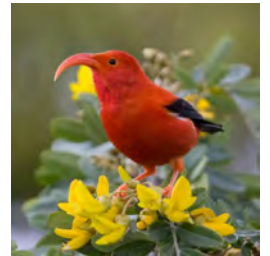
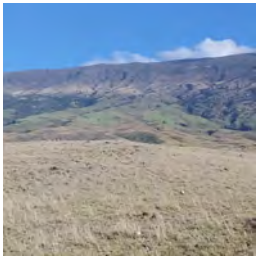




**PACIFIC ISLANDS**  
**CLIMATE ADAPTATION SCIENCE CENTER**

# **Research Portfolio 2019-2020**



## Included Projects

### Kaua'i

*Integrating Climate Science with Local Knowledge through Community Vulnerability Assessment on Kaua'i*

Alisha Summers/Daniele Spirandelli

*Assessing mosquito populations in Kaua'i to help limit the spread of avian diseases and inform the conservation of Hawaiian forest birds*

Dennis LaPointe

### O'ahu

*Science needs assessment to support management of loko i'a (Hawaiian fishpond) resources and practices critical to the Native Hawaiian community*

Rosie Alegado

*Enhancing social-ecological resilience and ecosystem services through restoration of coastal agroforestry systems*

Leah Bremer

*Vulnerability of coastal ecosystems to increased salinity from climate change*

Emily Conklin/Kasey Barton

*Impacts on climatic changes on a native and an invasive Hawaiian plant using a newly developed Intelligent Plant Growing System (ISP)*

Devon DeBevoise/Camilo Mora

*Fostering a SOEST culture of place-based and community-based pedagogy in support of coastal sustainability in Hawai'i*

Tineill Dudoit & Cory Mau/Barbara Bruno

*Coral Reef CO<sub>2</sub> variations at the Coastal Ocean Hawai'i Acidification Network (COHAMN): Impact of basin scale oceanographic forcing*

Lucie Knor/Eric DeCarlo

*A next-generation beach observing system for Hawai'i*

Anna Mikkelsen/Chip Fletcher

### Moloka'i

*Microbial biogeochemical cycling across a chronosequence of mangrove introductions across Hawai'i*

Becca Lensing/Rosie Alegado

*Developing geospatial models in Hawaiian watersheds to mitigate erosion and climate change*

Kimo Melcher/ Rebecca Ostertag

### Maui

*Identifying the risk of runoff and erosion in Hawai‘i’s national parks*

Lucas Fortini

*Managing non-native game mammals to reduce future conflicts with native plant conservation in Hawai‘i*

Steve Hess/Lucas Fortini

### Hawai‘i Island

*Working with natural resource managers to co-produce drought analyses in Hawai‘i*

Christian Giardina/Abby Frazier

*E Hui Pū: A collaborative approach to understand climate change impacts on traditional Hawaiian ‘Ōpelu (mackerel scad) aggregation sites in South Kona, Hawai‘i*

Courtney Hurt/John Burns/Tim Grabowski

*Determining effectiveness of high-elevation habitat restoration efforts for palila, an endangered honeycreeper: Increasing resilience to climate change impacts*

Kahua Julian/Pat Hart

*Supporting sea-level rise preparedness in Hawaiian national parks*

Philip Thompson

### Federated States of Micronesia

*The future resiliency of mangrove forests to sea-level rise in the Western Pacific: Initiating a national assessment approach*

Karen Thorne

*Assessing nearshore water quality of Pohnpei, Federated States of Micronesia (FSM)*

