

ARTÍCULO/ARTICLE

**Observations on the parental care of the Yellow-bellied Elaenia
Elaenia flavogaster subpagana (Tyrannidae)**Francine Voth¹, Jeff Port^{1,*}, Harold F. Greeney²¹*Bethel University Department of Biological Sciences, 3900 Bethel Dr. St. Paul, Minnesota, 55112, USA.*²*Yanayacu Biological Station and Center for Creative Studies c/o Foch 721 y Amazonas, Quito, Ecuador.**Autor para correspondencia/Corresponding author, e-mail: jport@bethel.edu

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**Observaciones del comportamiento parental de la Elenia Ventriamarilla *Elaenia flavogaster subpagana*
(Tyrannidae)****Resumen**

Observamos tres nidos de Elenia Ventriamarilla *Elaenia flavogaster subpagana* en La Selva, Costa Rica, uno de ellos con un solo pichón, observado por 21 h para documentar los comportamientos de incubación, crianza y alimentación. Cuantificamos el número de visitas por h por polluelo, las observaciones de traspaso de alimento y extracción del saco fecal, y podemos confirmar que dos adultos alimentaron a los polluelos. Los adultos visitaron el nido un promedio de $4,9 \pm 0,6$ h/polluelo. Observamos 18 eventos de alimentación entre los adultos. También observamos cinco casos de transferencia de alimentos del adulto que regresaba hacia el adulto que empollaba y finalmente al pichón. Los ítems alimenticios incluyeron Diptera, Coleoptera, Phasmatodea, Hymenoptera, Araneae y bayas.

Palabras clave: alimentación, Costa Rica, *Elaenia*, pichón, cuidado parental.**Abstract**

We observed three nests of Yellow-bellied Elaenia *Elaenia flavogaster subpagana* in La Selva, Costa Rica. One nest had a single nestling, which was observed for 21 h in order to document incubation, breeding and feeding behaviors. We quantified number of visits per h to the nestling, as well as food transfer events and fecal sac removal, and confirmed that two parents fed the nestling. Adults visited the nest 4.9 ± 0.6 h/nestling on average. We observed 18 feeding events between adults, and five food transfer episodes of the incoming adult to the incubating adult, and then to the nestling. Food items brought to the nest included Diptera, Coleoptera, Phasmatodea, Hymenoptera, Araneae and berries.

Keywords: Costa Rica, *Elaenia*, feeding, nestling, parental care.**INTRODUCTION**

Elaenia is a widespread tyrannid genus of tropical America represented by some 20 species. The Yellow-bellied Elaenia *Elaenia flavogaster* is a medium sized (16–17 cm; 21–29 g), widespread bird found from the southeastern parts of Mexico to northeastern Argentina (Hosner & Kirwan, 2019). Four subspecies are recognized, with *E. f. subpagana* (Brodkorb, 1943) found north of Panama to south-east Mexico (Hosner & Kirwan, 2019).

Elaenia flavogaster is relatively conspicuous, perching in the open and vocalizing frequently (Fitzpatrick *et al.*, 2004). It inhabits a variety of woodland habitats as well as scrub and savanna, but generally not dense forest, and feeds on fruit and insects (Crowell, 1968). It has been reported feeding its nestlings both berries and small insects (Skutch, 1960) and both sexes are known to contribute to nest construction and parental care (Skutch, 1960; Stutchbury *et al.*, 2007), but little additional work has been done on parental roles during reproduction. Adults are monomorphic in plumage, making it difficult to distinguish between sexes.

They are reported to live in pairs year-round and defend territories (French, 1991; Stutchbury *et al.*, 2007). Nests are compact, shallow cups built in a bifurcation or trifurcation of a horizontal, ascending, or erect branch, which may be either thin or thick (Skutch, 1960; Sherry, 1984; Chatellenaz & Ferraro, 2000). Firm, soft nest walls are composed of fine rootlets, vegetable fibers, bits of herbaceous stems and other fragments of vegetation, and lined with feathers and bark and held together with cobweb (Skutch, 1960; Fitzpatrick, 2004). Clutch size consists of two creamy white eggs, rarely one or three, and typically laid 2 days apart (Skutch, 1960). This study provides important observations on the frequency and duration of parental visitation during incubation and brooding, as well as limited identification of food items brought to the nestlings and observations on parental care.

