

## Natural history of Streak-necked Flycatcher *Mionectes striaticollis* in north-east Ecuador

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Describimos el nido y los huevos de *Mionectes striaticollis*; así mismo la ecología de anidación y alimentación, y el comportamiento de cortejo grupal, en el noreste de Ecuador. Esta especie anida durante los meses más lluviosos de esta área. Los nidos son estructuras colgantes, alargadas, en forma de pera y con entradas a los lados, como otros nidos del mismo género. Los huevos son totalmente blancos y miden en promedio  $19.31 \pm 0.46 \times 14.25 \pm 0.30$  mm. Durante el período de incubación la cobertura diaria fue de 48–83%. En el tiempo de incubación estudiado, los padres empollaron un 72%. Durante el período de alimentación, los individuos adultos dirigieron un 25% de sus ataques a frutas y el tiempo restante a insectos; las maniobras utilizadas fueron principalmente vuelo sostenido (38%) y espiguelo (24%). Los machos adultos defienden sus territorios de apareamiento ya sea solitariamente o en grupos de 2–6 individuos.

The genus *Mionectes* is comprised of five species of small, drab flycatchers distributed throughout Central and South America<sup>11</sup>. All inhabit the lower growth of humid forest interiors and regularly join mixed-species flocks<sup>3,11,12</sup>. They are notable among tyrannid flycatchers for being highly frugivorous<sup>11,18,28</sup> and *Mionectes* is the only genus in the family known to have a lek-based mating system<sup>8,14,17,24,28</sup>.

Whilst the geographically widespread Ochre-bellied Flycatcher *M. oleagineus* is relatively well studied<sup>15,17,19–26</sup>, breeding data for other *Mionectes* are few. Nest descriptions and basic observations have been published for four of the five (*M. macconelli*, *M. oleagineus*, *M. olivaceus*, *M. rufiventris*), but not for Streak-necked Flycatcher *M. striaticollis*. Although lekking behavior has been described for Streak-necked Flycatcher<sup>6</sup>, the only information concerning its nesting ecology is from eggs collected in Colombia<sup>13</sup>. Based on observations at ten nests, we describe the nests, eggs and incubation behaviour of adults. We also present information on adult measurements, lekking behaviour and foraging ecology.

### Materials and methods

Observations were made in the vicinity of Cabañas San Isidro and Yanayacu Biological Station & Center for Creative Studies (00°35'S, 77°53'W, hereafter YY), in Napo province, north-east Ecuador (elevation c.2,000 m). Land owned and protected by the Bustamante family at San Isidro has long been a mecca for birdwatchers, and San Isidro's recent generous support of biological research at adjacent YY has generated much scientific interest in the area. Large tracts of primary forest, dominated by Solanaceae, Melastomataceae, Lauraceae and Clusiaceae are

mixed with small pastures and areas dominated by *Chusquea* bamboo.

Nests and leks of Streak-necked Flycatcher were encountered and studied opportunistically during the course of field work on the natural history of butterflies and birds. They were not searched for specifically, but near-constant field work throughout the San Isidro preserve during the past three years has ensured equal effort year-round and across the various habitat types in the area. One nest was videotaped from 05h45 to 18h15, every other day, from the day the second egg was laid until the day of hatching. The camera was placed on a tripod 2 m away, and videos were watched and transcribed at a later date.

Apart from observations at nests, Streak-necked Flycatchers were mist-netted in August 2000, January 2001, March 2002 and February 2003. Nine standard morphological measurements were taken from each individual: wing-chord (relaxed, not flattened), tail-length, tarsus-length (from the intertarsal joint to the distal end of the last leg scale before the toes emerge), culmen (from the anterior end of the nares to the tip of the bill), exposed culmen (from the feather line at the base of the bill to the tip), and culmen-depth and width (both measured from the anterior end of the nares). Weight was also taken to the nearest tenth of a gram using an electronic scale. In addition, observations were made on moult and plumage, and blood samples were collected from all captured birds. Because Streak-necked Flycatcher is sexually monomorphic, determination of sex was impossible in the field. Birds caught in mist-nets at leks were sexed using a genetic method that detects a constant size difference in the CHD1 gene on the W and Z chromosome in birds<sup>4</sup>.

