

# Fossil and archaeological avifauna of Niue Island, Pacific Ocean

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## ABSTRACT

The archaeological and fossil avifauna of Niue Island in the southwest Pacific is described from ten sites. Fourteen species of birds, including an extinct species each of *Gallirallus* and *Nycticorax*, and an extirpated megapode (*Megapodius pritchardii*) were found. This increases the number of taxa known for the Niue fauna to 15 resident species, but faunas from surrounding islands indicate this is almost certainly an underestimate of original diversity.

KEYWORDS: Fossil avifauna, Holocene, Niue Island, Pacific Ocean.

## INTRODUCTION

The raised limestone island of Niue, centred on latitude 19°03' S and longitude 169°52' W, lies 800 km east of the Cook Islands, 560 km north-northwest of Samoa, and 480 km west of the Kingdom of Tonga (Figure 1). At 259 km<sup>2</sup> in area, it is large by Polynesian standards, and consists of a former lagoon (now at about 30-40 m elevation) surrounded by a ridge of coralline limestone which is the remains of the former reef and attains a maximum elevation of 68 m. There is an outer terrace at about 28 m encircling the island. The shoreline is a rocky wave platform of varying width, and sandy beaches are absent. There is no encircling coral reef. The island is mainly vegetated in forest or forest regrowth following subsistence agriculture. Small areas are in pasture, but all were probably forested in immediate prehuman times.

Kinsky and Yaldwyn (1981) studied the avifauna of Niue and recorded six seabirds, seven migratory waders, and 12 landbirds of which the two passerines are endemic subspecies, plus three species with unconfirmed records. (Table 1). Child (1982) reported White-faced Heron (*Ardea novaehollandiae*) as a vagrant. We saw a young Black-backed Gull (*Larus dominicanus*) on the wharf at Alofi on 12 June 1994, adding yet another vagrant species.

The fossil avifauna of Niue has not been studied previously, but studies on other Pacific islands, e.g., Steadman (1989; 1995) and Wragg and Weisler (1994) show that in all cases substantial numbers of species have become extinct following human colonisation.

