# PROTECTING PALAU'S NATURAL HERITAGE

The Republic of Palau, an island nation in the tropical western Pacific Ocean, harbors diverse mangrove, seagrass, and coral communities. Palau is at a crossroads due to improved access to, and development of, its largest island, Babeldaob. This is leading to increased sediment runoff, particularly in the Ngerikiil River/Airai Bay watershed, the most developed region of Babeldaob Island. The Palau Conservation Society and partners are making strides in management, research, and monitoring to focus attention and prevent further degradation of Palau's tremendous natural heritage.

#### PALAU'S DIVERSE AND INTACT MANGROVE, SEAGRASS, AND CORAL ECOSYSTEMS SUPPORT PALAUAN LIFESTYLES



Palau is located in the tropical west Pacific Ocean.



Tropical mangroves such as *Rhizophora spp.* (*tebechel*, *bngaol*) are abundant in Palau.

The Republic of Palau's location in the tropical western Pacific Ocean places it in a region with some of the highest marine biodiversity in the world<sup>1</sup>. This includes the distinct yet connected mangrove, seagrass, and coral ecosystems.

Mangrove forests (*keburs*) grow in the soft sediment of the intertidal zone. Dominated by *Rhizophora spp*. (*tebechel*, *bngaol*), the mangrove forests of Palau are extensive. They filter the estuarine waters on their way to the ocean, retaining nutrients and sediment from upland runoff. This benefits the water quality of the downstream waters and prevents erosion. Mangrove forests also provide habitat and a nursery ground for many species of fish and shellfish, which are important for commercial, recreation, and sustenance reasons. Mangroves are also culturally important, being a source of material for the traditional *bai* buildings.

The seagrass meadows (*kereker*) on the reef flats benefit from the water quality provided by intact mangrove forests, as seagrasses thrive in clear waters with low nutrients. With 10 species of seagrass (there are only 60 species worldwide), the meadows in Palau are diverse and largely intact. Seagrasses provide habitat and food for many animal species, including rabbitfish and endangered sea turtles and dugongs. They also filter the water by recycling nutrients and trapping sediments.



*Cymodocea rotundata* is one of 10 seagrass species (*char*) found in Palau.

Coral reefs (*chelemoll, melekesokl*) are comparable to tropical rainforests in terms of biodiversity, a result of the complex habitat structure and highly productive plant and animal communities. Palau's spectacular and extensive coral reefs are the main attraction for the nation's largest industry—tourism.

Unlike many regions of the world, Palau is fortunate to still have intact ecosystems that are healthy. Many places in the world have lost their healthy ecosystems and now are trying to restore them (see figure below). Palau has come to a crossroads—manage development to protect its unique ecosystems or face a scenario of costly restoration programs in the future.



Palau's near-pristine ecosystems need protection to prevent degradation.



Corals (*merand*) are intact and healthy. Palau's coral reefs support local fisheries and livelihoods.

## BABELDAOB IS CHANGING

Babeldaob, the largest island in Palau, accounts for 78% of its land area. Although much of the island is still covered in forest and savanna, land use has changed markedly over the past 40 years, not only impacting the island's unique ecosystems, but the surrounding marine environment.

Babeldaob's changing land use has been driven by increased accessibility to Koror, Palau's main population center. In 1977, the first bridge between Koror and Babeldaob (the K-B Bridge) was completed, making it significantly easier than the existing vehicle ferry to reach the island. When the bridge collapsed in 1996, the economy suffered. In 2002, the Japan-Palau Friendship Bridge was built. More recently, transportation around the island has been vastly improved by construction of the Compact Road, a high quality road that circles the island and is due for completion in 2007. One of the most notable effects of the improved access has been increased urbanization, particularly in Airai State, the southernmost state of Babeldaob. Improved transport has led to more people living on Babeldaob and commuting into Koror for work, seeking

weekend residences, or moving closer to the new national Capitol in Melekeok State.

Due to a combination of poor soils and steep hillsides, only a small proportion (about one-quarter) of the island is used for agroforestry or traditional crop production such as taro, tapioca, and sweet potato. However, improved access to Koror is leading to increased cash-based farming, potentially leading to further land-clearing and fires.

The gradual change in the Babeldaob landscape is leading to increased amounts of exposed soil (visible as red scars on the landscape), accelerating erosion, and deposition into creeks and coastal ecosystems during rain.

orests and savanna

Diverse reef and

seagrass communities

Seagrass meadows

Mangrove forests

(chelemoll, melekesok)

kereker)

(keburs)

Coral reefs

With Palau's population and tourist numbers continuing to increase, management needs to focus on ways to reduce soil exposure and erosion, if impacts to the coastal ecosystems are to be reduced.

> The Compact Road on Babeldaob has increased access and transport around the island, leading to

increased impacts in the watersheds.





Land clearing and development in the Ngerikiil watershed is causing erosion into Airai Bay, where the sediment smothers seagrasses and corals.

