

Eastern Blue-tongued Skinks, *Tiliqua scincoides scincoides*, feeding on fruits of the Red Leaf Fig Tree, *Ficus congesta*

Grant S. Turner

PO Box 2035, Innisfail Qld 4860, Australia. Email: g.s.turner@hotmail.com

Abstract

Faecal samples from three Eastern Blue-tongued Skinks, *Tiliqua scincoides scincoides*, from north Queensland's Wet Tropics region consisted exclusively of fruits of the Red Leaf Fig Tree, *Ficus congesta*, adding to the broad range of food items consumed by this omnivorous skink. Time-lapse photography over a two-month period showed that a particular *F. congesta* tree was visited repeatedly when in fruit by six individual skinks, which consumed fallen fruit, as well as fruit attached to the stems and racemes.

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Introduction

The Eastern Blue-tongued Skink, *Tiliqua scincoides scincoides*, is a large (ave. SVL 300 mm), terrestrial, omnivorous, live-bearing lizard found in all three eastern states of mainland Australia as well as parts of south-eastern South Australia, encompassing a broad latitudinal range that extends from Melbourne to the tip of Cape York Peninsula (Cogger 2014). While the species occurs in north Queensland's Wet Tropics along the Cassowary Coast, it does not occur in the dominant rainforest habitat there, but has established itself in agricultural areas (personal observation).

In this work, I record fruits of the Red Leaf Fig Tree, *Ficus congesta*, as a dietary item of *T. s. scincoides* from the Wet Tropics region and also describe the feeding habits and visitation patterns to the source tree.

Site details & methods

Observations were made on a sugar cane property near the town of Silkwood (17°45'S, 146°00'E), approx. 120 km south of Cairns. The habitat was a steep north-west facing slope consisting of

relatively open, early-stage, regenerating rainforest with a grassy understory bordered by stands of sugar cane and Guinea Grass, *Megathyrsus maximus*. Mature *F. congesta* were uncommon on the slope and it was the only *Ficus* species present. The particular *F. congesta* tree featured in this work (hereafter referred to as the source tree) was 3.5 m in height and had two main stems (approx. 0.1 and 0.2 m in diameter at ground level), with the larger stem bifurcating 0.6 m above the ground. Below this height were numerous peduncles, as well as racemes emanating from the larger stem, some of which extended up to 0.7 m along the ground. These structures periodically produced fruits that were readily accessible to skinks. For simplicity, I refer below to figs as 'fruits' though technically they are structures called scyonia, which are inflorescences (essentially modified, fleshy stems; Flaishman *et al.* 2008). Plant identifications were made using Cooper & Cooper (2004) and the Australian Tropical Rainforest Plants (2010) website.

Three *T. s. scincoides* were located incidentally during 2017-18 and retained briefly (< 24 hrs) for examination before being released at the point of capture. During this time, skinks were examined, measured and photographed. Mass was measured to the nearest 10 g using a 1 kg spring balance. Faecal samples were collected, examined with a hand lens while wet, and then dried.

The source tree was photographed using time-lapse sequences made on 39 days during daylight hours from approx. 6:30 am to 5:30 pm (EST) from the start of October through to the end of November 2018. A Maginon Vision camera was mounted on a tripod 1.2 m above ground and set on time-lapse so that a photograph was taken every minute to record the visitation of skinks to the source *F. congesta* tree. The frame of each photograph captured an area of ground approx. 3 m² where most fruit fell and included the two main stems of the tree; the area at the far side of the tree was mostly out of view. Feeding was deemed to have occurred if either a fig was in the skink's mouth or the skink exhibited typical pre or post-feeding postures (i.e., jaws agape with tongue extruded, swallowing with head and snout held upwards with mouth slightly agape and tongue extruded). Individual skinks were assigned a number and in most cases were easily identified by a combination of banding patterns (i.e., number of bands, bifurcation of bands, and cavities within bands) and dorsal ground colouration (either grey or yellow).