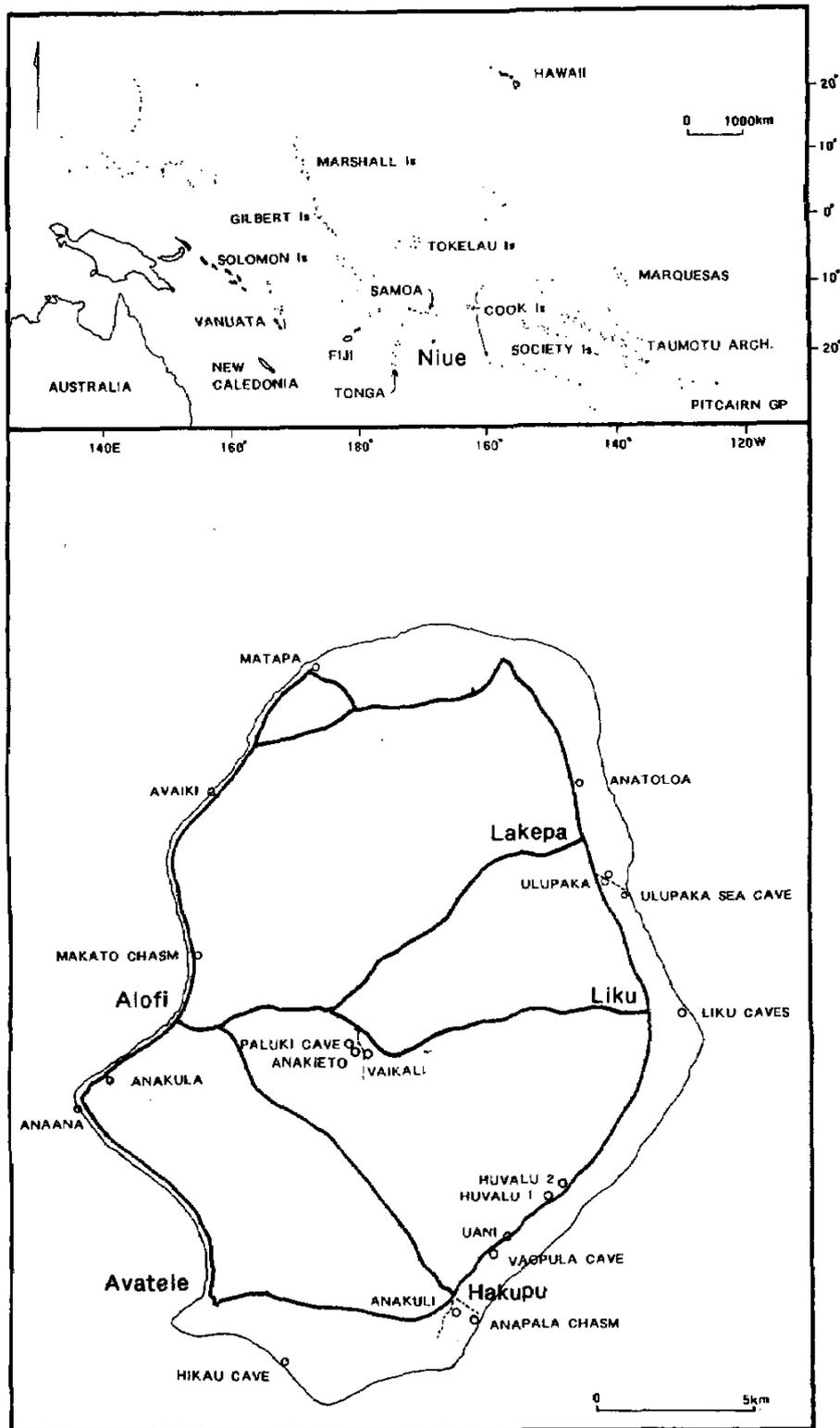


FIGURE 1 – The location of Niue in the central Pacific Ocean (above), and the sites studied on Niue Island (lower). Main centres of habitation are indicated by names in bold lower case letters and study sites by names in upper case. The main roads are shown as bold lines.

TABLE 1 – List of birds recorded from Niue Island by Kinsky and Yaldwyn (1981) and Child (1982). In the Status column V is vagrant, B is breeding species, V, u is unconfirmed record, M migrant.

Species	Common name	Status
<i>Macronectes</i> sp.	Giant Petrel	V
<i>Puffinus pacificus</i>	Wedge-tailed Shearwater	B
<i>Phaethon lepturus</i>	White-tailed Tropic Bird	B
<i>Phaethon rubicauda</i>	Red-tailed Tropic Bird	V, u
<i>Fregata minor</i>	Greater Frigate Bird	V
<i>Egretta sacra</i>	Reef Heron	V, u
<i>Ardea novaehollandiae</i>	White-faced Heron	V
<i>Anas</i> sp. ? <i>A. superciliosa</i>	Grey Duck	V, u
<i>Gallus gallus</i>	Feral Fowl	B
<i>Rallus philippensis goodsoni</i>	Banded Rail	B
<i>Porzana tabuensis</i>	Spotless Crake	B
<i>Porphyrio p. samoensis</i>	Purple Swampphen	B
<i>Pluvialis dominica fulva</i>	Pacific Golden Plover	M
<i>Numenius arquata orientalis</i>	Eastern Curlew	M
<i>Numenius tabitiensis</i>	Bristle-thighed Curlew	M
<i>Limosa lapponica baueri</i>	Eastern Bar-tailed Godwit	M
<i>Tringa incana</i>	Wandering Tattler	M
<i>Arenaria interpres</i>	Turnstone	M
<i>Calidris melanotos</i>	Pectoral Sandpiper	M
<i>Anous stolidus pileatus</i>	Common Noddy <sup>1</sup>	B
<i>Gygis alba candida</i>	White Tern	B
<i>Ducula pacifica</i>	Pacific Pigeon	B
<i>Ptilinopus porphyraceus</i>	Purple-capped Fruit Dove	B
<i>Vini australis</i>	Blue-crowned Lory	B
<i>Eudynamis taitensis</i>	Long-tailed Cuckoo	M
<i>Tyto alba lulu</i>	Barn Owl	B
<i>Collocalia spodiopygia</i>	White-rumped Swiftlet	B
<i>Lalage maculosa whitmeei</i>	Polynesian Triller	B
<i>Aplonis tabuensis brunnescens</i>	Polynesian Starling	B

<sup>1</sup> Kinsky and Yaldwyn (1981) were unsure of this species breeding status, but during our visit locals confirmed that it breeds on Niue.

The archaeology of Niue was first investigated in detail by Trotter (1979). He recorded 100 sites, mainly platforms, mounds, and burial sites in caves. Only three middens were recorded, although midden material was noted in some caves and structure sites as well. No avifaunal material was recorded from any of these sites.

The Niue Archaeological Project was established to investigate the sequence of colonisation and settlement, and the interaction of people on the environment (Walter and Anderson, 1995). Fieldwork was undertaken in June 1994 and January 1995 and preliminary results from these investigations indicated no archaeological site older than 2000 years (Walter and Anderson, 1995). The oldest was the inland site of Anatoloa where the vertical pitfall-type main entrance and large dry caverns extending from it were most conducive to fossil preservation.

