

## Birds of the Aleipata Islands, Samoa

RICHARD PARRISH\*  
 7B Kent Road, Whangarei 0112, New Zealand

GREG H. SHERLEY  
 United Nations Environment Programme, Private Mail Bag, Apia, Samoa

**Abstract:** An annotated checklist of birds recorded or reported on the Aleipata Is, Samoa is presented. Nu'utele and Nu'ulua Is were the focus of an attempt to eradicate Pacific rats (*Rattus exulans*) in 2009. The data presented are from bird surveys intended to provide baseline information to determine the effect of rodent eradication on the bird fauna. Fanuatapu or Namu'a Is were surveyed as experimental controls. A total of 42 species were recorded or reported, comprised of 24 species of land birds (including 3 introduced species) and 18 species of seabirds and shorebirds. Morphometric data are also presented from Friendly ground-doves (*Gallicolumba stairi*) that were removed from Nu'utele I and held in captivity during the rat eradication attempt.

Parrish, R.; Sherley, G.H. 2012. Birds of the Aleipata Islands, Samoa. *Notornis* 59 (3&4): 153-162.

**Keywords** Aleipata Islands; Samoa; ecological restoration; bird fauna, Friendly ground-dove

### INTRODUCTION

In Aug 2009 an attempt was made to eradicate Pacific rats (*Rattus exulans*) from both Nu'utele I and Nu'ulua I, 2 of the Aleipata Is in Samoa, by the Secretariat of the Pacific Regional Environmental Programme SPREP (Butler *et al.* 2011). This was the only rodent species present on these islands, and the eradication was intended as an initial step to restore the islands as far as possible to their pre-human state. Both islands lie outside the reef that fringes Upolu I and both are uninhabited by humans at present, although people have lived on Nu'utele I in the past. As there are few islands off the coast of Samoa, Nu'utele and Nu'ulua Is comprise the best prospective restoration areas in Samoa.

We visited both these islands together with Fanuatapu I and Namu'a I before the eradication attempt, to provide a pre-eradication survey of the bird faunas that could be used to compare with later surveys once the rats were removed. This would allow an assessment to be made on the effect that Pacific rats have on the avifauna of these tropical islands. The eradication attempt was made by applying the rat poison brodifacoum aerially by helicopter on Nu'utele and Nu'ulua Is. However, it appears to have failed or reinvasion has occurred on Nu'utele I, because Pacific rats were detected again in Aug 2010 (Butler *et al.* 2011). No rodent control was done on Fanuatapu or Namu'a Is because both islands form part of the fringing reef around Upolu I; Namu'a is inhabited and Fanuatapu is also visited frequently by humans. It would be possible for some rat species to swim to these 2 inner islands,

although it is believed Fanuatapu is rodent free (A. Tye, *pers. comm.*). These islands were included in the bird surveys as experimental controls in case other factors affected species numbers. For example, Lovegrove *et al.* (1992) visited Nu'utele I before and after cyclone Val and found that there were significantly fewer birds and species (8) during 6 counts after the cyclone than during the 10 counts conducted before the cyclone (13 species).

One potentially adverse effect of using poison to eradicate Pacific rats was that Friendly ground-doves (*Gallicolumba stairi*), known to be present on Nu'utele and Nu'ulua Is, could be susceptible to the toxins because these birds are ground-feeders (Bell 2000). An attempt was therefore made to remove as many birds as possible from Nu'utele I before the poison was applied, to hold them in captivity and to release them again where they were found after the operation was completed. In association with this, a survey of the Friendly ground-doves was conducted in Aug 2006 (Parrish & Tupufia 2007) in which 23 sightings of the birds were recorded on Nu'utele I. Most of these sightings were on the Vini flats where none had been seen before on the earlier surveys. This figure may have included re-sightings of the same birds but it did indicate that more birds were present than previously thought. We took the opportunity to record morphometric measurements from the Friendly ground-doves that were caught because such data from live birds is lacking for this species.

The 4 islands, Nu'utele, Nu'ulua, Namu'a and Fanuatapu, comprise the Aleipata Is. Previous information on the birds of the Aleipata Is was published principally by Whistler (1983), Park *et al.* (1992), and Lovegrove *et al.* (1992). Tarburton (2001) commented on the birds of the Aleipata Is, but did not visit them, and Biechle (1991) commented on the pigeon species on Nu'utele I.

Only Whistler (1983) referred exclusively to the Aleipata Is, while other authors mentioned the islands in papers dealing with Samoa as a whole. Whistler (1983) primarily examined the vegetation and flora but he also reported that 11 bird species were present, including breeding red-footed boobies (*Sula sula*), greater frigatebirds (*Fregata minor*), common (brown) noddies (*Anous stolidus*), blue-grey noddies (*Procelsterna cerrulea*) on Nu'utele and Nu'ulua Is, and red-footed boobies on Fanuatapu I. Park *et al.* (1992) visited Nu'utele, Nu'ulua and Fanuatapu Is as part of an ecological survey of Western Samoa and gave a more comprehensive record of the fauna there that included 25 species on Nu'utele I, 15 on Nu'ulua I and 11 on Fanuatapu I. They also noted that Pacific rats were present on Nu'utele I, while Whistler (1983) recorded that feral pigs (*Sus scrofa*) were present on Nu'utele I. Pigs appeared to be absent when we visited in 2000



Fig. 1. Map of the Aleipata Is showing places mentioned in the text.

and 2001. Whistler (1983) also reported a small herd of feral goats (*Capra hircus*) on Namu'a I, and that, prior to 1982, sea turtle eggs were collected on Nu'ulua I and taken to a hatchery on the mainland coast at Aleipata. Apparently the Aleipata Is had the only turtle breeding beaches in Western Samoa. Pigs and goats were absent when we first visited the islands in 2000 & 2001 but pigs and domestic hens (junglefowl, *Gallus gallus*) were present on Nu'utele I in 2003 having been introduced by the local villagers. Lovegrove *et al.* (1992) recorded 20 species of birds on Nu'utele I during counts pre and post Cyclone Val that struck Samoa on 6-9 Oct 1991.