Bryan Tonga/Tracy Wiegner

### Pacific Basin-wide

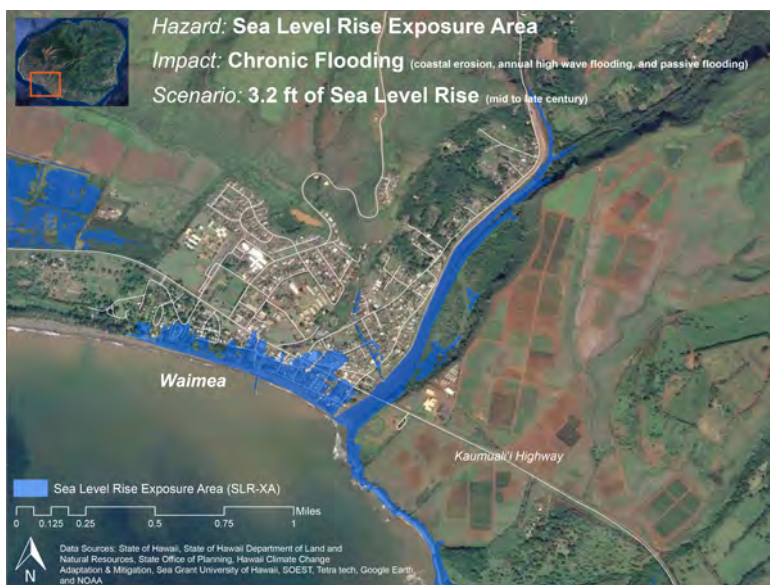
*The impact of climate change and sea-level rise on future flooding of coastal parks and refuges in Hawai‘i and the US-Affiliated Pacific Islands*

Curt Storlazzi



## Integrating climate science with local knowledge through community vulnerability assessment on Kauaʻi

*Alisha Summers/Daniele Spirandelli*



Map of west Kauaʻi region concerned in community vulnerability assessment. Blue shading shows where flooding would be if 3.2 ft of sea-level rise occurs.

### Significance

- Critical habitats & infrastructure on coastal plains at risk of rising seas & coastal erosion
- Planning for future conditions requires detailed local assessments of risks
- Risk management enhanced by credible science and community local knowledge

### Objectives

- Identify Kauaʻi community stakeholders' awareness and understanding of climate risks
- Identify strategies to incorporate into community plans
- Evaluate decision support tool for vulnerability assessment in one west Kauaʻi community

### Outcomes

- Documented decision-making process to prioritize adaptation options and provide guidance for other communities to use
- Inform the west Kauaʻi Community Plan update (in process)

# Assessing mosquito populations in Kauaʻi to help limit the spread of avian diseases and inform the conservation of Hawaiian forest birds

*Dennis LaPointe*



*Researcher sampling mosquitoes in the high mountain Alaka ʻi Swamp on Kaua ʻi.*

## Significance

- Native birds threatened by mosquito-borne diseases
- Forecasts suggest climate change will worsen declines in vulnerable bird populations
- Biologists across Hawaiʻi consider mosquito control a conservation priority

## Objectives

- Apply population-measuring statistical technique to provide estimates of Kauaʻi mosquitoes
- Assess key ecological parameters to meet benchmarks for use of bacteria technique
- Deploy male mosquitoes infected with fertility-damping bacteria to suppress wild populations

## Anticipated Outcomes

- Generate population density estimates of Kauaʻi mosquitoes
- Collect data on movement and mortality rates of mosquitoes
- Share results with conservation managers across the state who work to protect native birds



# Science needs assessment to support management of loko i‘a (Hawaiian fishpond) resources and practices critical to the Native Hawaiian community

*Rosie Alegado*



*He'eia fishpond, being restored by community stakeholders, supports abundant research, too.*

## Significance

- Fishponds provide food security and important links to island cultural traditions
- Climate impacts environmental, physical, and biochemical aspects of fishponds
- Input from loko i‘a leadership critical to addressing needed information gaps and research

## Objectives

- Facilitate, assess, and synthesize information gaps on adaptation for pond resource managers
- Document and help perpetuate Traditional Ecological Knowledge (TEK) for loko i‘a
- Grow collaborations between fishpond caretakers and university researchers

