

Extinctions and extirpations in Marshall Islands avifauna since European contact—a review of historic evidence

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Abstract—The Pacific Island avifauna underwent dramatic changes following the arrival of humans on the islands making several species and genera extinct. The decline continued after the arrival of the Europeans. Drawing on historic sources, this paper describes the local extinction of five bird species (*Gallirallus wakensis*, *Poliolimnas cinereus*, *Ptilinopus porphyraceus hernsheimi*, *Ducula oceanica ratakensis* and *Acrocephalus rehsei*) on the atolls of the Marshall Islands since European contact. The local extinction was largely due to the influences of European traders and planters, as well as a European-style copra economy, creating increased capabilities and demand for local hunting of land birds; changes to the ecosystems such as the clearance of swamps and taro patches to make way for coconut plantations, the introduction of predators by European traders and planters; and, on Wake Island, the actions of Japanese feather collectors and changes during World War II.

Introduction

Atoll environments, such as those of the Marshall Islands, are fragile and subject to environmental hazards such as typhoons and storm surges and the consequences of human settlement. Terrestrial animal populations suffer both from environmental hazards and from predation by humans and other species. The current distribution of species in Micronesia is an artifact of these natural and human forces. Historical ecology reconstructs previous distributions of animal species. But such reconstructions are only as good as the zooarchaeological or historical data available.

Steadman (1989, 1995) reviewed the evidence for extinctions and extirpations among Pacific birds following the settlement of islands by humans. There is abundant evidence that the initial human settlement of islands, and the concomitant environmental change brought about by land clearing activities of people and by the introduction of domestic and wild animals, impacted on a pristine wildlife. Most of this evidence is derived from archaeological and sub-fossil bone assemblages obtained from sites on high islands.

In Micronesia, as well as most of Oceania, for example, each island tended to sustain one or more species of flightless rails, nearly all of which are now extinct or extirpated (Steadman 1995, see also Olson & James 1991). Even though the islands of Micronesia, usually smaller than those of Polynesia and especially Melanesia, supported fewer endemic species, zooarchaeological research has shown extensive prehistoric extinctions in the Marianas (Steadman 1992, 1995).

Extinctions and extirpations on the atolls of the Carolines and Marshalls are often unclear, as many of these locales may not have existed in their present form 4,000 years ago (cf. models of the Holocene sea-level rise: Buddemeier et al. 1975 [Enewetak Atoll], Tracy & Ladd 1974 [Bikini]) and normally do not offer stratified cave deposits which were used on other islands to great effect for zooarchaeological research by Steadman (1995) and others. Despite this, drawing on archaeological midden remains, Steadman & Intoh (1994) could document the extirpation of several bird species, among them a rail, on the raised coral island of Fais, Yap State, Federated States of Micronesia.

But not all extinctions were caused by the initial arrival of people. Environmental and technological change subsequent to the establishment of colonial economies, such as coconut monoculture and improved hunting tools, may well also be to blame. Indeed, historic research has documented nineteenth century extinctions of rails on Kosrae (*Porzana monasa*; Finsch 1880a; Pratt et al. 1987, p.127) as well as the extirpation of a rail, possibly *Porzana cinerea*, on Ulithi Atoll, Yap State (Baker 1951, p 125).

Unlike the Marianas, Palau, Hawaii and the high islands of the Carolines, the Marshall Islands are solely atolls with the maximum elevations rarely exceeding 3m above the high tide mark. In view the nineteenth century observations of rails on Ulithi Atoll, the question arises whether rails once were widespread also on the atolls of the Marshall Islands. Moreover, what bird species other than rails may have been extirpated or extinguished in the Marshall Islands as part of environmental change processes? To date only very little is known and there is no comprehensive review of knowledge on the matter. In part, this is caused by the relative inaccessibility and scattered nature of the historic resources, and also by the fact that limited historic ecological research has been carried out in the Marshalls.

This paper compiles available historical and traditional information on now extinct or extirpated birds on the atolls of the Marshall Islands (inc. the northernmost atoll, Wake Island, currently under US jurisdiction). A discussion of the possible agents for the extirpations concludes the paper. Following Koford et al. (1994) the terminology used here differentiates between 'extinction' which is defined as the complete disappearance of all populations of a species, and 'extirpation' (local extinction) which is the elimination of a species from an island or local area, and which does not preclude later recolonization.