## METHODS

### Study area

The Aleipata Is lie off the southeastern corner of Upolu I (Fig. 1). Fanuatapu and Namu'a Is form part of the reef fringing this coast, while Nu'utele

and Nu'ulua Is lie 1.1 km and 3.5 km offshore, respectively. Access to the 2 islands beyond the reef is restricted by the continual and sometimes strong South-east Trade Winds, which make landing over the reefs dangerous, particularly so on Nu'ulua I. Whistler (1983) gives a detailed description of the various vegetation types and geology of the islands.

Nu'utele I (108 ha) rises to 200 m; much of the outside of the island consists of steep, mostly inaccessible cliffs. The island is an ancient tuff cone originally formed from tremendous steam explosions (Park *et al.* 1992). The eastern side of the island has been eroded away, leaving a horseshoe shaped bay (Nu'utele Bay). A reef has formed across the bay. Behind the beach is an area of flat land before the land rises steeply to the crater rim. The main landing is at Vini on the northern, sheltered shore where the local villagers have fales (beach huts) and gardens. Coconut palms (*Cocos nucifera*) are throughout the disturbed forest and gardens of the Vini flats, and in Nu'utele Bay. A track climbs steeply above Vini to the crater rim and then descends down into Nu'utele Bay. The rest of the island is untracked. Apart from the areas of garden at Vini the island is clothed in forest. Park *et al.* (1992) described 3 types of forest on the island: littoral forest, coastal forest and lowland forest. The coastal forest is a unique type of forest restricted to tuff cone volcanoes (Whistler 1983; Park *et al.* 1992). The lowland forest has a closed canopy over 20 m in height (Park *et al.* 1992). There is a coastal herbaceous strand on coral sand in Nu'utele Bay and at Vini. In Nu'utele Bay there are the remains of buildings from a former leper colony.

Nu'ulua I (*ca.* 25 ha) is also a tuff cone that has been eroded on the eastern side to form a bay. The outer arms of the bay have little vegetation and the sea has breached the arms forming small rock stacks. The island is around 100 m in height and the vegetation is very similar to that on Nu'utele I. There is no evidence of cultivation on the island but behind the beach there are some coconut palms. Whistler (1981) considered coconut palms to be native on the islands but had been boosted by plantings.

Fanuatu I is similar to Nu'utele and Nu'ulua Is in that it is an eroded tuff cone and is crescent-shaped due to erosion. It is ~7 ha in extent and ~30 m in height. The vegetation is mainly herbaceous strand and littoral shrubland with only a small area of low littoral forest. There is a navigational beacon on the highest point with an associated concrete path and steps giving access to the beacon.

Namu'a I is the only island that is inhabited on a regular basis. It too is an eroded tuff cone but does not have the horseshoe shaped bay on the east side

as the others. Whistler (1983) recorded that it was uninhabited during his visits in 1974-81 but that the remains of concrete buildings were present. It is 20 ha in extent and 70 m in elevation and mostly clothed in secondary coastal forest (Whistler 1983). The island now has a small resort on it. The flat area facing west and sheltered from the Trade Winds is grassed and there are several fales for visitors.

### Visits to the islands

We visited the islands on 7 occasions: Nu'utele I was visited 7 times (25-29 Jul 2000, 4-8 Jun 2001, 16-20 Jun 2003, 8-10 Aug 2006, 18-20 Aug 2006, 21-23 Jul 2009 and 27-30 Jul 2009); Nu'ulua I was visited 5 times (25 Jul 2000, 31 Jul 2000, 5 Jun 2001, 7 Jun 2001 and 18-19 Jun 2003). Namu'a and Fanuatu I were visited once each (14-16 June 2003, and 14 Jun 2003 from 1450h to 1650h, respectively).

### Bird surveys and capture

The visits in 2000-03 were to determine the fauna present on the islands, and involved surveys of insects, molluscs, rodents, birds and lizards (Stringer *et al.* 2003a, b; Parrish *et al.* 2004). These surveys involved setting pitfall traps and snap traps over Nu'utele and Nu'ulua Is. On Fanuatu I and Namu'a Is (and for the birds on all islands) the surveys consisted of recording the species seen, an estimate of their densities and distribution, and any breeding observations.

In 2006 and 2009 the visits were restricted to Nu'utele I, and concentrated on the survey and capture of Friendly ground-doves. Only incidental records of other birds and other fauna were kept (e.g. other species that were caught incidentally in the mist nets).

In 2006, 40 mm diameter mesh mist nets were erected on Vini flats at the toe of the hill where the track commences its climb to the summit ridge, to see if Friendly ground-doves could be caught. Nets used in 2009 were mostly 60 mm diameter mesh as it was found the doves easily escaped from 40 mm nets. They were set at the same site as in 2006, with additional nets set further east on Vini flats (closer to the area of fales and gardens but still at the toe of the hill), halfway up the hill track, and on the flats in Nu'utele Bay.

The doves were measured by GS using sliding vernier calipers, accurate to 0.1 mm for the culmen and tarsus, and a 30 cm ruler was used for the wing length, accurate to 1 mm. The total bill length was measured dorsally from the edge of the feather line (feathers folded back) to the extreme tip (distal end) of the bill. The maximum bill width and depth were measured at the base of the bill near the feather line. The tarsus length was taken from the rear side of the mid-point of the distal joint between the tibia and tarso-metatarsus to the fold created by turning

the toes backwards onto the tarso–metatarsus and measuring from the fold created by the rear toe. The wing length was measured with the wing flattened between the distal end of the longest primary to the leading edge of the marginal wing coverts which curve around the joint between the distal end of the radius and the carpal/meta–carpal joint. The doves were weighed in cloth bags with a 300 g Pesola balance. Some doves were metal and colour-banded at the time of capture, while the rest were banded in preparation for their return to Nu’utele I after the poison drop. Twenty-three of the doves (9 males and 15 females) were weighed immediately after capture (Table 1) and the 22 birds released back onto Nu’utele I were weighed and measured before release (Table 2).

