

# natural science

Hawaiian  
Islands



## Climate Change and Biodiversity in Melanesia

Off the coast of Papua New Guinea lies a small series of atolls known as the Kilinailau, or Carteret Islands. Nestled in the Solomon Sea, these remote, beautiful islands have long been home to nearly 1,600 people. And today, they are slowly being swallowed by a rising sea.

At high tide, waves inundate the islands, ruining wells, crops, and homes. Salt water has destroyed their coconut palms, and growing breadfruit or taro is impossible in the salted soil. Many islanders are near starvation. For more than twenty years, they have battled the slow, inexorable surge of the tide.

In 2005, the Papua New Guinea government began a permanent evacuation of the Kilinailau people, the first refugees of the effects of the climate change we are experiencing across the globe. Scientists expect the islands to sink back into the sea by 2015. Elsewhere in the Pacific, two uninhabited islands of Kiribati have already been engulfed.



Right: A New Guinea rainforest.  
Photo courtesy Michael Moore, 1998.

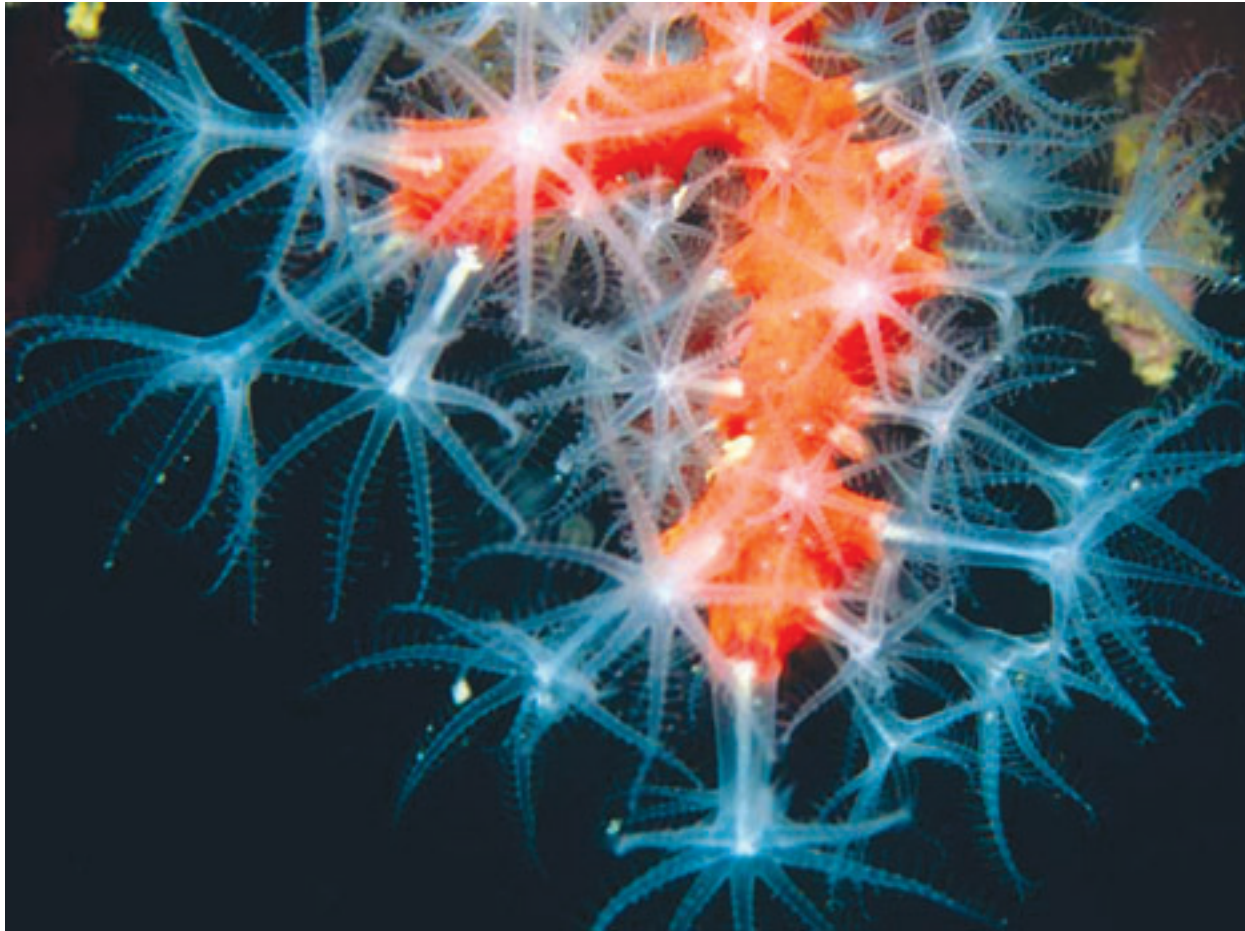
Opposite top: A closeup of a red coral,  
*Corallium rubrum*, Marine Photobank.  
Photo courtesy G. Marola, 2007.

Opposite bottom: Papua New  
Guinea's Raggiana Bird of Paradise  
(*Paradisaea raggiana*), photo courtesy  
Bruce Beehler.

The global climate *is* changing, with a slow but steady warming trend over the past fifty years. And, the UN’s Intergovernmental Panel on Climate Change (IPCC)—which shared the 2007 Nobel Peace Prize with former Vice President Al Gore—recently concluded that this temperature increase—now considered “unequivocal”—is very likely due to human activities. As temperatures increase and the sea levels rise accordingly, what the Kilinailau islanders face today may become more and more common. The rising sea levels will also have a devastating impact on the plants and animals that called Kilinailau home.

