulates, predators, disease and
competitors continue to threaten remnant dry forest bird populations and inhibit species recovery.

3-22 Response of a Hawaiian Subalpine, Dry Forest Bird Community to Prolonged Drought and Habitat Degradation by Feral Ungulates
Paul Banko¹, Richard Camp², Chris Farrmer³, Kevin Brinck², David Leonard⁴, Robert Stephens⁵
¹U.S. Geological Survey, Pacific Island Ecosystems Research Center, Hawai’i National Park, HI, USA, ²Hawai’i Cooperative Studies Unit, Pacific Aquaculture and Coastal Resources Center, University of Hawai’i at Hilo, Hawai’i National Park, HI, USA, ³American Bird Conservancy, Hawai’i National Park, HI, USA, ⁴Pacific Cooperative Studies Unit, University of Hawai’i at Mānoa, Honolulu, HI, USA, ⁵Pacific Cooperative Studies Unit, University of Hawai’i at Mānoa, Hilo, HI, USA

Birds with specialized feeding habits and species inhabiting dryland forests have suffered most from population decline and extinction during the past 200 years of anthropogenic change. Annual bird surveys during 1998-2011 in dry subalpine woodland habitat on Mauna Kea revealed that climate change is posing a major threat to specialist species and is affecting even some dryland generalist species. The abundance of the critically endangered palila (Loxioides bailleui), a specialist feeder on the seeds of māmāne (Sophora chrysophylla), declined by 79% after 2003. An endangered specialist insectivore, the ‘akiapōlā’au (Hemignathus munroi), was not detected in the survey area after 1998. The Hawai’i ‘amakihi (Hemignathus virens virens), a generalist feeder and the most abundant species on Mauna Kea, was the only native species to maintain a relatively stable population. Although populations of several of the most common introduced species also remained relatively stable, the Japanese white-eye (Zosterops japonicus), a well-entrenched generalist, declined in abundance. Drought prevailed in 74% of months during 2000-2011, and dry conditions reduced the annual māmāne seed crop, contributing greatly to the decline of the palila. We observed 23.6 times more māmāne saplings in ungulate-free plots than in plots exposed to ungulates, and browsing continues to lower habitat carrying capacity. Eliminating ungulates is critical to restoring the forest and mitigating the effects of drought. The response of palila and other forest birds on Mauna Kea illustrate how changing climatic conditions can interact with the effects of invasive species to intensify threats to endemic birds.

3-23 First Evidence for Annual Rings in a Native Hawaiian Tree: Investigating Growth Dynamics of Māmāne (Sophora chrysophylla) on Maunakea
Kainana S. Francisco¹, Patrick J. Hart¹, Edward R. Cook², Jinbao Li³, Tishanna B. Ben¹
¹Tropical Conservation Biology and Environmental Science, University of Hawai’i at Hilo, Hilo, Hawai’i, USA, ²Tree-Ring Lab, Lamont-Doherty Earth Observatory, Columbia University, Palisades, New York, USA, ³International Pacific Research Center, School of Ocean and Earth Science and Technology, University of Hawai’i at Mānoa, Honolulu, Hawai’i, USA

When trees form annual growth rings, the patterns can be used to provide information on tree age and growth dynamics that is essential to developing appropriate forest management strategies. Annual rings are not commonly produced in tropical trees because they grow in a relatively aseasonal environment, however, in the subalpine zones of Hawaii’s highest volcanoes, there is often strong seasonal variability in temperature and rainfall. Using classical tree ring analysis methods we evaluated the periodicity of growth rings in māmāne (Sophora chrysophylla), a native hardwood tree species, on Maunakea, Hawai’i. We collected cross-sections from 45 dead, fallen māmāne trees from three different sites on Maunakea, and found relatively strong
correlation in ring patterns among individual trees within a site. In addition, there is a good relationship between ring patterns and local precipitation data. We aim to produce ring chronologies that span multiple centuries. This will provide much-needed information on past climate variability in the Pacific and will allow us to make predictions on how future climate change may affect growth dynamics of this important tree. In addition, we have begun to apply tree ring analysis methods to other native tree species on Maunakea, including naio (*Myoporum sandwicense*) and ʻakoko (*Chamaesyce* spp.) with promising results.

3-24 The Effects of Conspecific Density on Native Tree Seedling Survival in Native-Dominated Wet and Dry forests on Hawaiʻi Island

Faith Inman-Narahari\(^1\), Rebecca Ostertag\(^2\), Susan Cordell\(^3\), Christian Giardina\(^3\), Lawren Sack\(^1\)

\(^1\)University of California, Los Angeles, Los Angeles, CA, USA, \(^2\)University of Hawaiʻi, Hilo, Hilo, HI, USA, \(^3\)Institute of Pacific Islands Forestry, Pacific Southwest Research Station, USDA Forest Service, Hilo, HI, USA

Increased mortality near conspecifics is hypothesized to increase biodiversity in tropical forests by regulating the spacing of common plant species. Although this density-dependent mortality has been found in many plant communities, we present the first test of this theory on seedlings in tropical dry forest and compare dry and wet forests within a region. We examined the effects and spatial extent of conspecific adult tree basal area (BA\(_{\text{con}}\)) on seedling survival within 5-m increments in wet and dry forests on Hawaiʻi Island. For this analysis, we used 1-2.5 years of seedling survival data for 10 native species in 192 1-m\(^2\) seedling plots located within two 4-ha Hawaiʻi Permanent Plot Network (HIPPNET) plots in which all trees \(\geq\)1-cm DBH were mapped. Because pathogen-induced mortality may increase in low light, we also tested the interaction between light and BA\(_{\text{con}}\) using measurements of diffuse photosynthetically active radiation taken at each seedling plot. In dry forest, BA\(_{\text{con}}\) positively affected seedling survival within 5m but had a negative effect from 5-10m; light and BA\(_{\text{con}}\) combined had approximately twice the positive effect on seedling survival than BA\(_{\text{con}}\) alone (1.1% to 2.1% increased survival per cm\(^2\) BA\(_{\text{con}}\)). In wet forest, BA\(_{\text{con}}\) affected seedling survival negatively within 5m and positively within 10-15m, with no significant BA\(_{\text{con}}\)×light interaction at any distance. Thus, in the dry forest, seedlings closer to adult trees had higher survival, possibly due to shading, while in the wet forest seedlings closer to conspecific adults have lower survival possibly due to increased predators or pathogens.


Edith Adkins\(^1\), Cynthia King\(^3\), Elliott Parsons\(^4\), Mark Wright\(^2\)

\(^1\)Department of Land and Natural Resources, Division of Forestry and Wildlife, Hilo, HI, USA, \(^2\)University of Hawaiʻi at Mānoa, Honolulu, HI, USA, \(^3\)Department of Land and Natural Resources, Division of Forestry and Wildlife, Honolulu, HI, USA, \(^4\)Three Mountain Alliance, Kailua-Kona, HI, USA

Blackburn's sphinx moth (*Manduca blackburni*) is one of Hawaii’s largest native insects, and is a federally listed endangered species. *Manduca blackburni* larvae feed on plants in the nightshade family (Solanaceae). The native larval host species, ʻaiea (*Nothocestrum* spp.) is in decline throughout the State. *Manduca blackburni* has host-shifted to tree tobacco (*Nicotiana glauca*), an invasive plant, that is spreading across dry, arid landscapes. Once thought extinct, *M. blackburni* larvae have been found to be locally abundant on *N. glauca*. A Habitat Conservation Plan is
being developed in North Kona to assess and mitigate for potential take of Blackburn’s sphinx moth due to clearing of roadways and fuel breaks. In order to determine potential adverse impacts to *M. Blackburni*, and to maximize avoidance of take, we initiated surveys for eggs and larvae and documented host plant use to estimate density and distribution of *M. blackburni* in the Plan area. To date, 148 survey transects (14 in 2010, 40 in 2011, 94 in 2012) have been completed. Data are being analyzed to examine how host plant size, leaf density, location, and elevation affect the distribution of *M. blackburni*. These data will inform the development of mitigation efforts for *M. blackburni* in Pu’u Wa’awa’a and Pu’u Anahulu, and survey methodology may be applied elsewhere in the State to assess population densities and potentially evaluate the status of this species.

3-26 Increasing the Impact and Success of Ecological Restoration in Hawaiian Dryland Ecosystems

Susan Cordell¹, Erin Questad², Jim Kellner³, Greg Asner⁴, Kealoha Kinney³, Jarrod Thaxton⁵

¹USDA Forest Service, Institute of Pacific Islands Forestry, Hilo, HI, USA, ²Cal Poly-Pomona, Pomona, CA, USA, ³University of Maryland, College Park, MD, USA, ⁴Carnegie Institution, Palo Alto, CA, USA, ⁵University of Puerto Rico, Mayaguez, Puerto Rico

Ecological restoration is a priority in ecosystems where invasive species are abundant. However, restoration can be difficult when invasive species have had large impacts on ecosystem properties and land-use has caused significant environmental degradation. Restoration is also challenging in landscapes where resources are limited and plant growth is slow. We developed tools to assess restoration potential and aid restoration planning for a dry forest landscape in Hawai‘i. This area provides habitat for many threatened and endangered species, is at risk of further damage by fire fueled by invasive grasses, and is the focus of extensive management and restoration efforts. We developed restoration indicator variables from light detection and ranging (LiDAR) and spectroscopic measurements from the Carnegie Airborne Observatory (CAO). Specifically, we used analyses of fire fuels, topography, and tree density derived from the CAO data combined with field microclimate measurements to identify areas with the greatest need for restoration and areas with high potential for restoration success. Areas in need of restoration had conditions favorable to the spread of wildfire. Areas with high potential for restoration success had conditions favorable for plant growth, such as reduced wind speeds, greater water availability, and greater shade. We developed restoration planning tools for three ecosystems and identified areas of the landscape suitable for different restoration targets, including restoration for native biodiversity, endangered plant populations, and fire prevention.

3-27 The Mauna Kea Forest Restoration Project: Accomplishments through 2012

Robert Stephens¹, David Leonard¹, Jackson Bauer¹, Cheyanne Rapoza¹, Joseph Kern¹, Kuulei Vickery¹, James Riedman¹, Joanna Zeigler³, David Duffy¹, Scott Fretz²

¹Pacific Cooperative Studies Unit, Honolulu, HI, USA, ²Hawai‘i Division of Forestry and Wildlife, Honolulu, HI, USA, ³AmeriCorps Hawai‘i Youth Conservation Corps, Hilo, HI, USA

The Palila is a federally endangered honeycreeper almost entirely dependent on mamane and is now only found on Mauna Kea. In 2006, the Mauna Kea Forest Restoration Project (MKFRP) was created to mitigate for the loss of Palila Critical Habitat from the Saddle Road Realignment by restoring mamane forest at Puu Mali (PMMA) and Kaohoe mitigation areas (KMA). Since removing sheep, goats and cattle from KMA, on Mauna Kea's southwestern slope, natural regeneration of mamane saplings is 24 times higher than outside the exclosure. At PMMA, on
the mountain’s northern slope, MKFRP staff and volunteers planted >50,000 seedlings and scattered 136 pounds of seed between 2010 and 2012. Six-month mamane seedling survival improved from 25% in 2010 to 69% in 2011 because of increased precipitation and by refining planting protocols based on data related to survival. Additionally, 17.5 pounds of mamane seed scattered in March 2011 over 20 x 0.17 acre plots resulted in 923 seedlings germinating as of July 2011. By January 2012, an additional 246 mamane sprouted resulting in 1.03 seedlings per 100 seeds scattered. As of March 2012, 1-year seedling survival estimates were 59%; similar to outplanting survival. These results are encouraging as seed scatter may provide a means for restoring forest over a larger area in a shorter time frame for less cost than would be possible via outplanting of nursery grown seedlings.

3-28 Tropical Dry Forest Conservation and Restoration Challenges and Successes at Three Sites on Hawai‘i Island

Elliott Parsons¹, Jen Lawson², Wilds Brawner³
³Three Mountain Alliance, Kailua-Kona, HI, USA, ²Waikoloa Dry Forest Initiative, Waikoloa, HI, USA, ³Hawai‘i Forest Industry Association, Kailua-Kona, HI, USA

Tropical dry forest in Hawai‘i has been reduced by as much as 95% in land cover over the last two centuries due to a variety of causes including wildfire, invasion by non-native species, and human modification of the environment. While some mature native canopy trees remain at some sites, existing dry forest areas are often heavily impacted by non-native grasses and shrubs and native understory is often sparse or missing. To overcome these challenges and restore dryland forests, effective partnerships are needed between agencies, community groups and volunteers. Restoration projects that bring together a diversity of people interested in helping recover dryland forest areas are critical to making progress in dryland forest conservation and restoration. Here we highlight three projects located in tropical dry forest on Hawai‘i Island where partners are helping make a difference in the struggle to restore dryland forest: Pu‘uwa‘awa‘a ahuupua‘a, Waikoloa Dry Forest, and Ka‘ūpūlehu. Partners include the watershed partnership: Three Mountain Alliance, the Hawai‘i Forest Industry Association, and the Waikoloa Dry Forest Initiative. Pu‘uwa‘awa‘a ahuupua‘a, located in north Kona on the northern slope of Hualalai is roughly 40,000 acres from the top of the Forest Bird Sanctuary to Kiholo State Park Reserve. Pu‘uwa‘awa‘a contains many remnant stands of ‘ōhi‘a, Lama, and wiliwili and also has a large number of rare and endangered plants. Waikoloa Dry Forest includes a 275 acre fenced conservation area to the south of Waikoloa Village and contains wiliwili and some of the last endangered uhiuhi trees. Ka‘ūpūlehu dryland forest includes a 70 acre conservation area that has been actively restored by the Hawai‘i Forest Industry Association since 1993.
and the ecological roles of their corresponding kino lau as a way to influence current management strategies. Four marine species were chosen as kino lau of the four main Hawaiian akua, Kū, Kāne, Lono, and Kanaloa. These species are manō (shark) as Kū, ‘o’opu (goby) as Kāne, ‘anae (mullet) as Lono, and he’e (octopus) as Kanaloa. The roles of each Akua that influence and contribute to a stable and balanced society were identified. The biology of their kino lau were also identified and extensively studied through literature reviews, interviews, and visual observations made at Pihemanu (Midway Atoll). Our results found associations between the roles of Akua and kino lau in behavior, reproductive cycles, seasonal variability in abundance, and morphology. Through the correlations found between each kino lau and the Akua they represent, results will help to broaden perspectives into existing regulatory practices and also support effective adaptive management plans.

4-2 He Hua nō i ka Noiʻi Noelo: The Application of Hawaiian Place Names in Scientific Inquiry
Puaʻala Pascua, Melanie Dudley, Hōkū Pihana
University of Hawai‘i at Hilo, Hilo, USA

Hawaiian place names exemplify the interaction between people and place and attach an identity to the surroundings based on key geographic, environmental, historical, and/or cultural features of the area. Through integrating historical accounts of study sites with their physical characteristics, we aim to research the ecological characteristics of selected places in Hawai‘i and the description of those characteristics in their names. This study examined Wailuku and Wailoa on Hawai‘i Island and three different Waimea located on Hawai‘i Island, Kaua‘i, and O‘ahu. Our results demonstrated that the Hawaiian place names given to these locations accurately reflect the environmental conditions and characteristics of that location. We therefore conclude that Hawaiian place names are a definitive source of data for future environmental research. We extended our research on Pihemanu (Midway Atoll) to interpret and name places by applying the integrated methodology of extensive observations by local residence of Pihemanu and Kūʻula participants. Through this process, new names were suggested for previously unnamed locations, and some pre-existing names were reconfirmed to represent the characteristics of the place while other place names required revision. The process of naming places reflects the scientific method of collecting observations, proposing a hypothesis to describe the phenomenon, testing the hypothesis and resulting in a product. Thus the outcome of the practice of naming represents an important source of environmental data.

4-3 Ka Wai Moʻo Mau: A Comparison of Midway and Hawai‘i Island’s Water Cycle
Jessica Cleghorn, Aleysia-Rea Kaha, William Lundin
University of Hawai‘i at Hilo, Hilo, HI, USA

Humans are embodiments of the water cycle and, on a larger scale; play an intricate role in how water flows through our environment. A generalized model of the water cycle is often applied to understanding the water cycle throughout Hawai‘i but does not account for the influences of the extensive range of climates and topographies of our islands and also the influences of humans. Our project investigated the water cycle in relationship to place specific climate, topography, and human interaction hoping to support local communities and the future care of their waters. We studied the water cycle of two sites, Waipi‘o Valley (Hawai‘i Island) and Pihemanu (Midway Atoll). We correlated Hawaiian and English documentations on water cycles of the particular locations with our field observations on environmental parameters. Various phases of the water
cycle were then recorded using Hawaiian language descriptive phrases. These phrases enabled us
to interpret movement, form, location, and function increasing our understanding of the different
phases of the water cycle and further supported an intimate understanding of water specific to
place and human use. We then developed specific models of the water cycle for each of Waipi‘o
and Pihemanu. We found that these two locations at opposing ends of the Hawaiian island chain
differed in types of water phases and human interactions within it. The approach of incorporating
self into environmental cycles employed in this study creates stewards invested in the
environment they manage.

4-4 Hoʻomeheu Nā Hulu Following Our Ancestral Path
Kanoe DeRego, Mahina Chang, Hoku Tobin
University of Hawai‘i at Hilo, Hilo, USA

The ‘alae ke‘oke‘o is an endangered waterbird that is endemic to all the Main Hawaiian Islands,
except Kahoʻolawe. They have also been known to sporadically occur as a vagrant within the
Hawaiian archipelago as far west as Kure Atoll. Given that human activities have reduced their
habitats it is important to assess available wetland environments for their suitability as ‘alae
ke‘oke‘o habitats. We studied Lokowaka pond in Keaukaha, Hawai‘i and Pihemanu (Midway
Atoll) for their suitability as ‘alae ke‘oke‘o habitat, as defined in the James Campbell National
Wildlife Refuge Comprehensive Conservation Plan, using three parameters: vegetation structure,
food abundance, and threats. Along with the three parameters, we established a personal
relationship with these sites and incorporated knowledge and insight from the local communities.
Our preliminary results indicate that although Lokowaka’s ‘alae ke‘oke‘o population is stable
and the food is abundant, the prevalent predator presence and vegetation structure suggest
susceptibility to predation. On Pihemanu the wetland habitats provide abundant food sources,
and minimal susceptibility to predation. However only transient individuals are known to reside
and competition with other species is questionable. Further assessment of these sites will support
the possible establishment and management of populations, which may in turn help to increase
the number of this endemic species.

4-5 Being True to Hawaiian Knowledge in Resource Management: The Native Hawaiian
“Research” Plan
ʻAulani Wilhelm, Keoni Kuoha
NOAA Papahānaumokuākea Marine National Monument, Honolulu, HI, USA

Papahānaumokuākea Marine National Monument (PMNM) recognizes that Hawaiian and non-
Hawaiian knowledge traditions and disciplines each provide valuable tools in the practice of
science and resource management in Hawai‘i. Therefore, enhancing our access and use of
traditional knowledge strengthens our ability to manage our resources. To this end and driven by
mandate, PMNM has collaborated with the Office of Hawaiian Affairs (OHA) to go into
Hawaiian communities to help us formulate a plan for Native Hawaiian “research” in the
Northwestern Hawaiian Islands for the next several years. The discussion and feedback
generated with communities has been powerful, and our agencies have learned from this
interaction—learning that we intend to share as broadly as possible. In this presentation, we will
take a look at the mandates that require the application of Hawaiian knowledge in resource
management at PMNM. We will also delve into our present efforts to develop a Native Hawaiian
research plan and take a look at how this process may redefine research in the future.
Since passage of the Tropical Forest Recovery Act in 1992, and release of the TFRA Task Force Report in 1994, numerous efforts have made significant strides in achieving a compelling vision for conserving Hawai‘i’s natural and cultural legacies through conservation management, education and research, economic development, and most importantly developing critical partnerships. In the twelve years since the first assessment in 2000, and on the 20th anniversary of the Act, a symposium that seeks to review again the accomplishments of the TFRA Act and the Action Plan in the 9 Guiding Concept areas outlined in the 1994 Plan will be explored. The nine Guiding Concept areas are: 1) Working Relationships; 2) Traditional and Community Uses; 3) Stewardship; 4) Incentives; 5) Training and Education; 6) Research and Demonstration; 7) Planning, Inventory and Monitoring; 8) Economic Development; 9) Innovative Funding. I will present information on the following three Concept Areas: Traditional and Community Uses, Economic Development, and Innovative Funding.

Traditional and Community Uses - Appreciation for and knowledge of traditional uses and cultural concerns of native Hawaiians and members of the local community have greatly increased in the past 20 years, but sensitivity towards the rights, responsibilities and practices of indigenous people of Hawai‘i and towards the values and concerns of local community members need to be expanded. While there is some integration of knowledge systems, efforts may not show the hoped for progress in understanding, respecting and accommodating local cultural values in today’s forests unless efforts to move this integration forward succeed.

Economic Development - The past 20 years has seen important efforts to build a forest industry, and continued support is required for expanding these efforts with the goal of creating a sustainable, commercial forest to promote economic diversification within the state. Actions considered instrumental in this guiding concept include management for sustainability of all forest resources and assurance of the right to use. The resource base for economic development has been established but developments have stalled. The challenges of associated economic hurdles will be explored.

Innovative Funding – There is a large need to identify and secure new funding for forest-related projects and programs. Innovative funding sources, such as revenues from water yields and carbon sequestration, would permit forests to sustainably pay for their upkeep. A multi-agency and private sector grants program, whereby funds would be jointly raised, administered and distributed, would be in keeping with the cooperative spirit of those with overlapping interests in Hawai‘i’s forests.

The relationship of Hawai‘i’s forestry programs and USDA financial assistance is guided by a “State-Wide Assessment and Natural Resource Strategy” (SWARS) process that echoes the 1992 Hawai‘i Tropical Forest Recovery Act. As the Act did for Hawai‘i, the 2008 Farm Bill asked all states to identify issues and enumerate strategies in a “Forest Action Plan”. The Farm Bill additionally emphasized the use of modern GIS technology to conduct comprehensive
assessments of forest resources across all lands - public, private, rural and urban. This provided a tool for the designation of spatial priority areas within which to focus landscape-level efforts. The Farm Bill also set up a process for ongoing implementation and accountability for the state Forest Action Plans. Annual grant proposals from state foresters to the USDA Forest Service are now keyed to strategies in the state's own plan. A national MOU with the USDA NRCS pledges to use these assessments, strategies and priority areas in NRCS forestry-related technical and financial assistance. Assessments and strategies may be updated when states desire, and it is anticipated that the 2013 Farm Bill will again call for review and revision of state plans, in coordination with natural resource agencies and public stakeholder advisory groups. These two processes should be brought together; the public interest and consultation for both plans should merge them into a single plan that expresses Hawai’i’s most important visions and goals for its forests, guiding all partners in collaborative implementation.

4-8 Toxoplasma gondii detection in soils from urban O‘ahu
Alisa Davis, Christopher Lepczyk, Susan Crow, Clifford Morden
University of Hawai‘i at Mānoa, Honolulu, HI, USA

Feral cats have flourished in urban areas of Hawai‘i due to the state's favorable climate and people’s positive perception of cats. However, the presence of large numbers of feral cats has raised concern both in terms of predation of native species and as vectors of disease. One disease, in particular, that has aroused a great deal of attention is toxoplasmosis, caused by the Toxoplasma gondii parasite. Cats are the definitive host of T. gondii and concerns arise regarding transmission to humans due to the relationships people have with cats. Another concern is the fact that the parasite has infected endemic and endangered species found in the state. Toxoplasma gondii oocysts are shed by cats in their excrement and can persist in soil between one and four years. The presence of T. gondii at cat colony sites could be an important factor when making decisions for the management of feral cats in the state. We tested soil samples taken from cat colony sites at the University of Hawai‘i at Mānoa for oocysts using molecular identification methods. Given that cats are definitive hosts of T. gondii, we hypothesized that the presence of toxoplasmosis will be spatially contained within close proximity of defecation sites at cat colony locations and that a soil dispersion solution would increase detection rate of oocysts. If T. gondii oocysts are present in soil at the University of Hawai‘i at Mānoa, then cat colonies may cause potential health hazards for the university community, and possibly indirectly affect native wildlife.

4-9 Impact of Feral Pig (Sus scrofa) Removal on Soil Carbon Fluxes in Hawaiian Tropical Montane Wet Forest
Michael Long1, Creighton Litton1, Christian Giardina2, Jed Sparks3
1Department of Natural Resources and Environmental Management, University of Hawai‘i at Mānoa, Honolulu, HI, USA, 2USDA Forest Service, Institute of Pacific Islands Forestry, Hilo, HI, USA, 3Department of Ecology and Evolutionary Biology, Cornell University, Ithaca, USA

Feral pigs (Sus scrofa) disturb vegetation and soils, and may alter soil carbon (C) fluxes (soil-surface CO2 efflux (FS); aboveground litterfall (FL); and total belowground carbon flux (TBCF)), yet very few studies have quantified these impacts globally. In Hawai‘i, feral pigs are widely distributed in native forests but their ecosystem-level impacts are largely unknown. In this study, annual FS, FL and TBCF were quantified in each of five paired sites (pig removal vs. pig present) along a chronosequence of feral pig exclosures ranging from 6.5 to 18.5 years since feral pig
removal in native tropical montane wet forest on Hawai‘i Island. We hypothesized that: (i) $FS$, $FI$, and TBCF would all increase following feral pig removal due to native understory vegetation recovery; and (ii) the relative difference in $FS$, $FI$, and TBCF between pig removal and pig present sites would increase with time since pig removal. Across all sites, $FS$ was 22% higher with feral pig removal ($P<0.05$), and the relative difference in $FS$ between pig removal and pig present sites increased linearly and positively with time since feral pig removal ($r^2 = 0.90$, $P<0.01$). $FI$ did not differ between treatments ($P=0.39$), or with time since removal ($P=0.70$). TBCF increased marginally with feral pig removal ($P=0.05$), and the relative difference in TBCF increased linearly and positively with time since feral pig removal ($r^2 = 0.86$, $P<0.05$). These results suggest that feral pig removal alters soil C cycling, and potentially soil carbon storage, in native Hawaiian wet forests.

4-10 Successes and Challenges Using Highly Trained Dogs and Systematic Approaches to Remove Ungulates from Large Conservation Areas
Francis Quitazol, Ed Misaki, Mark White, Mel Johansen, Brian Naeole
The Nature Conservancy, Hawai‘i, USA

In 2007, The Nature Conservancy (TNC) contracted with the New Zealand Company Prohunt to remove pigs from conservation areas on Maui and Moloka‘i. The Prohunt pig removal technique uses a systematic approach with highly trained hunting dogs, equipped with GPS tracking technology. Their method offers an effective alternative to removing pigs, especially in areas where snaring is not allowed or other methods have failed to remove the last ungulates. Over the past three years, TNC has implemented the Prohunt “one dog per hunter” approach using several hunting teams conducting systematic “sweeps”. The program shows early signs of success, with many lessons learned about proper kennel maintenance, dog handling and training, and animal control techniques. TNC is also in the process of outsourcing animal control efforts on Maui and Moloka‘i, thus requiring the need to transfer the necessary technology, knowledge, and skills to carry out a successful Prohunt-like approach. Here we discuss the important components of our dog programs, results achieved to date, challenges associated with transferring the technique to contractors, and guidance for those interested in starting similar programs.

4-11 The Kīpuka Project: A study of the Interactive Effects of Rat Predation and Forest Size on Food Webs
Devin Leopold1, Tadashi Fukami2, Christian Giardina1, Daniel Gruner3, David Flaspohler4
1US Forest Service, Hilo, HI, USA, 2Stanford University, Palo Alto, CA, USA, 3University of Maryland, College Park, MD, USA, 4Michigan Technological University, Houghton, MI, USA

While habitat size and isolation have been theoretically and empirically correlated with biodiversity, the relationship between habitat fragmentation and underlying ecological processes remains a central question in ecology. This topic is relevant for conservation planning because habitat fragmentation represents a significant component of anthropogenic global change. Despite extensive habitat fragmentation research, most model systems are plagued by confounding factors that may obscure direct effects of fragmentation. We identified a model ecological study system on Hawai‘i Island consisting of forest patches, or kīpuka, of varying size, shape and isolation, and surrounded by early successional lava flows from 1855 and 1882 Mauna Loa volcanic eruptions. We have mapped and targeted 32 kīpuka ranging in size from 0.1 - 10 ha for a study investigating the interactive effects of habitat size and introduced rodents (Rattus rattus) on native bird diversity and arboreal arthropod food webs. Preliminary results
indicate absolute height as the best predictor of rat presence in the forest canopy. Coupled with a strong correlation between canopy height and kīpuka size, this suggests that rats may have a greater impact in the canopies of smaller kīpuka. A large-scale rat removal treatment was initiated in 16 of the 32 kīpuka to quantify direct and indirect impacts on native bird and arboreal arthropod communities. We present results of an ongoing long-term food-web study and detail efforts to locally control introduced rodent populations in a native Hawaiian forest.

4-12 The effects of yellow crazy ant (*Anoplolepis gracilipes*) invasion and subsequent control on burrow-nesting seabirds in the Hawaiian Archipelago

Sheldon Plentovich¹, Todd Russell², Christine I. Camacho³

¹U. S. Fish and Wildlife Service, Honolulu, HI, USA, ²Marine Corps Base Hawai‘i, Kaneohe, HI, USA, ³Bureau of Statistics and Plans, Hagatna, GU, USA

Yellow crazy ants (*Anoplolepis gracilipes*) are a significant threat to biodiversity due to a rapidly expanding range and the potential to reach high densities that can negatively affect multiple trophic levels within ecosystems. Extirpation of ground-nesting seabirds has been reported anecdotally subsequent to yellow crazy ant invasion. Yellow crazy ant control is difficult and has not been demonstrated to have positive effects on nesting seabirds. Here we report the effects of ant invasion and subsequent control on burrow-nesting seabirds following the invasion of more than half of a 1.25-ha wedge-tailed shearwater (*Puffinus pacificus*) colony located on windward O‘ahu. The number of active burrows dropped from 105 in 2006 to two in 2010 in invaded areas, with no corresponding decline in active burrows in adjacent, uninvaded areas. Ant control efforts reduced ant densities by more than 90% and resulted in an increase in active burrows from two to 36 in a single season. Burrows appear to be abandoned by adults prior to egg laying due to irritation by ants. Chicks surviving in invaded areas had significant swelling and irritation around the eyes and bill, presumably the result of exposure to formic acid. We conclude that yellow crazy ants constitute a significant risk to ground-nesting seabirds and may lead to dramatic reductions in seabird numbers by reducing available nesting habitat and causing significant injuries to the few chicks that survive in invaded areas.

