

# Annual Report 2014

## New University Director on board!



**Kelvin Richards**, Professor of Oceanography at the University of Hawai'i at Mānoa (UHM), has taken the helm as the University Director for the Pacific Islands Climate Science Center. Richards is currently also Director of the International Pacific Research Center and holds a joint appointment with the UHM Oceanography Department, which he chaired from 2010 to 2013.

A 1978 PhD in oceanography from the University of Southampton, Richards' research interests include ocean stirring and mixing effects on the dynamics of Earth's environment and their impact on ocean biology, including the waters around Hawai'i. Beyond his extensive scientific publications, Richards' many accomplishments include serving on international scientific committees, leading the international research program Mixing in the Equatorial Thermocline, and participating in research cruises to the equatorial Indian and Pacific Oceans with the R/V *Mirai* (JAMSTEC) and the R/V *Falkor* (Schmidt Ocean Institute).

## Habitat modeling software helps scientists and park managers

In September 2014, **Casey Jones**, **Maia Kapur**, **Frank Mancini**, and **Tamara Wong**—all University of Hawai'i early career biology scientists with projects supported by the PICSC—took part in the workshop *Software for Assisted Habitat Modeling (SAHM)*, developed by the Invasive Species Science Branch of the U.S. Geological Survey's Fort Collins Science Center and the U.S. Department of the Interior's North Central Climate Science Center. This helpful software, for example, lets scientists view on several monitors simultaneously where the endangered silverswords are likely to survive in 5, 10, 25, or 50 years based upon rainfall projections in climate models.



Noelani Puniwai

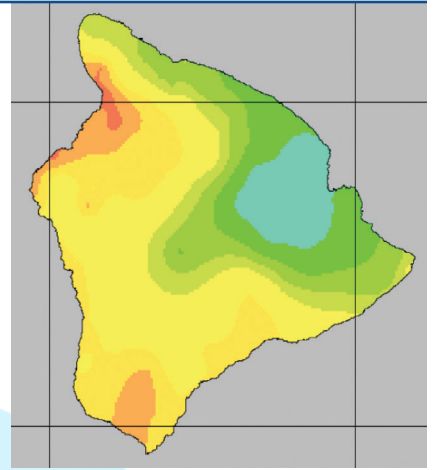
## Rising Voices

The second annual *Rising Voices* conference, hosted by the National Center for Atmospheric Research met in Boulder, Colorado, with over 70 participants from across the country. **Noelani Puniwai** (PhD candidate, UHM), a representative for Hawai'i and the Pacific Islands, took part in the three-day event to discuss ways for indigenous peoples to find respectful and sustainable solutions to climate-change impacts. This year's meeting, *Adaptation to Climate Change and Variability: Bringing Together Science and Indigenous Ways of Knowing to Create Positive Solutions*, resulted in setting up a climate-migration task force for peoples facing displacement and a climate change corps of youth leaders and veterans to support resiliency in indigenous and non-indigenous communities.

Participants also decided to create a formal process for taking part in the National Climate Assessment, to support tribal and indigenous water rights and access to water quality, and proposed to include more traditional ecological knowledge and perspectives in natural resource management, environmental policy, educational content, and climate change research.

## Forecasting rainfall changes for the Hawaiian Islands

The Hawaiian Islands are too tiny to register on maps for rainfall projections of global climate models. Climate scientist **Oliver Ellison Timm**, formerly with the UHM International Pacific Research Center and now with NY State University at Albany, and his colleagues have developed a statistical method to combine global climate models with historical, high-quality monthly rainfall observations across the complex, varied island geography. Results suggest the windward sides of islands will remain wet or become wetter during Hawai'i's wet season (November–April), while leeward sides will become drier due to changing winds and high- and low-pressure regions. The “dry” season may see less rainfall generally. This information should help in planning for water use and plant conservation.