THW joined the Niue Archaeological Project on both field trips and, when not helping in excavation of archaeological sites, searched for fossils in caves. The aim of the present paper is to describe the avifaunas obtained from these investigations.

## METHODS

Faunal material was recovered from archaeological sites following sorting of material retained on either 6 mm or 3 mm sieves. Bird bones were sorted in the laboratory and forwarded to THW for identification.

Fossils were located in caves by visually scanning floors particularly in places where older remains may have persisted. Once remains were located they were either collected at the time, or they and their enclosing sediment were collected, and the bones sorted later. Twenty five caves were searched for fossils, but few were found. This was because of a combination of factors: 1, land crabs are present in all areas up to at least 1 km from the coast and scavenge all dead things; 2, most caves contained little sediment and had been formed under phreatic conditions during periods of higher sea level rather than having a vadose origin; 3, most were at a shallow depth below the land surface, which combined with the porosity of the coral limestone and regular rainfall, has resulted in much deposition of calcite on the cave floors; 4, people have and do regularly enter the caves, which has created much disturbance to cave floors. In severe cases 'sediments' of charcoal from coconut-frond torches is many centimetres deep.

Radiocarbon dating was done in the Rafter Laboratory, Institute of Geological and Nuclear Sciences Ltd, Lower Hutt, New Zealand. The two dates obtained were Accelerator Mass Spectrometry dates on collagen (Steadman *et al.* in prep).

## ABBREVIATIONS

MNZ, Museum of New Zealand Te Papa Tongarewa (catalogue numbers prefixed with S); OU Anth, Otago University Anthropology Department (catalogue numbers with the form '\*\*\*\*-BB-\*\*'). When listing specimens x/y is number of bones over minimum numbers of individuals (MNI); cmc - carpometacarpus, cor - coracoid, d - distal, hum - humerus, juv - juvenile, p - proximal, rad - radius, s - shaft, scap - scapula, stern - sternum, tt - tibiotarsus, L - Left, R - right, e.g., dR - distal right.

## SITE DESCRIPTIONS

The locations of the sites described here are shown in Figure 1. Ana is Niuean for cave.

### Anakieto

The single entrance to Anakieto is a small (<1m<sup>2</sup>) diameter pitch about 5 m deep that opens into a chamber about 10 m wide. A passage about 5 m wide leads off from here. Profuse speleothem growth combined with charcoal in all hollows has resulted in few suitable surfaces for fossil preservation and location. The only fossil found was embedded in flowstone.

### Anakula

A small excavation was made in the archaeological deposit in this rockshelter just above the road southwest of Alofi (Figure 1). Few bones were found.

### **Avaiki**

A small excavation was made in the archaeological deposit in this collapsed cave (Walter and Anderson 1995) in which no avian remains were found.

### **Anakuli**

Anakuli is a pothole about 5 m deep that is 100 m behind the schoolhouse at Hakupu. It is described in detail by Steadman *et al.* (in prep) and is the only site where a prehuman fauna was certainly obtained as shown by conventional radiocarbon dates (NZA 5884, 4523±92 yrs BP; NZA 5885, 3447±75 yrs BP), and lack of Pacific Rat (*Rattus exulans*) in the deposit.

### **Anatoloa**

Anatoloa is the longest cave on Niue with several hundred metres of unsurveyed passages, although Grinsted (1979) provided a sketch map. There are three entrances. The main entrance is a 10x15 m vertical sided hole dropping to a floor about 8 m below the ground. A passage about 3-5 m wide extends about 200 m south of this entrance. To the north the passage is initially about 20 m wide but narrows after 100 m to about 15 m wide, and shortly after the floor slopes up to a small entrance (the middle entrance). Descending a slope from this entrance a passage can be followed about 200 m to the top entrance after passing a blind passage on the left. At least 100 m of passage continues beyond the top entrance.

White-rumped Swiftlets (*Collocalia spodiopygia*) have, or recently had, colonies as evidenced by guano piles in several parts of the cave.

All passage floors were searched carefully for fossils. However, profuse speleothem growth, localised thick sediments from swiftlet droppings, and charcoal accumulations contrived to limit available fossil sites. Bones were found only in the area between the middle and the main entrances, and immediately around the main entrance, suggesting that most bones were derived from the main entrance. The following sites are defined.

Site 1 - about 30 m north of the main entrance in a niche on the eastern side.

Site 2 - about 3-4 m closer to the main entrance than site 1 and in a small (0.5 m high and wide) side passage bones were found in dry sediment between rocks on the floor.

Site 3 - north of the main entrance, in the light zone and in the centre of the passage, a large rock had a crack in it that contained sediment from which a few bones were excavated.