4-13 Working Towards the Eradication of Yellow Crazy Ants (*Anoplolepis gracilipes*) at Johnston Atoll National Wildlife Refuge

Stefan Kropidlowski², Lee Ann Woodward¹, Sheldon Plentovich¹

¹U.S. Fish and Wildlife Service, Honolulu, HI, USA, ²University of Hawai‘i‘i-Hilo, Hilo, HI, USA

Johnston Atoll, located in the Central Pacific Ocean, is one of the most remote atolls in the world. It represents the only available sea bird nesting habitat in over 750,000 square miles of ocean and hosts 15 breeding species including what may be the worlds largest population of Red-tailed Tropicbirds (*Phaethon rubricauda*). In January 2010, an infestation of Yellow Crazy Ants (*Anoplolepis gracilipes*) was discovered to have formed a high density “supercolony” throughout 54.7 hectares of Johnston Island. Nearly all ground nesting seabirds within the infestation abandoned their nesting sites presumably due to the high density of ants. The substantial impact on the seabird community and the known ecological impacts caused by this ant elsewhere prompted the U.S. Fish and Wildlife Service to deploy a strike team in an effort to eradicate the infestation. After 14 months of experimental trials and 2 unsuccessful control treatments, a bait strategy was developed that achieved >99% declines in the number of *A. gracilipes* and the number of monitoring station detections. The effective methodology involved the manual application of bait mixed with nutrition sources found to be the most attractive to the
ants on Johnston Island. The preferred attractant was protein (canned cat food) which was mixed with thickeners, water, and the active ingredient dinotefuran at a concentration of 0.05%. Two treatments involving 15 and 9 application days over 13 weeks were necessary. Within weeks of the decline an increase in Red-tailed Tropicbird nesting was observed within the infested area.

4-14 Who Wants Feral Cats in the Hawaiian Islands and Why?
Cheryl Lohr, Christopher Lepczyk
University of Hawai‘i at Mānoa, Honolulu, HI, USA

Feral cats (Felis catus) are abundant in the Hawaiian Islands and pose a threat to native wildlife through predation and the spread of disease. A combination of factors including the submission of State bills and County resolutions has created the impression that a large segment of society supports the presence of feral cats in the islands and in-situ management techniques. The purpose of this research was to quantify the perceptions and desires of Hawai‘i residents regarding the abundance and impact of feral cats. In 2011, we disseminated a social survey to approximately 5,000 Hawai‘i residents including pre-identified wildlife stakeholders and a random sample of the general public. Data were analyzed using the potential for conflict index (PCI) and Wildlife Stakeholder Acceptance Capacity (WSAC) models. PCI results indicate that there is a high level of consensus within every stakeholder group that the abundance of feral cats should be decreased. Despite this result 12% of respondents would like to see populations of feral cats persist in the islands. Peoples’ desire to see the abundance of cats reduced was highly correlated (0.54) with whether or not people enjoyed seeing feral cats: 84% of survey respondents dislike seeing feral cats. We also asked survey recipients if feral cats should be removed permanently or relocated away from areas with threatened or endangered wildlife: The majority of people (78%) support the idea of permanently removing feral cats, whereas 10.1% would prefer to see feral cats relocated away from the specified area, and a small proportion of people (3%) believe that feral cats that are being fed do not kill other animals. This research reveals that a small segment of society supports the presence of feral cats and that the majority of people would prefer to see feral cats removed from areas with threatened native fauna.

4-15 Bivalve Shellfish Culture in Hawai‘i and the Pacific Islands: Unrealized Potential for Food Security, Conservation and Ecological Services
Maria Haws1, Robert Howerton2, Angela Hi‘ilei Kawelo3, Kelii Kotubety3, Walter Ritte4, Roberto Quintana5

1Pacific Aquaculture and Coastal Resources Center, University of Hawai‘i Hilo, Hilo, HI, USA, 2University of Hawai‘i Sea Grant College Program/University of Hawai‘i Maui College, Maui, HI, USA, 3Paepae ‘O He‘eia, Kāne‘ohe, HI, USA, 4Hawaiian Learning Center, Kaunakakai, HI, USA, 5Hawaiian Shellfish, LLC, Bay Center, WA, USA

Hawai‘i has over 200 species of bivalves and the Pacific Islands have many more. Bivalve shellfish (e.g., clams, oysters, mussels) have played an important role in Pacific Island economies and cultures. Bivalves also provide important ecological services such as provision of habitat, improvement of water quality and carbon sequestration. Culture of giant clams and pearl oysters in the Pacific Islands by communities and families is still growing and has become a recognized form of sustainable, small-scale livelihood. Aquaculture of these species has also assured that populations of some threatened species are maintained. Hawai‘i lags behind the rest of the Pacific and the U.S., despite its biological potential, due to legal obstacles which makes selling locally-grown bivalves illegal. Recent trials in traditional Hawaiian fishponds with
oysters and clams have been successful. Trials in Hilo Bay testing oysters as a means to improve water quality also show promise. Research on native bivalve species has increased the biological knowledge of previously little-known species. If legal obstacles can be overcome, small-scale bivalve farming, shellfish restoration and water quality mitigation would allow local communities to utilize bivalves to provide multiple economic, cultural and ecological benefits. This presentation will provide an overview of research related to the conservation and utilization of bivalve shellfish in Hawai‘i and the Pacific Islands. Strategies whereby this important natural resource can be conserved, yet utilized for the benefit of all, will also be discussed.

4-16 Implementing Best Management Practices to Improve Water Quality in Agricultural Watersheds
Jean Brokish, Bob Maglasang, Carolyn Unser, Ann Bryant
O‘ahu Resource Conservation and Development Council, Kunia, Hawai‘i, USA

Many of Hawaii’s streams and water bodies do not meet water quality standards for pollutants like sediment, nitrogen and phosphorus, which cause problems for near shore environments. These pollutants are often problems in watersheds experiencing intensive agricultural use. Through funding from EPA’s Clean Water Act (distributed locally by the Hawai‘i Department of Health, Clean Water Branch), the O‘ahu Resource Conservation and Development Council has worked collaboratively with farmers in the Waimanalo Watershed on Windward O‘ahu and the Honouliuli Watershed in Central O‘ahu. Best management practices were selected to reduce soil erosion and nutrient inputs, and varied from site to site based on local conditions like crop, soil type, slope, and rainfall. Pollutant load reductions were calculated using a combination of field measurements and the Revised Universal Soil Loss Equation (RUSLE). Results indicate that treating a relatively small portion of the area managed for agriculture in the Waimanalo Watershed reduced annual loads of sediment by 285 tons, nitrogen by 5800 lbs, and phosphorus by 1200 lbs. Initial measurements from the Honouliuli Watershed indicate that installing a combination of engineered and vegetative practices have reduced the amount of sediment entering Pearl Harbor by more than 3000 tons per year. Continued, widespread implementation of best management practices in other agricultural watersheds is expected to result in similar load reductions and ultimately, improved water quality.

4-17 Practice Makes Perfect: How the Human Element Affected Nitrogen Cycling in Traditional Dryland Farming
Noa Lincoln
Stanford University, Palo Alto, CA, USA

In pre-European times the agricultural productivity of the dryland agricultural systems in Kona were likely limited by soil nitrogen levels. This talk examines the nitrogen cycle around sugarcane (Saccharum officinarum) and highlights the importance of the mulching practices within these dryland systems. We examined in depth the nitrogen cycle associated with sugarcane and used this information to assess the impact of specific indigenous practices associated with the farming and mulching of sugarcane leaves. This work highlights the large impact that seemingly small changes in agricultural practices can have on soil quality and productivity.
4-18 The Benefits of Restoring Natural Function to Hawaiian Streams
Stephen Blanton
AECOM, Portland, OR, USA

Current issues with Hawaiian streams include water quality, flooding, and coral reef degradation. These issues can be attributed to past and current management practices. For example, the traditional ahupua’a principles were replaced by the plantation approach to managing water resources and further pressures were placed on streams by the expansion of agriculture and urbanization. The need for more useable land resulted in changes to stream alignments which typically involved channelization and bank hardening with rock walls or concrete so that floodplains could be converted to developments or additional farmland. These past practices removed the natural functions of streams. However, changes in our understanding of the value of a natural functioning stream and the health of its watershed have led to new approaches in managing streams. Recent projects on the Hanalei River, Kaua’i and the Wailoa Stream in the Waipi’o Valley, Big Island were based on an assessment of natural riverine functions and—instead of trying to control the stream—the assessment looked at ways to work with the natural functions of the individual stream systems. A foundation of the assessment was determining the bankfull flow capacity of a reference reach of the stream; i.e., the flow rate associated with the greatest sediment transport capacity of a stream. The restoration of a stream reach to convey bankfull flow provides for a more stable channel that can reestablish natural functions required for a healthy stream environment. This and other benefits of restoring natural stream functions will be a focus of this presentation.

4-19 Community-based Science Research: The Laulima A ‘Ike Pono Internship at He‘eia Fishpond
Kirsten Fujitani1, Leila Hufana2, Koa Matsuoka3, Megsi Siple1, Judith Lemus1
1Hawai‘i Institute of Marine Biology, University of Hawai‘i, Kāne‘ohe, USA, 2Hawai‘i Pacific University, Kāne‘ohe, USA, 3University of Hawai‘i, Mānoa, USA

The Laulima A ‘Ike Pono (LAIP) internship program is a partnership between the University of Hawai‘i and Paepae o He‘eia that gives community interns an opportunity to immerse in scientific research and Hawaiian culture at He‘eia Fishpond in Kāne‘ohe Bay, O‘ahu. Funded by the National Science Foundation, interns work with Hawai‘i Institute of Marine Biology graduate students studying biogeochemical processes and foodweb ecology, while also learning about Hawaiian culture through stories, chants and participating in traditional fishing practices commonly used in the He‘eia area. Due to changes in ownership, land use, and the introduction of invasive species, the fishpond has fallen into disrepair. Paepae o He‘eia is working to restore the pond as a community food and cultural resource and LAIP endeavors to support this effort through community internships. He‘eia fishpond currently serves as a model for bridging the gap between science and community while demonstrating that cultural practitioners, scientists, and volunteers all play key roles in the conservation and preservation of the fishpond for future generations. The establishment of red mangrove (Rhizophora mangle) and gorilla ogo (Gracilaria salicornia) have contributed to the degradation of He‘eia fishpond. LAIP interns will present the methods and preliminary results of two research projects: 1) the effects of mesopredator browsing on mangrove infauna and of mangrove removal on those infaunal communities; 2) the role of G. salicornia on the fishpond food web using stable isotopes. They will also discuss their cultural experiences in the internship and the relevance of these studies to the community.
4-20 Linking Recreation and Research: A Critical Evaluation of Coral Reef Health Monitoring Data Derived from Reef Check Hawai‘i Volunteers
Rachel Knapstein, Catherine Unabia
Hawai‘i Pacific University, Kāne‘ohe, HI, USA

Citizen-based programs are increasingly popular for environmental monitoring; their efforts increase sample size and data availability at decreased cost, however, the reliability and efficacy of their data for scientific or management purposes remains unclear. We investigate the ability of Reef Check Hawai‘i (RCH) volunteers to collect expert-equivalent data regarding coral reef community composition as well as whether RCH surveys adequately assess reef ecosystem health compared to studies by coral reef scientists. We conducted comparison surveys using three experience classes of volunteers: novice, intermediate, and expert. One member of each class simultaneously surveyed the transect belt or line to assess focal fish and invertebrate species abundance and substrate composition. Evaluating each survey component separately, analysis indicates that inter-observer variability among classes is minimal when assessing substrate composition or focal invertebrate abundances, but increases for counts of highly mobile focal fish. This suggests that trained RCH volunteers are effective in coral reef monitoring. Subsequent analyses comparing RCH data with studies by NOAA Coral Reef Ecosystem Division and HIMB Coral Reef Assessment and Monitoring Program found similar abundances of focal fish species and substrate composition, suggesting that RCH survey data accurately assess coral reef ecosystem health. To more easily communicate and compare results, we apply a mathematical index to evaluate the status of 30 reef habitats (400m² area) sampled by RCH volunteers. These results further enhance the value of volunteers, suggesting that scientifically sound data by collected by trained volunteers supervised by scientists may help amplify efforts of coral reef scientists and managers.

5-1 Sometimes It Takes an Army: The O‘ahu Army Natural Resource Program, Seventeen Years of Native Habitat and Endangered Species Adaptive Conservation
Kapua Kawelo
U.S. Army Garrison, Hawai‘i, Schofield Barracks, HI, USA

The U.S. Army Garrison Hawaii’s O‘ahu Natural Resource Program (OANRP) is responsible for managing more than 100 endangered species from the Wai‘anae and Ko‘olau Mountains and has been conserving native habitats and endangered species since 1995. OANRP has grown from a staff of four to its current staffing of 50 personnel and an annual budget of $6 million. The Army worked with numerous conservation professionals and agencies in Hawaii to develop intensive management plans, the Mākua and O‘ahu Implementation Plans (MIP and OIP), that guide this work. Presentations will include reviews of adaptive management and innovations in the OANRP ungulate, invasive plant and rodent control programs. In addition, endangered species stabilization efforts for over 50 Hawaiian plant taxa, 6 endangered kāhuli tree snails and the O‘ahu ‘Elepaio will be reviewed. These program area presentations will reflect back on their starting point, current status and future challenges. In addition, presenters will reflect on MIP and OIP habitat management and species stabilization goals and the progress made to date. The OANRP has been recognized nationally by the U.S. Fish and Wildlife Service as setting the standard for restoration efforts across DOD. Lessons learned over the evolution of the Army’s
program will be tied to the broader context of endangered species recovery and the challenges of managing Hawaiian ecosystems at widely varying levels of intactness.

5-2 Drawing Battle Lines: Evolving Defensive Strategies in the Continuing War on Feral Ungulates
Matthew D. Burt¹, Simoi Luafalemana¹
¹Research Corporation University of Hawai‘i, Honolulu, HI, USA, ²U. S. Army Garrison Hawai‘i, Schofield Barracks, HI, USA

The first O‘ahu Army Natural Resources Program (OANRP) fenced unit was completed in 1997 encompassing 62 acres in the upper reaches of Kahanahāki Valley (Mākua). This investiture has since lead to the protection of another 1,412 acres in both the Wai‘anae and Ko‘olau Mountains. Under the guidance of both the Mākua and O‘ahu Training Area Implementation Plans, a total of 5,755 acres have been proposed for protection and intensive management. As each new fence is constructed, the OANRP has incorporated newer materials and improved upon methods to increase the longevity of the life of the fences. With the completion of each fence also comes the, sometimes daunting, task of eliminating the animals within. This endeavor has encouraged the OANRP to always make an effort to incorporate a multi-pronged approach with eradication efforts to increase efficiency and embrace newer ideas and technologies in the continuing evolution of ungulate eradication.

5-3 Taking Aim at Invasive Weed Targets: Highlights From Ten Years of O‘ahu Army Natural Resources Program Control Efforts.
Jane Beachy
O‘ahu Army Natural Resources Program, Schofield Barracks, Hawai‘i, USA

For the O‘ahu Army Natural Resources Program (OANRP), invasive weed management is integral to meeting the rare taxa stabilization goals outlined in the Mākua and O‘ahu Implementation Plans (IPs). As a result of the design of the IPs, OANRP must work in intact summit forest, highly degraded lowland forest, and everything in between. This poses particular challenges in developing and maintaining effective, efficient weed management programs. OANRP uses a three-pronged approach, dividing weed control tasks into surveys, incipient invasive control, and site-based weed control. Control efforts are strengthened through partner agency collaborations. Regular surveys of access roads, landing zones, and trails uncovered several high-risk, new State and island records, including two State Noxious Weeds, in the last year alone. These taxa, including Chromolaena odorata, are priorities for incipient invasive control by OANRP and partner agencies. Highly invasive incipients are controlled both in and outside of designated Management Units (MUs), with the goal of eradication. OANRP controls 61 incipient species at 180 sites on Army and partner lands. Several small infestations of Pennisetum setaceum and Buddleja madagascariensis have been functionally eradicated through these efforts. Site-based weed control focuses around rare taxa, native forest patches and fuel breaks within MUs. While it can be difficult to track the progress of site-based efforts, even with vegetation monitoring, regular investments of moderate amounts of time over a sustained period can lead to the recovery of unique forest types, such as has been observed in the mesic forest crowning ‘Ōhikilolo ridge, Mākua.

5-4 The O‘ahu Army Natural Resources Adaptive Rat Control Program - Fighting the Never-Ending Battle
Joby Rohrer, Katie Franklin  
O'ahu Army Natural Resources Program, O'ahu, Hawai'i, USA

Since 1997 the Oahu Army Natural Resources Program (OANRP) has been combating rats in Oahu’s forests to protect native plants, invertebrates, and birds. The Program began with a few staff members placing bait stations and snap traps around individual endangered plants and has since expanded to incorporate the knowledge gained through many years of trial and error, international expertise, new technologies and methodologies, and the labor of over 50 staff. OANRP now has hundreds bait stations and snap traps as part of small-scale rat control grids in 12 different Management Units (MUs) across O‘ahu. Additionally, three large-scale snap trap grids covering a total of 263 acres have been installed in the Wai‘anae Mountains to protect native species ecosystem wide. This session will discuss different rat control and monitoring methods utilized by OANRP over the last 15 years; it will highlight some of the success stories and mention some of the obstacles the Program has encountered. Finally, it will focus on the future of rat control methods, including the use of self resetting traps. Adaptive management is essential for effective rat control, and OANRP is continually developing new weapons of rat destruction.

5-5 Endangered Plant Conservation Efforts on O‘ahu, Hawai‘i: Stability in the Pacific Rim
Matthew Keir, Lauren Weisenberger  
O‘ahu Army Natural Resources Program, Honolulu, HI, USA

Protecting endangered plant species involves obtaining and organizing biological data, conducting surveys, monitoring populations and collecting for propagation and genetic storage. In conjunction with threat control, this work allows managers to attempt outplantings to create stable populations for taxa in threat of extinction. OANRP conducts conservation work for 51 plant species, including 49 angiosperms across 23 families, one fern, and one lycopod. These are managed in 349 populations, of which half must be stabilized and all represented in ex situ genetic storage. Long-term genetic storage secures propagules until threats can be controlled and contributes to diversifying genetic representation at reintroductions. Propagules of 38 species are being stored, representing 113 populations. Reintroduction efforts, threat management, discovering new plants, and an increasing understanding of the biology of these species have led to an increase in the size of 82 populations. Each population has a unique set of threats and a specific toolset may be necessary to overcome them. Some useful tools include hand-pollination, protocols for determining optimal seed storage conditions and re-collection intervals, horticulture techniques such as micropropagation, climate-controlled growth chambers for germination and seedlings, and cloning large trees. Practices that can increase the likelihood of stabilization include using a sling-box to transport plants, using an auger to drill holes for outplanting and improving propagation protocols to increase the production, cleanliness, and survival of outplants.

5-6 O‘ahu Army Natural Resource Program Kāhuli Conservation: Tactical Innovations, Morale Shaking Setbacks and Uncertain Victory.
Daniel Sailer¹, Vince Costello¹  
¹U.S. Army Garrison Hawai‘i, Schofield Barracks, HI, USA, ²Pacific Cooperative Parks Study Unit, Honolulu, HI, USA
Army Conservation work with six Kāhuli (Achatinella) species on O‘ahu is a result of Endangered Species Act consultations with the U.S. Fish and Wildlife Service regarding potential training impacts to federally listed taxa. The Mākua and O‘ahu Implementation plans, written during these consultations, outline specific action strategies for achieving stable populations of Achatinella mustelina in the Wai‘anae Mountains and A. byronii/decipiens, A. bulimoides, A. lila, A. livida, and A. sowerbyana in the Koʻolau Mountains. Executing these plans often feels like a game of chutes and ladders, small victories tempered by unpredictable setbacks. Conserving Kāhuli is extremely challenging because of numerous predators for which clear control measures are not yet available. To combat the rosy wolf snail (Euglandina rosea), the Army has supported life history studies and research with detection dogs and predator barriers. For rats, snap trap grids are deployed at an ecosystem scale. Control tactics are under development for the Kāhuli’s newest opponent, Jackson’s chameleons (Chamaeleo jacksonii). The Army continues to support the University of Hawai‘i Tree Snail Laboratory as a safety net for catastrophic loss of field populations. Tracking population trends is difficult due to the snails’ cryptic habits and small numbers. The challenges faced for Kāhuli are instructional for conservation efforts of other island snail fauna. Without conservation allies, the quest to prevent Kāhuli extinction is unlikely to succeed.

5-7 Battles Won in the War to Save an Endangered Hawaiian Flycatcher

Philip Taylor
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1U.S. Army Garrison, Hawai‘i, Schofield Barracks, HI, USA, 2Pacific Cooperative Studies Unit, Honolulu, HI, USA

The O‘ahu ‘Elepaio (Chasiempis ibidis) is an endangered forest bird found only on the island of O‘ahu. Nest predation by rats, mosquito-borne diseases, and habitat loss have lead to a population decline for the species. Listed as state and federally endangered in 2000, the O‘ahu Army Natural Resources Program took the ‘Elepaio “under its wing” in 2005 and has been actively managing the endemic flycatcher through rat control and monitoring during the breeding season. Even with management retreats and advancements throughout O‘ahu the ‘Elepaio population has doubled in size at program management areas over the last seven years. With persistent conservation management of the O‘ahu ‘Elepaio the future looks promising for a species once on a path to extinction.

5-8 Hawaiian Mesoherbivores, Past and Future

Lida Pigott Burney1, David Burney2, James Juvik3
1Makauwahi Cave Reserve, Kalaheo, HI, USA, 2National Tropical Botanical Garden, Kalaheo, HI, USA, 3University of Hawai‘i-Hilo, Hilo, HI, USA

Many Hawaiian plants lack chemical and physical defenses against mammalian teeth and stomachs. It is less well known that these islands once supported very large flightless ducks and geese that grazed and browsed the native vegetation in their own way, using beaks modified to function similarly to the jaw of a tortoise. In some other island areas of the world that lack native large mammals, giant birds and particularly giant tortoises have occupied similar niches into the historical period. There is abundant documentation that these creatures were keystone elements of their island ecosystems. Mauritian conservationists have discovered that giant tortoises imported from Aldabra can control weedy vegetation with remarkable efficiency, while doing no harm to established native trees and shrubs. At the Francois Leguat Giant Tortoise and Cave Reserve on Rodrigues Island, 500km east of Mauritius in the Indian Ocean, tortoises from
Aldabra and Madagascar have been used very effectively to facilitate the rapid establishment of more than 130,000 native plants, nearly all highly endangered. Tortoises appear to greatly prefer invasive plants from continental areas over island plants, perhaps because mainland species are not typically adapted to tortoises and giant birds, but rather to mammalian herbivores. At the Makauwahi Cave Reserve on Kaua‘i, we are performing systematic tests using *Geochelone sulcata* on a native reforestation project, to test the hypothesis that tortoises can enhance native plant survival by reducing competition from non-native weed species. In the first year of experimentation, we can already see several positive effects.

**5-9 Upper Limahuli Preserve Animal Management: An Evolving Endeavor**  
Chiemi S. Nagle, Matthew P. Lucas, Emory Griffin-Noyes, David Burney  
*National Tropical Botanical Garden, Kalaheo, HI, USA*

The Upper Limahuli Preserve (ULP) is a hanging valley located in northwest Kaua‘i at 900 meters that is owned and managed by the National Tropical Botanical Garden (NTBG). The preserve is a 153 hectare refuge for many rare and endangered plant species as well as Hawaiian Petrels (*Pterodroma sandwichensis*) and Newell’s Shearwaters (*Puffinus newelli*). As endangered, endemic, cryptic, ground-nesting seabirds, there are many contributing reasons for their decline such as artificial light attraction, power-line collision, and predation on chicks and adult birds during breeding season by introduced predators. As a result, a predator management program was started in 2009 beginning with the construction of an ungulate-proof fence. Since the completion of the exclusionary fence, conservation projects have been undertaken in the ULP to protect seabirds from introduced predators; however, the majority of this long-term work was funded by intermittent grants. Starting in August 2011, consistent funding began with the approval of an interim Habitat Conservation Plan (HCP) from Kaua‘i Island Utility Cooperative (KIUC). This allowed for the implementation of a more comprehensive predator management program that increased the frequency and duration of trapping efforts, diversified the types of control methods, and allowed for the development of direct and indirect monitoring efforts. This has led to the increased catch of target species, as well as some interesting responses from sustained trapping and species removal. Despite increased intensity and presence of this endeavor, populations of target species in control areas still remain, albeit at a reduced rate.

**5-10 Long-term Impacts of Exotic Grasses on Ecosystem Processes and Species Composition**  
Stephanie Yelenik, Carla D'Antonio, Nicole DiManno  
*University of California, Santa Barbara, CA, USA*

Exotic species are well known to alter both plant species composition and ecosystem function in the habitats they invade, although the long-term interactions of these impacts are largely unexplored. In Hawai‘i Volcanoes National Park the African C₄ grass *Melinis minutiflora* became invasive in the 1970’s after wildfires. This aggressive invader was found to have positive feedbacks with both fire and soil nitrogen (N), presumably helping the grass maintain its dominance to the detriment of native species. More recent data suggests that feedbacks with soil N are breaking down due to high ecosystem N loss over time, and *Melinis* is losing its vigor. If new niches are opening up in *Melinis* grasslands, which species will take advantage of open spaces, and what role does depleted ecosystem N play in the ability of new species to survive and grow? We established an outplanting experiment to test the performance of 5 native and 2 exotic woody seedling species in intact and cleared *Melinis* plots, at different levels of nitrogen.
Seedling growth rates and survivorship were increased by Melinis removal. Growth rates of all species, except the three N-fixers, were greater in N addition plots. In fact, N-addition was detrimental to the invasive N-fixer Morella faya, potentially due to the increased growth of Melinis. Our initial results suggest that lower N cycling rates later in Melinis invasion will be a relative benefit to N-fixing species. Although native N-fixers are present, Morella is most likely to succeed due to high growth rates.

**5-11 Fantasy Football for Ecology and Conservation: Building Hybrid Ecosystems in Hawaiian Lowland Wet Forests**

Laura Warman1, Susan Cordell1, Rebecca Ostertag2, Jodie Schulten2, Amanda Uowolo1, Peter Vitousek3

1Institute of Pacific Islands Forestry, USDA Forest Service, Hilo, Hawai‘i, USA, 2University of Hawai‘i at Hilo, Hilo, Hawai‘i, USA, 3Stanford University, Stanford, CA, USA

As novel assemblages of native and non-native species become increasingly common globally, many conservation and restoration efforts have concentrated on the removal of exotic (and often invasive) species. However, in some cases, removing non-native species is no longer economically or ecologically feasible. Furthermore, some of these non-native, non-invasive species may be providing important ecosystem goods and services, including benefits to native species. Hawaiian lowland wet forest communities contain a mixture of native and invasive species, and most have very low rates of native species regeneration. How can we facilitate sustainable native biodiversity and maintain ecosystem goods and services, while minimizing management inputs? We suggest an approach similar to fantasy football, where ‘teams’ of species are picked to work together to form self-sustaining units. We present an approach for choice of species (‘players’) based on functional trait characteristics of native and non-invasive introduced species, and on functional diversity indices from existing lowland forests with varying degrees of domination by exotic species. We tested this approach by determining the functional characteristics of 29 candidate species across east Hawai‘i Island. Using trait data, together with functional diversity data from naturally-formed assemblages in the region, we suggest that new hybrid communities can be experimentally assembled based on principles of complementarity and redundancy.

**5-12 Fire and the Invasive Grass-Fire Cycle: Management Approaches**

Andrew Pierce1, Sierra McDaniels3, Mark Wasser3, Alison Ainsworth3, Creighton Litton1, Christian Giardina2, Susan Cordell2, Gregory Asner4

1University of Hawai‘i, Mānoa, Honolulu, HI, USA, 2United States Forest Service, Institute of Pacific Islands Forestry, Hilo, HI, USA, 3Hawai‘i Volcanoes National Park, Volcano, HI, USA, 4Carnegie Institution for Science, Stanford, CA, USA

Wildfire is a severe and growing threat to native species conservation in Hawai‘i. Over the past 100 years, expanding invasive grasses, a warming and drying climate, and lack of integration between science and management have exacerbated the threat of novel fire regimes (i.e., those that are well outside of natural or historical fire regimes in Hawai‘i). Because of Hawai‘i’s unique combination of complex climate, topography, endemic species, and invasive plant threats, approaches to fire science and management that typify mainland ecosystems are suboptimal in Hawai‘i, but are applied for lack of locally relevant approaches. I will discuss several advances in local fire science that could provide a framework for addressing future fire-related management issues in Hawai‘i. At Hawai‘i Volcanoes National Park, prescribed fires over the
past 13 years have not yet changed the vegetation composition of a low-elevation kipuka, where invasive molasses grass and Natal red-top are still serious threats to native Aʻaliʻi shrublands. At Pohakuloa Training Area, progress has been made in mitigating wildfire threat to rare native plants through the installation of fire breaks, however fencing exclosures increase potential fire intensity by allowing for more fine fuels. Finally, the comparison of time series of remotely sensed data on fine fuels, weather, climatic indices, and fire risk indices has improved our ability to identify the conditions that are conducive to fire ignition and spread. Each of these efforts illustrates progress in understanding the best approaches to managing wildfire in Hawaiʻi and together they provide a foundation on which future fire management decisions can be made.

