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Nestling diet and provisioning rate of Variegated Flycatcher *Empidonomus varius* in south-east Brazil

Variegated Flycatcher *Empidonomus varius* is a common Neotropical tyrannid that occurs from Venezuela and Colombia through Brazil to Uruguay and north-central Argentina¹². Populations from central Brazil southwards are austral migrants, moving mainly to western Amazonia post-breeding^{12,13,18}. Little is known of its reproductive biology, except brief descriptions

of nests and eggs, and seasonality^{1,7,9,10,15,16}. There are no studies quantifying the diet of, and provisioning rate to, nestlings¹². We present quantitative data on food and provisioning rate to nestlings, along with observations on parental care, at a single nest in south-east Brazil.

The study was conducted at Itirapina Ecological Station (IES), São Paulo state (22°11'–22°15'S 47°51'–48°00'W; 700–740 m), which encompasses 2,300 ha of mostly Cerrado vegetation, from grasslands to gallery forests, and supports a diverse avifauna of 270 species^{13,20}. Climate is subtropical with marked dry (April–September) and wet (October–March) seasons²⁰.

Field observations were made on 11–13 November 2020, with a Nikon D500 and D7200 cameras, together with Nikkor 200–500 mm f/5.6E AF-S VR tele zoom and Nikkor 600 mm f/4D AF-S II telephoto lenses, respectively, both mounted on tripods. Using camouflaged or neutral clothing, we positioned ourselves c.10 m from the nest, and never used flash, in order to avoid stressing the birds or inducing any behavioural changes. Photographs were taken in continuous shooting mode (4–6 frames/second) during behavioural events, permitting subsequent selection of the best images for analysis and possible food identification. Insect identification was based on the literature¹⁷.

The nest (Fig. 1a) was found opportunistically on 11 November 2020 in a *cerrado* (*sensu stricto*)³ at 22°11'31"S 47°54'50"W, 720 m, in the extreme north of IES, municipality of Brotas. It was at the base of a horizontal branch fork in a *Aspidosperma tomentosum* (Apocynaceae) tree, c.2.1 m above ground, and was a simple platform 15 cm in outer diameter and 7 cm in total height; it comprised mainly twigs, thin roots and other plant fibres. The nest contained three very young nestlings (Fig. 1b), estimated to be three days old or less when found (M. R. Francisco pers. comm.). It was similar to nests mentioned



Figure 1. Nest of Variegated Flycatcher *Empidonomus varius*, Itirapina Ecological Station, south-east Brazil, November 2020: (a) at the base of a horizontal fork on a branch of *Aspidosperma tomentosum* (Apocynaceae), in cerrado (J. C. Motta-Junior); (b) adult with three nestlings, shortly after sunrise (I. N. Perazzolo); (c) and (d) difference between the adults that tended the nestlings, with individual 1 (c) having a broader, more even-width and whiter supercilium than individual 2 (d) (J. C. Motta-Junior)

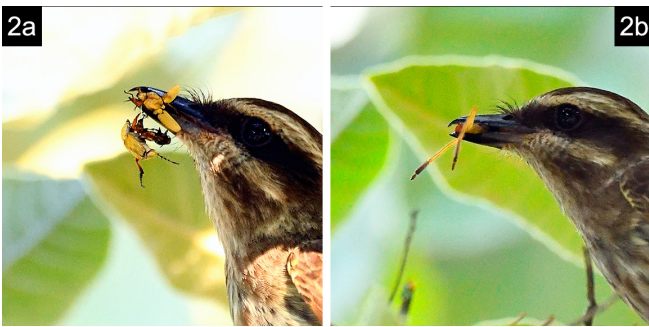


Figure 2. Examples of food items delivered to three Variegated Flycatcher *Empidonomus varius* nestlings, Itirapina Ecological Station, south-east Brazil, November 2020: (a) a beetle *Macroductylus* sp. (Melolonthidae) brought by adult individual 1 (J. C. Motta-Junior); (b) Araneae by individual 1 (I. N. Perazzolo); (c) fruit of *Miconia albicans* (Melastomataceae) by individual 1 (J. C. Motta-Junior); (d) winged Formicidae by individual 1 (J. C. Motta-Junior); (e) dragonfly *Erythrodiplax* sp. (Libellulidae) by individual 2 (J. C. Motta-Junior); (f) spittle bug (Cercopidae) by individual 2 (I. N. Perazzolo)

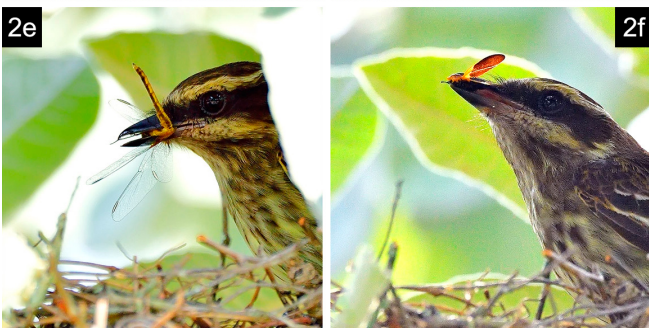




Figure 3. Individual 2 covering the nest and nestlings at various times (a–c: J. C. Motta-Junior, d: I. N. Perazzolo) and swallowing faeces over a one-second period; Itirapina Ecological Station, south-east Brazil, November 2020 (e–f: J. C. Motta-Junior)

in the literature, which are platforms or low cups¹⁹, composed of twigs, rootlets, leaf ribs and plant fibres placed horizontally on tree forks 1–8 m above ground, outer diameter 11–15 cm, depth 5.5–7.0 cm, with 2–3 eggs/young^{9–12,14–16}. One of the nests reported in the literature was also in a horizontal fork of the same tree species (*A. tomentosum*)¹⁰.

