Breeding Biology of the Atiu Swiftlet

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Summary

Tarburton, M.K. (1990). Breeding biology of the Atiu Swiftlet. *Emu* **90**, 175-179.
The Atiu Swiftlet *Aerodramus leucophaeus sawtelli* builds most of its nests from lichen, fibre from the crown of the coconut tree and saliva. Nests were smaller and less often placed in total darkness than those of other species that also have two chicks. Most nests were built in September and the last chicks probably fledged in April. Both parents share the incubation of their two white eggs and both begin moulting their flight feathers while incubating. As well as replacing lost eggs and young broods some parents relaid after successfully fledging their first brood. The average weight of newly hatched chicks was 1.1 g and at the time of fledging (53 days later) was 9.5 g. Each brood was fed six times a day. Chicks do not have any of the parasitic louse flies that are common on other swiftlets in the south-west Pacific but they are killed by crabs. Atiu sustained 380 breeding Atiu Swiftlets during the season, which means the density was 7.1 ha per breeding bird.

Introduction

The Atiu Swiftlet *Aerodramus leucophaeus sawtelli* is found only on Atiu in the Cook Islands (Fig. 1). Although it was first described as a distinct species (Holyoak 1974) it was later placed in the 'ultra species' *leucophaeus* to show its affinities with *A. (leucophaeus) leucophaeus* from the Society Islands and *A. (leucophaeus) ocistus* in the Marquesas Islands (Holyoak & Thibault 1978; Holyoak 1980). The islanders had named it the Kopeka.

This swiftlet breeds in only two of the numerous limestone caves of the raised coral reef (makatea) which forms a peripheral ring around the island of Atiu (Fig. 1). To date the only published work on the breeding of this bird has been that of Holyoak (1980) which was based on a visit to Takitaki Cave in September 1973. This paper adds to our knowledge of this bird's breeding biology.

Methods

Because Takitaki Cave and its swiftlets have been used from at least early this century as a tourist attraction and I did not want tourists and their island guides disturbing my work, I made my daily measurements of eggs and chicks in Tupuranga Cave. As most islanders did not know of the birds nesting at the rear of Tupuranga Cave I could be sure these birds would be subject to less disturbance than those in Takitaki Cave.

The methods used for weighing and measuring the eggs, chicks, adults and their nests are the same as in Tarburton (1988). Some adults were marked on the rump and/or tail with different coloured texta paints to allow the recognition of individuals. Flight speed data were obtained by timing the birds over a measured ten metres at the entrance to Takitaki Cave.

Individual chicks were identified with daubs of fast-drying model paint placed on their head, shoulder or rump. Once the chicks were old enough they had an individually numbered aluminium band from the New Zealand Bird Banding Scheme, Wellington, New Zealand, placed on one leg.

Because my visit was late in the breeding season and few breeding attempts could be followed right through, the following assumptions were made in estimating the breeding success: two eggs were always laid, eggs that disappeared soon after my first visit were not the result of desertion. Because there were few newly hatched chicks, only two broods of three could be manipulated to determine whether food was the factor that was limiting clutch size to two.

Measurements throughout are given in the form: mean ± *s.e.*

Results

Nests, nest site and colony size

All nests were made of plant material and held together and to the wall with a small amount of saliva. Most nests had the bracket and cup construction typical of swiftlets (Medway 1966). Some that were placed on ledges had very little bracket — instead, the cup rested on a base. The major component of 50 nests was: Coconut crown fibre (in 64% of nests), lichen (24%), casuarina needles (6%), grass (2%), angiosperm leaves (2%) and passionfruit tendrils (2%). The percentage of nests (n = 50) with the following components was: Coconut crown fibre (88%), Atiu Swiftlet feathers (54%), lichen (42%), casuarina (20%), inflorescence from the shrub *Ocimum gratissimum* (8%), grass (6%), angiosperm leaves (6%), passionfruit tendrils (6%), moss (2%) and Atiu Swiftlet egg shell (2%).