5-13 Wildlife Stakeholder Acceptance Capacity for Game Species in Hawaiʻi
Cheryl Lohr, Christopher Lepczyk
University of Hawaiʻi at Mānoa, Honolulu, HI, USA

All of Hawaii‘s 6 game mammals and 15 game birds were introduced to the Hawaiian Islands. For some of these animal species there is conflict among people over how each species should be managed. Some stakeholders desire abundant populations of game whereas others desire less abundant game. The purpose of this research was to quantify the perceptions and desires of Hawaiʻi residents in regards to 4 game mammals, wild pigs (Sus scrofa), goats (Capra hircus), mouflon (Ovis musimon), and axis deer (Axis axis), and 2 game birds, wild turkeys (Melagris gallopavo), and the zebra dove (Geopelia striata). In 2011, we disseminated a social survey to approximately 5,000 Hawaiʻi residents including pre-identified wildlife stakeholders and a random sample of the general public. On average 46% of pre-identified stakeholders and 20% of the general public responded to the survey. Data will be analyzed using the potential for conflict index (PCI) and Wildlife Stakeholder Acceptance Capacity (WSAC) models. The PCI will describe the variation in the desired abundance or social carrying capacity for each species. We will use nonparametric tests to determine if the social carrying capacity for a given species varies among islands or communities. WSAC models can be used to identify reasons why stakeholders value game, or why they desire more or less abundant game populations. We will compare results among the 6 game species selected for study to determine whether stakeholders‘ values vary among species or whether stakeholders have a consistent environmental ethic. This research will clarify stakeholders‘ perceptions and desires for game in Hawaiʻi and will help managers to design more acceptable management plans.

5-14 Predicting the Effects of Sea Level Rise and Introduced Fishes on Hawaiian Anchialine Pool Ecosystems
Lisa Marrack
UC Berkeley, Berkeley, CA, USA

Sea levels are expected to rise between 0.75 to 1.9 m by 2100 and will affect coastal habitats worldwide. Anchialine pools are brackish coastal systems occurring in porous substrate where marine and groundwater mix. In Hawaiʻi, pools support numerous endemic invertebrate species and are important cultural resources. In some pools, ecosystem degradation may occur because introduced fishes prey on the endemic grazing shrimp Halocaridina rubra allowing macroalgae to accumulate. My goal is to predict anchialine ecosystem response to sea level rise in the context of current stressors. Using high resolution LiDAR data, I am modeling sea level rise scenarios on the Big Island of Hawaiʻi. Although some anchialine pools will be inundated, new
habitat will be created in low-lying, high-relief terrain. Connectivity analyses show that sea level rise will facilitate dispersal of introduced fishes into some pool habitats. Climate change scenario planning should aim to protect locations where future anchialine habitats are likely to occur. Additionally, invasive fish removal efforts should target pools most likely to be sources of introduction for future habitat.

5-15 Expanding the Viewshed of Nomenclature: Aligning Paradigm Needs of Conservation and Culturally Vibrant Communities
Katie Kamelamela, Tamara Ticktin
University of Hawai‘i, Mānoa, USA

Communities around the world depend on flora, fauna and minerals for contemporary subsistence and cultural perpetuation. The Hawaiian Islands case study reviewed here seeks to answer: 1) what are the current gathering practices of Native Hawaiians?; 2) what proportion of plants gathered is native, Polynesian Introduced and introduced?; as well as 3) what implications do contemporary gathering practice interests have for conservation in Hawai‘i? From 2008-2010, participant observation and semi-structured interviews recorded over 44 plant species to be gathered, with most being introduced after the arrival of 1778 (n=21), followed by Polynesian-introduced (n=14) and then Native (n=9). In comparative semi-structured interviews (n=20) conducted between O‘ahu and Hawai‘i Island, which focused on plants used in traditional underground cooking techniques or imu, in 2011 illustrates how resources (human, environmental) influence availability and species preference for firewood. Mesquite (*Prosopis pallida*), like many other introduced species, has been given a Hawaiian name Kiawe, a measure of its significance in Hawai‘i. Kiawe is a dryland plant species introduced to Hawai‘i in the 1880s as fodder for cattle. Today, kiawe has been identified by users as the most commonly gathered and valued resource for firewood (85%) but is also identified as a “pest plant” by conservation managers. It is imperative to know what kinds of plants people use and their understanding of what “native” means. To provide insight to conservation efforts and place-based partnerships in Hawai‘i a paradigm expansion to align management needs with local cultures’ needs must include integrating this understanding into extension and management.

5-16 An Integrated Modeling and Decision Support Framework for Sustaining Tropical Water Resources in the Face of Global Change
Richard MacKenzie1, Christian Giardina1, Keith Reynolds2, Paul Hessburg3
1USDA Forest Service, PSW, Hilo, HI, USA, 2USDA Forest Service, PNW, Corvalis, OR, USA, 3USDA Forest Service, PNW, Wenatchee, WA, USA

Ensuring that tropical landscapes continue to provide clean, fresh water to sustain life is among the greatest natural resource challenges facing tropical regions. Climate change, invasive species, and novel wildfire are growing threats already impacting Pacific Island watersheds and their associated ecosystem services. Efforts to develop long-term, large-scale management strategies to meet these challenges are severely constrained by: (i) lack of detailed impact assessments of independent and interactive effects of these stressors on Pacific Island landscapes; (ii) efforts to assess tropical ecosystem vulnerability to wildfire and climate change lag behind temperate regions; (iii) lack of integrated ridge-to-reef information on how social, hydrological, and ecological variables collectively control water systems; and (iv) extremely limited access to modeling and decision support tools. The consequences of these gaps for resource managers are
exacerbated by the rapid pace of global change in the Pacific Islands, lack of scientific infrastructure, high cost associated with gathering resource data, and technical difficulties associated with scaling plot-level data to landscapes. We present a Tropical Decision Support Tool (TDST) to increase the effectiveness of management of Pacific Island landscapes. Using stakeholder input, traditional ecological knowledge, various ecological, hydrological, and physical data sets, and downscaled climate data, this user-friendly TDST can identify landscape scale management priorities based on risk and benefits maps and assess the efficacy of modeled management actions on priority areas. If this proves to be successful, the adoption of the TDST in other tropical locations can be easily achieved because of its highly exportable and modular nature.

5-17 Using the Distributed Hydrology-Soil-Vegetation Model to Examine the Impacts of Climate Change and Invasive Species Cover on Stream Flow in Tropical Watersheds

Ayron Strauch\(^1\), Christian Giardina\(^2\), Richard MacKenzie\(^2\), Greg Bruland\(^1\)

\(^1\)University of Hawai‘i at Mānoa, Honolulu, HI, USA, \(^2\)USDA Forest Service, Hilo, HI, USA

Freshwater is a vital resource for agriculture, development, consumption and native biota of tropical island systems. However, the availability of freshwater resources is threatened by climate change and invasive species, while few studies have examined how these stressors or their potential interactions affect stream flow in tropical watersheds. We used the Distributed Hydrology-Soil-Vegetation Model (DHSVM) to assess the effect of climate warming, altered precipitation and expanding invasive species cover on stream flow in 87 watersheds located along the Hilo-Hamakua Coast of Hawai‘i Island. These watersheds represent a highly constrained precipitation gradient spanning 3500 mm in mean annual precipitation (MAP). Using the DHSVM calibrated for a six-year period (water year 2006 to 2011), we assessed how: 1) mean annual temperature change; 2) MAP change; and 3) change in Psidium cattleianum (strawberry guava) cover will influence daily, monthly, and annual water flow as well as flow variability. Our results demonstrate the negative impact increased \(P.\ cattleianum\) cover and decreased rainfall will have on downstream flows. We also found a negative relationship between flow variability \((Q_{10}:Q_{90})\) and MAP, and a positive relationship between flow variability and watershed size across the precipitation gradient. Further, watersheds with greater MAP experienced a greater loss of mean monthly stream flow compared to similarly-sized watersheds with lower MAP, whereas the percent of flow lost was greatest in low MAP streams. Watersheds with lower MAP had much more variable stream flow compared to similarly-sized watersheds with higher MAP. We conclude that predicted climate and vegetation changes in tropical environments will decrease stream flow and increase flow variability, with anticipated impacts on human and biological systems, especially downstream water users and in-stream freshwater biota. These effects will be exacerbated in drier watersheds, but significant stream flow will be lost in all watersheds. The restoration of degraded and/or invaded forest will reduce the impact of climate change variables on stream flow.

5-18 Impacts of an Exotic Coastal Phreatophyte (Kiawe, Prosopis pallida) on Groundwater Availability in Leeward Coastal Hawai‘i - How Much Water Do They Use?

Yoshiyuki Miyazawa\(^1\), Bruce Dudley\(^2\), Flint Hughes\(^3\), Thomas Giambelluca\(^4\), Rebecca Ostertag\(^2\), Suzanne Tillery\(^4\)

\(^1\)Research Institute of East Asia Environment, Kyushu University, Fukuoka, Japan, \(^2\)University of
In leeward Hawai‘i, rainfall is very low near the coast, but higher in upslope recharge areas, raising both the ecological and economic importance of groundwater availability in coastal areas. We examined the groundwater use of *Prosopis pallida*, an invasive phreatophyte which dominates land cover in leeward, coastal Hawai‘i. Using stable oxygen isotopes, we calculated the proportion of total water use by this species that is derived from groundwater (rather than local rainfall), and based on sapwood allometry and sapflow measurements, estimated its stand level groundwater use. These data are examined in comparison with groundwater flow rates estimated with a hydrogeological model of the study area to estimate the effect of water use by *Prosopis* on total shallow groundwater flow. Stable isotope data indicate that groundwater use by this species is limited to a narrow band near the coast. Water use in this area is compared with data from upland areas, and with water use in stands of the same species in the southern United States reliant on rainfall to meet their water requirements.

**5-19 The Impact of Altered Stream Flow on the Health and Dynamics of an Endemic Amphidromous Shrimp**

Ralph Tingley¹, Dana Infante¹, Richard Mackenzie², Ayron Strauch³, Patra Foulk⁴

¹Michigan State University, East Lansing, Michigan, USA, ²Institute of Pacific Islands Forestry, Hilo, Hawai‘i, USA, ³University of Hawai‘i, Mānoa, Hawai‘i, USA, ⁴University of Hawai‘i, Hilo, Hawai‘i, USA

The vulnerability of Hawai‘i’s stream ecosystems to changes in climate is of major concern to managers, researchers and citizens alike. While efforts are being put forth to predict potential shifts in precipitation and air temperature that will occur over the next century, understanding an individual species’ vulnerability within a stream remains a challenge. A series of perennial streams along the Hilo/Hamakua coast on the island of Hawai‘i offers a unique opportunity to study species response to changes in climate as these streams are located across a strong gradient in annual precipitation (<3500 to 7000 mm/year), while other landscape factors (i.e., slope, drainage area, geology) are similar. The endemic atyid shrimp, *Atyoida bisulcata*, is a primary consumer in the high elevation reaches of these watersheds and is of ecological and cultural importance to Hawai‘i. Using this space for time substitution, we sampled nine streams that decrease in discharge across the gradient, recording relative density, growth rate, size, body condition and habitat selection of *A. bisulcata*. Initial results indicate that population size, length and overall health of individuals decrease with lower mean annual precipitation, while habitat selection shifts from high velocity areas within the stream reach to plunge pools, which may offer refuge during low flows. With increased seasonal data, an expansion of study sites to multiple islands, and by relating precipitation to annual flow variables, we hope to develop an understanding of the mechanisms driving species response to climate change that can be incorporated into vulnerability estimates at a broader scale.

**5-20 Decision Support Tools for Prioritizing and Quantifying Management Impacts on Watershed Health**

Paul Hessburg¹, Keith Reynolds², Richard MacKenzie³, Christian Giardina³

¹Pacific Northwest Research Station, USDA Forest Service, Wenatchee, Washington, USA, ²Pacific Northwest Research Station, USDA Forest Service, Corvallis, Oregon, USA, ³Pacific Southwest Research Station, USDA Forest Service, Hilo, Hawai‘i, USA
Decision support tools (DST) have become popular with agencies seeking to guide and prioritize management activities and strategies. DSTs have been used in the business, agriculture, human management, and engineering realms, among others, for decades, and more recently in the natural resources fields to help with managing such issues as reducing fire and fuel loads and restoring hydrological functions of managed watersheds. While there are many different types of DSTs currently being used in the natural resources, and more are being developed, they are typically defined as computer-based systems that systematically process information in a predetermined fashion with the goal of generating output to support or guide an end-user’s decision making process. Incorporating DSTs into the operational framework of an organization or set of organizations can thus help plan the actions required to achieve future desired conditions. In this session, we will review DST concepts and the Environmental Management Decision Support (EMDS) system, an application currently being used to inform decision making on fire and watershed function in the Pacific Northwest USA. We highlight opportunities to adapt and use EMDS to inform management decisions in Hawai‘i, and review initial progress on a pilot project on windward Hawai‘i Island.

5-21 Linking Watershed Function, Traditional Knowledge, and Nearshore Environments: How do Flow Reductions Affect Marine Fishes and Coral Assemblages
James Akau, Richard MacKenzie
USDA Forest Service, PSW, Hilo, HI, USA

Increased sea surface temperatures, ocean acidification, and altered hydrological regimes are expected to have serious consequences for nearshore fish communities. Using a naturally occurring precipitation gradient on Hawai‘i Island, I will examine how nearshore fish communities respond to changes in hydrological inputs. I will also present a Hawaiian perspective on how these changes may impact Hawaiian culture. For example, the endemic kumu is highly prized by both cultural practitioners and fisherman. In Hawaiian religion, the ennobled kumu serves as a ho‘okupu (offering) to the gods. With its delectable flesh and red coloration, this fish shares venerated qualities specific to the fishing deity Ku‘uula‘okekai (red sacred Ku of the sea). Numbers of kumu have been on the rapid decline since the 1950’s due to overharvesting and watershed degradation. Climate change impacts, therefore, could exacerbate these other stressors with both ecological and cultural implications.

6-1 Game Cameras in Natural Resource Management: Overview, Comparison of Features, and Applications for Today’s Users
Alison Cohan1, Francis Quitazol1, Nicolai Barca2, Stephanie Tom3
1The Nature Conservancy Maui Program, Makawao, HI, USA, 2The Nature Conservancy Kaua‘i Program, Lihue, HI, USA, 3The Nature Conservancy, Honolulu, HI, USA

Game cameras allow users to scout areas 24/7 remotely, and have been used for decades for hunting, security systems, and wildlife research. For resource managers, the ability to observe animal activity with real-time camera technology allows for rapid response and more efficient use of staff time. The simplest game camera will detect the animal and take a photograph along with information such as date, time, and temperature. Sophisticated models can have fast trigger speed, minimal delay, effective weatherproofing, take 1080p HD video, be operated remotely, use a wireless sensor, and send images instantly via cellular or wireless networks. We used
Evaluating Options for Participating in Carbon Credit Markets on State of Hawai‘i Forest Lands

Elizabeth Boxler¹, Melissa Sprecher², Sheri Mann², Creighton Litton¹

¹University of Hawai‘i at Mānoa, Mānoa, HI, USA, ²Department of Land and Natural Resource, Division of Forestry and Wildlife, Honolulu, HI, USA

Within the past 30 years the scientific community has become increasingly aware of anthropogenic alterations to global climate through the emission of atmospheric greenhouse gases like carbon dioxide (CO2). One proposed way to mitigate rising atmospheric CO2 is carbon credit (CC) trading, where the goal is to increase the amount of carbon sequestered in terrestrial ecosystems, and/or reduce the amount of CO2 emitted. In the voluntary CC market, buyers are environmentally concerned individuals or corporations that emit greenhouse gases and want to offset their “carbon footprint” via CC trading. These buyers pay for CCs that are created through either carbon sequestration or reduced emission activities created by CC sellers. The State of Hawai‘i is exploring becoming an accredited CC seller by reforesting degraded state lands. In addition to CC opportunities, these activities would also provide a number of additional public benefits like watershed protection and biodiversity habitat. The State is investigating selling CCs on the most appropriate voluntary market and to the most suitable vender. There are many companies that issue CCs in the voluntary CC market therefore voluntary CCs are subject to different standards, methodologies, and verification techniques depending on the CC issuing company. The State of Hawai‘i is interested in selling CCs on the voluntary market to fund longstanding goals of reforestation, while continuing to meet the basic Mission of protecting Hawaii’s forests. In this presentation we will explore various opportunities that exist for the State of Hawai‘i to participate in the voluntary CC market.

Map Concepts for Conservation Biologists

David Benitez

National Park Service, Division of Resources Management, Hawai‘i Volcanoes National Park, USA

Maps are powerful tools to convey information about the world we live in. A knowledgeable and skilled map maker is able to summarize complex data and clearly deliver important messages. Conservation biology professionals can leverage their subject matter expertise with cartographic fundamentals to create more aesthetic, informative, and engaging map products which stand alone or support written or photographic documentation of natural resource conditions. Through a series of examples from conservation work in Hawai‘i, I will review the basic components of
an effective map, illustrate key cartographic principles to clearly present information, and review the importance of tailoring a map to the appropriate audience. These examples will include maps from invasive plant mapping and control, fence construction, and wildfire management.

6-4 EPSCoR Hawai‘i Geospatial Data Repository and Image Services
Lisa Canale, Donna Delparte, Kohei Miyagi
University of Hawai‘i at Hilo, Hilo, Hawai‘i, USA

Twenty years ago there was Landsat for those in the know, ten years ago Hawai‘i agencies pooled resources to purchase imagery for geospatial professionals, seven years ago Google Earth 3.0 was released bringing the ability to explore place to the masses, today EPSCoR Hawai‘i Geospatial Data Repository (HGDR) team is working towards serving imagery of Hawai‘i and its metadata to anyone with a computer and internet access. Utilizing robust infrastructure and ArcGIS Server Image Services, the Hawai‘i Geospatial Data Repository is positioned to be the go-to place for viewing Hawai‘i imagery and incorporating imagery into a geospatial workflow. The HGDR team is also developing innovative ways of conducting web-based imagery analysis for scientists, technologists, and students.

6-5 Long-term Monitoring Meets Mapping: Integrating Data Tools to Manage Coastal Strand Vegetation at Kaloko-Honokōhau National Historical Park
Alison Ainsworth1, Corie Yanger1, Sallie Beavers2
1Pacific Island Network Inventory & Monitoring Program, Hawai‘i National Park, HI, USA, 2Kaloko-Honokohau National Historical Park, Kailua-Kona, HI, USA

Hawaiian coastal strand vegetation communities have been heavily impacted by anthropogenic stressors including development and invasive species over the past 250 years and now face the increasing threat of sea level rise. Kaloko-Honokōhau National Historical Park on leeward Hawai‘i Island protects 3 km of semi-pristine coastal strand habitat along this highly developed coast. To assist managers in making resource decisions, the Inventory and Monitoring Program (I&M) collected vegetation community data and produced a vegetation map that together create a detailed view of vegetation status. In 2011, the I&M program installed 15 long-term monitoring plots (10 x 20 m) in the park’s coastal strand. Plots will be monitored every five years to detect changes in vegetation composition and structure. Over 40% of the 44 species encountered were native including the rare endemic sprawling shrub maiapilo (Capparis sandwichiana). The coastal strand's frequent disturbance regime, diverse environmental conditions (e.g., substrate age, type, sea spray), and anthropogenic influences (e.g., visitor use) are reflected in variation of species richness, understory cover, and tree density among plots. These differences are depicted in the Park’s 2010 I&M vegetation map where the coastal strand is divided into eleven different plant community associations. Coupling the finely delineated vegetation type boundaries with quantitative species composition and stand structure monitoring data describe the coastal strand's current status. Most importantly, the baseline vegetation map and long-term vegetation monitoring data will provide essential tools to detect and quantify future vegetation community changes with the growing threats of invasive species, development, and climate change.

6-6 Implementing a Conservation Data Sharing Network for the Island of Maui, Hawai‘i
Samuel Aruch1, Dan Eisenberg2, Kerri Fay3, Jill Labram4, Brooke Mahnken5, Sarah McLane4
1Natural Resource Data Solutions LLC, Haiku, Hawai‘i, USA, 2East Maui Watershed
Within the East and West Maui conservation landscapes, individual land managers have been working collaboratively towards a compatible information structure. For the last several years representatives from conservation entities on the Island of Maui, Hawai‘i have been working together to develop voluntary natural resource data standards. With these products we are better able to collaborate, exchange information, set and measure goals. We will present the methods and outcomes of our collaboration, as well as the challenges, needs, and next steps of our project.

6-7 Building Community Stewardship to Manage Their Resources from Ridge to Reefs
Fatima Sauafea-Le’au
NOAA Fisheries Pacific Island Regional Office, Honolulu, Hawai‘i, Wallis and Futuna

American Samoa has undertaken a participatory approach that engages communities from all sectors within a village to partake in a process, based on their needs and goals, to develop watershed management strategies and work collaboratively with stakeholders in implementing these strategies. The approach is known as the Participatory, Learning and Action (PLA) and has ensured a wider participation and capacity building at the village level. It is a bottom-up approach that aids in gathering information using a diverse range of activities and tools and guarantees for active participation of local people to strengthen their capacity to learn and act. Through this approach, the community learns about their own environment and is better able to identify the needs, and subsequently implement appropriate strategies to meet those needs. The PLA approach is being used as a basis for the Faga'alu Village Watershed Management, in a participatory process, whereby activities are undertaken to raise community awareness, enhance collaboration among the local and federal agencies, improve partnership between village and government, support the priority goals and objectives for the American Samoa coral reef management, and address additional management issues within the village watershed. In addition, the watershed process for Faga’alu village has included the Conservation Action Planning (CAP) tools by The Nature Conservancy (TNC), which assisted to refine the objectives and strategies of Faga'alu watershed action plan. The outcomes and lessons learned from Faga'alu will surely assist to identify ways to better adapt the process to other priority watersheds and resource areas in American Samoa.

6-8 Establishing Resilient, Sustainably Financed, Protected Areas Network (PAN) in Palau
Umiich Sengebau¹, Lukes Isechal², Steven Victor¹
¹The Nature Conservancy, Koror, Palau, ²Palau International Coral Reef Center, Koror, Palau

In November 2003, a landmark piece of legislation, the Protected Areas Network (PAN) was passed by the Olbiil Era Kelulau (Palau National Congress) and signed into law by President Tommy E. Remengesau, Jr. The Act provides a framework for Palau’s National and State governments to collaborate to establish a nationwide network of terrestrial and marine protected areas that will protect areas of biodiversity significance, important habitats and other valuable resources that are essential for the future social, cultural, economic, and environmental stability and health of Palau. The PAN Act was prompted when 1997/1998 El Nino with high fluctuations in seawater temperature caused Palau's massive coral bleaching event in Palau. The coral bleaching phenomena killed one third of Palau’s reef. The need to design protected areas that are
more resilient to the threat of climate change became the utmost priority. Prior to 2003, the protected areas were of various types ranging from traditional closures or "bul" to State and National conservation areas protected by legislation, most of these have been protected primarily for resources management purposes as a response to an immediate problem or the management of a very specific element of biodiversity. With the PAN Act framework in place, Palau turned its attention to securing sustainable funding by instituting the environmental protection fee (green fee) for all departing visitors to Palau. The fund generates approximately US$1.5 Million for the PAN. Palau also has over US$6 Million to date generated from the Micronesia Challenge pledges in endowment with Micronesia Conservation Trust that can be drawn upon to supplement shortage in green fee in any given year. The ultimate goal for the Palau endowment is US$10 Million.

6-9 ‘Āina Kaumaha: A Hawaiian Perspective on Resource Management
Namaka Whitehead
Kamehameha Schools- Land Assets Division, Kailua-Kona, Hawai‘i, USA

The genealogies of the Hawaiian people recognize a shared ancestry with our islands and all the native life that exist upon them: plants, birds, fish, insects, weather systems, aquifers. Just as these natural elements have evolved together over many thousands of years to shape the unique native ecosystems and landscapes of Hawai‘i, so too have these native landscapes shaped our cultural identity, traditions, and practices as a people. Acknowledging the profound depths of this relationship, the vision of the Kamehameha Schools’ 2011 Natural Resources Management Plan is “I Hawai‘i no nā Hawai‘i i ka ‘āina.” Hawaiians are Hawaiians because of the land. With holdings of over 365,000 acres on five islands, the land legacy of the Kamehameha Schools provides for our people a link to a chiefly lineage and the special relationship our ancestors had to these lands. We understand that these lands embody the cultural, spiritual, and natural wealth of our ancestors and hold the promise of our future. We recognize that the privilege of their conveyance into our Trust is associated with a kaumaha or profound responsibility to honor these ancestral connections to land and to care for the natural and cultural resources contained therein. Our plan, informed both by ancestral wisdom and contemporary science, looks back on past accomplishment and forward to establish strategies, actions, and measureable goals for resource management on Kamehameha Schools’ lands.

6-10 Understanding Mo: Traditional and Re-Emerging Conservation Practices in the Marshall Islands
Ingrid Ahlgren
Australia National University, Canberra, ACT, Australia

As low-lying coral atolls, with no arable soil and limited fresh water, the Marshall Islands provides a challenging geographic location for human settlement. They are not ideal for long-term habitation, yet the Marshallese people have lived there continuously for an estimated 2-3,000 years. Paramount to this survival was a keen understanding of their environment and the balance necessary between human and ecological interaction. This paper investigates one specific traditional measure - mo - which I propose was key to ensuring Marshallese survival and sustainable resource usage. The modern understanding of mo is as a traditional system of chiefly-designated portions of land, a whole islet, or a reef area, as a restricted site. They exist on every atoll spanning the Marshalls, and are usually associated with bwebwenato, stories used to pass on local cosmologies and cultural mores. Historically, they involved rituals and chants, and
the belief that failure to observe them would result in harm to the community or environment. Today, development by foreign investors has expanded to even the most ‘traditional’ of outer atolls in the form of fisheries, aquaculture, and surf- and eco-tourism, enveloping and usurping these once-taboo mo areas. As a result, in addition to the threat of climate change and increasing urbanization, a growing grassroots conservation movement is inspiring a resurgence of such land and resource restrictions. In 2008, a national conservation plan (“Reimaanlok”) was developed in conjunction with the Micronesia Challenge to formally address the loss of biodiversity and set goals and targets for conservation. In it, mo is used as a central guiding principle for the future of Marshallese conservation efforts. Its origins, however, are not fully understood nor its relevance widely agreed upon. In this paper, I present my research plan and initial findings on the origin of and traditional understandings of mo, in addition to how it is being interpreted and utilized today. Preliminary ethnographic research reveals that the term is used broadly and includes special swimming, bathing, and surfing sites for high chiefs - a seemingly non-conservation based definition. Yet, as one high chief (iroij) explains, the motive for designating such areas was to “conserve that land, reef and coral head from general use so that in a time of special need or difficulty there will be land, reef and coral head that can be harvested for the use and benefit of everyone”. I explore this disparity using a variety of methods and sources - including linguistic, ethno-historic, geological and geographical data - to develop an in-depth understanding of this important Marshallese tool, and with the intention of greater application for modern efforts in sustainability and conservation practices in the country.

6-11 Monitoring Culturally Sensitive Resources - A Case Study for Lake Waiau
Donna Delparte
University of Hawai‘i at Hilo, Hilo, HI, USA

Declining rainfall over the past several years on Mauna Kea has resulted in lower water levels for Lake Waiau. Lake Waiau is a high-elevation lake that is a Hawaiian sacred site. To monitor the change in lake levels, any approach must not disturb the site. To measure minor fluctuations in water level, four survey approaches were evaluated for accuracy and cost effectiveness. These methods range from terrestrial based LiDAR data collection to 3D gaming technology of MicroSoft Kinect. The results of this study indicate that a cost effective and non-invasive survey method can be implemented on a regular monitoring basis that accurately tracks lake level fluctuations.

6-12 Imu o nui mai mauka i kai: Contemporary Native Hawaiian Gathering Practices in Culturally Vibrant Communities
Katie Kamelamela, Tamara Ticktin
University of Hawai‘i at Mānoa, Honolulu, HI, USA

Communities around the world depend on plants for subsistence and cultural perpetuation. There is limited data available on contemporary gathering practices in indigenous communities, especially within the Pacific. Factors affecting current gathering practices in Hawai‘i include ungulates, disease, invasive species, water diversion, urbanization, climate change and national security. This research addresses: 1) what plants Hawaiians commonly gathered and cultivated historically; 2) plants currently gathered in culturally vibrant communities; and 3) plants currently wanted or sold in Hawai‘i. In an ahupua‘a case study it was observed that 60% of plants gathered were in support of imu practices. Imu, or umu, is a traditional food preparation technique utilized across Oceania for over 4,000 years, where staples are baked or steamed in an
underground oven, for nutritional or ceremonial purposes. A comparison of gathering practices was conducted utilizing 2 years of participant observations, (20) semi-structured interviews, (130) surveys and online market tracking methodology. The gathering of native species for timber is a historical preference on Hawai‘i Island for imu and is possible because of continued land clearing in areas such as Puna and Hilo. Practitioners would rather see timber, native and invasive, be put to use rather than rot or used for mulch. Native Hawaiians still depend on plants for subsistence and cultural perpetuation. Understanding what plants are commonly gathered and what species the community would like to gather more of can provide insight for conservation efforts and place based partnerships in Hawai‘i.

6-13 Belau Watershed Alliance: A Community Initiative That Has Become a Genuine Partnership Between Communities and Agencies and Has Advanced Community Resource Management in Palau.
Joyce Beouch¹, Umiich Sengebau², Lukes Isechal³, Steven Victor²
¹Palau Conservation Society, Koror, Palau, ²The Nature Conservancy, Koror, Palau, ³Palau International Coral Reef Center, Koror, Palau

Communities and resource agencies worked often in isolation before the Belau Watershed Alliance, formerly known as Babeldaob Watershed Alliance, was formalized. The Palau communities used to avoid resource agencies for the fear that their development interests would be impeded by agencies pushing their own conservation agendas that do not necessarily meet the best interest of their communities. The alliance recruited other communities to join by engaging them through a culturally appropriate communications strategy. The resource agencies joined voluntarily as they began to see progress. Today, resource agencies and organizations are revising their strategies to meet the best interest of the communities through this partnership that has become a national as well as a regional model for Micronesia.