We collected foraging data on adults away from nests (following Remsen & Robinson<sup>10</sup>) in March–April 2002, January–February 2003 and

July–August 2003. Upon encountering a bird, we waited five seconds and then recorded the first 1–3 attack manoeuvres performed, prey type (fruit or insect) and prey substrate (if insect). At the site of the first attack observed, we also estimated the bird's height, canopy height, the bird's horizontal position in the vegetation (inner, middle or outer third), and foliage density (scale of 0–5, with 0 indicating 100% of light passing through a 1-m sphere around the bird, and 5 indicating 0%). If with a flock, we also noted the number of Streak-necked Flycatchers in the flock.

## Results

### Adult measurements, moults and appearance

We collected blood samples and morphological measurements from nine adult males and five adult females caught at YY. Mean data are presented in Fig. 1. Statistical analysis indicates that females were smaller than males in all of the characters measured except culmen-depth and width (independent *t*-test, *P* values in Fig. 1). One female caught on 4 January 2001 had a large brood patch. None of the birds caught during any of the mist-netting periods were moulting any of their feathers.

**Foraging behaviour** Although Streak-necked Flycatcher is regularly found alone, mixed-species canopy flocks at YY often contained 1–2 individuals. Streak-necked Flycatcher is typically silent when foraging, but occasionally gives a squeaky call<sup>5,7,12</sup> in conjunction with the sharper alarm call of Rufous-breasted Flycatcher *Leptopogon rufipectus*. Streak-necked Flycatchers are not exceptionally active foragers, and may perch for extended periods whilst scanning vegetation. During our observations, the species typically attacked prey by sally-hovering (38%), gleaning (24%), reaching-out or up (16%), or hanging-up or upside-down (11%); it also used sally-pouncing (5%), leaping (3%) or probing (3%) (*n*=37 attacks by 30 birds). Sallies were directed upward or upward-diagonal and were generally c.50 cm in distance. In our sample, 25% of attacks were for fruit (e.g. *Myrica pubescens* [Myricaceae] and *Miconia* spp. [Melastomataceae] berries), 42% were for insects on live leaves, 14% for insects on moss, 14% for insects on bark and 5% for insects on dead flowers. At YY, Streak-necked Flycatcher

foraged 8.1±4.2 m (mean ± SD) above ground and 9.4±5.7 m below the top canopy (*n*=28). Streak-necked Flycatchers primarily attacked prey in the outer third (68%) of foliage, in areas of moderate foliage density (mean of 2.8 on a 0–5 scale). Non-quantified observations of frugivory showed that Streak-necked Flycatchers often feed on berries of *Myrica pubescens*, *Miconia* spp. and mistletoe (Loranthaceae) in our study area.

**Leks and territorial behaviour** Male Streak-necked Flycatchers at YY defend display territories either solitarily or in leks of 2–6 males. Leks have been observed on several occasions and the vocalisation of males at these sites has been previously recorded<sup>7</sup>. While lekking, territorial males sing continuously throughout the morning from perches 1–6 m above ground. The song, a series of rhythmic and squeaky notes, is very similar to that given by lekking Tawny-bellied Hermits *Phaethornis sylvatophorus*, and was originally labeled so on Moore & Lysinger<sup>7</sup>, but has been corrected in later editions (M. Lysinger pers. comm.). While singing, territorial males snap their head rapidly sideways with each song unit. As observed by Miller<sup>6</sup> in singing birds in Colombia, the bill swings both sharply to the side and upward with each stroke, in synchrony with the song units. Wing-flicking or twitching often occurs in conjunction with this sideways movement of the head.

Two leks were observed in the vicinity of YY. The first was discovered on 9 January 2001 and was located in a small patch of second-growth forest beside the Cosanga River. This site had relatively little vegetation below 1 m, but did contain a dense tangle of vines 2–3 m high. Six territorial males were caught and banded within c.0.5 ha, and there were at least two other males singing in the area that evaded capture. The second lek was located in dense vegetation beside the access road to YY, at the top of a steep ravine with a small stream at the bottom. Only two individuals were heard singing at this location, one c.3 m from the road and one further down the slope, out of sight from but within hearing range of the first. Only one, a male, was caught at this lek.