Observations

Skink size and faecal samples

Measurements of the skinks indicate that they were all sexually mature adults (Table 1; see Shea 1992). Faecal samples from the three *T. s. scincoides* were all similar in appearance being dark brown to black, and consisted exclusively of compacted *F. congesta* fruits, most of which had a soft rind, and though partially digested, were largely intact. Seeds were very numerous and clearly visible both within the compacted fruits and also between compacted fruits in all samples. The latter were presumably derived from digested fruits or perhaps the ingestion of fruit portions. No other items were found in the faecal samples. The blackened appearance of the rind and flesh of the fruits within faecal samples appeared almost identical to the decayed fruits that had accumulated around the base of the tree.

Time-lapse sequences

A total of 52 visits by *T. s. scincoides* to the source tree were recorded over the 39 days. No *T. s. scincoides* activity was recorded before 6:30 am, and only one occurrence after 3 pm. Almost all recorded activity occurred between 10 am and 3 pm (n = 31; 79%). The earliest visit to the tree was at 8:53 am and this was one of only seven recordings before 10 am (18%). Six individual adult *T. s. scincoides* were recorded visiting the tree.

Table 1. The morphological details of three Eastern Blue-tongued Skink, *Tiliqua s. scincoides*, the composition of faecal samples, the fruiting state of the probable source Red Leaf Fig Tree, *Ficus congesta*, and the distance each skink was located from the tree.

Abbreviations of measurements are as follows: SVL = snout to vent length, TL = tail length, HL = head length (from the tip of the snout to the posterior edge of the interparietal scale along the midline) and HW = head width (at the widest point). Length measurements (SVL, TL, HL and HW) are all in millimetres (mm) and mass in grams (g).

Date	Skink number	Measurements of <i>T. s. scincoides</i>	Faecal composition	Red Leaf Fig Tree (Source)
7/4/17	#2	♂ SVL 333, TL 202, HL 56.5, HW 46.9, Mass 690	At least 12 partially digested but mostly intact <i>F. congesta</i> fruits & numerous seeds.	Many fruits: decayed through to immature; skink 10 m away
10/4/18	#4	♀ SVL 282, TL 160, HL 39.9, HW 36.5, Mass 405	At least 9 partially digested but mostly intact <i>F. congesta</i> fruits & numerous seeds.	Many fruits: decayed through to immature; skink 35 m away
9/9/18	#6	♀ SVL 315, TL 210, HL 52.4, HW 42.1, Mass 470	10 partially digested but mostly intact <i>F. congesta</i> fruits & numerous seeds.	Decaying & immature fruits only; skink 50 m away

All six skinks were recorded feeding multiple times (Table 2). Visits to the tree were generally of two kinds: (i) a 'pass-by' where skinks moved more-or-less in one direction and (ii) a 'loop' where skinks doubled back and/or crossed over their path (at least once; Fig. 1). Both types of visits (in nearly all instances) involved skinks actively foraging as photos show their snouts probing the ground. A loop typically involved a skink circling the base of the tree ($n = 16$; 73%). Not surprisingly, significantly more time was spent completing a loop rather than a pass-by ($t = 5.94$, $df 27$, $P < 0.0001$), with the average amount of time spent completing each being 11.9 min (5 to 29 min; $n = 22$) and 3.9 min (1 to 12 mins; $n = 30$), respectively. Feeding was recorded on both types of visits. On overcast or rainy days ($n = 7$), no visits by skinks were recorded, and there were no sightings of active skinks on such days. Towards the end of the observation period (November), a protracted dry spell meant that, despite good weather for *T. s. scincoides* activity, fruit fall was negligible and the only fruits on the tree were small, green and unripened. This coincided with reduced visitation by *T. s. scincoides*, with only two of the six individuals recorded making visits, and no visits by skinks on six of these days despite other sightings indicating they were active.