In a total of 8.1 hours of observations, during 05h40–10h04 and 15h59–18h00, we recorded 133 deliveries of food by the adults (presumably a pair) (Fig. 1c–d), of which 78 were made by individual 1 (58.6%) and 55 by individual 2 (41.4%). Adults were identified individually by their obvious facial patterns (Figs. 1c–d). The provisioning rate to the nestlings

was 16.4/hour, virtually the same in both morning (16.3/hour) and afternoon (16.7/hour).

The diet of the nestlings composed mostly arthropods, especially insects, such as winged ants and beetles (Table 1). Among beetles, more than half (51.4%) of the nestlings' diet involved a *Macroductylus* sp. (Melolonthidae) (Fig. 2a), which

genus is phytophagous and can cluster on flowers, leaves or buds of various plants, behaviour that probably makes it easier for this flycatcher to obtain large numbers of these beetles. An illustration from Brazil² of orange tree blossoms showed individuals of *Macroductylus affinis*, including males on females, with their front legs supported on the posterior part of the female's prothorax. Such behaviour is common when *Macroductylus* spp. are abundant, and presumably, male and female may then be predated simultaneously by the birds. In 29 deliveries, the adult brought 2–3 individuals of this beetle (Fig. 2a).

The second-commonest item (6.8% of deliveries) was a yellowish-winged ant, which was caught in flight and delivered at a rate of 1–4 individuals per visit to the nestlings (Fig. 2d). Other arthropods like spiders (Fig. 2b) and fruit (e.g. *Miconia albicans*, Melastomataceae, Fig. 2c) were poorly represented (Table 1). The very low proportion of fruit, in a species that is regularly frugivorous in adults, can be explained by the young age of the nestlings, which require more protein and lipids for growth⁴.

We also observed 11 visits to inspect the nest without bringing food, mostly by individual 2 (72.7%). The behaviour of covering the nest and nestlings was performed 40 times, exclusively by individual 2 (Fig. 3a–d), with each event lasting c.1–8 minutes, typically <2 minutes in most cases. We observed 18 faecal sacs being removed from the nest, 12 (67%) by individual 1 and six (33%) by individual 2. Individual 2 ingested the nestlings' faeces (Fig. 3e–f) on all six occasions, whereas individual 1 ingested them during nine of the 12 observations, the other three being taken away from the nest. The habit of ingesting nestling faeces is well known in other birds^{5,8}, especially during the first few days of nestling care, when they contain incompletely

Table 1. Identity and quantification of food items provided by the adults to three Variegated Flycatcher *Empidonomus varius* nestlings during three days of observation, Itirapina Ecological Station, Brazil, November 2020. NID: unidentified.

Food items	n	%
Plants		
Fruit of <i>Miconia albicans</i> (Melastomataceae)	1	0.6
NID green fruit	1	0.6
NID beige fruit	1	0.6
Animals		
Araneae	1	0.6
Blattaria	1	0.6
Coleoptera (NID)	5	2.8
Coleoptera (Chrysomelidae) sp. 1	1	0.6
Coleoptera (Chrysomelidae): <i>Megalostomis</i> sp.	1	0.6
Coleoptera (Curculionidae)	1	0.6
Coleoptera (Tenebrionidae)	4	2.3
Coleoptera (Melolonthidae): <i>Macroductylus</i> sp.	91	51.4
Diptera (Asilidae)	1	0.6
Hemiptera (Cercopidae)	1	0.6
Hymenoptera (Apidae)	1	0.6
Hymenoptera (Formicidae): winged form sp. 1	12	6.8
Hymenoptera (Formicidae): winged form sp. 2	1	0.6
Hymenoptera (Formicidae): winged form sp. 3	2	1.1
Hymenoptera (Formicidae): winged form sp. 4 large	1	0.6
Hymenoptera	3	1.7
Insecta and Arthropoda NID	21	11.9
Odonata (Libellulidae): <i>Erythrodiplax</i> sp.	2	1.1
Orthoptera (Acrididae): nymph	1	0.6
Other unidentified items	23	13.0
TOTAL	177	100.00

digested food. At least three hypotheses, not mutually exclusive, have been proposed to explain why adults consume their nestlings' faeces: (1) they may be nutritious (low digestion efficiency by very young nestlings), (2) provide water, and (3) ingestion may be preferable compared to the energy 'cost' of simple removal⁶. Removing accumulated faeces from the vicinity of the nest is also believed to minimise predator detection^{6,8}.

Finally, at least during the first five or so days after hatching,

parental care is shared by both adults, as reported for most Tyrannidae¹², with individual 1 mainly bringing food, and individual 2 mostly removing faeces and checking/covering the nest and nestlings. However, it is important to stress that our observations were based on a single nest (over three days), so our findings may have been biased by the availability and quality of prey in the nest environs during our brief period of monitoring.

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