

BIRDS OF UNIVERSIDAD DE LOS LLANOS (VILLAVICENCIO, COLOMBIA): A RICH COMMUNITY AT THE ANDEAN FOOTHILLS-SAVANNA TRANSITION*

Jorge Enrique Avendaño^{1,3}, Nattaly Tejeiro-M.², Jessica Díaz-Cárdenas², Jhon Jairo Amaya-Burgos², Andrés Felipe Aponte², Natalie Gamboa², Yoliver Esmeralda José Salcedo-Sarmiento², Álvaro Javier Velásquez-Suárez² & Andrea Morales-Rozo¹

Abstract

Objectives: To conduct a bird inventory at the Barcelona campus of Universidad de los Llanos Villavicencio, Colombia, with the aim of estimating species richness, abundance and habitat associations of the local avifauna. **Scope:** Characterization of the local avian diversity and its association with different types of natural and transformed ecosystems. **Methodology:** We inventoried birds using sight and auditory records made weekly between August 2013 and August 2014, plus opportunistic observations made between 2013 and 2018. We estimated species richness using non-parametric estimates, and categorized local abundances and habitat associations based upon encounter frequencies. **Main results:** We recorded a total of 210 species (189 species through systematic observations, plus 21 recorded non-systematically). The list includes one Colombian near-endemic, 20 migrant species, and four range extensions for the Orinoco basin. The heterogeneous vegetation sustains a rich community composed mainly by species associated with urban zones, gallery forest and artificial lakes. Most species were rare and occasional, which suggests that they are visitors or maintain small populations within the campus. **Conclusions:** This study provides basic data on bird diversity of transformed ecosystems in the Orinoco basin, and highlights the importance of mosaics of savanna, forest and transformed ecosystems as refuges and stopover areas of resident and migratory birds.

Key words: Andean foothills, fragmented ecosystems, Orinoco basin, range extensions, urban birds.

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¹ Programa de Biología y Museo de Historia Natural, Universidad de los Llanos, Villavicencio, Meta, Colombia.

² Programa de Biología, Universidad de los Llanos, Villavicencio, Meta, Colombia.

³ Current address: Laboratorio de Biología Evolutiva de Vertebrados, Departamento de Ciencias Biológicas, Universidad de Los Andes, Bogotá, Colombia. E-mail: jorgeavec@gmail.com

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AVES DE LA UNIVERSIDAD DE LOS LLANOS (VILLAVICENCIO, COLOMBIA): UNA RICA COMUNIDAD EN LA TRANSICIÓN ENTRE EL PIEDEMONTE ANDINO Y LA SABANA

Resumen

Objetivos: Desarrollar el inventario de las aves del campus Barcelona de la Universidad de los Llanos, Villavicencio, Colombia, con el objeto de estimar la riqueza de especies, abundancia y asociaciones de hábitat de la avifauna local. **Alcance:** Caracterización de la diversidad aviar local y su asociación con diferentes tipos de ecosistemas naturales y transformados. **Metodología:** Inventariamos la avifauna tomando registros visuales y auditivos semanales entre agosto de 2013 y agosto de 2014, además de observaciones no sistemáticas entre 2013 y 2018. Estimamos la riqueza de especies usando estimadores no paramétricos, y categorizamos las abundancias locales y asociaciones de hábitat con base en la frecuencia de encuentros. **Principales resultados:** Registramos un total de 189 especies a través de observaciones sistemáticas, además de 21 registradas de manera no sistemática para un total de 210 especies. El listado incluye una especie casi amenazada para Colombia, 20 especies migratorias y cuatro ampliaciones de distribución para la cuenca del Orinoco colombiano. La heterogeneidad de la vegetación mantiene una rica comunidad compuesta principalmente por especies asociadas a zonas urbanas, bosque de galería y lagos artificiales. Muchas especies fueron raras y ocasionales, lo cual sugiere que son visitantes o mantienen pequeñas poblaciones dentro del campus. **Conclusiones:** Este estudio provee datos básicos sobre la diversidad de aves en ecosistemas transformados en la cuenca del Orinoco, y resalta la importancia de los mosaicos de sabana, bosque y ecosistemas transformados como refugio y áreas de parada de aves residentes y migratorias.

Palabras clave: ampliación de distribución, aves urbanas, cuenca del Orinoco, piedemonte llanero, ecosistemas fragmentados.

INTRODUCTION

The Orinoco basin covers c. 981,000 km² between Colombia and Venezuela, from which 343,350 km² (35%) are found in Colombia, representing c. 30% of the country terrestrial area (LASSO *et al.*, 2010). This region known as Eastern plains or *Llanos Orientales* is characterized by a great diversity of landscapes and ecosystems, which mainly involves different types of savannas (i.e. seasonally flooded, dry), as well as Andean, Amazonian, and Guianan forested habitats (RANGEL-CH., 2014). The Colombian Orinoco basin contains high levels of species diversity. To date there are records of 4347 species of vascular and 471 species of non-vascular plants, 685 fish species, 122 species of reptiles, 71 species of amphibians, 761 species of birds and 196 species of mammals (LASSO *et al.*, 2010; ACEVEDO-CHARRY *et al.*, 2014; MINORTA-CELY & RANGEL-CH., 2014; PARDO-MARTÍNEZ & RANGEL-CH., 2014; RINCÓN-E. *et al.*, 2014; ROMERO *et al.*, 2014; TRUJILLO-P. *et al.*, 2014). However, despite this high biological diversity, knowledge of particular

ecosystems and community dynamics is still scarce particularly due to the lack of complete or long-term inventories, which are necessary to understand the species richness and turnover of taxonomic groups across different ecosystems and subregions (LASSO *et al.*, 2010).