Extensive clearing for agriculture in the 1990s and construction of the Compact Road and other uncapped roads in the 2000s have accelerated the rate at which soil is eroded from Ngerikiil River watershed and deposited into Airai Bay. This process is evident to the casual observer who can see substantial areas of exposed soil, rivers and creeks that turn reddish brown after rain, and a muddy river plume that forms in the Bay after storms. The shallow and enclosed nature of Airai Bay means that it is particularly susceptible to increased sediment loads. In recent years, corals have been buried and smothered by the sediment, leading to a phase shift from a coral- to algae- dominated system.<sup>2</sup> Similarly, seagrass meadows that were

once extensive in the Bay are now sparse and any surviving seagrasses are showing signs of stress. Mangroves surrounding Airai Bay play a vital role in minimizing sediment impact. Sediment studies show that approximately 15% of fine riverine sediments are deposited in the mangroves during river floods, which protects the water quality in Airai Bay. However, gradual accumulation of sediment within the mangrove communities has also resulted in the mangrove forests expanding and encroaching into the creeks and the Bay. Unlike many other regions of Palau, management of Airai Bay needs to focus on restoration of an impaired ecosystem rather than protection of an intact one. Because

Land use on Babeldaob Island affects the terrestrial and aquatic ecosystems.

griculture and food production

Land clearing

Compact Road



Changing influences and land use in Palau and Babeldaob Island over the past century.

of Airai Bay's restricted water circulation, recovery is likely to be a slow process-more reason for management to act quickly and aggressively to solve the problem.



### PALAU'S FUTURE: PROTECTION OR RESTORATION?

#### MANAGEMENT, MONITORING, AND RESEARCH RECOMMENDATIONS

#### MANAGEMENT

abeledadabelididididididididididi

Land use planning: Develop and implement best management practices for agriculture, housing, and other development. Land use planning needs to involve the entire community from land owners to policy makers.

*Erosion protection:* Erosion of soil from Babeldaob into coastal waters makes erosion protection a priority. Need

**Terrestrial monitoring:** Monitor changes in land use, terrestrial biota (e.g., insects and birds), forest cover (particularly riparian vegetation), and soil exposure.

Water quality monitoring: Monitor sediment and nutrient loads into receiving waters, with a focus on runoff during rain events. Marine monitoring: Monitor critical habitats, namely mangroves, seagrasses, and corals, using remote sensing and ground surveys. to minimize soil exposure, establish new vegetation, and protect existing vegetation along rivers and streams.

**Marine conservation:** Palau has been at the forefront in establishing marine protected areas (MPAs). Enforcement of MPAs and strategic establishment of new MPAs could be considered.

Sediment and nutrient sources: Help prioritize management actions by determining the sources (e.g., housing and road construction, farming, forests) of sediments and nutrients using isotopic tracers.

**Stream delivery:** Research into hydrodynamics of stream flow will give information about the ability of streams to deliver sediments and nutrients from the watershed.

> **Pesticide use assessment:** A survey of pesticide and herbicide use on Babeldaob Island would establish a priority list of potential sources.

MONITORING

#### RESEARCH

#### WORKSHOP PARTICIPANTS



Wayne Andrew—Hatohobei State, Mike Aulerio—Palau Automated Land and Resource Information System, Eileen Babauta—Koror State Government, Ngebtach Banks—Ministry of Health, Umai Basilius—Palau Conservation Society, Asap Bukurrou-Palau Conservation Society, Loyola Darius-Bureau of Arts & Culture, Lora B. Demei-Bureau of Marine Resources, Bill Dennison-University of Maryland Center for Environmental Science, N. Dilyaur Malsol-Bureau of Marine Resources, Carol Emaurois-Palau International Coral Reef Center, Jesse Gekanski-Moir—Belau National Museum, Sireno Hideo—Palau International Coral Reef Center, Tarita Holm—Bureau of Agriculture, Tiare Holm—Palau Conservation Society, Paul Homar— Hatohobei State, Collin Joseph-Melekeok State, Heather Ketebengang-Palau Conservation Society, Lerince Kelmal—Kayangel State, Scott Kiefer—Palau Conservation Society, Ann Kitalong—The Environment, Inc., Valentino Kloulchad—Ngerchelong State, Rola Lin—Koror State Government, Ben Longstaff—University of Maryland Center for Environmental Science, Renguul V. Masahiro-Palau Conservation Society, Liz Matthews—Palau Conservation Society, Stargell Namis—Koror State Government, Kimie Ngirchechol— Environmental Quality Protection Board, Junior Ngiraked—Koror State Government, Jolie Liston—Ganda & Associates, Ilebrang U. Olkeriil-Koror State Government, Alan Olsen-Belau National Museum, Kyoko Oshima—Palau International Coral Reef Center, Edwin Polloi—Melekeok State, Robin Putney—Palau Conservation Society, Scott Rehmus—Palau Conservation Society, Bena Sakuma—Belau Cares, Phoebe Sengebau—Bureau of Marine Resources, Umiich Sengebau—The Nature Conservancy, Kathy Sisior— Bureau of Marine Resources, Foober O. Skebong-Palau Conservation Society, Jane Thomas-University of Maryland Center for Environmental Science, Debbie Toribiong-Ministry of Health, Yalap P. Yalap-Palau Conservation Society.

#### REFERENCES

- 1. Republic of Palau. 2005. National Biodiversity Strategy and Action Plan. Office of Environmental Response and Coordination, Koror, Palau.
- 2. Golbuu, Y., S. Victor, E. Wolanski, & R.H. Richmond. 2003. Trapping of fine sediment in a semi-enclosed bay, Palau, Micronesia. Est. Coast. Shelf Sci. 57: 941-949.

FURTHER INFORMATION Palau Conservation Society

011 (+680) 488-3993 pcs@palaunet.com www.palau-pcs.org







#### SCIENCE COMMUNICATION

Integration & Application Network Bill Dennison, Ben Longstaff, and Jane Thomas Graphics, design, and layout by Jane Thomas ian@umces.edu www.ian.umces.edu