METHODS

We studied nests of *Elaenia flavogaster* in the vicinity La Selva Biological Station, Puerto Viejo de Sarapiquí, Costa Rica (10.4220, -84.0150, 80 m a.s.l.) during March and April 2011. At one nest we recorded, at various intervals, the details of parental care during incubation and brood rearing, using a camouflaged video camera set on a tripod about 5 m from the nest. Mean time on nest and number of daily visits are reported as mean \pm standard error (SE). Egg dimensions are given to the nearest 0.1 mm and weight to the nearest 0.01 g. We describe nestling growth and feather development following the terminology in Proctor & Lynch (1993).

RESULTS

A single nest was followed intermittently from nest construction through successful fledging, with a total of 2.8 h recorded during incubation, and 18.4 h recorded during the nestling period, all between 06h00–14h00 local time. Two additional nests, with two eggs each, were located and eggs were measured and weighed. Incubation at the single observed nest was 15–16 days and fledging occurred at 14 days.

Nest

Nests were built at heights of 1.2–4.8 m (N = 3), all saddled over horizontal branches smaller in diameter than the nest. Nests were composed of leaf rachides, leaves, and bits of flexible fibers, bound together with spiderwebs into a compact, fairly shallow cup. They were thinly lined with seed down, lepidopteran cocoons, and a few feathers. The inner lining was the last portion completed prior to laying of the eggs, though in some cases additional feathers were added during early incubation. Nests took between 3–5 days to complete and appeared to be constructed by only one individual, presumably the female, as this is the pattern typical of this species described by Skutch (1960).

Eggs and incubation

Egg measurements were taken from three nests (Table 1) within 1–2 days of laying. Fresh eggs had an average weight of 3.05 ± 0.13 g and measured $22.18 \pm 0.25 \times 16.16 \pm 0.25$ mm (N = 5). One nest was observed during early and mid-incubation for 2.8 h. On-bouts averaged 10.1 ± 4.2 min (N = 4) with off-bouts 8.2 ± 4.5 min (N = 3) and nest attendance was 56% overall. Only one adult was observed at the nest during incubation and, as we could not distinguish between the sexes, we can only presume that this was the female, as is well documented for other tyrannids (Fitzpatrick *et al.*, 2004).

Table 1: Egg measurements collected from three Yellow-bellied Elaenia *Elaenia flavogaster subpagana* nests in La Selva, Costa Rica in March–April 2011.

Nest	Weight (g)	Dimensions (mm)	
		length	width
1- Egg 1	3.29	22.2	16.7
Egg 2	3.43	22.7	16.8
2- Egg 1	2.93	22.6	16.0
Egg 2	2.77	22.1	15.8
3- Egg 1	2.81	21.3	15.5
Mean	3.05 ± 0.13	22.18 ± 0.25	16.16 ± 0.25

Nestling development

One nest with a single nestling was measured during development, with the nestling weighed periodically until close to fledging. At hatching (weight = 3.3 g; Fig. 1), the nestling was pink skinned with a slightly orange cast. The tarsi and feet were similar in coloration, with white nails. The bill was dull yellow, the maxilla washed with dusky grey and bearing a small white egg-tooth. The gape was bright yellow and the mouth lining was bright orange-yellow. Dorsally, the nestling bore short, bright white tufts of natal down on the capital, spinal, femoral, curial, and alar tracts. Below, down coloration was similar, though sparser, and present on the cervical, submalar, ventral sternal, and ventral abdominal tracts. On all feather tracts, but especially on the capital and spinal tracts, individual nessoftiles were slightly more plumose basally, creating an overall spotted look to the nestling.