## Creating erosion hazard maps for the Hawaiian Islands

Over the past 80 years, nearly 10% of Hawai'i's sandy beaches have been lost to the sea and fully 70% are in a state of chronic erosion. Sea-level rise now accelerates that threat. Geologists **Chip Fletcher** and **Tiffany Anderson** at UHM are including historical shoreline observations in an engineering model to forecast how the expected sea-level rise over the next decades may erode and flood sandy beaches on Kaua'i, Maui, and O'ahu. By overlaying model results onto such shoreline features as geology, elevation, density of houses, roads, and parks, they are creating erosion hazard maps that will help relevant agencies assess exposure to future shoreline erosion as sea level rises.



Dolan Eversole, UHM Sea Grant

## Effects of shifting climate on Hawai'i mountain vegetation

Tropical mountains are thought to contain many species adapted to harsh environments, but their adaptive traits may make them particularly vulnerable to rapidly shifting climates. Graduate student **Alison Ainsworth** and advisor **Don Drake**, UHM Botany Department, are using a novel method based on plant species data for over 1000 plots on three Hawaiian Islands in order to identify which species are habitat “specialists.” They have found that to date most species identified as “specialists” are restricted to living in small, high-elevation areas that are climatically challenging. The scientists are now testing whether this specialization can be linked to specific plant traits and how native and non-native species differ.



Gisela Speidel

## Keeping the 'ōhi'a tree alive

The lovely 'ōhi'a lehua is the most common tree in Hawai'i's mountain forests, but its future depends on whether young plants can survive. **Kasey Barton** in the UHM Botany Department, and **Tiffany Knight** in the Biology Department, University of Washington, are studying 'ōhi'a lehua forests for evidence of seedling survival. They have found healthy forests in both wet and dry habitats, but the seedlings often do not thrive. Management, however, is fostering seedling establishment in such areas as Hawai'i Volcanoes National Park. In a huge experiment, the scientists are now transplanting seedlings into different areas to see how well they do under such varying conditions as elevation, rainfall, or soil. Their findings will guide work to maintain or reestablish 'ōhi'a forests.



L to R: Casey Jones (see back page), Tiffany Knight, and Kasey Barton.



## Guam's caves and corals hold clues to climate change

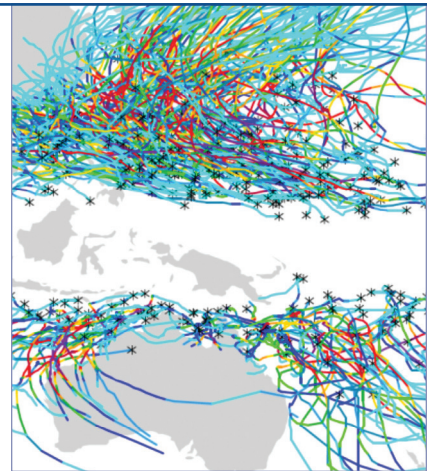
The caves and corals of Guam in the remote western Pacific give **Mark Lander**, **John Jensen**, and their students at the University of Guam along with partners at the University of Texas, important clues to past and present behaviors of the warm waters of the Indo-Pacific—the “Earth’s climate engine”—including the length and severity of El Niños and other dry and wet cycles. Their findings will help improve global climate models in forecasting local and global climate, and will also give local and regional managers of water and agricultural resources a more reliable basis to forecast the onset, duration, intensity, and effects of wet and dry periods. Moreover, the study will show how climate change will affect Guam’s major aquifer, which supplies 80% of Guam’s drinking water.

Jacob Kanrad collecting samples in a cave. (Courtesy John Jensen)



## High-resolution climate projections for Pacific islands

The small islands of the tropical and subtropical Pacific, home to over 9 million people, include 15 sovereign nations and several territories. The small isolated ecosystems and communities of these islands, already vulnerable to flooding from rising sea levels and storms, are under grave threat in face of anticipated climate change. **Yuqing Wang** at UHM and his team are creating climate models at very high resolution to produce projections of average changes and changes in extreme events for the islands of Guam and American Samoa. The research team is improving a model to simulate storm systems that cause extreme rainfall events and windstorms. This model will aid other research in hydrological and ecosystem models for Pacific islands.