EXTINCT OR EXTIRPATED RAILS IN THE MARSHALL ISLANDS

In much of Micronesia rails have been encountered in the historic past, most prominently on the high islands (Table 1). In the Carolines, rails have been known from the atolls of Fais (Steadman and Intoh 1994) and 'nearby' Ulithi (Baker 1951, p 125). Flightless rails also existed on isolated atolls in the northern Central Pacific, such as Laysan in the north-western Hawaiian Chain (25°7'N 171°53'W), which supported the Laysan rail (*Porzana palmeri*) either until rabbits released on the atoll in 1903 had changed the vegetation (Munro 1944:50-51; Harrison 1990:36) or until the feather collecting pogroms at the turn of the century (Spennemann 1998c-d). Neighboring Lisianski Atoll (26°N 173°57'W) historically also supported a rail species, of which no further details are known (Baldwin 1947). The Laysan rail survived on Midway Atoll (28°12'N 177°22'W), where it had been introduced in 1891, until the introduction of black rats and avian malaria at the end of World War II. A 1923 re-introduction to Laysan (from Midway) failed soon after (Wetmore in Olson 1996:184) and a 1929 introduction to Pearl and Hermes Reef also failed (in 1930; Baldwin 1947; Grant 1947; Harrison 1990:18; 39).

The avifauna of the Marshall Islands as a whole has been reviewed by Amerson (1969), and Fosberg (1990); subregional and atoll-specific compilations and records have been produced by Fosberg (1966) and Thomas (1989) for the northern Marshalls; by Porter (1953), Bryan (1959), Casey (1966) and Fosberg (1966) for Wake; by Schipper (1985) and Clapp (1988) for Kwajalein; by Anderson (1981) for Ujelang and northern atolls; by Finsch (1880b-c) and Schnee (1904) for Jaluit and the southern atolls, by Spennemann and Benjamin (1992) for Ebon; and by Pearson and Knudsen (1967), Carpenter et al. (1968), Johnson & Kleinholz (1975), Hailman (1979) and Berger (1987a-b) for Enewetak. Yocom (1964) compiled records of vagrants and birds wintering in the area, which was added to by numerous authors. None of these studies comment on the presence of

Table 1 Records of extinct or extirpated rails in Micronesia and NW Hawaii.

Group	Island	Type	Species	Status	Reference
Carolines	Fais	atoll	<i>Poliolimnas cinerea</i> ?	extirpated	Steadman & Intoh 1994
Carolines	Kosrae	high island	<i>Poliolimnas monasa</i>	extinct	Baker 1951, p. 121
Carolines	Pohnpei	high island	<i>Porzana</i> spp.?	extirpated	Steadman & Intoh 1994
Carolines	Ulithi	atoll	<i>Poliolimnas cinerea micronesiae</i>	extirpated	Baker 1951, p. 125
Hawaii	Laysan	atoll	<i>Porzana palmeri</i>	extinct	Baldwin 1947
Hawaii	Lisianski	atoll	<i>Porzana</i> sp. ?	extinct	Baldwin 1947
Marianas	Guam	high island	<i>Porzana cinerea micronesiae</i>	extirpated?	Baker 1951, p. 125
Marianas	Guam	high island	<i>Gallirallus owstoni</i>	extirpated	Jenkins 1983
Marianas	Rota	high island	<i>Poliolimnas cinerea micronesiae</i>	extirpated	Steadman & Intoh 1994
Marshalls	Bikini	atoll	<i>Poliolimnas cinerea</i> ?	extirpated	Baker 1951, p. 125
Marshalls	Bokak	atoll	<i>Poliolimnas cinerea</i> ?	extirpated	Spennemann 1998b
Marshalls	Eneen-Kio	atoll	<i>Gallirallus wakensis</i>	extinct	Rothschild 1903
Palau		high island	<i>Ralina fasciata</i>	extirpated	Baker 1951 p. 120

a ground-dwelling bird, such as a rail or a megapode, in the Marshall Islands proper. Amerson (1969, p. 309) drawing on Yamashina (1940, p. 679) mentions that a *Poliolimnas cinerea micronesiae* (white-browed crake) was historically recorded as a vagrant on Bikini Atoll (11°30'N 165°25'E). The main distribution of this species is in the Carolines and the Marianas, with local extirpations on (historical) record (such as Fais; Baker 1951). It is thus significant to mention, that such a bird is also mentioned in the historic materials for another atoll in the Marshall Islands.

