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RECENT CHANGES IN THE AVIFAUNA OF MAKATEA ISLAND

(TUAMOTUS, CENTRAL PACIFIC)

BY

JEAN-CLAUDE THIBAUT AND ISABELLE GUYOT

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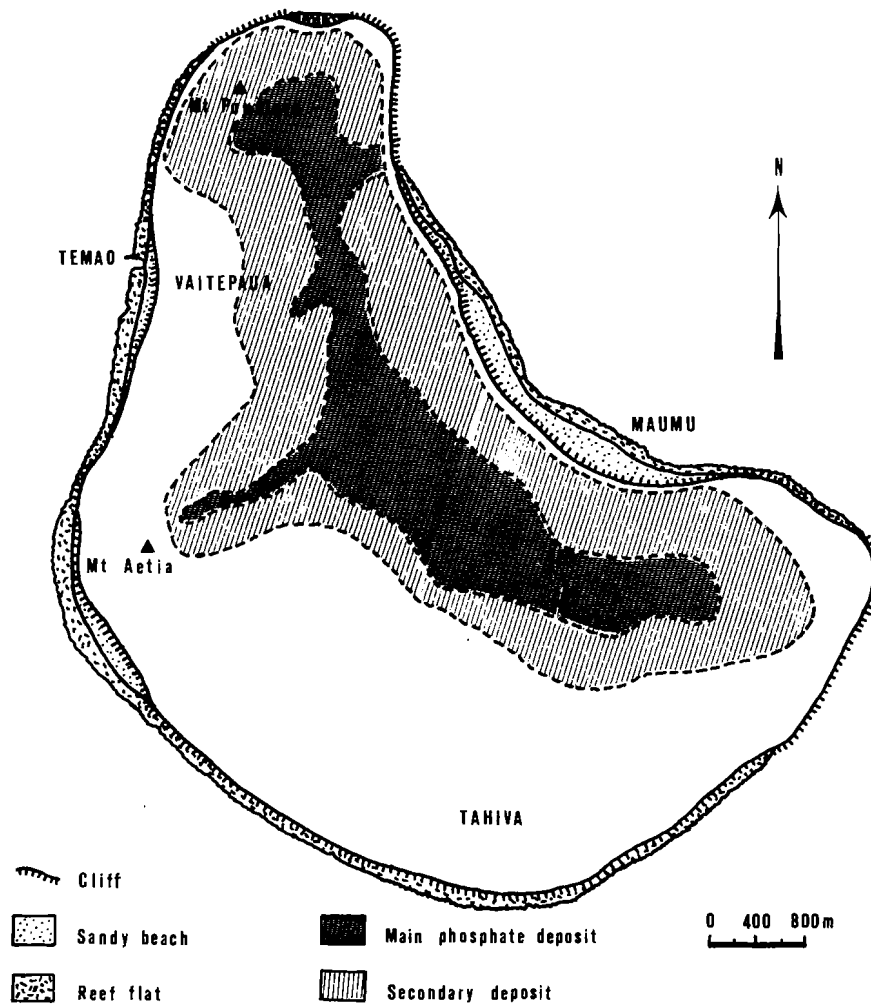


Fig. 1 : Makatea Island and the phosphate mining areas in the past

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INTRODUCTION

Makatea (148°15'W, 15°50'S) belongs to the Tuamotu archipelago and is situated about 240 kilometers north-east of Tahiti. It is an uplifted coral island surrounded by cliffs ranging from 5 to 70 meters in height. It is 9 km long and 5.5 wide and has an area of about 28 sq.km. The island has a plateau-like surface with Mt Puutiare (111 m) and Mt Aetia (90 m) as highest points. Data on the climate are fragmentary. Precipitations are less important than in the Society Islands with a yearly mean of 1.700 mm (FLORENCE 1982). The geomorphology is complex (see MONTAGGIONI 1985). Its main characteristic was its easily accessible phosphate deposits found at the bottom of small depressions. Tricalcic phosphate was elaborated from the action of rainwater in coral limestone and dejections of birds (BOUZAT 1986). The human population is nowadays about 30 inhabitants whereas 3.000 people were living on Makatea in 1962, when phosphate was mined (DOUMENGE 1963).

