Notornis, 2017, Vol. 64: 106-108
0029-4470

SHORT NOTE

Diet of the Atiu swiftlet (*Aerodramus sawtelli*): an aerial insectivore on a small island in the South Pacific

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The Atiu swiftlet (*Aerodramus sawtelli*) is the only swiftlet species recorded in the Cook Islands (South Pacific) and only nests in two (Tupuranga and Takitaki caves) of the many caves on the 26.9 km^2 Atiu Island (also known as Enuamanu Island or "Island of the Birds"). In December 1987 and January 1988, 380 Atiu swiftlets were recorded breeding in the two caves. The nests, like most other swiftlets, are composed of vegetable matter and saliva. However, unlike other swiftlets, this species does not clump its nests together in high alcoves of the dark section of a cave; rather, the nests are spaced out to reduce predation by coconut (*Birgus latro*) and land crabs (*Cardisoma longipes*) and are just as likely to nest in the twilight as well as the totally dark portions of the two caves due to the absence of visually-oriented predators (Tarburton 1990).

Received 28 July 2016; accepted 16 April 2017
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The Atiu swiftlet lays two eggs and is the only swiftlet known to be able to gather enough food to raise an experimentally added third nestling, indicating that it may not be under the food constraints that other species are (Tarburton 1990). This species also makes more feeding trips to its nestlings per day than other swiftlet species (Tarburton 1990). Although home to a variety of bird species (Gill 1996), the Atiu swiftlet is the only aerial insectivore on the island and as such may take a wide range of the available aerial invertebrates.

This current study documented the prey delivered to nestlings at Tupuranga (-20.012277, -158.121404) and Takitaki caves (-20.003208, -158.090685). Sampling was conducted 8, 15, 16, 20, 25 December 1987 and 13 January 1988. Nineteen adult swiftlets were caught in a mist or sweep net when returning to their nests, as each parent did approximately 3 times a day. Sometimes caught birds voluntarily ejected their food boluses; a total

Table 1. Composition of Atiu swiftlet prey in 19 food boluses. "Dominant" is defined as constituting the highest percentage; SE = standard error; "+1=" signifies that that order was also equally common in 1 or 2 other boluses.

Order	No. where dominant	% where dominant	% range in all boluses	Mean % of samples where present ± *se*	No. of boluses present in	No. in total sample	% individuals in total sample
Hymenoptera	7(+1=)	35 - 85	0 - 85	20 ± 13.9	8	1177	62
Lepidoptera	3(+1=)	64 - 69	0 - 69	27 ± 9.4	8	136	7
Blattodea	3	60 – 100	0 - 100	27 ± 18.8	5	33	2
Diptera	1(+2=)	69	0 - 69	19 ± 17.0	15	225	12
Thysanoptera	1	67	0 - 67	16 ± 10.4	6	39	2
Isoptera	1	66	0 - 66	22 ± 29.8	4	108	6
Coleoptera	1	58	0 - 58	8 ± 4.5	12	64	3
Homoptera	0	0	0 - 33	12 ± 7.8	13	98	5
Aranae	0	0	0 - 12	4 ± 1.8	6	13	1

of 19 boluses were collected and subsequently examined under the microscope as detailed in Tarburton (1986). In addition, available prey was sampled at 13 locations (where swiftlets were often seen feeding) for 5 minutes at a height of 1-6 m above ground using a sweep nets; a total of 34 samples were collected between the hours of 0830-1945 h over the period 9 December 1987 to 14 January 1988.

The weight of 15 of the 19 boluses ranged from 0.09-0.43 g (*mean* = 0.1997 g). The 19 boluses contained 1893 arthropod prey (*mean* = 189, *range* = 6-858). The boluses with the fewest prey items contained solely or mostly larger cockroaches (Blattodea) ranging from 5-13 mm in length.

The 1893 arthropod prey items included 13 spiders, with all other prey items being insects. The Order of each prey item and their abundance in the boluses are provided in Table 1. Social insects (Hymenoptera) were found in more boluses than any other Order. Moths (Lepidoptera) and cockroaches were the next most dominant, with plant bugs (Homoptera) and spiders (Aranae) being the only groups that did not dominate in any bolus. Beetles dominated in only 1 bolus, contra Fullard *et al.* (2010). However, that study was based on faecal remains, which are known to represent a bias towards beetles due to their hard exoskeleton (Jahn *et al.* 2010).