The internal dimensions of 30 nests from Tupuranga Cave were not significantly different ($P > 0.75$) to those from 47 nests in Takitaki Cave so they have been pooled. The total sample averaged 52.3 ± 0.6 mm across, 48.9 ±

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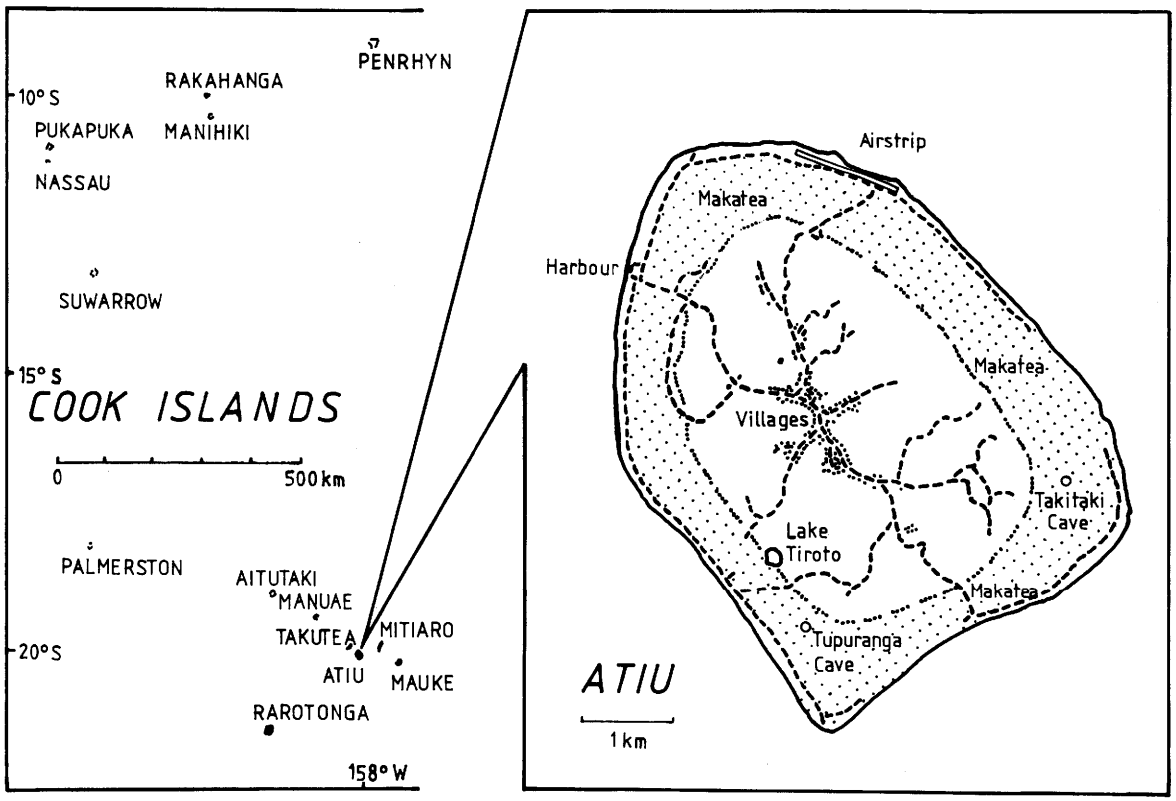

FIGURE 1 Location of Atiu within the Cook Islands and of the two caves on the island of Atiu that contain breeding (and roosting) colonies of Atiu Swiftlets.

0.7 mm front to back and 16.4 ± 0.6 mm in depth. The average volume index (l x w x h) of the Atiu nests was 41.9 cm^3. While the front rim of the nest eroded during breeding a few birds built onto the rim, one bird doing so as late as 13 January in Takitaki Cave.

About half the nests of both colonies were in total darkness and the others were in the twilight zone. However, birds flying to or from their nests used their echolocatory call even in the twilight. Takitaki Cave had 74 currently active nests which were an average 4.8 ± 0.1 m above the cave floor and 2.5 ± 0.2 m from their nearest neighbour's nest. Tupuranga Cave had 116 active nests which were an average 3.2 ± 0.2 m above the cave floor and 1.8 ± 0.3 m from their nearest neighbour's nest. Half of a sample of 52 nests were on ledges and half were on vertical or overhanging walls. Ten per cent of all nests were on flowstone and several were on stalactites.