The rich flora, compared to the atolls, contains several endemic plants. Among them is a palm tree Pritchardia vuyltekeana. FLORENCE (1982) distinguishes three different plant communities:

- coastal community (Argusia argentea, Scaevola sericea, Cordia subcordata, Hibiscus tiliaceus, Guettarda speciosa, Morindia citrifolia, Pandanus tectorius...),

Antenne du Muséum National d'Histoire Naturelle et de l'Ecole Pratique des Hautes Etudes, Centre de l'Environnement, B.P. 1013, Papetoai - Moorea, Polynésie française.

- forest community of the plateau (Homalium mouo, Pisonia grandis, Xylosma suaveolens, Pandanus tectorius, Alysia scandens, Allophyllus ternatus, Rapanea ovalis...),

- secondary groves of the mined area (Morindia citrifolia, Guettarda speciosa...). In the latter area, formerly logged, we notice a vigorous recolonization by the vegetation.

This note presents the changes in the avifauna of Makatea during the XIX and XXth centuries.

MATERIAL AND METHODS

The island was first mentioned by Roggeveen in 1722 (JOURDAIN 1970), but visits became regular only during the XIXth century. An evangelist of the "London Missionary Society" settled down in 1829 (NEWBURY 1986), which supposes that exchanges with the outside were regular at that time. This probably explains the presence of bird specimens collected outside the Scientific Expeditions (e.g. description of Ptilinopus purpuratus chalcurus in 1859 by GRAY).

The present paper is based on the data collected during eight visits between 1839 and 1987. Time between these visits varied from 3 to 60 years. The visits were short (from a few hours to several weeks). By comparing the list of species observed or collected each time, it is possible to follow the changes that occurred in the composition of the avifauna. Some visits were however too short to give accurate estimates of species composition. This is alas the case of the first one in 1839 (PEALE 1848) which could have informed us about the composition of the Makatea avifauna at a time when many extinctions occurred in the Polynesian avifauna following the arrival of the Europeans (introduction for instance of new predators). We have to wait until 1901 (SEALE MS) to have a reliable reference of the present situation and to be able to appreciate the impact on the avifauna of major disturbances such as, in the case of Makatea, phosphate mining which drastically changed the vegetation of the island.

The following visits were used for our analysis:

- 1839: the United States Exploring Expedition, the 9th of September (PEALE 1848).

- 1899: Steamer "Albatross", the 26th of September and 6th of October (TOWNSEND and WETMORE 1919).

- 1901-02: A. Seale collected birds for the Bishop Museum (Honolulu), from the 29th of December 1901 to the 26th of January 1902 (SEALE MS).

- 1922: the Whitney South Sea Expedition (R.H. Beck and E. Quayle) collected birds for the American Museum of Natural History (New York), in August.

- 1929: the Crane Pacific Expedition during a brief stay (MAYR and CAMRAS 1932).
- 1932: the botanist Wilder mentions a rather complete list of birds (WILDER 1934).
- 1972: J.-C. Thibault stayed on December 18-19, in the village and in the inner forest.
- 1986-87: I. Guyot and J.-C. Thibault stayed from December 27, 1986 to January 4, 1987, visiting the northwest and northeast coasts, the area of the village Vaitepaua, as well as the area of Tahiva in the interior.

RESULTS

We present in chronological order data collected by the different visitors which are summarized in tables 1, 2 and 3.

- 1839: PEALE (1848) mentions only two species Ducula pacifica aurorae, qualified as "common", and Vini peruviana which is only indicated, without further details, in the collected bird list.

- 1899: TOWNSEND and WETMORE (1919) give the first census of the avifauna, but Vini peruviana is not mentioned. All other landbirds observed are qualified as "common".

- 1901-02: SEALE (MS) collected one specimen of Vini peruviana, confirming Peale's data. He notes in his journal that this species "is now quite scarce". All other species are considered as common, but Ducula pacifica is found only "in the wilder parts". He proves the breeding of seabirds (the same species as nowadays).

- 1922: the Whitney South Sea Expedition collected all the earlier mentioned landbirds at the exception of Vini peruviana which disappeared since the Seale's visit. All the birds are qualified as "common".

- 1929: the Crane Pacific Expedition collected only two species (MAYR and CAMRAS 1938) but did not bring any new information.

- 1932: WILDER (1934) mentions four breeding landbirds and four breeding seabirds.

- 1972: the only difference observed by Thibault with Seale's results 80 years before was the presence of the probably introduced Lonchura castaneothorax. Several tens of individuals were seen in the village gardens. Ducula pacifica aurorae was common but confined to the inner forest. Ptilinopus purpuratus chalcurus was frequent in all wooded habitats even in the village (one observation every 50th to 60th meters). Acrocephalus caffer eremus was well distributed in all wooded habitats but less abundant in the inner forest.