Skinks approached the tree from various directions, generally with the head down probing or 'investigating' the ground. Frequently, skinks foraged beneath the racemes located low on the main stem (Fig. 2). The ground around the base of the tree had accumulated rotting fruits, often accompanied by the chewed remains of fruits left by Fawn-footed Melomys (*Melomys cervinipes*),

Table 2. The frequency of visits and of feeding by individual Eastern Blue-tongued Skinks, *Tiliqua s. scincoides*, at the Red Leaf Fig Tree, *Ficus congesta*.

Skink number	No. of visits (no. of days)	No. of times feeding was recorded
#1	11 (10)	9
#2	13 (13)	16
#3	9 (9)	6
#4	4 (4)	3
#5	3 (3)	5
#6	12 (7)	8

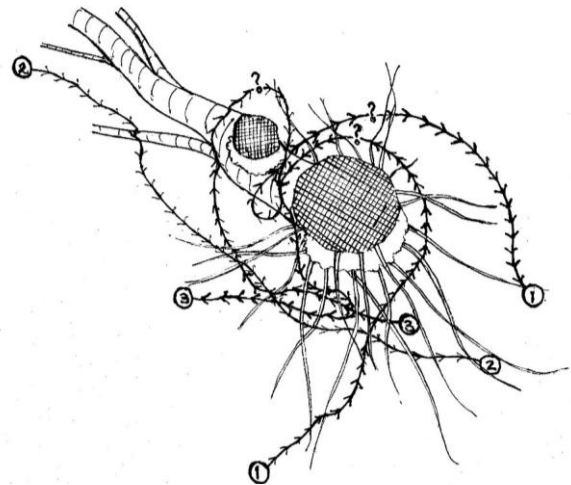


Figure 1. Examples of three paths made by three individual Eastern Blue-tongued Skinks, *Tiliqua s. scincoides*, on visits to the Red Leaf Fig Tree, *Ficus congesta*, tree as viewed from above.

The cross-hatched areas are the two main stems of the tree, the lines trailing off to the top left are above ground roots and the thin lines emanating from the thicker stem are racemes (only some are drawn). Tracks 1 and 3 are loops while track 2 is a pass-by (see text). Question marks indicate regions on the far side of the tree where skinks were temporarily out of view.

Spectacled Flying-foxes (*Pteropus conspicillatus*), and Double-eyed Fig-Parrots (*Cyclopsitta diophthalma macleayana*). Skinks fed on fallen fruit, consisting of both ripe (yellow) and decaying fruit, as well as full-sized, unripened (green) fruits that were attached to racemes around the base and main stem of the tree (Fig. 3). Further, it was noted that no small, hard green fruits were consumed. On six occasions, skinks were recorded climbing part way up the stem, some with their head and body leaning vertically against it, attempting to access figs growing higher-up (Fig. 4); in all these instances there were few or no ripe figs on the ground and none on the more accessible racemes. With one exception, only one skink was recorded at the tree at any one time. The exception occurred when a second skink appeared at the base of the tree when another was part way up the main stem, resulting in a two-minute overlap, however, no interaction between them was recorded. There were three instances when different skinks visited the tree within 30 minutes of another. The largest number of skinks to visit the tree during a single day was three ($n = 4$). Most skinks visited the tree just once in a day (88%), but two individuals visited the tree twice ($n = 6$).



Figure 2. An Eastern Blue-tongued Skink, *T. s. scincoides* (#2) consuming a fruit attached to a raceme sprouting from the base of the Red Leaf Fig Tree, *Ficus congesta*.



Figure 3. An Eastern Blue-tongued Skink, *T. s. scincoides* (#2) consuming a ripe (yellow) fruit that had recently fallen from the Red Leaf Fig Tree, *Ficus congesta*.



