A Joint Climate Change Newsletter from the PICCC and the PICSC

Issue 2, January 2016

PACIFIC PANDANUS

NAVIGATING WITH THE BEST CLIMATE SCIENCE

In this issue...

Aloha, Hafa adai, Yokwe, Talofa, Alii, Mogethin, Ran allim, Kaselehlia, Hello!

This quarter's issue is dedicated to the dual themes of **VULNERABILITY** and **RESILIENCE**. In the context of climate change, vulnerability is the extent to which systems are prone to adverse impacts due to climate change. Vulnerability assessments serve to analyze the projected impacts and risks to biological and socioeconomic sectors. These vulnerability assessments examine species' ability to survive and thrive in response to external changes.

Resilience is the ability of a system or population to absorb, change, adapt, or evolve to be better prepared for impacts. Science, policy, and community-level actions can all contribute to resilience of a system. On Page 2 read how the *Pandanus* tree has aided communities to become more resilient through its usefulness as a food and construction source. One example of resilience is using information about coral reef vulnerability and identifying management actions to address and protect coral reefs. The article on Page 4, "Bubbling Under the Surface," digs deeper into the resilience theme.

PACIFIC ISLANDS CLIMATE SCIENCE CENTER PICSC

PACIFIC ISLANDS CLIMATE CHANGE COOPERATIVE

Our Missions

Pacific Islands Climate Science Center
The Mission of the PICSC is to provide scientific information, tools, and services regarding land, water, wildlife, and cultural resources to managers, community members, and decisionmakers in order to anticipate, monitor, and adapt to climate change and variability.

Pacific Islands Climate Change Cooperative
The PICCC aims to assist those who manage native species, island ecosystems, and key cultural resources in adapting their management to climate change. The PICCC does this by connecting science, traditional knowledge and practices, and management actions to achieve adaptation.

Why the *Pandanus*?

You may wonder why we, the editors, chose the *Pandanus* tree as a symbol for our climate science newsletter. Not only is the *Pandanus* tree found throughout the tropical Pacific Ocean, therefore, spread across the region that we serve as organizations, but it is an integral part of coastal natural communities and cultural practices. Most, if not all, peoples in this region use it for weaving, a food source, or medicinal purposes, finding its usefulness second only to the coconut, especially on low islands.

Sarah's first observations...
My first experiences with *Pandanus*, or *hala* as it is known in Hawai'i, were not the most pleasant ones. I was taking my first long hike on Hawai'i Island to the Waimanu Valley, where a lush isolated beach on the north side of the island is known for its inspirational ocean vistas. The hike was arduous, long, and scorching. Straggling into the valley at dusk, I met my first hala trees. I soon discovered how hala leaves on a narrow hillside trail can be dangerously sharp, with their serrated edges, and slippery, creating an almost frictionless environment in which no shoe can find a hold. I did finally make it to my destination at one of the most treasured secluded beaches of the Big Island, but with no help from the hala trees! Over the years, though, I have come to appreciate this hardy plant whose stilted roots lift up out of the soil or bare coastal rock, its long palm-like leaves tossing about in the ocean breezes, and its fruits a puzzle of natural mathematical design like a psychedelic, sometimes edible, Rubik's cube.


Pandanus *trees, Keaukaha, Hawai'i. Credit: S. Nash*

Two years ago, I visited the Republic of the Marshall Islands (RMI) as part of an agroforestry and climate variability project connecting the PICSC, NOAA, University of Hawai'i-Hilo, USDA-Forest Service with the RMI Department of Research & Development (R&D), College of the Marshall Islands (CMI), and others. I recognized my prickly leaved friend all over the island.

Pandanus across the Pacific...
Over the past 20 years, the R&D Agriculture Division, CMI, and cultural practitioners have led research on the history and prevalence of *Pandanus* in the Marshalls. Known as *bōb*, it is found throughout the low-lying islands and atolls. The leaves are woven into sleeping

Pandanus, continued

mats and were traditionally used for sails, clothes, and thatching. Marshallese still chew its fruits, or keys, and now use the juice to make shakes, jams, and baby food where they can take advantage of the high vitamin A content and other minerals.

