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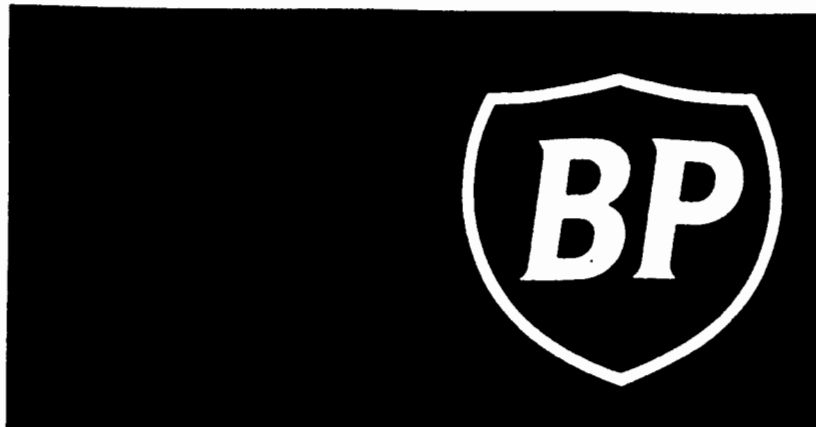


Project Tuttururu : Final Report

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Project Tukururu

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Project Tuttururu

Summary

In order to assess the situation of the 'Tuttururu' or Polynesian ground-dove (*Gallicolumba erythroptera*), a critically endangered Dove of French Polynesia, two 21 day expeditions from Makemo and Mangareva islands allowed the project leader and one team of two students (from Makemo only) to visit eight islands including five of them where the species was observed in 1922-23. Data were also collected on other land birds and endangered species present on those islands such as the Tuamotu sandpiper *Prosobonia cancellata*, Atoll Fruit-dove *Ptilinopus coralensis*, Tuamotu reed-warbler *Acrocephalus atyphus*, Spotless Crake *Porzana tabuensis* and Bristle-thighed Curlew *Numenius tahitiensis* and on introduced predators (cats, rats, pigs and dogs) as well.

In June 99, Tepoto, Tuanake, Hiti and Motutunga were visited during 2 to 4 days each with a speed-boat. Despite intensive researches, no individual from the *G. e. pectoralis* form was detected. This form may be extinct however an inhabitant of Fakarava claimed to have seen this bird (one male) in 99 in the village. This bird has been imported from an other (unidentified) island.

In October 99, the project leader landed from ship to Tenarunga for 18 days at a temporary village of copra farmers and visited Tenararo, Vahanga and Maturai Vavao with a small boat during a single day of expedition for each of those three islands. Only one population of minimum 16-30 *G. e. erythroptera* has been found at Tenararo.

Polynesian ground-doves were still present in the only rat-free island whereas Tuamotu sandpiper were also present in two islands with predators but remained uncommon there, and were probably only visitors in those islands. Atoll fruit-dove were much more common in the rat-free island than in the island where rats were present, and were extinct or present with a very low encounter rate in the islands where rats and cats were present.

Recommendations and actions proposed in order to rescue the Polynesian ground-dove and the Tuamotu sandpiper from extinction are :

- Protect Tenararo from predator and human disturbances;
- Create *in situ* security populations for both species through island restoration in Acteon group;
- Create an *ex situ* security population for the Polynesian ground-dove;
- Study those remaining populations;
- Perform additional surveys in Central Tuamotu Archipelago and in the Acteon group;
- Use the history of the Tuttururu for public awareness.

Project Tukururu

1. Introduction

The Tukururu or Polynesian Ground-dove (*Gallicolumba erythroptera*) is classified as critically endangered by BirdLife International (Collar et al, 1994; Stattersfiel et al, 1998). Except few individuals seen in 1968 at Maturei-Vavao (Tuamotu islands) (Lacan et Mougin, 1974) and in 1990-91 at two Rangiroa islets (Monnet et al, 1993), the range of the species, partly established by the Whitney Expedition (1920-1922), have been rapidly declining (Thibault, 1988; Steadman, 1989). Despite the visit of several Tuamotu islands by ornithologists (Seitre et Seitre, 1992; Poulsen et al, 1985; Holyoak et Thibault, 1984; Petitot et Petitot, 1975), no other population has been found. Ground-doves are vulnerable to rats and cats and numerous islets have been cleared for coconut plantations with the development of coconut groves for copra in the Tuamotu archipelago leading to destruction of the suitable habitat, accidental introduction of rats, then intentional introduction of cats (Holyoak et Thibault, 1984). Hurricanes may also represent a threat for its survivals and recently, the two small islets of Rangiroa have been devastated by a storm generated by El Nino and no bird has since been seen (P. Siu, personal communication).

In the hope to find remaining populations of *G.e. erythroptera*, in the Center Tuamotu archipelago and *G.e. pectoralis* in the South and to establish a species conservation plan in order to secure the future of this species, the visit of several inhabited islets where the Polynesian ground-dove may still survive was planned.

2. Material and methods

Table I present a summary of the available data on the range of the Society island ground-dove before the expeditions.

In June 99, the project leader and two students visited Tepoto, Tuanake, Hiti and Motutunga from Makemo during 2 to 4 days each with a fisherman speed-boat. In October 99, the project leader landed from ship to Tenarunga for 18 days in a temporary village of copra farmers and visited Tenararo, Vahanga and Maturei Vavao with a small boat during a single day of expedition for each of those three islands.

