



How to Save an Island From Climate Change

September 15, 2022

A group of NOAA experts and partners have taken on the monumental task of protecting a small Hawaiian atoll from climate change.



Lalo (French Frigate Shoals) is one of the world's largest tropical seabirds rookeries, but climate change threatens the atoll's seabirds and other animal inhabitants. Credit: NOAA

Despite being no more than 11 acres in area, East Island of Lalo—the atoll also known as French Frigate Shoals—holds immeasurable value. Situated within the [Papahānaumokuākea Marine National Monument](#), East Island (and Lalo as a whole) is vital habitat for various land- and ocean-dwelling species. It's also a culturally significant place for Native Hawaiians.

In September 2018, however, [Hurricane Walaka](#) (a Category 3 at the time of its closest approach to Lalo) nearly wiped it off the map.



East Island before (left) and after (right) Walaka. Credit: NOAA

East Island has since begun to recover, its sands and loose gravel slowly returning to create the small island it once was. But the alarming and sudden disappearance of the islet was a sobering reminder of the climate-related threats looming over Lalo and other low-lying atolls. It also sparked efforts to determine how best to protect the islands' natural and cultural resources in the face of rapid climate change.

"What does active management look like in a remote location where the power of nature is greater than anything we can do?" asked Malia Chow, Essential Fish Habitat and Pacific Marine National Monuments Branch Chief, [NOAA Fisheries Pacific Islands Regional Office](#).

A coalition of resource managers, scientists, and Hawaiian cultural experts from NOAA and partnering agencies are working hard to spotlight and answer this and other difficult questions. They've held two workshops to amass the state of knowledge around the current

and future threats to Hawaiian monk seals, seabirds, sea turtles, and coral reef ecosystems at Lalo. They've determined the greatest threats to be:

- Flooding and inundation from sea level rise and storms
- High sea surface and subsurface temperatures
- Entrapment from damaged and decaying infrastructure at Lalo's Tern Island



Green sea turtle trapped by decaying infrastructure at Lalo. Credit: NOAA

Now, the collaborators will hold another series of webinars to determine potential adaptation measures to protect the species that live at Lalo.

“Multifaceted issues like this need an all-hands on deck approach,” said Ann Barlow, natural resource management specialist in NOAA’s Monuments Program. “We’re fortunate that the different NOAA offices, and so many agency, cultural, and academic experts, are all willing to lend their expertise to developing the resilience plan.”

Immeasurable Value, Measureable Problems

Lalo’s landmass is a vital habitat for Hawaiian monk seals, seabirds, and green sea turtles; its reefs are home to countless other fish and invertebrate species. But the atoll can be a challenging home.

At Tern Island, monk seals, seabirds, and sea turtles live among damaged and decaying military structures, remnants of World War II. These structures are trapping and killing the animals, and seabirds have occasionally been killed from falling debris due to high winds and rain. This entrapment issue is only exacerbated by marine debris such as derelict nets and fishing gear.

If that’s not enough, the animals are also already experiencing the effects of sea level rise and increased temperatures, which will only worsen in the years to come.

Hawaiian Monk Seals



Lalo is a primary refuge for about 20 percent of the endangered Hawaiian monk seal population in Papahānaumokuākea. The atoll provides safety from sharks, sandy beaches for nursing and birthing, and a resting site necessary to reach foraging areas farther up the island chain. Two of Lalo’s primary pup birthing islands—Whale-Skate and Trig—are now [submerged](#), while the third, East Island, is roughly half its pre-Walaka size.

Seabirds



Tern Island is a primary rookery for seabirds in the Papahānaumoku Marine National Monument. Credit: NOAA

The atoll, especially Tern Island, serves as one of the largest tropical seabird rookeries in the world. Sea level rise is already occurring on Tern, causing a loss of emergent land and vegetation. Shrub-nesting seabirds need vegetation for shade and nesting, while burrowing seabirds need the vegetative roots to secure sand and burrows. And that's not the only problem.

"Increased air temperatures are a big issue for seabirds," said John Marra, Pacific Islands Regional Climate Director, NOAA's [National Centers for Environmental Information](#). Acute heat stress causes nesting seabirds to pant or stand off of their nest to cool down, which could affect egg development. High temperatures can also directly kill eggs and chicks, and chronic heat could cause nesting seabirds to abandon Lalo.

Hawaiian Green Sea Turtles

High temperatures are a [well-known problem for sea turtles](#), too, because the sex of hatchlings depends on the nest incubation temperature. Warmer temperatures produce more females, eventually creating a population with too few males to reproduce effectively—if they have adequate nesting areas to reproduce at all.