The doves were held in cages made of garden mesh shade cloth and wire before being transported to Apia in cloth bags and plastic fish boxes where they were held in cardboard boxes for 4 to 7 days before being transferred into an aviary until the poison drop was finished and it was deemed safe to return the doves.

## RESULTS

A total of 42 bird species was observed by us or reported by others on and around the Aleipata Is, comprising 13 seabirds, 5 shorebirds and 24 land birds. Records for each species are given in the next section, including the Samoan and scientific names. Three species (junglefowl, common myna *Acridotheres tristis* and red-vented bulbul *Pycnonotus cafer*) are not native to Samoa. Only 5 species were common to all 4 islands. Nu’utele I, which is much larger with a greater area of forest, had far more forest or land bird species (20) than the other islands. Thirteen species were observed breeding. Three species (Pacific pigeon *Ducula pacifica*, white-rumped swiftlet *Aerodramus spodiopygius* and Samoan starling *Aplonis atrifusca*) were observed (sometimes in large numbers) near dusk coming in from Upolu I, presumably to roost. Tongan fruit bats (*Pteropus tonganus*) were also seen flying in from Upolu I at the same time but they were visiting from their daytime roosts to feed on the island(s) overnight, whereas the Samoan fruit bat (*Pt. samoensis*) feeds both during the day and night and resides on Nu’utele and Nu’ulua Is.

## SPECIES ACCOUNTS

**Wedge-tailed shearwater/Taio** (*Puffinus pacificus*) and **Audubon’s shearwater/Taio** (*P. lherminieri*).

Park *et al.* (1992) reported seeing several petrel burrows at the “northern end of the summit ridge” of Nu’utele I but were uninhabited at the time. They considered these burrows were possibly of these 2 species. We specifically searched for burrows

of seabirds but found none. There are abundant burrows of land crabs and coconut crabs (*Birgus latro*) all over the islands including the higher ridges. We sniffed in the entrance of every large burrow found to see if we could detect the unmistakable smell of procellariids, but none showed any evidence of being occupied. None was seen on the many boat trips we made out to and between the islands, and no recognizable procellariid calls were heard at night.

**White-tailed tropicbird/Tava’e** (*Phaethon lepturus*)

This species, which is common on the 2 main Samoan Is appears to be rare on the Aleipata Is, with just 2 records by us. Two were seen on Nu’utele I in Jun 2001 and 2 in Jul 2009.

**Red-footed booby/Fua’ö** (*Sula sula*)

We estimated *ca.* 100 pairs on Nu’utele I in 3 separate colonies, and *ca.* 200 pairs on Nu’ulua I in Jun 2000. In Jul 2001 we made no estimate of number but recorded that they were breeding on both islands. In Jun 2003 we estimated *ca.* 50 pairs on Nu’utele I and *ca.* 250 pairs on Nu’ulua I. On each on those first 3 visits spanning Jun and Jul we noted the colonies contained nests whose contents ranged from eggs to very large chicks.

Park *et al.* (1992) recorded 40 pairs breeding on the east side of Nu’utele I and *ca.* 250 pairs on Nu’ulua I. Neither Park *et al.* (1992) or we recorded red-footed boobies on Fanuatapu I, but a black-and-white photograph in Whistler (1983) shows a large chick present that the author claims is a red-footed booby. However, chicks of red-footed and brown boobies look very similar and so it is unclear if red-footed boobies breed there.

**Brown booby/Fua’ö** (*S. leucogaster*)

In Jul 2000 we estimated 30 pairs on Nu’utele I, and 50 pairs on Nu’ulua I. In Jun 2001 we just noted that the birds had large chicks. In Jun 2003 we saw *ca.* 25 pairs on Fanuatapu I, *ca.* 25 pairs west of Fautefulefu Point, Nu’utele I (but there were breeding birds elsewhere that were not counted) and counted 32 pairs on Nu’ulua I.

Park *et al.* (1992) recorded 30 pairs on Nu’utele I, up to 50 pairs on Nu’ulua I, and 8 pairs on Fanuatapu I, but noted these latter birds were not seen breeding.

**Masked booby/Fua’ö** (*S. dactylatra*)

Park *et al.* (1992) reported a single masked booby amongst 30 brown boobies on Nu’ulua I on 17 Sep 1991. We did not record this species.

**Greater frigatebird/Atafa** (*Fregata minor*)

In Jul 2000 we counted *ca.* 100 pairs on Nu’ulua I; chicks were visible in some nests. We again recorded

them breeding in Jun 2001 but made no estimate of numbers. In Jun 2003 we saw a maximum of 32 birds on Nu'ulua I, and they appeared to be nesting. At the same time we saw one flying over the top of Namu'a I, but unlike Park *et al.* (1992) and Tarburton (2001) we did not see any on Fanuatapu I. On all of our visits we saw them commonly either circling over Nu'utele I or flying past Vini and off Fautefulefu Point.

Park *et al.* (1992) stated that Nu'ulua I contains a major breeding colony of this species but gave no numbers. They also reported seeing a pair in trees on Fanuatapu I. Lovegrove *et al.* (1992) estimated 100 pairs on Nu'ulua I in Sep 1991. Tarburton (2001) reported seeing birds flying over both Namu'a and Fanuatapu Is.

#### **Lesser frigatebird/Atafa** (*Fregata ariel*)

Park *et al.* (1992) recorded small numbers of lesser frigatebirds amongst the greater frigatebirds on Nu'ulua I. They also recorded seeing 1 male on Fanuatapu I. We were unable to confirm this species on the islands, but separating the 2 species of frigatebird is difficult. A photograph of *ca.* 40 birds flying over Nu'ulua I taken in Jun 2001 was later enlarged and an attempt made to identify the species. All those identified were greater frigatebirds.