Table I : available data on the range of *Gallicolumba erythroptera* (from Thibault, 1988; Monnet et al, 1993; Steadman, 1989)

Taxa	extinct	present in 1922-1923, uncontrolled since	present those last 30 years (numbers)
<i>G.e.erythroptera</i>	Moorea, Tahiti, Marutea Sud Huahine, Mangaia, Atiu	Vanavana, Tenararo, Tenarunga, Maria	Maturei Vavao (few)
<i>G.e.pectoralis</i>	Aratika, Hao, Manihi?, Tikehau?, Tahanea?, Makemo?	Tuanake, Hiti	
<i>G.e.erythroptera</i> ?			Rangiroa (12-20 birds; extinct ?)

Surveyed species

A particular attention was carried out for all the restricted range species which could be found during the expeditions: the Society ground-dove (*Gallicolumba erythroptera*); but also the Tuamotu Sandpiper (*Prosobonia cancellata*), considered as endangered, and the Atoll Fruit-dove (*Ptilinopus coralensis*), near threatened (Strattersfield et al., 1988), which were both collected in Acteon group and at Tuanake and Hiti (W.E., 1920-1922). The Tuamotu Reed-warbler (*Acrocephalus atyphus*) was found at Tuanake, Hiti, Tahanea and Tepoto (Holyoak & Thibault, 1984) but no warbler have ever been described in Acteon group. The spotless Crake (*Porzana tabuensis*) was reported at Tuanake and Hiti (W.E., 1920-1922).

The Bristle-thighed Curlew, *Numenius tahitiensis* which breed in western Alaska was also surveyed because it is a vulnerable species (Collar et al, 1995).

Density estimation and encounter rate

During the first expedition, sightings of those different bird species were recorded by two observers during transects of approximately 200 m length along the forest edges of the lagoon or oceanic shore. Those transects were alterned with 10 minute point counts at 50 to 150 meters from the forest edge, in the middle of the forest, every 200 meters. However, in the second expedition, because most of the islands were visited within a single day, transects only were performed, mostly along the oceanic forest edge, the Society-island ground dove's favourite habitat on Maturei-Vavao according to local peoples. Both transects and point counts were coupled with regular habitat description (see below).

For transects, at each sighting we recorded perpendicular distance from the transect route, and flock size. For point counts, each sight was recorded with the distance from the central point of the census station. Distance were estimated within categories 0-5 m, 5-10 m, 10-15 m, 15-20 m, 20-30 m and 30 m or +. Other assumptions made were: (1) birds directly on the transect route were never missed; (2) individual were not counted twice; (3) sightings were independent events; (4) the probability of observing a bird decreased with distance from the transect; and (5) distance estimation were made from the point of departure of birds that flew away, flushed or were attracted (Franzreb, 1981; Buckland et al, 1993; Bibby et al, 1998). Estimates of density were obtained by fitting a detection function to the perpendicular distance data for transects, and to the distance from the central point for point counts. Detection function fitting and density estimation were performed by the program 'DISTANCE' (Laake et al, 1993). Data were entered as exact flock sizes, and distance as either the exact measure (± 2 m) or the mid-point of defined distance intervals.

As Buckland et al (1993) pointed out, to obtain adequate results from the DISTANCE programme, sample sizes (i.e. the number of groups of animals detected) should generally be at least 60-80 for transect, and reach 80-100 contacts by sampling unit for point count. Except for the Tuamotu Reed-warbler which was observed in almost sufficient number at Tepoto and for the Tuamotu sandpiper at Tenararo (see table II), none of the other birds species were abundant enough to allow the data analysis by the DISTANCE program (Bibby et al, 1998). We therefore decided to present our data under the form of encounter rates in order to allow the comparison of relative abundance between species and islands (see table III).

Table II. Effort (number of kilometres covered; number of 10 min point counts performed; hours spent in the field looking for bird) on each island and numbers of sightings of groups (total number) of focused species

Island	Area (ha)	Efforts	Ground-dove	Tuamotu sandpiper	Fruit-dove	Red warbler	Spotless Crake	Curlew
Tepoto	50	13.4 km	0	0	11 (14)	22 (28)	0	0
		82 Pc	0	0	16 (17)	47 (58)	0	0
		38.97 h	0	0	27 (31)	69 (86)	0	0
Tuanake	300	10.7 km	0	0	14 (19)	12 (14)	0	1 (1)
		48 Pc	0	0	16 (21)	15 (18)	0	0
		24.87 h	0	0	30 (40)	27 (32)	0	1 (1)
Hiti	150	11.0 km	0	0	8 (10)	34 (40)	1 (1)	2 (2)
		38 Pc	0	0	5 (7)	27 (30)	0	3 (3)
		27.88 h	0	0	13 (17)	61 (70)	1 (1)	5 (5)
Motutunga	138	5.6 km	0	0	1 (1)	2 (3)	0	0
		24 Pc	0	0	2 (3)	5 (6)	0	0
		14.6 h	0	0	3 (4)	7 (9)	0	0
Tenarunga	250	34.5 km	0	1 (1)	0	0	0	3 (4)
		61.56 h	0	1 (1)	0	0	0	3 (4)
Tenararo	100	6.5 km	7 (12)	177 (246)	29 (34)	0	0	28 (49)
		5.5 h	7 (12)	177 (246)	29 (34)	0	0	28 (49)
Vahanga	250	13.1 km	0	2 (2)	0	0	0	9 (11)
		6.25 h	0	2 (2)	0	0	0	9 (11)
Maturei Vavao	1500	10.0 km	0	0	0	0	0	6 (12)
		3.42 h	0	0	0	0	0	6 (12)