The rejuvenation of *Pandanus* in Marshallese culture has led to recent interest in its products and cultural importance with annual festivals, weaving gatherings, and nurseries devoted to *Pandanus* cultivation. In fact, trade talks have begun in order to export the juice to foodies in New Zealand (Read full article here).

Inset: Ripe fruits, or drupes or keys, of the Pandanus; *Young fruit of the* Pandanus

Over 200 *Pandanus* varietals have been documented in RMI alone, but there are as many on Kiribati and other tropical Pacific nations where *Pandanus* is found. In Kiribati, *te kaina* is known as the ancestral tree, where the first people originated in local mythology. It also provides the raw materials for a wide range of uses such as baskets, food wrappers, housing, medicines, decorations, and perfumes. In the I-Kiribati diet, the ripe fruits are consumed raw or made into a paste and dried or boiled and added to grated coconut.

In Pohnpei, the keys of *kipar* are eaten and used as dental floss, while the prop roots are consumed for medicinal purposes. The Mwokillese people would also gather during kipar season to harvest and make recipes.

In American Samoa, some varieties of *Pandanus*, including *lauʻie* and *laufala*, are used to weave fine mats (*ʻie toga*). Fine mats have high cultural value in American Samoa—the mats are traditionally made by women in the community and intended to be exchanged at special occasions such as weddings and funerals, matai chief title ceremonies, and the opening of a new *fale*, or community meeting house. The mats are offered as a measure of respect and welcome and valued as a token of traditional culture.

Similarly, the Chamorro of the Mariana Islands have used *Pandanus* to create mats, hats, and baskets for many generations. Today, weavers continue to make these items to sell locally or to tourists. Moreover, with the recent invasion of the Rhinoceros beetle, which has damaged coconut plantations in the islands, weavers who used to use coconut leaves now incorporate *Pandanus* in their crafts.

So, the next time you see a *Pandanus* tree, you can imagine its cousins dotting the shores across the tropical Pacific, its leaves woven into mats, its keys chewed, or simply sat under for its shade. More than just simply a tree, the *Pandanus* has contributed to the health and environmental and economic resilience of communities throughout the Pacific.

The Many Names of Pandanus

Location	*Pandanus* translation
Pohnpei	*Kipar*
Chuuk	*Fach*
Kosrae	*Mweng*
Yap	*Choy*
American Samoa	*Lau`ie/Laufala*
Marshall Islands	*Bōb*
Kiribati	*Te kaina*

Some resources used in this article:
K. Kusto, N. Vander Velde, and B. Vander Velde. Recent efforts to document and preserve Pandanus in the Marshall Islands.
Atoll agroforestry on Tarawa and Abemama, Kiribati

Bubbling Under the Surface

Coral Reef Resiliency in the Marianas

Coral reefs are sensitive to changes in the marine environment, including changes to water chemistry, temperature, wave exposure, and pollution, to name a few. To protect coral reefs, resource managers must determine which reefs are most resilient to natural and human-made changes in the ocean. Scientists and managers working on this project sought to assess the resilience, or capacity to resist or recover from disturbance, of fringing reefs in the Commonwealth of the Northern Mariana Islands (CNMI).

To assess reef resilience, a team of scientists and resource managers from CNMI agencies collaborated to survey 78 sites on the islands of Rota, Aguijan, Tinian, and Saipan and to evaluate indicators of resilience (such as numbers of juvenile corals and herbivorous fish). The project team then interpreted their results to identify targets for different types of management actions. They identified sites that met criteria for actions such as land-based sources of pollution reduction and monitoring recovery following coral bleaching. Fifty-five of the survey sites met at least one of the management action criteria.