A rail or crake on Bokak Atoll

On November 30th, 1895, the Imperial German Government District Administrator Dr. Georg Irmer, normally resident in Jaluit, conducted an inspection of Bokaak (formerly known as Taongi Atoll; 14°32'N 169°00' E), a northern atoll of the Marshall Islands, to collect guano samples for analysis and to reaffirm the German claim to the island. Irmer observed a vast number of seabirds as well as a species of large ground dwelling bird (Irmer 1895; Krieg 1895). Unfortunately this bird is not further described, and apparently no specimens were collected. Given Irmer's German terminology ('Trappe'=bustard), and given Steadman's (1995) work, we can assume it to be an endemic megapode, rail or crake of some description (Spennemann 1998b). Average shorebirds, such as Bristle-thighed Curlews (*Numenius tahitiensis*) and the like can be ruled out as Irmer and his Marshallese crew would have readily recognised them. Modern ornithological reports do not mention such a bird ever occurring in the Marshalls (cf. Amerson 1969; Fosberg 1990). It is also conceivable that the bird sighted by Irmer was a vagrant white-browed crake, similar to the one reported as a vagrant on Bikini Atoll. It is not totally clear from Irmer's (1895) description whether he saw only one or more individuals.

The Wake Island rail

A flightless rail, *Gallirallus wakensis*, was the only non-migratory land bird native to Wake Island (or Eneen-Kio, 19°17'N 166°37'E), which is, geographically the northern-most atoll of the Marshall Islands (Rothschild 1903, Mayr 1945). This bird survived the Japanese plumage collection pogroms of 1904, 1906 and 1908 (Wetmore in Olson 1996:111, 184, Bryan 1959, Spennemann 1998c-d), and became extinct during World War II (Bailey 1951, Fosberg 1959, Bryan 1959, Grant 1947).

It is worth noting that references to endemic or vagrant crakes, and the Wake Island rail all stem from the northern, and traditionally less densely populated atolls of the Marshall Islands (see Figure 1). Here the human-induced habitat changes were less dramatic than on the southern, more populated atolls. The occurrence of rails on Wake, Bikini and possible Bokaak testifies that long-distance dispersal was possible and that some animals successfully reached new locales. The hunting of sea-shorebirds is still common in the Marshall Islands (cf. Anderson 1981, Thomas 1989).

OTHER EXTINCT OR EXTIRPATED AVIFAUNA IN THE MARSHALL ISLANDS

In addition to the rails, there are other two bird species that we know about from historic sources, such as fruit pigeons, a possible reed warbler and more modern localized extirpations of vagrants and introduced domestic birds.

Fruit-pigeons

The Crimson-crowned Fruit Dove (*Ptilinopus porphyraeaeus hernsheimi*) once occurred on Ebon Atoll (4°38'N 168°40'E) and is recorded from there with one skin collected in 1859 by B.G. Snow, a Protestant missionary stopping over in Ebon en route from Kosrae (Amerson 1969: 206, Hezel 1989: 200ff). The bird was first described for Ebon as *Ptilinopus marshallianus* by Peters and Griscom (1928:104) and is included in a variety of bird lists of the 1930s (cf. compilation by Baker 1951: 184, Amerson 1969: 205). The species was not seen after World War II. Today the species is still well distributed in the Caroline Islands, especially on the high islands of Pohnpei, Chuuk and Kosrae (Baker 1951: 184-186, Pratt et al. 1987, p. 197).

The Micronesian Pigeon (*Ducula oceanica ratakensis*) occurred on Ebon in the 1860s when it was already under heavy predation. As Doane (1861) put it: "There are few Columbidae, *Carcophaga oceanica*, which manage to elude the keen search of the natives. These birds are occasionally heard cooing away in the tops of some quite isolated bread-fruit tree". This bird was extirpated on Ebon. The extirpation on Ebon can possibly be attributed to excessive hunting for European traders and crew of passing ships, who would have offered much desired trade goods in return. The ICBP compilation lists the status of *Ducula oceanica* as indeterminate (Pratt et al. 1987), while the Marshall Islands National Biodiversity Study lists it still as occurring on Lae, Lib, Namdrik and Majuro (there as a pet) (National Biodiversity Team 2000: 283).

In addition to *Ducula oceanica* and the Long-Tailed Cuckoo (*Eudynamis taitensis*) Doane (1861) mentions another songbird which he heard, but which he could not identify.

