PACIFIC ISLANDS
CLIMATE CHANGE
COOPERATIVE

2012 HIGHLIGHTS

Pacific Islands Climate Change Cooperative

About PICCC

The Pacific Islands Climate Change Cooperative (PICCC) is one of a network of 22 Landscape Conservation Cooperatives working across North America, the Pacific Islands, and the Caribbean to address large-scale conservation issues such as climate change, habitat fragmentation, invasive species, and drought.

The PICCC partnership brings together state and federal agencies, cultural and natural resource managers, universities, conservation groups, educators and other key partners to address the critical impacts of climate change on native species, island ecosystems, and cultural resources in the Pacific Islands. The PICCC's members and partners span the Pacific region, from Hawaii and the US-affiliated islands in the Samoan, Mariana, and Micronesian archipelagoes.

Mission

The PICCC's mission is to improve the ability of native island species, island ecosystems, and key cultural resources to withstand future climate change impacts.

Goals

- To provide the science and technical expertise needed to support conservation planning at landscape scales that are beyond the reach or resources of any one organization.
- To generate the tools, methods, and data, that managers need to design and achieve their conservation goals.
- To promote collaboration among members in defining shared conservation goals.

A Region in Peril

Pacific Islands including Hawai'i, the Mariana Islands, America Samoa, and other island groups are facing multiple challenges from a warming climate. Thousands of unique island plant and animal species, including more than 450 species on the U.S. Endangered Species list, are threatened by a variety of effects of environmental change. As mentioned in the 2010 State of the Birds report, oceanic birds risk losing essential habitats from rising sea levels and invasive species. Over 90% of U.S. coral reefs are also located around the Pacific Islands, which are at risk from increased ocean temperatures and acidification. Other negative impacts of a warming climate include changes to rainfall patterns and freshwater availability; increasing diseases in wildlife, corals, and fisheries; wildfires; coastal erosion; and even the permanent flooding of low-lying islands. Fortunately, regional and local organizations are strengthening their capacity to respond to climate-driven environmental change through the assistance of the PICCC. The PICCC is providing information, strategies, and tools to help managers anticipate climate change effects and prioritize where to focus their resources.

PICCC's Integrated Approach to Understanding Climate Change

As climate change contributes to large-scale ecosystem changes, management organizations require new information and tools to address novel conservation challenges. To meet this need, the PICCC launched an effort in 2011 to identify the resource management goals, barriers, and climate factors that are of most concern to its member organizations. From this emerged an Integrated Science Framework that identified science priorities for the PICCC to undertake in 2012 and beyond.

The Integrated Science Framework provides sideboards for the PICCC's science activities by identifying research focus areas and their interactions with specific climate factors. The research focus areas will improve our understanding of how to:

- maintain or improve ecosystem function,
- maintain or improve the status of at-risk species, and
- preserve key cultural and natural resources and their uses.

Specifically, the PICCC membership wishes to understand how to achieve these goals in the face of high-priority climate factors such as changes in rainfall, storm frequency and intensity, sea level, ocean chemistry, and sea surface temperature.

Within this context, the PICCC developed a set of Science Priorities for 2012 to reflect the immediate needs of its member organizations for meaningful science products that will best position our partnership in adapting management practices to the impacts of climate change. These priorities address the need for:

- critical climate change information at island-relevant scales;
- better understanding of ecological and social responses to climate change;
- advanced analytical methods and models to evaluate adaptive responses; and
- tools to visualize or compare future states for natural and cultural resource managers.