## Anticipated Outcomes

- Needs assessment to support capacities of loko i‘a in climate adaptation
- Inform future fishpond practices to boost resilience in the face of climate change impacts
- Improve communication between loko i‘a leadership and academic institutions

# Enhancing social-ecological resilience and ecosystem services through restoration of coastal agroforestry systems

*Leah Bremer*



*A thriving lo'i, or taro field, is one example of successful, culturally significant agroforestry efforts.*

## Significance

- Agroforestry provides important ecosystem services and food production for communities
- Many historical agroforestry lands lie fallow, promoting invasive weeds and higher fire risk
- Agroforestry furthers traditional cultural practice restoration and sustainable management

## Objectives

- Evaluate two agroforestry methods regarding biodiversity, costs, and biocultural outcomes
- Develop scenarios at different scales (ahupua'a and state) for future agroforestry systems
- Evaluate ecosystem service and biodiversity benefits to identify priority restoration areas

## Anticipated Outcomes

- Improve understanding of links between agroforestry, biodiversity, and ecosystems
- Describe successful protocol for monitoring aspects of agroforestry systems
- Produce statewide maps identifying priority areas for agroforestry restoration

## Vulnerability of coastal ecosystems to increased salinity from climate change

*Emily Conklin/Kasey Barton*



*Coastal plant seedlings being grown to test salinity tolerance under controlled conditions.*

### Significance

- Specialized coastal habitats are vulnerable to increasing sea levels and storm surge
- More frequent droughts subject coastal plants to higher saline conditions
- Relative salinity tolerance of coastal plants important to find for best management

### Objectives

- Test salinity tolerance for range of salinities in variety of native and non-native coastal plants
- Apply and evaluate experimental approach for fast quantification of tolerance in the field
- Disseminate information through partnerships, community workshops, and new web tool

### Anticipated Outcomes

- Provide critical information for coastal plant conservation under future salinity conditions
- Identify species with higher salinity tolerance for targeted restoration efforts
- Develop a Salinity Tolerance Index Website for results dissemination



# Impacts on climatic changes on a native and an invasive Hawaiian plant using a newly developed Intelligent Plant Growing System (ISP)

*Devon DeBevoise/Camilo Mora*



*New plants sprout in the IPS, testing their growth viability under different conditions.*

## Significance

- Viability of plants under climate change is uncertain
- Temperature, moisture, and CO<sub>2</sub> changes may work against each other
- Forest health vital for ecological resilience

## Objectives

- Understand native vs invasive species responses to simultaneous env. changes
- Use IPS for testing concurrent changes in temperature, soil moisture, and CO<sub>2</sub>
- Combine results with climate projections to predict areas of species suitability

## Anticipated Outcomes

- Inform managers about climate change tolerance of two important Hawaiian trees
- Map viable areas for each species, based on results and climate projections
- Demonstrate advantages of UH-built IPS units for similar growth studies

# Fostering a SOEST culture of place-based and community-based pedagogy in support of coastal sustainability in Hawai‘i

*Tineill Dudoit/Cory Mau/Barbara Bruno*



*Students collect water samples at Maunalua Bay, O‘ahu, as they learn about conditions along their own coastline.*

## Significance

- Pacific and Hawai‘i coastal communities face challenges to ecosystem health
- Educating public and leaders critical for ensuring informed future decision making
- SOEST at UH Mānoa perfectly situated to enhance education through place-based teaching

## Objectives

- Compile wide range of PBT resources; make available to SOEST faculty for use in all levels of classes
- Create story maps for integrating and distributing place-based information
- Measure degree of incorporation of PBT into SOEST curricula

## Anticipated Outcomes

- Ultimately contribute to the development of a well-trained local workforce who can tackle pressing coastal issues
- Generate electronic and physical libraries of PBT resources
- Evaluation of faculty engagement with PBT

# **Coral Reef CO<sub>2</sub> variations at the Coastal Ocean Hawai'i Acidification Network (COHAMN): Impact of basin scale oceanographic forcing**