#### **Eastern reef heron/Matu'u** (*Egretta sacra*)

Up to 3 birds at a time were seen on Nu'utele I, and they were seen also on Fanuatapu and Namu'a Is, but not Nu'ulua I. We only saw grey morph birds. The white morph appears to be uncommon in Samoa and we never encountered any in visits over 9 years in Samoa. We saw no evidence of them breeding on the islands but it is likely that they do.

#### **Junglefowl/Moa'aivao** (*Gallus gallus*)

Junglefowl were not present on the islands on our first 2 visits, but we discovered on our third visit that the local villagers had released them onto Nu'utele I. They were expected to be vulnerable during the 2009 rat eradication, but survived (A. Tye, *pers. comm.*).

#### **Banded rail/Ve'a** (*Gallirallus philippensis*)

Banded rails appear to be quite common on both Nu'utele and Nu'ulua Is. They were more commonly heard than seen. A chick was seen on Nu'ulua I in Jul 2000 and another chick was caught in a mist net in forest behind Nu'utele Bay in Aug 2009.

#### **Pacific golden plover/Tuli** (*Pluvialis fulva*)

Single birds were seen on Nu'ulua I on 2 occasions (Jun 2001 & Jun 2003). Park *et al.* (1992) recorded 1 on Vini beach on Nu'utele I.

#### **Bristle-thighed curlew/Tuli'olovalu** (*Numenius tahitiensis*)

Park *et al.* (1992) recorded a single bristle-thighed curlew on Fanuatapu I but we did not record any on our surveys.

#### **Wandering tattler/Tuli** (*Tringa incana*)

Frequently seen and recorded on all 4 islands, with a maximum of 4 seen at a time.

#### **Ruddy turnstone/Tuli'alomalala** (*Arenaria interpres*)

Seen on Nu'utele and Nu'ulua Is in Jul 2000; 5 were also seen on Nu'ulua I in Jun 2003. Park *et al.* (1992) also recorded turnstones on Nu'ulua I.

#### **Brown noddy/Gogo** (*Anous stolidus*)

We recorded around 50 pairs on the cliffs between Vini and Tagiataia Point on Nu'utele I, and 20+ pairs on rocky islets at either end of the bay on Nu'ulua I in Jul 2000. In Jun 2001 we noted that they were common and breeding on both Nu'utele and Nu'ulua Is but gave no estimate of numbers. In Jul 2003 we recorded the following estimates: *ca.* 200 pairs on Fanuatapu I, *ca.* 50 pairs on Namu'a I, *ca.* 100 pairs on Nu'utele I, and *ca.* 220 pairs on Nu'ulua I, giving a total population for the island group of *ca.* 570 pairs. In 2006 and 2009 their presence was noted, but no estimates were made of numbers.

Park *et al.* (1992) reported that about 100 pairs of brown noddies bred in niches in the cliffs on Nu'utele I, with nests containing eggs and downy young. They saw downy young on Nu'ulua I, but gave no numbers. They reported at least 200 pairs on Fanuatapu I, again with eggs and downy young.

Tarburton (2001) stated that he discovered the 1st recorded breeding of this species in Samoa – 3 active nests at Papapapaitai Waterfall on Upolu I in Mar 1995. However, as stated above, brown noddies were reported breeding on the Aleipata Is in 1991 by Park *et al.* (1992).

#### **Black noddy/Gogo'uli** (*A. minutus*)

Park *et al.* (1992) and Lovegrove *et al.* (1992) did not report this species on the Aleipata Is. Child (1979) reported seeing 2 birds on a lagoon at Maninoa on the south coast of Upolu I, and a single bird on a cliff ledge on Fanuatapu I. Tarburton (2001) reported seeing 2 from the ferry between Upolu and Savai'i Is. We did not see any ashore on the Aleipata Is, but saw birds flying past Vini on Nu'utele I in Jun 2001 and again in Aug 2006. We also saw them flying past us whilst in a boat between Nu'utele and Nu'ulua Is in Jun 2001. Watling (2001) states this is generally the "commonest seabird encountered throughout Western Polynesia although Samoa appears to be an exception". Tarburton (2001) and Watling (2001) reported they breed in American Samoa at Tutuila,

T'au, Rose and Swains Is. Our observations show that flocks occasionally visit or pass by the Aleipata Is.

#### **Blue-grey noddy/Laia** (*Procelsterna cerrulea*)

In Jul 2000 we saw a pair on cliffs to the east of Vini, amongst brown noddies. They appeared to be nesting but we could not confirm this, as the site was inaccessible. A pair was seen on Nu'ulua I in Jun 2001.

Park *et al.* (1992) reported small numbers off Vini on Nu'utele I and reported plenty of suitable nesting habitat on the cliffs, but they did not see any nests. They also reported 2 pairs defending niches in the northwestern cliffs of Fanuatapu I, but again saw no nests.

Whistler (1983) claimed blue-grey noddies along with other seabirds nested in large numbers on the islands, while Park *et al.* (1992) speculated that these islands were possibly an important breeding site for this species in Samoa. Our surveys suggest that in fact very few inhabit the islands. Tarburton (2001) saw this species only in American Samoa, and not at all in Samoa, during 1994-97.

#### **White tern/Manusina** (*Gygis alba*)

We recorded white terns on every visit to Nu'utele and Nu'ulua Is, with a maximum of 5 seen at a time. A flock of 5 was also observed on Namu'a I during our visit in Jun 2001.

Park *et al.* (1992) also recorded them on Nu'utele and Nu'ulua Is. None was seen on Fanuatapu I by us or by Park *et al.* (1992). They are likely to nest on the 3 other islands but neither Park *et al.* (1992) nor we found nests, but we did see apparent courtship flights over and into the forest.