In comparison to the bolus results, Diptera were the most commonly caught taxa in the sweep net samples, with 127 individuals caught. This was followed by Homoptera (39 individuals) and Hymenoptera (37 individuals).

Of note in this current study was the taking of cockroaches (Blattoidea: Blattidae), which have not been reported in dietary studies of 8 other swiftlets (Harrisson 1976; Waugh & Hails 1983 Tarburton 1986, 1993; Lourie & Thompkins 2000; Valdez *et al.* 2011; Collins unpub.; Collins & Francis *in prep*.)

The mean prey size recorded in the Atiu swiftlet boluses was 2.6 mm (*se* = 0.05, *n* = 1893, *range* = 1-13 mm). The largest prey items were a 13 mm cockroach and 3 10 mm moths. On average, cockroaches were the largest prey (*mean* = 8.9 mm), then moths (*mean* = 7.0 mm), thrips (Thysanoptera) (*mean* = 5.5 mm), plant bugs (*mean* = 3.6 mm), beetles (Coleoptera) (*mean* = 3.0 mm), termites (Isoptera) (*mean* = 2.7 mm), spiders (Aranae) (*mean* = 2.6 mm), and flies (Diptera) (*mean* = 2.2 mm).

The fact that social insects (Hymenoptera) dominated in more boluses of Atiu swiftlet than any other prey group is a contrast to studies of White-rumped swiftlets in Fiji, where flies (Diptera) dominated in nearly half of the boluses (Tarburton 1986). Both flies and social insects, along with plant bugs, were the dominant species in prey selected by Australian swiftlets (Tarburton 1993). In Australia, these 3 groups of insects were closely followed by spiders, which was not the case in either Fiji or Atiu.

The mean prey size of the Atui swiftlet (*mean* = 2.6 mm) was larger than that taken by the white-rumped swiftlet in Fiji (*mean* = 2.5 mm; Tarburton 1986), but smaller than those taken by the Australian swiftlet in Queensland (*mean* = 3.6 mm; Tarburton 1993) (Table 2). These findings align with previous studies that have shown that both intra-specifically and inter-specifically, larger aerial insectivores take larger insects than smaller ones (Hespenheide 1971; Dyrcz 1979; Collins *et al.* 2009; Collins 2015).

Table 2. Body mass of swiftlets and average prey size.

Swiftlet species	Location	Body mass (± *se*)	Prey size (± *se*)	Source
White-rumped swiftlet	Fiji	8.19 ± 0.06 g (*n* = 102)	2.48 ± 0.11 mm (*n* = 7309)	Tarburton (1986)
Atiu swiftlet	Atiu	8.56 ± 0.06 g (*n* = 144)	2.6 ± 0.05 mm (*n* = 1893)	Current study
Australian swiftlet	Queensland	9.3 ± 0.04g (*n* = 400)	3.64 ± 0.24 mm (*n* = 6583)	Tarburton (1993)

However, to gain robust correlations between prey and predator size, larger samples taken over a longer period of time and through a range of weather conditions are required. This requirement is indicated by the significant difference in the 2 samples for *Apus apus* (Lack & Owen 1955) between prey caught in fine weather and those caught in wet weather. Similar differences were found in the prey of white-rumped swiftlets, as well as large differences in different seasons or years (Tarburton 1986).

While Hymenoptera and Diptera have been the most abundant prey in the sampled diet of most swifts and swiftlets studied to date, the Atiu swiftlet appears to have replaced Diptera with Lepidoptera and Blattodea, possibly because the flies on Atiu are smaller, and the moths and cockroaches are of a more favourable size, or contain more energy per volume. A larger sample of targeted invertebrate surveys are required to obtain a better understanding of the prey items that are available on Atiu Island.

ACKNOWLEDGEMENTS

I thank Charles T. Collins for critically reviewing the first two drafts of this script for me, and the staff at *Notornis* for all their help with the third draft.

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Keywords Atiu swiftlet; *Aerodramus sawtelli*; aerial insectivore; boluses; diet; Aitu Island; Cook Islands; South Pacific