Green sea turtles basking on the sand at Lalo. Credit: NOAA

More than 90 percent of Hawaiian green sea turtles nest at Lalo, particularly East Island. Sea turtles return to nest at the beaches where they were born, and the loss of emergent land at Lalo means they'll need to find other sites. When East Island almost disappeared, some turtles were seen nesting at Bellows Beach on O'ahu. This location poses a whole other suite of human-caused threats.

Coral Reefs



Healthy coral and reef fish in Lalo waters. Credit: NOAA

Chronic heat can also be devastating for Lalo's iconic coral reefs.

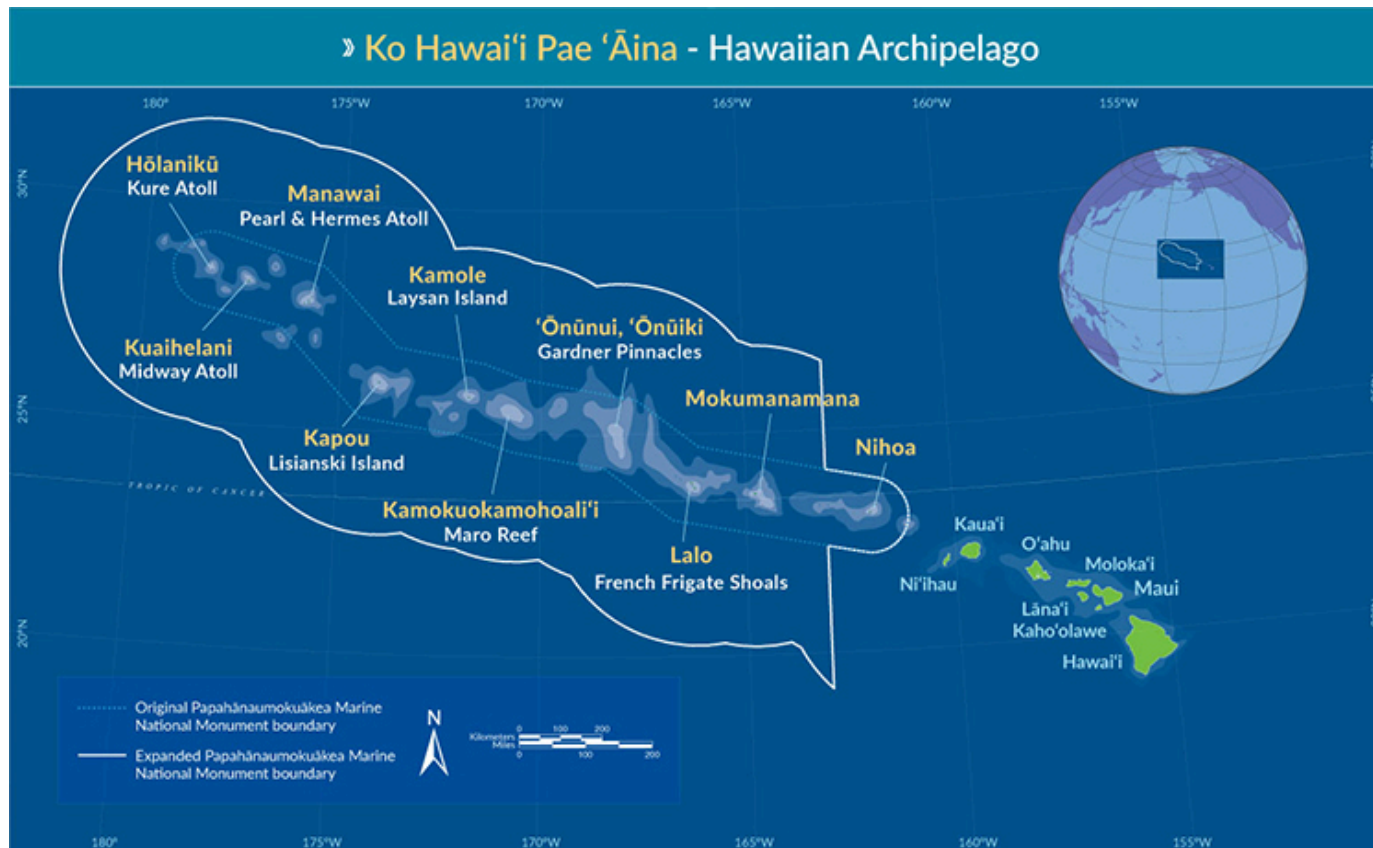
"Lalo has one of the most important coral reef ecosystems, with the greatest variety of species, in Papahānaumokuākea," said Kiloaulani Ka'awa-Gonzales, a University of Hawai'i [Sea Grant](#) E. Gordon Grau Fellow in the NOAA [Office of National Marine Sanctuaries](#). High ocean temperatures and the associated ocean acidification can bleach reefs. A dead reef cannot provide suitable habitat for marine animals, and the loss of these species will reduce the food available for Lalo's land-dwelling species.