Site 4 - bones were collected from sediment under a rock near the western side of the passage at the base of the slope below the middle entrance, in the direction of the main entrance.

Site 5 - north of the main entrance and east of the passage to the middle entrance a 2 m wide 0.5 m high passage opens to a 30 m long chamber. Bones

were found in wet black comminuted charcoal accumulated in a hollow just inside the entrance to this chamber.

Site 6 - a few bones were found on a dry ledge on the western side of the passage about 40 m from the middle entrance towards the main entrance, which were probably accumulated by rats.

Site 7 - at the base of the slope on the southern side of the middle entrance, coral rubble on the floor at the low point of the eastern side of the passage has dry sediment containing bones around the blocks.

Archaeological investigations in the main entrance revealed cultural deposits up to 2 m deep and about 2000 years old (Walter and Anderson 1995). Therefore, it seems probable that all the fossils found in this cave post-date human arrival in Niue.

### **Vaopula Cave**

Vaopula Cave is about 100 m long and passes under the Hakupu - Liku Road about 1.5 km north of Hakupu. It has entrances at each end.

### **Uani**

Uani is a short c. 50 m long cave on the eastern side of the road about 2 km north of Hakupu. Its entrance is 5 m from the road, and a crawling-height passage descends down to pools of water under the road.

### **Ulupaka Cave**

Ulupaka Cave is an unmapped cave of 200-300 m length whose two entrances lie to the north and south of the 'Ulupaka Sea Track'. The south entrance is only a few metres off the road where a carpark denotes the start of a foot-track to the north entrance. The south entrance is about 8 m wide and 3 m high and is nearly closed by a rear wall 5-8 m in from the dripline. Access to the inner cave is via a narrow passage that has been partially hewn from roof speleothems and partly from the floor sediments. There are remains of human burials and extensive midden accumulations on the floor.

Faunal material assumed to be of archaeological origin was collected from the surface of the entrance zone of the South entrance. A small excavation was made (Ulupaka II) and several bird bones obtained which are now in the Anthropology Department, Otago University. Examination of the floor areas in the inner cave was rewarded by a small deposit at the base of a small sloping passage about 40 m in from the entrance. A few millimetres of dry sediment in an area of less than 0.5 m<sup>2</sup> had presumed naturally deposited bones, although, inexplicably, a single basalt flake from an adze was found here also. No bones were found elsewhere in the cave, which has extensive speleothem deposition throughout.

The north entrance of Ulupaka opens into a large elongated doline that had formed by collapse of the former cavern. In a small entrance close to the north entrance, sediments contained abundant bones of mainly the Pacific Rat, which

from breakage patterns and site locality are assumed to have been derived from owl pellets. At the far end of the doline an impressive arch feature leads to an extension of the cave system northwards. Except for those of one swiftlet, no bones were found in this part of the cave despite extensive searching.

### **Ulupaka Sea Cave**

At the end of the Ulupaka sea track access is gained to the reef via a ladder down the cliff. Here, an old sea cave is about 10 m above the reef. It has several skylights and many niches in its walls. Humans probably deposited the few bones collected from the surface of the cave. A few bones, obtained from a test pit in a midden, are now in the Otago University Anthropology department.

### **Paluki Cave**

The entrance to Paluki Cave is 95 m south and 34 m west of the origin of the survey of the Paluki mound complex (Anderson and Walter, in prep): A small entrance drops down a few metres into a single chamber about 12 x 40 m that was mapped by us. Extensive archaeological deposits were found on the floor of the cave including bird bones (Wadsworth, 1995). Surface bones collected are in the Otago Anthropology collection.

### **Paluki Mound Complex**

Extensive excavations were made on the mound complex at Paluki, which will be described by Anderson and Walter (in prep). Numerous chicken bones were found, but few of other species.

### **Other potential sites**

Apart from the above sites where bones were found, THW also searched the following for fossils without success: 1, a small cave at the head of Anapala Chasm; 2, a cave entered via an 8 m pitch near the carpark at Matapa; 3, the Liku sea caves - Maselulu, Vehokaho, and Halavai; 4, Huvalu Forest #1, a small cave entered via 4 m drop through a narrow entrance about 40 m west of the road; 5, Huvalu #2, a horizontal entrance leading to 40 m of passage, about 50 m west of the road about 1 km north of #1; 6, three small caves in the forest south of Paluki; 7, Vaikali, a single chamber close to the road southeast of the Paluki mounds; 8, a cave on the sea side of the road, 100 m north of the Ana Ana lookout, where a 5 m pitch accesses a 30 by 15 m chamber; 9, Hikau Cave at Vaiea; 10, Makato Chasm; 11, sea caves near Avaiki; and 12, several sea caves between Matapa and Talava arches.