Birds are one of the groups comparatively better studied in the Colombian Orinoco basin (OLIVARES, 1974; HILTY & BROWN, 1986; MCNISH, 2007; ACEVEDO-CHARRY *et al.*, 2014; ACEVEDO-CHARRY, 2017). However, the few studies conducted have traditionally focused in the Andean foothills in Meta, Casanare and Arauca departments (SALAMAN *et al.*, 2002; ACEVEDO-CHARRY, 2017), whereas regions such as the alluvial and dissected plains of the Meta River watershed, the transition between the Orinoco and Amazon basins and the *Serranía de la Macarena* remains poorly studied (OLIVARES, 1962; LEMKE & GERTLER, 1978; CADENA *et al.*, 2000; ROJAS & PIRAGUA, 2000; OCAMPO-PENÚELA & ETTER, 2013; RESTREPO-CALLE *et al.*, 2014). On the other hand, although some areas like the Andean foothills in the Meta department and surroundings of Villavicencio city have historically received more attention by ornithologists, most data correspond to non-systematic observations, sporadic collection of specimens and low-sampling effort studies focused on punctual localities (MEYER DE SCHAUENSEE, 1948-52; NICÉFORO, 1945, 1947, 1948, 1955; SULLIVAN *et al.*, 2009; MURILLO-PACHECO & BONILLA-ROJAS, 2016), which restrict our understanding of the species richness and composition at smaller geographical scales.

Given the complex ecosystem diversity of the Colombian Orinoco basin, coupled with the high rate of land conversion in recent decades along the Andean foothills (SÁNCHEZ-CUERVO *et al.*, 2012), baseline data on bird communities associated to conserved and fragmented ecosystems is essential to understand local and regional patterns of species diversity, and to developing and implementing policies for conserving birds and their habitats. As an approximation of the diversity and dynamics of a bird community associated to a typical landscape of the Andean foothills-savanna transition, we present the results of a mid-term bird inventory conducted in the Barcelona campus of Universidad de los Llanos. Based on our findings, we discuss the patterns of species richness, abundance and habitat associations of the local avifauna, and document four range extensions for the Orinoco basin.

MATERIALS AND METHODS

Study site

The Barcelona campus of Universidad de los Llanos (4°04'N; 73°34'W; c. 400 m), hereon referred to as *Unillanos*, is located in the municipality of Villavicencio, Meta department, Colombia (Figure 1). It occupies c. 45 ha that corresponds to the foothills

savanna ecosystem (JARAMILLO-J & RANGEL-CH., 2014). Original habitats such as forest, savannas and wetlands were present until the establishment of a cattle farm in 1974. Since then, habitat modification increased due to the construction of buildings and crop areas. A process of assisted vegetal succession with native trees (e.g., *Jacaranda caucana*, *Tabebuia rosea*, *Hura crepitans*, *Caryodendron orinocense*, *Erythrina poeppigiana*, *Brownea grandiceps*, *Bauhinia picta*, *Samanea saman*, *Ceiba pentandra*, *Cariniana pyriformis*, *Matisia cordata*, *Cedrela* sp., *Ficus* sp.) and foreign (e.g., *Manguijera indica*, *Annona montana*, *Spathodea grandiflora*, *Bauhinia divaricate*, *Azadirachta indica*, *Averrhoa carambola*) has been implemented within the campus in the last decades (L. S. Suárez & L. M. Quíñones, pers. comm.).

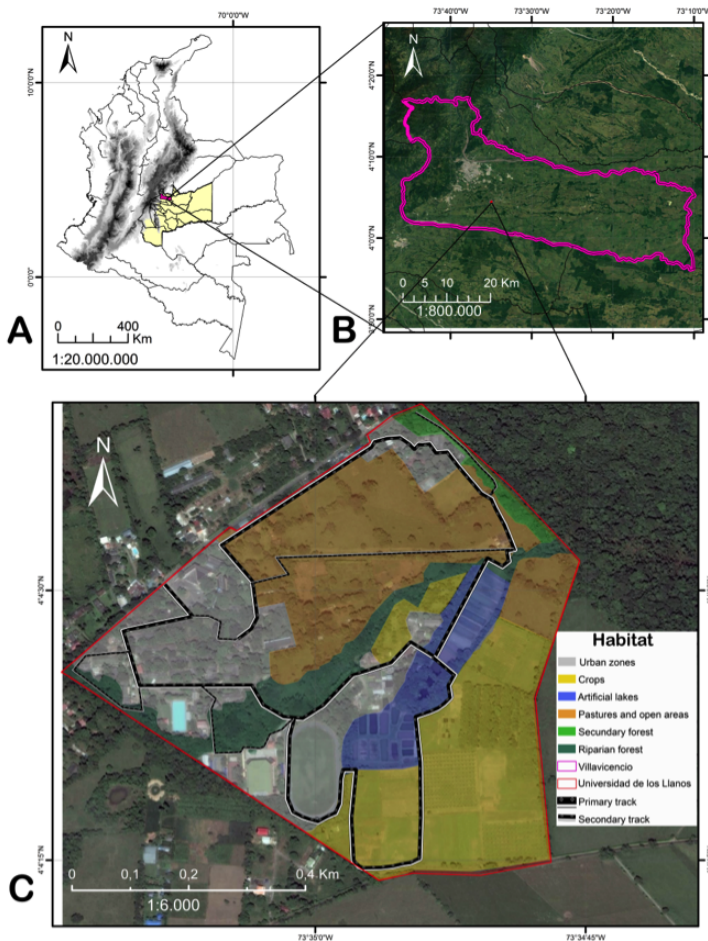


Figure 1. Map showing the geographic location of the Barcelona campus of Universidad de los Llanos, Colombia (A), and indicating its location at the transition of the foothills of Eastern Andes and savanna plains of the Orinoco basin (B). The lower inset (C) show different habitat types sampled in the campus and tracks visited during extensive observations.