Two days later (weight = 5.8 g; Fig. 1), its appearance had changed little, but the bill had become more yellow, with reduced dusky coloration on the maxilla. The tarsi, and especially the toes, had become more yellowish. At 4 days old (weight = 9.2 g; Fig. 1) the nestling still had no visible contour feather development dorsally, but primaries and rectrices had just begun to emerge through the skin, and ventrally the emerging tips of contour feathers along the ventral sternal tract were visible as tiny white spots. The eyes remained closed. The most distinct visible change was a darkening of the skin dorsally, the dark reddish grey skin strongly contrasting with the dorsal down tufts. By 6 days of age (weight = 12.7 g; Fig. 1), nestling primaries had emerged through the skin c. 4–5 mm, secondary pins were emerged 2–3 mm, and wing coverts were 1–2 mm long. The rectrices had also emerged only 1–2 mm. Contour feathers were just emerging through the skin, whitish dorsally and yellowish ventrally. After this point, nestling feather development progressed much more rapidly. Eyes began opening between day 5 and 6, and feathers of the wing and tail ruptured their sheaths around day 8. By day 10 (weight = 15.8 g; Fig. 1), most contour feathers had broken their sheaths about 0.5 mm, with the exception of the capital tracts, which remained unbroken. Dorsally, contour feathers were olivaceous brown, ventrally they were olivaceous on the ventral sternal tracts, and bright yellow on the lower breast and abdomen. The bright white tufts of natal down remained along all feather tracts. The buffy tips of emerging wing coverts were beginning to form two visible wing bars. The bill was now largely dusky pink, darker along the culmen. The gape, the very tips of the mandible and maxilla, and the mandibular tomia remained bright yellow. The mouth lining had darkened to deep reddish orange, and the egg tooth was still attached.

By day 12 (mean weight = 17.3 g; Fig. 1), the nestling was well feathered, with coloration similar to that of 10-day-old nestlings. Natal down tufts had largely broken from the tips of emerging contour feathers, remaining only on some feathers of the capital and ventral abdominal tracts. The tips of the wing coverts were buffy white, forming two distinct wing bars. The tips and outer margins of the flight feathers and rectrices were buff. The basal halves of the secondary flight feathers and rectrices were still sheathed, as were the basal 1/3–1/4 portions of the primaries. The bill had become mostly black, contrasting strongly with the yellow gape and tomia of the mandible. The egg tooth remained attached. Eyes were now fully open and the nestling was now very alert, preening itself while alone in the nest and crouching low into the nest at the approach of observers. To avoid force-fledging young, it was not handled after 12 days of age. It left the nest with olive brown upperparts, no coronal patch, distinctly buffy wing bars, and tail about half the length of fully adult birds, generally similar to the description of immature birds given by Hosner & Kirwan (2019). At one nest, fledging occurred 14 days after hatching.

Parental care and feeding behavior

Behavioral observations were made at one nest on 2 days; the day of hatch (7.88 h) and day 5 post-hatch (10.43 h). Two individuals were observed simultaneously at the nest during brooding and feeding, although identification of individuals or sex was not possible. By day 5, one adult spent most of the time shading the nestling rather than brooding due to the exposed location of the nest and warm conditions. The average visit duration during the observed period was 12.7 ± 1.6 min ($N = 174$), with adults visiting the nest between 3 and 18 times per h to feed the single nestling. We observed 36 feeding events on the day of hatch (mean 4.5 ± 1.1 times/nestling/h) and 72 feedings on day 5 (mean 6.9 ± 0.7 times/nestling/h) (Table 2). There were 51 visits where the adult only brooded the nestling and an additional 15 visits where an adult visited but neither brooded nor fed. Nest attendance averaged 74% during the days observed after hatch.

While we could not confirm identity of the adults, one individual appeared to remain on the nest more frequently than the other. The second adult was observed bringing food items to the nest and either feeding the nestling directly or transferring the food item to the brooding adult (*i.e.*, allofeeding). In five of 106 feeding visits (4.7%),

the food item was transferred to the brooding adult before being fed to the nestling. In addition, on 18 occasions (16.9%) allofeeding occurred with the food ingested by the brooding adult rather than being fed to the nestling.