Habitat description

We recognised three locations within the studied areas: (1) along the oceanic forest edge; (2) along the lagoon forest edge; (3) in the centre of the island. On each island and, as much as possible, for each localisation, from 5 to 20 points of standardised description of the vegetation within the 50-m radius were performed. We estimated maximum vegetation height for three vegetation layers : ground, intermediate and canopy; the vegetation structure (% cover for each stratum); and the dominant species present on those layers.

Predator detection

The presence of cats was tested by visual contact, tracks and faeces whereas the presence of rats was tested both by visual contacts, damages caused on coconuts plantations and (if possible) by snap-traps or live-traps set during the night (see Table VII). Survey were also conducted from questioning the local population.

3. Results

Encounter rates

By using the encounter rates to give a crude ordinal scale of abundance (Adapted to the island situation from Lowen et al, 1996 in Bibby et al, 1998) we obtained the following categories for each species (see Table III)

Table III : Encounter rates (number of individuals per 1 field hour) and relative abundance of each species according to the islands

	Tepoto	Tuanake	Hiti	Motu- tunga	Tena- runga	Tenararo	Vahanga	Maturei Vavao
<i>Gallicolumba erythroptera</i>	-	- Ext	- Ext	-	- Ext	2.18 F	-	- ?
<i>Ptilinopus coralensis</i>	0.79 U	1.61 U	0.61 U	0.27 U	- Ext	6.18 F	-	- ?
<i>Acrocephalus atyphus</i>	2.21 F	1.29 U	2.51 F	0.62 U	-	-	-	-
<i>Porzana tabuensis</i>	-	- ?	0.04 R	-	-	-	-	-
<i>Prosobonia cancellata</i>	- Ext	- Ext	- Ext	-	0.02 R	44.73 A	0.32 U	- ?
<i>Numenius tahitiensis</i>	-	0.04 R	0.18 U	-	0.07 R	8.91 F	1.76 U	3.51 F

A = Abundant; C = Common; F = Frequent; U = Uncommon; R = Rare; - = not found; - ? = not found, reported previously; - Ext = not found, reported previously and probably extinct.

Polynesian ground-doves were only found at Tenararo where they remained relatively frequent. During the transect, 12 birds were seen by the project leader whereas four specimens were seen (three on the lagoon side and one near the village, on the oceanic side) by two inexperienced people who travelled the same day on the lagoon edge of the island during approximately 1500 meters, on the oceanic edge during 3000 meters and in the middle of the island during about 3000 meters.

Densities

The estimated density of Titi from Tenararo survey was 15.4/ha (effort = 6.5 km; n = 177 encounters, suggesting the presence of 1543 birds (490 - 4800, CV = 0.27) living in the island. Average cluster size was 1.38 ± 0.56 .

The estimated density of Tuamotu reed warbler on Tepoto was 3.1/ha (effort = 82; n = 47 encounters), suggesting the presence of 158 (105-239, CV = 0.21) individuals living in the island. Average cluster size was 1.26 ± 0.72 .

Polynesian ground-dove encounters: description, flock size, alimentation and habitat

Male, female and supposed juvenile male were easy to discriminate. The plumage of the females is brown but more black on the back and more yellow on the ear coverts. It was impossible to discriminate the older from the younger ones. The bill and the legs are black. The legs are very long for a *Colombidae* species, which is probably a distinctive feature of the ground-dove species (see pictures 1 & 2). The male have a white head with grey marks (on the crown, cheek and nape; a distinctive feature of the G. e. e. subspecies and of the Rangiroa population). Its back, rump and tail are grey-black. The mantle and shoulder of wings are of a nice red-rust colour turning to pink at the scapular level. The breast is white and the belly and under-tail coverts are black. Individuals supposed as being juvenile males have brown-rust mantle and the head is brown and grey with white patches whereas the breast is white with brown patches (picture 3).

The sex ratio and group encounter are presented in Table IV. Average cluster size was 1.7 ± 1.39 . In addition, the dead body of a juvenile male was found in the oceanic edge. No nest was found.

Table IV: group size, sex ratio and juvenile birds observed at Tenararo

Encounter n°	Group size	female	male	juvenile male
1	5	4	1	0
2	2	0	1	1
3	1	0	0	1
4	1	1	0	0
5	1	1	0	0
6	1	0	1	0
7	1	0	1	0
8	1	0	1	0
9	3	3	0	0
Total	16	9	5	2

No vocalisation was heard but the birds were seen first on the ground and then flying at two occasions.

In the oceanic edge, the birds were mainly found in the intermediate layer (L2) or on the ground (L1) of two types of habitat (see table V):

- an intermediate layer dominated by *Pandanus tectorius* and a soil covered by dead pandanus leaves, *Boerhavia tetrandra* and Naupata *Scaevola sericea*;
- the oceanic shore at the forest edge, with a ground covered by Naupata.