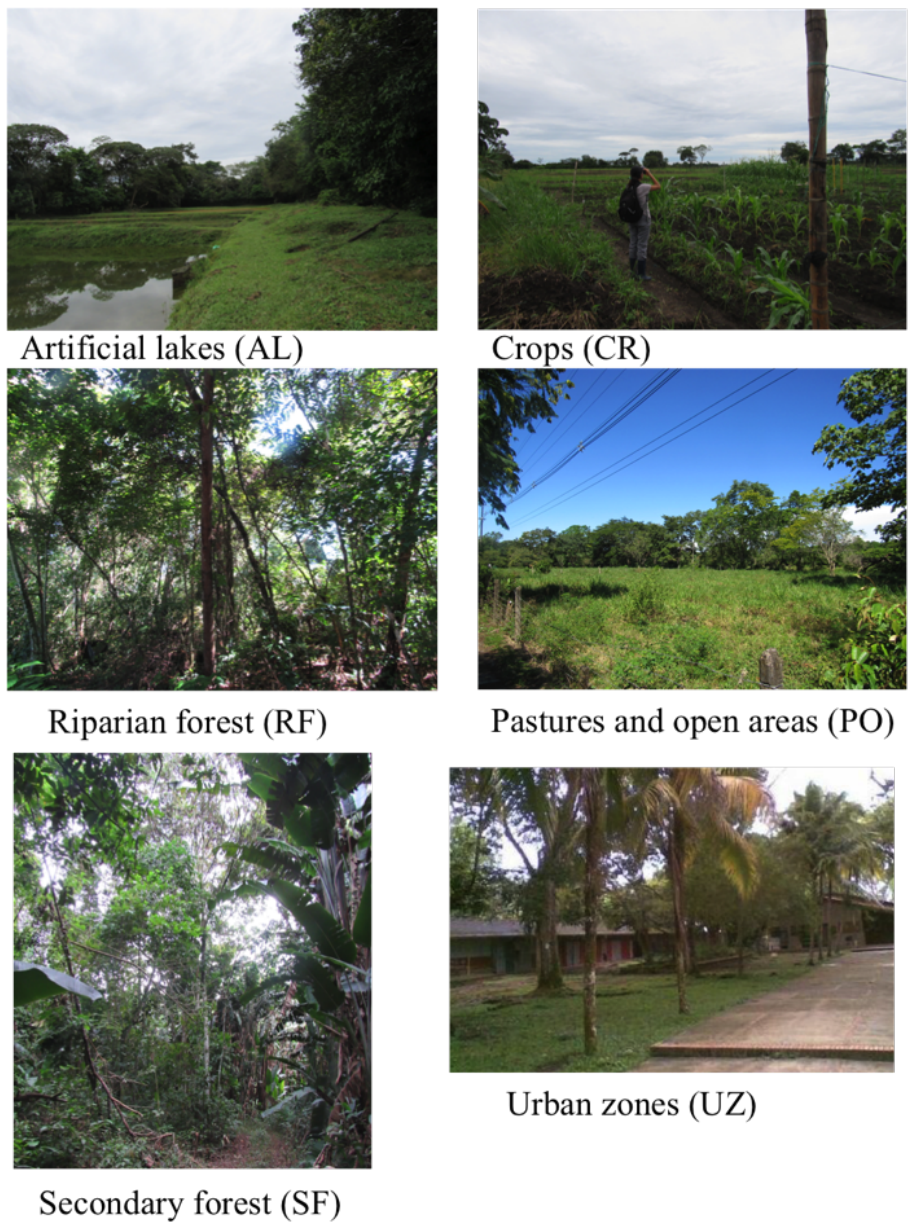


Figure 2. Types of habitats found within the Barcelona campus of Universidad de los Llanos. Photos by AMR.

Currently the area within and around the campus involves a matrix of at least six types of habitats (Figure 2): 1) artificial lakes (AL): ponds for pisciculture, surrounded by pastures, bushes and fences of trees; 2) crops (CR): mainly fruit trees (e.g. soursop, lime, plantain), and others crops like corn, cacao, bean, and pumpkin; 3) riparian forest (RF): small fragments bordering a stream that crosses the campus with trees of *Ochroma pyramidale*, *Piptadenia flava*, *Cecropia* sp and others Fabaceae; 4) pastures and open areas (PO): zones with pastures and fences of trees. 5) secondary forest (SF): a small area located at the north-east of the campus, connecting to a ~20 ha fragment dominated by *Phenacospermum guianensis*, *Erythrina* sp., *Bauhinia* sp. and other trees like *Cecropia* sp. and *Ochroma pyramidale*; and 6) urban zones (UZ): buildings and classrooms surrounded by native and foreign trees of 1-20 m height like *Poeppigia procera*, *Erythrina poeppigiana*, *Bauhinia picta*, *Swietenia macrophylla*, *Ceiba pentandra*, *Ficus* sp., among others. Humidity ranges between 47% and 75%, with an average temperature of 26°C and a unimodal annual rainfall of 4500 mm, with a rainy season from April to November (IDEAM, 2005).

Data acquisition and analysis

Between August and December 2013, and February and August 2014, we carried out 43 weekly visits to the study area. Additional observations were made opportunistically during 2013 and 2018. At least four observers walked (walking speed of c. 0.56km/h) along a ~1.7 km transect that crosses all available habitats on the campus (Figure 1). Birds were detected and identified visually and vocally during the most active period in the mornings (06:00 to 09:00 h). For every record, we recorded species identification, number of individuals, habitat (see above) and location on the campus. Bird identification followed HILTY & BROWN (1986) and MCMULLAN *et al.*, (2011). Avian taxonomy and lineal classification follows AVENDAÑO *et al.*, (2017).

To determine sampling completeness, we used the non-parametric species richness estimators Chao 2 and Jackknife 2, which were calculated using EstimateS 9.10 (COLWELL, 2013). We used the accumulative frequency of detection of each species per habitat as an approximation to its abundance and habitat preferences. The frequency of detection of each species across a total of 43 visits was categorized as: very common (VC; >90% of visits), common (C; 50-90% of visits), occasional (O; 10-50% of visits), and rare (R; <10% of visits) (STOTZ *et al.*, 1996).