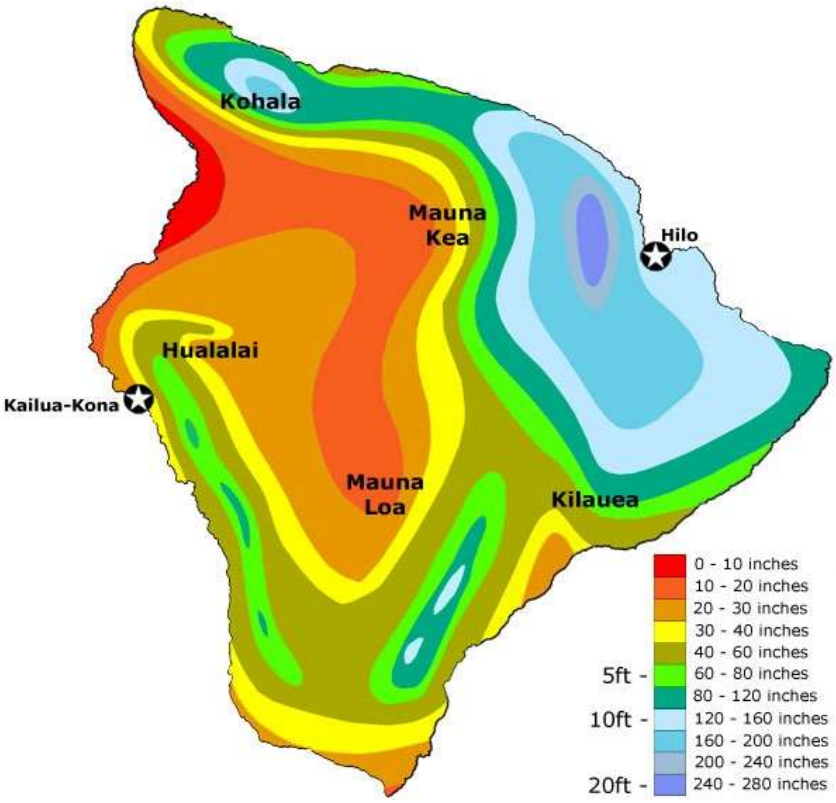
The Pacific Islands span a region of unparalleled ecological diversity that is vital to supporting rich, living cultural traditions. Pictured here is the village chief council of Nuu'uli, American Sāmoa, in a traditional ava ceremony to honor and welcome important visitors.

(Photo courtesy of Tavita Togia, National Park Service)

PICCC AT WORK: REFINING REGIONAL CLIMATE CHANGE PROJECTIONS FOR EFFECTIVE ADAPTATION

Researchers have found signs of changing water availability for the Pacific Islands. Recent analyses of rainfall records from Hawai'i show a 15% decline in precipitation over the last 15 to 20 years for the region (Diaz et al. 2005; Chu and Chen 2005). This declining trend in rainfall is corroborated by a decline in stream flow from early in the last century and significant drought intensification on some of the Hawaiian archipelago (Oki, 2004). Trade wind inversions (features of mid-latitude climates that cap cloud formation at high elevations) have been more persistent and occurring at lower elevation which may result in less precipitation in high elevation areas (Cao et al, 2007). These historical trends suggest a worrisome, drier future for people, wildlife, and plants in the Pacific Islands.

Climate downscaling to bridge science and management - As rainfall is distributed unevenly across the islands due to local topographical and climatic variability, detailed climate projections are crucial to help managers plan and adapt to a future where vital water resources are potentially scarcer. To meet this need the PICCC has partnered with several regional climate researchers to provide fine-scaled climate change projections. the PICCC's efforts include (1) statistical climate downscaling to estimate the future rainfall changes over the Hawaiian Islands for the 21st century and (2) dynamical climate modeling for Pacific Islands at a spatial scale (1 - 3 km) that is ecologically relevant to natural resource managers. Such efforts will not only yield better estimates of changes in precipitation but also changes in temperature extremes, storminess, and drought frequency - all factors of critical importance to land and marine managers in the region. The broad representation of regional resource managers in the PICCC, and their input into the ongoing research, will ensure that these PICCC science efforts lead to proactive and collaborative actions based on common interests in protecting resources of high ecological and cultural value.



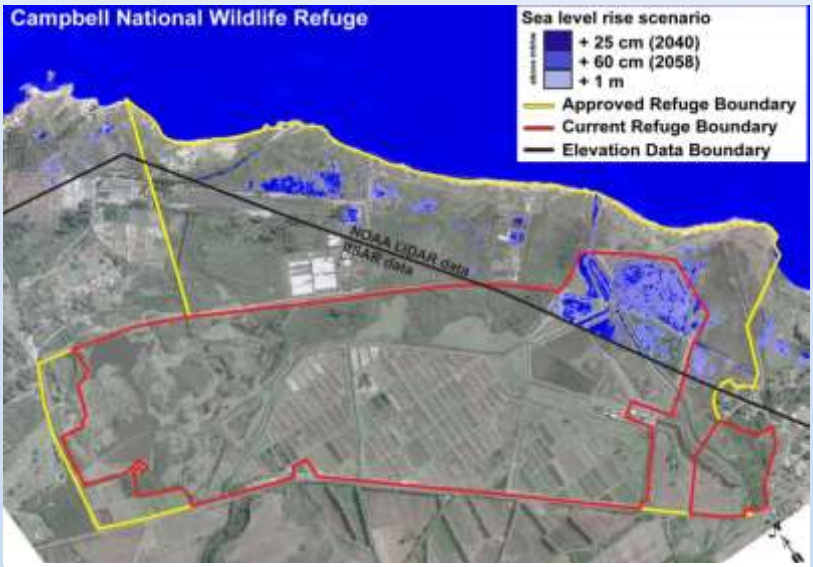
Variability of rainfall distribution is extreme in high Pacific Islands