This project represents globally relevant progress in the novel approach of using resilience assessments to inform, and even drive, management decision-making. Identifying potential targets for management action enables managers to consider these results during planning and decision-making processes. Scientist-manager collaborations formed during this project will facilitate use of the results by local managers for the coming years such as the development of education and outreach materials that raise awareness of climate change and reef resilience among community members and reef stakeholders.

Across the Pacific, assessing reef vulnerability and improving resilience is becoming more important. Climate variability like the recent El Niño, on top of an increasingly warming ocean, has led to concerns about resilience in the face of coral bleaching and acidification. Coral bleaching occurred in 2014 and throughout 2015 in American Samoa and Hawaiʻi.

Although coral reef ecosystems make up a very small percentage of ocean area, nearly a quarter of all marine species depend on them to survive. Millions of people across the Pacific rely on coral reefs for both food security and income, so any impact to these reefs will be felt acutely.

This project was funded by the PICCC to create a Google Earth tool that provides global projections of key threats to coral reefs, including coral bleaching, acidification, and calcification. This tool can be accessed online through the Coral Reef Watch website. Further funding from the PICSC allowed the team to apply the reef resiliency assessment and manager-decision tool to sites in the CNMI. See the PICSC 2013 project and 2015 project pages for more information.

Coral biologist Alice Lawrence assesses coral bleaching in American Samoa. Credit: XL Catlin Seaview Survey

Hawaiʻi's Narrowing Window of Opportunity to Protect Native Forest Birds

Forest birds are a point of pride for the people of Hawaiʻi. They populated Hawaiian history and mythology with their beautiful and unique colors, sounds, and stories. Today, tourists still flock to the islands to catch a glimpse of these enchanting creatures as they fly through the forest. And though the numbers of these unique birds have dwindled over the years due to threats like habitat loss and invasive species, they continue to serve as an emblem of an ecosystem that is as spectacular as it is fragile. But how will climate change impact these birds?

Global climate change is driving up temperatures in Hawaiʻi. This, in turn, is allowing mosquitos to move into prime high elevation areas, where for many years forest birds have sought refuge from threats within the remaining native forest. These mosquitos carry diseases, like avian malaria, which are deadly to forest birds.

On October 28, 2015, the PICCC and several partners released a new study (published in PLOS ONE) concerning the impacts of climate change on Hawaiʻi's treasured forest birds. This study found that without immediate and proactive conservation measures, these globally unique birds are at great risk of disappearing from Hawaiʻi's forests as warmer temperatures diminish the birds' current mosquito-free habitat. In the study, a team of scientists provides the first detailed set of range projections for each of the 20 remaining native forest bird species. The team found that nine of the most vulnerable species may lose 75% or more of their range as a result of the projected mosquito invasion of the higher elevation areas. Of these, six species may lose 90% or more of their current livable habitat this century.

Three threatened Hawaiian forest birds: ʻAkohekohe (Credit: J. Denny); ʻAkekeʻe (Credit: L. Behnke); and Akepa (Credit: J. Jeffrey)

The most threatened species include three endemic species from Kauaʻi—ʻAkekeʻe, ʻAkikiki, and Puaiohi. These birds are projected to experience complete range loss in climate-based range. Three additional species from other islands—Hawaiʻi ʻAkepa, ʻAkohekohe, and Maui Parrotbill—are also expected to lose more than 90% of their climate-based range.

While the results of this study look dire for the future of forest birds in Hawaiʻi, this doesn't necessarily spell the end. Instead, the study's authors make clear that the species are not doomed, however, something must be done immediately to address these threats.

Ongoing conservation and restoration actions have proven to be successful and still remain very important. But this research underscores that these efforts must be paired with new methods to deal with avian malaria and the spread of mosquitos as well as reclaiming large swaths of forest bird habitat that is currently uninhabitable due to disease. Conservation partners throughout Hawaiʻi and across the U.S. are coming together to step up to this challenge and begin implementing innovative actions to avoid avian extinctions.

