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Ecology and Conservation of the Palau Owl *Pyrroglaux podarginus*

Wade L. Eakle

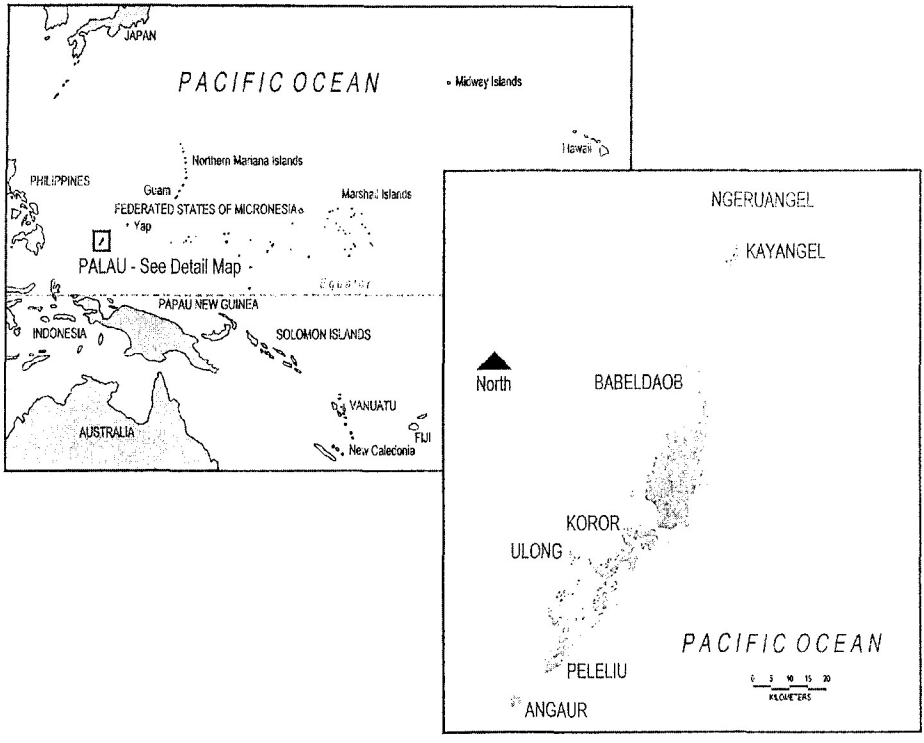
ABSTRACT

The Republic of Palau is an archipelago of several hundred volcanic and limestone islands and coral atolls in the western Caroline Islands, located 756 km southeast of the Philippines and 1300km south-west of Guam in the western Pacific Ocean. The endemic Palau Owl *Pyrroglaux podarginus* occurs on all major islands from Babaldaob to Angaur as well as smaller, high limestone islands, in coastal mangrove swamps, interior rainforests, wooded savannas and near villages in lowlands, where it feeds on insects, other arthropods and earthworms. Nesting in hollow trees and tree holes in dense vegetation, sometimes near the ground, from February-March, the owl has been described as abundant by some authors but highly endangered by others. The only known surveys were completed in the mid-1940s and late 1970s, but recent reports of owls heard in the Rock Islands and Koror suggest it may still be widespread. However, with construction of the 85km Palau Compact Road on Babeldaob, sensitive habitats including mangroves and rainforest have been impacted by erosion, dredging and soil disposal. The new road and planned developments may compromise future conservation efforts for the owl and other wildlife.

GEOGRAPHY AND HISTORY

As part of the western Carolina Islands, Palau is the westernmost part of Micronesia (Figure 1). The tightly clustered archipelago consists of the high islands of Babeldaob, Koror, Peleliu and Angaur; the low coral atolls of Kayangel and Ngeruangel; the small, isolated South-West Islands that extend 595km SW from the main islands, reaching almost as far as Indonesia; and the jungled "Rock Islands", of which there are more than 200. The bases of these limestone Rock Islands have been undercut by water erosion and by grazing fish and chitons that scrape the rock. Because of their unique shape, the Rock Islands are often likened to emerald mushrooms rising from a turquoise-blue sea (Rock & Toribiong 2000).