PICCC AT WORK: DEFINING THE SEA LEVEL RISE IMPACTS TO HAWAIIAN COASTAL ECOSYSTEMS

In the Pacific Islands, sea level rise (SLR) threatens low-lying terrestrial wetlands, estuaries, beaches, and a large portion of human settlements through accelerated coastal erosion and saltwater intrusion into streams and groundwater. Overall, SLR will increase the already troublesome competition between human development and fragile ecosystems on land-limited coastal plains. Pacific Islands coastal land managers are concerned about SLR but need to clarify potential impacts to their sites of interest for effective planning.

One meter elevation contour line for Honolulu (Source: C. Fletcher)

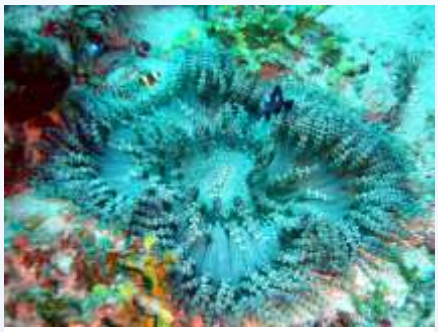
Sea-level Rise Modeling for effective Climate Change Adaptation - the PICCC has partnered with Dr. Charles Fletcher (Department of Geology and Geophysics, University of Hawai'i) to provide SLR impact maps that have high spatial and temporal specificity to meet the needs of coastal land managers. Map visualizations of SLR impacts will be constructed using LiDAR topographic data sets with overlays of Quickbird and vertical aerial imagery. These products will provide clear and high resolution visualizations of potential SLR impacts in terms of changing surface environments, proximity to human communities, and comparisons of modern versus future physical configurations.



Sea-level rise scenarios for James Campbell NWR, O'ahu (Source: C. Fletcher)

Ensuring Utility of Research to Coastal Land Managers - SLR scenarios will feed directly into planning and management assessments of the vulnerability of targeted species and ecosystems to assist PICCC partners in choosing among potential management strategies based on their likelihood for success. Following the initial mapping and flooding frequency analysis, stakeholder meetings will be used to assess needs and define gaps to identify and design final products. The outcome will be improved confidence and reliability, which will facilitate management decisions with regard to improving ecosystem and community resilience to the impacts of rising sea level.

PICCC AT WORK: DEVELOPING OPTIONS FOR CORAL REEF MANAGEMENT IN A CHANGING CLIMATE



Healthy coral reefs support a diversity of marine life (Photo courtesy of P. Brown, NPS)

Tropical coral reefs are among the most productive and diverse ecosystems in the world, where thousands of species coexist in a complex and productive community structure built by living corals. These ecosystems are declining due to human impacts, including climate change. Scientists around the world are documenting severe impacts to reefs from warming seas and ocean acidification. High water temperatures stress the corals and cause them to expel their crucial symbiotic algae. Without the colored algae living in tandem with the coral, the translucent coral animal exposes its white skeleton, giving a "bleached" appearance to the coral colony and can lead to coral death. One event in 1998 caused close to 16% of the world's coral to die. These events are becoming more frequent as the ocean continues to warm, putting the long-term future of coral reefs in doubt. Adding to this thermal stress is the increasing acidification of the ocean, caused as the oceans absorb rising levels of carbon dioxide from the air, which impede the ability of corals to build their limestone skeletons.