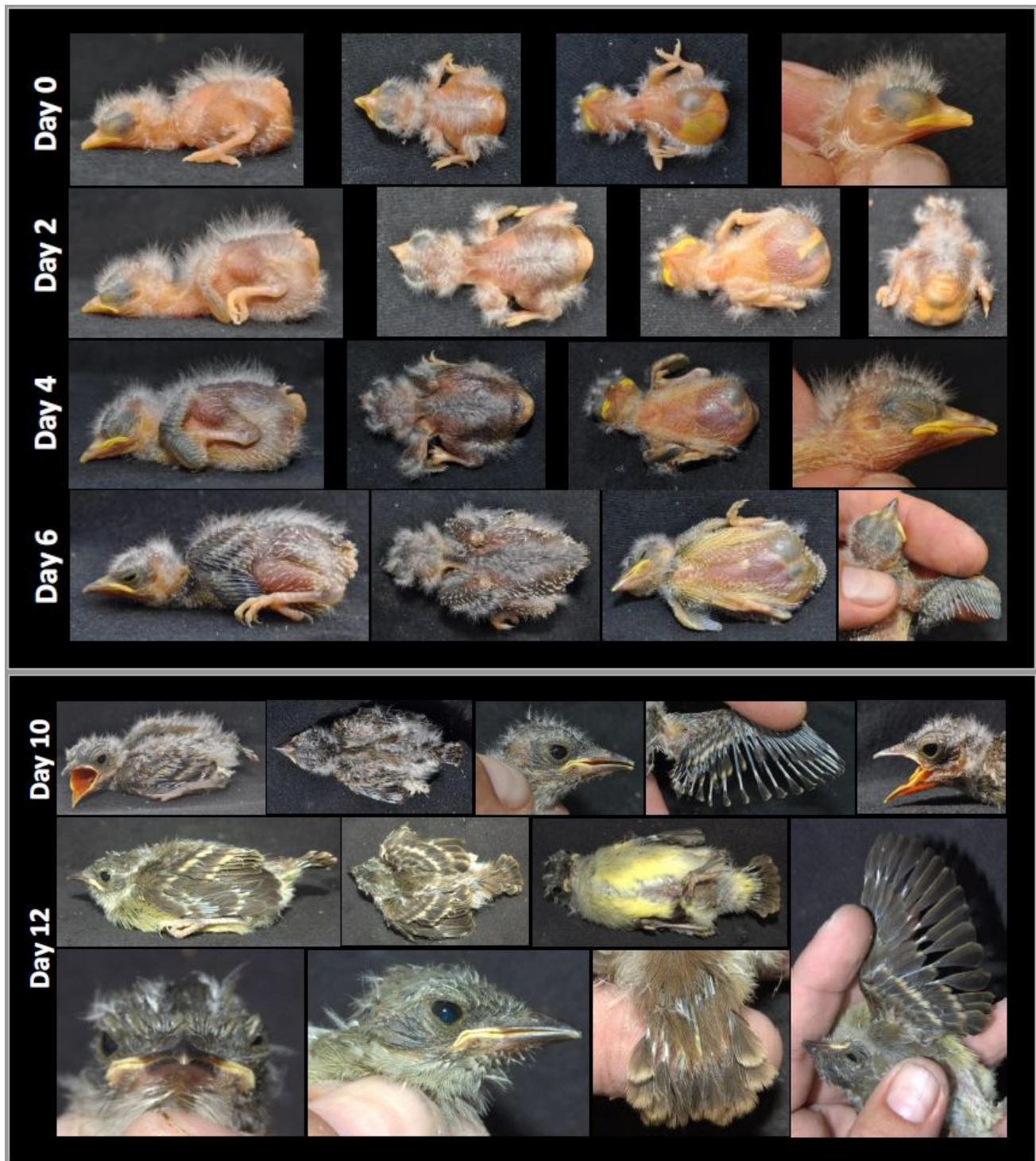


Figure 1: Growth and feather development of Yellow-bellied Elaenia *Elaenia flavogaster subpagana* at La Selva Biological Station, Costa Rica, in March–April 2011.