We also compared the composition and diversity of the Unillanos avifauna with published inventories in the Colombian Orinoco (e.g., ROJAS & PIRAGUA, 2000; OCAMPO-PENUELA & ETTER 2013, ACEVEDO-CHARRY, 2017), dividing avifaunas in different categories of taxonomic and ecological groups according to STILES & BOHÓRQUEZ (2000) as follows: frugivorous-granivorous terrestrial

or large (Tinamiformes, Galliformes and parrots of *Ara* and *Amazona* genera); birds of prey and scavengers (Falconiformes, Cathartiformes, Strigiformes); aquatic birds (including Alcedinidae); nectarivorous non-passerines (Trochilidae); other frugivorous-granivorous non-passerines (Columbidae, Trogonidae, Momotidae, Ramphastidae, Capitonidae), insectivorous non-passerines (Apodidae, others Piciformes, etc.); insectivorous suboscines (Furnariidae, almost all Tyrannidae); frugivorous suboscines (Cotingidae, Pipridae, *Mionectes*); ten-primaried-oscines, insectivorous-omnivorous (Hirundinidae to Vireonidae); nine-primaried oscines, insectivorous or omnivorous (Parulidae, Icteridae); nine-primaried oscines, frugivorous, granivorous or nectarivorous (Thraupidae, Emberizidae). Although these categories do not allow detailed species-level comparisons among communities (e.g. similarity analyses), this approach allowed us to determine if differences in species richness of particular bird groups within and among inventories, were the result of differences in the diversity and quality of available habitats, or to differences in the quantity and quality of sampling effort among inventories (STILES & BOHÓRQUEZ, 2000).

RESULTS

Species richness and composition

We recorded a total of 189 species through standardized sampling between 2013 and 2014. In addition, 21 species were recorded opportunistically during 2013 and 2018 for a total of 210 bird species in the campus, representing 49 families and 19 orders (Appendix 1). The families with higher number of species were Tyrannidae (28), Thraupidae (22), Icteridae (12), Ardeidae (10), Accipitridae (10), Psittacidae (9), Trochilidae (8), and Cuculidae (8); all of them accounted for 51% of total recorded species (Appendix 1). Estimated species richness ranged between 213 and 229 species according to the Chao 2 and Jackknife 2 estimators, respectively. Thus, the observed species richness ranges between 88.7% and 82.5% of the expected total avifauna for the campus. These estimates agree with the asymptotic tendency showed by the accumulation curve of observed species (Figure 3), suggesting that our inventory is representative of the local avifauna.

Excluding species recorded spontaneously, the frequencies of detection of species were not uniform (Figure 3) with most of them classified as rare (65 species; 35%) and occasional (59; 31%), followed by common (38; 20%) and very common species (27; 14%). Habitat preferences were also marked within the campus (Figure 4) with most species more frequently associated to urban zones (79; 42%). However, there were several bird species associated to riparian forests (30; 16%), artificial lakes (27; 14%), crops (22; 12%) and aerial species that overfly indistinctly different habitats (18; 9%). Secondary forest (6; 3%) and open-country species (7; 4%) were the least represented in the campus.

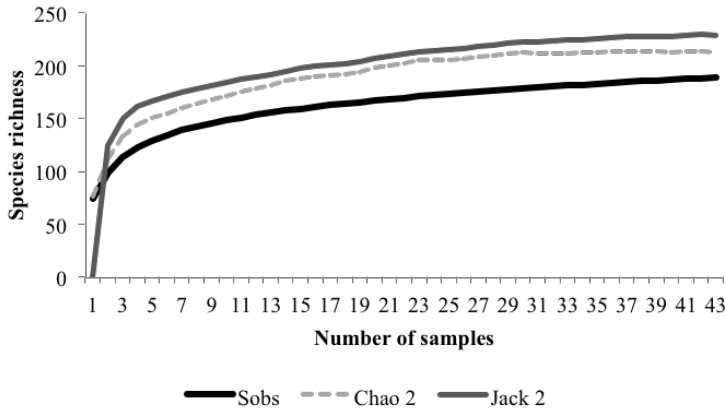


Figure 3. Species richness estimators of the avifauna from the Barcelona campus of Universidad de los Llanos. The asymptotic shape of the observed species richness curve (Sobs), compared to both species richness estimators, Chao 2 and Jack 2, suggests that the inventory is representative of the local avifauna.

In general, 188 out of 208 bird species recorded (90.4%) were residents, whereas 15 were boreal migrants, three were austral migrants and two have both boreal and austral populations (9.6%) (Appendix 2). The migrant species recorded through standardized sampling between 2013 and 2014 showed some preliminary phenology patterns. Boreal migrants such as Yellow-billed Cuckoo (*Coccyzus americanus*), Yellow Warbler (*Setophaga petechia*), American Redstart (*Setophaga ruticilla*) and Blackpoll Warbler (*Setophaga striata*) were the first arrivals during the fall migration (October). Particularly, Solitary Sandpiper (*Tringa solitaria*) and most warblers were common and stayed in the area until the spring migration (April). Baltimore Oriole (*Icterus galbula*), Summer Tanager (*Piranga rubra*) and Scarlet Tanager (*Piranga olivacea*) were less frequent and mainly recorded later in the year (November), but Barn Swallow (*Hirundo rustica*) was also recorded in the spring migration (April). Fork-tailed Flycatcher (*Tyrannus savana*) and Red-eyed Vireo (*Vireo olivaceus*) were recorded during all periods of migrations possibly due to the presence of boreal and austral migrant populations. Austral migrants such as Brown-chested Martin (*Progne tapera*) were recorded on March, June and July. Variegated Flycatcher (*Empidonomus varius*) and Small-billed Elaenia (*Elaenia parvirostris*) were mainly recorded in May and August (Appendix 2). Finally, the list also includes one near endemic, Spectacled Parrotlet (*Forpus conspiciellatus*) (CHAPARRO-HERRERA *et al.*, 2013), and two species of global conservation concern, White-throated Toucan (*Ramphastus tucanus*) (Vulnerable) and Festive Parrot (*Amazona festiva*) (Near threatened) (IUCN, 2017) (Appendix 1), although these species are not threatened at national level (RENJIFO *et al.*, 2014, 2016).