A New Tool for Coral Reef Management - The ability of coral reef managers to address bleaching is currently limited to predicting events and monitoring their effects on the reef ecosystem. In an effort to expand the range of management options, the PICCC is funding a proof-of-concept study of technologies that may cool selected reefs and buffer them from acidification. The Climate Foundation has developed a field-based cooling system for reef water, and has demonstrated that small amounts of cooling can produce dramatic, rapid reductions in coral bleaching on coral reefs. Seasonally high temperatures at a reef on the island of Tutuila in American Samoa cause predictable bleaching of corals, creating an ideal test site. Initial tests have shown that reducing peak water temperatures by about 1-2° C enables two sensitive species of coral to regain and retain their healthy color during periods of thermal stress. The Climate Foundation also is testing modification of seawater chemistry to counteract ocean acidification. The conservation potential of these technologies will depend on their effectiveness, scalability, cost, and ability to be deployed to remote reefs affected by bleaching. The support of the PICCC is crucial to this exploratory effort to develop practical management tools for a currently intractable impact of climate change on one of the Pacific's most valued ecosystems.

At a coral reef on the island of Tutuila, American Samoa, local reef water was cooled by 1-2° C and directed onto bleached Acropora muricata *and* Acropora pulchra*. These photos depict the thermally-induced bleaching reversal within a 24 hour period. The top photo is a coral patch before treatment; the bottom photo is the same patch after treatment. (Photos courtesy of B. Von Herzen)*

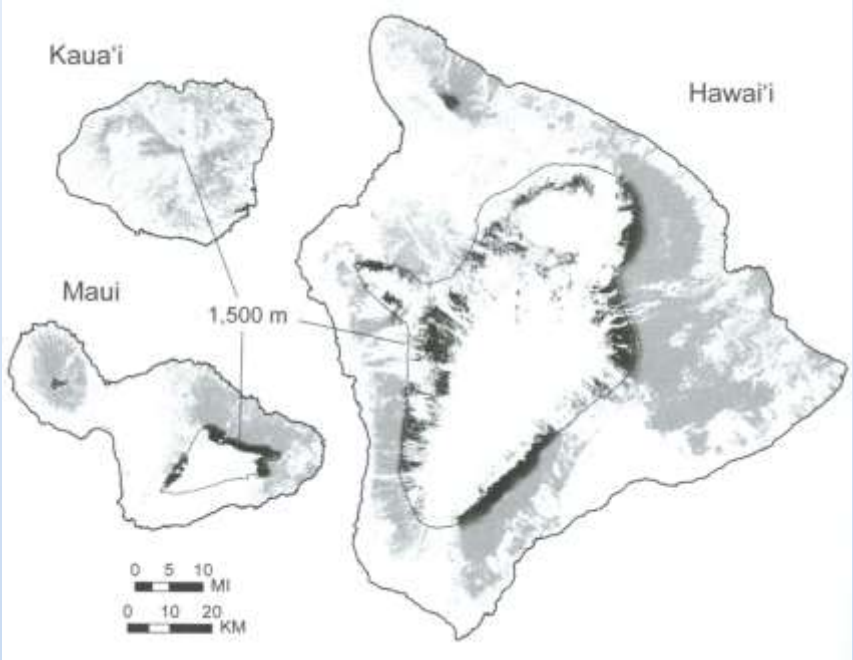
PICCC AT WORK: SAFEGUARDING HAWAIIAN FOREST BIRDS FROM CLIMATE CHANGE

'Akepa, an endangered endemic Hawaiian forest bird (©Jack Jeffrey photography)

Hawaiian endemic forest birds have suffered from centuries of introduced predators, disease, competitors, and quickly degrading habitats. Today they are arguably one of the most threatened species groups on the planet with 11 forest bird extinctions recorded since the 1960s alone. Climate change unfortunately exacerbates past threats by, among other things, allowing disease-bearing mosquitos to encroach on high elevation, disease-free refugia and by slowly unraveling habitats and plant species that forest birds depend on.