## **RESULTS**

### **Systematic list of bird bones found in Niue caves**

#### **Pelecaniformes: Phaethontidae**

#### ***Phaethon lepturus dorotheae* White-tailed Tropic Bird**

Anatoloa Cave, surface, 1994, OU Anth 46-BB-(18-21), 56-BB-(1-2), 117-BB-1, 181-BB-1; (7 bones).

Anatoloa Cave, excavations main entrance, 16 June 1994, OU Anth, square C7, 50-200 mm, 180-BB-(2-6), 5 bones; square C7, 0-50 mm, 116-BB-(3-5), 3 bones; square C7, 0-50 mm, 122-BB-(2-3), 2 bones; square C7, 0-40 mm, 132-BB-2, 1 bone; square E7, layer 1, 142-BB-1, 1 bone; (12 bones).

Anatoloa Cave, site 2, 16 June 1994, MNZ S35216, 1/1.

Uani Cave, Hakupu, 20 January 1995, MNZ S35250, 1L cor.

Ulupaka Cave, south entrance, surface, 28 June 1994, MNZ S35258, 1/1; OU Anth 236-BB-1, 1dL hum.

Ulupaka Cave, south entrance excavation, OU Anth, layer 1, square Q3, 240-BB-(4-13, 15-18), 1sL1dR1dL hum, 1pR1sL1sR ulna, 1d+sR1dL3sL rad, 1pL tt, 3sR1L cor; layer 1b, 243-BB-(4-13), 1dL1L ulna, 2sR1sL hum, 1dL cmc, 1L1dL rad, 1pL ulna juv, 1L cmc juv, 1dL tt juv; (27/4).

Ulupaka Cave, south entrance excavation, OU Anth, layer 2, square Q2, 242-BB-(2-4), 1sR ulna, 1dR hum, 1sL cmc; square Q3, 245-BB-(2-6), 2dR1dL hum, 1L1R cor, 1sR ulna; layer 2a, square Q3, 239-BB-2, 1dR rad; (10/3).

#### **Ciconiiformes: Ardeidae**

##### ***Nycticorax* n. sp. Extinct Niue Night Heron**

Anakuli Cave, Hakupu, 7-12 January 1995, MNZ S unreg., 48/4.

#### **Galliformes: Phasianidae**

##### ***Gallus gallus* Feral Fowl**

Anakieto Cave, Paluki, 17 June 1994, MNZ S35245, 12/1 juv.

Anakuli Cave, Hakupu, 27 June 1994, MNZ S35214, selection of bones.

Anatoloa Cave, surface, 1994, OU Anth, 46-BB-(22-23), 131-BB-2, 132-BB-(4-6); (6 bones).

Anatoloa Cave, excavations main entrance, June 1994, OU Anth, layer 3, 94-BB-1, 1 bone; 0-50 mm, 122-BB-4, 1 bone; layer 3, 188-BB-1, 1 bone; (3 bones).

Cave on side of road Alofi, 14 June 1994, MNZ S35243, 3/1.

Anakula, area 2, layer 2, OU Anth, 23-BB-1, 1 bone.

Paluki mound site excavations, OU Anth, numerous bones.

#### **Galliformes: Megapodiidae**

##### ***Megapodius pritchardii* Niuafo'ou Megapode**

Anakuli Cave, Hakupu, 7-12 January 1995, MNZ S unreg., 7/2.

**Gruiformes: Rallidae*****Gallirallus philippensis* Banded Rail**

Anatoloa Cave, site 3, 16 June 1994, MNZ S35228, 16/1.

Anatoloa Cave, site 6, 16 June 1994, MNZ S35226, 1/1.

Anatoloa Cave, surface main entrance, 16 June 1994, OU Anth, 46-BB-(7-13), 8 bones.

Ulupaka Cave, 40m south entrance, 27 June 1994, MNZ S35255, 6/1.

Ulupaka Cave, south entrance excavation, OU Anth, layer 1, square Q3, 240-BB-14, 1dL tt; surface and test pits, 228-BB-1, 1pL tt; (2/2).

Paluki mound site excavations, OU Anth, 436-BB-66, 1dL tmt juv. 1/1.

***Gallirallus n. sp.* Extinct Niue Rail**

Anakuli Cave, Hakupu, 7-12 January 1995, MNZ S unreg., 4/1.

***Porzana tabuensis* Spotless Crake**

Anakieto Cave, Paluki, 17 June 1994, MNZ S35244, 35/1.

Anakuli Cave, Hakupu, 9 January 1995, MNZ S35247, 2/1.

Anatoloa Cave, 20m south of main entrance, 23 June 1994, MNZ S35211, c. 65/1.