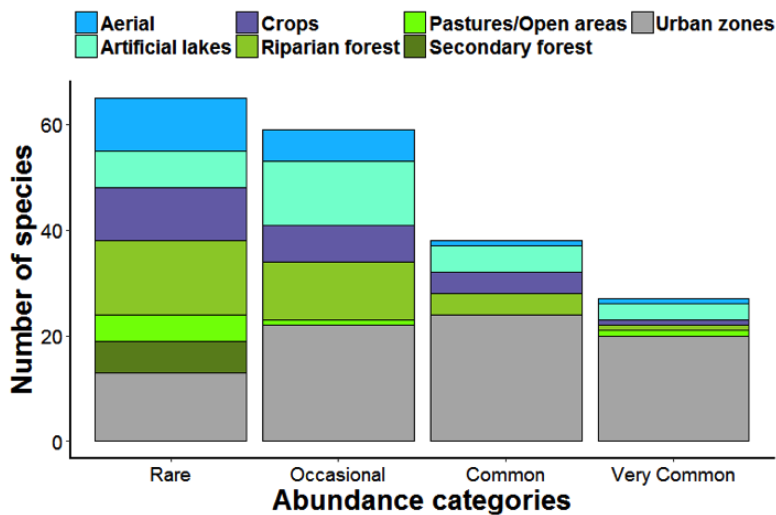


Figure 4. Frequency of detection of each species per habitat as an approximation to its abundance and habitat preferences at the Barcelona campus of Universidad de los Llanos between 2013 and 2014.

Range extensions

Rufous-vented Chachalaca, *Ortalis ruficauda*. Singles or pairs observed less frequently than Speckled Chachalaca *O. guttata* along tree fences and gallery forest inside the campus and surroundings. This species is known from the east of the Eastern Andes from Norte de Santander and Arauca (HILTY & BROWN, 1986), with recent records south to Tauramena in Casanare (XC243616). Our record represents a range extension of c. 100 km south, confirming the presence of this species for first time in the Meta department.

White-tipped Dove, *Leptotila verreauxi*. It occurs locally in lower numbers than Gray-fronted Dove *L. rufaxilla*, from which it is distinguishable by the greyish brown crown and blue-orbital skin instead of the greyish blue crown and red-orbital skin of its congener (HILTY & BROWN, 1986) (Figure 5). This species is historically known from northern Vichada (HILTY & BROWN, 1986; RESTALL *et al.*, 2007), however, a recent number of observations and specimens along Arauca, Casanare, Meta and Vichada departments suggest a more extensive distribution in the Eastern Llanos (SULLIVAN *et al.*, 2009; ACEVEDO-CHARRY *et al.*, 2014).



Figure 5. New bird records for the Meta department, Colombia, documented in the Barcelona campus of Los Llanos University. A: *Conirostrum speciosum*, B: *Leptotila verreauxi*.

Festive Parrot, *Amazona festiva*. A group of six individuals observed in April-March 2014 in the canopy of trees of the urban zone. Previously recorded in Arauca, Casanare, Vaupés and Amazonas departments (HILTY & BROWN, 1986; RODRÍGUEZ-MAHECHA & HERNÁNDEZ-CAMACHO, 2002). Our record, together with a recent sighting south of Sierra de la Macarena (SULLIVAN *et al.*, 2009), confirm the species' presence in Meta department.

Chestnut-vented Conebill, *Conirostrum speciosum*. A pair (September 2013) and a solitary male (March 2014; Figure 5) were recorded foraging in trees and bushes surrounding the urban area of the campus. Males were identified by their dull gray plumage and contrasting rufous undertail coverts. The species' distribution in northern South America is disjunct with isolated populations in Venezuela, Guianas and Ecuador (HILTY & BROWN, 1986). In Colombia, the species has been largely known by 'Bogotá' specimens, however, a recent specimen was collected at the Gazaunta River watershed, municipality of Medina, Cundinamarca department (IAvH-A 10126) in the east slope of the Eastern Andes. There are several sightings along the Andean foothills and the Llanos in Meta and Casanare departments (SULLIVAN *et al.*, 2009). These new data confirm the species' presence along the Andean foothills and Eastern Llanos of Colombia possibly extending north to populations in Apure, Venezuela (HILTY, 2002).

DISCUSSION

Despite occupying a third part of continental Colombia and harboring 40% of the country's bird diversity (LASSO *et al.*, 2010; ACEVEDO-CHARRY *et al.*, 2014), the avifauna of the Colombian Orinoco is considerably less studied than other regions in the country (AVENDAÑO *et al.*, 2017). The only three bird inventories conducted

in the region have focused mainly on primary or scarcely fragmented ecosystems (ROJAS & PIRAGUA, 2000; OCAMPO-PENÚELA & ETTER, 2013; ACEVEDO-CHARRY, 2017). Therefore, our inventory of the Unillanos campus is instrumental in filling the knowledge gap on the regional bird species diversity, as well as contributing to understanding the effects of landscape transformation in the avifauna of ecosystems located on the Andean foothills-savanna transition.

When comparing the Unillanos avifauna with that documented for the well-preserved humid forests and savannas of Caño Limón in Arauca department (ROJAS & PIRAGUA, 2000), we found that the Unillanos campus supports a species-rich avifauna. However, the Unillanos avifauna has fewer species (210 vs. 253) and sustains a different composition of aquatic birds, birds of prey and insectivorous suboscines (Table 1), which is not surprising given that Caño Limón includes natural savannas, seasonal ponds, flood zones and large extensions of riparian forest. Similarly, although the study conducted by OCAMPO-PENÚELA & ETTER (2013) focused mainly on birds restricted to highplain and riparian forests in San Martín de los Llanos, Meta department; there were large differences in species composition. Particularly, the Unillanos campus lacks forest interior species that are more susceptible to forest fragmentation and local extinctions such as large frugivores (e.g. *Lipaugus vociferans*), woodpeckers (*Celeus* spp) and ground insectivores (several *Thamnophilids*). A similar pattern is found when comparing the Unillanos campus and Tame River avifaunas (Table 1), particularly due to the presence of a high number of forest suboscines found at foothills of Tame River (e.g. *Rupicola peruvianus*); although the Unillanos campus stands out by the numerous aquatic birds, birds of prey, open-country insectivores and boreal migrants. The absence of several forest species at the Unillanos campus probably is in line with a generalized loss of natural ecosystems in the Apure-Villavicencio and the Llanos ecoregions as a result of agriculture and pasture expansion promoted by the Colombian government since the second half of the 19th century (LÓPEZ 1989; SÁNCHEZ-CUERVO *et al.*, 2012). Indeed, bird collections led by Museo de La Salle personnel in the middle of the past century at the Villavicencio city (NICÉFORO MARÍA 1945, 1947, 1948, 1955; HILTY & BROWN, 1986), and surrounding localities to the Unillanos campus (e.g. Ocoa River, Apiay), suggest that many species associated to mature forest, morichal, and natural savannas have been locally extirpated.