6-14 West Maui Ridge 2 Reef Initiative: The Umbrella Plan
Cindy Barger, Athline Clark
U.S. Army Corps of Engineers, Ft. Shafter, HI, USA

The U.S. Army Corps of Engineers and State of Hawai‘i Department of Land and Natural Resources are sponsoring the developing of the West Maui Ridge to Reef Initiative under Section 729 of the Water Resources Development Act (WRDA) of 1986. The West Maui Ridge to Reef Initiative will provide an umbrella process to coordinate the variety of partnership initiatives within the study area. The goal is to restore and enhance the health and resiliency of West Maui coral reefs and nearshore waters through the reduction of land-based pollution threats from the summit of Puu Kukui to the outer reef. It will build off of the Ka’anapali-Kahekili Watershed Management Plan (WMP) and expand into the Kahana and Honolua watersheds. This presentation will provide a description of the proposed risk informed decision framework that will guide the coordination and collaboration process for this plan.

6-15 Ka’anapali-Kahekili Watershed Management Plan
Tova Callender
National Fish and Wildlife Foundation, Maui, Hawai‘i, USA

The Ka’anapali-Kahekili Watershed Management Plan (WMP) sponsored by NOAA is an initial evaluation being conducted as part of the U.S. Coral Reef Task Force’s Watershed Partnership
Initiative. This project is a collaborative effort, relying on partnerships with EPA, DOH, NRCS, DLNR, the West Maui Mountain Watershed Partnership, the County of Maui, TNC, West Maui Soil and Water Conservation District and community groups to ensure the effort is well informed and complimentary to ongoing work in the area. By engaging with the community throughout the planning process and through the formation of a locally based working group, actions identified in the plan to reduce the generation and transport of land-based pollutants will be carried out by community groups, individuals and businesses, with the help of grant funds. The concentration of interest in this area through its designation as a priority reef and watershed and resulting agency support, combined with the continual effort to engage community partners increases the odds of positively impacting environmental change and community stewardship. By virtue of the connection to the USCRTF effort, progress and lessons learned from this project will be shared with regional and national partners across a wide array of agencies and groups. The plan will also serve to inform the larger West Maui Ridge to Reef Initiative underway by the U.S. Army Corps of Engineers and Department of Land and Natural Resources. By testing this approach to watershed planning and stakeholder engagement, it can then be adjusted and used as a template for planning the next three watersheds in the area.

6-16 Kahekili Conservation Action Plan
Lunalilo Kekoa
Division of Aquatic Resources, Kahului, Maui, USA

Conservation Action Plans (CAP) for Kahekili, Molokini, and Kaho’olawe have been initiated by The Nature Conservancy with grant support from NOAA’s Coral Reef Conservation Program. The CAP process guides project teams to identify effective conservation strategies. It provides an objective, consistent and transparent accounting of conservation actions and the intended and actual outcomes of conservation projects. The goal of these CAPs is to develop priority strategies for implementation to address existing and future threats facing coral reef ecosystems in these regions. CAP teams for each location met during three workshops to identify priority targets, resource status, priority threats, and strategies to address those threats. The focus of this presentation is to share the outcomes from the CAP and how actions listed in the plan will implemented.

6-17 West Maui Coastal Use Mapping Project
Kalisi Mausio1, Arielle Levine2
1TBG Contractor to NOAA, Pacific Services Center, Honolulu, Hawai’i, USA, 2IMSG Contractor to NOAA, Coral Reef Conservation Program, Pacific Islands Regional Office, Honolulu, Hawai’i, USA

Coral reefs in Hawai’i are facing increasing pressures from a growing variety of ocean uses, as well as increased coastal development and watershed impacts. The West Maui Coastal Use Mapping Project is intended as a first step to improving regional coastal and watershed management activities in the Honolua - Wahikuli region. The baseline information collected through this project will provide a better understanding of human uses, issues, and constraints in these regions. It can help inform managers so they can make management decisions to better protect the ecosystem, while minimizing impacts on those who depend on marine resources and reducing user conflict. The project includes collecting and mapping existing watershed information, conducting a mapping workshop with local residents and stakeholders using participatory GIS, and follow-up stakeholder consultation to verify spatial non-spatial workshop
outcomes. The mapping project addressed questions such as: Who are the primary resource users in the region? Where do activities take place, and where is activity most concentrated? To what extent do different user-groups rely on local coastal/marine resources? What local management activities are already in place? Where is there a potential for user conflicts? What are perceived problems (and potential solutions) in the region? What are potential opportunities for management action? Maps from the workshop are providing information to local management processes including, the Kahekili CAP and the Kaʻanapali-Kahekili Watershed Plan. An online mapping tool was also developed and posted on www.hawaiicoralreefstrategy.com.

6-18 Kaʻanapali-Kahekili Makai Watch
Liz Foote
Coral Reef Alliance (CORAL)/Project S.E.A. Link, Maui, Hawai‘i, USA

As part of a collective effort to enhance the management of near-shore marine resources, the Department of Land and Natural Resources (DLNR) and several Non-Government Organizations (NGOs) have collaborated to create a Makai Watch Program designed to involve the public in the oversight and management of important marine areas in three ways: 1) education and outreach, 2) surveillance and enforcement, and 3) biological and human use monitoring. The Makai Watch approach is based on the idea that people who use, deal with, or live closest to the natural and cultural resources are in the best position to help in understanding the nature of the area. Community members are the ‘eyes and ears’ that look out for their resources, and their direct involvement reduces inappropriate uses of those resources. Kaʻanapali/Kahekili Makai Watch is co-coordinated by DLNR Division of Aquatic Resources, The Coral Reef Alliance (CORAL) and Project S.E.A.-Link. It encompasses the newly established Kahekili Herbivore Fisheries Management Area (KHFMA). Efforts focus on: 1) citizen science utilizing the Coral Reef Monitoring Data Portal, 2) outreach and education in support of the KHFMA, and 3) general outreach and education efforts which promote marine resources stewardship by all stakeholders. This presentation will describe how the Kaʻanapali Makai Watch program has addressed unique conservation challenges faced within this new type of protected area, as well as its education, outreach and monitoring efforts which could serve as models for other Makai Watch programs. Marine resource stewardship initiatives coordinated by the program target a range of community stakeholders, from youth and school groups, to residents, visitors, and local businesses such as the area’s hotels. In addition, information will be shared about an online tool available to Makai Watch communities, the Coral Reef Monitoring Data Portal, which provides a resource for citizen science efforts statewide.

6-19 Nest Site Limitation and Predation in the Puaiohi or Small Kauaʻi Thrush (Myadestes palmeri): Using Nest Boxes to Expand and Protect the Range of an Endangered Species
Barbara Heindl¹, Lisa Crampton¹, Eric VanderWerf²
¹Kauaʻi Forest Bird Recovery Project, Hanapepe, HI, USA, ²Pacific Rim Conservation, Honolulu, HI, USA

The Puaiohi (Myadestes palmeri) is a critically endangered thrush endemic to the island of Kauaʻi, Hawaiʻi, where it is restricted to the remote, high elevation forests. Puaiohi primarily nest in cavities found in steep stream-side cliffs, and nest site availability may limit the species’ abundance and distribution. To address this limitation, from 2000-07 nest boxes were placed in three streams occupied by Puaiohi, and the boxes have been used several times. Nest predation by rats is a major cause of nest failure and mortality of nesting females in natural nest sites and
potentially in nest boxes. We tested the most commonly used boxes in areas known to have high rat densities, but outside the range of Puiaiohi, by baiting nest boxes and monitoring nightly activity with automated field cameras. Based on information from these trials, three new designs were developed that reduced the ability of rats to access boxes. We erected ten copies of each of the three rat-resistant designs beside existing boxes (n=75) to assess whether modifications to make boxes more rat resistant might deter Puiaiohi from using nest boxes in the wild. Boxes were installed in the area prior to release of captive bred Puiaiohi familiar with boxes and were monitored during the breeding season by field cameras and staff to assess use. We present results from our design trials and field deployment, and summarize past and present challenges and successes in the development and use of artificial nest boxes to increase reproductive potential of the Puiaiohi.

6-20 Contemporary Genetic Diversity for the Kiwikiu (Maui Parrotbill; *Pseudonestor xanthophrys*)

Hanna Mounce¹, Claire Raisin², David Leonard³, Jim Groombridge²

¹Maui Forest Bird Recovery Project, Makawao, HI, USA, ²Durrell Institute of Conservation and Ecology, University of Kent, Canterbury, Kent, UK, ³Pacific Cooperative Studies Unit, Division of Forestry and Wildlife, Honolulu, HI, USA

The Kiwikiu (Maui Parrotbill; *Pseudonestor xanthophrys*), with a population of ~500 individuals, is currently restricted to 40 km² of wet rainforest on the windward side of east Maui. Historical records indicate that a drier, koa dominated forest was preferred habitat for Kiwikiu. Establishing a second population is a high priority recovery action and habitat management of the Kahikinui area of leeward east Maui is ongoing to support this action. While translocation is an important conservation tool which has contributed to the recovery of endangered species, it is important to consider the genetics of the founders used to establish new populations. To this end, blood samples were taken from 120 Kiwikiu to evaluate the current genetic structure of the population. To evaluate nuclear DNA, we developed a species specific microsatellite library and genotyped individuals across 14 polymorphic loci. Heterozygosity was examined for individuals captured east and west of the Koolau gap to determine whether this dominant landscape feature is a dispersal barrier. To evaluate mtDNA, we sequenced a section of the control region to examine nucleotide and haplotype diversity. The current genetic diversity in the population will inform the following: 1) how many individuals are needed for translocation, and 2) what individuals should be selected. Measuring genetic parameters before undertaking intensive management efforts is crucial to understanding their potential effects on translocation success. Kiwikiu proved to have higher levels of heterozygosity east of the Koolau gap and individuals from this area will be given a higher value for translocations.

6-21 Do Hawaiian Lobeliads Need Bird Pollinators to Reproduce? A Test Using Restoration Plantings Where Nectarivorous Honeycreepers are Present and Absent

Richard Pender, Clifford Morden

Botany Department, University of Hawai‘i, Honolulu, Hawai‘i, USA

With limited exceptions, Hawaiian lobeliad species are believed to have evolved flowers adapted for bird pollination. Despite the wide scale extinction and decline of nectarivorous bird species in Hawai‘i, few studies have been undertaken to assess how pollinator decline has impacted the reproduction of Hawaiian lobeliads. To address this question, pollination ecology studies were undertaken using four endangered lobeliad species at two restoration sites. The first site, Hakalau...
National Wildlife Refuge on Hawai‘i, where Clermontia lindseyana and Clermontia pyrularia are being restored, has relatively large populations of nectarivorous honeycreeper species. The second site, Kahanahaiki Gulch in the Wai‘anae Mountains on O‘ahu, where nectarivorous honeycreepers are rare, is a restoration site for Cyanea superba subsp. superba and Delissea waianaeensis. ‘I‘iwi (Vestiaria coccinea) and Hawai‘i ‘amakihi (Hemignathus virens) were infrequent floral visitors to C. lindseyana and C. pyrularia at Hakalau. ‘Amakihi primarily nectar robbed flowers, while ‘i‘iwi appeared to provide limited pollinator service to each Clermontia species. At Kahanahaiki, the introduced Japanese white-eye (Zosterops japonicus) primarily nectar robbed the flowers of C. superba and D. waianaeensis and are probably ineffective pollinators of either species. All four species employ a mixed mating system, whereby both autogamy (self pollination) and xenogamy (pollen transfer to flowers on different plants) would likely occur naturally. However, under extant field conditions, these species are reproducing primarily by autogamy and are significantly pollen limited. The potential impacts of pollinator loss (including; inbreeding depression and changes in plant population demographics) in these and other lobeliad species warrant future research attention.

6-22 Characterizing Space Use and Estimating Home Range Sizes of ‘Akikiki, an Elusive Endangered Kaua‘i Honeycreeper
Lucas Behnke1, Liba Pejchar2, Lisa Crampton1
1Kaua‘i Forest Bird Recovery Project, Hanapepe, HI, USA, 2Colorado State University, Fort Collins, CO, USA

The ‘Akikiki, or Kaua‘i Creeper (Oreomystis bairdi) was listed as federally Endangered in spring 2010, after having been a candidate for listing under the Endangered Species Act for 16 years. Despite this status, very little research has been completed on the basic ecology or threats to this species. Space-use or how ‘Akikiki use the landscape, an important aspect of the species’ life history, has only been anecdotally characterized. We used two common methods of quantifying space-use in birds, territory mapping and radio-telemetry, at five sites across the range of the ‘Akikiki on the island of Kaua‘i. We present results from two breeding seasons of territory mapping, and a comparison of breeding season and non-breeding season telemetry data on movements of individual ‘Akikiki. We used kernel density (KD) as well as minimum convex polygon (MCP) calculations to estimate home range sizes. Breeding season territory mapping in 2011 resulted in mean home range estimates of 4.00 hectares using 95% KD and 1.19 hectares using MCP (n=12), whereas pre-breeding season radio-telemetry resulted in mean home range estimates of 11.02 hectares using MCP (n=4). Our findings suggest that there are temporal differences in space use, and that individual ‘Akikiki use and may require much more area than previously thought. Our findings will help to prioritize future research and conservation efforts for this unique and charismatic species.

6-23 Native and Non-native Frugivore Movement Patterns and Implications for Seed Dispersal
Joanna Wu, Donna Delport, Patrick Hart
University of Hawai‘i at Hilo, Hilo, HI, USA

The thrush, ‘Ōma‘o (Myadestes obscurus), is the last remaining native frugivore in Hawai‘i, and disperses seeds in a kīpuka landscape fragmented by lava flows on the Island of Hawai‘i. Over the past few decades, an introduced opportunist, the Japanese White-eye (Zosterops japonicus), has become the most common bird in Hawai‘i. The Japanese White-eye consumes and disperses
some seeds, and its abundance makes it a potentially significant part of the ecosystem. However, little is known about the movement and seed dispersal patterns of either of these species. We used radio-telemetry to study movements, tracking nine ‘Ōma’o and nine Japanese White-eyes. The average 50% kernel home range size of ‘Ōma’o is 2.13 ha in the breeding season, and 3.14 ha in the non-breeding season. During the approximately 30 minutes required for gut passage of consumed fruit, ‘Ōma’o move an average of 133 m, with a large variability in distances traveled. ‘Ōma’o primarily spend time in a core area, but make trips to the surrounding lava matrix and neighboring kipuka and thus are likely to be dispersing seeds to those areas. Preliminary data from the breeding season suggest that Japanese White-eyes exhibit a wide range of movements, though ongoing work will provide concrete results. Fecal sample analysis and previous studies suggest that Japanese White-eyes consume less fruit than ‘Ōma’o, but their high densities across Hawai‘i bring up the question of how much seeds they disperse overall. This study is the first to track movements of the Japanese White-eye in Hawai‘i.

6-24 Spatial and Seasonal Aspects of Food Resources for Hawaiian Forest Birds
Anya Tagawa, Jonathan Price
University of Hawai‘i, Hilo, Hawai‘i, USA

Currently, one of the greatest challenges in conservation is prioritization of limited management efforts to best conserve habitats of Hawaiian forest birds. This study characterizes various community types, emphasizing structure, composition, and phenological patterns of plants species that serve as important food resources for Hawaiian forest birds. Eight sites represent plant communities established within a matrix of moisture and elevation. The first component characterized the basic structure and canopy volume of all plant species intercepted. Mesic low- and mid-elevation sites contained the highest canopy volume of both nectar- and fruit-resources. The second component involved a phenological study that focused on the timing and abundance of important fruit and flowers utilized by native forest birds. Fruit and flower production varied by species, site, and time of year. Data obtained from both components will be employed to determine spatial and temporal variation in food resource abundances within the greater island landscape, and provide a baseline for landscape-scale habitat management for native forest birds. Taken together canopy volume and fruit abundance estimates underscore the importance of mesic habitats.

6-25 The Nesting Habitat and Spatial Distribution of Lāna‘i’s Endangered Hawaiian Petrel (Pterodroma sandwichensis).
Marie VanZandt¹, Donna Delparte¹, Fern Duvall², Jay Penniman³
¹University of Hawai‘i, Hilo, Spatiail Data Analysis Lab, Hilo, HI, USA, ²Division of Forestry and Wildlife, State of Hawai‘i Department of Land and Natural Resources, Honolulu, HI, USA, ³Maui Nui Seabird Recovery Project, Pacific Cooperative Studies Unit, University of Hawai‘i at Mānoa, Honolulu, HI, USA

Spending the majority of their life as sea and appearing over land nocturnally during the breeding season, the endangered Hawaiian Petrel (Pterodroma sandwichensis) has a unique set of constraints determining its spatial distribution. In a colony on the island of Lāna‘i, previously thought extirpated, we investigated the nesting habitat selection and at sea distribution of the Hawaiian Petrel. Conducting extensive night surveys followed by daylight searches, eighty-eight nesting burrows were located in the summer of 2011. Binomial logistic regressions, was used to investigate habitat preferences of Hawaiian Petrel. The probability of nest occurrence was
strongly tied to areas dominated by native understory vegetation (<75%), open canopies and steeper slopes. Utilizing the nest site predictive model and high resolution satellite imagery, in a GIS, the remaining suitable habitat, on the island of Lāna‘i, was quantified. These results will guide habitat restoration efforts; specifically targeted removal of invasive strawberry guava (*Psidium cattleianum*). In August 2011, twenty geolocating tags were deployed on breeding birds to determine non-breeding season migration routes. Preliminary data collected from ten of those tags in the Spring of 2012 provides information on these at-sea distributions and patterns. All tags are scheduled to be removed in August 2012.

6-26 A Story of Predation, Eradication, and Recovery from within Hawaii’s First Predator Proof Fence at Ka‘ena Point Natural Area Reserve

Lindsay Young¹, Eric VanderWerf², Michael Lohr¹, Andrew Titmus², Christopher Miller³

¹Pacific Rim Conservation, Honolulu, HI, USA, ²University of Hawai‘i, Department of Natural Resource and Environmental Management, Honolulu, HI, USA, ³Hawai‘i Division of Forestry and Wildlife, Honolulu, HI, USA

The coastal strand ecosystem at Ka‘ena Point Natural Area Reserve on O‘ahu hosts one of the largest seabird colonies in the main Hawaiian Islands and contains multiple species of endangered plants. Due to the negative impacts of invasive alien mammals on native species, a peninsula-style predator-proof fence was constructed at Ka‘ena Point in 2011. Predator removal efforts began upon fence completion and were informed by two years of rodent monitoring and ten years of large mammal control. Diphacinone in bait boxes spaced 25m apart and multiple-catch mouse traps 12.5 apart were deployed to remove rodents and mongooses. Cats were removed with a combination of cage traps and padded leg-hold traps. Tracking tunnels were run monthly and spatial maps of rodent catch were generated to determine areas of high activity. Snap traps were deployed in areas of high activity and bait was refreshed in surrounding live traps in these hot spots. Cats, mongooses, and rats were eradicated within three months, and mice were eradicated after eight months. Since eradication, incursions of cats and mongoose have been infrequent (2/year), but rodent incursions have been more frequent (monthly). Buffer predator control is necessary to limit predators from re-invading around the coastal ends. The removal of predators has already resulted in a record number of Wedge-tailed Shearwater chicks in 2011, and increased Laysan Albatross reproduction in 2012. Predator removal is also anticipated to encourage other seabird species to nest at Ka‘ena Point, and to enhance regeneration and recruitment of native plants and invertebrates.

CONCURRENT SESSION 7:  AUGUST 2, 2012

7-1 Thinning *Acacia Koa* to Improve Multiple Stand Attributes

Thomas Baribault, Nicholas Koch, Kirk Derasin

*Forest Solutions, Inc., Kamuela, HI, USA*

Scarification is a reliable strategy for restoring *Acacia koa* forest on sites that previously supported the species. Koa stands regenerated via scarification typically show high densities, 2000 to 7000 stems ha−¹, persisting for decades. From ecological and economic perspectives, high stem densities are inconsistent with optimal outcomes. Stands containing fewer trees with larger, healthier crowns and faster growth rates are superior habitat for native fauna and represent better economic value. Thinning can convert high-density thickets into productive timber stands or habitat areas. The present study reviews thinning treatments applied to
scarification-regenerated koa stands in the Hōnaunau Forest, South Kona, Hawai‘i Island. Stands were thinned in 2004 by percentage basal area (BA) removal. Tree growth, including diameter and height, was measured through 2011. We used analysis of variance to identify differences in tree growth between site indices and thinning treatments. In site indices I and II, thinning induced significantly greater diameter, height, and volume growth upon removal of 40% BA versus other treatments. In site index III, thinning significantly increased diameter growth, but neither height nor volume. Effects of thinning on diameter, height, and volume were most substantial in site indices I and II; 40% BA removal increased volume growth by 191% to 260% above the control, and 43% to 75% above less aggressive treatments. The strong effects of 40% BA removal on scarification-regenerated koa suggest that thinning can markedly improve stand quality, even when the treatment is applied 24 years post-establishment.

7-2 Annual Patterns of Demography in Hawaiian Forests: The First Two Years of Recensus in the Hawai‘i Permanent Plot Network (HIPPNET)
Joshua VanDeMark1, Susan Cordell2, Thomas Giambelluca3, Christian Giardina2, Creighton Litton3, Faith Inman-Narahari4, Rebecca Ostertag5, Lawren Sack4
1EPSCOR-ENDER, Hilo, HI, USA, 2USDA Forest Service Pacific Southwest Research Station Institute for Pacific Islands Forestry, Hilo, HI, USA, 3University of Hawai‘i at Mānoa, Honolulu, HI, USA, 4University of California Los Angeles, Los Angeles, CA, USA, 5University of Hawai‘i at Hilo, Hilo, HI, USA

Long-term monitoring of forest function is important in understanding fluctuations in forest dynamics and structure over time. To examine these processes in Hawaiian ecosystems, we used standardized methods developed by the Center for Tropical Forest Science to establish a 4-ha plot in montane wet forest on the island of Hawai‘i. All stems within the plot ≥1 cm diameter were tagged and measured. A 0.4-ha subset of the plot was recensused approximately two and three years later. In the first recensus, diameter growth rates of canopy dominants Acacia koa and Metrosideros polymorpha were 0.71 cm yr⁻¹ (SD=0.61, n=49) and 0.11 cm yr⁻¹ (SD=0.29, n=232), respectively. Both A. koa (n=50) and M. polymorpha (n=238) experienced mortality of ~1.0% yr⁻¹. Recruitment was limited to a total of 16 stems of 7 different species. In the second recensus, diameter growth rates of Acacia koa and Metrosideros polymorpha were 0.82 cm yr⁻¹ (SD=0.70, n=51) and 0.15 cm yr⁻¹ (SD=0.31, n=230), respectively. Neither A. koa, or M. polymorpha, experienced mortality. Recruitment during this period totaled 36 stems of 8 species, but did not include A. koa or M. polymorpha. Annual growth rates were similar over both recensus periods, mortality remained low for canopy dominants, and overall recruitment increased. Compared to other tropical forests Hawaiian wet forests have low growth rates and overall low recruitment, making them particularly susceptible to non-native invasions and changes in climate. Continued monitoring will be important to assess how such perturbations affect structure and function of Hawaiian forests in the future.

7-3 Advantage Conferred on Koa Crop Trees by Targeted Silviculture Persists Despite Overall Slowing Growth Rates
Paul Scowcroft1, James Friday2, Travis Idol2
1USDA Forest Service, Pacific Southwest Research Station, Institute of Pacific Islands Forestry, Hilo, HI, USA, 2Department of Natural Resources and Environmental Management, College of Tropical Agriculture and Human Resources, University of Hawai‘i at Mānoa, Honolulu, HI, USA
The first decade of the 21st century saw a flurry of silvicultural research to develop management guidelines for growing marketable trees in secondary Acacia koa forests. One such study at 1700-m elevation on Mauna Loa examined thinning, alien grass control, and phosphorus fertilization treatments applied selectively in 2002-2003 to individual koa crop trees. The short-term response (2003-2005) was gratifying with stem diameter growth doubling where thinning was combined with grass control and phosphorus fertilization. Even without thinning, grass control coupled with fertilization improved diameter growth by 35%. But would those gains persist without additional management intervention? Additional measurements in 2006, 2009 and 2011 showed that the gains have been sustained. Average DBH increment (stem diameter at breast height) during 2003-2011 for the thinned-herbicided-fertilized trees was still twice what it was for untreated trees: 0.78 and 0.37 cm yr\(^{-1}\), respectively. However, these growth rates were lower than initially observed, and reflect a general decline in tree vigor for all treatments during that period. For thinned-herbicided-fertilized trees mean annual DBH increment was greatest in 2003-2005 at 1.20 cm yr\(^{-1}\). By 2009-2011, it was only 0.30 cm yr\(^{-1}\). Mean annual increments for untreated trees during those same intervals were 0.57 and 0.19 cm yr\(^{-1}\). Although DBH growth rates decline naturally with age, the large three- to four-fold reductions observed in this 9-year study might be driven by repeated exposure to vog, which is known to damage koa foliage. Nevertheless, gains due to a one time silvicultural intervention persist.

**7-4 Impacts of the Tsunami of March 11, 2011 on Vegetation at Kanahā Pond Wildlife Sanctuary**

Fern Duvall\(^0\), Charles Chimera\(^0\), Isabelle Walker\(^0\)

\(^0\)DLNR, Division of Forestry and Wildlife, Kahului, HI, USA, \(^2\)Hawai‘i-Pacific Weed Risk Assessment, Makawao, HI, USA, \(^3\)Americorps, Kahului, HI, USA

On March 11, 2011, ocean surges caused by a 9.0 magnitude earthquake off of Honshu, Japan reached the Hawaiian Islands and inundated extensive areas along Maui’s north shore, including large portions of Kanahā Pond Wildlife Sanctuary. The surges traveled one-third the sanctuary’s width at its greatest extent (water depth 1.37 m), filling normally dry areas with seawater, some unfortunate sea life, coral rubble, and other debris. Initial assessments suggested that certain native coastal plants including Scaevola taccada, Ipomoea pes-caprae, and Sesuvium portulacastrum fared better than introduced species. Twenty-six of 30 introduced species were moderately to heavily impacted by inundation, with 25 of 30 experiencing high levels of mortality in affected areas. Particularly vulnerable were introduced grasses and herbaceous taxa, as well as the invasive shrub Plucaea indica. After one year, however, the introduced grass, Cynodon dactylon, which initially dropped in cover from 62% to 51%, appears to be recovering, and currently occurs along 54% of monitoring transects. Two natives, I. pes-caprae and S. portulacastrum, are also recovering to or increasing from pre-tsunami levels. The introduced palm Phoenix dactylifera, also appears to be recovering after apparently severe initial impacts. Several native species, particularly Dodonaea viscosa, Pandanus tectorius, and the culturally important sedge Makaloa (Cyperus laevigatus) experienced high levels of mortality and may not recover without management intervention. These results suggest that future tsunamis or rising sea levels and storm surges predicted to accompany climate change will dramatically alter coastal vegetation and may eliminate all but the most resilient taxa.

**7-5 Examining the Use of Nurse Plants for Restoring Hawaii’s Degraded Submontane Woodlands**
Nicole DiManno, Stephanie Yelenik, Carla D'Antonio
University of California at Santa Barbara, Santa Barbara, California, USA

“Nurse plants” act as facilitators of plant recruitment, survivorship, and growth by ameliorating harsh abiotic conditions. There’s been increased interest in using nurse plants for restoration of degraded environments. The seasonal submontane woodlands of Hawai‘i Volcanoes N.P. have been degraded by repeated wildfires and invasions of exotic grasses. Only one native shrub, *Dodonaea viscosa*, appears to have naturally regenerated in the exotic grasslands dominated by *Melinis minitiflora*. Scattered adult *Styphelia tameiameia* are present because they potentially survived initial fire or recruited in at a low rate. We are documenting which native species are producing seedlings in these sites, whether established woody plants increase their success, and if so, which nurse plant characteristics are important in facilitation. We chose three woody species to investigate as potential nurse plants: *Dodonaea, Styphelia* and the exotic tree *Myrica faya*. We surveyed underneath these plants and in adjacent *Melinis* patches to compare their influences on natural seedling recruitment. We also planted seven native species under the different potential nurse plants, under *Melinis* and where *Melinis* had been cleared. All natural recruits and planted seedlings will be monitored for survivorship and growth rates. Finally, we characterized nurse plant canopy and soil characteristics and will relate these characteristics to seedling success. Preliminary data show that only *Dodonaea* is recruiting seedlings into *Melinis* patches. In contrast established shrubs have a greater diversity of naturally recruiting native seedlings under them. This study will help identify the characteristics of potential nurse plants that facilitate the survival of target restoration species.