Figure 1. Palau archipelago in the north-west Pacific Ocean showing the major islands of Babeldaob, Koror, Peleliu and Angaur.



The islands of Palau represent two distinct geological formations. Babeldaob, parts of Koror, and a few small islands in the Koror vicinity are of volcanic origin. All others are of recent limestone formation. Thick, tropical broadleaf forests cover most of the volcanic and virtually all of the limestone substrate. Extensive mangrove forest grows around much of Babeldaob, and to a lesser extent around Koror, Peleliu, and the other small islands. Notable exceptions to the forest habitats of most islands are the savannas of Babeldaob where the highly leached soils support grasses, ferns and scattered *Pandanus* trees. Freshwater lakes and marshes are limited in Palau, but the water-filled bomb craters on Babeldaob, as well as abandoned, flooded phosphate pits on Angaur and Peleliu augment the limited natural wetlands (Engbring 1988).

It is generally believed that Palau's first inhabitants came from eastern Indonesia, settling in the Rock Islands by at least 1000 BC. The first Europeans to sight Palau were most likely the Spanish in 1543, but it was not until 1783 when the English landed that any significant contact began between Palauans and Westerns. The British were Palau's main trading partners until Spain expelled them in 1885. Spain sold Palau to Germany in the wake of the Spanish-American War, with the Germans using Palauan forced labour to start coconut plantations and other business ventures. Germany lost its Micronesian possessions after World War I, when Japan was entrusted with a mandate over Palau (Galbraith *et al.* 2000).

The Japanese occupied Palau until the end of World War II. Japan expanded the commercial ventures started by the Germans and developed many more, including phosphate mines, rice fields, and pineapple plantations. After 1922 all of Japan's Pacific possessions were administered from Koror, and in the late 1930s, Japan closed Palau to the outside world and began concentrating its efforts on developing military fortifications throughout the islands (Galbraith *et al.* 2000).

During the final stages of World War II, as the Allied offensive moved westward across the Pacific, Japanese installations in Palau became a target for attacks. Peleliu was the site of one of the bloodiest battles of the War. The first U.S. invasion forces to land on Peleliu came ashore on 15 September 1944. After three months of fighting, over 15,000 men were killed. During the fighting, Peleliu's forests were bombed and burned to the ground (Galbraith *et al.* 2000). After the War, the United Nations (UN) established the Trust Territory of the Pacific, which included the Northern Marianas, Pohnpei, Chuuk, Yap, Kosrae, the Marshall Islands and Palau. Under UN guidelines, the United States was obliged to foster the development of political and economic institutions, with the ultimate goal of helping Micronesians achieve self-sufficiency. As the years passed, most islands formed their own independent state or nation. By 1990, Palau had become the last trust territory in the world. In 1994, a Compact of Free Association between Palau and the U.S. was approved, providing Palau with the largest settlement of any Micronesian island nation - $450 million in U.S. aid over the first 15 years of the agreement. Palau was recognized as a UN member in December 1994 (Galbraith *et al.* 2000).