- 1986-87: the introduced Lonchura castaneothorax has disappeared. A new species Zosterops lateralis was observed; it has probably colonized the island from Tahiti. This species is not abundant but is found isolated or in small

flocks in several places (village and inner forest). Ducula pacifica aurorae is restricted to the inner forest. It was not observed in the vegetation recolonizing the former phosphate exploitation site. The inhabitants never observe it in or near the village. In the interior we could only go to Tahiva but the uniformity of the forest suggests that D. p. aurorae lives from Aetia in the west to the southeast coast, which represents about one third of the island (see Fig. 1). In this area, the progression is made difficult by enormous blocks of coral (the "feo"). The birds are mainly recorded in small natural clearings. Transects made in the forest allowed us to count 10 to 15 individuals per kilometer. It is impossible to accurately evaluate the size of the population, but it can be estimated to be between 100 and 500 individuals. Situations of P. p. chalcurus and A. c. eremus are the same as in 1972. Finally Gallus gallus, not recorded before but probably introduced long ago, is regular in the village but absent elsewhere. In general, birds are not hunted anymore.

DISCUSSION

I. THE LANDBIRDS

Two forms are endemic : Acrocephalus caffer eremus and Ptilinopus purpuratus chalcurus.

The absence of several species has to be noted, for example, Porzana tabuensis which is known on neighboring atolls (Rangiroa, Tikehau: HOLYOAK and THIBAUT 1984, POULSEN and al. 1985). It is possible that the absence of wet areas in Makatea is the reason. Gallicolumba erythroptera had formerly a vast distribution in the Society and Tuamotu archipelagos; PEALE (1848) found it on other islands of the Tuamotu but did not mention it for Makatea. Aerodramus spp., present in the Society and Marquesas Islands, could find many favorable breeding sites in the numerous cliff caves. Halcyon gambieri is present on the nearby island of Niau where the forest shows a structure similar to one observed in Makatea.

In the XXth century, five native species were noted, from which one (Vini peruviana) disappeared between 1902 and 1922. This extinction is most probably related to a particularly violent hurricane or to the introduction of a predator (e. g. Rattus sp.), than to the mining which was just starting at that time. During the same period two species appeared. Lonchura castaneothorax (well established in the Society Islands) today extinct which was probably introduced from Tahiti at a time when Makatea had many residents and the exchanges between the two islands were frequent (1930-60); Zosterops lateralis on the other hand has probably colonized Makatea on its own. The colonization

process of the Society Islands by this introduced species was completed in less than 30 years (HOLYOAK and THIBAUT 1984).

II. THE SEABIRDS

Only six seabirds breed on Makatea (table 2) and only little information was collected last century. Data collected between 1901-02 and 1987 show that there have not been any important changes. The data obtained in 1972 and 1986-87 underline the low number of Phaethon lepturus and Sula leucogaster, both being cliff breeders. Sula sula, Anous stolidus and Gygis alba have relatively high numbers. These three species find good breeding conditions in the large inner forest. In 1901-02, SEALE (MS) noticed that Sula sula was "largely used as food by the natives". Today, it appears that the situation has improved for nesting seabirds as this practise has ended.

The absence of breeders of some species, such as Sterna fuscata or Procelsterna cerulea, is puzzling. They may be conspicuous at other times of the year. It is also possible that a nocturnal Procellariiforme may breed in the cliffs, following the descriptions of the inhabitants who name such a bird "NOHA" (= Pterodroma rostrata in Tahiti).

III. THE CONSEQUENCES OF THE INDUSTRIAL PHOSPHATE MINING

The main changes that occurred in Makatea since the last century are related to phosphate mining. The "Compagnie française des Phosphates de l'Océanie" founded in 1908 obtained the mining concession on the whole island in 1917. Mining stopped in 1964 following the exhaustion of the deposit which covered half of the island. The forest was destroyed and burnt to allow the phosphate extraction of a volume close to 11.2 millions tons (BOUZAT 1986). Mining left a vast excavation in the main deposit and also smaller holes, several meters deep, in the secondary deposit, which gave rise to a specially chaotic landscape.