*Lucie Knor/Eric DeCarlo*



*One of four buoys off O'ahu contributing to a decade-long global effort to monitor carbon in the sea.*

## **Significance**

- Coral reefs are threatened by increasing carbon in the ocean, through acidification
- Understanding reef health requires high-resolution data on coastal CO<sub>2</sub> ocean budgets
- COHAMN is part of the longest continuous high-temporal resolution record of reef CO<sub>2</sub>

## **Objectives**

- Continue monitoring four coral reef sites for CO<sub>2</sub> and other biogeochemical parameters
- Understand how benthic and water column activities control the tropical CO<sub>2</sub> system
- Resolve local vs. basin-scale drivers of the inorganic carbon system for near-shore reefs

## **Anticipated Outcomes**

- Understand the balance between biological, chemical, and physical processes operating at local and basin scales, forcing the CO<sub>2</sub> system in reef settings
- Facilitate fundamental studies by collaborators and international efforts, benefiting policy decision-making



## A next-generation beach observing system for Hawai‘i

*Anna Mikkelson/Charles Fletcher*



*Some standard surveying to verify data using new technologies for creating next-gen system.*

### Significance

- Beach management increasingly difficult with sea-level rise
- Beach erosion a widespread Hawai‘i problem, threatening property and infrastructure
- Decision-makers need better information on short-term shoreline changes

### Objectives

- Develop new beach monitoring system to improve accuracy and spatial/temporal coverage
- Apply latest technologies for topo/bathy surveying to enhance survey quality
- Combine with existing databases to describe beach processes seasonally and after events

### Outcomes

- Improved speed/sampling frequency, quality, and resolution for beach profiling
- Improved understanding of beach and coastal processes (sediment budget & transport)
- Contributed to improved sea-level rise hazard projections





# Microbial biogeochemical cycling across a chronosequence of mangrove introductions across Hawai‘i

*Becca Lensing/Rosie Alegado*



*Mangrove removal sites and dates around He'eia Fishpond, O'ahu.*

## Significance

- Mangroves, invasive in Hawai‘i, spread rapidly across the islands since their introduction
- Mangrove detritus is difficult for native microbes to process, clogging local nutrient cycling
- Fisheries managers would benefit from better understanding of mangrove-microbial interaction

## Objectives

- Investigate association between microbial community make-up, mangroves, & ecosystems
- Determine whether established mangrove areas altered microbe community make-up
- Determine whether mangrove removal restores ecosystem functioning

## Anticipated Outcomes

- Provide new insights into long-term sensitivity of coastal ecosystems to mangrove
- Determine resilience of coastal ecosystems after mangrove removal
- Provide recommendations to local fisheries for best management success

# Developing geospatial models in Hawaiian watersheds to mitigate erosion and climate change

*Kimo Melcher/Rebecca Ostertag*



*A drone is outfitted with sensors to collect detailed data on an eroded landscape in Moloka'i.*

## Significance

- Increased soil erosion impacts near-shore ecosystems by excess sediment & nutrients
- With climate change, landscape management to combat erosion is challenging
- Managers identified two erosion-prone watersheds as priority intervention areas

## Objectives

- Collect high resolution imagery of landscapes, using drones and LIDAR, to create DEMs
- Identify erosion hotspots and detail sediment movement across landscapes
- Identify suitable areas to recreate habitats for native vegetation and mitigate erosion

## Outcomes

- High-resolution orthomosaics and DEMs created for Moloka'i site
- Imagery processing ongoing for Hawai'i Island site
- Habitat suitability and hydrology models will be shared with local land managers

## Identifying the risk of runoff and erosion in Hawai‘i’s national parks

*Lucas Fortini*



*Runoff generates erosion in Maui uplands, dumping choking sediment into coastal ecosystems.*

### Significance

- Haleakalā National Park (HNP) experiences vegetative shifts with climate change
- Different vegetation changes infiltration of water into soils, leaving some areas drier
- Excessive runoff and soil erosion increasingly problematic for park managers