7-6 Modeling Remnant Rare Plant Locations on the Island of Kaua‘i : Using What We Know to Guide Where To Go.
Matthew P Lucas¹, Clay Trauernicht², Kenneth R Wood¹, Natalia Tangalin¹
¹National Tropical Botanical Garden, Kalaheo, Hawai‘i, USA, ²University of Tasmania, Newnham, TAS, Australia

Much of Hawaii’s endangered flora is at a critical threshold; over 40% of species have <50 individuals in the wild. Known populations face very high risks of genetic bottlenecks and extirpation due to disturbance from landslides, fire, invasive species, and land conversion. This makes finding and collecting propagules from new populations of rare plants an important part of their survival. These populations are primarily restricted to remnant habitat that is less affected by these drivers of extinction while still providing some degree of suitable habitat. Characterizing this habitat should aid in locating similar sites across the landscape and help prioritize surveys for new rare plant populations. By compiling NTBG collection data from over 20 years of known rare plant locations on Kaua‘i we were able to analyze patterns of rare plant occurrence for habitat characteristics in elevation, slope, rainfall, relative annual shade, wind speed, wind exposure, and spatial autocorrelation. The best combinations of these variables were used to construct a unique generalized linear model (GLM) for each moisture zone resulting in a predictive map of relative likelihood of rare species presence across the entire landscape. The hope is that areas modeled with higher values will have an increased occurrence of undiscovered rare plant populations. Earlier stages of this model resulted in interesting discoveries on Kaua‘i including a lone specimen of *Caesalpinia kavaiensis*. We discuss how this model has potential for Kaua‘i and other islands to help efficiently steer both rare plant survey and restoration efforts towards a higher success rate.
**7-7 Moisture and El Niño Drive Cloud Forest Community Composition and Upper Limit on Haleakalā**

Shelley Crausbay¹, Sara Hotchkiss²

¹Colorado State University, Fort Collins, CO, USA, ²University of Wisconsin, Madison, WI, USA

High mountains in Hawai‘i harbour the last un-invaded reaches of intact cloud forest and today they are warming rapidly and experiencing greater aridity. Understanding the cloud forest’s sensitivity to climate change is extremely relevant to conservation. We use data from a coupled vegetation-climate network to ask how vegetation relates to climate patterns on the landscape today. The network brackets the cloud forest's upper limit on windward Haleakalā and it captured the strong El Niño (EN) event in the winter of 2009-2010. This EN induced extreme drought and heat - winter rainfall declined 90%, relative humidity declined 30%, and temperature increased ~2.5°C relative to mean winters. We developed distribution models relating vegetation to temperature, rainfall, and relative humidity from this EN period and neutral periods (climate means). Mean rainfall drives the cloud forest’s community composition and relative humidity during an EN event sets the upper limit. We tested whether EN drove the forest limit over long time scales by reconstructing forest line dynamics over the past 3,300 years with fossil pollen and modeling the forest line's relationship to past climate variability. Forest line was higher three times in the past and dynamics tracked changes in EN frequency. Our data suggest this important ecosystem is predominantly driven by moisture, not temperature, and future changes in moisture availability will affect cloud forest composition and distribution. A drier climate with more frequent El Niño may alter community composition and lower the forest line, reducing forest bird habitat and complicating high-elevation forest restoration efforts.

**7-8 Climate Change Vulnerability Assessment of the Low Lying Northwestern Hawaiian Islands**

Michelle Reynolds¹, Crystal Krause¹, Karen N. Courtot¹, Paul Berkowitz², Jamie Carter⁰

¹USGS, Pacific Island Ecosystems Research Center, Kilauea Field Station, Hawai‘i National Park, HI, USA, ²Hawai‘i Cooperative Studies Unit, Pacific Aquaculture and Coastal Resources Center, University of Hawai‘i at Hilo, Hilo, HI, USA, ³NOAA, Pacific Services Center, Honolulu, HI, USA

Climate change projections predict sea-level rise may inundate low lying islands across the globe, placing island biodiversity at high risk. The Northwestern Hawaiian Islands (NWHI) extend 1930 km beyond the main Hawaiian Islands and are home to more than 14 million seabirds and 11 endangered plants and animal species. Responding to the urgent need to assess climate change vulnerability and prepare response strategies for the world’s largest seabird rookery, we used remote sensing techniques to estimate island topography, classify vegetation and model potential sea-level rise impacts to island habitats and wildlife. We created GIS models to predict the land area of the NWHI lost to +1.0 m of passive sea level inundation by 2100. With the +2.0m sea-level rise scenario, 4 islands at French Frigate Shoals will be completely submerged by 2100. Habitat loss at Pearl and Hermes Atoll and French Frigate Shoals will be the most affected from sea-level rise. We predict shrub dependent species will be impacted the most from sea-level rise. These climate change scenarios and potential impacts emphasize the need for early climate change adaptation and mitigation planning for continued persistence of vulnerable species dependent on the NWHI.
7-9 E Kū i ka ‘ōhi‘a ‘ihi -- O Kū of the Sacred ‘Ōhi‘a: Cultural Significance of Our Dominant Watershed Tree
Sam ‘Ohukani‘ohi'a Gon III
The Nature Conservancy of Hawai‘i, Honolulu, HI, USA

As dominant tree of the majority of forest communities in Hawai‘i, it is no surprise that ‘ōhi‘a lehua and other Metrosideros species bear great Hawaiian cultural significance. The tree itself is considered the physical manifestation of Kū, one of the four principal Hawaiian deities. Its wood is incorporated into the two most sacred structures of the heiau (temples) of governance: the kiʻi akua (god figures) and the lele (offering platform). The flowers of ‘ōhi‘a, called lehua, are symbolic of the fires of Pele, the blood of warfare, the kinolau of Laka deity of hula, and hard-won, long-trained expertise. The role that lehua blossoms play as the mainstay of Hawaiian honeycreepers and other nectarivorous birds was not ignored; the attraction of birds to lehua is used as a metaphor of courtship, popularity, and high regard. The bog form of lehua has a special name, lehuamakanoe, that denotes its mist-shrouded habitat and confers a sacredness afforded only to deities. Material and other cultural uses incorporate the wood of ‘ōhi‘a in houses, tools, weapons, religious structures, food preparation tools and containers, the foliage and flowers in lei, and the tender parts of flowers, foliage and roots in herbal medicine. As a prevalent and easily recognized presence in ecosystems from sea level to tree-line, numerous ‘ōlelo no‘eau (wise and poetical sayings) refer to ‘ōhi‘a as a positive symbol of strength, sanctity, and beauty. All of these primary cultural underpinnings should not be ignored when considering the value of ‘ōhi‘a as an element of essential conservation value.

7-10 ‘Ōhi‘a Dieback on the Island of Hawai‘i - A 40 Year Perspective
James D. Jacobi1, Dieter Mueller-Dombois2, Hans Juergen Bohemer3
1U.S. Geological Survey, Pacific Island Ecosystems Research Center, Honolulu, HI, USA, 2University of Hawai‘i at Mānoa, Botany Department, Honolulu, HI, USA, 3University of Bonn, Interdisciplinary Latin America Center, Bonn, Germany

The distribution of ‘ōhi‘a within the Hawaiian Islands is truly remarkable, spanning dry to wet habitats from sealevel to treeline. Within its range ‘ōhi‘a is the dominant tree in most habitats. If something were to reduce its abundance or distribution, the result could be an ecological catastrophe. This is precisely the concern that arose in the early 1970s when large sections of ‘ōhi‘a forest on the windward side of the island of Hawai‘i experienced widespread canopy dieback. An initial assessment indicated dieback covered >34,500 ha in forests along the Hamakua coast. The cause of this phenomenon was not immediately apparent; leading hypotheses included impacts from introduced fungal pathogens, and a natural process linked to vegetation succession and substrate conditions. Major research efforts were undertaken by Dr. Dieter Mueller-Dombois and students at the University of Hawai‘i, and by the U.S. Forest Service. Ultimately, both programs concluded that this dieback was a natural phenomenon, but extrinsic factors, specifically invasive plant species, may alter the outcome of natural succession following dieback. In 1976, 25 permanent vegetation plots were established in both dieback and non-dieback areas to assess changes over time in ‘ōhi‘a and its associated plant community. Since then the plots have been resampled five times. Results indicate that many of the dieback plots are recovering to a healthy closed canopy. However, in some sites, introduced plants have invaded and may limit the natural recovery. Additionally, new areas of dieback have been identified around the island and are currently being mapped and assessed.
7-11 'Ōhi‘a Dieback as a Natural Process in Succession
Dieter Mueller-Dombois
University of Hawai‘i at Mānoa, Botany Department, Honolulu, HI, USA

The U.S. Forest research team concluded (1985) that nothing can be done about this forest illness or abnormality called “decline disease”. In a January 1984 Honolulu Star-Bulletin article Charles Hodges said, “The dieback problem can now be left to the ecologists.” From the beginning in 1975, our ecological team had approached the ‘Ōhi‘a dieback problem as a natural process in succession. This turned out to be verifiable through: (1) the cohort senescence theory; and (2) the long-term primary succession of aging volcanic landscapes. The cohort senescence theory is based on the prevailing cohort structure of the natural ‘ōhi‘a forest stands, which are the result of their disturbance history and demographic life cycle. ‘Ōhi‘a forest stands can be compared to tree plantations that will collapse if not harvested before they advance into their senescing life stage. The long-term primary succession consists of a short (1-2 K years) progressive stage, followed by a longer-term stage (of perhaps 2-30 K years) at the nutrient peak (or ecosystem climax). Thereafter follows a third very slow regressive stage proceeding over a time span of another (multi K) years. During that time, Hawai‘i’s rain forest habitats undergo basic changes in synchrony with forest development and redevelopment in the form of auto-succession. In the more extreme and marginal cases, forest habitats change into bogs and stream ecosystems.

7-12 The Fate of ‘Ōhi‘a forests; Evidence from Seed Dynamics, Invaded Systems, and Successional Pathways
Susan Cordell
USDA Forest Service, Institute of Pacific Islands Forestry, Hilo, HI, USA

‘Ōhi‘a (Metrosideros polymorpha) is an ecological marvel. Ranging from sea level to 2500m ‘ōhi‘a persists across a rainfall gradient from 500mm to 600m, germinates on substrates from 50 to 4 million years old, reproduces at tree heights from less than 1m in bogs to greater than 30m on rich volcanic soils, and is the oldest recorded angiosperm in the U.S. ‘Ōhi‘a is a prolific seeder, shade intolerant, and relies on a gap dynamic disturbance regime for successful recruitment. Unfortunately, these tenacious traits of ‘ōhi‘a have become vulnerabilities in today’s Hawai‘i. Fast growing, resource efficient, shade tolerant non-native species have reduced recruitment success of ‘ōhi‘a in disturbed environments such as lowland wet and dry ecosystems and several studies have shown that Hawaiian lowland wet forests will likely shift to non-native species dominance due to lack of regeneration of native trees. While seed rain in these forests is overwhelmingly dominated by ‘ōhi‘a, seedbanks of both disturbed and intact Hawaiian forests are overpoweringly dominated by non-native species. To promote ‘ōhi‘a dominance or a trajectory towards a functionally native ecosystem, site specific management prescriptions may be necessary. In highly disturbed systems promotion of hybrid systems may offer ways to go forward rather than backwards, whereas management of pristine environments should focus on reducing non-native species encroachment and disturbance regimes. Overall, management and research efforts should be directed towards maintaining the structure and much of the biodiversity of native forests for ‘ōhi‘a to persist into the future.

7-13 ‘Ōhi‘a Recovery Following the 1985 Clear-cut in Wao Kele O Puna: Rebirth and Hope for Hawaii‘i’s Most Esteemed Tree
Flint Hughes¹, Dennis Grossman², Greg Asner³

¹Institute of Pacific Islands Forestry; USDA Forest Service, Hilo, Hawai‘i, USA, ²Conservation
Conserving native biodiversity is of paramount importance in Hawai‘i, where endemism in the flora exceeds 90%. ‘Ōhi‘a (Metrosideros polymorpha) is the foundation tree of Hawaii’s forests. Unfortunately, it is vulnerable to the influences of invasive species, many which were purposefully introduced as part of well-intentioned efforts during the 1900s to augment and/or replace Hawaii’s forests in the name of ecosystem services. Here we report on consequences of 27 years of succession following deforestation (i.e., clear-cut) of mature ‘ōhi‘a-dominated forest on Kīlauea Volcano. Native species, and particularly ‘ōhi‘a, successfully re-colonized clear-cut areas and grew quickly throughout secondary succession. Aboveground forest biomass averaged 160 Mg/ha in recovering clear-cut areas; more than half the biomass of adjacent intact native forests (292 Mg/ha). ‘Ōhi‘a trees made up the vast majority (88%) of biomass in recovering forest, and exhibited impressive stand-level growth rates (i.e., 6 Mg/ha/y). The surprising rate of recovery by ‘ōhi‘a was attributable to a combination of factors; relatively well-developed soils, the capacity to coppice from stumps, and abundant seed sources afforded by adjacent intact ‘ōhi‘a-dominated forests. This last factor underscores the need to maintain as much native-dominated forest as possible to sustain Hawaii’s native biodiversity. In contrast, where localized stands of the alien invasive tree, albizia (Falcataria moluccana), had established, ‘ōhi‘a was virtually absent, accounting for only 10% of total biomass. These latter results provide further confirmation that “novel” forest constituents such as albizia and other alien tree species represent serious impediments to the existence of Hawaii’s native forests.

7-14 The Many Forms of ‘Ōhi‘a Lehua: Do They Matter?
Elizabeth Stacy, Jennifer Johansen, Keenan Morrison, Tomoko Sakishima, Yohan Pillon
University of Hawai‘i Hilo, Hilo, HI, USA

Yes. The highly variable tree, Metrosideros polymorpha, dominates Hawaii’s forests and comprises a wide range of endemic forms with divergent but overlapping morphologies and geographic ranges. We are studying how Hawaii’s island structure and striking environmental gradients have contributed to the evolution of these forms. Our study of neutral genetic structure among 23 populations of M. polymorpha on Hawai‘i Island revealed distance-dependent gene flow, clustering of populations by variety, and significant differentiation of varieties associated with extreme habitats. The extreme differentiation of the Hawai‘i Island-endemic riparian var. newellii from other varieties indicates unexpectedly rapid local adaptation (within 500,000 years) within a long-lived, continuously distributed, and highly dispersible tree species. Further, var. newellii populations group with a glabrous bog form of M. polymorpha from Kohala, indicating a likely pathway for the evolutionary origin of var. newellii. In addition, our studies of two common forms on Hawai‘i Island, early-successional var. incana and late-successional var. glaberrima, revealed partial, late-acting reproductive barriers consistent with a genetic mechanism that is usually attributed to reproductive isolation between species. Further, var. incana seedlings showed greater growth and survivorship in high-light treatments, while var. glaberrima showed greater survivorship in low-light treatments, indicating that successional gradients can drive evolutionary divergence in long-lived tree species. Combined, these results indicate significant roles for both habitat diversity (strong divergent selection) and genetic drift in the evolutionary diversification of extremely widespread, long-lived, and highly dispersible woody species.
7-15 There is More to ‘Ōhi’a Than Meets the Eye
Naupaka Zimmerman, Peter Vitousek
Stanford University, Stanford, CA, USA

There is growing concern that ‘ōhi’a (Metrosideros polymorpha) will be faced with a number of challenges in the near future, from pathogens to climate change. Due to its role as the ‘backbone’ of many native forests in Hawai‘i, it will be important to understand how ‘ōhi’a may respond to these changes. Coupled with this growing need is an emerging understanding of the importance of leaf microbial communities for the growth and fitness of their host plants. This talk will describe recent research into the non-harmful and highly diverse communities of fungi in the leaves of ‘ōhi’a. While these communities have been known about for decades, new molecular techniques have let us get a sense, for the first time, of how incredibly diverse they are as well as how the communities are structured across wildly different environments. Recent research has shown that some of these fungi, known as endophytes, can help protect their host plant from pathogens and herbivory, and even reduce the negative effects of environmental stressors like drought and low nutrients. Much of this research has been in agricultural grasses, however, and we are just beginning to understand the role these communities play in woody plants. Understanding this cryptic microbial diversity in ‘ōhi’a will, therefore, have implications for our understanding of plant-pathogen interactions and the adaptation of ‘ōhi’a to diverse and changing environments in the decades and centuries to come.

7-16 Examining ‘Ōhi’a Lehua Through the Lens of Hula
Kehau Nelson-Kaula
University of Hawai‘i at Hilo, Hilo, Hawai‘i, USA

My formal training in the ‘aiha’a style of hula began over twenty years ago when I joined Hālau o Kekuhi. Hula is a reflection of our natural world and all that the environment encompasses. As an ‘ōlapa, or dancer, my function is to visibly portray what the chant is communicating in order to bring those elemental forces to life. What can hula tell us about ‘ōhi’a, the lava flow pioneer and dominant species of forests? The answer lies in the chants. Chants can reveal a great deal of information, and the fact that ‘ōhi’a is referenced over and over again reflects its ecological significance, which in turn reflects its importance to our cultural integrity.

7-17 Modeling the Demise and Rebirth of West Maui’s Newell’s Shearwater and Hawaiian Petrel Colonies
David Ainley0, David Zajanc0, Greg Spencer0
1H.T. Harvey & Associates, Los Gatos, CA, USA, 2FirstWind Energy, Maui, USA

Several hundred endangered Hawaiian Petrels (HAPE, Pterodroma sandwichensis) and <100 threatened Newell’s Shearwaters (NESH, Puffinus auricularis newelli) remain in colonies in West Maui, Hawai‘i. These may be genetically distinct populations, raising issues for endangered species’ recovery programs that seek preservation of genetic diversity. Population modeling indicates that HAPE and NESH could be extinct from West Maui within three decades and two decades, respectively. On the basis of interest and resources, First Wind, as mitigation for the Kaheawa Wind Power I and II wind energy projects, propose to reverse extinction of these two species from West Maui by establishing predator-free colonies. As part of that effort, we developed a deterministic population dynamics model, with demographic values taken from the literature, for evaluating growth of ‘artificial’ colonies at Makamaka‘ole (West Maui).
Modeling results and experience with similar projects in New Zealand show that reversing the trend is possible, if this mitigation option is implemented soon. Through “social attraction”, these new artificial colonies would “borrow” recruits from the decreasing nearby colonies. The new colonies would experience growth quickly, but existing colonies would experience an increased rate of decline. Overall however, based on population modeling, the species populations’ trends would change from decreasing to increasing within 30 years, despite the hastened population decrease in the existing colonies. Within 20-30 years, depending on species, self-sustaining, growing colonies of HAPE and NESH should exist once again in West Maui.

7-18 Occupancy Surveys for a Critically Endangered, Highly Cryptic, Single Island Endemic, the Puaiohi
Kevin Brinck², Richard Camp², Marcos Gorressen², Barbara Heindl¹, Lisa “Cali” Crampton¹
¹Kaua‘i Forest Bird Recovery Project, HI Division of Forestry and Wildlife, PCSU, Hanapepe, HI, USA, ²University of Hawai‘i, Hilo, Hilo, HI, USA

The federally endangered Puaiohi is endemic to Kaua‘i and is thought to number between 200-800 individuals. The species is cryptic and restricted to deeply incised, meandering streams, and using standardized point transect surveys to determine abundance and distribution is problematic. Here we describe the development of a survey technique based on occupancy analysis to improve accuracy and precision of population estimates, and report preliminary estimates from two years of range-wide surveys. In the pilot year (2011), we established 20 stations along each of five streams; three with high Puaiohi density and two with low density. We surveyed each station six times during the breeding season. Each 17.5 minute survey consisted of two 4-minute “base” count periods and an 8.5 minute count period consisting of three 30-s playbacks of Puaiohi vocalizations interspersed with silence to determine whether playback improved detection. In each period we recorded any Puaiohi detected and noted if it was detected previously. Analyses indicated that: 1) more detections occurred in the first base period than the second, 2) compared to base periods, playback increased detection probability by 5%, and 3) detection increased with additional visits until the 5th visit. Based on these results, we refined the protocol, and in 2012 we surveyed two low and three high density streams, resurveying one high density stream to control for temporal variability. We then estimated occupancy probability of high and low density streams and combined this estimate with habitat information to produce a preliminary model of Puaiohi population size and distribution.

7-19 Assessing Arthropod Resources for the Endangered Kiwikiu (Maui parrotbill) at Nakula Natural Area Reserve, a Potential Site for Reintroduction
Robert Peck¹, Paul Banko², Justin Cappadonna¹, David Leonard³
¹Hawai‘i Cooperative Studies Unit, Pacific Aquaculture and Coastal Resources Center, University of Hawai‘i at Hilo, Hawai‘i National Park, HI, USA, ²U.S. Geological Survey, Pacific Island Ecosystems Research Center, Hawai‘i National Park, HI, USA, ³Pacific Cooperative Studies Unit, University of Hawai‘i at Mānoa, 1151 Punchbowl Street, Honolulu, HI, USA

The mesic koa-ōhi’a (Acacia koa-Metrosideros polymorpha) forest at Nakula Natural Area Reserve on the leeward slope of Haleakalā Volcano, Maui, is being considered as a reintroduction site for the endangered kiwikiu (Maui parrotbill; Pseudonestor xanthophrys), an insectivorous Hawaiian honeycreeper currently restricted to montane habitat on windward Haleakalā. Evaluating foraging opportunities for kiwikiu is an important step in planning their reintroduction because their habitat requirements may be narrow due to their specialized foraging
behavior, which includes extracting prey from wood. To assess prey availability at Nakula, we compared arthropod abundance there with abundance at Waikamoi Preserve and Hanawi NAR, areas that currently support populations of kiwikiu. During February-May 2011 we sampled arthropods on ʻōhiʻa at all three sites and koa at Nakula and Waikamoi using two generalized sampling methods: traps on tree trunks sampled the bark fauna and clipping branch tips sampled the arthropod community on twigs and foliage. Our results suggest site-level differences in arthropod abundance between the two sampling methods. On koa and ʻōhiʻa foliage, the most abundant arthropods (Araneae, Lepidoptera, Pscoptera and Homoptera) were at least as abundant at Nakula as they were at the other sites. In contrast, the most common arthropods (Araneae, Neuroptera, Homoptera, Collombola and Coleoptera) on bark surfaces were less abundant at Nakula compared to the other sites. This outcome and the results from other sampling methods targeting known arthropod prey will aid in the evaluation of critical resources for kiwikiu at Nakula NAR.

7-20 Detecting the Elusive: Documenting Hawaiian Hoary Bat Activity on Oʻahu
Ling Ong¹, Adam Miyamoto¹, Mitchell Craig², Robert Roy³, David Cowan³
¹SWCA Environmental Consultants, Honolulu, Hawaiʻi, USA, ²First Wind, Honolulu, Hawaiʻi, USA, ³First Wind, Portland, Maine, USA

Hawaiian hoary bat activity was documented in multi-year studies of two lowland sites on the north shore of Oʻahu. Hawaiian hoary bats showed seasonal presence at both sites, with increased activity in the spring and summer months, similar to activity patterns documented on the islands of Hawaiʻi and Kauaʻi. Activity rates over ponds appear to be higher than in forested areas, suggesting that water features may be attractive foraging habitat for the species. Multiple foraging bouts occurred over the ponds, with highest activity during the early night and shortly after midnight. A map of bat detections (sightings and acoustic detections) is presented to show known locations of sightings on the island of Oʻahu documented in recent years.

7-21 Stretching the Boundaries: Long-distance Translocation of Millerbirds Provides Hope for Endangered Species and Ecosystem Recovery
Sheldon Plentovich¹, Holly Freifeld², Chris Farmer³, George Wallace⁴, Robby Kohley³, Peter Luscomb³, Cameron Rutt³, Eric VanderWerf⁶, Theirry Work⁷, Lindsay Young⁶
¹U. S. Fish and Wildlife Service, Honolulu, HI, USA, ²U. S. Fish and Wildlife Service, Portland, OR, USA, ³American Bird Conservancy, Hawaiʻi Volcanoes National Park, HI, USA, ⁴American Bird Conservancy, Washington, DC, USA, ⁵Pacific Bird Conservation, Honolulu, HI, USA, ⁶Pacific Rim Conservation, Honolulu, HI, USA, ⁷U. S. Geological Survey, National Wildlife Health Center, Honolulu, HI, USA

The Northwestern Hawaiian Islands have lost many native species, including the Laysan Millerbird (*Acrocephalus familiaris familiaris*), which went extinct on Laysan in the 1920s after ecosystem destruction by introduced rabbits and livestock. We successfully translocated 24 Nihoa Millerbirds (*A. f. kingi*) 1,037 km by sea from Nihoa to Laysan in September 2011. The translocation was the culmination of over five years of research and two rounds of captive feeding trials on Nihoa and was only possible after more than 20 years of habitat restoration on Laysan. Millerbirds were captured over 1.5 days on Nihoa, then transported 3 days to Laysan in a modified vessel cabin. Birds were held in captivity from 4.5 to 6 days. All birds survived transport, and were released on Laysan on 10 September 2011 with a mean weight gain of 5.3% (range: -1.7 to +17.6%). All 24 birds were observed singing and conducting other territorial
interactions by 4 October, and nesting behaviors such as begging and allofeeding were observed within the first few weeks. Translocation has been successfully used in Hawai‘i to reintroduce native birds such as Laysan Ducks on Midway, but small insectivorous passerines pose much greater challenges for captive management, feeding, and medical care. This translocation provides a model that is applicable for restoration of other endangered birds and island ecosystems.

7-22 Reproduction and Movement Patterns of Translocated Millerbirds on Laysan
Chris Farmer1, Sheldon Plentovich2, Robby Kohley1, Cameron Rutt1, Holly Freifeld3, George Wallace4
1American Bird Conservancy, Hawai‘i Volcanoes National Park, Hawaii‘i, USA, 2U.S. Fish and Wildlife Service, Honolulu, Hawaii‘i, USA, 3U.S. Fish and Wildlife Service, Portland, Oregon, USA, 4American Bird Conservancy, The Plains, Virginia, USA

The global population of Millerbirds (Acrocephalus familiaris) was estimated at approximately 775 individuals in 2011, and has historically fluctuated between 30-800 birds. The species is thus at high risk of extinction due to demographic and environmental stochasticity. We translocated 24 Millerbirds from Nihoa to Laysan Island to reduce these risks. The intended sex ratio was 12:12; subsequent behavioral observations indicated the translocation cohort was actually 13 males and 11 females. All 24 birds survived the transport and release, and at least 88% (21/24) of the birds were alive as of March 2012. The birds have displayed two periods of reproductive activity, fall 2011 and spring 2012. Ten nests from at least eight females were discovered in fall 2011. Eggs were laid in three nests, five were abandoned, and the fate of two was indeterminate. One clutch hatched two nestlings, but the nestlings did not survive and the eggs of the other two clutches disappeared, and were most likely depredated. Five pairs of Millerbirds have been observed carrying nesting material in spring 2012, and one nest completed. The birds’ territories and movements on Laysan (1023 ha) have been much greater than previously observed on Nihoa (63 ha). The translocation and survival rate of Millerbirds are encouraging, but multiple successful breeding seasons will be required to establish a self-sustaining population of Millerbirds on Laysan. Our results with a small, insectivorous passerine indicate that translocation can be successfully employed worldwide to protect a diverse range of avian species under challenging logistical conditions.

7-23 Movement Ecology of the Endangered Nēnē
Steven Hess1, Christina Leopold2, Kathleen Misajon3, Darcy Hu4, John Jeffrey5
1U.S. Geological Survey Pacific Island Ecosystems Research Center, Hawai‘i National Park, HI, USA, 2Hawai‘i Cooperative Studies Unit, University of Hawai‘i at Hilo, Hawai‘i National Park, HI, USA, 3U.S. National Park Service, Division of Resources Management, Hawai‘i National Park, HI, USA, 4U.S. National Park Service, Pacific West Regional Office, Hawai‘i National Park, HI, USA, 5Jack Jeffrey Photography, Pepeekeo, HI, USA

The endangered nēnē (Branta sandvicensis) underwent a severe population decline in the early 20th Century and did not reestablish traditional movement patterns on Hawai‘i Island until recently. We used satellite telemetry to study three aspects of reestablished nēnē movement patterns: seasonal altitudinal movements; multi-scale habitat selection; and home range. Nēnē moved from low- and mid-elevation breeding and molting areas in September-April to remote high-elevation areas during the non-breeding season of May-August in the opposite direction of most tropical bird species. We determined factors influencing habitat selection by nēnē at two
scales using binomial Generalized Linear Models. Meso-scale habitat modeling revealed that nēnē preferred alien grass and human-modified landscapes while breeding and molting, and native subalpine shrubland during the non-breeding season. The best model supported by model selection included: season, elevation, distance to water, land cover class, and the interactions elevation x land cover class, and season x distance to water. Fine-scale habitat modeling included all predictors from the top-ranked meso-scale model and three additional predictors, but yielded little additional resolution. Results were consistent with historical records, although dissimilar from previous habitat preference studies of other subpopulations of nēnē. We used Brownian Bridge movement models to identify home ranges of nēnē throughout their annual cycle. Analyses showed common, well-defined movement routes by previously isolated subpopulations to sequential home ranges in preferred seasonal habitats between breeding and non-breeding sites. Restoration of nēnē throughout their entire altitudinal range may be important for reestablishing traditional movement patterns and appropriate seasonal behaviors.
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P-1 An Overview of the Hawai‘i Agriculture Research Center Water Conservation Plan in Protection of the Honouliuli Watershed Preserve
Matthew Falco, Jayme Barton
Hawai‘i Agriculture Research Center, Kunia, HI, USA
The Honouliuli Watershed, on the island of O‘ahu, is part of a 23 square mile preserve on the eastern slope of the Wai‘anae mountain range. The watershed feeds the Pearl Harbor Aquifer, the largest source of drinking water for O‘ahu and home to 35 threatened and endangered species, making it an important source of biodiversity on the island as well. In cooperation with the Natural Resources Conservation Service, the Hawai‘i Agriculture Research Center (HARC) has designed and implemented a water conservation plan to manage its 107 acres of farmland surrounding the watershed preserve. HARC has developed measures to mitigate the problems of erosion, soil compaction, sedimentation, runoff, and undesirable air movement in protection of the nearby land. HARC has employed such practices as conservation cover, critical area planting, grassed waterways, sediment basins, vegetative barriers and windbreaks to minimize runoff that may otherwise find its way into the watershed.

P-2 Breadfruit: A Global Perspective on Conservation and Use of a Traditional Oceanic Crop
Diane Ragone
National Tropical Botanical Garden, Kalaheo, Hawai‘i, USA
Conservation of breadfruit diversity is of global significance. It is one of 30 crops covered by the International Treaty on Plant Genetic Resources for Food and Agriculture. The National Tropical Botanical Garden has been involved in the conservation of breadfruit germplasm since 1977 and established the Breadfruit Institute in 2003 to promote the conservation and use of breadfruit for food and reforestation. It maintains the largest and most diverse collection of breadfruit in the world, with more than 120 cultivars from 34 Pacific islands conserved in field genebanks. Some of the accessions are rare or extinct in their home islands. Within this collection are accessions that represent breadfruit’s entire domestication process, including the two wild progenitor species *Artocarpus camansi* and *A. mariannensis*, domesticated *A. altilis*, and interspecific hybrids between *A. altilis* and *A. mariannensis*. This collection provides unique opportunities to study this important staple crop. Research includes assessing genetic and morphological diversity and evaluation of nutritional composition, fruit yield and other characteristics. Our research has identified accessions with distinct traits that will help guide future germplasm conservation initiatives and nutrient-rich, productive cultivars that can make significant contributions to food security in the tropics. The Breadfruit Institute is engaged in an initiative to distribute selected cultivars for tree planting projects to support sustainable agriculture, agroforestry, and income generation. This initiative involves collaboration with university researchers, the private sector, and government and non-governmental agencies. It is a model for benefit sharing of revenues derived from commercialization of a traditional Oceanic crop.