In both leks, males displayed on small territories (10–30 m wide) within hearing range of one another. Within their territories, males used

Figure 1. Male and female morphometric data from adult *Mionectes striaticollis* caught at Yanayacu Biological Station, Ecuador. Numbers are mean ± standard deviation. *P* values are from independent sample *t*-tests. Birds were sexed using a molecular sexing technique as described in the text.

Sex (N)	Weight (g)	Wing (mm)	Tail (mm)	Tarsus (mm)	Culmen (mm)	Depth (mm)	Width (mm)
♂ (9)	15.1±0.7	67.6±1.5	52.7±1.9	17.8±0.3	8.5±0.3	3.8±0.1	4.3±0.6
♀ (5)	13.3±1.2	62.5±3.1	49.7±2.0	16.8±0.7	8.1±0.2	3.5±0.3	4.2±0.3
<i>P</i>	<0.003	<0.001	<0.015	<0.002	<0.050	<0.078	<0.640

many perches, singing on one perch for 0.5–2.0 minutes, then making a swift direct flight to a new perch, commencing to sing and twitching their wings immediately upon landing. Males appeared to follow regular pathways through their territories. Territory owners responded aggressively to intruders, immediately chasing the intruder from the territory. Birds also responded aggressively to playback of either their own song, a neighbour's song or a stranger's song. In a typical response to playback, the territory owner first increased its singing rate. As playback continued, the bird stopped singing or sang a muted song, while flying between a series of perches throughout the territory and eventually flying directly toward, and perching near, the playback speaker.

**Nests** These are pendant, elongate, pyriform structures with a side entrance (Fig. 2). The egg chamber is a tightly woven ball of moss and plant fibres, suspended in a mass of living moss attached to a pendent vine above, and usually hanging loosely below. Egg cups were lined with soft seed down, dry moss and pale fibres. The entrance is roughly centrally located on the side of the egg chamber and is often, but not always, slightly hooded. Usually a few strands of hanging moss obscure the view of the opening. Three nests were measured to the nearest 0.5 cm and mean measurements were: total nest height 46.5 cm, max. width 15.5 cm, egg chamber outside height 15 cm, egg chamber outside depth 15 cm, entrance max. width 5 cm, entrance max. height 4 cm, egg cup diameter 5 cm, egg cup depth 4 cm, egg chamber inside max. height 9 cm, pendant tail of moss hanging below egg chamber 13.5 cm, and upper 'inverted tail' of moss above egg chamber 16.5 cm. Nests were suspended from thin vines, rootlets, drooping twigs or other such fragile attachment points. Often the vine or rootlet was connected to more substantial substrate (i.e. the ground) both above and below the attachment point of the nest. Nests ranged in height from 0.8 to 3.0 m above ground, averaging ( $\pm$  SD)  $1.4 \pm 0.6$  m and were found hidden inside tangles of vegetation as well as in more exposed sites.

All nests were located within 5 m of streams and five were suspended directly over water. Nests were found along small, 1–3 m-wide streams, as well as larger, 10–40 m-wide rivers. All but one were located inside relatively intact, moss- and epiphyte-laden forest with canopy height of 15–25 m and characterised by a relatively dense understorey of *Cyathea* spp. (Cyatheaceae) tree ferns, other fern genera, various Rubiaceae and Solanaceae saplings, and a variety of herbaceous Piperaceae, Gesneriaceae and Urticaceae. A single nest was found in highly disturbed forest, lacking canopy cover, but covered by a dense stand of bamboo (*Chusquea* sp.) averaging 3 m in height. No



Figure 2 (left). Nest of Streak-necked Flycatcher *Mionectes striaticollis* at Yanayacu Biological Station, Napo province, Ecuador (H. F. Greeney)

nesting activity for this species has been confirmed away from streams.

**Eggs** All observed eggs ( $n=17$ ) were uniform white. When fresh, eggs had a distinct orange cast due to the thinness of the shell, but became pure white within 3–4 days. Eggs remained wet looking and slightly sticky for c.8 hours after being laid. They ranged from 18.5–20.1 mm in length and 13.9–15.0 mm in width. Mean measurements ( $\pm$  SD) for 14 eggs were  $19.31 \pm 0.46 \times 14.25 \pm 0.30$  mm. Eggs weighed whilst still fresh (i.e. still orange-tinged,  $n=5$ ) averaged  $2.038 \pm 0.024$  g. Clutch size was usually three, occasionally two, and the mean of seven nests was 2.7.