#### **Bridled tern/Gogo'uli** (*Onychoprion anaethetus*)

Tarburton (2001) reported 6 flying from Lalomanu on Upolu I out towards Nu'utele and Nu'ulua Is.

#### **Blue-crowned lory/Segavao** (*Vini australis*)

Lovegrove *et al.* (1992) reported this species on Nu'utele I on 17 Aug 1991 prior to Cyclone Val (6-9 Oct 1991) but that they failed to locate it in counts after the cyclone. Whistler (1983) stated they were possibly on the islands. We did not record them during any of our visits so Cyclone Val may have extirpated them on the islands.

#### **White-throated pigeon/Fiaui** (*Columba vitiensis*)

Heard on Nu'utele I in Jul 2000 and 3 were seen on Nu'ulua I in Jun 2003.

Park *et al.* (1992) reported that white-throated pigeons were absent from Nu'utele I, but suggested that they may occasionally visit from the mainland. As we recorded them only on 2 occasions, they may indeed be occasional visitors.

**Table 1.** Mass of Friendly ground-doves (*Gallicolumba stairi*) at time of capture on Nu'utele I.

	Average mass (g)	Range	Number
Females	117.1	102 – 135	15
Males	148.3	120 – 165	9

#### **Friendly ground-dove/Tu'aimeo** (*Gallicolumba stairi*)

On our first 3 visits to the islands we recorded Friendly ground-doves on both Nu'utele and Nu'ulua Is but never saw more than 3 birds on any visit. This suggested that there were low numbers of birds on the islands. Park *et al.* (1992), Lovegrove *et al.* (1992) and Butler (2006) also reported low numbers.

In Aug 2006, RP was contracted to conduct a survey to assess numbers and see if birds could be caught. Sightings of 23 birds were recorded. This figure probably included sightings of birds on more than one occasion but showed that there were more birds than previous surveys indicated. Most of these sightings were on the Vini flats where none had been seen before in spite of us spending more time there than elsewhere on the islands. Two mist nets with a mesh size of 40 mm were set late in the evening of 10 Aug 2006, and the following morning 2 Friendly ground-doves were in the nets. However, as we approached the nets the birds struggled and managed to free themselves. Three mist nets were set again on 18 Aug at the same location and a female dove was caught the following morning, but it too escaped. Then a male entered the net, and it was left for 5 min until it was enmeshed and the bird was secured.

The rat eradication operation planned for 2006-07 was delayed until Aug 2009. In Jul 2009 RP was contracted to capture birds on both Nu'utele and Nu'ulua Is, with the birds to be moved to aviaries at Vailima near the capital Apia. Rough seas prevented us landing and capturing any on Nu'ulua I. A total of 26 birds (10 males, 16 females) was captured on Nu'utele I. Seventeen doves were moved to Vailima on 23 Jul 2009 and the remaining 9 were moved on 30 Jul 2009. Twenty-five of the birds were caught in mist nets of 60 mm and 1 bird was caught in a 40 mm mesh net. Twenty-one of the doves were caught on Vini flats (all at the toe of the hill where the forest meets the disturbed cultivated area). One was captured halfway up the track to the crater rim and 4 in forest on the flats behind Nu'utele Bay. Fifteen of the doves were caught in a single set of 3 nets in the middle of Vini flats at the toe of the hill. The birds were held in captivity until it was deemed safe to return them following the rat eradication attempt; the 22 surviving birds were released on 17 Sep 2009.

**Table 2.** Morphometric data of Friendly ground-doves (*Gallicolumba stairi*) from Nu'utele I, Samoa before release.

	Culmen length (mm)	Culmen depth (mm)	Culmen width (mm)	Tarsus (mm)	Wing length (mm)	Mass (g)
Females						
Mean	16.35	5.69	5.15	28.16	138	111
SD	0.79	0.33	0.31	0.91	3	11
SE	0.81	0.34	0.32	0.94	3	11
Number	16	16	16	16	16	15
Males						
Mean	18.3	6.10	5.66	30.72	147	134
SD	0.97	0.50	0.48	0.98	4	13
SE	1.03	0.53	0.51	1.04	4	14
Number	9	9	9	9	9	7

Three birds died in captivity due to stress and failure to feed adequately, and 1 bird was euthanized following a banding mishap (McCulloch & Collen 2009). Our morphometric data shows males are slightly larger and heavier than females (Tables 1 and 2).

Not much is known about the ecology of Friendly ground-doves. The fact that we caught so many in a single set of 3 nets suggests they are not strongly territorial, at least not during Aug. We anticipated that we would need to move the nets following the capture of a pair, but as we continued to see doves at the net sites we did not move the nets around.

The majority of doves were caught in the second lowest pouch of the mist nets (the nets were positioned with the bottom line touching the ground) but 1 was caught in the topmost pouch. Watling (2001) stated that Friendly ground-doves prefer to escape by running, but when forced to fly do so with swift rapid flight through the sub stage of the forest.

#### **Tooth-billed pigeon/Manume'a** (*Didunculus strigirostris*)

Beichle (1991) stated that he saw this rare species on Nu'utele I but Park *et al.* (1992) did not record them. We did not see or hear any, and it appears that they are either very rare or no longer present on the islands.

#### **Pacific pigeon/Lupe** (*Ducula pacifica*)

The Pacific pigeon is the most abundant pigeon on the islands, particularly on Nu'utele I. A flock of 15+ was seen in one *Dysoxylum* tree in Jul 2000. None was seen on Fanuatapu I during our short visit. Flocks were regularly seen flying above the canopy moving between different fruiting trees. Every

evening on Nu'utele I individuals and small flocks could be seen flying onto the island from Upolu I, presumably returning after feeding there and to roost in a safer environment. Park *et al.* (1992) also commented on the numbers commuting to and from the mainland.