P-3 Baseline Study for Food Self-Sufficiency in Hawai‘i County – Mapping Agricultural Land Use
Nicolas Turner¹, Jeff Melrose¹, Donna Delparte¹
¹University of Hawaii at Hilo, Hilo, HI, USA, ²County of Hawai‘i Department of Research and Development, Hilo, HI, USA

Hawai‘i is the remotest chain of islands in the world, heavily dependent on food imports. Pre-contact Hawai‘i was completely self-sufficient with staples such as kalo, ‘ulu, ‘uala. After western contact most people were still dependent on locally produced foods to subsist. In a period of 60 years, from 1900-1960 Hawai‘i became fully integrated in world food production. In 2012, Hawai‘i Island is deeply dependent on the global food system. Increasing the Island’s food self-sufficiency is emerging as a topic of interest for state and county agencies. This study presents the results of an extensive mapping effort of key agricultural resources on the island of Hawai‘i using satellite imagery, County of Hawai‘i tax data, and site visits. The mapping effort emphasizes the variability of agricultural activities that occur Island-wide and the regional differences that underlie existing agricultural activities. Strategies to enhance food production need to be cognizant of what occurs today and why, such that effective strategies are implemented to increase local food production in the future. A food self-sufficiency spatial data repository has been developed for Hawai‘i County and the general public to interactively visualize agricultural activity in each district of the island.

**ALIEN & INVASIVE SPECIES**

**P-4 Changes in Land Cover and Fire Risk Associated with Nonnative Grass Invasion in Hawai‘i**
Lisa M. Ellsworth, Creighton M. Litton, Alexander P. Dale
University of Hawai‘i at Mānoa, Honolulu, HI, USA

It is generally accepted that grass invasion and subsequent fires result in conversion from forest to grassland throughout the tropics. However, there is little published data to support this paradigm on a landscape scale in Hawai‘i. Moreover, no studies have been conducted in Hawai‘i to examine changes in fire potential on a landscape scale following conversion to grassland. Our objectives were to: (i) use field data and modeling to examine potential fire behavior in forests vs. grasslands, and (ii) measure land cover change from 1950-2006 in and around two heavily managed areas on O‘ahu, Hawai‘i. We quantified fuel loads, height, and moisture in forest and nonnative grassland (*Megathyrsus maximus*) plots (*n*=6). These data were used to predict potential fire behavior in forest vs. grassland using the BehavePlus fire model. We then quantified land cover change from 1950-2006 with historical imagery. Fuel moistures and fuel loads did not differ between treatments, but mean fuel height was lower in forests (72 cm) than grasslands (105 cm; *P*<.001). Predicted rate of spread was higher in grasslands (12.7 to 38.3 m min⁻¹) than forests (0 to 18.7 m min⁻¹) (*P*<0.001), and flame lengths were higher in grasslands (4.3-11.2 m) than forests (0-5.6 m; *P*=0.01). Rapid conversion from forest to grassland occurred before aggressive fire management practices were implemented (~1990). These results demonstrate that conversion from forest to nonnative grassland significantly impacts potential fire behavior. Slower conversion rates in recent years suggest that active fire management is reducing future fire potential.

**P-5 Monitoring and Control of Feral Cats on Kaho‘olawe: One Step Towards Eradication**
James Bruch, Paul Higashino, Lyman L. Abbott, Lopaka White
Kaho‘olawe Island Reserve Commission, Wailuku, HI, USA
The island of Kahoʻolawe provides an extraordinary opportunity for conservation and has been referred to in numerous recovery plans for declining populations of Hawaiian avifauna. The feral cat (*Felis silvestris catus*) is widely recognized as one of world’s most destructive invasive species and has been implicated in the decline or extinction in a number of native avian species. Of the main eight Hawaiian Islands, Kahoʻolawe presents the best chance to eradicate feral cats due to its limited access, remoteness, relatively small size (116 sq km) and reserve status. With assistance from a U.S. Fish and Wildlife grant, the Kahoʻolawe Island Reserve Commission (KIRC) restoration program monitored and controlled feral cats from November 2008 to February 2011. Monitoring techniques included camera traps, tracking stations, spotlight surveys, trapping, and diet and disease analysis. Feral cat density was estimated to be high based on capture rate and regular monitoring surveys. Cat track observations declined significantly (P<0.001) during the course of the study. Twenty-two out of forty-six (47.8%) of cats tested positive for seroprevalence to the parasitic protozoa *Toxoplasmosis gondii*. A major component of prey items consisted of invertebrates mainly comprised of centipedes and intertidal crabs. With cooperation from the Island Conservation (IC) organization, information gathered helped create an implementation plan for the eradication of feral cats on Kahoʻolawe. This poster presentation summarizes the results from this project.

**P-6 Vegetation Structure Change: Post-Treatment of *Pennisetum setaceum* in Lowland Dry Communities of Manukā Natural Area Reserve**

Jennifer Randall, Lisa Shizuma, Ian Cole, Lisa Hadway  
DLNR/DOFAW/NARS, Hilo, HI, USA

Introduced on Hawaiʻi Island in the early 1900s as an ornamental grass from Africa, *Pennisetum setaceum* has spread rapidly throughout the leeward side of the island. This species colonizes vigorously in dry open environments over a wide elevation range and has been observed to grow rapidly in response to fire in dry lowlands. In the lowland dry communities of Manukā Natural Area Reserve, situated in South Kona, staff has been actively working to manage *Pennisetum setaceum*. Ungulate exclusion and invasive species control are considered critical management actions. Will native species recover which may have been once displaced? Or will other non-native species replace *Pennisetum*? To better understand the impacts of these actions we installed three control plots and surveyed in a *Pennisetum setaceum* dominated lowland dry grassland. Adjacent to the plots, three acres were indiscriminately sprayed and a fenced exclosure constructed. After several retreatments, three plots were surveyed in the exclosure. Results show *Pennisetum setaceum* cover decreased 77%. The native herb *Waltheria indica*, became the dominant species. Percent cover of non-native grass *Melinis repens*, also increased. Notably, a small percentage of native grass *Heteropogon contortus*, recovered after the initial herbicide treatment. The vegetation structure within the exclosure changed dramatically. Observing what may occur when a dominant invasive species is removed, may be important in implementing effective management efforts in the future.

**P-7 Ungulate Management Plan for Keauhou-Kaʻu Unit**

Anthony Kim, Neal Okuda, Karin Schlappa  
Three Mountain Alliance, Volcano, Hawaiʻi, USA

The Three Mountain Alliance (TMA), formerly known as ‘Ōlaʻa Kīlauea Partnership consists of nine partners and has existed a little over 18 years. Many of the fenced units that TMA manages are small in comparison to the largest member of them, the Keauhou-Kaʻu unit. Consisting of
23,191 acres, the unit is a mix of scrub/shrub, evergreen forest, grassland and bare lava. Due to limited personnel, estimating population densities for such a vast remote area is challenging. Is it worth dividing this big unit in order to thoroughly survey smaller areas, or is there another way to reach our goal to determine that ungulate populations are dwindling or have ceased to exist? All sheep were removed from the upper elevations in 2008, leaving feral pigs the remaining ungulate threat. 95% of all ungulates caught are released alive and given to the land manager for Kamehameha Schools. Due to decreased ungulate density, TMA has initiated the next step to survey for ungulate activity in more remote areas. This included establishing new survey transects based on vegetation types in the more remote, high elevation areas of the unit. Systematic surveys along the new transects in addition to incidental scouts throughout lower Keauhou will help to determine new locations for future control activities. Over the next four years, TMA will carry out this new ungulate management plan to further reduce or eliminate ungulates from Keauhou unit.

P-8 Tracking Invasive Plants in the Subalpine Shrubland of Hawai‘i Volcanoes National Park
Melissa Simon, Alison Ainsworth, Corie Yanger
Pacific Island Network Inventory & Monitoring Program, Hawai‘i National Park, HI, USA

For decades, nonnative species have colonized and degraded native plant communities across the Hawaiian Islands. Despite the long history of invasive plant management in Hawai‘i Volcanoes National Park (HAVO), limited species inventories exist for the difficult to access subalpine shrubland community. Identified by resource managers as a monitoring priority, the subalpine shrubland vegetation spanning the Kahuku Unit and Mauna Loa Strip has seen minimal human disturbance compared to lowland areas. Long term monitoring for nonnative species in this area is essential and will allow the Park to target invasions at their initial stages, thus reducing future ecological and economical costs. In 2011, the Inventory & Monitoring Program surveyed 20 transects (5x500m) for nonnative plants in four subalpine zones: NW Kahuku, Interior & West, Above Kau Forest, and Mauna Loa Strip. All nonnative species detected were herbs or grasses. Over half (65%) of the area sampled contained at least one nonnative species, but cover was low with no species averaging greater than 1% cover on any transect. Nonnative species richness was greatest in NW Kahuku (37±1 species) and lowest in Mauna Loa Strip (1±1 species). Similarly, nonnative frequency and cover were highest in NW Kahuku likely due to the abundance of feral ungulates and a history of disturbance in this zone. Invasive plant species monitoring is scheduled to continue within HAVO’s subalpine shrubland every five years to detect and inform park managers of any increases in invasive species frequency or localized cover within this unique relatively intact vegetation community.

P-9 First Establishment of a Biocontrol Agent for Strawberry Guava in Hawai‘i
Nancy Chaney, M. Tracy Johnson
USDA Forest Service, Volcano, HI, USA

A biological control agent for strawberry guava (Psidium cattleianum), the Brazilian scale insect Tectococcus ovatus, was released and established in Volcano, Hawai‘i, in January 2012. The initial release site will serve as a demonstration of the specificity and impact of the agent in advance of future releases in native forests, where it is intended to slow the spread of strawberry guava. The demonstration site is a common garden planted with three well-known varieties of strawberry guava (red, yellow and spindle-fruited) as well as common guava (Psidium

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guajava). In addition to measuring the suitability of biocontrol on the different varieties of strawberry guava, this release provides information on the rate of *T. ovatus* population development in the field, dispersal of the agent within a tree, and dispersal between trees.

**P-10 Restoration and Management of a Montane Dry Forest on Hawai‘i Island**

Melissa Tavares  
*University of Hawai‘i at Hilo, Hilo, Hawai‘i, USA*

This study focuses on the impacts of feral ungulates and pasture grasses on natural regeneration of native seedlings in a montane (1,500 m - 2,000 m) dry forest on Hawai‘i Island known as Lupea. Situated between Hualalai, Mauna Kea, and Mauna Loa, Lupea contains the largest and most intact ‘Ili‘ahi (Sandalwood, *Santalum paniculatum*) stand and the second-largest Māmane (*Sophora chrysophylla*) forest on Hawai‘i Island. Non-native vegetation can create barriers to native seedling establishment, survival, and growth by altering nutrient, light, and water acquisition. Feral ungulates not only browse on native species, but also create disturbances that allow invasive species to establish. However, despite these frequently observed patterns, the interplay between feral ungulates, pasture grasses, and native vegetation is poorly understood. We therefore applied a factorial design to 1-acre plots with control, herbicide and duff removal, and fencing treatments. Seed bank and seed rain are being analyzed to understand the present and future regeneration potential of this forest. Seedlings have been outplanted within these treatment plots to understand the survival and growth potential of established seedlings. Sampling of vegetation is ongoing and will be completed in May 2013. The results of this study will guide the Three Mountain Alliance in the design and implementation of site-specific management and restoration plans.

**AVIFAUNA**

**P-11 Maui’s Protected Areas Shelter Long-lived Hawaiian Honeycreepers**

Hanna Mounce¹, C. Robby Kohley², Cameron Rutt², David Leonard³  
¹Maui Forest Bird Recovery Project, Makawao, HI, USA, ²American Bird Conservancy, Hawai‘i National Park, HI, USA, ³Pacific Cooperative Studies Unit, Division of Forestry and Wildlife, Honolulu, HI, USA

Tropical birds generally exhibit high adult survival in comparison to their shorter-lived temperate counterparts. In Hawai‘i, there is scant published data available on the maximum life spans within Hawaiian honeycreepers. What data is available has illustrated some remarkable longevity records but is restricted to few species. Researchers have been marking and re-sighting color-banded individuals of six species of honeycreepers within the Hanawi Natural Area Reserve (NAR) since 1992. We analyzed these data in order to estimate minimum age for the oldest individuals of ʻĀkohekohe (*Palmeria dolei*), Hawai‘i ʻAmakihi (*Hemignathus virens*), Maui ʻAlauahio (*Paroreomyza montana*), Kiwikiu (*Pseudonestor xanthophrys*), ʻIʻiwi (*Vestiaria coccinea*), and ʻApapane (*Himatione sanguinea*). From these data we identified 37 individuals with a minimum age in excess of 10 years within five of these species. This extends the known longevity records for ʻĀkohekohe, Kiwikiu, Maui ʻAlauahio, Hawai‘i ʻAmakihi and ʻApapane, with the oldest individual being a Hawai‘i ʻAmakihi over 17 years old. The Hanawi NAR is part of a larger effort to protect and preserve Hawai‘i’s unique natural resources and the best remaining habitat for Maui’s native forest birds. Through fencing and threat eradication, the Hanawi NAR has remained the most pristine forest habitat available for these birds on Maui.
This habitat protection may have been a vital component in the longevity capabilities of these species. Survival is a key factor in all population demographics and for these species to be routinely capable of such long lifespans may bode well for current and future conservation measures.

**P-12 Experiments with Developing and Using Supplemental Feeders for Kiwikiu (Maui Parrotbill; *Psuedonestor xanthophrys*): Potentials for Translocation Efforts and Population Productivity Levels**

Laura Berthold¹, Hanna Mounce¹, David Leonard²
¹Maui Forest Bird Recovery Project, Makawao, HI, USA, ²Pacific Cooperative Studies Unit, Division of Forestry and Wildlife, Honolulu, HI, USA

The Kiwikiu (Maui Parrotbill; *Psuedonestor xanthophrys*) is an endangered Hawaiian Honeycreeper with a population of ~500 individuals on the northeast slope of Haleakalā, East Maui. Long-term monitoring data suggests that the stability of this population is unclear. We do know that the species is currently restricted to ~40 km² of available habitat. Furthermore, recent intense demographic research has found productivity levels within the core of the population may be inadequate to sustain the population. Two management strategies that could be critical toward recovering this species are: 1) determining a method of population management that will increase the reproductive output, and 2) expanding available habitat and creating a second population through reintroductions on the leeward side of Haleakalā. Providing supplementary food to birds has been used in conservation and research applications for decades. It can increase a population’s reproductive output by improving the parent’s ability to provide food for young. Additionally, supplemental food stations are often used when reintroducing a population to new habitat areas. During the 2012 breeding season, we aimed to design and implement the provision of supplementary food for Kiwikiu in The Nature Conservancy’s Waikamoi Preserve. Feeding stations were set up in Kiwikiu pair home ranges and monitored by remote cameras and observations. Results from this preliminary study will guide us in future decisions regarding the use and applicability of supplemental feeding. This could be a powerful management tool for both increasing the current population of Kiwikiu and supporting a reintroduced population on the leeward side.

**P-13 Forest Bird Status and Patterns in the National Park of American Samoa**

Seth Judge¹, Richard J. Camp², Visa Vaivai³, Patrick J. Hart⁴, Greg Kudray⁵
¹Hawai‘i-Pacific Islands Cooperative Ecosystem Studies Unit, University of Hawai‘i at Hilo, Hilo, HI, USA, ²Hawai‘i Cooperative Studies Unit, University of Hawai‘i at Hilo, Hawai‘i National Park, USA, ³National Park Service, National Park of American Samoa, American Samoa, ⁴Department of Biology, University of Hawai‘i at Hilo, Hilo, HI, USA, ⁵Inventory and Monitoring Program, Hawai‘i Volcanoes National Park, Hawai‘i National Park, USA

The National Park of American Samoa (NPSA) was surveyed for forest birds and habitat characteristics from June through August, 2011. This information provides the first datum in the time-series of monitoring for long-term trends in forest bird distribution, density, and abundance within NPSA. A total of 185 stations on 20 transects were surveyed within the NPSA units on Tutuila and Ta’u Islands. We conducted 8-minute counts using the point-transect distance sampling method. A total of 2,516 birds were detected from 13 species in both units. All species were either endemic or indigenous to the islands of American Samoa. Nearly every species detected was broadly distributed in the predominantly native rainforests of NPSA. Sufficient
detections were made of seven species, allowing for density estimation. The Wattled Honeyeater was the most conspicuous, widespread, and abundant species in both units (we estimate almost 150,000 birds). The Samoan Starling (Aplonis atrifusca), Polynesian Starling (Aplonis tabuensis), and Collared Kingfisher (Halcyon chloris) were widespread and occurred in modest densities. The remaining nine species occurred at less than 20% of stations surveyed and in low relative abundances. The White-rumped Swiftlet (Aerodramus spodiopygius) and Cardinal Honeyeater (Myzomela cardinalis) were detected in small numbers. The Purple Swamphen (Porphyrio porphyrio) and Banded Rail (Gallirallus philippensis) were most often detected in areas close to villages and agroforestry plantations. The Blue-crowned Lorikeet (Vini australis) and Fiji Shrikebill (Clytorhynchus vitiensis) occur specifically among the Manu’a Island Group (which includes Ta’u). The former was detected in most survey areas and the latter was patchily distributed in the unit. The Many-colored Fruit-dove (Ptilinopus peroussi), a species of concern, was detected in very small numbers in both units. The Spotless Crake (Porzana tabuensi), which is extirpated on Tutuila Island, was not detected during our survey and remains a species of concern. Densities of most species were higher in the Tutuila unit than on Ta’u, where forests may still be rebounding after hurricanes in 2004 and 2005. Population estimates from our surveys were similar or higher than previous island-wide surveys. NPSA canopy and understory composition was predominantly native, and trees formed a dense closed canopy at nearly 90% of the stations sampled. NPSA continues to harbor an abundant and diverse avian community. We expect most populations to remain stable in the park; however, more information is needed to determine status and trends of rare species in American Samoa and additional protection may be warranted.

**P-14 Territory Selection by Puaiohi: Influence of Food Abundance, Nest Sites, and Forest Composition and Structure**

Lauren Solomon¹, Lisa Crampton¹, Ruby Hammond¹, Pauline Roberts²

¹Kauai Forest Bird Recovery Project, Hanapepe, HI, USA, ²Sapphos Environmental, Inc., Pasadena, CA, USA

The critically endangered Puaiohi, Myadestes palmeri, is the only extant frugivorous songbird native to Kaua‘i. Facing myriad anthropogenic threats, and thought to number only a few hundred individuals, it is confined to the remote Alaka‘i Wilderness above 1000-m elevation. Breeding pairs establish territories along deeply incised streams and typically nest on steep cliffs along these streams. The relative influence of topography, vegetation, food and availability of suitable nest sites on Puaiohi space use and distribution is unknown. We located nests from 2007-2011 and spot-mapped territories from 2009-2011 along two streams and evaluated the distribution of cliff walls, food and vegetation within used (territories) and unused sections of streams. The number (range 18-22) and location of territories was similar among years, and nests (N=87) and nest walls (N=48) were often reused. Our results suggest that Puaiohi prefer larger nest walls; walls with nests were significantly taller (12.9 ± 5.6 m) than walls without nests (P=0.02) and walls with nests used multiple times were larger than walls with nests used once. We surveyed food and vegetation in 2010 at 35 plots (18 inside territories, 17 in unused areas) and initial results suggest that fruit of two species (Leptecophylla tameiameiae and Broussais arguta) influence territory distribution. We discuss how such preferences restrict use of streams outside their current range and assess implications for management, including suitability of release sites for future Puaiohi translocations.
P-15 Seabirds as Ecosystem Service Providers: Allochthonous Nutrients Effects on Plant Communities and Soil in Hawai‘i.
Julia Rowe, Creighton Litton, Chris Lepczyk
University of Hawaii at Manoa, Honolulu, HI, USA

Historically seabirds were found in Hawai‘i across all islands and in diverse habitats ranging from the mountains to the coast. Their current range has been reduced to inaccessible cliff areas on five of the main islands. What ecosystem services do seabirds provide? How does their loss impact the ecosystems that they used to occupy? Seabirds are substrate engineers, depositing marine phosphorous (P) and nitrogen (N) to land through guano and other organic material. This nutrient input, in turn, is likely to be an important driver of ecosystem productivity and plant community composition. While similar research has been conducted in other island ecosystems these factors have not been assessed for Hawai‘i and they may differ significantly between island systems. Soil pH, soil and foliar N and P content, and foliar δ15N stable isotope composition from three areas (abandoned and current seabird colonies as well as historically non-seabird areas) will be assessed, and vegetation surveys of plant composition and cover will be quantified to assess the level of impact extant seabird colonies have on plant community structure. I will address community and ecosystem ecology level questions, including: How do seabird derived nutrients, along with their loss, affect plant species richness, the abundance of plant taxa of conservation concern, and the presence and success of nonnative plants. This assessment of seabirds’ ecological roles will provide a greater understanding of the vital role of seabirds in Hawaiian ecosystems as well as inform our sea bird conservation strategies and native forest restoration efforts.

P-16 50 Years of Collaborative Nēnē Management: Successes, Challenges and Lessons
1USFWS, Honolulu and Hawai‘i Is., HI, USA, 2National Park Service, Hawai‘i Is. and Maui, HI, USA, 3State Division of Forestry and Wildlife, Hawai‘i, USA, 4San Diego Zoo Institute for Conservation Research, Volcano, HI, USA

The endangered nēnē, Hawaii’s State Bird, was once nearly extinct but now has populations established State-wide. From an estimated wild population of less than 30 birds in the 1960s, nēnē numbers are now at approximately 2,500 wild individuals. The Nēnē Recovery Action Group (NRAG) is a team of biologists and managers from different government and non-government organizations. Together, the team has shown success such as maintaining existing populations and establishing new populations. Along with success come challenges such as human-nēnē interactions, losing captive propagation as a tool for maintaining nene populations, and the effects of windmills on this endangered species. With all of the successes and challenges, lessons on collaboration, nēnē biology, and politics help lead the team toward future nēnē management.

P-17 Comparing mtDNA diversity in the Kiwikiu (Pseudonestor xanthophrys) and the Maui ‘Alauahio (Paroreomyza montana)
Peter Motyka1, Hanna Mounce1, David Leonard2, Jim Groombridge3
1Maui Forest Bird Recovery Project, Makawao, HI, USA, 2Pacific Coorperative Studies Unit,
On the island of Maui, there are two extant insectivorous honeycreepers, the endangered Kiwikiu (*Pseudonestor xanthophrys*) and the Maui ‘Alauahio (*Paroreomyza montana*). Both have undergone similar historic range contractions and now occupy 40-50 km² on East Maui. The current Kiwikiu population is estimated at ~500 individuals while the Maui ‘Alauahio is estimated at >10,000. Differences in life history may likely explain the smaller remnant population of Kiwikiu and why Kiwikiu, at a more eminent risk of extinction, are more endangered than the ‘alauahio. For the former species, genetic factors may increase extinction risk. Using control region sequence data, we compared mtDNA diversity within these two endemic birds to evaluate the genetic diversity in two species that have undergone similar environmental constraints. We identified 14 haplotypes in the Maui ‘Alauahio (Hd = 0.901 ± 0.032; \(\pi\) = 0.006) and only 3 in the Kiwikiu (Hd = 0.382 ± 0.50; \(\pi\) = 0.001). While correlations between population size and genetic diversity in wild populations are expected, these species presumably suffered a similar scale of habitat loss yet the magnitudes of the effects on each were quite different. We attribute these differences largely to differences in population size and extent of recent population decline in the Kiwikiu, but other factors such as the time that each species has had to accumulate genetic diversity (‘alauahio arising approximately a million years before the Kiwikiu) and overall species fecundity (‘alauahio fledging twice as many chicks per year as Kiwikiu) may also have played a role.

**P-18 Nectar-mimic Feeding Rates and Assimilation in a Captive Hawaiian Forest Bird**

Mark K. Kapono¹, Paul C. Banko²

¹Hawai‘i Cooperative Studies Unit, Pacific Aquaculture and Coastal Resources Center, University of Hawai‘i at Hilo, Hawai‘i National Park, HI, USA, ²U.S. Geological Survey, Pacific Island Ecosystems Research Center, Hawai‘i National Park, HI, USA

To investigate the feeding ecology of Hawaiian forest birds, we explored nectar characteristics of several endemic and introduced flowers. Earliest appraisals indicated a dichotomy in nectar use by pollinating birds based on sugar carbohydrate profiles of the nectars. Long-tube corollas with protected nectaries and sucrose-rich nectars were aligned with hummingbirds, whereas open flowers with unprotected nectaries and hexose-rich nectars were associated with passerines. Others have shown that sugar carbohydrate profiles of endemic nectars tend to be hexose-rich. High-performance liquid chromatography (HPLC) analyses of heavily-exploited nectars indicated that the endemic ‘ōhi‘a (*Metrosideros polymorpha*) was hexose-rich, invasive banana poka (*Passiflora mollissima*) was sucrose-rich, and the endemic māmane (*Sophora chrysophylla*) contained similar proportions of fructose, glucose, and sucrose. To determine preferences for nectars of different compositions, we conducted side-by-side choice feeding trials in which captive Hawai‘i ‘amakihi (*Hemignathus virens virens*), an endemic Hawaiian honeycreeper, were offered nectar-mimics compounded using published data and results of our HPLC analyses. Our results revealed relatively high consumption of sucrose-rich nectar-mimics when paired with hexose-rich nectar-mimics. Additionally, using a commercially available blood glucometer, we determined that our experimental birds assimilated the metabolically active glucose, presumably through hydrolysis of the sucrose present in the nectar-mimics. Therefore, at least some Hawaiian honeycreepers readily accept and assimilate sucrose-rich nectars. Additional trials may help explain the strong attraction of māmane nectar to various honeycreepers and identify potential physiological constraints in native birds. Detailed knowledge of the interactions...
between nectar-producing plant species and the birds that pollinate them may aid conservation planning.

**P-19 Accurate Estimation of the Abundance and Population Sizes of the Critically Endangered Nihoa Millerbird and Nihoa Finch.**

Marcos Gorresen\textsuperscript{1}, Richard Camp\textsuperscript{1}, Kevin Brinck\textsuperscript{1}, Chris Farmer\textsuperscript{2}, Michelle Reynolds\textsuperscript{3}

\textsuperscript{1}Hawai‘i Cooperative Studies Unit, University of Hawai‘i at Hilo, Hawai‘i National Park, HI, USA, \textsuperscript{2}American Bird Conservency, Hawai‘i National Park, HI, USA, \textsuperscript{3}U.S. Geological Survey, Pacific Island Ecosystems Research Center, Hawai‘i National Park, HI, USA

Reducing extinction risks to the endemic Nihoa Millerbird (\textit{Acrocephalus familiaris kingi}) and Nihoa Finch (\textit{Telespiza ultima}) requires understanding these species’ abundances so as to project future trends in population size, evaluate the potential impact of translocation, and prioritize management actions. However, the current survey protocol, based on a fixed-width strip-transect method, has produced a wide range of annual population estimates for both species and made timely status assessments problematic. For example, the estimated mean Millerbird population has varied widely from a low of 31 birds to a high of 814 birds over the past 20 years. In 2010 and 2011, a point-transect survey method that uses a variable distance was tested as an alternative approach to estimating bird density. Results show that the point-transect method was more efficient than was the strip-transect method in that it yielded an eight-fold and a four-fold increase, respectively, in the number of Millerbird and Finch detections relative to survey effort. Additional benefits of the point-transect method are that they allow for modeling covariates of interest (e.g., vegetation type) and handling nuisance variables (e.g., observer error). For example, modeling showed that birds behind an observer were attracted and birds in front of an observer were pushed away relative to the direction of travel. Such behavior cannot be modeled from strip-transect data, but can be with the point-transect method, thereby yielding more accurate estimates of bird abundance.

**P-20 Conservation of Seabirds on Kaua‘i: Collaboration and Partnerships for the Future**

Brooke McFarland, André F. Raine

\textit{Kaua‘i Endangered Seabird Recovery Project, Hanapepe, HI, USA}

The Kaua‘i Endangered Seabird Recovery Project (KESRP) focuses on the conservation of rare and endangered seabirds on the island of Kaua‘i, specifically Newell’s Shearwater (\textit{Puffinus newelli}), Hawaiian Petrel (\textit{Pterodroma sandwichensis}) and Band-rumped Storm-Petrel (\textit{Oceanodroma castro}). Ensuring the long term survival of these species requires a complex approach, which includes filling knowledge gaps on distribution, assessing the effectiveness of various management practices, developing new techniques to augment existing populations and undertaking outreach to inform the local community about relevant conservation issues. To advance these goals, which span multiple property boundaries, partnerships have been developed with state, federal, non-profit, university, private and commercial organizations. Data collection, which provides a vital component in the creation of effective management plans, has been conducted with partners at land-management agencies, universities and with private entities. These relationships have also allowed for the development of novel survey methodologies, additional ways to express project outputs, and the facilitation of large scale conservation measures such as social attraction and translocation. Lastly, an integral aspect of conservation is community outreach to increase public awareness and support for the conservation of these species. This can most effectively be achieved in tandem with local schools.
and organizations such as the Save Our Shearwater Program, the National Tropical Botanical Garden and Island School. Developing these diverse and dynamic partnerships provides the best opportunity to further conservation goals and ensure the long-term survival of these species.