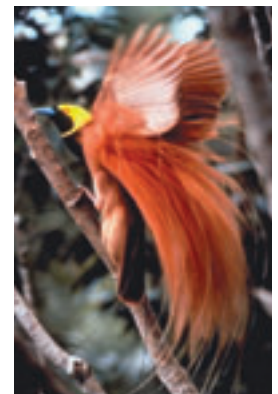
How will climate change impact human societies and biodiversity in the Pacific? Today, Bishop Museum scientists are working on this very question—one that is of increasing concern to Pacific Island communities. In 2007, Bishop Museum, in collaboration with the South Pacific Regional Environment Programme (SPREP), received a grant from the John D. and Catherine T. MacArthur Foundation to assess the vulnerability of island ecosystems in Melanesia in the face of projected climate changes. Museum scientists Dr. Allen Allison, Dr. Stephen Leisz, and John Burke Burnett are investigating the projected impacts of climate change on biodiversity in Melanesia, while researchers at SPREP study the institutional and socio-economic abilities of the countries of Melanesia—Papua New Guinea, Indonesia’s Papua province, Solomon Islands, Vanuatu, New Caledonia, and Fiji—to adapt to the changing climate.

The island nations of Melanesia lie deep in the tropical western Pacific and are home to a breathtaking array of cultural and biological diversity. Melanesia’s seas and coral reefs are the epicenter of the world’s marine biodiversity, and its islands host some of the



most diverse terrestrial ecosystems on the planet. Here, giant clams, birds of paradise, tree-climbing kangaroos, and over half of the world’s species of coral can be found. This spectacular diversity makes Melanesia especially important; yet it is also exceptionally vulnerable to habitat degradation and habitat loss. Effective conservation strategies are essential to preserving Melanesia’s rich natural resources. In order to be successful in the coming years, these strategies must also account for the impact of global climate change.

This past fall, a diverse group of scientists met on O’ahu to explore these topics. Climatologists and





# Effects of climate change in Melanesia

## Coral Bleaching

Coral bleaching occurs when corals expel their colorful symbiotic algae as a reaction to environmental stressors, such as high ocean temperatures. These events can permanently damage coral reefs, and are likely to become more frequent as sea surface temperatures rise. All of Melanesia's reefs and oceans are warming, with northern Melanesia likely to experience more frequent and prolonged coral bleaching events before the southern areas of the region. However, recent scientific studies suggest that some species of corals are less susceptible to warming than others. Careful management of marine protected areas fostering diverse communities of corals may provide healthy coral reef ecosystems with some degree of adaptability in response to higher sea surface temperatures.

## Rising Sea-levels

Sea-levels in the northern Melanesia area have been rising faster than the global mean. This implies that sea levels will continue to rise faster in Melanesia than the global average, which is currently projected by the IPCC to be around one-half to one meter by 2100.

## Ocean Acidification

Oceans naturally absorb CO<sub>2</sub>, but the scale of recent man-made emissions is so large that the chemistry of the Earth's oceans is changing. When oceans



absorb CO<sub>2</sub>, carbonic acid forms. Global ocean surface waters have become more acidic in recent decades, and are projected to reach levels of acidity by 2100 that have not been seen for possibly tens of millions of years, and never on such a rapid timeframe.

Acidification of ocean waters reduces the availability of calcium carbonate required by organisms such as corals, sea urchins, clams, and zooplankton. Acidification also interferes with respiratory processes in fishes, and may impact their food supply

Based on the most recent scientific projections, calcium carbonate levels in the world's equatorial regions will become marginal for corals and phytoplankton by 2070, and even sooner in the higher latitudes, towards the poles. This will result in the slowing or even reversal of reef formation and shell formation, possibly resulting in major disruptions to marine food webs.

Above left: *Acropora* Table Coral, Marine Photobank. *Acropora* corals are especially susceptible to bleaching when stressed. Photo courtesy Pat Faulkner.

Above right: Blue-ringed angelfish (*Pomacanthus annularis*), Indonesia. Photo courtesy James Maragos.

Right: Tree kangaroos are found in the rainforests of New Guinea. Photo courtesy Kris Helgen.

oceanographers—those at the vanguard of Pacific climate change research—came together with experts in the marine and terrestrial ecosystems of Melanesia to discuss possible scenarios, and the efforts that might help mitigate some of the likely effects of climate change.

One of the main preliminary conclusions reached at the workshop was that intact, healthy habitat can boost an area's resilience in the face of climate change. Climate change is not a new phenomenon, and over the millennia, ecosystems in Melanesia have proven to be quite resilient to fluctuations in climate. However, logging, mining, over-fishing, and pollution have all taken their toll in many parts of Melanesia, and these areas may be



more vulnerable and less resilient to climate change today.

Establishing effective marine and terrestrial protected areas in Melanesia and across the Pacific is one crucial step towards sustainability. Such reserves will protect not only the biological diversity of the region, but may help to mitigate the effects of climate change as well.

The MacArthur-funded project will continue through 2008, and will ultimately produce a set of recommendations to aid policy makers in designing conservation and management approaches that can be successful

in the climate of today and tomorrow. For more information on the project, visit Bishop Museum's website, [www.bishopmuseum.org](http://www.bishopmuseum.org).