Louse-flies (Hippoboscidae) which are common on White-rumped Swiftlets *Aerodramus spodiopygius* and in their nests in Fiji (Tarburton 1986) were not found at all on the Atiu Swiftlets.

The breeding season

Most nests contained well grown chicks when the caves were first entered on 7 December 1987. Some chicks were already flying and would have come from eggs laid prior to 22 September if we assume minimum incubation to be the same as for White-rumped Swiftlets in Queensland (25 days) plus their known minimum fledging period (51 days). The date of the last known replacement eggs was 11 January and chicks from these eggs would not fledge until between 27 March and 2 April. The breeding season is estimated to occur from late August/September when nests are being built until April when the last chicks were fledged.

The eggs

The clutch consists of two eggs (n = 28), white without gloss and elliptical to long elliptical. The eggs were laid

three and a half to seven days apart ($\bar{X}$ = 4.7, n = 7). The average dimensions of 43 eggs from Tupuranga Cave were 18.3 ± 0.1 x 12.8 x 0.1 mm. The average weight of 41 fresh eggs was 1.53 ± 0.02 g. This fresh weight represents 17.9% of the average adult weight (8.56 ± 0.06 g, n = 144).

Catching and marking both parents showed that both sexes incubate. Hatched egg shells were removed by parents or trampled to small fragments in 1-3 days.

TABLE 1 Progress of moult in the primary flight feathers of Atiu Swiftlets.

	7 Dec-9 Dec	10-18 Dec	19-28 Dec	29 Dec -7 Jan	8-15 Jan
No. examined	20	51	35	37	44
No. not in moult	11	9	4	5	8
No. in moult					
P1	3	9	3	2	4
P2	**6**	10	4	5	3
P3	—	**14**	8	8	2
P4	—	5	**9**	8	4
P5	—	2	5	3	**12**
P6	—	—	1	4	6
P7	—	2	1	2	3
P8	—	—	—	—	2
P9	—	—	—	—	—
P10	—	—	—	—	—

NOTE: Pn = the number of the most recently moulted (smallest or missing) flight feather. Numerals in boldface = mode of each 10 day interval.

Moult in the breeding season

Data in Table 1 show that most Atiu Swiftlets begin to moult their primaries in late November or early December. If this moult rate continued as it did during December and January, then moult of the primaries takes about 120 days to complete. The rate of moult in five re-trapped birds confirmed this prediction.

Head moult was seen in a bird moulting its fifth primary. Moult in the secondaries and secondary coverts was seen in a bird that was moulting its sixth primary. Moult in the tail and tail coverts was seen in a bird moulting its seventh primary.

Egg loss and replacement

From 25 clutches of two eggs, 54% hatched (36% disappeared, 10% never hatched). Of the six pairs that successfully fledged chicks before 18 December, only two laid a second clutch (16 and 29 days later). Of the six pairs that lost young chicks before 18 December, only two relaid (17 and 38 days later). However, of six pairs that had lost eggs up to 24 December, four re-laid between 10 and 18 days later. One pair that lost its second clutch did not produce a third.

Nestling development

The average weight of newly hatched chicks was 1.1 g, (range = 1.0-1.15 g, n = 3). The pins of the primaries in the only case recorded broke through the skin on the fourteenth day when the wing was 16.5 mm long. The average time taken for the first flight feathers to break out of their sheaths was 21.7 ± 0.8 days (range = 18-24 days, n = 7), when the wing measurement was between 27 and 33 mm (29.9 ± 0.9).

The average wing measurements for individuals from each of the three different brood sizes are shown in Figure 2. These show a consistent relationship to each other which is not the case with the average weight measurements for individuals from the three different brood sizes (Fig. 3).

Observations throughout 22 December on nine nests containing one to three nestlings showed that 6.1 ± 0.2 feeding visits (range = 5-7) were made to each nest.