The full study, "Large-scale range collapse of Hawaiian forest birds under climate change and the need for 21st century conservation options," is available online in PLOS ONE. This research was supported by the U.S. Geological Survey, the Pacific Islands Climate Change Cooperative, the Pacific Islands Climate Science Center, and the U.S. Fish and Wildlife Service.

More Climate Waves

Luka Mossman & Kehau Springer of Conservation International describe their projects on Hawaiʻi Island to UHH faculty. Credit: S. Nash

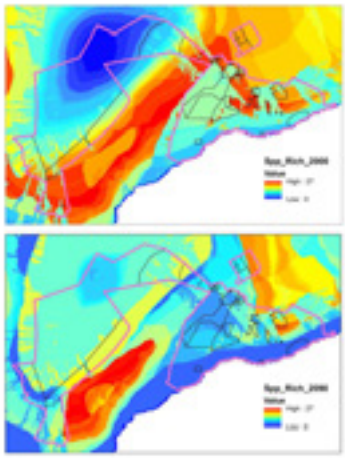
Initiating Collaborations on Hawaiʻi Island Through the Manager Climate Corps

University of Hawaiʻi at Hilo (UHH), as part of the PICSC consortium, held a meeting with Hawaiʻi Island natural resource managers and UHH faculty to initiate a network of managers and researchers working as teams on climate adaptation and resiliency research, called the Manager Climate Corps. The focus of the January 12 meeting was to begin the process of building collaborative graduate projects as well as long-term connections in this burgeoning network. Faculty at the meeting represented diverse departments from Business and Economics to Geography and Environmental Engineering and shared their ideas for developing climate knowledge products alongside managers and UHH PICSC staff. These collaborative products are intended to draw from and build on the experience and knowledge of a wide variety of island resource managers (e.g., traditional fishpond groups, county planners, watershed managers, farmers) and UHH and agency researchers. The overall goal of UHH Manager Climate Corps is to develop research and networking partnerships with Hawaiʻi Island natural resource managers to help our island community build resilience and adaptation approaches in the face of climate change impacts.

Spreading the News about Climate Impacts to Silverswords

Paul Krushelnycky (University of Hawaiʻi-Mānoa) will co-host a webinar on 10 February 2016 describing biological system impacts and responses to climate change as part of the Department of the Interior Climate Academy. The Climate Academy is an online course instructing natural resource managers about climate adaptation tools, current and established climate science, and science communications. The course is developed in partnership with US Fish & Wildlife Service's National Conservation Training Center, The Wildlife Society, The National Park Service, and state agencies. Dr. Krushelnycky's ongoing work on climate change impacts to the endangered Haleakalā silversword and its habitat is supported in part by the PICCC and the PICSC. You can read more about Dr. Krushelnycky's work in the first issue of the *Pacific Pandanus*.

Credit: P. Krushelnycky



Species richness map for Hawaiʻi Volcanoes National Park and environs, showing higher values in warmer colors.

Webinar: Impacts of Projected Climate Change Effects on Vegetation Management Strategies in Hawaiʻi Volcanoes National Park

Jim Jacobi (USGS, Pacific Island Ecosystems Research Center) and Rick Camp (Hawaiʻi Cooperative Studies Unit) presented their team's findings on December 9 as part of the PICSC's webinar series. Jacobi and Camp described how climate change is expected to alter the seasonal and annual patterns of rainfall and temperature in the Hawaiian Islands. This is a major concern for resource managers at Hawaiʻi Volcanoes National Park (HAVO) where current preserves for listed species may no longer provide suitable habitat in the future as climate changes. Expanding invasive species' distributions also may pose a threat to areas where native plants currently predominate, thereby requiring additional management action. Their work forecasts where 39 native and invasive species distributions are likely to expand or contract within HAVO and how those distributions align with current protected areas and "hotspots" of species richness. A recorded version of the webinar will be available soon on the PICSC website!

Climate In Action

Pacific Island Leaders Meet in Paris at the COP21

In the past, the people of the Pacific felt that their voices were ignored on the world stage. At the 21st Conference of Parties (COP) in Paris, Pacific leaders were determined to get their voices heard, and their commitment paved the way for a historic agreement.