Figure 4. An Eastern Blue-tongued Skink, *T. s. scincoides* (#4) climbs part way up the base of the main stem to consume a large green fruit from the Red Leaf Fig Tree, *Ficus congesta*.

Discussion

Much of what is known about the dietary preferences of *T. s. scincoides* has been collected from animals kept in captivity. Detailed information on the subspecies' natural diet is lacking, despite it being reasonably common throughout much of its broad geographic range (see Shea 1982; Greer 1989). In captivity, *T. s. scincoides* is known to feed on a wide variety of fruits (Longley 1939; Greer 1989 and references therein; Unverzagt 2004), so the observations of fig-feeding in the wild are unsurprising. While figs occurred exclusively in the three faecal samples, it is unlikely that they constituted an exclusive food source for the lizards. Instead, they are probably eaten regularly and in large numbers when available. Only a few native plant foods consumed by wild *T. s. scincoides* have been identified to genus or species level. These include: seeds, fungi, dandelion flowers, Lantana *Lantana camara* leaves and *Persoonia* sp. fruits (Rose 1974; Shea 1982;

Webb & Simpson 1985; Koenig *et al.* 2001). Fig-feeding has been recorded in the much smaller Black Mountain Rock Skink, *Liburnascincus scirtetis*, which has been observed consuming portions of fallen fruits (Goodman 2004).

Ficus congesta occurs throughout northern Australia (NT, Cape York Peninsular, NE Qld), offshore islands, the Torres Strait Is., Pacific Is. and Malesia (Cooper & Cooper 2004). While its habitat includes rainforest, it favours disturbed sites and 'is a typical regrowth species along roads etc.' (Australian Tropical Rainforest Plants 2010). In this work, the occurrence of *F. congesta* was amongst a suite of rapidly growing, primarily bird-dispersed, pioneer rainforest species (personal observation). Its fruits are known to be eaten by both the Southern Cassowary, *Casuaris casuaris*, and the Spectacled Flying-fox (Cooper & Cooper 2004).

Several features of *F. congesta* fruiting patterns may make it an attractive food source for local *T. s. scincoides*. With multiple crops produced each

year (at least three), and in large quantities, *F. congesta* fruit constitute a reliable food source and with crops of fruit ripening asynchronously over several weeks, each fruit-fall period may last more than a month (personal observations). With crops of fruit ripening asynchronously over several weeks, each fruit-fall period may last more than a month. Being a heavy-bodied, small-limbed, terrestrial skink, *T. s. scincoides* was unable to access fruits more than about 0.6 m above the ground. However, the large clusters of fruit low on the main stem, and also on racemes (which fan-out from the base and run along the ground), meant that many fruits were directly accessible to skinks, which were therefore not dependent on fallen fruit alone.

Shea *et al.* (2002) suggested that populations of *T. s. scincoides* in metropolitan Sydney depended, in part, on the availability of introduced food species (most notably the Garden Snail, *Cornu aspersum*). The *T. s. scincoides* individuals recorded in this work are part of a population that has presumably spread from suitable adjoining habitat, likely facilitated by the spread of agriculture in the region. The extent to which the survival of populations of *T. s. scincoides* in agricultural lands of the Wet Tropics depends on particular food plants is unknown. The nutritional value of fruits of *F. congesta* and most of the 850 *Ficus* spp. is unknown, but in the few species for which it has been determined, varies considerably (Parr *et al.* 2011 and references therein). However, the broad range of vertebrates and invertebrates that feed on *F. congesta* fruits (personal observation) would suggest that it that it is substantial. Several *Tiliqua* spp. have been implicated as dispersal agents of other plant species (e.g. Blotched Blue-tongued Skink, *T. nigrolutea* and fungal spores; Webb & Simpson 1985), although evidence of seed viability is lacking in all instances. Whether viable *F. congesta* seed is present in the faecal pellets of *T. s. scincoides*, and hence, whether skinks are a dispersal agent for this fig species, is unknown.

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