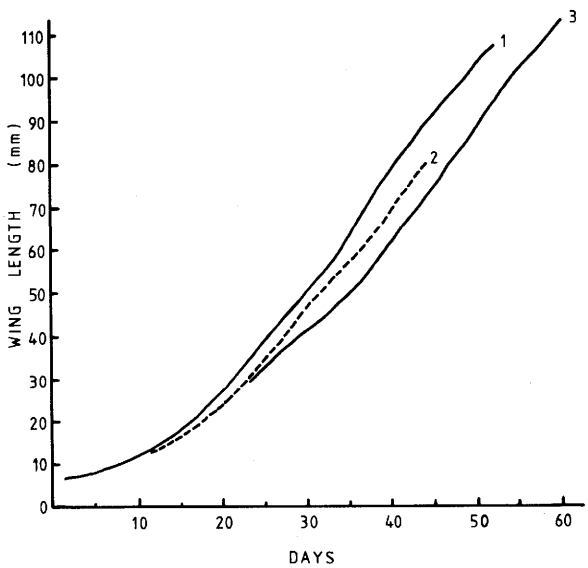

FIGURE 2 Average wing lengths for chicks from broods containing one, two and three chicks. Natural broods of one and two are compared with a manipulated brood of three. The curves were drawn by eye from the plotted points. Standard errors were never more than twice the thickness of the lines and so are not shown.

The nestling period

The average age at fledging was 53.3 ± 1.2 days (n = 8) when average wing length was 110.2 ± 2.3 mm, which is 92% of adult wing length (120.4 ± 0.1 mm, n = 144). The average weight at fledging was 9.49 ± 0.22 g which is 110.9% of average adult weight (8.56 ± 0.06 g, n = 144).

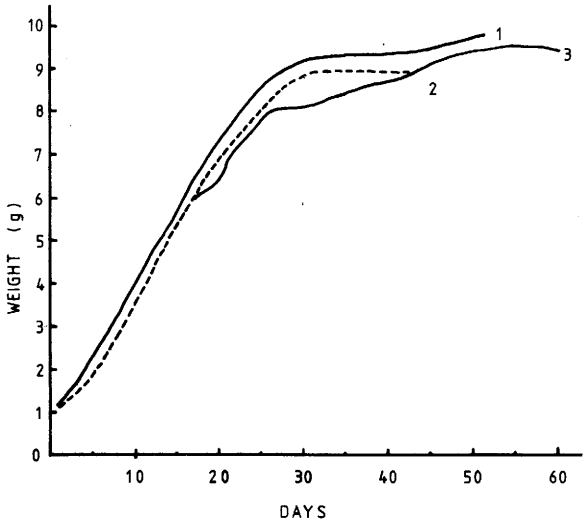

FIGURE 3 Average weights for chicks from natural broods of one and two chicks compared with the average weights of chicks in a manipulated brood of three. Standard errors were never more than twice the thickness of the lines and so are not shown.

Nesting success

From 34 clutches an average of 0.62 ± 0.1 chicks were fledged. Only three pairs raised both chicks and 15 raised one chick. One of the two manipulated broods of three lost two chicks within two days of the manipulation and this may have been the result of disturbance. The other pair fledged all three chicks at average weight and wing size but took seven or eight days longer to get their chicks to this size.

Chick mortality

The major causes identified for chick deaths were starvation after falling out of the nest and crab predation. Both Coconut Crabs *Birgus latro* and Land Crabs *Cardisoma longipes* were seen climbing over the roof of the caves, in total darkness and near the nests. Out of the seven nests that fell from the wall, two were cut in half by some sharp object such as a crab's chela. One of the chicks had its lower leg cut off and another chick sustained two deep and fatal lacerations to its body.

Discussion

The nests contained smaller amounts of saliva than was used by swiftlets in Fiji and was similar to the abnormally small amount used by swiftlets during a dry year at Chillagoe, Queensland. Small amounts of saliva allow nests to fall apart more readily than those with more saliva. The volume index of the Atiu nests (41.9 cm^3) was closer to that of the White-rumped Swiftlet in Fiji (52 cm^3; Tarburton 1986) which hold two young than to that of

TABLE 2 A comparison of the Atiu Swiftlet with two subspecies of White-rumped Swiftlets.