The people of the Pacific islands attributed great importance to December's meeting, as their very future largely hinges on the outcome. Pacific island leaders used the opportunity to be on the world stage to highlight their vulnerable positions, showcase their commitments to mitigate climate change, and demand both commitment and follow-through to reduce greenhouse gases from leaders across the world.

Tony de Brum (Republic of the Marshall Islands Foreign Minister) joined with colleagues to create a Coalition of High Ambition. Representing more than 90 countries, this coalition joined the voices of all those committed to a highly ambitious agreement including an "ambition mechanism," firm recognition of the goal of attaining warming below 1.5 degrees Celsius, a clear pathway to a low carbon future, and a strong package of support for developing countries.

President Obama met with leaders from nations including the Marshall Islands and Kiribati and called on global leaders to commit financing to the most vulnerable nations. President Obama stressed the right to "dignity and sense of place" that the people of the Pacific islands deserve.

On COP 21's Day of Action, Palau highlighted the ocean reserve created to ban commercial fishing in 500,000 square kilometers of ocean in order to allow marine diversity to recover.

Conference attendees included Dr. John Peterson, representing the University of Guam and PICSC (as the Consortium Lead at UOG), and eight students from the University of the South Pacific representing several delegations including the Republic of the Marshall Islands and the Federated States of Micronesia. Their attendance is helping to build capacity across the Pacific islands for the future.

In the end, more than 190 countries reached a historic global agreement, resolving to reduce pollution and combat climate change. The countries agreed to develop a pathway to keep temperatures below 2 degrees Celsius, with an ambitious goal of limiting temperature change to below 1.5 degrees Celsius. What does this mean for the Pacific islands?

If the countries maintain their commitments, this could mean a reduction in the severity of the worst climate change impacts to the islands, including sea level rise, coral bleaching and ocean acidification. Although islands will still have to contend with some impacts of climate change, these commitments can provide a chance to improve the lives and livelihoods of those across the Pacific.

Foreign Minister Tony de Brum speaks during a press conference of the Coalition of High Ambition during the COP 21 in Paris, France (Credit: Takver, Flickr)

Climate In Action

Palau's Revolutionary Marine Sanctuary to Contend with Climate Change

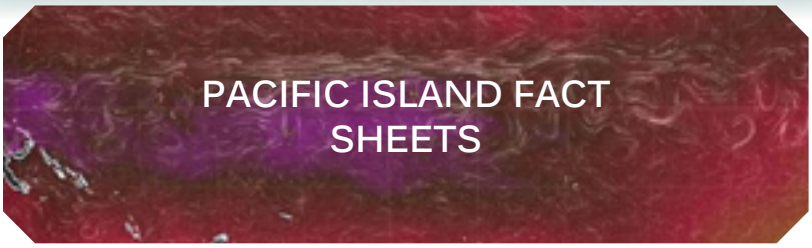
Not content to simply sit back and watch as the world makes slow progress towards climate change mitigation, Palau is taking proactive steps to address local impacts of global climate change. After the country recently revealed the Climate Change Policy for Climate and Disaster Resilient Low Emissions Development, Palau is now doing even more to protect their marine environment in the face of climate change.

Divers inspect a large purple soft coral protruding from the surrounding rock wall in Palau. Credit: Pacific Deep Reefs Exploration 2011, NOAA-OER

The many threats of climate change to marine life are in turn threatening the communities of the Pacific people. Marine life is vulnerable to the many changes in the ocean, including ocean acidification, coral bleaching, and sea level rise. The impacts to fish populations are putting Pacific islanders at risk to lose sustainable food security and livelihoods.

What can islands do to confront this problem? Palau is trying something ground-breaking, enacting legislation to create a National Marine Sanctuary, in order to protect a vast amount of its marine zone (80%) from activities like overfishing, oil drilling, and other potentially damaging activities. The total area being devoted to this protected area is 193,000 square miles, making it the sixth largest marine sanctuary in the world.