Despite the lack of forest interior and other sensitive species, the Unillanos campus harbors several forest species such as tinamous (*Crypturelus cinereus*), toucans (*Ramphastos tucanus*, *Pteroglossus* spp), large parrots (*Amazona* spp), and large insectivorous species (*Nyctibius* spp, *Campephilus melanoleucos*). This suggests that the campus maintain some level of landscape heterogeneity to serve as refuge for significant numbers of birds. Nonetheless, the large number of rare and occasional species in the campus, as well as the low representation of secondary forest species, suggests that many

species are visitors or maintain reduced populations locally (MORANTE-FILHO *et al.*, 2015; SHAW *et al.*, 2013). This pattern has been documented in other University campuses from Colombia such as those of Universidad del Valle and Universidad del Magdalena (MUÑOZ *et al.*, 2007; STREWE *et al.*, 2009), which lack of fragments of mature forests and have suffered gradual processes of forest fragmentation and isolation. In this sense, given that the extension and connectivity of highplain and riparian forests in the Llanos are key attributes for maintaining regional bird diversity (OCAMPO-PEÑUELA & ETTER, 2013); the preservation of remnant vegetation patches and forest corridors around the Unillanos campus is fundamental to maintain populations of resident and visitor forest species in the region.

Table 1. Comparison of numbers of species in different taxonomic-ecological groups (see text for definitions) among the Unillanos campus, Caño Limón (ROJAS & PIRAGUA, 2000), Río Tame (ACEVEDO-CHARRY, 2017; includes only data from El Oso and Santa Librada study sites, c. 600-850 m) and San Martín de los Llanos (OCAMPO-PEÑUELA & ETTER, 2013).

Group	Unillanos	Caño Limón	Río Tame	San Martín
No Passeriformes				
Frugivore-granivorous, terrestrial/large	8	8	10	6
Aquatic birds	26	47	13	1
Bird of prey and scavengers	20	28	7	5
Nectarivorous	8	7	11	3
Other frugivorous-granivorous	18	15	17	11
Insectivorous	22	23	16	13
Passeriformes				
Insectivorous suboscines	30	41	34	22
Frugivorous suboscines	6	4	10	7
Ten-primaried oscines, insectivorous-omnivorous	15	17	16	10
Nine-primaried oscines, insectivorous or omnivorous	10	13	8	3
Nine-primaried oscines, frugivorous, granivorous o nectarivorous	28	24	29	6
Total resident species	189	227	171	87
Total austral migratory species	3	4	0	0
Total boreal migratory species	16	22	5	4
Total	210	253	176	91

In the case of open-country species, our data suggests that the avifauna associated to urban zones is more species-rich than that found in open habitats (pastures, artificial lagoons, and aerial space), or even forest habitats. Likewise, urban-associated species tend to be more abundant (SILVA *et al.*, 2015). Although this pattern could reflect in part a bias in sampling urban areas, these areas in the campus stand out due to their heterogeneous vegetation, which consists of native and planted trees with a tall canopy, high proliferation of epiphytes and adjacent scrubs (see Methods, Figure 2). The complex vegetation and buildings seems to offer a high concentration of resources as refuge, food, and structures to nest, which could explain why bird diversity is higher at urban zones. In this sense, urban zones at Unillanos are analogous to the wooded parks and shrubby habitats found in other University campuses, where bird diversity documented there has been higher than in other local habitats (MARÍN-GÓMEZ, 2005; MUÑOZ *et al.*, 2007; STREWE *et al.*, 2009).

Our study is the second in reporting data on phenology of boreal and austral migratory birds in the Colombian Orinoco (e.g. STILES, 2004). For most boreal species, periods of arrival, wintering and departure seem to agree with documented phenology patterns (HILTY & BROWN, 1986). However, these patterns were difficult to distinguish in *T. savanna* and *V. olivaceus*, which are known to have boreal, austral and resident populations in the Llanos and Amazon (STILES, 2004). On the other hand, documentation of austral migrants such as *E. parvirostris*, *E. varius* and *P. tapera* were more detailed during the second year of study possibly as a result of a greater emphasis on open habitats. Abundances of waders and waterfowl species are known to fluctuate in the Llanos due to seasonal migratory movements imposed by drastic droughts and floods (HILTY & BROWN, 1986; OCAMPO-PENÚELA, 2010). Our observations suggest that some migratory movements could occur in some aquatic species (*Dendrocygna* spp., *Jacana jacana*). Moreover, temporal concentration and absence of several *Sporophila* seedeaters and *Sicalis* yellow-finches suggest possible local movements or even migratory or nomadic movements, which deserve more detailed studies at local and regional scales (HILTY, 2002).

Finally, it is worth to mention that bird community comparisons like those implemented in this study could be affected by different flaws reported by REMSEN (1994). First, although we recorded a total of 210 during our systematic sampling, we consider that only 124 species (65%) can be treated as core members of the local avifauna, namely species that breed or migrate through the campus and that were recorded in the area >10% of visits. In this sense, detailed or coarse estimates of species abundance covering uniform spans of time between seasons are key to distinguish core from no core species, which will allow us to understand what species play relevant roles in community ecology and conservation. Second, differences in quantity and quality of sampling effort could lead to misleading comparisons of species richness between habitats within a same area, as well as between different study sites. Indeed,