Parameter	*A. l. sawtelli* Atiu	*A. s. assimilis* Fiji	*A. s. chillagoensis* Qld.
Time taken to replace lost clutches	10-18 days (n = 4)	7-17 days (n = 27)	6-18 days (n = 41)
Temperature at nests	22.5-23°C	24.8-26.4°C	22.5-23.5°C
Time for emergence of flight pins	14th day (n = 1)	11th day (8-15 d) (n = 61)	—
Time for emergence of flight feathers	21.7 ± 0.8 days (18-24, n = 7)	18.6 ± 0.3 days (15-27, n = 61)	18.7 ± 0.4 days (16-24, n = 24)
Number of feeds per brood of 2 per day	6.1	2.8	5.2 (good yr.) 2.9 (poor yr.)
Average weight of food bolus	0.20 ± 0.02 (n = 15)	0.22 ± 0.02 (n = 35)	0.33 ± 0.02 (n = 32)
Nestling period	53.3 days (n = 8)	45 days (n = 21)	46.1 ± 0.8 days (good yr.) 51 ± 1.3 days (poor yr.)
Breeding success (No./clutch)	0.62 (n = 34)	1.1 (n = 21)	0.9 (n = 62, good yr.) 0.6 (n = 18, poor yr.)
Pairs raising an extra chick/pairs given extra chick	1/2	1/11	0/27

NOTE: Data for Fiji are from Tarburton (1986) and that for Chillagoe from Tarburton (1988).

White-rumped Swiftlet nests at Chillagoe (25 cm^3; Tarburton 1988) which hold only one chick at a time.

The nest site and colony size

In the South Pacific, most swiftlets that have totally dark nest sites available use them. The proportion of Atiu Swiftlets on Atiu that nest in the twilight zone is unusually large and probably results from the absence of predators that hunt visually.

Allowing two breeding adults for each nest indicates that Atiu supported 380 breeding adults in the 1987-88 season. The Atiu Swiftlet forages over the whole of Atiu (which has an area of 2695 ha; Tudor 1972) though less frequently in the area of the wharf and airstrip. Thus, the density of Atiu Swiftlets sustained is one per 7.1 ha.

The breeding season

The estimated date for the beginning of the 1987-88 breeding season is similar to that found by Holyoak (1980) when in September nests were either empty or contained one or two eggs.

Measurable comparisons with the White-rumped Swiftlet

In most of the breeding parameters shown in Table 2, the Atiu Swiftlet is closer to the White-rumped Swiftlet at Chillagoe in poor seasons than to the White-rumped Swiftlet in Fiji or in good seasons at Chillagoe.

The incubation period was not determined but it is likely that this period is similar to the 27 days taken by *A. s. chillagoensis*, a similar-sized bird nesting in sites with similar temperatures.

The average number of chicks fledged was low in this comparison. However, as some pairs produced second clutches after successfully raising one brood the real difference in performance would be much less. Because four pairs deserted (of 19 brooding pairs handled), it is possible that other individuals or pairs reduced their effort thus causing an artificially lower success rate during this study on Atiu. Desertion in South Pacific swiftlets has not been previously recorded and any further work on the birds of Atiu would do well to take this into consideration.

The successful fledging of three chicks by the parents with the artificially enlarged brood suggests that the parents were able to supply more food on Atiu during that season than parents in Fiji or Queensland. That this is the case is supported by the data showing that while the average weight of the food delivered to a brood on Atiu is not significantly smaller ($t_{34} = 0.9$, $P > 0.1$) than that delivered to a brood of the same size in Fiji, the number of feeding trips made per day is double that made to Fijian broods. White-rumped Swiftlets at Chillagoe have a brood of only one and experience a very erratic food supply so that feeding comparisons with this subspecies are unlikely to be justifiable. Food might be more abundant on Atiu as there are no competing aerial insectivores unlike the other two locations. These parameters indicate that the success of the parents in the extremely small manipulated sample of this study may be characteristic.

That the Atiu Swiftlet delivered more food to its chicks which took longer to fledge than two other swiftlets need not be contradictory. This is because the amount of food delivered to chicks may be independent of food demand (Ricklefs 1987).

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