Anatoloa Cave, site 7, 30 January 1995, MNZ S35227, 19/2.

Anatoloa Cave, excavation, 1994, OU Anth, square C7, layer 1, 50-200 mm, 180-BB-1, 1 bone.

Anatoloa Cave, Site 1, 16 June 1994, MNZ S35221, 2/1.

Anatoloa Cave, surface, main entrance, 16 June 1994, OU Anth, 46-BB-(5-6), 2 bones; 78-BB-(1-2), 2 bones; 142-BB-2, 1 bone; (5 bones).

Ulupaka Cave, north entrance, owl deposit, 22 June 1994, MNZ S35260, 1/1.

***Porphyrio p. samoensis* Purple Swamphen**

Anatoloa Cave, excavation all layers, 1994, OU Anth, square E3, layer 2, 215-BB-1, 1 bone.

Anatoloa Cave, site 2, 16 June 1994, 35207, 23/1.

Anatoloa Cave, site 3, 16 June 1994, 35230, 1/1.

Anatoloa Cave, site 5, 16 June 1994, 35233, 3/1.

Anatoloa Cave, site 7, 30 January 1995, 35236, 4/1.

Anatoloa Cave, south of main entrance, 23 June 1994, 35235, 1/1.

Anatoloa Cave, surface main entrance, 16 June 1994, 35208, 4/1.

Anatoloa Cave, surface main entrance, 16 June 1994, OU Anth, 46-BB-(27-28), 5 bones; 132-BB-1, 1 bone; 192-BB-1, 1 bone; (7 bones).

Ulupaka Cave, south entrance, 40m in, 27 June 1994, 35253, 24/1.

Paluki mound site excavations, OU Anth, 425-BB-14, 1dL ulna, 1/1.

### **Charadriiformes: Sternidae**

#### ***Anous stolidus* Common Noddy**

Anatoloa Cave, excavation, 1994, OU Anth, square E7, layer 1, 89-BB-1; square E18, layer 1, 194-BB-1; (2 bones).

Ulupaka Cave, south entrance, surface, 28 June 1994, MNZ S35257, 3/1.

Ulupaka Cave, south entrance excavation, OU Anth, layer 1b, 243-BB-(2-3), 1p+sR rad, 1R cor; layer 2, square Q2, 242-BB-(9-13), 1sR fem, 1R rad, 1 pt stern, 1dR cor, 1dR hum, 2dR cmc, (9/2).

Ulupaka sea cave, surface, 22 June 1994, MNZ S35251, 5/2.

Ulupaka sea cave, square 1, 21-40 cm, OU Anth 139-BB-(8-11), 3sL ulna, 1dsR hum, 2sR hum, 1L scap; 41 cm – base, 139-BB-(2-6), 1L cor, 1dL hum, 2dR cmc, 1pL ulna, 1 ant. stern; test pit, 140-BB-1, 1sR ulna; (14/3).

Paluki Cave, OU Anth, 260-BB-2, 1L rad; 368-BB-3, 1pL ulna; 302-BB-18, 1L hum; (4/1).

Paluki mound site excavations, OU Anth 436-BB-64, 1dL tt;

#### ***Gygis alba* White Tern**

Avatele, 80 cm deep in test pit, 29 June 1994, MNZ S35249, 1R hum.

Paluki mound site excavations, OU Anth 436-BB-65, 1sL hum.

### **Columbiformes: Columbidae**

#### ***Ducula pacifica* Pacific Pigeon**

Anatoloa Cave, excavations, 1994, OU Anth, square E18, layer 1, 56-BB-(1-2), 3 bones; square E3, layer 1, 82-BB-1, 1 bone; square C7, 0-50 mm, 122-BB-1, 1 bone; square C7, 0-40 mm, 132-BB-3, 1 bone; square D7, 60-150 mm, 148-BB-1, 1 bone; square E18, layer 1a-1b, 156-BB-(1-2), 2 bones; square E3, layer 1, 174-BB-1, 1 bone; square C7, layer 1, 180-BB-1, 1 bone; (11 bones).

Anatoloa Cave, surface main entrance, 16 June 1994, OU Anth, 46-BB-(14-17), 4 bones; 73-BB-(1-2), 2 bones; 74-BB-1, 1 bone; 175-BB-1, 1 bone; (8 bones).

Ulupaka Cave, south entrance, surface, 28 June 1994, MNZ S35256, 2/1.

Ulupaka Cave, south entrance excavation, OU Anth, square Q3, layer 1, 240-BB-(3, 19-22), 2dR1sR1pL cor, 1sR ulna, (5/3).

Ulupaka Cave, south entrance excavation, OU Anth, square Q2, layer 2, 242-BB-(5-7), 1L scap, 1pR cor, 1sL hum (3/1).