#### **Many-coloured fruit dove/Manuma** (*Ptilinopus perousii*)

We did not see many-coloured fruit doves on the islands, but heard them many times on Nu'utele I. We were accompanied by local villagers and staff from the Ministry of Natural Resources and Environment (previously the Department of Environment and Conservation) on every visit, and they instructed us on the sounds made by the various doves and pigeons. The killing of pigeons and doves for food is widespread in Samoa and so many locals know their calls.

Park *et al.* (1992) did not record this species, but did say that the larger fruit pigeons may occasionally visit from the mainland. Whistler (1983) recorded the species but did not state on which island or islands.

#### **Crimson-crowned fruit dove/Manutagi** (*Pt. porphyraceus*)

Common on Nu'utele I but apparently absent from the other islands. On Nu'utele I in Jul 2009 one was caught in a mist net, and a nearly fledged chick was rescued from an attack by 2 wattled honeyeaters (*Foulehaio carunculata*). Beichle (1991), Park *et al.* (1992) and Lovegrove *et al.* (1992) all recorded them on Nu'utele I.

#### **Long-tailed cuckoo/Aleva** (*Eudynamis taitensis*)

A single feather of this species was found on the summit of Namu'a I in Jun 2003.

**Barn owl/Lulu** (*Tyto alba*)

One was seen in Jul 2000 and another in Aug 2007. Both were seen emerging from the forest at Vini on Nu'utele I at dusk. Park *et al.* (1992) saw one on Nu'ulua I, and Whistler (1983) also stated that they were present. It is not known if they are resident in small numbers on the islands or if they are infrequent visitors from the mainland.

**Flat-billed kingfisher/Ti'otala** (*Todiramphus recurvirostris*)

Several were seen on Nu'utele, Nu'ulua and Namu'a Is. Two were caught in mist nets on Nu'utele I in Aug 2009. We did not record them on Fanuatapu I, but Park *et al.* (1992) recorded "kingfisher" there, which is presumed to be this species.

**White-rumped swiftlet/Pe'ape'a** (*Aerodramus spodiopygius*)

This species was commonly seen hawking over the forest canopy on Nu'utele I and was seen once on Nu'ulua I. They were not seen on either Fanuatapu or Namu'a Is. They were observed flying from the Upolu I to Nu'utele I at dusk and possibly roost in a cave on the island. One was caught in a mist net on Nu'utele I in Aug 2009, indicating that they sometimes hunt low down in the forest.

**Samoa broadbill/Tolaifatu (ula)** (*Myiagra albiventris*)

This species was plentiful and seen on numerous occasions on Nu'utele I, with fledglings seen in Jul 2000. It was not recorded on any of the other islands.

**Samoa fantail/Se'u** (*Rhipidura nebulosa*)

We recorded a fantail on Nu'ulua I in Jul 2000. During the visit in Jul 2009, C. Shuster (*pers. comm.*) recorded 1 fantail whilst conducting 5-minute bird counts up on the summit ridge of Nu'utele I.

Park *et al.* (1992) and Lovegrove *et al.* (1992) did not record any fantails on Nu'utele I before or after Cyclone Val. It appears that it is a rare species on the islands and probably just a few visit from Upolu I on occasions. None has been recorded on Namu'a or Fanuatapu Is.

**Samoa whistler/Vasavasa** (*Pachycephala flavifrons*)

An abundant species on Nu'utele I, but not recorded on the 3 other islands. This species was susceptible to being caught in mist nets, with 2 caught in Aug 2006 and 33 in Aug 2009. Fledglings were seen in Jul 2000.

**Polynesian triller/Miti** (*Lalage maculosa*)

A very common species on Nu'utele I, but only a few were seen on Nu'ulua and Namu'a Is. Three were caught in mist nets on Nu'utele I in Aug 2009.

**Samoa triller/Miti(tai)** (*L. sharpei*)

We only recorded this species on 3 occasions: 1 on the crater rim on Nu'utele I and 1 in Nu'utele Bay (both in Jun 2001), and 1 caught in a mist net at Vini on Nu'utele I in Aug 2009. Neither Park *et al.* (1992) or Lovegrove *et al.* (1992) recorded this species on the islands, and so it is probably an infrequent visitor from the mainland.

**Wattled honeyeater/Lao** (*Foulehaio carunculata*)

The wattled honeyeater is probably the most abundant passerine in the Aleipata Is group. Fledglings were seen in Jul 2000. Twelve were caught in mist nets on Nu'utele I in Aug 2009.

**Cardinal honeyeater/Segasega mau'u** (*Myzomela cardinalis*)

Lovegrove *et al.* (1992) reported that cardinal honeyeaters arrived on the islands following Cyclone Val. They are common on the 2 main islands of Samoa, but were not recorded by us on any of the Aleipata Is. It is likely they arrived on the islands after the cyclone because of a shortage of food. However, A. Tye (*pers. comm.*) reported seeing them on both Nu'utele and Nu'ulua Is in Aug 2011, and so they may have recolonised since our visits.

**Polynesian starling/Miti Vao** (*Aplonis tabuensis*)

A few seen on Nu'utele I, but generally uncommon. One downy juvenile and a bird with a deformed wing were seen in Jul 2000. Park *et al.* (1992) reported that they were more common on Nu'utele I than on the mainland, in contrast to our observations. A. Tye (*pers. comm.*) reported 2 on Nu'ulua I in Aug 2011.

**Samoa starling/Fuia** (*Aplonis atrifusca*)

Samoa starlings are very common on 3 islands, but not on Fanuatapu I (probably because of the lack of forest there). They were frequently seen in flocks. Flocks would also fly in at night from Upolu I to roost on Nu'utele I.

**Red-vented bulbul/Manu Pālagi** (*Pycnonotus cafer*)

Common around Vini on Nu'utele I in Jun 2001, but not seen again or elsewhere.

**Common myna/Maina Fanua** (*Acridotheres tristis*)

Two seen on Namu'a I in Jun 2004 is our only record for the islands.