**P-21 Shorebird Protection Strategies to Minimize Non-target Mortality during a Rat Eradication at Palmyra Atoll National Wildlife Refuge**

James Breeden¹, Lesanna Lahner², Renee Breeden³

¹U.S. Fish and Wildlife Service, Honolulu, HI, USA, ²Seattle Aquarium, Seattle, WA, USA, ³U.S. Geological Survey, Honolulu, HI, USA

Palmyra Atoll National Wildlife Refuge is located in the Northern Line Islands, 1,000 nautical miles south of Honolulu and provides extensive foraging habitat for shorebirds. In order to minimize non-target mortality, the rat eradication was performed in June while the majority of adult shorebirds are in their Alaskan breeding grounds. In addition to the timing of the project, a species listed as “high concern”, U.S. Shorebird Conservation Plan, the Bristle-thighed curlew (*Numenius tahitiensis*), was captured using novel capture techniques and successfully held in captivity for 3 months to prevent bait exposure.

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**CLIMATE CHANGE**

**P-22 Seabird Vulnerability to Climate Change in the Northwestern Hawaiian Islands: A Focus on Two Species at Midway Atoll**

Karen Courtot¹, Michelle Reynolds¹, Paul Berkowitz², Crystal Krause¹, Elizabeth Flint³

¹U.S. Geological Survey, Pacific Island Ecosystems Research Center, Hawai‘i National Park, HI, USA, ²Hawai‘i Cooperative Studies Unit (PACRC, UH Hilo), Hawai‘i National Park, HI, USA, ³U.S. Fish and Wildlife Service, Pacific Reefs National Wildlife Refuge Complex, Honolulu, HI, USA

As part of Papahānaumokuākea Marine National Monument, the Northwestern Hawaiian Islands (NWHI) provide protected nesting habitat for a large assemblage of tropical seabirds. The small low-lying islands of the NWHI are, however, especially vulnerable to the effects of climate change such as sea-level rise (SLR), severe storms, and washover events. Rapid SLR from climate change could lead to a reduction of island size and habitat loss, shrinking already limited habitat for the millions of seabirds that nest in this region. In this study, we developed an index to evaluate the relative vulnerability of seabird species nesting in the NWHI to negative climate change impacts at the breeding colonies. To develop the index we used nine factors, derived from species’ attributes, such as temporal overlap with storm season, flexibility in habitat use, and conservation status. Factors were scored on a three-point scale and organized into three groups for evaluation: 1) exposure to negative climate change impacts, 2) adaptive capacity, and 3) population status. Species varied greatly in their vulnerability to increased threats from climate change. We further evaluated exposure to climate change impacts for two species at a globally important colony, the Laysan albatross (*Phoebastria immutabilis*) and Bonin petrel (*Pterodroma hypoleuca*) at Midway Atoll. Using nesting distribution and abundance data, in combination with spatially explicit predictions of inundation and habitat loss, we assessed the impact of a range of SLR scenarios (+0.5 m - 2.0 m) on these populations and their nesting habitat at Midway Atoll.
P-23 Water, Water, Everywyere: The Effects of Predicted Sea Level Rise in Hawai‘i
Patrick Myles Walsh
*University of Hawai‘i at Hilo, Hilo, USA*

How will Hawaii’s low-elevation areas and natural fresh water resources be affected by sea level rise due to the eminent effects of the changing climate? This project synthesizes information from a variety of scientific assessments and recently published research to summarize what is known about the observed and projected effects of climate change to the islands of Hawai‘i. Specifically focusing on the effects resulting from the combination of long-term sea level rise, normal seasonal heating (which causes the volume of water to expand and thus the level of the sea to rise) and how this will affect the islands of Hawai‘i. Utilizing Digital Elevation Models and Satellite Imagery combined with Geographical Information Systems to produce statistical and visual interpolation for the islands of Hawai‘i through the next 50-100 years.

P-24 A Comparison of Different Carbon Credit Systems in the Voluntary Market for Potential Use in Hawai‘i
Elizabeth Boxler0, Melissa Sprecher0, Sheri Mann0, Creighton Litton0
1University of Hawai‘i at Mānoa, Natural Resource and Environmental Management, Mānoa, HI, USA, 2Department of Land and Natural Resource, Division of Forestry and Wildlife, Honolulu, HI, USA

Within the past 30 years the scientific community has become increasingly aware of how humans are altering global climate through the emission of atmospheric greenhouse gases like CO2. One proposed solution to this problem is carbon credit trading, where environmentally concerned individuals or corporations that emit greenhouse gases pay other corporations to reduce their greenhouse gas emissions through improved technology or to sequester carbon through activities such as reforestation. The Kyoto Protocol requires signers to return their greenhouse gas emissions to 1990 levels by 2012 (United Nations 1998), and carbon trading is one option to help achieve this goal. In addition, there is emerging recognition of carbon market opportunities for countries like the United States that did not sign the Kyoto Protocol, and companies and individuals there are taking the initiative to engage in voluntary carbon trading. There are many different methods of verifying and validating carbon credits that are sold on the voluntary market, which may or may not be appropriate in certain situations. In addition, different carbon trading organizations only recognize certain types of projects. This study was conducted to compile information on five common voluntary carbon credit systems for potential use in Hawai‘i. Specifically, we attempted to make this information available in an understandable format to assist individuals or corporations to easily compare advantages and disadvantages of each system in either buying carbon credits on the voluntary market or selling carbon credits through specifically forest projects that sequester carbon.

P-25 Insect Emergence Across a Precipitation Gradient in Hawaiian Streams: Potential Effects of Climate Change on Terrestrial Food Resources
Therese Frauendorf1, Richard MacKenzie2, Ayron Strauch1, Greg Bruland1
1University of Hawai‘i at Mānoa, Honolulu, HI, USA, 2Institute of Pacific Islands Forestry, Pacific Southwest Research Station, USDA Forest Service, Hilo, HI, USA

Climate change is expected to influence structure and function of watersheds; yet measuring these effects is difficult and predictive model systems are rare. Aerial adults of aquatic insects
are important indicators of ecosystem change and an important link between terrestrial and aquatic systems as they facilitate flow of energy and nutrients between the two. As a result, adult aquatic insects are expected to be an important food source for many endangered and endemic animals (e.g., Hoary bat, Hawaiian thrush, Hawaiian moorhen). Few studies have examined seasonal patterns and impacts of climate change on insect emergence. I will present results from a recently initiated study comparing abundance, biomass, and diversity of aquatic insect emergence across four headwater streams that vary in flow and are located across a precipitation gradient (<3500 – 7000 mm/yr) along the Hamakua coast of Hawai‘i Island. These parameters will also be compared to temperate systems to see how the Tropics might differ. At each stream three conical traps will be deployed bimonthly in each dominant habitat (plunge pools, riffle/runs, and side pools) for a period of 14 days. Insects will be identified to the lowest feasible taxonomic level, dried, weighed, and expressed as emergence production (g dry mass/m²/d). Emergence, abundance, and biomass is predicted to increase with increasing rainfall, since rainfall will lead to higher flow, increasing wetted habitat and nutrient supply, forcing larvae to emerge. Such changes may have important implications on the presence of endangered species as well as other endemic predators in Hawai‘i.

P-26 Stream Flow and Grazing Impact Biofilm Growth in Hawaiian Streams
Patra Foulk¹, Ayron Strauch², Ralph Tingley³, Richard MacKenzie⁴
¹University of Hawai‘i Hilo, Hilo, HI, USA, ²University of Hawai‘i Mānoa, Honolulu, HI, USA, ³Michigan State University, East Lansing, Michigan, USA, ⁴US Forest Service Institute of Pacific Islands Forestry, Hilo, HI, USA

The importance of benthic biofilm in temperate streams has been well documented, yet few studies have focused on its role in tropical stream function. Endemic tropical algal communities support high levels of biodiversity, regulate nutrient dynamics, and potentially provide food for native shrimp. These algal communities and the services they provide may be threatened by altered stream flow resulting from human activities and climate change. Understanding how benthic biofilm responds to changes in stream flow and the role it plays in food webs will provide insight into how changes in stream flow will impact stream ecosystems and influence watershed management decisions. Benthic biofilm response to changing stream flows (bottom-up control) and grazing by an endemic macroinvertebrate assemblage (top-down control) were examined using exclusion experiments in 3 streams that vary in flow on Hawai‘i Island, Hawai‘i. Preliminary results from mesh exclusions show that algal response to flow and grazing were both significantly higher in the stream with intermediate flow. Electric exclusion experiments and stable isotope analyses are being conducted in support of these findings to shed light on the impact of changes in biofilm on food web structure. Lower responses in the high and low flow streams suggest that changes in stream flow that may result from climate change will significantly impact algal communities in Hawaiian streams.

P-27 Three Mountain Alliance Watershed Partnership: Forest Restoration at Keauhou Ranch
Lauren Solodky, Karin Schlappa
Three Mountain Alliance, Volcano, Hawai‘i, USA
What was once logged of the largest Koa trees, and used as a cattle ranch for over a hundred years, has become the main restoration site for the Three Mountain Alliance (TMA) Watershed Partnership. Keauhou Ranch, one of the larger land areas owned by Kamehameha Schools rests in the Kau districts on Hawai‘i Island with both wet and dry climates. With many hands from staff and student volunteer groups, all seeds are collected locally. TMA shares a greenhouse with our partner agency, Hawai‘i Volcanoes National Park, where seeds are sown, germinated, and transplanted into their pots. Management of seedlings consists of watering, fertilization with organic locally-made products, pesticide application, and sanitation. When plants are ready for the soil, volunteer groups ranging in age and experience donate their time to give back to the watershed. An opening Hawaiian chant welcomes the land with the people, and brings awareness to the wao akua. A discussion follows to reflect on what a Hawaiian forest is and our connection to it as people living in Hawai‘i. Per visit, anywhere from 50-300 native seedlings find homes in the 18-acre site depending on group size and time allowance. Photo points, GIS data, and records of species outplanted help to document the recovery of this sacred land. Thousands of native canopy and understory plant species have been outplanted since TMA started this reforestation project. With the help of partner agencies, volunteers, and staff, the landscape of pasture is returning to its native roots.

P-28 Restoration Model for Lowland Wet Forests of Hawai‘i

Cindy Jaya Dupuis

University of Hawai‘i, Hilo, HI, USA

Background/Question/Methods: The Hawaiian Islands, with their high degree of endemism, have been greatly altered by introduced species, resulting in transformed vegetation communities and a loss of endemic taxa. The Easternmost part of the Big Island contains some of Hawai‘i’s last remnants of lowland wet forests (LWF). The goal of this project is to provide a baseline from which precise and effective restoration strategies may be implemented. An extensive vegetation survey was conducted throughout the lower elevation (<300m) region of East Hawai‘i with a focus on its five forest reserves. Plots were stratified to represent combinations of variables including substrate age (<200yrs, 200-750yrs, 750-1500yrs), and elevation (0-100m, 101-200m, 201-300m). A hierarchical sampling approach was used to survey different aspects of vegetation. A basic assessment was conducted for all plots, in which canopy cover of native and non-native tree species >3 meters in height was estimated. When native canopy relative cover was greater or equal to 66.6%, or when rare species were encountered, a detailed assessment was conducted.

Results/Conclusions: A total of 325 plots have been completed throughout all five forest reserves. Preliminary analysis suggests significant trends in the distribution of vegetation according to substrate age in LWF of East Hawai‘i. The average number of native species was greater on the middle aged substrate of 200-750yrs (3.19spp) than on the younger substrate of <200yrs (1.85spp.) and on the older substrate of >750yrs (1.79spp.). Percent cover of native species was also greater on the middle aged substrate of 200-750yrs (90%) compared with younger and older flows (56% and 70% respectively) Native species represent 59%, 65% and 43% of the vegetation’s average relative cover according to increasing substrate age. Also, the relative cover of native tree species progressively increases with elevation (48%, 56% and 64%). Percent cover of native tree species at lower elevations within the lowland region reaches a high of 89% between 201-300 meters compared to 72% at <100m and 58% between 101-200m. All 34 rare species’ locations were found entirely on the 200-750yrs substrate. Relative percent cover of native tree species surrounding rare plants was 66% compared with 56% in
systematically located plots without rare species. Percent cover of native trees surrounding all rare plants found was 94% while non-native tree cover made up 47%. The findings of this research indicate suggestive trends which could enlighten the motions of restoration.

P-29 Restoration at Waikoloa Dry Forest

Jen Lawson¹, Jake Henry²

¹Waikoloa Dry Forest Initiative, Waikoloa, HI, USA, ²Cornell University, Ithaca, NY, USA

The Waikoloa Dry Forest (WDF) on Hawai‘i Island has been cared for by a grassroots organization of people from the Waikoloa Village community since 2003. Today, the Waikoloa Dry Forest Initiative (WDFI) manages these 275 acres of remnant lowland dry forest by excluding feral ungulates, controlling invasive species maintaining fuels and propagating and planting common and rare native species. The WDFI also encourages participation in the forest through the Waikoloa Future Foresters children’s program, and collaborations with outside organizations such as local school groups, university students and researchers. With a budget of less than $100,000 a year partnerships and volunteers are invaluable. At the WDF some of our most productive work days, valuable research and successful endeavors are largely due to outside organizations lending a hand, donating time and supplies or collecting and supplying data. The restoration of this driest of Hawaiian tropical dry forests will take many years and the cooperation of many groups. Here we share some updates on our progress, the results of some of our partnerships and some of our plans for the future.

P-30 The Potential for Restoration to Break the Grass / Fire Cycle in Dryland Ecosystems in Hawai‘i

Susan Cordell¹, Greg Asner², Jarrod Thaxton³, Erin Questad⁴, Jim Kellner⁵, Kealoha Kinney⁵, Mark Chynoweth⁶, Samuel Brooks¹, Amanda Uowolo¹

¹USDA Forest Service, Pacific Southwest Research Station, Hilo, HI, USA, ²Carnegie Institution for Science, Stanford, CA, USA, ³University of Puerto Rico – Mayaguez, Mayaguez, Puerto Rico, ⁴California State Polytechnic University – Pomona, Pomona, CA, USA, ⁵University of Maryland, College Park, MD, USA, ⁶University of Hawai‘i - Mānoa, Mānoa, HI, USA

Tropical dry forests in Hawai‘i are declining at alarming rates, largely a result of fire that originates with invasion of native ecosystems by fire-prone invasive grasses and shrubs. These novel fire regimes have serious impacts to cultural and natural resources, and the health and safety of the region's citizens. We hypothesize that native ecosystem preservation and restoration may be the most cost-effective management tools to reduce fuel loads, fire danger, and fire impacts while also controlling invasive species establishment and spread. We have combined newly developed remotely sensed information with field-based studies on the Island of Hawai‘i to: 1.) define the current condition and historical changes to tropical dry forests, 2.) develop technology for restoration planning and ecosystem monitoring, 3.) quantify restoration potential and develop restoration prescriptions for remnant dryland ecosystems, and 4.) develop effective fire risk reduction measures that protect forest fragments and initiate succession of degraded grasslands into native woody communities. Remotely sensed data has provided insights on historical dryland communities, aerial photography analysis reflects forest change over time, high-resolution ecosystem mapping has informed restoration planning efforts, and near real time web based satellite monitoring provides land managers an effective tool to evaluate fire danger. Field-based methods will address the potential for restoration of native species to alter ecosystem structure to reduce fuel loads and fire danger, the major barriers to restoration across remnant...
P-31 Effect of *Batis maritima* (Pickleweed) Removal Method, Weeding and Watering on the Survival and Growth of Native Plant Species at a Coastal Wetland in Hawai’i

Shahin Ansari, Tiffany Thair

*SWCA Environmental Consultants, Honolulu, HI, USA*

Most wetland research in Hawai’i has focused on understanding the life history and habitat use of endangered Hawaiian waterbirds. Much less attention has been given to developing restoration techniques for wetland plants. Records of success and failure of native wetland plant restoration efforts are largely anecdotal. Ahua Reef at Hickam Air Force Base, O’ahu, is a 1.6 hectare degraded coastal wetland largely invaded by *Batis maritima* (pickleweed). We investigated how different *B. maritima* control methods (herbicide versus mechanical removal) affect the survival and growth of five native wetland plant species: *Cyperus javanicus*, *Cyperus polystachyos*, *Fimbristylis cymosa*, *Lycium sandwicense* and *Sesuvium portulacastrum*. Within a randomized experimental block design, 1440 seedlings (288 individuals/species) were outplanted in December 2011. Preliminary results indicate that the percent cover of re-invaded *B. maritima*, three months after treatment, was significantly greater in manually removed *B. maritima* squares (6.6%) than squares treated with herbicide (1.9%). Removal treatment type did not affect the initial survival of the native species, except for *L. sandwicense*, which showed greater survival in the manually removed (97.5%) than herbicided squares (82.7%). Compared to manual removal of *B. maritima*, herbicide application appears to lower the initial rate of *B. maritima* re-invasion; however, herbiciding may decrease survival for some native outplants. During the course of this study, the native outplants will also be subjected to various weeding and watering treatments. Study results will contribute to the long-term conservation and management of Ahua Reef and potentially guide other coastal wetland projects in the Pacific Island region.

P-32 A Hot Water Root Dip as a Pre-Plant Procedure to Help Assure Land Managers that Plant Recovery Efforts on Their Lands are Safe and Clean for Reintroduction

Douglas Okamoto0, Nellie Sugii0, Adam Williams0

1Harold L. Lyon Arboretum; University of Hawai’i, Honolulu, Hawai’i, USA, 2Native Ecosystem Protection and Management; DOFAW, Honolulu, Hawai’i, USA

As a conservation program develops and ages, new problems arise and need to be dealt with. In the area of the horticulture of native plants for the purpose restoration these problems are usually in the form of a new pest or disease that has been introduced to the State or a new awareness of a pest that has been around in the past. Problems involving the above ground parts of a plant are usually visually evident and can be dealt with. Problems with the below ground parts of a plant can present many problems. Recent findings of several species of small invasive snails that inhabit the soil or media and a growing awareness of the problems that root mealybugs presents to plants in the nursery and in the wild has made it necessary to find a new strategy to deal with these pest before a plant is outplanted. We are evaluating the procedures put forth by the University of Hawai’i College of Tropical Agriculture and Human Resources of a hot water dip for root mealybug control. We are testing native plant tolerances to the hot water dip procedure to see if it can be used without negative effects to plants that are intended for outplanting. We are also evaluating the effects of this procedure on the control of invasive snails.
P-33 An Environmental Education Management Strategy for Effective Rainforest Conservation of Mānoa Falls Trail, O‘ahu
Mojca Stubelj Ars¹, John Cusick²
¹University of Nova Gorica, Nova Gorica, Slovenia, Slovenia, ²University of Hawai‘i Mānoa, Honolulu, Hawai‘i, USA

Increased use of Manoa Falls Trail, a commercial trail located close to the Waikīkī resort district, has led to environmental degradation, compromising ecosystem services and hiker safety. The purpose of this study is to assess the status of the trail, compare it with data from a 2001 survey, and provide Na Ala Hele State Trails Program resource managers with support for decision making towards effective management of the rainforest ecosystem and trail system. A survey of 785 hikers was conducted in January 2012 composed of questions focused on the following themes: hiker perception of and satisfaction with the trail, assessment of sustainability and environmental awareness, individual behaviors and practices related to sustainability, and demographic data. This presentation reviews the results of the survey and discusses options for consideration by Na Ala Hele trail managers to minimize environmental degradation, particularly soil erosion due to average use by 300-500 daily and 120,000 hikers a year. Preliminary results indicate willingness to pay a $5 fee, an interest in environmental education resources, particularly related to biodiversity conservation, cultural history and minimizing current impacts. The innovative use of posted signs, informational tables, and viewing stations, would improve educational experience of hikers. A strategy to improve environmental education and awareness is presented. The authors discuss current environmental, social and economic impacts of trail use and the efforts to lower the number of visitors and to secure funds for trail maintenance and ecological restoration of a high-demand tourist destination on O‘ahu.

P-34 COSEE (Centers for Ocean Science Education Excellence) Island Earth: Enhancing Ocean Literacy for Hawai‘i
Carlie Wiener, Judith Lemus
Hawai‘i Institute of Marine Biology, University of Hawai‘i Mānoa, Kāne‘ohe, HI, USA

This presentation will provide an overview of a new COSEE (Centers for Ocean Science Education Excellence) program specifically designed to meet the needs of resident and visitor populations in Hawai‘i. COSEE Island Earth is a three-year NSF (National Science Foundation) funded program which is part of the large COSEE networks, with 14 sites in total. This Hawai‘i based center has been created to provide a state-wide hub for integrating sciences and education through community outreach and resource networks for the marine sciences. COSEE Island Earth’s goals and specific projects will stress science and ocean literacy principals that are applicable and specific to the needs of Hawai‘i residents. Special emphasis on connecting modern research with traditional knowledge, and ocean management and policy will be highlighted emphasizing how science can be communicated to different community groups in our islands. Student-centered learning will be an integral part of the COSEE Island Earth objectives, using fellowships and symposia to bridge formal and informal education.

P-35 Broadening The Spectrum: Methods to Engage Community in Hawaii’s Environmental Conservation Efforts
Sui-Lan Ho‘okano, Ho‘oululahui Erika Perry, Noelani Puniwai, Ulu Ching  
University of Hawai‘i at Hilo, Hilo, HI, USA

In an effort to broaden the level of community engagement, the Pacific Islands Programs for Exploring Science has developed a variety of community and K-12 STEM initiatives. These efforts include: community events, youth programs, providing engaging natural science activities within DOE classrooms and A+ afterschool programs, field trips, classroom resources, and teacher workshops. The experiences are designed to develop interest, nurture curiosity, ingrain a deeper understanding and respect for Hawaii’s unique ecosystems within our communities, increase the interest of our youth in natural science careers, and connect the broader community to natural resource management efforts and conservation challenges. Impact on participants is measured via questionnaires completed by the individual at the end of the experience (or during the community event). For example, participants in a 2011 one-week summer camp, Manowai o Hanakahi, were educated about land and sea connectivity, coastal and marine resources, and traditional and modern approaches to resource management. Additionally, as part of the place-based pilot program, members’ gained experience with modern and traditional protocols, tools and methodologies considered routine within the disciplines. Post-program assessments completed by the middle school participants indicate that after their 1-week experience: 95% felt science was now more interesting to them; 95% said science seemed more fun than before; 90% had increased confidence in their ability to do science; 95% felt their knowledge of science was enhanced, and 81% said the idea of a science career seemed more possible. These and other results will be presented and discussed.

FOREST HEALTH & MANAGEMENT

P-36 Dirt Bike Erosion Sampling: Using a Condition Class Method to Estimate Erosion on Trail Systems  
John Comcowich, Jill LaBram  
West Maui Mountains Watershed Partnership, Lahaina, HI, USA

Throughout the ridges of windward West Maui, there is a network of dirt bike trails. Many of the trails extend deep into the heart of the watershed causing massive amounts of erosion leading to terrestrial habitat loss and sediment run off which negatively impacts both riparian and marine ecosystems below. Our goal was to estimate the total amount of soil lost on a particular trail system in Waihe‘e as a result of dirt bike activity. Due to a lack of trail erosion studies of this nature and because the trail system varied greatly in both depth and width along the entirety of the trail, the West Maui Mountains Watershed Partnership developed a condition class sampling method. The trail was broken down into condition classes based on maximum depth and width. Each individual condition class of the trail was then randomly sampled by their measuring cross sections. Some trail sections were too large and varied to fit neatly into a class; these “Super Trail” sections were measured and sampled separately to maintain accurate erosion estimations in highly eroded sections. The condition class sampling method is a way to accurately estimate the total destruction that has been caused by dirt bike activity up to date, with the ability to easily re-sample and compare the volume of soil loss across the landscape. The resulting estimates may be used to inform managers, communities, and agencies and help them work toward solutions that limit erosion which is negatively impacting terrestrial, riparian and marine ecosystems.
P-37 Extant Nectarivorous Honeycreepers Do Not Function as Adequate Pollinators of Clermontia kohalae at its Upper Elevational Limit: Implications for Conservation
Richard Pender
Botany Department, University of Hawai‘i, Honolulu, Hawai‘i, USA

Hawai‘i has undergone wide-scale avian species decline and extinctions since the arrival of humans to the archipelago. This is particularly apparent in forest bird species, and most notably in the Hawaiian honeycreeper lineage. As many as five species of honeycreepers and five species of Hawaiian Mohoidae are believed to have obtained all or most of their diet from plant nectar, and therefore were likely important pollinators. In extant forested habitats, only three specialist nectarivorous honeycreeper species persist, all with restricted ranges. To assess the impacts of this pollinator decline for the bird pollinated Hawaiian lobeliad, Clermontia kohalae, bird and diurnal insect pollinator observations were undertaken using 41 plants at this species’ upper altitudinal distribution on Kohala Mountain, Hawai‘i. Two honeycreeper species, ‘i‘iwi (Vestiaria coccinea) and Hawaii ‘amakihi (Hemignathus virens), rarely visited the flowers of C. kohalae. In almost all cases, these potential pollinators nectar robbed the flowers from the base of the perianth. Diurnal insect visitors were also extremely rare and are unlikely to act as substitute pollinators. Manipulative pollination treatments indicate that C. kohalae has evolved a mixed-mating system whereby selfing (autogamy) partially compensates for the lack of functional pollinator activity. However, flowers are significantly pollen limited, producing fewer seeds than they are fully capable of. The reproductive shift from a mix of autogamy/xenogamy to full autogamy, combined with the impacts of pollen limitation, warrant future inbreeding depression and demographic studies in this, and other Hawaiian lobeliad species.

P-38 A Brief Report on the In-Vitro Germination of Ochrosia compta K. Schum. (Hōlei)
Nellie Sugii, Cindy Nose, Peter Wiggin, Douglas Okamoto
Harold L. Lyon Arboretum, University of Hawai‘i at Mānoa, Honolulu, Hawai‘i, USA

Ochrosia compta K. Schum. (Hōlei) is a flowering tree species in the family Apocynaceae, and endemic to the islands of O‘ahu and Moloka‘i. This common species is becoming increasingly rare in its native habitat, with wild populations composed of primarily mature individuals and little natural recruitment. Due to the common status of Ochrosia compta, it is not actively monitored or collected for ex-situ storage and propagation. The recalcitrant nature of Ochrosia compta seeds do not allow for conventional seed storage and previous greenhouse attempts in seed germination have had inconsistent results with low rates (5-10%) or no germination. The purpose of this study was to investigate the feasibility of micropropagation as an alternative means to germinate Ochrosia compta seeds and to develop a suitable, reproducible protocol that can be applied to future submissions, as well as sister Hawaiian species and genera. This report shows positive preliminary findings in the utilization of in-vitro ovulo and embryo culture. For ovulo culture, the embryo with intact endosperm was excised from the seed coat. Embryo culture entailed the complete excision of the embryo from the seed coat and surrounding endosperm. All propagules were plated into petri dishes containing ½ strength Murashige and Skoog medium and grown under the routine light and temperature lab conditions. Germination was observed in both the ovulo and embryo cultures after 3 weeks. Due to the less invasive nature and relatively easy process of the ovulo as compared to embryo treatment, ovulo culture will be pursued in any future research.
MANAGEMENT TOOLS

P-39 Data Management in Support of Conservation Efforts
Karin Schlappa1, Samuel Aruch2
1Three Mountain Alliance Watershed Partnership, Hawai‘i National Park, HI, USA, 2Natural Resource Data Solutions, Haiku, HI, USA

Three Mountain Alliance (TMA) Watershed Partnership lands include 1,116,306 acres under the stewardship of 9 agencies. TMA staff has dramatically increased efforts of weed control, ungulate control, and reforestation over the last 18 years since the partnership started (originally as ‘Ōla‘a Kīlauea Partnership). Conservation and restoration efforts carried out on TMA land require collaboration on localized and landscape scale projects and include a wide variety of tasks, materials, and person hours that need to be tracked for reporting and planning purposes. In response to changed needs for detailed data, TMA has implemented new data management policies that include standardized data collection and data entry procedures. A relational database that is already being used by several land management agencies and non-profit organizations in Hawai‘i was customized for TMA needs. Automated report functions have been set up in the database so that hours worked, weed control areas covered, length of fence inspections, or number of species out-planted can be easily summarized for a chosen time frame or a specific area. Links to a geographically explicit database and customized maps allow for quick visualizations of accomplishments as well as upcoming tasks. This is step one in changes to data management. In the future, we would like to enhance and expand these databases to include additional management activities that would incorporate the efforts of key TMA partners such as The Nature Conservancy (TNC) and the State Division of Forestry and Wildlife (DOFAW).

Erin Zanre, Creighton M. Litton, Christopher A. Lepczyk, Steven Gray, Catherine Chan-Halbrendt, Carl Evensen
University of Hawai‘i at Mānoa, Hawai‘i, USA

Watershed degradation in Hawai‘i represents a shared problem that requires the development of a collective understanding of the issues and meaningful cooperation by stakeholders to address. While there is common interest to improve watershed functioning to ensure the long-term sustainability of essential ecosystem services, watershed management is nonetheless frequently impeded when multiple stakeholders with independent, and sometimes contrasting, interests interact across a shared landscape. To address challenges to watershed management planning in Hawai‘i, fuzzy cognitive mapping (FCM) techniques will be used to model stakeholders’ perceptions of how socio-ecological system dynamics affect their individual land and resource use priorities within a Hawaiian watershed. Connecting local stakeholders’ land and resource use priorities with key watershed management objectives will enable the identification of shared opportunities and/or constraints through engagement of a diverse array of interest groups. This study will elucidate opportunities to better address watershed-scale management goals that necessitate collective, multi-stakeholder involvement. FCMs will also be used to assess the potential effects of different management scenarios to identify those which best balance watershed management goals with the interests of local stakeholders. Furthermore, biophysical and socio-economic indicators of identified opportunities and constraints will be mapped using a spatial statistical approach to enable identification of priority landscape areas for potential...
management focus and/or collaboration initiatives. Collectively, this work seeks to identify the potential benefits of utilizing stakeholder perceptions to inform strategic watershed planning as well as promote a methodology that can facilitate collaborative watershed management efforts under conditions of uncertainty.