**Egg laying and incubation** We did not observe an entire clutch being laid but once the second and third eggs were laid one day apart. At this nest, the second egg was laid between 06h45 and 07h15. Incubation period at one nest was 19 days from the

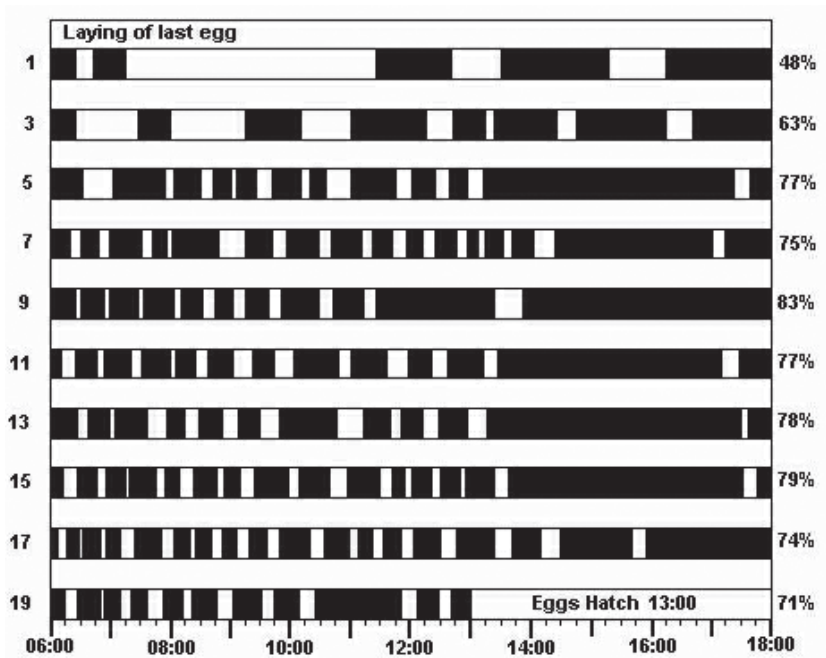


Figure 3. Incubation patterns at one nest of Streak-necked Flycatcher *Mionectes striaticollis*. Solid areas show adult presence at the nest. Numbers on left represent the day of incubation (as measured from the laying of the last egg). Percentages on right represent total coverage of the egg from 06h00 to 18h00. Time of day given below.

laying of the last egg to synchronous hatching of the entire clutch.

At the videotaped nest, incubation rhythms were recorded every other day beginning the day after laying of the final (third) egg (day 1 of incubation), through the day of hatching of the entire clutch (day 19) (see Fig. 3). Results are presented for the period from 06h00–18h00 (daylight hours). Throughout the incubation period, daily coverage was 48–83%. Coverage across the entire study period was 72%.

The general pattern was for the adult to leave the nest for the first time between 06h00 and 06h30 and to return for the last time between 17h30 and 18h00. Days 1 and 3 were characterised by fewer (4–7) but longer on- and off-bouts. Days 5–17 were characterised by more (8–17) and shorter on- and off-bouts in mornings, with an extended on-bout late afternoon (159–252 minutes). For the entire study period, 104 on-bouts lasted 11–252 minutes and 112 off-bouts 4–250 minutes. They averaged  $42 \pm 51$  and  $17 \pm 25$  minutes respectively. After day 3, however, the longest period the eggs were unattended was 31 minutes and periods of recess lasted an average  $13 \pm 5$  minutes. For days 1 and 3 the average period of attendance was  $63 \pm 28$  minutes and for days 5–19 the average was  $41 \pm 55$  minutes.