Marine reserves like this one help to battle back against climate change, as these can increase populated sizes and reproductive rates of threatened species, increase biomass, and improve habitat recovery by safeguarding areas. It also provides the world with an example of local actions that have the potential to improve the environment on a global scale.



Pacific RISA's El Niño Fact Sheets

El Niño is a complex weather pattern characterized by unusually warm water in the equatorial Pacific Ocean. As one phase of the El Niño Southern Oscillation (ENSO), El Niño appears every two to seven years and can last for nine to twelve months, or more. This disruption in the oceanic and atmospheric system has important consequences for weather and climate all over the world.

Have you heard about the current El Niño? Are you wondering about the impacts to your island home? Our colleagues at the Pacific RISA have developed factsheets that describe the projections of physical impacts to sectors in the following locations: Hawaiʻi, American Sāmoa, Guam and the Commonwealth of the Northern Marianas Islands, the Federated States of Micronesia, the Republic of Palau, and the Republic of the Marshall Islands. These fact sheets are tailored and can help to inform decision-makers, resource managers, and members of the public across the Pacific.

Find your fact sheet here!

Climate In Action

In Guam: Is Soil a Carbon Sink or Carbon Source?

Golabi with Vetiver grass plots, Guam. Credit: M. Golabi

As countries discuss how to mitigate climate change impacts, they look to carbon sequestration as a solution for cutting back carbon dioxide levels. Soils have been discussed as a carbon sink, where carbon from the atmosphere can be stored, but they are discovering in Guam that soils can also be a carbon source as well. Dr. Mohammad Golabi, Professor of Soil and Environmental Sciences at the University of Guam, has found that soil microbes emit carbon dioxide into the air when the soil is disturbed during plowing, tilling, or even the turning caused by off-road vehicles. Golabi says, "By increasing the numbers of CO_2 capturing plants, we can actually reduce the effect of carbon dioxide considerably." He and his team are evaluating different farming practices and have observed that systems without tillage retain more carbon than tilled soils. Golabi's group is also looking at increasing the sequestration capabilities of soil through inputs as well as using Vetiver grass to capture CO_2 and reduce soil erosion.

Calendar

Recent events...

October

19-23 LCC virtual all-hands meeting

28 Release of Forest Bird Vulnerability Assessment

November

30 UN Conference of Parties 21, Paris

December

3 PICCC Steering Committee meeting

9 PICSC webinar: J. Jacobi and R. Camp: Impacts of projected climate change effects on vegetation management strategies in Hawai'i Volcanoes National Park

14-18 American Geophysical Union Fall Meeting, San Francisco, CA

January

11-15 NOAA's Office of Coastal Management Pacific Program Manager's Meeting, Honolulu, Hawai'i

12 UHH PICSC Meeting of Faculty and Manager Climate Corps, University of Hawaii at Hilo

Wave Forecasting Gathering, American Samoa

Coming up...

January

26-28 Hawaiian Wetlands and Waterbird Workshop, Kaneohe, O'ahu

February

11 Hawai'i Sea Level Rise Vulnerability & Adaptation Workshop, Honolulu, Hawai'i

March

14-18 Pacific Risk Management Ohana (PRiMO) Conference, Honolulu, Hawai'i

April

11-15 Regional Conference on Island Sustainability, University of Guam (see Opportunities, next page)

Opportunities

- The **Island Resilience Initiative**, launched by **Context Partners** along with the **Global Island Partnership (GLISPA)** at the UN Climate Change Conference (COP 21) in Paris this December, is releasing 20 new prize concepts to combat climate change. Read more at the White House's website.

- The **2016 NOAA Coastal Management Fellowship** provides on-the-job education and training opportunities in coastal resource management and policy for postgraduate students and project assistance to state coastal zone management programs. The two-year program matches postgraduates with state coastal zone programs to work on state projects and selected by NOAA Coastal Services Center. Read more at the fellowship website. Applications due: January 22.

