

REPUBLIC OF PALAU

INTRODUCTION

Area: 492 sq.km.

Population: 13,873 (1986 census); 14,106 (1988 estimate).

The Republic of Palau, situated between latitudes 6°53' and 8°12'N and longitudes 134°08' and 134°44'E, is located at the extreme western edge of the Caroline Islands. The archipelago lies about 800 km north of the equator, 740 km east of the Philippine Islands and 6,000 km southwest of Hawaii. It consists of approximately 350 islands including several high islands formed by Eocene volcanic activity and numerous low and raised coral and coralline limestone islands and islets. The islands are encircled by barrier, fringing and patch reefs with inner and outer reef flats. The barrier is some 450 km in length and encompasses a lagoon with an area of about 1,450 sq.km. The barrier reef is particularly well developed on the western side, where it is up to 2.5 km in width. The reef systems of the Palau Islands are considered to be the richest in the Pacific, with the highest species diversity (UNEP/IUCN, 1988).

With an area of 367 sq.km, Babeldaob is by far the largest island in the archipelago, comprising about three quarters of the total land mass. This island, parts of neighbouring Koror (9.3 sq.km) and a few small islands in the vicinity of Koror are of volcanic origin, and are characterized by rolling, forested hills, coastal bottomlands and tidal flats with mangrove forest. The maximum elevation on Babeldaob is about 240 m. All other islands are of more recent limestone formation. Two large islands in the south, Peleliu (12.7 sq.km) and Angaur (8.4 sq.km), are raised coral platforms with jagged hills and level coastal areas. The famous Rock Islands of Palau are extremely steep, coralline limestone islands, typically undercut along the water's edge. They occupy the area from Koror south to Peleliu, and include the large islands of Ngerukdabel (19.0 sq.km) and Mecherchar (8.8 sq.km).

Palau has a humid maritime tropical climate with only slight seasonal variations. The mean annual temperature on Koror, the capitol, is 27°C, with a mean diurnal range of about 7°C. The average annual rainfall is 3,730 mm. Rainfall varies little from month to month, although February, March and April are slightly drier than the average. The relative humidity averages about 90% at night and 75-80% during the day. Although Palau lies outside the main paths of severe tropical disturbances and typhoons, such storms with high winds occasionally hit the islands.

The Palau Islands had been settled for nearly 2,000 years before contact with European traders and missionaries in the 17th and 18th centuries. Spain claimed sovereignty over the Caroline Islands, including Palau, in 1885, but maintained only loose reign until 1899, when the islands were sold to Germany. Germany lost its Micronesian possessions after World War I, when Japan was entrusted with a mandate over Palau. Following World War II, the U.S. was given responsibility for Palau as a Trust Territory. The Republic of Palau was established as a constitutional democratic government in January 1981, and in February 1986, Palau and US Government representatives formally signed a Compact of Free Association. However, this has yet to be approved, and Palau remains a remnant of the former Trust Territory of the Pacific (IUCN, 1991).

There is relatively little agriculture in Palau, and this is primarily for subsistence purposes. Major

crops include cassava, taro, sweet potatoes, bananas, papayas, coconuts and a variety of vegetables. The economy is based on fishing, tourism and aid.

Although the Palauan islands at one time may have been completely covered with native forest, they are now only 75% forest (Cole *et al* 1987). Most of the remaining land is classed as grassland, agro-forest or secondary vegetation. Almost all of the agro-forest and secondary vegetation was once forested land, but the origins of the grasslands are less certain. During the Japanese Administration (1914-1945), large areas in southern Babeldaob were cleared of native forest for pineapple and sugar cane fields. During the same period, bauxite mining in Ngardmau State on the northwest coast destroyed native forest.

Summary of Wetland Situation

The wetlands of the Republic of Palau have been described in some detail by Stemmermann and Proby (1978). These authors identified 84 wetlands, and suggested that there may be more, as they were unable to survey most of the rock islands. The 84 sites included the following:

mangrove forests	33
coastal saline marshes	4
lowland swamp forest with high canopy	11
lowland swamp forest with low canopy	10
freshwater marsh/open canopy swamp	1
savannah wetland/upland marsh	2
cultivated wetland (taro swamp)	17
flooded bomb craters	1
reservoir	1
riparian wetlands	8
ruderal wetlands (roadside ditches)	5

Stemmermann and Proby (1978) considered two sites to be of great interest and worthy of special protection: an area of mangrove forest and swamp forest in Ngeremeduu (Ngatpang) Bay on Babeldaob; and a unique stand of *Bruguiera* in a depression on Mecherchar Island.

