Nest architecture and placement of three manakin species in lowland Ecuador

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El conocimiento sobre los hábitat de reproducción de muchas especies tropicales es limitado. En particular, la biología de anidación de varias especies de la familia Pipridae, conocida por sus característicos despliegues de machos en asambleas de cortejo, es poco conocida. Aquí proporcionamos descripciones y comparamos la arquitectura de nidos y lugares de anidación utilizados por tres especies de saltarines: Saltarín Cola de Alambre *Pipra filicauda*, Saltarín Coroniblanco *P. pipra* y Saltarín Coroniazul *Lepidothrix coronata*, presentes en la Amazonia baja del Ecuador. Encontramos 76 nidos de *P. filicauda*, 13 nidos de *P. pipra y* 41 nidos de *L. coronata*. Los resultados indican que *P. filicauda* y *L. coronata* usan hábitat similares para anidar (flancos o crestas de quebradas pequeñas), mientras que *P. pipra* tiende a anidar en sitios relativamente abiertos rodeados por sotobosque más denso. Las tres especies construyen nidos pequeños, poco profundos, los cuales, a pesar de ser similares, son distinguibles debido a sus componentes estructurales y características de ubicación. Este estudio contribuye a nuestro conocimiento sobre los hábitos de anidación de la avifauna tropical.

Manakins (Pipridae) are widespread throughout warm and humid regions of Central and South America[4,10,14], but reach their greatest diversity in lowland Amazonia where up to eight species may occur in sympatry[1,4,14]. Manakins are small, understorey and subcanopy frugivores characterised by having short tails, chunky bodies and small bills[14]. Males of many species are well known for their colourful plumages and complex displays performed at leks. Females possess duller plumages and are entirely responsible for nest building and rearing the young.

Current knowledge of manakin nesting behaviour is based on detailed nest descriptions and female behaviour at the nest of relatively few species[2,3,6,12,14,16]. Described manakin nests are small flattened cups suspended between horizontal forks of low shrubs and trees. Nests are generally well camouflaged using a variety of materials including moss, dead leaves or palm fibres, and possess internal linings consisting primarily of fungal rhizomorphs[4,14]. The breeding season, where known, occupies up to six months, during either the dry or wet season according to locality[14,15]. In lowland Ecuador, manakins generally breed during the drier months and females of all three study species have been observed to make repeated nesting attempts within a single season (all authors pers. obs.).

Here we provide basic nest descriptions for three sympatric manakin species (Wire-tailed Manakin *Pipra filicauda*, White-crowned Manakin *P. pipra* and Blue-crowned Manakin *Lepidothrix coronata*) from a site in lowland eastern Ecuador. Nests of all three have previously been mentioned or described from other localities (e.g., *P. filicauda* from Venezuela and Brazil[11,12], *P. pipra* from French Guiana[16], and *L. coronata* from Central America[13]). There is no published information, however, on the nesting biology of these three species in Ecuador and, due to observed geographic variation, such data are valuable. Furthermore, little is known concerning how syntopic species differ in nest architecture attributes (e.g., nest structure and size), nest placement (e.g., height and distance to stem), and nest habitat utilisation. Here we compare and contrast nest architecture, placement and habitat use of three syntopic manakins in eastern Ecuador.

Methods

The study was conducted between December 2003 and March 2006 at Tiputini Biodiversity Station (TBS, 00º38'S 76º08'W), prov. Orellana, eastern Ecuador. TBS is a 650-ha biological station at c.200 m elevation within the greater Yasuní Biosphere Reserve. TBS is dominated by primary *terra firme* forest and seasonally inundated *várzea* (see Loiselle *et al*.[5] for a detailed site description).

Nests were located by systematically searching two 100-ha study plots as well as around known lek sites away from the study plots. Systematic nest searching was supplemented by following radio-tagged females to their nests[15]. Radio transmitters (Holohil Systems Ltd.) weighing 0.54–0.70 g (models BD-2N and BD-2; <5% of the bird's body weight) were attached using a Rappole harness[9].