Paluki Cave, OU Anth 292-BB-3, 1pL fem.

***Ducula* sp.**

Anakuli Cave, Hakupu, 7-12 January 1995, MNZ S35248, 1/1.

Anatoloa Cave, surface main entrance, 16 June 1994, MNZ S35242, 1pR radius.

**Strigiformes: Tytonidae*****Tyto alba* Barn Owl**

Anatoloa Cave, surface, 1994, OU Anth, 46-BB-(1-4), 131-BB-1, (5 bones).

Anatoloa Cave, site 1, 16 June 1994, MNZ S35220, 1/1.

Anatoloa Cave, site 2, 16 June 1994, MNZ S35217, 1/1.

Anatoloa Cave, site 4, 16 June 1994, MNZ S35239, 20/1.

Anatoloa Cave, site 5, 16 June 1994, MNZ S35232, 16/1.

Ulupaka Cave, 40 m in south entrance, 27 June 1994, MNZ S35252, 13/1.

Anakula, area 2, layer 2, OU Anth, 17-BB-(1-5), 5/1.

**Apodiformes: Apodidae*****Collocalia spodiopygia* White-rumped Swiftlet**

Anatoloa Cave, excavation all layers, 1994, OU Anth 109-BB-1, 1 bone.

Anatoloa Cave, site 1, 16 June 1994, MNZ S35219, 13/3.

Anatoloa Cave, site 2, 16 June 1994, MNZ S35218, 17/4.

Anatoloa Cave, site 3, 16 June 1994, MNZ S35231, 3/1.

Anatoloa Cave, site 6, 16 June 1994, MNZ S35213, 46/4.

Anatoloa Cave, site 7, 16 June 1994, MNZ S35238, 1/1.

Anatoloa Cave, site 7, 30 January 1995, MNZ S35237, 6/1.

Anatoloa Cave, south of main entrance, 23 June 1994, MNZ S35234, 4/1.

Anatoloa Cave, surface main entrance, 16 June 1994, OU Anth 162-BB-1, 1 bone.

Ulupaka Cave, north entrance, past arch, 28 June 1994, MNZ S35259, 6/1.

Ulupaka Cave, north entrance, owl deposit, 22 June 1994, MNZ S35263, 2/1.

Vaopula Cave, near Hakupu, 21 June 1994, MNZ S35212, 1 cranium.

**Passeriformes: Sturnidae*****Aplonis tabuensis* Polynesian Starling**

Anakieto Cave, Paluki, 17 June 1994, MNZ S35209, 6/1.

Anatoloa Cave, excavations, 1994, OU Anth, square K3, layer 1b, 95-BB-1, 1 bone; square C7, 0-50 mm, 116-BB-(1-2), 2 bones; (3 bones).

Anatoloa Cave, site 1, 16 June 1994, MNZ S35210, 19/1.

Anatoloa Cave, surface main entrance, 16 June 1994, MNZ S35225, 1R ramus.

Anatoloa Cave, surface main entrance, 16 June 1994, OU Anth, 46-BB-24, 1 bone; 132-BB-(7-8), 2 bones; 192-BB-2, 1 bone; (4 bones).

Ulupaka Cave, north entrance, owl deposit, 22 June 1994, MNZ S35261, 1/1.

## **Mammalia**

### **Pteropodidae**

#### ***Pteropus tonganus* Pacific Flying Fox**

Anatoloa Cave, surface main entrance, 16 June 1994, OU Anth, 2 bones.

Ulupaka Cave, north entrance, owl deposit, 22 June 1994, MNZ S35265, mandible, tooth.

Ulupaka Cave, south entrance excavation, Layer 1, Q3, OU Anth 240, 6 bones; surface and test pits, OU Anth 228, 2 bones.

### **Rodentia: Muridae**

#### ***Rattus exulans* Pacific Rat**

Anakieto Cave, Paluki, 17 June 1994, MNZ S35246, skeleton.

Anatoloa Cave, site 1, 16 June 1994, MNZ S35222, 10/2.

Anatoloa Cave, site 2, 16 June 1994, MNZ S35215, 30/4.

Anatoloa Cave, site 3, 16 June 1994, MNZ S35229, 10/2.

Anatoloa Cave, surface main entrance, 16 June 1994, MNZ S35241, 17/4.

Anatoloa Cave, surface main entrance, 16 June 1994, OU Anth, 22 bones.

Ulupaka Cave, north entrance, owl deposit, 22 June 1994, MNZ S35264, many bones.

Ulupaka Cave, 40 m in south entrance, 27 June 1994, MNZ S35254, 15/2.