Food items

Most items brought to the nest were not identifiable due to the small size, condition of the item or video quality. A small percent of items was identified, and included invertebrates (Diptera, Coleoptera, Phasmatodea, Hymenoptera, and Araneae) and several types of berries. At least one bullet ant (*Paraponera clavata*) was fed to the nestling. On one occasion an adult was observed attempting to feed a berry to the nestling nine times over

the span of 40 s. The adult would place the berry in the nestling's mouth, remove it, replace it and then remove it again when the nestling had difficulty swallowing the item. Finally, the adult swallowed the berry and departed from the nest.

Table 2: Average number of feeding visits per h by two adult Yellow-bellied Elaenias *Elaenia flavogaster* near La Selva, Costa Rica during two days of nest attendance. Data from 18.4 h of observations that took place between 06h00–17h00 each day in March–April 2011.

Time of day	Feeding visits/h (mean)
06h00	4.5
07h00	7
08h00	2.5
09h00	7.5
10h00	5
11h00	3.5
12h00	6.5
13h00	7
14h00	7
15h00	10
16h00	4
Mean	5.9 ± 0.6

Nest maintenance behavior

Nest maintenance by removing fecal material was observed on 27 occasions (mean = 2.5 ± 0.2 /nestling/h). Adults ingested fecal sacs at the nest, often immediately after feeding the nestling. On other occasions, while one adult fed, the other adult ingested the fecal sac. Removal of the fecal material from the nest location was not observed.

DISCUSSION

This study adds to our understanding of *Elaenia flavogaster* nestling growth and parental behavior, including visit duration during incubation and brooding, feeding behaviors, and fecal sac removal. Biparental care occurs in this species, with both parents providing food to a single nestling in the nest we observed. Skutch (1960) describes both male and female provisioning a single nestling at a rate of 11–12 times/h for a nestling of comparable age, and elsewhere notes rates between 4–20 times/h (Skutch, 1947). Our rates were comparable to those described by Skutch, with as many as 18 visits/h when the nestling was 5 days old. We were unable to identify the sex of the adults at our nest, but circumstantial evidence suggests that female incubated and brooded, as described by Skutch (1960). One of the individuals appeared to stay at the nest in the days following hatch while the other (the putative male) would bring food items and depart. Nest attendance increased during brooding compared to incubation, with longer and more frequent bouts.

Elaenia species have been described as largely frugivorous (Foster, 1987), while *E. flavogaster* has been reported consuming *Cecropia* catkins (Oniki *et al.*, 1994) and had 95.8% fruit by volume in their stomachs, comprising a wide variety of seeds and fruits like *Conostegia*, *Ficus*, *Hampea*, *Viburnum*, and *Sapium* sp. (Marini & Cavalcanti, 1998). We observed adults feeding a variety of berries to the nestling. In addition, we documented a variety of invertebrates, including insects and spiders, fed to the nestling, although the identified items represented only a small percentage of the total food items brought to the nest. Allofeeding and transfer feeding were common while observing this pair. While not previously documented for *E. flavogaster*, allofeeding is common among highly sociable birds and has been reported in other Tyrannidae (Fitzpatrick *et al.*, 2004), as well as in Old World flycatchers (*e.g.*, Narcissus Flycatcher *Ficedula narcissina*; Wang *et al.*, 2008). Feeding during the reproductive cycle has been linked to increased nest attendance in a number of bird species (Matysioková & Remeš, 2014).

We did note a trend toward increased nest attendance during breeding compared to our observations during incubation (74% and 56%, respectively) and this may reflect the need to shield the nestlings from the sun and heat of the day. The exposed location of the nest on a horizontal branch may require higher levels of parental care compared to species nesting in more sheltered areas. Skutch (1960) noted this behavior commonly within his observations of *E. flavogaster* as well, and it may be a widespread behavioral trait, as this species has been frequently reported to nest in exposed locations.

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