Nests were monitored until fledging or failure, after which we measured nest attributes[7,8]. All nest measurements were taken using callipers, a metric ruler, metre tape, compass and dbh tape. Nest height was measured in metres from the rim of the nest to the forest floor. Distance to stem was measured to the nearest 1 cm from the anterior portion of the nest to the nearest large stem, which in most instances was the bole of the host plant. Number of contacts was recorded as the number of other non-host plants or lianas touching the nest tree. Overall height of the support plant was measured or approximated in metres from the top of the host plant crown. Plant dbh was measured in cm. Because nests were rarely perfectly round, we took two external and internal measurements to the nearest 1 cm, one along the axis of the supporting branch and the other perpendicular to the supporting branch. Nest depth was measured in cm from the bottom of the cup to the nest rim.

To compare nest characteristics and placement across species, we ran a Kruskal-Wallis rank sum test due to the non-normality of the data. For variables with significant effects, we performed a post-hoc Tukey-Kramer HSD test to determine which species were significantly different.

Results

General habitat utilisation

We found and characterised a total of 130 manakin nests (76 *P. filicauda*, 13 *P. pipra*, 41 *L. coronata*). In general, nests of the three species tended to be in relatively open forest with variable understorey vegetation density. *P. filicauda* and *L. coronata* exhibited significant overlap in nesting habitat use and were often found nesting beside or at the crest of small ravines which flow seasonally with run-off. *P. filicauda* uses open understorey dominated by *Rinorea* (Violaceae) treelets, whereas *L. coronata* requires low shrubs because of its low nest height preferences. *P. pipra* generally nests in open forest with denser surrounding understorey vegetation than the other two species; on six occasions nests were adjacent to canopy light gaps or treefall gaps.

Nest descriptions

Pipra filicauda.—Open shallow cup, typically in a horizontal fork; several nests were constructed with single dead branches as part of the fork (Fig. 1a). Nest is internally lined with dark brown to black rhizomorphs, which may re-sprout after the nest has been inactive for c.7–10 days. The outside of the nest cup comprises whole dead leaves with an occasional live moss. One nest in moss-laden inundated forest had the external lining entirely of moss, but this seems exceptional. Nesting material is bound together and attached to the external fork using spiderwebs. Supporting plants were trees and treelets of *Rinorea viridifolia*, *R. lindeniana* and *R. apiculata* (Violaceae), but also of several other families and genera including *Psychotria*, *Rudgea* and *Ixora* (Rubiaceae), *Sorocea* (Moraceae) and *Neea* (Nyctaginaceae).

Table 1. Nest measurements for three manakin species at Tiputini Biodiversity Station, Ecuador. Values are mean ± SD, with range between parentheses. DBH measurements for *L. coronata* were not taken due to the short stature of trees and shrubs utilised.

	L. coronata	*P. filicauda*	*P. pipra*
Nest height (m)	0.6 ± 0.2 (0.4–1.9) *n*=41	2.4 ± 1.4 (0.9–8.4) *n*=76	4.3 ± 2.4 (1.9–9.8) *n*=13
Distance to central stem (cm)	16.4 ± 0.2 (0–100) *n*=41	61.7 ± 45.0 (2.5–157.0) *n*=58	92.8 ± 34.0 (50–150) *n*=11
Number of contacts [a]	1.9 ± 1.6 (0–7) *n*=41	3.4 ± 2.6 (0–11) *n*=59	6.0 ± 2.1 (3–9) *n*=11
Plant height (m)	1.0 ± 0.4 (0.5–2.4) *n*=41	3.4 ± 1.9 (1.1–25.0) *n*=60	7.5 ± 5.8 (2.1–18.4) *n*=13
Plant dbh (cm)	-	2.3 ± 1.5 (0.6–7.3) *n*=60	10.6 ± 11.8 (1.8–40) *n*=10
Diameter internal 1 (cm) [b]	4.1 ± 3.2 (3.1–4.8) *n*=41	4.6 ± 0.5 (3.7–5.7) *n*=60	4.0 ± 0.3 (3.7–4.5) *n*=6
Diameter internal 2 (cm) [c]	4.3 ± 3.4 (3.7–5.4) *n*=41	4.7 ± 0.5 (3.8–7) *n*=60	4.6 ± 0.2 (4.4–4.9) *n*=6
Diameter external 1 (cm) [b]	5.3 ± 5.0 (4.3–6.5) *n*=41	5.5 ± 0.6 (4.3–7.2) *n*=60	5.2 ± 0.7 (4.3–5.8) *n*=6
Diameter external 2 (cm) [c]	5.5 ± 5.6 (4.6–7.5) *n*=41	5.7 ± 0.6 (4.5–7.5) *n*=60	5.6 ± 0.7 (4.5–6.4) *n*=6
Depth internal (cm)	2.5 ± 0.5 (1.4–3.8) *n*=41	1.9 ± 0.5 (0.5–3.9) *n*=54	1.6 ± 0.7 (0.5–2.6) *n*=6

[a] Number of individual plants touching the plant where nest is located.
[b] Measured on a horizontal line tangent to the central stem.
[c] Measured on a horizontal line perpendicular to the central stem.