Figure 1 shows that half of the island was drastically modified; no bird extinction seems to be the result of the mining. For two species (Ptilinopus p. chalcurus and Acrocephalus c. eremus), mining did not change the abundance and distribution. However, for Ducula p. aurorae, it seems to have reduced the forest area which nowadays less than a thousand hectares. On the other hand, it seems likely that it is because of the great difficulty to penetrate into the inner forest that its population was not exterminated through hunting, one of the rare hobbies of people employed by the company (700 in the 1960's).

IV. COMPARISON WITH THE SITUATION IN TAHITI

Ducula, Ptilinopus and Acrocephalus also breed in Tahiti

or are represented by local forms. In Tahiti, D. p. aurorae has become very rare and has not been observed with certainty since 1972 (HOLYOAK and THIBAUT 1984). Neither hunting, nor habitat destruction seems responsible for this situation. It was already rare towards the middle of last century (see PEALE 1848), a phenomenon which has been amplified since the introduction of a raptor (Circus approximans). Ptilinopus p. purpuratus is not rare in Tahiti, but is restricted to the densest vegetation. The introduction of Circus approximans seems also responsible for this situation. Today, Acrocephalus c. caffer has been limited to a particular type of vegetation such as bamboos, since the introduction of Acridotheres tristis. Before this introduction, it could be found in more types of habitats and was one of the commonest birds. For these forms, competition and predation by introduced species seem to have been the main causes of regression.

CONCLUSION

Island birds are "generalists" that develop life strategies that minimize extinction risks. One of the strategies consists in having a habitat use as diversified as possible (see LACK 1970, BLONDEL 1986 for examples). Most birds of Eastern Polynesia largely fit such a claim (insectivorous, HOLYOAK and THIBAUT 1977; frugivorous, HOLYOAK and THIBAUT 1978). Some are able to rapidly make profit from man-made modifications to habitats. They use cultures, gardens and secondary forests (e. g. Acrocephalus caffer, Ptilinopus dupetithouarsii in the Marquesas Islands).

Ducula pacifica aurorae also shows a generalist strategy, using dry forest on coral limestone (Makatea) and humid mountain forests (Tahiti). But it was unable to quickly colonize the parts of Makatea with modified vegetation while another frugivorous bird (Ptilinopus purpuratus) was able to do so. Since the end of the mining, over twenty years ago, D. p. aurorae has remained limited to a small part of the island, occupied by a fairly high density. Another pigeon, the Marquesas Pigeon (Ducula galeata) shows a similar behavior: since its discovery, in the years 1840 (BONAPARTE 1855), it has had the same distribution limited to a few valleys of one island only (Nuku Hiva), while other valleys also show habitats that seem suitable. The general distribution of these two species shows however that both of them lived on several islands, which suggests that there were enough exchanges between populations to avoid phenotypical differentiation despite important habitat differences. Ducula galeata for instance, probably lived on several islands of the Marquesas Islands in the past (HOLYOAK and THIBAUT 1984) and similarly D. p. aurorae

breeds on both Makatea and Tahiti and it is possible that this form, or a similar one, bred in the past on other islands (fossil records of Ducula cf. aurorae or Ducula cf. pacifica on Henderson Island, STEADMAN and OLSON 1985).

But the possibility that these pigeons were introduced on some islands by Polynesian people in the past must also be considered, these species having been formerly domesticated in Polynesia (see PEALE 1848 p.200, Lemaire and Schouten in O'REILLY 1963, THIBAUT 1986).

The behavior of these pigeons contrasts with the behavior of Ducula p. pacifica (Western Polynesia, Melanesia and Micronesia, MAYR 1945) which shows a high mobility in searching for food, using a wide range of habitats (dry and humid forests, plantations) and often crosses sea straits to travel from one island to another (MAYR 1945, WATLING 1982). At a short time scale, the pigeons of Eastern Polynesia show well "the fear of flying of island species" (DIAMOND 1981).

This incapacity to rapidly colonize new kinds of habitats for some polynesian birds has to be taken into account by conservation policies. It demonstrates the need to preserve habitats for species that may quickly become extinct because they are unable to adapt to rapid changes in their environment.