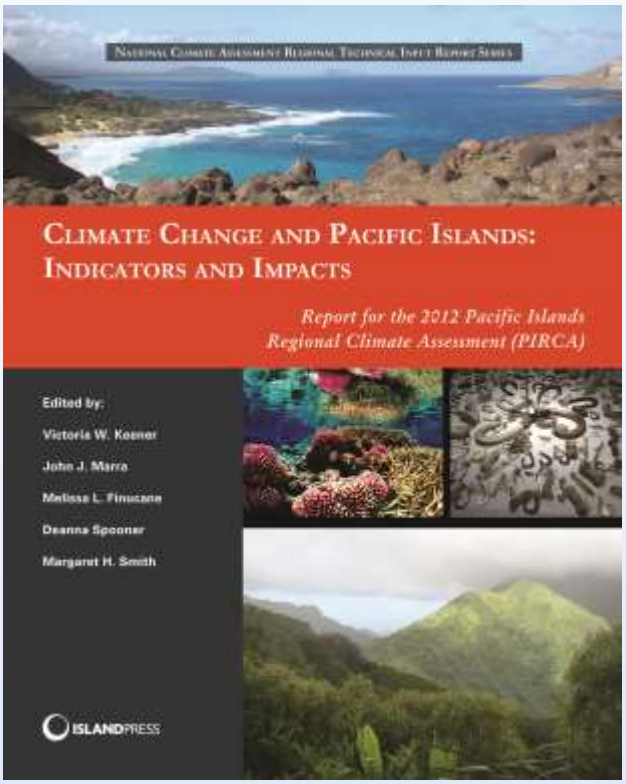
In partnership with the FWS, USGS, University of Hawai'i, and NOAA, the PICCC is trying to elucidate the potential impacts of climate change on Hawaiian forest bird species. Based on PICCC-supported regional climate projections, climate researchers are working collaboratively with the PICCC's in-house scientists to develop predictive models of potential future habitat for native Hawaiian birds and other biologically important species. These models can be used to identify species most at risk as well as invasive species and diseases that may expand their range and impact. the PICCC also is funding research on the genetic adaptability of Hawaiian honeycreepers to avian malaria.

This research, coupled with other PICCC efforts aimed at improved future temperature projections for the Hawaiian islands, will yield critically needed information to adapt current forest bird conservation plans, recovery efforts, and related management actions.



With climate change, viable forest bird habitat (dark shaded areas) will likely be reduced by avian malaria now restricted to elevations < 1500 m (black line) and by changes in the distribution of plant communities forest birds depend on (Pratt et al. 2009).

PICCC IN PARTNERSHIP: THE PACIFIC ISLANDS REGIONAL CLIMATE ASSESSMENT (PIRCA)



Throughout 2012, the PICCC co-led a groundbreaking effort linking more than 100 scientists, resource managers, educators, community members, and other stakeholders in a collaborative effort aimed at assessing climate change indicators, impacts, and adaptive capacity of the Hawaiian archipelago and the US-Affiliated Pacific Islands. The Pacific Island Regional Climate Assessment (PIRCA) held three technical workshops between November 2011 and January 2012 to provide a foundation for a sustained assessment process. These workshops also fed into a technical report to the National Climate Assessment, which ultimately was published in December 2012 under the title "Climate Change and Pacific Islands: Indicators and Impacts - Report for the 2012 Pacific Islands Regional Climate Assessment."

Also in December, to coincide with the report's publication, the PICCC co-hosted a forum in Honolulu, Hawai'i, with close to 150 people participating in the public session featuring sector leaders from across Hawai'i and the Pacific. Forum highlights can be viewed online at http://vimeo.com/pirca

The 2012 PIRCA report represents the beginning of a sustained process of assessment and information exchange across the Pacific Islands region. In conjunction with other regional assessments and national assessments, we anticipate the 2012 PIRCA will provide guidance for decision makers seeking to better understand how climate variability and change impact the Pacific Islands region and its communities.

To download the PIRCA report please visit
http://www.cakex.org/virtual-library/climate-change-and-pacific-islands-indicators-and-impacts

Opening session of the Pacific Islands Regional Climate Forum December 10-12, 2012, in Honolulu, HI (Photo courtesy East-West Center)

PICCC Members

American Bird Conservancy
Bernice Pauahi Bishop Museum
Hawai‘i Conservation Alliance
Hawai‘i Department of Land and Natural Resources
Hawai‘i Wetland Joint Venture
Kamehameha Schools
National Oceanic and Atmospheric Administration
National Park Service
Office of Hawaiian Affairs
Pacific Science Association
The Nature Conservancy Hawai‘i
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U.S. Army Garrison Hawai‘i
U.S.D.A. Forest Service
U.S.D.A. Natural Resources Conservation Service
U.S. Geological Survey
U.S. Fish and Wildlife Service
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*(Photos: front cover, Ofu Lagoon, American Sāmoa; back cover, Hakalau Forest National Wildlife Refuge; this page, fat Guam partula tree snail (*Partula gibba); *all courtesy of D. Spooner, USFWS)*