Lakes and Marshes

Lakes and marshes are limited in Palau. There are only two natural freshwater lakes of any size; Ngardok and Ngerkall. Both are on Babeldaob and are relatively small and remote. The "marine lakes" of Palau are mostly land-locked, saltwater lakes on some of the high limestone islands, with a distinctive but very limited fauna. Artificial lakes and ponds include one reservoir (a water supply for Koror), water-filled bomb craters on Babeldaob and abandoned, flooded phosphate pits on Angaur and Peleliu (Engbring & Suzuki, 1988).

Freshwater marshes occur in areas just slightly above sea level and surrounded by mangroves, along most of the larger perennial streams and in depressions in upland areas. The vegetation of these marshes includes tall reeds, especially *Phragmites karka*, sedges and other taller herbaceous growth. Where the water is somewhat brackish, the fern *Acrostichum aureum* may be present. Over 130 ha of freshwater marsh are cultivated for taro, and here the edible vine *Ipomoea aquatica* may be found (Cole *et al*, 1987).

Saline marshes generally occur along the coast near mangroves or in depressions in sand or mud flats. Most areas of saline marsh are tiny, although there is one patch of 0.4 ha on Ngebad Island. Common species include *Cyperus javanicus*, *Derris trifoliata* (especially at the edge of mangroves), *Eleocharis geniculata*, *cymosa*, *Lippia nodiflora*, *Paspalum distichum* and *Vigna marina*. A number of woody species characteristic of coastal sand dunes, swamp forests and mangroves may surround or be sparsely scattered in the marshes (Cole *et al.*, 1987).

Swamp Forest

Swamp forests occur where soils are inundated with fresh or slightly brackish water. The most common habitat for such forests is in low-lying areas, just inland of mangroves and above tidal influence. The coastal lowland swamps of Palau are generally quite disturbed, with *Hibiscus tiliaceus* being a common component after disturbance. Taro cultivation is a common competing land use for these swamp areas, and is probably the main reason for the clearing of swamp forest (Cole *et al.*, 1987).

Species common to swamps on the landward side of mangroves and along rivers include *Horsfieldia amklaal*, *Cynometra ramillora*, *Calophyllum soulattri*, *Barringtonia racemosa*, *Heritiera littoralis*, *Samadera indica* and, in its understorey, *Stemonurus ammui*. The climbing vine *Derris trifoliata* is commonly found growing on trees. A swamp forest association typical of low areas with impeded drainage is the *Horsfieldia amklaal*, *Barringtonia racemosa* and *Donax canniformis* type. This type of swamp forest occurs in coastal areas and also quite commonly along streams in the interior hills of Babeldaob. Remnants of swamp forest on Peleliu are dominated by *Barringtonia racemosa* and *Terminalia catappa*. On Angaur, *Barringtonia racemosa*, *Hibiscus tiliaceus* and *Areca catechu* (betelnut) grow in a swampy area near the airstrip (Cole *et al.*, 1987).

Mangrove Forest

Extensive mangrove forest grows around much of Babeldaob, and to a lesser extent around Koror, Peleliu and some of the smaller offshore islands. The mangroves of Babeldaob Island are well developed, especially on the south and southwest coasts, and all but 32 km of the island's 157 km of coastline are bounded by mangroves. Ten species of mangrove have been recorded (Woodroffe, 1987), with well developed stands reaching 15-20 m in height. *Sonneratia alba* and *Rhizophora mucronata* are dominant on the seaward side of the mangroves (Stemmermann and Proby, 1978). At the mouths of larger rivers and around bays, *Rhizophora mucronata* and *R. apiculata* grow in pure stands or mixed with *Sonneratia* and some *Bruguiera gymnorrhiza*, while on the landward side of the mangroves, the species mix may include *Lumnitzera littorea* and *Xylocarpus granatum*. In the upper parts of estuaries, *Rhizophora* spp. are rare; *Sonneratia* remains common and *Bruguiera*, *Xylocarpus* and *Lumnitzera* become common. *Heritiera littoralis* is found along the landward side of mangroves and upstream, while *B. gymnorrhiza* has been found growing inland in totally enclosed sink-holes in limestone areas. Stands of *Nypa fruticans* occur along the lower portions of some rivers and at their mouths (Cole *et al.*, 1987).

There is a small stand of mangroves in Kayangel Atoll, along the shore of a saltwater pond in the interior of a small islet adjacent to Kayangel Island proper. This stand of *Bruguiera* and *Rhizophora* trees was planted by the Palau Department of Agriculture and Forestry in the mid 1970s (Cole *et al.*, 1987).