**DISCUSSION**

We agree with Park *et al.* (1992) and Lovegrove *et al.* (1992) that the Aleipata Is are the most important sites in Samoa for brown and red-footed boobies and greater frigatebirds. The brown noddy, white tern and white-tailed tropicbird populations on the

islands are not as significant as they are widespread on the 2 main islands and breed in a number of places.

Nu'utele I and to a lesser extent Nu'ulua I hold the most important populations of Friendly ground-doves in Samoa, and these are significant in terms of the entire Western Polynesian population. Watling (2001) considered the Friendly ground-dove to be the most endangered of all Samoan birds.

The islands, in particular Nu'utele I, are important roosting sites for forest birds that feed on Upolu I during the day. They hold significant populations of Pacific pigeon, crimson-crowned fruit dove, Samoan broadbill, Samoan whistler, Samoan starling and wattled honeyeater.

Thirteen species of birds were confirmed breeding. Another 8 species (white-tailed tropicbird, reef heron, white tern, many-coloured fruit dove, Pacific pigeon, flat-billed kingfisher, Polynesian triller and Samoan starling) are likely to breed on the islands. A further 4 species (barn owl, white-rumped swiftlet, Samoan fantail and Samoan triller) may breed on the islands. As all of our visits occurred during the dry season (Jun till Aug), it is possible that some species breed at other times of the year that we missed.

It is apparent from the capture and release exercise that Friendly ground-doves are susceptible to stress from capture, transport and holding in aviaries. Three birds (2 males, 1 female) are likely to have died as a result of stress and not feeding adequately (McCulloch & Collen 2009). All birds showed a drop in weight from the time they were 1st captured and their subsequent release with males dropping an average of 14 g and females 6 g. One juvenile female dropped in weight from 90 g to 65 g at death, and an adult male dropped from 165 g to 95 g at death (McCulloch & Collen 2009). The other male was unbanded and its capture weight is unknown, but it was 90 g at death. Dieter Rinke (*pers. comm.* in Butler 2005) also reported the ground-doves are "extremely nervous and injure their beaks when trying to escape through wire". This susceptibility to capture, holding and release should be taken into account for any future attempts to hold Friendly ground-doves. It may be preferable to hold the birds on site as recommended by Parrish & Tupufia (2007).

The Pacific rat eradication appears to have failed, or Pacific rats have reinvaded on Nu'utele I. SPREP are attempting to ascertain if the Pacific rats are survivors or reinvaders by analysing genetic data (A. Tye, *pers. comm.*). It is not known yet if the eradication was successful on Nu'ulua I. We recommend that a further attempt be made to remove Pacific rats from Nu'utele I, and also Nu'ulua I if it is shown that they still persist on the latter.

Another threat to the fauna populations on Nu'utele and Nu'ulua Is is the presence of yellow crazy ants (*Anoplolepis gracilipes*). We 1st discovered this species in the Aleipata Is on Nu'ulua I in 2003. The ants were extremely abundant with hundreds per m<sup>2</sup>. On Nu'utele I in 2006 we discovered they were present in a small area in Nu'utele Bay near the former leper colony. By 2009 a small infestation was discovered at Vini (D. Butler, *pers. comm.*). This species of ant is known as invasive, abundant and damaging (Holway *et al.* 2002). Yellow crazy ants have substantial potential to affect a wide variety of terrestrial flora and fauna, preying on both vertebrate and invertebrate species. They are known to attack and feed on many species including birds (Haines & Haines 1978; Feare 1999; Green *et al.* 1999). Advances have been made in the techniques to eradicate invasive ants, and we recommend that attempts be made to eradicate them from Nu'utele and Nu'ulua Is.

In a recent survey and report commissioned by SPREP, Hoffmann (2011) found infestations of yellow crazy ants at Nu'utele Bay (0.37 ha), Vini Beach (>2.6 ha) and the western ridge top (1.36 ha) and 2 isolated detections on the central ridge. He states the population at Nu'utele Beach has declined in size from ~8 ha in 2003 to 0.37 ha in 2011; with reasons for this decline unclear (Hoffmann 2011). In his recommendations to SPREP, Hoffmann (2011) advocated eradicating the populations at Nu'utele Bay and on the western and central ridges but only controlling their spread at Vini Beach.

It appears that the introduced junglefowl were not eradicated as a result of the poison drop, and pigs also still survive, with piglets being seen post poison drop. These need to be eradicated even if no further attempts are made to eradicate the Pacific rats and yellow crazy ants, as pigs are capable of severely impacting on the island's existing biota.

Lovegrove *et al.* (1992) advocated the island thrush (tutulili, *Turdus poliocephalus*) as a possible species to be translocated to Nu'utele I. We support this, and recommend that the following species also be considered for translocation: tooth-billed pigeon (if indeed absent), Samoan parrotfinch (segaula, *Erythrura cyaneovirens*), blue-crowned lory, scarlet robin (tolaiula, *Petroica multicolor*) and possibly ma'oma'o (*Gymnomyza samoensis*), which is threatened by habitat loss. Potential source populations need to be carefully assessed to ensure they can sustain harvesting for translocation. We believe it is probably unnecessary to re-introduce Samoan fantail as they should be capable of returning themselves.

Even if the Pacific rat eradication has been successful on Nu'ulua I, any re-introductions there should await the outcomes of re-introductions to Nu'utele I to gauge their success or failure. Nu'ulua

It is much smaller, but could potentially support more species as part of metapopulations shared with Nu'utele I, with birds moving between the 2 islands. No re-introductions should occur until decisions regarding further eradication attempts of the Pacific rats and yellow crazy ants are made.