Polynesian ground-doves were frequently perched on Pandanus branch or under direct Pandanus covert, walking on dead leaves, probably looking for small insects or crustaceans. They were seen feeding on *Boerhavia* flowers at several occasions. The other plant species present in abundance were the Kahaia or Tafano, *Guettarda speciosa* and the Tohonu, *Messerschmidia argentea*.

Table V: habitat description of oceanic forest edge at Polynesian ground-dove encounter at Tenararo

n	L1			L2			L3		
	max height	dominant species	% of cover	max height	dominant species	% of cover	max height	dominant species	% of cover
7	7-8	<i>Cocos</i> (6)	3.1	4.2	<i>Guettarda</i> (7) <i>Pandanus</i> (6) <i>Messerschmidia</i> (5)	39.3	< 1	<i>Scaveola</i> (7) <i>Boerhaavia</i> (6) <i>Cassytha</i> (3) <i>Lepturus</i> (3) <i>Pandanus</i> (2)	72.8
1	-	-	-	2	<i>Messerschmidia</i>	10		<i>Scaveola</i>	60

n = sample size by habitat type

In order to compare the habitat differences at Tenararo (where the species is still present) and Tenarunga (where the species is probably extinct), habitat description of oceanic forest edge at Tenarunga are presented in table VI. In the intermediate layer, the vegetal species found in Polynesian ground-dove habitat are still present at Tenarunga whereas on the ground (L3), young Pandanus and Kainoka, *Cassytha filiformis* are much less frequent. In both layers, the percent of cover of L2 and L3 are much less dense at Tenarunga, reflecting the activity of clearing soil for copra exploitation.

Table VI: habitat description of oceanic forest edge at Tenarunga

n	L1			L2			L3		
	max height	dominant species	% of cover	max height	dominant species	% of cover	max height	dominant species	% of cover
10	8-10	<i>Cocos</i> (10)	7.2	4.3	<i>Pandanus</i> (9) <i>Messerschmidia</i> (9) <i>Guettarda</i> (5)	7.2	< 1	<i>Scaveola</i> (9) <i>Boerhaavia</i> (7) <i>Lepturus</i> (9) <i>Metuapua</i> (7) <i>Portulaca</i> (5)	26.2
2	-	-	-	2	<i>Messerschmidia</i> (2) <i>Pandanus</i> (2)	55	0.5	Variable	60

Habitat description performed on other islands are not presented.

Predator detection

The results obtained are presented in Table VII

Table VII : trails, rodent encounter (per 10 hours of field work) and rat catch according the method used.

Island	trails	rat encounter (species)	No trap-night and results obtained					
			snap-traps	rat catch (% and species)	tubes	rat catch	live-traps	rat catch
Tepoto		0.51 (1 black & 1 Pacific rat)	5	0	54	0	-	
Tuanake		2.01 (5 Pacific rats)	19	0	-		-	
Hiti		0.72 (2 Pacific rats)	20	2 (10 %, Pacific rats)				
Motutunga	cat	0.00	36	6 (16.7 %, 4 black rats and 2 Pacific rats)	30	0		
Tenarunga	cat & pigs	0.00	152	4 (2.6 %, 2 black rats, 1 Norway and 1 Pacific rat)			117	0

Those results ascertain the presence of rats in five on 8 islands, the presence of cats on two islands and of pigs on one of them. Most rats were Pacific, *Rattus exulans* however black rats *Rattus rattus* were present on three of them and Norway rats *Rattus norvegicus* were detected at Tenarunga.

Visit duration was too short at Tenararo, Vahanga and Maturei Vavao for assess the presence of introduced species on those islands. However, except at Tenararo, Polynesian and black rats are said to be present at Vahanga and Maturei Vavao.

If we synthesize the collected data and the results of the survey performed with local people, we obtained a better understanding of the level of colonisation and exploitation of each island by human being population and of introduced species such as rats, cats but also pigs and dogs (Table VIII).

Table VIII : Situation of human presence, coconut plantation and introduced species on each island. The term district means that the island is more or less regularly exploited for copra by the population from an other Tuamotu island.

	Tepoto	Tuanake	Hiti	Motu- tunga	Tena- runga	Tenararo	Vahanga	Maturei- Vavao
Black rats	+	-	-	+	+	-	+ ¹	+ ¹
Pacific rats	+	+	+	+	+	-	+ ¹	+ ¹
Norway rats	-	-	-	-	+	-	-	-
Feral cats	-	-	-	+	+	-	-	-
Feral pigs	-	-	-	+	+	-	-	-
Dogs	-	-	+ old ¹	+	+	-	-	-
Coconut plantation	+	++	+	++	+++	+++	+++	+++
Human presence	+ (old)	district	district	+	district	-	district	district

1: according testimony of local people

4. Discussion

Range of the species and size of the remaining population

Despite intensive research efforts, no *G.e.pectoralis* were found at Tuanake, Hiti, Tepoto and Motutunga and none of the forty people present at Makemo during the project presentation were able to recognise the species. An inhabitant from Takume recognised the bird and remembered its local name (Tutururu). She said that it was a bird of ancient times, now extinct at Takume where she saw a dead body of the bird when she was young. This form may either be extinct or persist in other islands because an inhabitant we met at Papeete in September claimed she had seen a similar bird (but with the head completely white) in January 99 at the village of Fakarava. She added that this bird was imported from an other island but was unable to precise which one. As the white head is a feature of the *G.e.pectoralis* form and the picture available on the species was the picture of the other sub-species, with a white and grey head, her testimony may be reliable.