RESUME

L'avifaune nicheuse de Makatea est bien connue depuis le XIXème siècle. Plusieurs inventaires permettent de suivre les modifications intervenues dans sa composition. On relève ainsi la présence de cinq espèces terrestres (dont une éteinte) et de six oiseaux marins nicheurs. L'exploitation industrielle du phosphate, entre 1908 et 1964, a provoqué un changement considérable de la végétation de l'île, puisque plus de la moitié de sa superficie fut défrichée, mais elle n'a pas entraîné d'extinction d'oiseaux. Deux espèces (Ptilinopus purpuratus chalcurus et Acrocephalus caffer eremus) réoccupent avec succès les boisements secondaires qui recolonisent l'ancienne mine. Ce comportement a d'ailleurs été constaté dans d'autres îles de Polynésie où ces espèces exploitent largement les milieux anthropisés. En revanche, un carpophage (Ducula pacifica aurorae) a vu sa répartition se limiter à la partie de forêt laissée intacte, couvrant une superficie inférieure à un millier d'hectares. L'incapacité d'étendre rapidement sa "niche-habitat" le rend particulièrement vulnérable.

ABSTRACT

The avifauna of Makatea has been well-known since the XIXth century. Several inventories enable to follow modifications which occurred in its composition. We notice five landbirds (one is now extinct) and six breeding seabirds. The industrial phosphate mining, between 1908 and 1964, has drastically changed the vegetation of the island, half the area of which has been destroyed. But it seems that this phenomenon has not provoked the extinction of birds. Two species (Ptilinopus purpuratus chalcurus and Acrocephalus caffer eremus) successfully occupy the secondary vegetation which colonizes the old mining area. A similar situation exists on other islands of Eastern Polynesia where these species or similar forms exploit largely man-made areas. On the other hand, the distribution of a pigeon (Ducula pacifica aurorae) has been reduced to the inner forest, not destroyed by the mining, which covers less than one thousand hectares. Its inability to rapidly extend its "habitat-niche" makes it very vulnerable.

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TABLE 1: NESTING LANDBIRDS OF MAKATEA ISLAND

	1839(1)	1899(2)	1902(3)	1922(4)	1929(5)	1932(6)	1972(7)	1986-87(7)
<u>Egretta</u> <u>sacra</u>		X	X	X		X	X	X
<u>Ptilinopus</u> <u>purpuratus</u> <u>chalcurus</u>		X	X	X	X	X	X	X
<u>Ducula</u> <u>pacifica</u> <u>aurorae</u>	X	X	X	X		X	X	X
<u>Vini</u> <u>peruviana</u>	X		X	!			!	!
<u>Acrocephalus</u> <u>caffer</u> <u>eremus</u>		X	X	X	X	X	X	X
<u>Zosterops</u> <u>lateralis</u>							-	X
<u>Lonchura</u> <u>castaneothorax</u>				-	-	-	X	-

Legend : X = present, ! = extinct, - = absent

(1) PEALE 1848, (2) TOWNSEND and WETMORE 1919, (3) SEALE MS, (4) Whitney Exp. in HOLYOAK and THIBAUT 1984, (5) MAYR and CAMRAS 1938, (6) WILDER 1934, (7) this work.

TABLE 2: NESTING SEABIRDS OF MAKATEA ISLAND

	1899(1)	1901-02(2)	1922(3)	1972(4)	1986-87(4)
<u>Phaethon lepturus</u>		N	N	N2	N2
<u>Sula leucogaster</u>			N	N2	N2
<u>Sula sula</u>		N	N	N3	N3
<u>Anous stolidus</u>	N	N	N	N3	N3
<u>Anous tenuirostris</u>		N	N	N	N2 (5)
<u>Gygis alba</u>		N	N	N4	N4

Legend : N = nesting, N2 = 10-99 pairs, N3 = 100-999 p., N4 = 1.000-9.999 p.
 (1) TOWNSEND and WETMORE 1919, (2) SEALE MS, (3) Whitney Exp. in HOLYOAK and
 THIBAUT 1984, (4) this work, (5) numerous non-breeding.

TABLE 3: LIST OF VISITORS ON MAKATEA ISLAND

	1899(1)	1901-02(2)	1922(3)	1932(4)	1972(5)	1986-87(5)
<u>Fregata minor</u>		P		P		P
<u>Fregata ariel</u>					P	P
<u>Numenius tahitiensis</u>	C			P		
<u>Arenaria interpres</u>				P		
<u>Pluvialis fulva</u>	C			P	P	P
<u>Heteroscelus incanus</u>		P	C	P	P	P
<u>Sterna fuscata</u>						P
<u>Sterna bergii</u>					P	P
<u>Urodynamis taitensis</u>		P	C	P		P

Legend : (1) TOWNSEND and WETMORE 1919, (2) SEALE MS, (3) Whitney Exp. in HOLYOAK and THIBAUT 1984, (4) WILDER 1934, (5) this work; C = collected, P = present