### Objectives

- Supply expressed need for current and predicted runoff and erosion risks
- Compare soil infiltration & rainfall, as well as predicted conditions, to assess runoff risks
- Inform future management decisions on climate adaptation planning for HNP

### Anticipated Outcomes

- Leverage existing soil infiltration data to develop maps illustrating runoff probabilities for multiple landscapes
- Detail current and potential conditions under climate change at HNP and across the Hawaiian landscape to inform management planning



# Managing non-native game mammals to reduce future conflicts with native plant conservation in Hawai‘i

*Steve Hess/Lucas Fortini*



*Mouflon sheep and axis deer are two game species that proliferate in Hawai‘i, threatening native plants.*

## Significance

- Herbivorous, non-native game mammals threaten native plant species conservation
- Efforts also to sustain populations of feral pigs, goats, and deer for subsistence & sport hunting
- Conflicting conservation efforts need to be addressed and management optimized

## Objectives

- Balance long-term endangered plant recovery with non-native game management
- Map current & future distribution of game and plant species to identify optimal zones for each
- Inform locations for vegetation conservation plans and priority game management

## Anticipated Outcomes

- Compile comprehensive map of ungulate species distribution for Maui and Lāna‘i
- Identify optimal game management and rare plant conservation areas
- Map optional areas for game and plant management under different climate scenarios



# Working with natural resource managers to co-produce drought analyses in Hawai‘i

*Christian Giardina/Abby Frazier*



*Climate change is bringing more drought to Hawai‘i, increasing wildfire risks and damage to ecosystems.*

## Significance

- Rainfall shifts in Hawai‘i with climate change will impact vegetation cover, invasive species growth, watershed function, and fire behavior
- Cooperation between managers and researchers necessary to maximize planning for hotter, drier climate

## Objectives

- Synthesize historical & future climate projections (variability & drought) for Hawai‘i Island
- Assess manager responses to recent drought & wildfire events
- Develop maps of risks and management responses for both drought and wildfires

## Anticipated Outcomes

- Create geospatial drought products to inform drought-resilience planning by managers
- Share maps with managers across the state to help reduce wildfire risk and protect threatened landscapes

# **E Hui Pū: A collaborative approach to understand climate change impacts on traditional Hawaiian ‘ōpelu (mackerel scad) aggregation sites in South Kona, Hawai‘i**

*Courtney Hurt/John Burns/Tim Grabowski*



*South Kona resident measures ‘ōpelu caught off the coast to document recent impacts on the fishery.*

## **Significance**

- ‘Ōpelu (mackerel scad) is an economically and culturally significant Hawaiian fishery
- Recent declines due to unsustainable fishing practices and rising ocean temperatures
- Fisheries are critical sources of food security for local Hawaiian communities

## **Objectives**

- Gather current data on ‘ōpelu reproduction (spawning time and growth rates)
- Evaluate current and future environmental conditions in known fish aggregation sites
- Incorporate traditional knowledge and scientific data to inform sustainable fishery practices

## **Anticipated Outcomes**

- Generate new understanding of environmental and fishery connections
- Adapt local fishing practices and state management actions to minimize climate impacts
- Combine science and traditional knowledge to regenerate the ‘ōpelu fishery

# Determining effectiveness of high-elevation habitat restoration efforts for Palila, an endangered honeycreeper: Increasing resilience to climate change impacts

*Kahua Julian/Patrick Hart*



*A beautiful palila cracks open a māmane seed pod.*

## Significance

- Palila are threatened by habitat loss, with destruction of māmane forests
- Experimental reforestation of māmane trees at higher elevations from decades ago needs evaluation to inform ongoing restoration efforts

## Objectives

- Provide data on growth & survival rates of māmane outplanted in 1980s and 2015-2018
- Provide data on effectiveness of previous plantings in context of substrates, slopes, etc.
- Produced guidelines to optimize current planting techniques for native bird habitats