Regarding the *G.e. erythroptera* form, the short time spent at Vahanga, Tenararo and Maturei-Vavao implies that only positive responses could be taken in consideration so that we could only ascertain that the bird is extinct at Tenarunga and surviving at Tenararo. However, the species was not found at Vahanga and at Maturei-Vavao by the Whitney expedition in 1925 and the bird have never been seen at Vahanga by local people. Discovered in 1968 (Lacan et Mougin, 1974), the small population of Maturei-Vavao was still present in 1987 according to local people. Three groups of 5, 5 and 12 birds were present on the island at this time and remained in the same area i.e. three different islets during the four months of island exploitation. Because of the short time available during the visit to Maturei-Vavao, two of those three islets have been visited during one hour in the oceanic edge but none were found. Since no *Prosobonia cancellata* and *Ptilinopus coralensis* were found at Maturei-Vavao whereas both species were recorded as being present by local people in 87, and since rats are reported to be present there, the forecast about Polynesian ground-dove survival on this island is poor. The species may also persist at Maria and Vanavana islands where it was present in 1925. However, those islands were not priority islands for the survey because rat infestations are reported there by local people. They claim that 'rats are so frequent at Maria that people are bitten during the night'; 'rats are frequent at Vanavana but have few impact on the coconut productivity because they remain on the ground'. This suggests that Norway rats are present there.

It is difficult to establish the exact population number at Tenararo because of the small number of encounters and the lack of data on the lagoon side and on the middle of the island. However, according to the data available today, it seems that the forest near the oceanic edge is the preferential habitat of the species. In 1988, brother Joel Aumeran has travelled during half a day in the lagoon side of the island looking specially for birds and has been able to see only one female (but at this time the bird was not identified as a Polynesian ground-dove because of the morphological difference with the male). Due to the small size of the island and to the fact that we have travelled through the species favourite habitat, we can only extrapolate a minimum population size of about 16-30 birds.

With only one localisation identified today and the probable reduced size of the remaining population, our data confirm the fact that the species is critically endangered and need urgent protection measures and management.

Situation of the other species

The presence of Polynesian ground-dove, the spectacular abundance of Tuamotu sandpiper, and the important populations of Atoll Fruit-dove and Bristle-Thighed Curlew on Tenararo make this island as one of the most important of the Tuamotu Archipelago for bird conservation.

The Tuamotu Sandpiper (*Prosobonia cancellata*) - considered as endangered - was formerly present at Tepoto, Hiti and Tuanake in the Raevski group but were not found and are probably extinct there presently. The species was also present at Maturei-Vavao in 82; Vahanga, Tenarunga and Maria in 1925, but the low number of birds observed at Vahanga (n = 2) and at Tenarunga (n = 1) suggests that those birds are visitors to those islands rather than established there. Moreover, none were seen at Maria island in 1986 by local people. This species seems also to be fully in decline and the population of Tenararo, with a minimal number of 500 birds, is essential for its survival. The other Tuamotu Sandpiper populations identified this last decade are at Tahanea (12-15 birds only), Anuanuraro (30-40 birds) and Morane (150-200 birds) (Collar et al, 1994). During the transect, an important bias was evident, in spite all our efforts to avoid it. All the birds were very tame and approached us as long as we were on their 'territory'. Afterwards, they turned back to their place and other birds arrived. In fact during all the transect, we were continuously surrounded by between 5 to 25 birds. The situation was identical for those which had travelled on the lagoon shore and on the middle of the island. Thus it seems that we were not particularly travelling through their favourite habitat.

The Atoll Fruit-dove (*Ptilinopus coralensis*) was not found at Maturei-Vavao and at Tenarunga, and remains relatively uncommon on the other islands, confirming the general decline of the species. Moreover, the Fruit-doves in Tenararo were not vocal as opposed to all other populations of Fruit-doves found during the first expedition. If this finding was confirmed, this particularity would suggest the existence of an important speciation phenomenon.

The Tuamotu Reed-warbler (*Acrocephalus atyphus*) was found at Tuanake, Hiti, Tahanea and Tepoto (Holyoak & Thibault, 1984) and is still from frequent to uncommon there. The spotless Crake (*Porzana tabuensis*) was reported at Tuanake and Hiti (W.E., 1920-1922) but seen only at Hiti by the Whitney Expedition. This species is particularly difficult to detect and persist on other islands of the pacific in good number including on Tahiti island (Caroline Blanvillain, personal observation) despite rat colonisation and numerous feral cats.

The exact situation of the Bristle-thighed Curlew, *Numenius tahitiensis* which breed in western Alaska during winter is difficult to establish since the periods of the two expeditions (June and November) were different: The first one took place after the traditional May formation of breeding group and the second one took place after the return to their wintering grounds in July and August. Individuals seen at Tuanake and Hiti may therefore represent sub-

adults which over-summer on the wintering grounds until their third year (Marks and Redmond, 1994a). However, from both expedition, its distribution seems to vary according the human and predator populations and probably other factors more difficult to establish (see below).