Table 2. Nest placement and architectural variation of three species of manakins (*P. filicauda*, *P. pipra* and *L. coronata*) evidenced using non-parametric Kruskal-Wallis rank sum tests. Different letters represent statistical differences among species assessed by Tukey-Kramer HSD post-hoc comparison tests.

	L. coronata	*P. filicauda*	*P. pipra*	χ_2	P
Nest height	A	B	C	64.90	<0.01
Distance to stem	A	B	B	32.87	<0.01
Number of contacts	A	B	C	17.18	<0.01
Internal diameter 1	B	A	B	27.99	<0.01
Internal diameter 2	A	B	B	16.21	<0.01
External diameter 1	A	A	A	1.52	0.47
External diameter 2	A	A	A	1.56	0.46
Depth	A	B	B	21.88	<0.01

Pipra pipra.—A small, shallow open-cup nest constructed in a horizontal fork at the end of small branches, in small to medium-sized trees (Fig. 1b). The outside of the cup comprises primarily dead leaves (whole or pieces) and, infrequently, fragments of palm fronds. The inner lining is generally of thin pale brown fibres, less frequently dark brown fibres or a mixture of both. Some nests have dead leaves hanging below the base. Nesting material is bound together and attached to the branch using spiderwebs. *P. pipra* uses supporting plants including, but not limited to, *Rinorea viridifolia* (Violaceae) and *Miconia fosteri* (Melastomataceae).

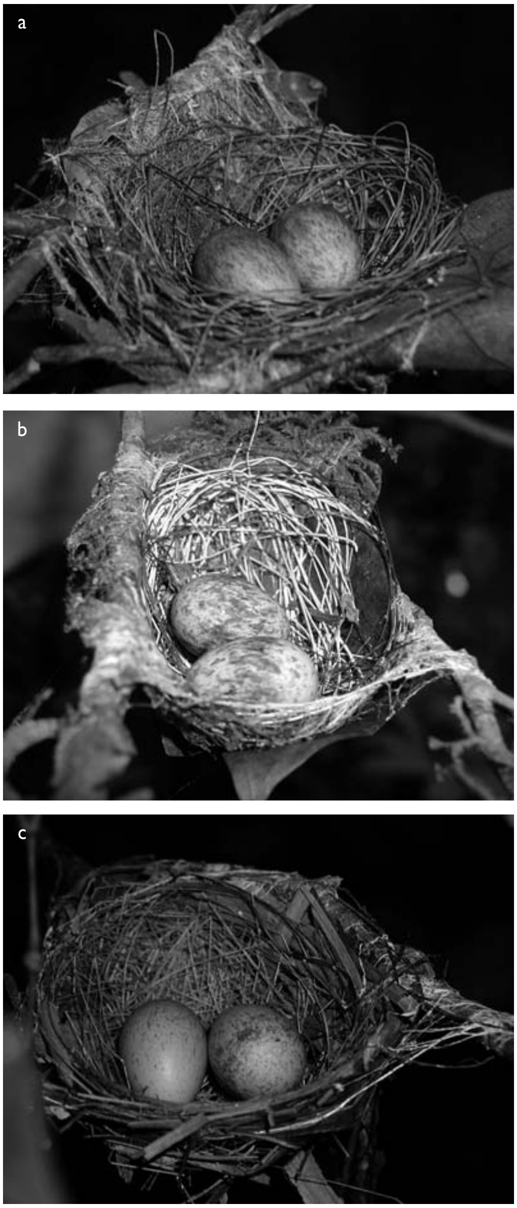

Figure 1. Visual comparison of three manakin nests and their eggs, from Tiputini Biodiversity Station, Ecuador: a) Wire-tailed Manakin *Pipra filicauda*, b) White-crowned Manakin *Pipra pipra* and c) Blue-crowned Manakin *Lepidothrix coronata*.