one of the main issues that we faced when comparing species richness between Unillanos and other bird communities laid in the variety of sampling spans, and differences in the intensity of sampling techniques. These flaws could be compensated by implementing a combination of sampling techniques that emphasizes the use of sound-recordings and extensive observations, supplemented with mist-netting across different seasons. This methodology has been proposed as the most effective and efficient to conducting inventories in several Neotropical ecosystems. Particularly, by facilitating the detection of secretive or low-abundant forest species (STILES & ROSSELLI, 1998; STILES & BOHÓRQUEZ, 2000; AVENDAÑO *et al.*, 2018). Third, the diversity of ecosystems in the Colombian Orinoco involves mosaics of habitats (e.g. morichal within savanna), which could lead to misleading comparisons of species richness among areas varying in the number of habitat types. Although community comparisons as a whole are necessary to understand patterns of species richness and turnover at a regional scale, comparing species totals by ecological and taxonomic categories allows to identify more clearly some aspects of the composition and ecological niches of the respective avifaunas (STILES & BOHÓRQUEZ, 2000). Finally, the proximity of other habitats as sources of wanderers and occasional visitors (no core species) should be taken into account when comparing species richness within and among specific natural or modified habitats. This is particularly relevant in forested habitats in the Orinoco basin, whose edges are visited by open-country species (OCAMPO-PENUELA & ETTER, 2013), as well in crops or savannas that are visited by forest species (TAMARIZ-TURIZO *et al.*, 2017). Given the urgent need of conducting rapid inventories and mid-term studies on the dynamics of bird communities from the Colombian Orinoco, we urge researchers to address these concerns at the time of designing future studies. Implementation of these practices will give us the opportunity to make more complete assessments of the variation in species diversity at local and regional scales, as well as to get more precise evaluations of the conservation status of many areas.

In summary, we found that the Unillanos campus harbors a rich bird community composed by resident, boreal and austral migratory species. The avifauna associated to urban and open habitats was comparatively richer in species, and these were more abundant than their forest counterparts. However, despite anthropogenic disturbances within and around the campus, we found a good proportion of species associated to riparian and secondary forests. Our mid-term monitoring of the Unillanos avifauna also allowed us to distinguish several species that are probably part of the core avifauna of the campus, from a good component of species that are wanderers and occasional visitors from adjacent areas. In this sense, the mosaic of habitats in the campus and surroundings offer the opportunity to conduct detailed studies on community ecology of natural and fragmented ecosystems. Particularly, understanding how bird diversity vary spatially, and what species or ecological groups are more susceptible to habitat degradation is relevant for developing management and conservation strategies

(KATTAN *et al.*, 2006). In the same line, our data suggest that the geographic location of the Unillanos campus and the Villavicencio region in general is strategic to understand the poorly documented migration patterns and the impact of landscape transformation in the behavior, ecology and demographics of many austral grassland birds, as well as several Nearctic species (STILES, 2004; OCAMPO-PENUELA, 2010; JAHN *et al.*, 2017). These few areas of avian research are promising, and their development will not only impact our knowledge and conservation of avian communities at local and regional scales, but also will contribute to fill the knowledge gap on diversity and ecology of the largest area of grasslands in northern South America.

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REFERENCES

- ACEVEDO-CHARRY, O.A., 2017.- Birds of Río Tame of the Andes-Orinoco transitional region: species check-list, biogeographic relationship and conservation. *Ornitología Colombiana*, 16: eA03-4.
- ACEVEDO-CHARRY, O.A., A. PINTO-GÓMEZ & RANGEL-CH., J.O., 2014.- Las aves de la Orinoquia colombiana: una revisión de sus registros: 691-750 (en) RANGEL-CH., J.O. (ed.) *Colombia Diversidad Biótica XIV: La región de la Orinoquia de Colombia*. Universidad Nacional de Colombia, Bogotá, D.C.
- AVENDAÑO, J.E., C.I. BOHÓRQUEZ, L. ROSSELLI, D. ARZUZA-BUELVAS, F. ESTELA, A.M. CUERVO, F.G. STILES & RENJIFO, L.M., 2017.- Lista de chequeo de las aves de Colombia: Una síntesis del estado de conocimiento desde Hilty & Brown (1986). *Ornitología Colombiana*, 16: eA01.
- AVENDAÑO, J.E., LÓPEZ-O, J.P. & LAVERDE-R, O., 2018.- Bird diversity of the Cúcuta valley (Colombia) and biogeographical affinities with dry forest avifaunas of northern South America. *The Wilson Journal of Ornithology*, 130: 213-223.
- CADENA, C.D., ÁLVAREZ-REBOLLEDO, M., PARRA, J.L., JIMÉNEZ, I., MEJÍA, C.A., SANTAMARÍA, M., FRANCO, A.M., BOTERO, C.A., MEJÍA, G.D., UMAÑA, A.M., CALIXTO, A., ALDANA, J. & LONDOÑO, G.A., 2000.- The birds of CIEM, Tinigua National Park, Colombia: an overview of 113 years of ornithological research. *Cotinga*, 12: 46-54.
- CHAPARRO-HERRERA, S., ECHEVERRY-GALVIS, M.Á., CÓRDOBA-CÓRDOBA, S. & SUA-BECERRA, A., 2013.- Listado actualizado de las aves endémicas y casi-endémicas de Colombia. *Biota Colombiana* 14: 235-272.
- COLWELL, R.K., 2013.- EstimateS: Statistical estimation of species richness and shared species from samples. Version 9. User's Guide and application published at: <http://purl.oclc.org/estimates>.
- HILTY, S.L., 2002.- *Birds of Venezuela*. second edition. Princeton University Press, Princeton, New Jersey.
- HILTY, S.L. & BROWN, W.L., 1986.- *A guide to the birds of Colombia*. Princeton University Press, Princeton, NY.
- IDEAM., 2005.- *Atlas climatológico de Colombia*. Disponible en: <<http://www.ideam.gov.co/>> (27 July 2017).
- IUCN., 2017.- The IUCN red list of threatened species. Disponible en: <<http://www.iucnredlist.org/>> (27 July 2017).
- JAHN, A.E., BEJARANO, V., CUETO, V.R., DI GIACOMO, A.S. & FONTANA, C.S. 2017.- Movement ecology research to advance conservation of South America's grassland migratory birds. *Perspectives in Ecology and Conservation*, 15: 209-215.
- JARAMILLO-J. A. & RANGEL-CH., J.O., 2014.- Las unidades del paisaje y los bloques del territorio de la Orinoquia: 101-152 (en) RANGEL-CH., J.O. (ed.) *Colombia Diversidad Biótica XIV: La región de la Orinoquia de Colombia*. Universidad Nacional de Colombia, Bogotá, D.C. KATTAN, G.H., FRANCO, P., SAAVEDRA-RODRÍGUEZ, C.A., VALDERRAMA, C., ROJAS, V., OSORIO, D. & MARTINEZ, J., 2006.- Spatial components of bird diversity in the Andes of Colombia: implications for designing a regional reserve system. *Conserv. Biol.*, 20: 1203-1211.
- LISSO, C.A., USMA, J.S., TRUJILLO, F. & RIAL, A., 2010.- *Biodiversidad de la cuenca del Orinoco: bases científicas para la identificación de áreas prioritarias para la conservación y uso sostenible de la biodiversidad*. Instituto de Investigación de Recursos Biológicos Alexander von Humboldt, WWF Colombia, Fundación Omacha, Fundación La Salle e Instituto de Estudios de la Orinoquia (Universidad Nacional de Colombia), Bogotá, D.C.
- LEMKE, T.O. & GERTLER, P.E., 1978.- Recent observations on the birds of the Sierra de la Macarena, Colombia. *The Condor*,