The annañ bird

Traditional stories of the Marshall Islands, as recorded by German ethnographers at the turn of the century, mention a small bird called *annañ* (also: *anang* and *annāng*), considered to be the property of the chiefs. This bird, of which no proper physical descriptions exist, is reported to have been of the size of a butterfly and to have possessed a pleasant smell. The bird, which seems to have been a small ground dwelling species, is said to have lived among rocks around the shores of the northwestern Marshall Islands (Erdland 1906:183, 1914: 245, Krämer and Nevermann 1938:89, 113; 294-295; 300), but must have also occurred on Jaluit (Schnee 1904).

An oral tradition from Wotho Atoll (10°5'N 165°50'E) deals with the construction and launch of a canoe. The chant required for the launch lists one bird after the other, while the men stand on one leg. Only once the name of the last and

smallest bird, the *annañ*, has been called, the canoe can be launched (Erdland 1914: 245). The attributed habit of living among the rocks of the shoreline, does not fully match that of any other bird species known from the Marshalls.

Erdland's dictionary of 1906 contains an entry on the bird based on informants (Erdland 1906:138), which is repeated in the current quite comprehensive Marshallese dictionary (Abo et al. 1976: 16).

According to Krämer & Nevermann (1938: 89) the bird became extirpated/extinct around 1880. Like the Bokak rail this bird is not mentioned by the early data provided Otto Finsch (1880b-c). Paul Schnee (1904) mentions that informants had told him in 1902-03 of an unnamed small song bird which had lived on Jaluit, and which had been a ground-dwelling bird. Based on his informants descriptions of the bird, Schnee speculates that the bird might have been a Nauru Reed-Warbler (*Acrocephalus rehsei*), which was frequent on Nauru (0°32'S 161°56'E) in his time (Schnee 1904; Pratt et al. 1987: 254–25). The habits of the Nauru Reed-Warbler's two closest relatives, that of the Nightingale Reed-Warbler (*A. luscinia*), which is common in the Marianas, and the Caroline Islands Reed-Warbler (*A. syrinx*), which is wide-spread on both on atolls and high islands in the Caroline Islands (Baker 1951:251–260, Pratt et al. 1987: 253–254), do not match with the attributed habits of the *annañ* bird.

Reed-warblers are described by Engbring et al. (1990) as an edge species, on atolls living in shrubby vegetation surrounding the swampy areas of atolls, such as taro patches and cane swamps as well as brackish water marshes. They tend to avoid open and exposed ground. On Ant Atoll, where have been recorded from very small coconut-covered islets, the birds tend to prefer broadleaf trees and bushes (Baker 1951: 253 ff.; Engbring et al. 1990: 140–141). The latter habitat observation is consistent with the reputed habit of the *annañ* living amongst the rocks of the shoreline.

CAUSES FOR THE EXTINCTIONS/EXTIRPATIONS

What are the possible causes for the extirpation and extinction among the Marshall Islands avifauna?

Local predation

Local hunting of land birds by the Marshallese always occurred. Traditionally, hunting pressure was regulated by a number of taboos (Tobin 1958:47 ff.) and the Marshallese culture had established bird refuges (Tobin 1952; 1958), such as the atolls of Bokak, Bikar (12°15'N 170°06'E), the island of Jemo (10°07'N 169°33'E) and Taka (11°18'N 169°35'E) and the islets of Erik and Luij on uninhabited Erikup Atoll (9°08'N 170°00'E). These refuges were mainly for sea- and shorebirds.

However, the irregular occurrence of typhoons created food shortages (Spennemann & Marschner 1995) and thus increased utilization of wild bird resources. Chamisso (1910:169), who visited the central Marshalls in 1817, comments that land *and* seabirds are comparatively rare on the inhabited atolls, a sign

of sustained hunting pressure. Ethnographic and historic sources describe the various techniques employed by the Marshallese in catching Micronesian Pigeons and Fruit Doves, especially during the breadfruit season (Krämer & Nevermann 1938:113; Erdland 1906:182-183). These included the use of slip-nooses, sticks and slingshots. The introduction of firearms certainly improved the ability of the local population to hunt even those birds which perched too high up on a tree to be caught with traditional techniques, even though, as Doane (1861) observed, the Marshallese went to great lengths to capture them.