Table 1: Area of Wetland Vegetation in the Republic of Palau

	Babeldaob	Other high islands	Coral islands	Rock islands	Total
Freshwater Marsh	448	<1	27	0	475
Cultivated Marsh	107	2	25	0	134
Saline Marsh	0	0	25	<1	25
Swamp Forest	1,617	15	47	1	1,680
Mangrove Forest	4,025	205	435	43	4,708
Total	6,197	222	559	44	7,022

After Cole *et al* (1987).

Wetland Fauna

Wetland birds include the Yellow Bittern (*Ixobrychus sinensis*), Rufous Night-Heron (*Nycticorax caledonicus*), Cattle Egret (*Bubulcus ibis*), Pacific Reef-Heron (*Egretta sacra*), Grey Duck (*Anas superciliosa*), Banded Rail (*Rallus philippensis*), Slaty-legged Crake (*Rallina eurizonoides*), White-browed Crake (*Porzana cinerea*), Purple Swampphen (*Porphyrio porphyrio*) and Common Moorhen (*Gallinula chloropus*). As freshwater habitats are limited, most of the freshwater species are uncommon, and the Grey Duck and Common Moorhen are in danger of extinction in the islands (Engbring & Suzuki, 1988).

Situated only 740 km from the east coast of Mindanao in the Philippines, the islands of Palau are easily reached by migrant shorebirds in the East Asian/Australasian flyway, and many species using this flyway have been recorded during the migration seasons. The commoner migrants include Pacific Golden Plover (*Pluvialis fulva*), Wood Sandpiper (*Tringa glareola*), Grey-tailed Tattler (*Heteroscelus brevipes*), Common Sandpiper (*Actitis hypoleucos*), Whimbrel (*Numenius phaeopus*), Ruddy Turnstone (*Arenaria interpres*) and Rufous-necked Stint (*Calidris ruficollis*) (Engbring & Suzuki, 1988).

Formerly widespread, the Estuarine Crocodile (*Crocodylus porosus*) was almost exterminated in the Palau Islands by Australian hunters following an incident in which a tourist was injured. However, the species is now recovering under protection, although most of the individuals are small and extremely secretive. Amphibians include an endemic species of ranid frog (Dahl, 1986) and the introduced toad *Bufo marinus*.

In general, Palau's natural environments, including wetlands, remain in good condition, partly due to the low population density. In recent years, less wetland taro is being grown,

and this has resulted in a loss of some prime habitat for rails and other waterbirds (Engbring & Suzuki, 1988). Unplanned development on the island of Koror is also a cause for concern. Nearly all birds are fully protected by local law, but with an increase in guns and speed boats and the simultaneous decline in the authority of the chiefs, illegal hunting is becoming more common and could pose a threat to some species of waterbirds.

Wetland Research

Detailed vegetation maps of Palau have been prepared by the Forest Service, U.S. Department of Agriculture, in cooperation with the Government of Palau (Cole *et al.*, 1987), and these provide information on the extent and composition of the mangrove forests, freshwater swamp forests, freshwater marshes and saline marshes. The Forest Service has also carried out an inventory of the timber resources of Babeldaob which includes information on the mangrove and swamp forests (MacLean *et al.*, 1988). Information on the extremely rich and diverse reef systems has recently been summarized by UNEP/IUCN (1988). The birds of Palau are relatively well known, and an excellent field guide has been prepared by Engbring and Suzuki (1988).

There are two scientific laboratories in the Republic of Palau: one for marine scientists and the other shared by the Office of Conservation Management and the Entomological Office.

Wetland Area Legislation

Prior to 1981, some United States federal legislation and Trust Territory legislation was applicable. This included the Trust Territory Endangered Species Act (1975) which protects listed species and allows for the acquisition of land or water for the purpose of conserving threatened species. Other Trust Territory Acts and US legislation relevant to nature conservation and the environment in Palau have been summarized by IUCN (1991). The Palau National Code makes various provisions for the protection of species and establishment of protected areas. Section 202 of the Code protects most bird species and their eggs, section 203 protects Dugongs (*Dugong dugon*) and section 206 creates a Fish and Game Commission (Dahl, 1980). Sections 3001 to 3004 provide for the creation, prohibitions, penalties and regulations relating to Ngerukewid Islands Wildlife Preserve. This preserve, established by District Order in 1956, is the only legally established and perennially protected natural area in the Republic of Palau. Also known as the "Seventy Islands", the Ngerukewid Islands are an outlier of the "Rock Islands" comprising a cluster of 37 limestone islands, islets and rock pinnacles which rise steeply from the surrounding lagoon waters. The total area of the preserve is 1,200 ha of which the islands comprise only 90 ha (Thomas *et al.*, 1989). There is no surface freshwater in the islands, and the only wetlands are two tiny patches of mangroves.