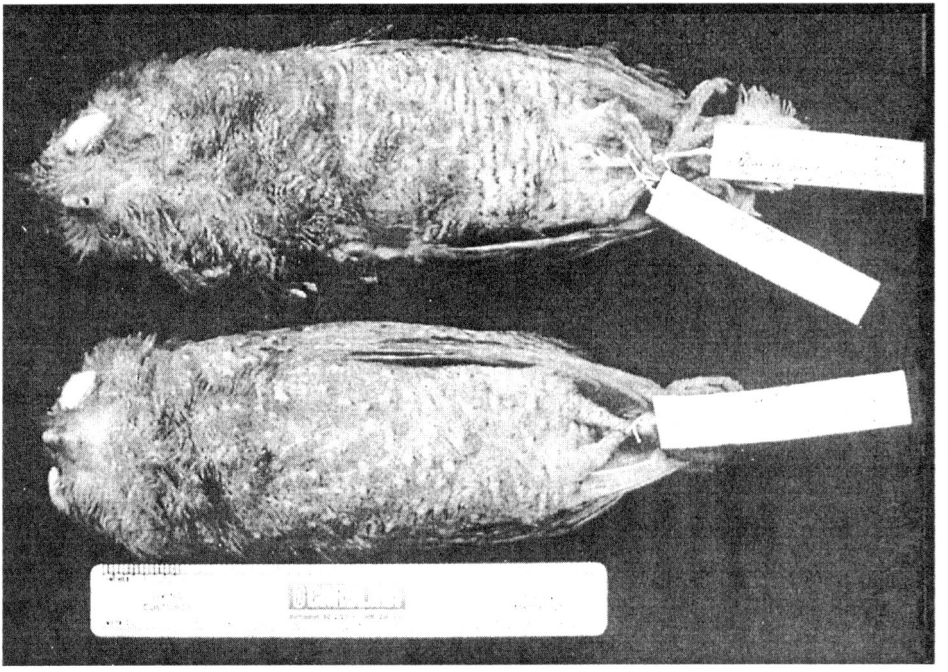
THE AVIFAUNA

Of the 141 species of birds of 41 families recorded from Palau, the majority, 91 species, are migratory or vagrant and do not breed in Palau. The other 50 species are resident, nesting within Palau and are present year-round (Engbring 1988). Baker (1951) and Owen (1977) listed the Osprey *Pandion haliaetus* as resident based on Mayr's (1945) statement that it "apparently breeds" in Palau. There have been no subsequent references for breeding and additional evidence is needed before assuming it ever bred in Palau (Pyle & Engbring 1985). Pratt & Bruner (1981) described an immature hawk as a Common Buzzard *Buteo buteo*, but the bird was not well seen and could have been confused with other Asian buteos (Pyle & Engbring 1985). Other diurnal raptors that winter in Palau, or migrate through or are vagrant in the archipelago, include the Brahaminy Kite *Haliastur indus* (Engbring & Owen 1981), Chinese Goshawk *Accipiter soloensis* (Engbring & Owen 1981), Oriental Hobby *Falco severus* (Owen 1977; Engbring 1988), and Peregrine Falcon *Falco peregrinus* (Baker 1951).

The Short-eared Owl *Asio flammeus* , resident in Pohnpei and vagrant in the Northern Marianas and Marshall Islands (Baker 1951; Owen 1977), was reported in Palau by König *et al.* (1999), while the Brown Hawk-owl *Ninox scutulata* is considered a hypothetical vagrant (Engbring 1983). The Palau Owl or Palau Scops Owl *Pyrroglaux podarginus* is endemic and the only resident owl and known breeding raptor in Palau (Engbring 1988). The dark rufous-coloured owl is about 22cm in length, with barely visible ear-tufts and bare

tarsi (Figure 2). The adult female resembles the male, but is darker above with fine vermiculations. Darker and lighter colour morphs apparently exist (König *et al.* 1999). The owls have white bills, a light gray cere, a brown iris, and feet that are pale gray above and cream below. The rufous tail has indistinct dark brown bars, and the sandy-rufous wings have pale rufous-buff bars (Marshall 1949).

Figure 2. Ventral view of male (bottom) Palau Owl collected by J. Marshall on 3 November 1945 on Koror Island (USNM #385677) and female (top) collected by P.J.R. Hill on 11 June 1950 on Ngutuckdapel Island (USNM #442810).