- The **National Institute on Environmental Health Sciences (NIEHS) CIImate Change and Environmental Exposures Challenge** calls on talented software developers, data scientists, and other innovators to create data visualizations, tools, and applications making use of the best available science on environmental exposures and increases in temperature, precipitation, flooding, and sea level rise. Read more at NIEHS Challenge webpage. Deadline for submissions: February 1st.

- The **NASA Student Airborne Research Program** invites highly motivated undergraduates to apply to fly onboard the NASA DC-8; assist in the sampling and measurement of atmospheric solar radiation, gases, and aerosols; and image land and water surfaces. Students will work in multidisciplinary teams for eight weeks to study surface, atmospheric, and oceanographic processes. For more information, email sarp2016@nserc.und.edu. Application deadline is February 2; apply here.

- The **NOAA Office of Education** has announced the **Environmental Literacy Grants (ELG) Funding Opportunity** for education projects designed to strengthen the public's and/or K-12 students' environmental literacy. Successful projects will advance NOAA's mission to enable informed decision-making necessary for community resilience to extreme weather events and hazards and focusing on geographic awareness and the vulnerabilities associated with a community's location. Read more at the Grants website. Application deadline is February 8.

- The **Office of Insular Affairs** is requesting proposals for its **Technical Assistance Program (TAP)** which provides grant funding for short-term projects intended to meet the immediate needs of the insular areas. For 2016, the highest priority for TAP will be for climate change adaptation planning, assessment, or implementation. Applicants from U.S. territories must coordinate with the offices of their respective governors, and applicants from the Freely Associated States must coordinate with the offices of their respective presidents. Read more at DOI grants website. Application deadline is March 1.

- The **7th Regional Conference on Island Sustainability** is a forum for remote Pacific island and Alaskan communities to explore issues within their regions, collaborate on research, and build awareness of sustainable practices and lifeways. The conference will take place April 11-15 and is co-hosted by the **University of Guam Center for Island Sustainability** and the **University of Alaska Fairbanks.** Contact Elvie Tyler at elvie.tyler8@gmail.com for submission details. Submission deadline is 4:00 pm, March 4 (ChST).

- Applications are now open for the **IMBER ClimEco5 summer school** that will be held in Natal, Brazil, from 10-17 August 2016. ClimEco5 will focus on anthropogenic and natural changes affecting the ocean, and will emphasize linkages between these and social, economic and policy issues associated with maintaining sustainable and productive oceans. Read more at the summer school website or email imber@imr.no.

Staff In Focus

Romina King

Romina King is the Climate Coordinator at the PICSC and for the Center for Island Sustainability at the University of Guam. She recently completed her PhD at the University College Cork in Ireland on vulnerability and adaptation to climate change in Guam. Her study integrated climate change impacts to Guam and the Commonwealth of the Northern Marianas with rural community perceptions and knowledge of those impacts.

Read more about Romina's work in: **What do Guam communities, watersheds, and puppetry have in common? Romina King!**

Lucas Fortini

Lucas Fortini is employed by the U.S. Geological Survey to seve as the PICCC's Research Ecologist. He has studied ecosystems around the world from the Amazon to mainland USA to Hawai'i. In order to understand how ecosystems react to change, Lucas applies his knowledge of both theoretical modeling and field ecology. Despite the inherent uncertainties with climate change, Lucas believes that ecosystem models can help managers make more informed decisions and plan for different climate scenarios. Read more about Lucas' work looking at the vulnerability of Hawai`i's forest birds on the PICCC website and on page 5 of this newsletter!

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Missing our list of stakeholders and partners? Visit the PICCC and the PICSC websites to see the full lists and links to our partners' websites.

Do you have climate work that you would like us to highlight in our next quarterly newsletter? Please send in submissions to the editors: snash@hawaii.edu & whitney.peterson@piccc.net
To be added to or removed from the mailing list please also contact the editors by email.

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