Polynesian Ground-dove behaviour and habitat

Polynesian ground-dove reported most favoured habitats were atoll's primary forests (*Pandanus tectorius*, *Pisonia grandis*) with herbs, shrubs and ferns or dense shrubs (*Pemphis acidula*, *Tournefortia argentea*, *Guetarda speciosa*...) (Monnet et al, 1993; Thibault and Holyoak, 1984). The Tenararo population was present in dense shrubs (*Pandanus*, *Pemphis* and *Tournefortia*) under modified coconut-tree canopy. The Polynesian ground-dove population found at Rangiroa where seen to eat *Portulaca* buds, *Euphorbia* leaves and *Digitaria* seeds (Monnet et al, 1993). Those from Marutea Atoll (near group Acteon) fed on *Tournefortia argentea* and *Morinda citrifolia* seeds (Seurat, 1903). According to Beck and Quayle (W.E., 1920-1922), they also feed on small insects and seeds of small shrubs (also including *Tournefortia* and *Morinda*), leaves and fruits. In the present study, birds were frequently associated with *Boheravia tetrandra* and were seen feeding on its flower buds or remaining on the cover of *Pandanus tinctoria*, probably looking for small insects. At three occasions, single animals were seen near an Atoll Fruit-dove (less than 2 meter) and Beck and Quayle reported that ground-doves brought on the boat used to eat Fruit-dove food remains. They are reported to feed while perching on shrubs or scratching on the ground with their feet (Monnet et al, 1993) and to be able to maintain fruits with their feet in order to eat them. None of these behaviour could be observed during our limited time of contact with the species.

They seem to be gregarious and residents (Whitney Expedition, 1920-1923) and local people testimonies seem to confirm those assessments.

The only data available on its reproduction come from specimens collected by the Whitney Expedition (1920-1922) and by Lacan et Mougins (1974). Some specimens collected in Acteon group in May and June were sexually active whereas the 3 specimens collected (also in Acteon group) by Lacan & Mougins (1974) in March-April were inactive. No nest nor eggs have been described. In this study we were unable to find neither nest nor eggs and all the juveniles found were old enough to reach the adult size.

Threats identification

At Tenararo, the population live on an island modified by an important development of coconut plantation. However the Copra have never been exploited since its implantation in 1977 and the density of the intermediate and low vegetal layer remain much more important here than at Tenania. This density may be important for the survival of the species.

It has been reported that natural disasters such as storms or hurricanes have a direct impact on species survival (Holyoak & Thibault, 1984; P. Siu, personal communication). The size of the island also have its importance. In the Tuamotu Archipelago, the less disturbed areas presently persist only in the smaller islands or islets, less interesting to clear for coconut's plantation than bigger one. Because of their small size, those islets are more vulnerable to natural disasters. Tenararo is the smaller island of the Acteon group.

Possible threats at the origin of species extinction in Tuamotu Archipelago (in addition to natural disaster) could be appreciated if we compare data available in Table III and VIII. Islands could be classified in three categories according their minimal predator colonisation: 1) Motutunga and Tenarunga where Polynesian rat, black rats and cats are present are the more disturbed islands; 2) Tepoto, Tuanake, Hiti, Vahanga and Maturei-Vavao which get at least one species of rats and 3) Tenararo, the only one where no introduced predators are present.

Acknowledging the fact that wild cats are very difficult to detect in the field, it seems that the introduction of rats alone, and probably even Polynesian rat alone, are sufficient threats which could lead to the extinction of Tuamotu sandpiper and Polynesian ground-dove in the Tuamotu Archipelago. However, the survival of both species at Tahiti and Moorea until 1769-1777 (between the first and the third expedition of Capitaine Cook), therefore their probable coexistence of more than one century with the Polynesian rat on those islands reduce the value of this hypothesis even though the interactions between those species could be highly different in a volcanic island than those existing within an atoll. Interestingly, a Tuamotu sandpiper population present in 1922 at Makarua islands (Gambier islands) is now extinct (Holyoak & Thibault, 1984) whereas the only predator present on this small island (50 ha) is the Polynesian rat (Thibault & Bretagnolle, 1999). The impact of black and Polynesian rats on birds is now well documented (Atkinson, 1985), and Polynesian rats have been show to have a major impact on eggs and chicks of several species of bird nesting on burrows (Bell in Merton, 1970), on the ground (Fleet, 1972) or in nests perched on branches of more than 3 meters (Flack & Lloyd, 1978). The very tame behaviour of Tuamotu sandpiper and Society-island ground dove is probably a factor which explain the impact of rats on their population.

If we compare the situation of the Atoll Fruit-dove within the island, we can see that Motutunga (where cats and rats are presents) gets the lower encounter rates of the central Tuamotu Archipelago islands whereas it is extinct at Tenarunga (where cats and rats are presents). The situation of the species is also much better at Tenararo (the only rat-free island) than at Tuanake, Hiti and Tepoto where rats only were detected. It seems therefore that there is a possible impact of cats and rats populations on Atoll Fruit-dove populations.

Because of the smaller sample size, it is difficult to get any reliable tendency for Reed-warbler and Spotless crane populations. Moreover, the Spotless crane is a species very difficult to found and may be still present and undetected at Tuanake.

It is interesting to see that Bristle-thighed Curlew in both expeditions were not found in the 2 more perturbed islands in term of predators i.e. Motutunga and Tenarunga, but also the only islands with human population at the time of the expedition.