#### ACKNOWLEDGEMENTS

We thank Suzanne Bassett, Brian Bell, Dave Butler, Colin Ogle and Ian Stringer for help in the field. Latu Afioga, Lima Aluini, Natasha Doherty, Fialelei Enoka, Niuluga Evamaila, Afele Failagi, Czarina Iese, Pulea Ifopo, Cedric Schuster, Susau Siola, Tapa Suaesi, Toni Tipane, Foua Toloa, Samani Tupufia, Moeumu Uili, Fa'afetai Uitime all of the Ministry of Natural Resources and Environment assisted us in the field and looked after the catering and transport. We thank Suzanne Tai of the Department of Environment and Conservation and Alan Tye of the Secretariat of the Pacific Regional Environmental Programme for providing support and funding. Conservation International funded the rat eradication and Friendly ground-dove capture and captive holding. Loraine Wells and Hannah Soult drafted Fig 1. Ian Stringer provided extensive improvements to an earlier draft and an anonymous reviewer also provided helpful comments.

#### LITERATURE CITED

- Bell, B.D. 2000. Feasibility survey on the removal of rats. Nu'utele and Nu'ulua Islands, Samoa 21 July to 1 August 2000. Wildlife Management International Ltd, PO Box 14492, Wellington, New Zealand. 15p.
- Biechle, U.R. 1991. Status and acoustical demarcation of pigeons of Western Samoa. *Notornis* 38: 81-86.
- Butler, D.J. 2005. Restoration of Nu'utele & Nu'ulua, Aleipata Islands, Samoa. Protection of Friendly ground doves during proposed rat eradication. Unpublished report prepared for Samoan Ministry of Natural Resources & Environment, Secretariat of the Pacific Regional Environmental Programme and Pacific Programme of the Cooperative Islands Initiative. 4p.
- Butler, D.J. 2006. Restoration of Nu'utele & Nu'ulua Islands, Aleipata Island Group, Samoa. Report of expedition to trial the capture and holding of Friendly ground doves (*Gallicolumba stairi*). Unpublished report prepared for Samoan Ministry of Natural Resources & Environment, Secretariat of the Pacific Regional Environmental Programme and Pacific Programme of the Cooperative Islands Initiative. 13p.
- Butler, D.J.; Tye, A.; Yylie, M.; Tipama'a, F.T. 2011. Eradicating Pacific rats (*Rattus exulans*) from Nu'utele and Nu'ulua Islands, Samoa – some of the challenges of operating in the tropical Pacific. Pp. 407-412 in Veitch, C.R., Clout, M.N. & Towns, D.R. (eds) *Island invasives: eradication and management*. IUCN, Gland.
- Child, P. 1979. Some bird observations from Western Samoa. *Notornis* 26: 171-179.
- Feare, C. 1999. Ants take over from rats on Bird Island, Seychelles. *Bird Conservation International* 9: 95-96.
- Green, P.T.; O'Dowd, D.J.; Lake, P.S. 1999. Alien ant invasion and ecosystem collapse on Christmas Island, Indian Ocean. *Aliens* 9: 2-4.
- Haines, I.H.; Haines, J.B. 1978. Pest status of the crazy ant, *Anoplolepis longipes* (Jerdon) (Hymenoptera: Formicidae), in the Seychelles. *Bulletin of Entomological Research* 68: 627-638.
- Hoffmann, B. 2011. The status and impacts of yellow crazy ants (*Anoplolepis gracilipes*) on Nu'utele, Aleipata Islands, Samoa: final report. Commonwealth Scientific and Industrial Research Organisation. Unpublished report to Secretariat of the Pacific Regional Environmental Programme. 41p.
- Holway, D.A.; Lach, L.; Suarez, A.V.; Tsutsui, N.D.; Case T.J. 2002. The causes and consequences of ant invasions. *Annual Review of Ecology and Systematics* 33: 181-233.
- Lovegrove, T.; Bell, B.; Hay, R. 1992. The indigenous wildlife of Western Samoa: impacts of Cyclone Val and a recovery and management strategy. New Zealand Department of Conservation, Wellington. 53p.
- McCulloch, B.; Collen, R. 2009. The captive care of Friendly ground doves – Vailima Botanic Gardens, Apia 2009. Unpublished report to Secretariat of the Pacific Regional Environmental Programme and Ministry of Natural Resources and Environment, Apia. 10p.
- Park, G.; Hay, R.; Whistler, A.; Lovegrove, T. 1992. The national ecological survey of Western Samoa. The conservation of biological diversity in the coastal lowlands of Western Samoa. New Zealand Department of Conservation, Wellington, 199p.
- Parrish, R.; Stringer, I.; Lester, P. 2004. Fauna survey of the Aleipata Islands, Samoa, 3<sup>rd</sup> Progress Report. IAS Technical Report No. 2004/05. Institute of Applied Sciences, The University of the South Pacific, Suva, Fiji. 17p.
- Parrish, R.; Tupufia, S. 2007. Report on Friendly (Shy) ground-dove (*Gallicolumba stairi*) work on Nu'utele Island and Upolu Island, Samoa. IAS Technical Report No. 2007/02. Institute of Applied Sciences, The University of South Pacific, Suva, Fiji. 12p.
- Stringer, I.; Parrish, R.; Sherley, G. 2003a. Report on the first monitoring visit to Nu'utele and Nu'ulua Islands, 25-31 July 2000. IAS Technical Report No. 2003/10. Institute of Applied Sciences, The University of the South Pacific, Suva, Fiji. 14p.
- Stringer, I.; Parrish, R.; Bassett, S. 2003b. Report on the second monitoring visit to Nu'utele and Nu'ulua Islands, 4-8 June 2001. IAS Technical Report No. 2003/11. Institute of Applied Sciences, The University of the South Pacific, Suva, Fiji. 12p.
- Tarburton, M.K. 2001. Observations on the status of the land birds, wading birds and seabirds of Samoa. *Emu* 101: 349-360.
- Watling, D. 2001. *A guide to the birds of Fiji and Western Polynesia including American Samoa, Niue, Samoa, Tokelau, Tonga, Tuvalu and Wallis & Futuna*. Environmental Consultants (Fiji) Ltd. 272p.
- Whistler, W.A. 1983. Vegetation and flora of the Aleipata Islands, Western Samoa. *Pacific Science* 37: 227-249.