TAXONOMY

Hartlaub & Finsch (1872) were the first to describe the Palau Owl (as Pelew Owl *Noctua podargina*) from a collection of birds sent to them by early Pacific Island explorers, and suggested that its nearest relative was *Noctua ochrecea* in the Celebes, now Sulawesi, Indonesia. The Marquis Yamashina (1938) concluded that the owl could not belong to the genera *Ninox*, *Scops*, or *Otus* and placed it in the monotypic genus *Pyrroglaux*. However, this taxonomic placement has not been accepted by all authors, with some concluding that the generic name *Pyrroglaux* should not be recognized and that the owl correctly belongs in the genus *Otus* (Mayr 1945; Baker 1951; Grossman & Hamlet 1964; Burton 1973; Clark *et al.* 1978; Amadon *et al.* 1988).

Mayr (1945) and Baker (1951) suggested that the morphological characters of the Palau Owl were no more distinctive than those found in other members of the widespread genus *Otus*, and that the bird was probably derived from the

Mountain or Spotted Scops Owl *Otus spilocephalus* of Asia and Malaysia. Amadon *et al*, (1988) considered *Pyrroglaux* to be a subgenus of *Otus*, but König *et al.* (1999) placed the owl in the genus *Pyrroglaux,* noting that further studies are necessary to clarify its taxonomy. Even the common name (Palau Owl or Palau Scops Owl) and species name (*podargina* or *podarginus*) have been inconsistently applied since its first description by Hartlaub & Finsch (1872).

HABITAT USE

Marshall (1949) conducted the first extensive investigation of the Palau Owl in 1944-45 for the U.S. Army Medical Museum. His one specimen was later turned over to the U.S. National Museum (USNM #385677, an adult male collected 3 November 1945 on Koror Island). He found owl pairs spaced at 100m intervals in woodlands and adjacent mangrove lagoons on Koror, where he observed 33 pairs. He observed only four pairs in a patch of natural woodland still remaining on Peleliu. The owls frequented the middle and upper parts of woodland and tall trees in the lagoons.

Baker (1951) reported owls roosting in mangrove thickets during the day, and Engbring (1988) suggested that the fertile, broken forest found in river bottoms could be its preferred habitat. König *et al.* (1999) reported owls common around villages on Koror, while others have simply reported rainforest, woodlands, mangroves, forests of high limestone islands and wφoded pockets of savannas as owl habitat (Mayr 1945; USFWS 1985; Amadon *et al.* 1988; Hume & Boyer 1991).

The owl is thought to nest in hollow trees (Mayr 1945) and tree holes (König *et al.* 1999) in dense vegetation (Engbring 1988).

FOOD HABITS

Very little has been reported on the food habits or foraging ecology of the Palau Owl, an area ripe for additional study. Several authors reported prey items as large orthopterans and centipedes (Marshall 1949), or insects, arthropods and earthworms (Engbring 1988; Hume & Boyer 1991; König *et al.* 1999). Pratt *et al.* (1980) and USFWS (1985) suggested that a 1950s campaign to control the Coconut Rhinoceros Beetle *Oryctes rhinoceros*, a serious introduced pest in coconut plantations and an owl prey item, may have negatively impacted owl populations. Reports were even received of owls being killed by beetles they had eaten, apparently eviscerated from within. The beetle control programme concluded in the late 1960s.

CONSERVATION STATUS

Marshall (1949) suggested that the 33 pairs of owls he observed on Koror in 1945 represented half the total population there. Coultas (cited in Baker 1951) reported it as fairly common in 1931. Based on their observations from 1976-79, Pratt *et al.* (1980) found the owls to be abundant throughout the archipelago, suggesting that the density of owls was greater than that of any mainland owl species with which they were familiar.