Other sections in the Palau Code provide for the protection of Ngerumekaol Channel as a spawning ground for groupers from April 1 to July 31 every year. There are also a number of State Ordinances which provide for the establishment of *Trochus* sanctuaries, some 21 of which have been established by the various states (IUCN, 1991).

The Republic of Palau has signed but not yet ratified the Convention for the Protection of the Natural Resources and Environment of the South Pacific (the SPREP Convention). Palau is not,

however, as yet a party to the Unesco Man and the Biosphere Programme, Ramsar Convention or World Heritage Convention, nor has it signed or ratified the Convention on the Conservation of Nature in the South Pacific or the Convention on Biological Diversity.

Wetland Area Administration

Management of recreation areas and historical sites falls under the Bureau of Community Services in the Ministry of Social Services, while that of conservation areas such as the Ngerukewid Islands Wildlife Preserve falls under the Bureau of Resources and Development in the Ministry of National Resources. Enforcement of the laws pertaining to these areas remains with the Bureau of Public Safety in the Ministry of Justice (Bureau of Resources and Development, 1989). A Division of Conservation and Entomology has been created within the Bureau of Resources and Development, with a broad remit to prepare conservation programmes and pest control and entomological activities (IUCN, 1991). This agency has not, however, as yet been involved directly with wetlands.

Organizations involved with Wetlands

Bureau of Resources and Development, Ministry of National Resources.

WETLANDS

Site descriptions compiled by Demei O. Otobed of the Division of Conservation and Entomology, Bureau of Resources and Development. The eight sites described below are the principal wetlands on the main island of Babeldaob. Many other smaller wetlands exist in the islands, and further study may reveal a number of these to be of international importance.

Wetland Name: Ngaraard-Ngardmau Mangroves

Country: Palau

Coordinates: 7°37'N, 134°36'E

Location: on the northwest coast of Babeldaob Island, between Ngardmau Point and Kloualtaoch; Ngaraard and Ngardmau States.

Area: 160 ha.

Altitude: Sea level to just over one metre above sea level.

Overview: A large area of mangrove forest and coastal swamps on the northwest coast of Babeldaob Island. The mangrove forest is rich in tree species, and serves to protect the immature stages of numerous marine organisms. The wetland provides important habitat for fruit bats, birds, crocodiles, fishes and crustaceans.

Physical features: An area of mangrove forest subject to tidal inundation. Several streams carry fresh water into the wetland, which adjoins very rich inner reef flats. In some places, especially near the mouths of the streams, the water is brackish. The substratum is dark and rich in organic matter.

Ecological features: Coastal mangrove forest with some freshwater swamps inland. Most of the mangrove tree species known from the Caroline Islands are present in the area.

Land tenure: Owned by the States and local chiefs. Adjacent land is owned partly by the

government and partly by local landowners.

Conservation measures taken: None.

Land use: The cutting of mangrove for timber, fishing, harvesting of mangrove crabs and bi-valves, and hunting of fruit bats and wild pigs.

Possible changes in land use: Road construction through the area.

Disturbances and threats: Excessive cutting of mangrove vegetation and landfill for development may pose threats in the future.

Hydrological and biophysical values: The mangrove forest filters silt from run-off entering from the land, thereby protecting the reefs from siltation. The forest also prevents coastal erosion and provides protection against tropical storms. The ecosystem supports a diverse community of marine organisms many of which are important to the local people.

Social and cultural values: The mangrove forest plays an important role in the lives of the local people by providing an important source of timber, foods such as mangrove crabs and bi-valves, and some medicines.

Noteworthy fauna: The Palau Fruit Bat *Pteropus pelewensis*, the Estuarine Crocodile *Crocodylus porosus* and the Dog-faced Snake (*Cerberus rhyncops*) occur in the mangroves. A variety of forest birds forage in the mangroves, and some waterbirds use the area for nesting. Invertebrates include the mangrove crab *Scylla serrata*, various other crabs, various bi-valves, gastropods and some tunicates.

Noteworthy flora: The area contains a well developed stand of mangrove vegetation containing most of the mangrove species occurring in the Caroline Islands.

Management authority and jurisdiction: The States of Ngaraard and Ngardmau. Reasons for inclusion: 1a, 2b, 2c. One of the best examples of mangrove forest on the west coast of Babeldaob, far from the capitol, Koror and still relatively undisturbed.