## Outcomes

- Lower plot slopes encouraged higher growth rates
- Mortality estimates from a small portion of plantings were encouraging
- Results suggest great potential for ongoing outplanting efforts to replace Palila habitat



## Supporting sea-level rise preparedness in Hawaiian national parks

*Philip Thompson*



*Excessive Hawai'i sea levels in 2017 damaged docks at the USS Arizona Memorial.*

### Significance

- Throughout 2017, Honolulu Harbor registered unmatched number of high-water events
- Sea-level rise (SLR) threatens infrastructure and cultural assets across the islands
- Resource managers need better information to prepare for SLR impacts and inundation

### Objectives

- Collaborate with managers to identify specific needs at two Hawai'i national parks
- Develop tools that provide current status and advanced notice of high water conditions
- Establish relevant water level thresholds to assess specific park vulnerabilities

### Anticipated Outcomes

- Provide tools to directly benefit managers of Valor in the Pacific and Pu'uuhonua O Hōnaunau national sites
- Identify at-risk assets at each park and assess their vulnerabilities
- Provide similar products for other coastal area managers



# The future resiliency of mangrove forests to sea-level rise in the Western Pacific: Initiating a national assessment approach

*Karen Thorne*



*Mangroves in Kosrae flood when sea levels rise faster than the trees can grow or migrate.*

## Significance

- Mangroves provide many ecosystem services for western Pacific Islands
- Coastal mangrove forests threatened by flooding from sea-level rise (SLR)
- Coastal development strangles mangroves' natural response to SLR (e.g. migration)

## Objectives

- Collect and compile data from Kosrae mangrove forests to create SLR vulnerability models
- Determine likely inland migration pathways for viable forests to inform management actions
- Enhance protection from development and deforestation by sharing with communities

## Anticipated Outcomes

- Model SLR vulnerability of Kosrae mangrove plots for predicted future conditions
- Improve resilience of Kosrae mangrove forests to continue supplying ecosystem services
- Create online story map of results to enhance communication to local stakeholders

## Assessing nearshore water quality of Pohnpei, Federated States of Micronesia (FSM)

*Bryan Tonga/Tracy Wiegner*



*Students collect water samples to test for sewage contamination in Pohnpei.*

### Significance

- Coral reefs in Micronesia being hit by climate change and coastal water contamination
- Seasonal changes in precipitation affect contamination of groundwater
- Minimal data currently available on groundwater and coastal water quality in Pohnpei

### Objectives

- Provide assessment of sewage contribution to coastal water contamination for Pohnpei
- Identify sewage pollution hotspots along the coast for priority intervention
- Share information with managers to address with climate change impacts in mind

### Outcomes

- Water and algal samples from 30 stations around Pohnpei have been collected over two summer seasons
- Samples have been analyzed for nutrient concentrations, nitrogen isotopes, and fecal bacteria

# The impact of climate change and sea-level rise on future flooding of coastal parks and refuges in Hawai‘i and the US-Affiliated Pacific Islands

*Curt Storlazzi*



*Flooding of Asan Beach at the War in the Pacific National Historic Park, Guam.*

## Significance

- National parks and wildlife refuges throughout the Pacific threatened by sea-level rise (SLR) inundation
- Coastal flooding threatens cultural resources and infrastructure
- Detailed understanding of relative flooding vulnerabilities at different sites is limited

## Objectives

- Combine state-of-the-art tools to create assessments of current SLR flooding risks at national parks and wildlife refuges
- Model future coastal flooding based on plausible scenarios of storm- and SLR-induced flooding in Hawai‘i and across the USAPI

## Anticipated Outcomes

- Create high-resolution maps of potential future inundation in areas of concern
- Share inundation scenario assessments for impacts on local natural resources
- Distribute pamphlets illustrating trends in resource impacts for different SLR scenarios