Because the owl suffered a reduction in its population on the islands of

southern Palau affected by World War II, it was listed as an Endangered Species by the U.S. Fish & Wildlife Service (USFWS) in 1970 (USFWS 1970). The original listing was based on surveys of southern Palau completed by military ornithologists a short time after U.S. forces invaded Angaur and Peleliu. As discussed above, these invasions caused serious destruction of vegetation and wildlife. No surveys were made of central or northern Palau at that time because the islands were still held by Japanese forces. It was thought owl populations continued to decrease after World War II, but since the 1960s steadily increased in numbers (USFWS 1985).

In 1985 the USFWS removed the owl from the list of Endangered and Threatened Wildlife and protection under the Endangered Species Act of 1973 was amended. The USFWS reported the owl to be found in high densities, estimating a population of over 300 birds on Peleliu and over 10,000 birds throughout the archipelago in 1978. The owl was considered to be distributed throughout its former habitat with stable populations at or near carrying capacity. In particular, the vegetation and bird life on Angaur and Peleliu was considered recovered (USFWS 1985).

Engbring (1988, 1992) reported the owl as common on all major islands from Babeldaob to Angaur, as well as numerous smaller, high limestone islands. However, König *et al.* (1999) described it as highly endangered.

Today, the Palau Owl is protected by local regulations, but is occasionally taken as a pet. The owl is still included on Palau's list of endangered species, but this is probably an artifact of poor information. However, given the lack of monitoring and accelerating economic development since 1994, the Palau Owl may be experiencing declines again from habitat loss and human disturbance (Holly Freifeld, pers. comm.).

FUTURE THREATS

In accordance with the 1994 Compact of Free Association with Palau, the U.S. committed to fund the construction of a safe, high quality, all-weather, two-lane road system on the island of Babeldaob (Figure 1). The 85km road will loop around the island with a northern spur and provide a direct transportation and communication link between the ten states on Babeldaob to the commercial and business centre on Koror. The road will be designed, engineered and built to similar highway design criteria applied to Hawaii and the continental U.S. (USACE 1998).

The Palau Compact Road will provide the residents of Babeldaob with the opportunity to live on their land and commute to work in Koror, as well as encourage inhabitants of the smaller, urban, overcrowded island of Koror to return to their villages on the larger, rural, sparsely populated island of Babeldaob. The U.S. Department of the Interior, Office of Insular Affairs, is the programme manager and U.S. project proponent. The Department of the Interior selected the U.S. Army Corps of Engineers as the project manager, responsible for all aspects of the project including planning, environmental review, design and construction. In 1998 the Corps of Engineers completed an Environmental Impact Statement in accordance with the National Environmental Policy Act of 1969 and other U.S. laws that examined the consequences of building the road system on Babeldaob.

The road was targeted for completion in 2002, but was still under construction in May 2003 (USACE 1998).

When completed, the road will facilitate future growth and development on Babeldoab and the relocation of the national capital from Koror to Melekeok. Unfortunately, the road will also adversely impact freshwater swamps, mangrove forests, undisturbed forest and grassland ecosystems over 78km (92%) of its planned length (USACE 1998). The physical removal of plant communities, with increased downstream transport of silt and soil, may result in additional sedimentation into coastal mangrove swamp forests. Mangroves trap silt and debris and retard their release into the sea and coastal reef, so their loss as a result of road construction could negatively affect reef and coastal ecosystems.

The Palau Compact Road will also provide new access to the interior of Babeldaob, enabling people to cultivate and develop the land (USACE 1998). This new development and growth on Babaldaob, the largest island in the Palau archipelago and the second largest island in Micronesia, probably represents the greatest threat to the future conservation of the Palau Owl and other at risk species including the Micronesian Megapode *Megapodius laperouse*, Nicobar Pigeon *Caloenas nicobarica*, Palau Ground-dove *Gallicolumba canifrons* and Giant White-eye *Megazosterops palauensis* (BirdLife International 2000).

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Wade L. Eakle
U.S. Army Corps of Engineers
South Pacific Division
333 Market Street
San Francisco. CA 94105, U.S.A.
E-mail: Wade.L.Eakle@spd02.usace.army.mil