Source: Demei 0. Otobed.

Wetland Name: Ngerkall Pond

Country: Palau

Coordinates: 7°36'N, 134°37'E

Location: near the northern tip of Babeldaob Island, 2 km northwest of Ngkekklau village, Ngarrard State.

Area: 1.3 ha.

Altitude: About 50 m.

Overview: A small pond, largely overgrown with aquatic vegetation, in the uplands of northern Babeldaob. The pond is 60 metres long, 45 metres wide and 60-90 cm deep. Ngerkall Pond is one of only two natural freshwater ponds of any size in Palau.

Physical features: A freshwater pond created as a result of a landslide. The pond is fed by run-off from the adjacent hillsides and has a small catchment area.

Ecological features: The aquatic vegetation consists of graminoids, sedges and *Hanguana malayana*. The wetland remains in an almost pristine condition.

Land tenure: The State Government and local Chiefs.

Conservation measures taken: None.

Land use: None; the wetland is undisturbed and there is no cultivation on the surrounding hillsides.

Disturbances and threats: There is some burning and hunting in the general area.

Hydrological and biophysical values: The pond traps sediments, acts as a natural water

storage reservoir, and may assist in the recharge of groundwater.

Social and cultural values: Local people occasionally use the pond as a source of drinking water, and the aquatic vegetation may have provided a source of sedges for weaving materials in the past.

Noteworthy fauna: The wetland probably still supports small numbers of the locally endangered Grey Duck (*Anas superciliosa*) as well as Purple Swampphen (*Porphyrio porphyrio*). Migratory waterbirds occasionally visit the area.

Noteworthy flora: The wetland supports a variety of freshwater aquatic plants with very restricted distribution in Palau.

Recreation and tourism: A few school children visit the area during hiking trips.

Management authority and jurisdiction: State of Ngaraard.

References: Anon (1956).

Reasons for inclusion: 1d, 2b. One of only two significant freshwater ponds in Palau, with rich aquatic vegetation still in an almost undisturbed condition.

Source: Demei 0. Otobed.

Wetland Name: Ngerbekuu River

Country: Palau

Coordinates: 7°33'N, 134°37'E

Location: on the east coast of Babeldaob Island, 2 km southwest of Ngermechau village, Ngiwal State.

Area: 122 ha.

Altitude: A few metres above sea level.

Overview: An area of freshwater swamps, lowland swamp forest with high canopy and adjacent mangrove forests along the Ngerbekuu River.

Physical features: A large area of mangrove forest, swamp forest and freshwater swamp in the estuary of the Ngerbekuu River. The mangrove area is influenced by the tides and some parts of the area are brackish.

Ecological features: The wetland incorporates fresh, brackish and saline ecosystems, and supports a wide diversity of mangrove and swamp forest species.

Land tenure: The State of Ngiwal and local chiefs hold title to the mangrove forests and freshwater swamps. There is some privately owned land along the Ngerbekuu River.

Conservation measures taken: None.

Land use: Some of the freshwater swamps are used for taro patches, and parts of the swamp forest are used for agro-forestry. Some mangrove trees are harvested for timber. The estuary is also a fishing ground for fin fish, crabs and bivalves.

Possible changes in land use: There is a proposal to build a causeway across the wetland to link the states of Melekeok and Ngiwal.

Disturbances and threats: Landfill, excessive cutting of timber and possible construction of a causeway.

Hydrological and biophysical values: The wetland protects the adjacent reef flats from siltation by trapping sediments carried down by the river. It is a highly productive ecosystem, with a rich and diverse fauna and flora still relatively intact.

Social and cultural values: Parts of the wetland are important for the cultivation of taro. The forests provide a valuable source of timber, and the estuary is an important fishing ground. There are some ancient dwellings of archaeological interest in the area.

Noteworthy fauna: The wetland supports populations of the Estuarine Crocodile (*Crocodylus porosus*) and the Palau Fruit Bat (*Pteropus pelewensis*). The mangrove crab

(*Scylla serrata*) is common.

Noteworthy flora: All of the mangrove species occurring in Palau are present, as well as a wide variety of the swamp forest and freshwater swamp species.

Management authority and jurisdiction: State of Ngiwal.

References: Smith (1983); Stemmermann & Proby (1978).

Reasons for inclusion: 1a, 2b, 2c. The wetland serves as a refuge for a wide variety of marine and terrestrial organisms.

Source: Demei O. Otobed.