5. Recommendations

1. Range of the Polynesian ground-dove:

- more survey are necessary in central Tuamotu Archipelago; in order to improve its chance of success, a survey near the local population is recommended. The picture of the bird (both sexes) should be sent to the mayor of Fakarava, Aratika, Anaa, Faaite, Toau, Kauehi, Hikueru and Marutea-north; Tahanea, Haraiki, Reitoru and Tekokota should be interesting to visit.
- in the South, the visit to Maturei-Vavao remains a first priority, Morane and possibly Maria and Vanavana could be interesting, at least Morane where the presence of Tuamotu sandpiper may represent the proof that the island is predator-free.

2. Study the remaining population at Tenararo:

- more transects are necessary in order to establish the size of the last Polynesian ground-dove population;
- more data should be collected on their reproductive and feeding behaviours;
- acknowledging that live-trap need several days in the field before to catch rodents (see table VII), predator detection should be improved on the island as in the other islands of the Acteon group.

3. Protect Tenararo from predator and human disturbances:

- if the creation of a sanctuary is not possible, delay the exploitation of the island until the creation of security *in situ* and *ex situ* Polynesian ground-dove populations;
- keep the name of the island secret, at least at a local level, in order to avoid traffic.

4. Create *in situ* and *ex situ* security populations:

- select (and if necessary restore by predator eradication programs) one or several Tuamotu Archipelago islands in order to translocate Polynesian ground-dove and create several other populations in the wild;
- create an *ex situ* security population, as ground-doves are usually easy to breed in captivity (Toone et al, 1993) and this could be the opportunity to increase the productivity of the species and to provide animals for future reintroduction programs.

5. Public Awareness:

- publish the history of the Tukururu in the local press (except the name of the island) in order to explain the importance of this remaining population; stimulate the respect of environment and show the impact of introduced species on the fragile ecological balance of an island;
- school conferences should help Polynesian children to learn the variety, originality and feature of their local avifauna & ecosystem.

6. Proposals for the future management of the endangered species in the Acteon group

Apparently, none of the island which have been exploited for copra, even at a very low level such as districts, present today a remaining population of ground dove (see table VIII). The present major problem to face for the Tenararo bird populations is the fact that the only productive coconut plantations remain in the Acteon group in this part of Tuamotu, where most islands are too small to allow pearl production, therefore where copra represent a substantial resource. This was the only place of the Tuamotu where burning the soil was forbidden and the current productivity of those islands 600 to 1000 kg/ha. This is twice to five time the productivity remaining in the other islands. Thus, there is a growing interest of the local population for the exploitation of those islands.

The islands of Acteon group are now managed by a society of Copra exploitation. This new society, with the support of the local government and the church, aim to restore employment and economical tissue at Reao and Pukarua islands, and there is a good dynamic suggesting the future exploitation of all the islands of the Acteon group. Its president, Father Joël Aumeran, is much concerned by wildlife conservation and understands the ecological importance of the island. He promised that the island is not going to be exploited next year. Rather than ask strictly the non exploitation of the island, we would like to obtain funds in order to reach several conservation steps:

- first step: study the Tukururu population at Tenararo, survey the birds and predator population at Maturei-Vavao and perform rodents eradication at Vahanga with the participation of the people of the Acteon group Society in order to restore an island which is regularly exploited for copra production. This eradication campaign would be the occasion to aware them of environment respect, to collect copra without intense native habitat destruction, to train them to rodent elimination techniques, then to take care about the introduction of predator on an island and in particular to train them to avoid in the long-term the accidental introduction of rats onto an island.
- second step: constitute a security captive population of Polynesian ground-dove in Tahiti;
- third step: eradicate rodents and other predators at least on Tenarunga and Maturei-Vavao;
- fourth step: translocate ground-dove populations from Tenarao or preferentially from captivity to others restored islands of the Acteon group.

The advantages of this methodology is that instead of forbidding (or to try to forbid !) the access or the long-term exploitation of Tenararo by the people directly interested by the island, we learn human beings and bird to live together, and with mutual interests. Indeed, rat-free islands will allow:

- the expansion of Polynesian ground-dove and Tuamotu sandpiper range (through translocation and may be natural aerial way, at least for the Tuamotu sandpiper);
- the maintenance within the Acteon group of a good copra productivity without the usual rodent degradation on coconuts plantations;
- the implantation of insectivore birds will probably allow a reduction of Coconut tree infestation by a local insect pest at the origin of the withering of numerous trees at Tenarunga and Vahanga.

A more detailed proposal, including all the recommendations of the present document, is presented in the 'Tuturu Follow-up Project Proposals' joined to this report.

