



CREATING CLIMATE SOLUTIONS

USDA FOREST SERVICE
INSTITUTE OF PACIFIC ISLANDS FORESTRY

MANGROVES & THE SEARCH FOR BLUE CARBON

Research that promotes
stewardship of blue carbon
ecosystems in the Pacific Islands



RESILIENT, HEALTHY BLUE CARBON ECOSYSTEMS = RESILIENT, HEALTHY PACIFIC ISLANDERS

Blue carbon is carbon stored in coastal ecosystems like mangrove forests, seagrass beds, and salt marshes. Blue carbon ecosystems make up less than 2% of the earth's coastal area but store ~15% of the carbon found in coastal sediments. Ensuring these ecosystems thrive helps lessen impacts of climate change and protects coastal communities and livelihoods.

Mangroves are ecologically and culturally important. Intact mangrove forests store more carbon than any other forest on Earth. They provide coastal communities with food, fiber, and fuel. They serve as barriers from tsunamis, typhoons, and sea level rise. By providing habitat for fish, birds, and invertebrates, they also support biodiversity. The Forest Service's Research and Development branch leads scientific efforts to support healthy mangrove forests and measure their ability to absorb and store carbon.

ACCOMPLISHMENTS

In partnership with Pacific Island organizations, the Forest Service has:

Measured the carbon storage of mangrove forests in the Republic of Palau and in Kosrae, Pohnpei, and Yap of the Federated States of Micronesia (FSM).

Established a network of 195 permanent mangrove monitoring sites in Palau and the FSM which scientists measure for carbon sequestration rates. One hundred twenty of those sites are also monitored for their response to sea level rise.

Helped model the impact of sea level rise on mangrove forests in Pohnpei and Kosrae. Identified vulnerable areas and actions to sustain mangrove resilience.

Forecasted coral reef and mangrove response to sea level rise in Pohnpei to understand potential inland flooding and assist climate adaptation planning.

Created a Blue Carbon Dream Team of Palauan, Fijian, and Samoan scientists who provide data essential to international carbon storage assessments and greenhouse gas reporting.

**THESE EFFORTS HELP PACIFIC ISLAND NATIONS DEVELOP AND
IMPLEMENT LOCAL SOLUTIONS TO CLIMATE CHANGE.**





UNDERSTANDING CHANGE IN DIVERSE ECOSYSTEMS

Pacific Island mangroves can be composed of multiple tree species with unique growth patterns, root structures, and habitat preferences. For example, some are more tolerant to salt water than others. Coastal development, erosion, and sea level rise change the soil and water conditions in mangrove forests, affecting their growth, carbon storage, biodiversity, and resilience. Like the forest ecosystems themselves, the pressures on mangroves vary among islands. Understanding how mangroves across the Pacific interact with and respond to changes in their environment helps prioritize areas for conservation or for restoration.

MEASURING BLUE CARBON

Mangroves sequester and store enormous amounts of carbon, mostly below ground. This is because mangroves grow in low-oxygen soils and sediments saturated with saltwater. As tree roots and leaves die and enter these harsh soil conditions, they decompose very slowly. The rapid build-up of plant debris drives the storage of carbon. The Forest Service uses innovative methods to precisely measure carbon storage and rates of change in Pacific Island mangroves.

SEA LEVEL RISE (SLR)

Sea level rise is the greatest threat to Pacific Island nations, and mangroves offer a solution to address this threat. In the past, mangroves have kept up with sea level rise through root growth, soil-building, and moving inland. Today human activities can degrade mangrove forests and sea level rise is accelerating. The Forest Service is using diverse methods to monitor how mangroves respond to saltwater inundation and identifying mangrove forests that fare best in the face of rising seas.

MANGROVE MONITORING

In 2010, scientists began monitoring 200 permanent mangrove plots across Micronesia. Today they continue to measure the plots for biomass, carbon stocks, soil-building, and forest floor elevation. With these measurements, scientists track how mangrove forests respond to changes in sea level and in land use. The monitoring network also brings resource managers together so they can share observations and methods for restoring and conserving mangroves.

RESULTS TO DATE

Most of Palau's mangroves are keeping up with current rates of sea level rise.

Belowground root growth is key to mangroves' resilience to sea level rise.

Interior mangrove areas are more resilient to sea level rise than fringe or riverine mangroves.

LiDAR measurements improve efforts to accurately monitor mangrove response to sea level rise.

Just 2.5 acres of Palau's mangroves remove ~20 tons of carbon dioxide from the atmosphere every year.

Short form mangroves represent almost of half of Palau's mangroves but store just as much carbon as tall mangroves.

FOREST SERVICE MANGROVE PARTNERSHIPS

Quantifying and monitoring mangrove forests among many Pacific Islands requires effective and committed partnerships. The Forest Service's Research and Development branch is fortunate to have support from many agencies and organizations. These partners provide leadership, knowledge, staff time, equipment, facilities, and access to study sites.

PARTNERSHIPS AND SUPPORT



Financial support from the U.S. Forest Service (Pacific Southwest Research Station, International Programs), USGS's Pacific Island Climate Adaptation and Science Center, USAID's Sustainable Wetland Adaptation and Mitigation Program, and the U.S Department of State's Bureau of Oceans and International Environmental and Scientific Affairs have made these efforts possible.

Long-term, large-scale monitoring of mangrove forests require lasting and consistent investments. Ongoing backing from our sponsors at the U.S. Forest Service, USGS, USAID, and the U.S. Department of State allow us to track the health and resilience of Pacific Island Blue Carbon ecosystems, develop models to identify resilient and vulnerable blue carbon ecosystems, and develop peer-to-peer knowledge exchange opportunities and capacity building to improve management of blue carbon ecosystems.

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GOALS OF MANGROVE & BLUE CARBON RESEARCH:

To support Pacific Island Nations' role in carbon markets.

To protect mangrove forests and other blue carbon ecosystems.

To understand the types and rate of change in blue carbon ecosystems

To develop and apply the next generation of tools for the sustainable management of blue carbon ecosystems.



USDA Forest Service photos by R. MacKenzie