Wetland Name: Ngardok Lake

Country: Palau

Coordinates: 7°31'N, 134°36'E

Location: about 4 km northwest of Melekeok town, Melekeok State, on the eastern side of Babeldaob Island.

Area: 3.4 ha.

Altitude: 20 m.

Overview: A small, natural, freshwater lake with some swamp vegetation. This is the largest perennial body of fresh water in Palau.

Physical features: Ngardok Lake is 720 m long, 180 m wide and 2.7 m deep, and has a volume of 15,000,000 gallons. It is situated in the largest water catchment area in Palau, and receives water from several rivers rising in Melekeok and Ngchesar states. Deltaic deposits at the mouths of these rivers support swamp vegetation.

Ecological features: The natural swamp vegetation is composed of sedges, grasses and various herbaceous species.

Land tenure: Owned by the Government of Melekeok State and local Chiefs.

Conservation measures taken: None.

Conservation measures proposed: It has been proposed that Ngardok Lake and surrounding areas be designated as a protected area.

Land use: None; the lake and surrounding areas remain in a natural condition, and there is no cultivation in the area.

Possible changes in land use: There is a proposal to dam the area for a hydro-electrical project for the State of Melekeok.

Disturbances and threats: There is some hunting in the vicinity of the lake, and nearby areas are occasionally subject to burning during the dry season.

Hydrological and biophysical values: The Ngardok Lake catchment area supplies water to a large part of the eastern side of Babeldaob, including the States of Ngchesar and Melekeok. The lake plays a role in natural flood control and maintenance of water quality in the area. The whole area provides important habitat for a wide variety of native animals and plants.

Social and cultural values: The Ngardok catchment is a very important source of freshwater. During periods of severe drought in the past, people from all over Babeldaob came to Ngardok Lake for drinking water.

Noteworthy fauna: The lake supports a small population of Estuarine Crocodiles (*Crocodylus porosus*), as well as various waterbirds, freshwater eels, several species of fish, gastropods and other freshwater invertebrates.

Noteworthy flora: The lake supports a variety of freshwater aquatic plants with very restricted distribution in Palau.

Conservation education: The lake is frequently visited by students and other individuals wishing to study its flora and fauna, and thus has considerable value for conservation

education.

Management authority and jurisdiction: Melekeok State Government.

References: Anon (1956); Stemmermann & Proby (1978).

Reasons for inclusion: 1d, 2b. Ngardok Lake is the only natural freshwater lake in Palau, and remains in a pristine condition.

Source: Demei 0. Otobed.

Wetland Name: Ngerdorech (Ngetkebau) River

Country: Palau

Coordinates: 7°26'N, 134°35'E

Location: on the east coast of Babeldaob Island, east of Ngersuul village, Ngchesar State.

Area: 100 ha.

Altitude: A few metres above sea level.

Overview: An area of freshwater swamps, lowland swamp forest and mangrove forest along the lower reaches and in the estuary of the Ngerdorech (Ngetkebau) River.

Physical features: The Ngerdorech River is one of the largest rivers in Palau. It originates at Ngardok Lake (Site 4) and empties onto the inner reef flats on the east coast of Babeldaob. Along its lower course, it supports a complex of freshwater swamps, swamp forest and mangrove forest.

Ecological features: Freshwater swamps, swamp forest and mangrove forest.

Land tenure: Taro patches in the freshwater swamps are privately owned. The mangrove forest and other parts of the swamp are owned by Ngchesar State and the local Chief.

Conservation measures taken: None.

Land use: Parts of the freshwater swamp are utilized for the cultivation of taro. Other activities include the cutting of timber, hunting, fishing and the gathering of medicines and edible plants. The river is an important source of water for Ngersuul village.

Disturbances and threats: Increased siltation in the freshwater swamps and mangroves; excessive removal of aquatic vegetation; possible re-routing of the watercourse; road construction; increased fanning activities; over-exploitation of timber, excessive hunting.

Hydrological and biophysical values: The wetland protects the adjacent reef flats from siltation by trapping sediments carried down by the river. It is a highly productive ecosystem, with a rich and diverse fauna and flora.

Social and cultural values: An important area for the cultivation of taro, cutting of timber, harvesting of natural medicines, and hunting and fishing. The river is navigable for some distance inland, and is important for transportation.

Noteworthy fauna: Palau Fruit Bats (*Pteropus pelewensis*), Estuarine Crocodiles (*Crocodylus porosus*) and Dog-faced Snake (*Cerberus rhyncops*). The wetland also supports a wide variety of forest birds, waterbirds, fishes, crabs and bivalves.