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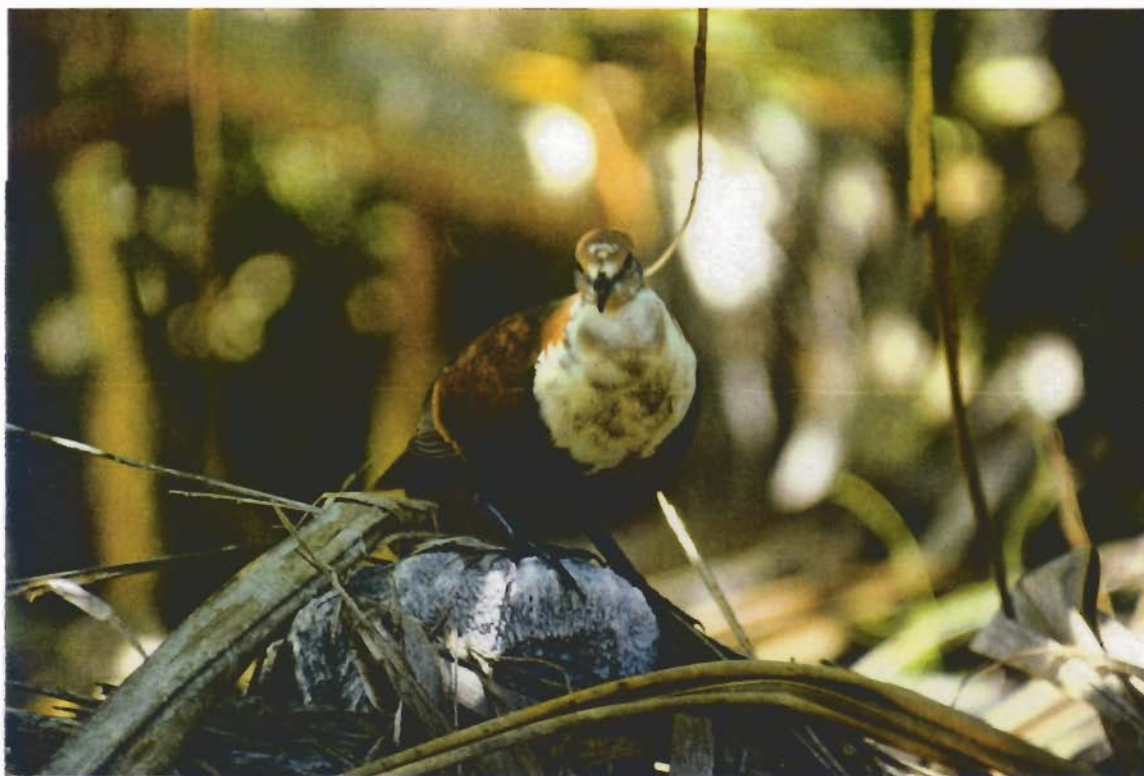
Pictures 1: Male Polynesian Ground-dove



Pictures 2: Female Polynesian Ground-dove



Pictures 3: Juvenile Polynesian Ground-dove



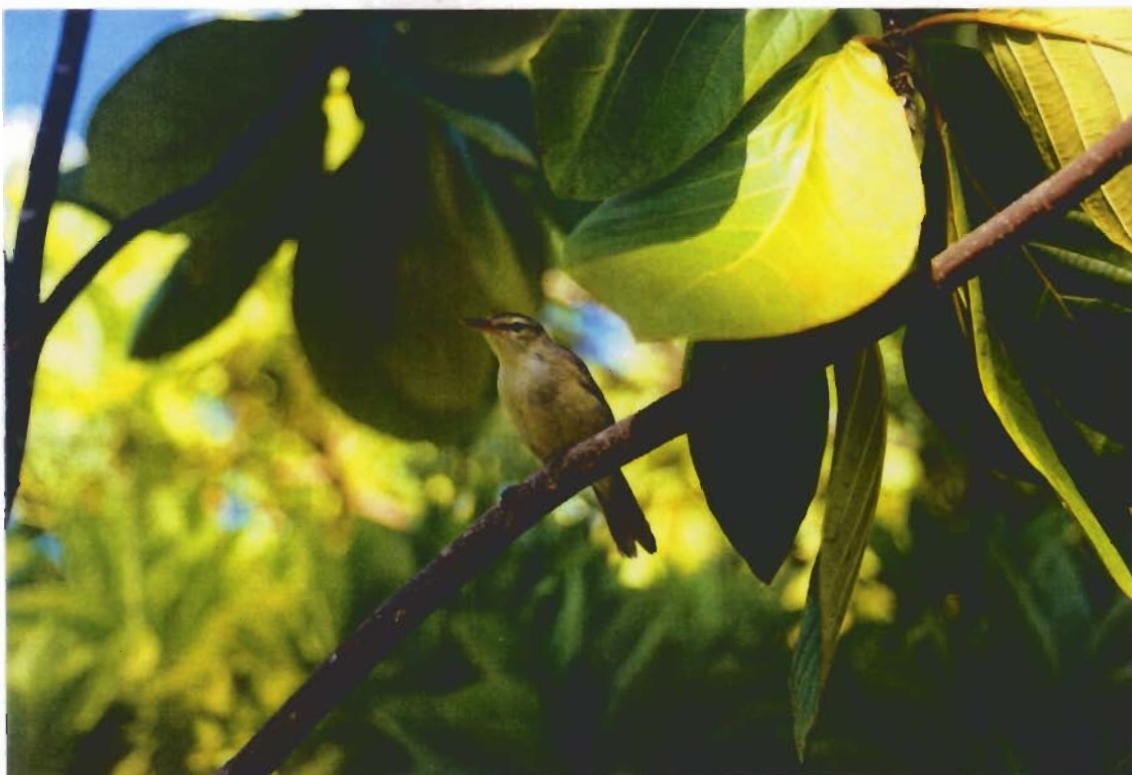
Picture 4: Tuamotu Sandpiper



Picture 5: Atoll fruit-dove



Picture 6: Tuamotu reed-warbler



Picture 7: Spotless Crake



Picture 8: Bristle-thighed Curlew