"Lalo has the greatest diversity of marine habitats of any of the Northwestern Hawaiian Islands," said Randy Kosaki, Research Ecologist with NOAA's Office of National Marine Sanctuaries. "Hurricane Walaka resulted in the near-complete destruction of all the rich coral growths on the south side of the atoll. It will take decades to recover, impeding recovery of all the other reef-associated organisms such as ulua, sharks, and the reef fish they and the monk seals feed on."

Looking to the Past to See the Future

Besides being biologically and ecologically important, Lalo holds a [sacred place in Hawaiian culture](#) because of its location within Papahānaumokuākea. In the genealogical creation chant, Kumulipo, the physical union between the earth mother, Papahānaumoku, and the sky father, Wākea, birthed the islands. The islands of Papahānaumokuākea are considered kūpuna (elder or ancestor), deserving of the same respect and reverence as human kūpuna. Younger generations mālama (care for) kūpuna, island or otherwise, and listen to their wisdom.

"Based on the Kumulipo, kānaka maoli (Hawaiians) are the younger siblings of our 'āina (natural resources)," Ka'awa-Gonzales said. "It is our kuleana (responsibility) to care for them accordingly, and in turn we strengthen that reciprocal relationship with our 'āina, our kūpuna."



Papahānaumoku Marine National Monument, which was designated in 2006 and expanded in 2016. Credit: NOAA

Haunani Kane, a Native Hawaiian geologist with [Arizona State University](#), has visited Lalo to [conduct research](#) with other Native Hawaiian scientists, community members, and lineal descendents.

“We treated each island as kūpuna or an elder,” she said. “We introduced ourselves by introducing the places that we came from. We returned [geologic] samples we took on previous trips, returning kūpuna back to where they came from.”

The work of these Native Hawaiian scientists on Lalo is helping to paint a clearer picture of the atoll’s history, both culturally and biologically, to understand its future.

“There is a Hawaiian proverb: ‘I ka wā ma mua, i ka wā ma hope,’ which means ‘time in front, time in back,’” Ka'awa-Gonzales said. This means that knowledge of the past can help address dilemmas of the present and future.

Kane is collecting and analyzing sediment cores from Lalo, which will reveal how the islands change over time. This includes how sediments and sands naturally move within the atoll, information that could help scientists develop long-term projections.

“What I am really interested in, is understanding the natural resilience of those places and how the islands operate,” she said. This information could go into the development of Lalo’s resilience strategy. The NOAA team will also be looking at other efforts around the world to safeguard island resources, such as in the Marshall Islands, Australia, and New Zealand.

Aerial view of Lalo's Tern Island. The island still has military structures from WWII, which are falling apart and trapping the animals that call Lalo home. Credit: NOAA

The real linchpin for the plan, Marra explained, are the tolerances and thresholds of Lalo’s species. Climate models can give scientists a general idea about future sea level rise and how air temperatures could change. But what environmental changes are too much for the animals, and when will they occur?

“On the ecosystem side of things, we don’t know what the threshold of the habitat is,” Marra said. “How many acres do you need for seals and turtles? How hot is too hot for the seabirds before they leave?”

It can be easy to focus on a doom-and-gloom narrative when faced with such a daunting task. We must determine how to protect Lalo’s resident species and habitat, as well as the

culture and history of Native Hawaiians, with the resources currently available. A better mentality, Ka'awa-Gonzales said, is to think about tangible management goals and then develop a timeline for achieving them.

"We have these big knowledge gaps with respect to the data necessary to produce long-term projections," Ka'awa-Gonzales said. "But we have enough information to make some decisions in the short- and medium-term while scientists and managers work to fill those gaps. The big key will be developing manageable goals and outcomes and focusing on capacity building to connect people to the places they manage."

Lalo is a special place for scientists, resource managers, and cultural practitioners. Credit: NOAA

The NOAA team involved in the effort to develop adaptation measures for Lalo includes subject matter experts from the NOAA Fisheries Pacific Islands Regional Office and Science Center; National Ocean Service's Office of National Marine Sanctuaries and Office of Coastal Management; National Environmental Satellite, Data, and Information Service; National Weather Service; and Office of Oceanic and Atmospheric Research.

Partners from the University of Hawai'i, U.S. Fish and Wildlife Service, Office of Hawaiian Affairs, and State of Hawai'i Department of Land and Natural Resources are also lending their expertise to the effort.

*Last updated by
[Pacific Islands Regional Office](#)
on February 04, 2025*