Noteworthy flora: The site supports a diverse wetland flora including many of Palau's endemic species and most of the mangrove species occurring in the Caroline Islands.

Conservation education: The site has considerable potential for conservation education.

Management authority and jurisdiction: State of Ngchesar, Ngersuul Hamlet.

References: Stenunermann & Proby (1978).

Reasons for inclusion: 1a, 2b, 2c. The wetland serves as a refuge for a wide variety of marine and terrestrial organisms.

Source: Demei 0. Otobed.

Wetland Name: Ngerikiil River**Country:** Palau**Coordinates:** 7°22'30"N, 134°33'30"E**Location:** at the south end of Babeldaob Island, east of the international airport, Airai State.**Area:** 130 ha.**Altitude:** Sea level to about 5 m.**Overview:** An area of freshwater swamps, lowland swamp forest with high canopy and mangrove forests along the lower reaches and in the estuary of the Ngerikiil River.**Physical features:** The site comprises the lower portion of the Ngerikiil River and its estuarine system in Airai Bay. The river is perennial, and supports freshwater swamps and swamp forest; mangrove forest occurs in the intertidal zone. Some of the swamps along the river are used for the cultivation of taro and gardening.**Ecological features:** Freshwater swamps, swamp forest and mangrove forest.**Land tenure:** The Airai State Government and local Chiefs hold title to most of the area.**Conservation measures taken:** None.**Land use:** Cultivation of taro, hunting and fishing, the cutting of timber, and the gathering of natural medicines. This wetland lies close to Palau International Airport.**Disturbances and threats:** Parts of the wetland have been reclaimed for agriculture, and some degradation occurred as a result of the construction of the airport. Burning, disturbance from farming activities and road construction have also caused some problems.**Hydrological and biophysical values:** The wetland protects the adjacent reef flats from siltation by trapping sediments carried down by the river. It is a highly productive ecosystem, with a rich and diverse flora and fauna.**Social and cultural values:** An important area for the cultivation of taro, harvesting of natural medicines, hunting and fishing. The river is an important source of fresh water for Airai State. There are some sites of archaeological interest in the wetland.**Noteworthy fauna:** Palau Fruit Bats (*Pteropus pelewensis*), Estuarine Crocodiles (*Crocodylus porosus*) and Dog-faced Snake (*Cerberus rhyncops*). The wetland also supports a wide variety of forest birds, waterbirds, fishes, crabs and bivalves.**Noteworthy flora:** The site supports a diverse wetland flora including many of Palau's endemic species and most of the mangrove species occurring in the Caroline Islands.**Conservation education:** The site has considerable potential for conservation education as it is located close to Koror and can be approached by land transportation.**Recreation and tourism:** Because of its proximity to Koror, the site receives more visits from tourists than most other wetlands in Palau.**Management authority and jurisdiction:** Airai State.**References:** Anon (1956); Smith (1983); Stemmermann & Proby (1978).**Reasons for inclusion:** 1a, 2b, 2c. Although somewhat disturbed as a result of a major development project (airport construction), the site continues to support a rich and diverse flora and fauna.**Source:** Demei O. Otobed.**Wetland Name: Ngerimel River****Country:** Palau

Coordinates: 7°21'30"N, 134°31'30"E

Location: at the south end of Babeldaob Island near Ngeruluobel village, west of the international airport, Airai State.

Area: 5 ha.

Altitude: Sea level to about 5 m.

Overview: A small area of freshwater swamp along the lower reaches of the Ngerimel River, and a larger area of mangrove forest at the mouth of the river.

Physical features: The site comprises freshwater swamps and mangrove forest along the Ngerimel River downstream of the Airai water storage reservoir. The wetland is natural but has been affected by the construction of the Airai Reservoir upstream. There is a water pumping station downstream of the dam, and many people live around the mouth of the river. A main highway cuts across the wetland.

Ecological features: Freshwater swamps and mangrove forest somewhat disturbed by human activities.

Land tenure: Mainly Ngeruluobel Hamlet, Airai State, with some private ownership.

Conservation measures taken: None.

Land use: Parts of the freshwater swamp are utilized for the cultivation of taro. Mangrove trees are cut for timber, and there is some hunting and fishing. Surrounding areas are under cultivation or used for human settlement.

Disturbances and threats: There is a considerable amount of disturbance to the area from farming activities, burning, oil spills, siltation, cutting of vegetation and landfill for house construction and other development.

Hydrological and biophysical: The wetland protects the adjacent reef flats from siltation by trapping sediments carried down by the river.