## **Reptilia**

### **gecko sp.**

Anatoloa Cave, site 2, 16 June 1994, MNZ S35224, 4 bones.

Anatoloa Cave, site 6, 16 June 1994, MNZ S35240, 21 bones.

Ulupaka Cave, north entrance, owl deposit, 22 June 1994, MNZ S35262, many bones, some probably *Gehyra*.

### ***Gehyra oceanica***

Anatoloa Cave, site 2, 16 June 1994, MNZ S35223, 1/1 frontal.

## **DISCUSSION**

Fourteen species of bird were found in the combined archaeological and fossil faunas of Niue Island. The single certain prehuman fauna in Anakuli was the only one with extinct species. It had remains of three species that are now extinct on

Niue: two of these are new and are globally extinct, the third, a megapode, survives on the Tongan archipelago.

The total fossil fauna under-represents the prehuman fauna as several currently extant species (Table 1) are absent, notably the Fruit Dove and the Lory. Columbids are rare in the collection with only the Pacific Pigeon identifiable, however one fragmentary radius from Anatoloa probably represents a larger species. Most mid-to central-Pacific Islands whose fossil avifaunas have been investigated had more than one pigeon, more than one dove and often more than one parrot in their unmodified faunas. For example, Henderson Island had an endemic genus of pigeon Columbidae, n. gen., n.sp., a ground-dove (*Gallicolumba* n. sp.), the Henderson Is. Fruit Dove (*Ptilinopus insularis*), a pigeon allied to the Polynesian Pigeon (*Ducula* n.sp.), and the Henderson Island Parrot (*Vini stepheni*) (Steadman 1989; Wragg and Weisler 1994). Eua, in Tonga, had the West Polynesian Ground-dove (*Gallicolumba stairi*), a Tooth-billed Pigeon (*Didunculus* n.sp.), two doves (Crimson-crowned Fruit-dove *Ptilinopus porphyraceus* and Many-coloured Fruit-dove *P. peroussi*), three pigeons (*Ducula david*, Pacific Pigeon *D. pacifica*, and *Ducula* n.sp.), and three parrots (*Vini solitaris*, Blue-crowned Lorikeet *V. australis*, and *Eclectus* n. sp.) (Steadman 1993, 1995). In the Cook Islands, Mangaia had three ground-doves (the Society Island Ground-dove *Gallicolumba erythroptera*, the Giant Ground-dove *G. nui*, and an undescribed species *Gallicolumba* n.sp.), a dove (Cook Islands Fruit-dove *Ptilinopus rarotonganensis*), two pigeons (Society Islands Pigeon *Ducula aurorae* and Nuku Hiva Pigeon *D. galeata*), plus at least two parrots (Rimatara Lorikeet *Vini kubli* and Conquered Lorikeet *V. vidivici*) (Steadman 1995). The various Marquesan Islands similarly had many species in these groups (Steadman, 1989). These data indicate that the islands surrounding Niue formerly had much more diverse columbid and parrot faunas than they do now, and so it seems probable that as the fossil fauna of Niue is further explored other species in these groups will be revealed.

The rail fauna existing in Niue in the prehuman period may similarly be under-represented by the existing record if the Tongan and Mangaian records are indicative (Steadman 1993, 1995). Possibly, extinct crakes and gallinules await discovery, in addition to the extinct *Gallirallus* species reported here, which is to be described by Steadman *et al.* (in prep).

The affinities of the avifauna of Niue lie with the geographically closest island groups of Tonga and Samoa (Kinsky and Yaldwyn 1981). The Tongan affinities are further enhanced by the discovery that Niue also had megapodes and night herons. The extinct night heron known from Eua is different to the Niue bird (Steadman 1993; Steadman *et al.* in prep). The Tongan and Samoan faunas suggest that the discovery of an extinct tooth-billed pigeon (*Didunculus* sp.) on Niue is not unlikely.

While several species of seabird are recorded here, procellariiforms are conspicuous by their absence. The Wedge-tailed Shearwater could be expected, as it is or was until recently, a breeding species on Niue. Other species of *Puffinus* and *Pterodroma* could be expected to have been present.

In summary, while the fossil avifauna of Niue is still very imperfectly known, it reveals that the avifauna was formerly more diverse than the extant 12 species, and that extinctions occurred late in the Holocene. The three extinct species, a megapode, a large flightless night heron, and a flightless rail, were all ground birds likely to have been hunted by the earliest inhabitants, however, proof of this association awaits the discovery of early-settlement archaeological sites. Comparisons with the faunas of adjacent islands suggest several more species are likely to have been originally present, particularly among columbids. The extant fauna of Niue is thus like those on most other Pacific islands: a mere remnant of a bird paradise.

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