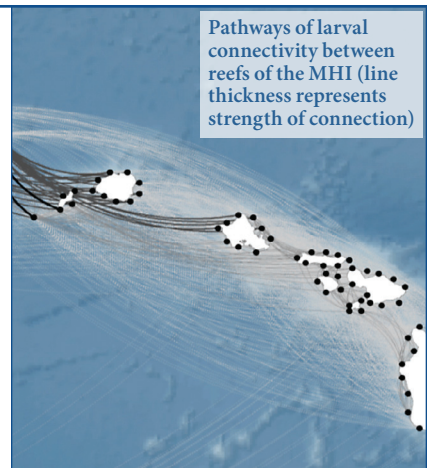
## Hawaiian seascapes and their management

Unlike landscapes, seascapes provide little long-term proof of their physical changes. As Hawai‘i climate changes, we need to observe and document past and current states of the ocean to predict and prepare for those changes. Led by PhD candidate **Noelani Puniwai** at UHM, this study focuses on discovering those interactions between human activity and the ocean environment that form ecological, socioeconomic, and cultural patterns and mental maps that provide insights when comparing observations, datasets, and conceptual maps. Combining physical data and human experiences will reveal such patterns and help determine how the marine environment may change. By identifying and using ocean and climate information most relevant to local ocean users, this research will support natural resource management.



## Coral reef community projections in Hawai‘i

Sharing a long geological and biological history, the Hawaiian Islands are connected through many pathways above and below the ocean waters. **Erik Franklin** (UHM) and his research team are investigating the pathways that marine organisms, such as young corals, urchins, and fish, travel through the islands from reef to reef. As climate change impacts ocean systems, the team is looking at how those physical systems are affecting biological communities and evaluating the response of coral reef ecosystems to different levels of climate change. This research supports marine resource managers make effective decisions to protect and support marine organisms and ecosystems.



# Student Research Highlights

**Scarlett Kettwich**, a 2013 recipient of a George Melendez Wright Climate Change Youth Initiative research fellowship, completed her Masters degree in the Tropical Conservation Biology and Environmental Science program at the University of Hawai'i at Hilo. She studied epiphyte communities (the plants living on trees) to understand how these climate-sensitive plants respond to changes in moisture and physical surroundings and to determine whether the health of these plants can be used as an indicator of likely forest changes. Results suggest that epiphytes depend upon the amount of fog for survival and that smaller species are more sensitive to a drying climate than larger species. *Advisor: Jon Price*

**Casey Jones** (*right*) a PhD student in Botany at the University of Hawai'i at Mānoa, is testing to see how 'ōhi'a lehua (*Metrosideros polymorpha*) seedlings thrive after being transplanted to 27 sites with different amounts of rainfall. This work will give insight into how well the seedlings have adapted to local rainfall amounts and whether they can adapt to drier and wetter areas. *Advisor: Kasey Barton*



**Rebecca Ziegler**, a marine science BS student, University of Hawai'i at Hilo, examined the levels of carbonate saturation (which is a measure of ocean acidification) in the ocean around coral reefs of Hawai'i Island for her senior thesis project. She developed a method to obtain uncontaminated diver-collected samples of carbonate saturation levels, contributing to an important step for the accurate charting of present and future ocean acidification. *Advisor: Steven Colbert*

## New PICSC Funded Projects

In competitions held in 2014, over \$600,000 were awarded to five new projects funded by the PICSC. All are now underway and answering key questions about climate change impacts in the unique environments of the Pacific Islands.

*"Vegetative Guide & Dashboard" Relating Atoll Agroforestry Recommendations to Predicted Climate and Sea Level Conditions in the Marshall Islands.*

**Maria Haws** (University of Hawai'i at Hilo)

*Measurement of ENSO-related Climate Variables and Ecosystem Responses in Hawai'i*

**Thomas Giambelluca** (University of Hawai'i at Mānoa)

*Hawaiian Seascapes and Their Management Implications*

**Noelani Puniwai** (University of Hawai'i CAFRNM)

*Empirical Projection of Future Shoreline Position and Inundation Due to Sea Level Rise*

**Charles Fletcher** (University of Hawai'i at Mānoa)

*Development of Statistical Methods to Estimate Baseline and Future Low Flow Characteristics of Ungaged Streams in Hawai'i*

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