Adults are generally silent around the nest, but if flushed may give one or two alarm calls before disappearing into the undergrowth. If approaching a nest when an observer is present, the adults generally stay low to the ground in dense vegetation and remain silent whilst maintaining a distance of at least 3 m from the observer. Whilst incubating eggs, adults generally stay in the nest until the observer is 1–2 m away, and often will not flush even if the nest is gently tapped or wiggled, provided the observer is invisible to the incubating adult. When approaching a nest with eggs, adults skulk low to the ground, remaining well concealed in thick vegetation, until they are within several metres of the nest. At this point they fly directly into the nest, pausing only briefly on the rim of the opening. When departing the nest they generally make a direct flight of at least 5 m and then perch in an exposed location 1–5 m above ground.

**Seasonality and nesting success** We were able to follow five nests to their eventual outcome. In three of the four nests which were found with eggs, the clutches disappeared and only the fourth was successful, eventually fledging two young. The fifth nest was discovered with three older nestlings that fledged successfully.



Generally, we found that nesting coincides with the wetter months at YY. A single nest was found under construction in June and nests where laying was in progress were found in early May (one) and early March (one). Nests with incubating birds were found in February (two) and April (three), and nests containing nestlings were found in May (one) and February (one). This would make breeding activity in the area extend roughly January–August, peaking around April.

## Discussion

Overall, the nest, eggs and nesting behaviour of Streak-necked Flycatcher are consistent with those of other *Mionectes*<sup>2,15,17,27,28</sup>. Moss is described as the most common material found covering nests in all congeners, and the nest of Streak-necked Flycatcher is no exception. Also like other *Mionectes*<sup>1</sup>, breeding by Streak-necked Flycatcher coincides with local peaks in rainfall.

Foraging behaviour of Streak-necked Flycatcher in Ecuadorian subtropical forest was generally similar to, but differed in some important ways from, that described for the species in Bolivian temperate forest<sup>9</sup>. For example, use of the sally-hover (=hover-glean) and hanging attack manoeuvres were relatively similar in Ecuador (sally-hover 38%; hanging 11%) and Bolivia (33%; 11%; Remsen<sup>9</sup>). Birds in Bolivia, however, used gleaning (=picking) for 56% of attacks, compared to 24% in Ecuador. This may be associated with differences in frugivory observed in the two sites. Of 18 attacks observed in Bolivia, 94% were for fruit and 6% were for insects on live foliage<sup>9</sup>, whilst in Ecuador 25% of attacks were for fruit and 42% for insects on live foliage. Frugivory and insectivory in Streak-necked Flycatchers may vary with the breeding season, which could explain part of the variation in foraging ecology between Ecuadorian and Bolivian sites. Many of the foraging data from Ecuador were collected in the breeding season. If the species is more frugivorous when not breeding, and if data from Bolivia were collected during the non-breeding season, the differences outlined above may be expected.

*Mionectes* are unique amongst New World flycatchers (Tyrannidae) in being highly frugivorous and for their lek-based mating system. Lekking behaviour has now been described in four of the five species in this genus: *M. oleagineus*, *M. rufiventris*, *M. macconelli* and, in this paper, *M. striaticollis*<sup>17,21,28</sup>. All four have some males that display in leks and some that maintain solitary territories throughout the breeding season, although some species appear to have a higher percentage of lone males than others<sup>8</sup>. Westcott & Smith<sup>24</sup> referred to this type of breeding system as lekking with variable male display spacing. Our observations indicate that the breeding system of

Streak-necked Flycatcher meets this description, with some males displaying solitary and others in leks of 2–6 males. Within leks, males display from perches 1–3 m above ground, similar to Grey-hooded Flycatcher *M. rufiventris* and Ochre-bellied Flycatcher. Studies of other species of *Mionectes* have described specific behavioural displays performed at leks by territorial males such as the 'jump display' and 'tail-cocked display' of Grey-hooded Flycatcher<sup>8</sup> and the 'hovering display' of Ochre-bellied Flycatcher<sup>24</sup>. Although specific flight displays were not observed during our opportunistic observations of leks of Streak-necked Flycatcher, more detailed studies at leks of this species may reveal such flight displays.

Whilst Streak-necked Flycatcher is not sexually dimorphic by plumage, in other *Mionectes* only the female partakes in nesting activities<sup>15,16,27,28</sup>. This has not been confirmed for Streak-necked Flycatcher but, as it also forms leks and only one adult has ever been observed attending a nest, we presume that adults attending nests were females.

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