Lepidothrix coronata.—An open, shallow cup in a horizontal fork within small shrubs or trees (Fig. 1c). Nests are lined externally with dry strips of palm and/or non-palm dry leaves and/or bark; very infrequently also moss. The colour of the internal lining is usually pale brown, less frequently whitish or yellowish, depending on the material. In approximately two-thirds of nests, the external lining hangs slightly down, draping below the external base of the cup. Like *P. filicauda* and *P. pipra*, nest materials are bound together and attached to the supporting fork by spiderwebs. Supporting plants are primarily shrubs such as *Rudgea* spp. and *Ixora killipii* (Rubiaceae), *R. viridifolia* and *R. lindeniana* (Violaceae).

Nest comparisons among species

We found significant differences in nest height, distance to the stem, number of contacts, internal diameter and depth across species (Tables 1–2). Nest height and number of contacts, however, were the only two variables that differed significantly across all three species. Significant differences for distance to stem, internal diameter and depth were driven by one species differing from the other two (Table 2). In general, *P. filicauda* constructed nests at intermediate heights above ground, with an intermediate number of contacts and larger internal diameter, whereas nests of *P. pipra* possessed more contacts and *L. coronata* had lower, smaller, deeper nests with fewer contacts to the surrounding vegetation (Table 1).

Discussion

In general, we found that these three manakins use similar habitats for nesting, though *L. coronata* and *P. filicauda* exhibit specific preferences for relatively open habitats in ravines. In contrast, *P. pipra* preferred open areas bordered by dense vegetation and treefall gaps. That *P. pipra* prefers to nest near patches of denser vegetation corroborates previous descriptions[15]. *P. filicauda* was previously described to prefer streamside habitats and even vegetation over water[11]. We found six out of 76 nests in these habitat types, suggesting the existence of some geographic variation in nest placement preferences in this species. Finally, Skutch[13] reported *L. coronata* nesting mostly in the understorey of primary forest, less frequently in tall second growth, and only very rarely in wooded patches in earlier stages of regeneration.

Despite a certain degree of habitat overlap, the three manakins exhibited distinct vertical stratification in nest placement, *L. coronata* closer to the ground (<1 m), *P. filicauda* at intermediate heights (2.4 ± 1.4 m) and *P. pipra* in the upper understorey to low subcanopy (4.3 ± 2.4 m). Where data are comparable, height preferences appear to be maintained across geographic regions[11,16]. Supporting plants were concordant with nest heights, with *L. coronata* preferring low, flat-topped shrubs such as *Rudgea*, *P. filicauda* small treelets of the genus *Rinorea*, and *P. pipra* larger subcanopy trees. These differences in nest-site selection are further evidenced by *P. pipra* having nests with the larger distance to the central stem and using trees with the largest dbh.

The physical appearance of nests described here are similar to previous descriptions for other manakins, in particular being constructed in peripheral horizontal forks, mainly of vegetable material, fungal rhizomorphs, leaf midribs, and bound using spiderwebs[14]. Nest size correlated to female body size (*P. filicauda* 13–17 g, *P. pipra* 12–14 g, *L. coronata* 8–11 g) and varied across the three species. Thus, *P. filicauda* had the largest nest, *P. pipra* intermediate and *L. coronata* the smallest. However, nest depth did not follow the same trend: *L. coronata* constructed deeper nests than the other two species. Nest appearance was most similar between *P. pipra* and *P. filicauda* as both used leaves for external camouflage, yet the majority of nests could be differentiated by internal lining colour, as *P. filicauda* tended to use darker lining than *P. pipra*. *P. pipra* was the only species to occasionally incorporate a tail of dead leaves hanging below the nest.

To date, the natural histories of many tropical birds lack documentation, in part due to the cryptic nature of their nests and behaviour. Here, we have detailed the similarities and differences in the nesting biology, specifically habitat utilisation and nest architecture, for three common manakins. In a broader context, documentation of species-specific natural history is essential as it lays the groundwork for more comprehensive ecological and evolutionary studies. Ultimately, knowledge of species-specific habitat utilisation provides a sound basis for proactive conservation management in the face of habitat alteration and deterioration.

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