Not only the local population, but also the early European traders and whalers drew on the local resources the islands provided. The traders, with their previous experiences on other islands (such as Pohnpei) desired pigeons as a more palatable wild bird than the stronger tasting shore-birds. The combination of the demand, the use of firearms, and the hunting ability of the local population fuelled by the desire to acquire trade goods proved deadly to the pigeons in the more populous atolls.

Japanese feather collectors and changes during war

The extinction of the rails on Wake Island and possibly also Bokak Atoll occurred due to actions by Japanese feather poachers so active in the Central Pacific in the early part of the twentieth century (Spennemann 1998a-d; 1999) and the impact of World War II. The Wake banded rail was unable to withstand the combined pressure of the wartime change of the ecology of the island (development and bombing) and the predation by starving Japanese soldiers (United States Strategic Bombing Survey 1947a). The ecosystems of those Marshallese atolls harboring Japanese military bases were certainly strained, with wild and domestic bird populations severely reduced. Mason (1947, p. 74) could document that the domestic bird population on Maloelap Atoll, a Japanese airbase during World War II (United States Strategic Bombing Survey 1947b; Look & Spennemann 1993) had been reduced by starving Japanese soldiers and Marshallese alike from over 1,000 chicken and over 100 ducks to 200 chickens and no ducks.

Clearance of swamps and taro patches

Rails are one of the most effective colonizers of small oceanic islands. Baker (1951, p. 51-52) argues that the habitat of *Porzana* sp. in Micronesia was limited to swampy areas, either brackish or freshwater swamps, such as taro patches and mangrove fringes. On larger islands sufficient mangrove fringes survived usually away from human habitation, to ensure the rails' survival while on the smaller coral atolls the patches were much more limited. He relates that a small rail, possibly *Porzana cinerea*, was extirpated in the early days of U.S. occupation on Ulithi, when the taro patches were cleared for military base development (Baker 1951, p. 125). Like the rails, the *annañ* may have preferred the swampy areas of the taro-pits and mangrove depressions—if the identification as a Nauru or Caroline Islands Reed-Warbler is correct and would have easily fallen prey to cats (see also Rauzon 1985; Domm & Messersmith 1990).

Since World War II the taro patches, traditionally a standard feature in the centre of larger atoll islets, have become increasingly disused due to the influx of imported foods. Most of the Marshall Islands taro patches are now dry depressions, often partially filled in (Spennemann 1992).

Introduction of predators

Shipborne rats, *Rattus rattus* (black rat) and *R. norvegicus* (Norway rat) may have been a major predator on Wake since the Japanese occupied it during World War II (Spennemann 1997). Polynesian rats (*R. exulans*) occur throughout the Marshall Islands (Spennemann 1997) and were present on Wake at least by 1840 (Cassin 1858, Peale 1848, Pickering 1879). While Polynesian rats are often blamed for the predation of eggs and hatchlings of seabirds and ground dwelling birds eggs (Atkinson 1978, Bourne 1981, Norman 1975) they do not appear to have been a major factor in the extirpation of the Marshallese bird populations.

The *annañ* appears to have been hunted to extinction in the Marshalls by cats (Erdland 1906: 183, Krämer and Nevermann 1938: 113, 294-295, 300), which were introduced by the Russian Otto von Kotzebue in September 1817 to prevent rats from destroying a garden they had erected on Wotje (9°26'N 170°00'E; Kotzebue 1821: III 175, Chamisso 1986:141, 196). A year later they had multiplied, and by the 1820s were spread by the Marshallese as pets throughout the archipelago. As early as 1823 cats are reported as becoming feral (Kotzebue 1830: I 308-309, Chamisso 1986:141, 199). The German colonial administration continued the import of cats to combat rats in coconut plantations (Biermann 1891, Merz 1910).

Conclusions

The historic record shows that a small number of land birds existed in the Marshall Islands at the time of European contact. These bird populations suffered due to the introduction of predators, such as rats and cats, and through environmental change of their habitats. In addition, increased indigenous and European hunting pressures, perhaps especially the introduction of guns, led to further decimation.

As the combined landmass of an atoll is very low, and as the individual islands are very small, no bird refuge existed on the heavily populated atolls, which would have allowed their survival. All traditional bird refuge islands (see above) were essentially too far north to support large taro swamps or breadfruit areas and therefore could only save breeding populations of seabirds.

Food shortages for the garrisons and environmental change brought about by the events of World War II sealed the fate of several bird species.

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