Social and cultural values: Many people live around the wetland and utilize its resources. The freshwater swamps are especially important for taro cultivation. Airai Reservoir provides water for Airai State and the whole of Koror State.

Noteworthy fauna: Palau Fruit Bats (*Pteropus pelewensis*), Estuarine Crocodiles (*Crocodylus porosus*) and Dog-faced Snake (*Cerberus rhyncops*). The wetland also supports a wide variety of forest birds, waterbirds, fishes, crabs and bivalves.

Noteworthy flora: Despite the disturbance from human activities, the site continues to support a diverse wetland flora including many of Palau's endemic species and most of the mangrove species occurring in the Caroline Islands.

Conservation education: The wetland has considerable potential for conservation education because of its proximity to densely populated areas. The site could be used to educate the local people about the effects of human activities on natural wetland ecosystems.

Management authority and jurisdiction: Ngeruluobel Hamlet, Airai State.

References: Anon (1956); Smith (1983); Stemmermann & Proby (1978).

Reasons for inclusion: 1a, 2b, 2d. An interesting freshwater swamp with a diverse flora rich in endemic species.

Source: Demei 0. Otobed.

Wetland Name: Ngeremeduu Bay

Country: Palau

Coordinates: 7°29'N, 134°31'E

Location: on the west coast of Babeldaob Island in Ngeremlengui, Ngatpang and Aimeliik States.

Area: About 1,500 ha.

Altitude: Sea level to about 10 m.

Overview: A large area of riverine marshes, swamp forest and mangrove forest around Ngeremeduu Bay, the largest indentation on the western side of Babeldaob.

Physical features: Ngeremeduu Bay is a large, tidal sea bay with a relatively narrow opening to the sea in the northwest corner and extensive mangrove swamps. Four large rivers, the Ngeremeskang, Ngkebeduul, Ngatpang and Ngimet, empty into the bay, providing an abundant supply of fresh water which creates brackish conditions in much of the bay. There are large areas of freshwater swamp and swamp forest along the lower reaches of the rivers and well developed mangrove forests, particularly in the estuary of the Ngeremeskang River in the northeast and around the island of Ngerasech in the south. The bay contains the most extensive area of mudflats in Palau.

Ecological features: Mangrove forest, swamp forest and freshwater swamps. Most of the mangrove tree species known from the Caroline Islands are present in the area. The freshwater swamps are the most diverse in Palau.

Land tenure: The bay is owned by the three State governments and local chiefs. Parts of the freshwater swamp and adjacent dry land are privately owned.

Conservation measures taken: None.

Conservation measures proposed: Stemmermann and Proby (1978) identified Ngatpang Bay as a wetland of great interest and worthy of special protection.

Land use: Cultivation of taro; hunting; fishing; collection of edible plants and medicines; cutting of timber, navigation and transportation.

Possible changes in land use: There is a proposal to construct a large international airport capable of handling jumbo jets near the bay.

Disturbances and threats: Landfill for housing and road construction; increased gardening and farming activities; over-exploitation of timber; overfishing and excessive hunting.

Hydrological and biophysical values: The mangrove forest filters silt from run-off entering from the land, thereby protecting the reefs from siltation. The forest also prevents coastal erosion and provides protection against tropical storms. The ecosystem supports a diverse community of marine organisms many of which are important to the local people.

Social and cultural values: A large number of people living around the bay are dependent on its natural resources for their livelihood. The bay is one of the best sources of crabs, sting-rays and many other economically important marine species on Babeldaob Island. The freshwater swamps are important for the cultivation of taro, while the mangrove and swamp forests provide a source of timber and natural medicines. There are many sites of historical importance in the area.

Noteworthy fauna: Estuarine Crocodile (*Crocodylus porosus*), Dog-faced Snake (*Cerberus rhyncops*) and a wide variety of land birds and waterbirds, fishes, crabs and other estuarine and marine invertebrates. Dugongs (*Dugong dugon*) occur in the bay.

Noteworthy flora: The site includes the largest and most diverse freshwater swamp communities in Palau, as well as large, well developed stands of mangrove with all the Palauan species present.

Scientific research and facilities: Some marine studies have been carried out on the inner reef flats at Ngatpang and Ngermetengel in Ngeremlengui State.

Management authority and jurisdiction: Ngeremlengui, Ngatpang and Aimeliik States. References: Anon (1956); Cole *et al* (1987); Stemmermann & Proby (1978).

Reasons for inclusion: 1a, 2b, 2c. The largest wetland in Palau, with the most extensive freshwater swamps and mangrove forests.

Source: Demei 0. Otobed.

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