P-41 EPSCoR Hawai‘i Scientific Data Management Portal – Managing and Sharing Legacy Datasets
Kohei Miyagi, Michael Best, Asael Temple, Donna Delparte
University of Hawai‘i EPSCoR Cyber Team, Hilo, HI, USA

Currently, many scientific datasets that have been collected over the past 20 years in Hawai‘i are stored on researchers’ local hard drives. These datasets are potentially at risk due to issues with maintenance and backup as well as the possibility of datasets being completely lost as researchers retire. The EPSCoR Hawai‘i Scientific Data Management Portal is a new user-friendly web portal interface to manage and maintain these scientific datasets. It is part of Hawai‘i Geospatial Data Repository and was developed by EPSCoR Hawai‘i Cyber team at University of Hawai‘i at Hilo. The portal provides way to store, search, query and share heterogeneous scientific data sets. The portal allows researchers to freely define data set schema from their traditional spreadsheet data. The technologies used to develop the portal are picked from OSS, open source software, and supports open standards for geospatial information, such as WMS and WFS. The portal supports various file formats for data export that increases compatibility for sharing data sets among multidisciplinary researchers for analysis. The durability of the datasets is backed up by the version control, caching and automated QA/QC. The portal provides a web-based, uniform and intuitive user interface to interact with any type of dataset; including, chart and data comparison/analysis tools that enable users to view and analyze the data on a web browser, without requiring additional software. The EPSCoR Hawai‘i Scientific Data Management Portal provides an efficient way to manage and share data across the state that promotes scientific research in Hawai‘i and beyond.

P-42 Phenological Examination of Acacia koa and the Effectiveness of Systemic Insecticides
Billy Sale¹, Nick Dudley², Tyler Jones², Sheri Smith³, Brian Strom⁴
¹University of Hawai‘i at Mānoa, Honolulu HI, USA, ²Hawai‘i Agriculture Research Center, Maunawili HI, USA, ³USDA Forest Service, Susanville CA, USA, ⁴USDA Forest Service, Pineville LA, USA

Acacia koa (koa) is a culturally and economically important native tree species to the islands of Hawai‘i. Historically, koa has suffered large losses due to land conversion and selective logging. Interest has been generated in the reforestation of Hawai‘i’s landscape with koa, but a high rate of mortality due to koa wilt disease has impeded such efforts. Previous research conducted by Hawai‘i Agriculture Research Center (HARC) has found wilt resistant koa families. These families have been used to outplant seed orchards in Maunawili, O‘ahu, to generate disease resistant seed. However, koa seeds are heavily predated by insects, making them unviable for germination. Predation has been attributed to three primary insects; the koa haole seed weevil, Araecerus levipennis, a bruchid beetle, Stator limbatus, and the koa seedworm, Cryptophlebia illepida. This study will examine the phenology of four families and examine if systemic insecticides are effective in decreasing seed predation. Trees were treated with one of two systemic insecticides; Emamectin Benzoate or Imidacloprid in March 2012, following peak flowering. Progression of seed formation will be followed until August 2012, when samples will
be taken to determine seed predation levels. Seeds will be individually analyzed for insect predation. It is expected that trees treated with insecticides will show a decreased level of predation.

**P-43 Habitat Suitability Modeling for the Restoration of Threatened, Endangered, and at-risk Plant Species in Dryland Ecosystems of Hawai‘i and Southern California**

Samuel Brooks, Erin Questad, James Kellner, Susan Cordell, Kealoha Kinney

1California State Polytechnic University, Pomona, CA, USA, 2USDA Forest Service, Pacific Southwest Research Station, Institute of Pacific Islands Forestry, Hilo, HI, USA, 3University of Maryland, College Park, MD, USA

Outplanting programs for threatened, endangered, and at-risk plant species (TER-S) recovery in dryland ecosystems of Hawai‘i and Southern California have had limited success. Unpredictable annual precipitation patterns, competition with invasive plant species, and poor quality native habitat all contribute to low survival rates. We propose that identifying sites that minimize water stress and thereby enhance plant growth, performance, and survival will significantly improve the recovery of TER-S. We have developed topographic models using elevation measurements from airborne light detecting and ranging (LiDAR) that accurately predict habitat suitability for existing TER-S at the Pōhakuloa Training Area (PTA) in Hawai‘i. Employing topographic models of habitat suitability to guide restoration efforts using a digital terrain model (DTM) with high spatial resolution (< 2m) can define areas of suitable topography for plant restoration by scoring the landscape for the presence of criteria associated with evaporative water stress. The criteria are combined to generate a spatially referenced habitat suitability model (HSM) that can guide field restoration efforts among four suitability classes: no criteria met (Class 0), one criterion met (Class 1), two criteria met (Class 2), and three criteria met (Class 3). In dry ecosystems, these high quality areas are often topographic depressions where soil and water accumulate and where plants are protected from strong winds. This will allow for identifying highly suitable areas of the landscape for outplanting efforts where plant growth, performance, and survival should be greater. We expect this guided approach to reduce the costs of restoration through increased survival rates.

**P-44 Kalaupapa National Historic Park Conservation Baseline Repository (1900-2000)**

Chris Nishioka, Donna Delparte

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

Kalaupapa National Historic Park is an area of spectacular natural features that have been influenced by anthropogenic changes ranging from pre-contact Hawaiian settlements, to isolated colony of Hanson’s Disease patients from 1866 until 1969 and more recently, since 1980, as a National Park. In cooperation between the University of Hawai‘i at Hilo and the National Park Service, a comprehensive spatiotemporal digital data repository for environmental history has been developed in a Geographic Information System (GIS) for Kalaupapa National Historic Park. The digital environmental history has pooled historical datasets in the form of aerial imagery, historic maps and photographs, as well as written sources as appropriate over the past 100 years. This comprehensive database of imagery and maps serves to build a foundation for environmental change analysis and to examine cultural resource vulnerabilities in the face of rapid vegetative changes. The repository provides spatially accurate baseline datasets that can be accessed interactively through popular visual interfaces such as Google Earth, ArcExplorer.
Online, and through Java scripted web pages to provide park personnel with a visual timeline of vegetation changes, to facilitate public awareness and highlight research efforts.

**P-45 Web Soil Survey: A Tool to Support Land Management Decisions**

Tony Rolfses¹, Cynthia Stiles¹, Michael Robotham¹, Jolene Lau¹

¹USDA-NRCS, Pacific Islands Area, Honolulu, Hawai‘i, USA, ²USDA-NRCS National Soil Survey Center, Lincoln, NE, USA

The USDA Natural Resources Conservation Service (NRCS) has been producing soil surveys for over a century throughout the United States, including Hawai‘i and the US-Affiliated Pacific Islands as part of the National Cooperative Soil Survey (NCSS) program. All NCSS soil surveys provide science-based information on the distribution and properties of the soils along with use and management interpretations in tabular and spatial (map) format. Soil survey information is used by land managers, land owners, policy makers, urban planners, students and everyone else in our community who is interested in having more knowledge of the soils under their feet.

Increasing the availability and accessibility of this vast wealth of natural resource information to the public has long been a priority of the NRCS. Traditionally soil surveys have been distributed as hardcopy manuscripts to public and university libraries as well as to local county NRCS and Cooperative Extension offices where they were provided free to the public upon request. With the increasing accessibility and popularity of web-based applications, the agency developed the Web Soil Survey in 2005 to make soil survey information (both spatial and tabular) easily available to anyone with an internet connection. Over six years later, WSS 2.3 receives hundreds of thousands of hits every month. This poster presentation will provide an outline of the major features of Web Soil Survey and the products that are available through the web site. In addition, NRCS staff will be present to provide a live interactive demonstration of the application focusing on issues of particular interest to conference participants.

**MARINE SYSTEMS**

**P-46 Analysis of Habitat Utilization by the Fish-hunting Cone Snail, Conus catus**

Jason Preble, Joseph

Occidental College, Los Angeles, CA, USA

Cone snails (genus *Conus*) are a large group of predatory, marine gastropods and include endemic Hawaiian species. Cone snails utilize specialized radula and venom to subdue their prey (worms, mollusks, or fish). Peptides in *Conus* venom are widely used as reagents in physiological studies and in pharmaceutical drug development because of their potency and selectivity. In spite of this biomedical importance, there is little management of this resource due to limited understanding of cone snail ecology. Our study’s goal is to assess habitat utilization on Kaua‘i by *Conus catus* and other *Conus* species using multi-year data, geographic information systems, and mark/recapture results. The highest densities of fish-hunting cone snails have been observed on marine benches around Poipu. This high density of a normally uncommon category has facilitated research in their ecology, specifically of *C. catus*. The shallow marine bench ecosystem is also amenable to global positioning on a meter/sub-meter scale and this seems to be the first study of its kind for marine invertebrates. Using this novel approach in lieu of traditional transects and quadrats allows for a more complete view of distributions. We are analyzing these field data for patterns that could give insight into how *C. catus* utilizes its habitat and what variations there are over time. We are also looking at morphometric data in order to assess...
growth rates, patterns of larval settlement, and sexual dimorphism. If our protocol is successful, we would like to extend our study to other Hawaiian Islands and elsewhere in the Pacific.

**P-47 Twenty Years of Hawksbill Sea Turtle (*Eretmochelys imbricata*) Nesting Activity on the Island of Maui, Hawai‘i (1991-2010)**

Cheryl King¹, William Gilmartin¹, Hannah Bernard¹, George Balazs²

¹Hawai‘i Wildlife Fund, Pa‘ia, HI, USA, ²National Oceanic and Atmospheric Administration, National Marine Fisheries Service, Honolulu, HI, USA

Critically endangered hawksbill sea turtles (*Eretmochelys imbricata*) predominantly nest on Hawai‘i Island within the Hawaiian Archipelago. Considerably lower numbers also nest on the islands of Maui, Moloka‘i and O‘ahu. Since Hawai‘i and Maui Islands are the only two that have long-term, active nest monitoring programs, the best statewide estimate is at least 100 reproductive females. Hawksbill nesting was first scientifically documented on Maui in 1991, and Hawai‘i Wildlife Fund initiated a community-based effort to systematically monitor these activities in 1996. A total of 62 nests and 51 false crawls were recorded in twenty seasons on eight different Maui beaches. Maui’s number of nests/year ranged from 0-8 (3.1 ± SD 2.7), and the number of females/year ranged from 0-4 (1.4 ± SD 1.1). Individuals laid 1-5 nests/season, with clutch sizes from 116-224 eggs (177.7 ± SD 27.5) for a total of 9,774 eggs. Nest success varied widely, from 0% to nearly 100%. Seven turtles have been tagged since 1997: four at Kealia, two at Kawiliilipoa and one at Oneloa. Five of the seven tagged turtles were fitted with satellite transmitters and their post-nesting foraging areas were found to be within the Main Hawaiian Islands: three off Hawai‘i Island and one each off Moloka‘i and O‘ahu. Due to research and intense protection actions against numerous threats, nesters and hatchlings are surviving, but the population remains small. Hawksbills are a long-lived species so it’s expected that these continued multi-agency conservation efforts will begin to show positive results within the next twenty years.

**P-48 Predictive Dietary Analysis using Stable Isotopes of a Blainville’s Beaked Whale (*Mesoplodon densirostris*) held for Rehabilitation**

Jason Turner¹, Robin Baird², Gregg Levine³, David Schofield³

¹Hawai‘i Cetacean Rehabilitation Facility, University of Hawai‘i at Hilo, Hilo, Hawai‘i, USA, ²Cascadia Research Collective, Olympia, Washington, USA, ³National Marine Fisheries Service, Pacific Islands Regional Office, Honolulu, Hawai‘i, USA

Diets fed to stranded dolphins and porpoises undergoing rehabilitation are typically those that have been developed for captive cetaceans, as many of the same species are involved. However, few studies have investigated diets fed to cetaceans that are rarely kept or rehabilitated, including beaked whales. Here we examine the isotopic signatures ($\delta^{13}C$, $\delta^{15}N$) of standard diets fed captive cetaceans, predicted diets from a single stranded Blainville’s beaked whale, predicted diets of five free-ranging Blainville’s beaked whales, and an assemblage of pelagic squid (N=3) and fishes (N=14) collected from similar habitats in Hawai‘i. On August 16, 2010, a sub-adult male Blainville’s beaked whale stranded on Maui and was transported to the Hawai‘i Cetacean Rehabilitation Facility, at the University of Hawai‘i at Hilo. Based upon existing protocols for beaked whale husbandry, the whale was fed *Loligo opalescens*. Samples of the captive beaked whale skin were collected during husbandry procedures, while skin samples of free-ranging animals were collected using biopsy darts as part of another study. All tissue samples were processed using standard techniques and analyzed using a Sigma Delta V Mass...
Spectrometer. Results indicate that predicted values for captive (-17.5 δ¹³C, 12.4 δ¹⁵N) and free-ranging beaked whales (-19.0±1.9 SD δ¹³C, 14.2±0.9 SD δ¹⁵N), were more like signatures from the pelagic squids Histiooteuthis hoylei and Cycloteuthis akimushkini (-18.1±1.4 δ¹³C, 11.3±2.6 δ¹⁵N) and L. opalescens (-19.4±0.7 δ¹³C, 13.0±0.5 δ¹⁵N) than other captive or opportunistic diets. Data such as these should be considered when developing diets for rarely held cetaceans.

**P-49 Estimating Population Parameters of Hawaiian Spinner Dolphins (Stenella longirostris) in Four Resting Bays on Hawai‘i Island**

Julian Tyne¹, Dave Johnston², Ken Pollock³, Lars Bejder¹

¹Murdoch University, Western Australia, Australia, ²Duke University, North Carolina, USA, ³North Carolina State University, North Carolina, USA

Since the 1980s, concerns have been raised about the extent of water-based tourism targeting spinner dolphins (Stenella longirostris) in their resting habitat off Hawai‘i Island. In 2010, spinner dolphins associated with the Hawai‘i Island were defined as a unique stock and consequently identified as one of the most vulnerable to anthropogenic disturbance. However, no recent abundance estimates have been determined. Therefore a sampling design is being employed to assess the local abundance, distribution and behaviour of spinner dolphins in four resting bays: Kauhako, Honaunau, Kealakekua and Makako Bays. Systematic boat-based photographic identification surveys have been carried out continuously over the past eighteen months following Pollock’s Robust Design (Primary period: each month; Secondary Period: 2-4 consecutive days in each of the four bays). Of the 204 surveys undertaken over 1,850 hours, spinner dolphins were observed on 104 (51%) occasions with group sizes ranging from 6 to approximately 250 dolphins. Preliminary abundance estimate over eight primary periods is 711 (SE ± 11; 95% CI = 692 - 737) spinner dolphins frequenting the study area. The precision of these preliminary abundance estimates will be tested over the next 3 to 5 years of continued data collection. In addition, passive acoustic loggers have been deployed in each bay, recording 30 seconds every 4 minutes with data collected continuously. These acoustic data allow for cross-validation with photographic survey records, and the method of deployment will provide an index of the regularity of dolphin presence in each bay before and after the implementation of time-area closures.

**P-50 Contemporary Levels of Harvest and Perceptions of Change in Abundance of Culturally Significant Macroalgae (limu) on O‘ahu Island**

Georgia Hart¹

¹University of Hawai‘i, Honolulu, HI, USA, ²University of Hawai‘i, College of Pharmacy, Hilo, HI, USA

Native Hawaiian marine macroalgae (limu) are a culturally and biologically significant resource threatened by a host of factors including development, invasive species and commercial harvest. In order to investigate current levels of harvest and to provide insights towards management for cultural value, this study uses ethnographic approaches to address the following questions: (1) How prevalent is limu gathering (harvest) among O‘ahu youth and their families?, (2) What factors predict intergenerational transmission of gathering practice?, and (3) What are the perceptions of the change in the quantity of limu on O‘ahu over time? The prevalence of limu gathering and the factors predicting generational transmission were assessed through surveys of public high school students, and were analyzed using a generalized linear mixed model. Perception of change in limu were examined through student-conducted interviews with limu
gatherers in their community. One-fifth of surveyed students had gathered *limu*, including more than one-third of students reporting Hawaiian ethnicity. Parental gathering was the strongest predictor of student gathering, though Hawaiian ethnicity was also important, particularly for male students. Adult *limu* gatherers consistently reported a decline in abundance of *limu* across several regions on O‘ahu, with the most commonly reported causes being harvest by non-traditional means and pollution. These results provide a baseline estimate of cultural use of important coastal resources and demonstrate the conservation value of the knowledge held by cultural practitioners. Conservation of nearshore ecosystems to promote *limu* would promote transmission of traditional gathering practice, including proper gathering technique, likely contributing to more sustainable harvest.

**RARE PLANT CONSERVATION**

**P-51 Hawaiian Rare Plant Facilities: Growing the State’s Rarest Plants**

Adam M. Williams

*Harold L. Lyon Arboretum, Honolulu, HI, USA,* *Hawai‘i Department of Land and Natural Resources, Division of Forestry and Wildlife, Honolulu, HI, USA*

The Hawaiian Rare Plant Facilities have developed over the last two decades through a multi-agency collaboration to address the critical need for conservation of the State’s rare plant taxa. Hawai‘i has the dubious title of “endangered species capital of the world” with approximately 350 plant taxa listed as endangered by the U.S. Fish and Wildlife Service, nearly 40% of the total number of species listed for the entire nation, while only comprising less than 1% of the country’s landmass. Working to try and reverse this dangerous trend, the Rare Plant Facilities were created to safeguard the genetic diversity of our vanishing flora, store seeds, and grow endangered species for restoration and reforestation. The facilities consist of the Harold L. Lyon Arboretum Micropropagation Laboratory (est. 1991) and Seed Conservation Laboratory (est. 1992), and four Rare Plant Nurseries: Volcano Rare Plant Nursery on Hawai‘i Island (est. 1993), Pahole Rare Plant Nursery on O‘ahu (est. 1995), Kokee Rare Plant Nursery on Kaua‘i (est. 2001), and Olinda Rare Plant Nursery on Maui (est. 2006). This poster will illustrate the key role these facilities currently play in the conservation of the State’s rare flora, their extensive partnerships with public and private agencies, and give a brief background of their establishment, history, and successes over the last two decades.

**P-52 The Floral Biology of Brighamia insignis (‘ōlulu), an endangered Hawaiian Lobeliad (Campanulaceae)**

Seana Walsh, Richard Pender, Clifford Morden

*Botany Department, University of Hawai‘i, Honolulu, Hawaii, USA*

*Brighamia insignis*, or ‘ōlulu, is a critically endangered Hawaiian lobeliad that is believed to have evolved flowers adapted for moth pollination. Despite its conservation status, little research has been conducted concerning the reproductive biology of this species. We studied a suite of floral biology traits (e.g., phenology, nectar characteristics, floral morphology) and the breeding system of cultivated *B. insignis* plants to determine if floral biology traits conform to previously proposed hypotheses regarding this species pollination syndrome. On average, flowers remain open for ± 6 days, spending ca. 1.6 days in the male (pollen dispersal) phase and ca. 4.6 days in the female (stigma receptive) phase. Corolla color progresses through distinctive phases, possibly to act as cues to pollinators. Nectar sugar composition, flora morphology, and fragrance
(produced over the entire course of a flower's life), provide further evidence that *B. insignis* likely evolved flowers adapted for insect (entomophilous) pollination. Manipulative pollination treatments suggest that the plants used in the study are self-incompatible and require out-cross (xenogamous) pollen to form viable seeds. Although preliminary, these results have pertinent implications for the conservation of this species. In the absence of natural pollinators, anthropogenic out-cross pollination may be the best, if not the only, means to maintain this species both in wild and restored populations.

**P-53 Lyon Arboretum Seed Conservation Laboratory: Storage Trends of Native Hawaiian Seeds**  
**Timothy Kroessig**  
*University of Hawai‘i- Lyon Arboretum, Honolulu, HI, USA*

Over a decade ago, researcher Alvin Yoshinaga of the Center for Conservation Research and Training at University of Hawai‘i set out to determine the potential of seeds from native Hawaiian plant species to survive traditional seed banking techniques. With this vision, Alvin founded the Seed Conservation Laboratory at the Lyon Arboretum’s Hawaiian Rare Plant Program in 1995. At that time many experts were skeptical that native Hawaiian seeds would be able to store well because of the trend for seeds from tropical regions to be short lived and poor candidates for seed storage programs. However, seventeen years and over four-hundred species later and our research, along with the efforts of many other conservation and research agencies, have led to the conclusion that many species of native Hawaiian plants have seeds that can be stored for many years under the right conditions. We now have five, ten, and fifteen year storage and germination results for numerous native Hawaiian plant species. Based on our findings we have been able to classify many species of Hawaiian seeds under one of three storage classifications: orthodox, intermediate, and recalcitrant. The research carried out at the Seed Conservation Laboratory demonstrates that seed storage can be an excellent tool for the conservation of Hawaii’s unique flora. Additionally, because it requires minimal manpower and limited facilities, seed storage should be further promoted and utilized for the preservation of our native forest ecosystems.

**P-54 Information Needs for Insect Conservation**  
**Raina Kaholo'a, Cathleen Bailey**  
*Haleakalā National Park, Kula, HI, USA*

Insects are a vast unseen resource that is seldom considered in natural resource management. To begin to incorporate insect conservation into resource management, open dialog between entomological researchers and resource managers need to occur. Entomologists should communicate to managers general information on the insect world as well as the roles that insects play in terrestrial ecosystems. Managers can better understand entomological research and its implications when it is put in the larger context of the ecosystem. Managers should communicate to researchers their information needs, which can help prioritize management activities. Managers need specific information to manage for insects, including what species are found where, and what factors affect those insect populations. Dialog between researchers and managers can lead to insect conservation actions that benefit multiple species and resources.
P-55 Summary of 5 years of Post-delisting Monitoring of the Tinian Monarch
Fred Amidon¹, Ann Marshall¹, Paul Radley², Eric VanderWerf³
¹U.S. Fish and Wildlife Service, Honolulu, USA, ²Division of Fish and Wildlife, Saipan, Northern Marianas Islands, ³Pacific Rim Conservation, Honolulu, USA

The Tinian Monarch (Monarcha takatsukasae) was removed from the endangered species list in 2004 and a 5-year post-delisting program was initiated in 2006. Monitoring was conducted from 2006 to 2011 and included breeding bird survey point counts, small-scale study plots to annually measure survival and territory occupancy of individually color-banded monarchs in areas where the introduced brown tree snake (Boiga irregularis) would be most likely to occur, as well as an island-wide forest bird survey using variable circular plot methodology. Results indicate survival rates vary by year but were lowest between 2006 and 2007. Territory size was largest at the introduced forest site and over half the Monarch pairs stayed together between years. The island-wide forest bird surveys indicate Tinian Monarch populations have declined since the first surveys were conducted in 1982. We recommend another island-wide forest survey be conducted and the results used to determine the vulnerability of the population in light of current threats, including predation, avian pox, development, military use expansions, and the possibility of the introduction and establishment of the brown tree snake from Guam.

P-56 Pacific Fire Science Consortium - The Hottest Partnership in the Pacific
Elizabeth Pickett, Christian P. Giardina, Susan Cordell, Creighton Litton
Hawai‘i Wildfire Management Organization, Kamuela, HI, USA

Despite an urgent need for detailed, relevant and accessible information, the Pacific region is generally underrepresented in regionally-specific fire science information and technology. While initial efforts have made significant progress in understanding fire dynamics, ecological impacts, and fuels mitigation in the Pacific region, there is a growing need for additional region-specific fire research. To maximize the value of this next generation of fire science, effective communication and bidirectional information transfer must be expanded and formalized so that future research is guided by manager needs, and knowledge and tools gained from the science are efficiently transferred back to end-users. The Pacific Fire Science Consortium was recently formed and funded to address this need for a collaborative and regionally specific approach toward effective fire prevention, mitigation, and management, and to stimulate and utilize “best available” research to reduce wildfire management costs and enhance our ability to effectively protect natural, cultural, and community resources from wildfire devastation. The Pacific Fire Science Consortium (PFSC) is working to develop a means of transferring knowledge among scientists, resource managers, decision makers, fire suppression agencies, and communities in Hawai‘i and the U.S. affiliated Pacific through the following initial deliverables: PFSC website, calendar of Pacific-based wildfire-related ground trainings and webinars, searchable bibliography of journal articles relevant to the region, wildfire-focused decision support tools, support of a fire management-focused outreach liaison, and the creation and hiring of a University of Hawai‘i Fire Science Extension Specialist position. The PFSC is part of the Joint Fire Science Program national network of Knowledge Exchange Consortia.
P-57 Establishment of an Acacia koa Improvement Program in Hawai'i for Restoration of Abandoned Pastureland
Oriana Rueda Krauss1, Charles Michler2
1Purdue University, Hardwood Tree Improvement and Regeneration Center, West Lafayette, IN, USA, 2U.S. Department of Agriculture, Forest Service, Northern Research Station, USA

Acacia koa A. Gray is one of the most important native timber trees in Hawai'i both economically and ecologically. But since many trees have poor form, the species does not generate maximum potential revenue so a lot of landowners prefer to grow other exotic species affecting the conservation of native Hawaiian ecosystems. In order to start an improvement program for A. koa on the island of Hawai'i, we used two established plus tree plantations and converted them into seed orchards. To do this, we developed a ranking system based on morphological characteristics, selected the best families or individuals, and rogued the sites. Since some of the restoration sites are located at high elevations, we also tested frost damage. To address this problem, we are performing an electrolyte leakage test by subjecting phyllode samples from the different families to several below freezing temperatures. For wood quality measurements, we will use a SilviScan-3 that will give us information about microfibril arrangement and wood density. We will also use a colorimeter to standardize wood color comparisons and sapwood/heartwood ratios to identify families that have potential to produce a larger amount of heartwood. In addition, we will perform a progeny test to evaluate the genetic worth of the parents by evaluating the performance of their progeny. With this information, we will produce improved stock of A. koa which will benefit landowners, entrepreneurs and natural ecosystems, increasing the conservation not only of koa, but also of many other species that depend on this ecosystem.

P-58 Responses of a Young Acacia koa Stand to Thinning and Other Silvicultural Treatments on Mauna Kea and Comparison with Studies in Older Stands
Travis Idol1, Rodolfo Martinez-Morales2, James B Friday1
1University of Hawai'i, Honolulu, HI, USA, 2Institute for Crop Research in the Semi-Arid Tropics, Niamey, Niger

Past studies of koa response to thinning and other silvicultural treatments have been conducted primarily in stands that were 20-30 years of age. This is generally considered too late for a first thinning operation as trees with superior stem form may become suppressed much earlier and thus be limited in their capacity to respond to increased light and other resources. We imposed all combinations of thinning, grass control, and phosphorus (P) fertilization in an 8-year old koa stand at 1700 m along the slopes of Mauna Kea, using stocking guidelines based on optimal crown space requirements and anticipated growth and crown expansion rates. Thinning significantly increased main stem diameter growth (62%); grass control and P fertilization increased this response slightly (70%). There was no decline in DBH growth response over 3 years. Fertilization increased soil available P but not foliar P. However, there was a positive correlation between foliar P and photosynthetic rate. The sustained response to thinning alone was also measured for 30-yr-old koa growing at a drier south Kona site, but the combination of all 3 treatments was necessary to increase DBH growth of 25-yr-old koa at a wet Mauna Loa site. At this same site, however, a 9-yr-old stand did respond positively to thinning alone. However, for both stands, DBH growth in all treatments declined after the first year. As seen in other studies, initial stem DBH and canopy area had a positive effect on subsequent growth rates. The creation of canopy gaps due to thinning did not result in epicormic branching or loss of stem.
form, suggesting early thinning by itself can be an effective intervention for improving the timber value of naturally regenerated koa stands. Canopy expansion and gap encroachment of surrounding trees suggests an additional thinning may be necessary approx. 10 years later. The lack of crown overlap in the interval should improve the average response as compared to the later thinnings in previous studies.

HAWAI‘I STATE SCIENCE FAIR AWARD WINNERS

P-59 Analysis of the Alleochemicals of the Invasive Strawberry Guava (*Psidium cattleianum*)
Ryan Mayeda
Mililani High School, Mililani, HI, USA

Being an extreme pest to Hawaiian ecosystems, the strawberry guava uses its physical shading and allelochemicals to eliminate competition. The main purpose of this study is to find the chemical, which is responsible for its invasive behavior. An extract was taken from the strawberry guava’s leaves and was taken and separated into eight different groups with increasing polarity. These were then planted in pots and grass was grown and the resulting inhibition zone was measured. From this experiment, results have shown that the strawberry guava’s main inhibitory chemical must be non-polar because the more non-polar the extract was, the greater the inhibition zone was. Being non-polar, perhaps the chemical principle that “like dissolves like” can be applied to this situation. This means that it may be possible to use a non-polar compound to counter the non-polar allelochemicals located in the strawberry guava.

P-60 Effect of Water Quality and Stream Habitat on ‘O’opu in Waipi‘o Valley
Polanimakamae Kahakalau
Kanu o Ka ‘Aina Charter School, Honoka‘a, HI, USA

This research project studies two freshwater streams in Waipi‘o Valley, to try to determine whether or not water quality and stream habitat affect the number and species of ‘O’opu living there. Specifically, the study compares data gathered in two runs and two riffles, located in the mid reaches of Hi‘ilawe and Wailoa Stream. These data include Temperature (°C), Dissolved Oxygen (D.O.), and Turbidity (NTU). In addition, the number, the type and the general health of the ‘O’opu at four sites observed, videotaped and recorded. This research neither confirmed nor disproved my hypothesis that water quality does not affect the number or the type of species of ‘O’opu in the midreaches of Wailoa and Hi‘ilawe Stream. In fact no relations between temperature, turbidity, and D.O., and the amount or the health of ‘O’opu could be determined. The data also neither confirmed nor disproved my other hypothesis that the stream habitat affects the number and type of ‘O’opu living there. However, comparing data gathered at multiple sites revealed very low D.O. levels, as well as several ‘O’opu with visible leeches, which may indicate that Waipi‘o Streams may be less healthy than expected, a subject which warrants further study.