80: 453-455.

- LÓPEZ, A.J.G., 1989.- Llanos orientales: Colonización y conflictos interétnicos, 1870-1970. *Boletín americanista*, 39: 79-105.
- MARÍN-GÓMEZ, O.H., 2005.- Avifauna del campus de la Universidad del Quindío. *Boletín SAO*, 15: 42-60.
- MCMULLAN, M., QUEVEDO, A. & DONEGAN, T.M., 2011.- *Guía de Campo de las Aves de Colombia*. Fundación ProAves. Bogotá, Colombia.
- MCNISH, T., 2007.- *Las aves de los Llanos de la Orinoquia*. Bogotá, Colombia.
- MEYER DE SCHAUENSEE, R., 1948-1952.- The birds of the Republic of Colombia. *Caldasia*, 22-26: 251-1212.
- MINORTA-CELY, V. & RANGEL-CH., J.O., 2014.- La riqueza y diversidad de las plantas con flores de la Orinoquia colombiana: 419-446 (en) RANGEL-CH., J.O. (ed.) *Colombia Diversidad Biótica XIV: La región de la Orinoquia de Colombia*. Universidad Nacional de Colombia, Bogotá, D.C.
- MORANTE-FILHO, J.C., FARIA, D., MARIANO-NETO, E. & RHODES, J., 2015.- Birds in anthropogenic landscapes: the responses of ecological groups to forest loss in the Brazilian Atlantic Forest. *PLoS One*, 10: e0128923.
- MUÑOZ, M.C., FIERRO-CALDERÓN, K. & RIVERA-GUTIÉRREZ, H.F., 2007.- Las aves del campus de la Universidad del Valle, una isla verde urbana en Cali, Colombia. *Ornitología Colombiana*, 5: 5-20.
- MURILLO-PACHECO, J.I. & BONILLA-ROJAS, W.F., 2016.- New records and distribution extensions of some bird species in the Colombian Andean-Orinoco, department of Meta. *Check List*, 12: 1876.
- NICÉFORO MARÍA, H., 1945.- Notas sobre aves de Colombia, I. *Caldasia*, 3: 367-395.
- NICÉFORO MARÍA, H., 1947.- Notas sobre aves de Colombia, II. *Caldasia*, 4: 317-377.
- NICÉFORO MARÍA, H., 1948.- Notas sobre aves de Colombia, III. *Caldasia*, 5: 201-210.
- NICÉFORO MARÍA, H., 1955.- Notas sobre aves de Colombia, IV. *Caldasia*, 7: 173-175.
- OCAMPO-PENUELA, N., 2010.- El fenómeno de la migración en aves: una mirada desde la Orinoquia. *Orinoquia*, 14: 188-200.
- OCAMPO-PENUELA, N. & ETTER, A., 2013.- Contribution of different forest types to the bird community of a savanna landscape in Colombia. *Ornitol. Neotrop.*, 24: 35-53.
- OLIVARES, A., 1962.- Aves de la región sur de la Sierra de la Macarena, Meta, Colombia. *Rev. Acad. Colomb. Cienc. Exact. Fis. Nat.*, 6: 305-350.
- OLIVARES, A., 1974.- *Aves de la Orinoquia*. Instituto de Ciencias Naturales, Universidad Nacional de Colombia.
- PARDO-MARTÍNEZ, A. & RANGEL-CH., J.O., 2014.- Mamíferos de la Orinoquia colombiana: 785-806 (en) RANGEL-CH., J.O. (ed.) *Colombia Diversidad Biótica XIV: La región de la Orinoquia de Colombia*. Universidad Nacional de Colombia, Bogotá, D.C.
- RANGEL-CH., J.O., 2014.- Ecosistemas de la Orinoquia colombiana: 807-847 (en) RANGEL-CH., J.O. (ed.) *Colombia Diversidad Biótica XIV: La región de la Orinoquia de Colombia*. Universidad Nacional de Colombia, Bogotá, D.C.
- REMSEN, J.V., 1994.- Use and misuse of bird lists in community ecology and conservation. *The Auk*, 111: 225-227.
- RENJIFO, L.M., GÓMEZ, M.F., VELÁZQUEZ-TIBATÁ, J.I., AMAYA-VILLARREAL, Á.M., KATTAN, G., AMAYA-ESPINEL J.D. & BURBANO-GIRÓN, J., 2014.- *Libro rojo de aves de Colombia. Volumen I: Bosques húmedos de los Andes y la costa Pacífica*. Pontificia Universidad Javeriana e Instituto Alexander von Humboldt. Bogotá, D.C., Colombia.
- RENJIFO, L.M., AMAYA-VILLARREAL, Á.M., BURBANO-GIRÓN, J. & VELÁZQUEZ-TIBATÁ, J., 2016.- *Libro rojo de aves de Colombia. Volumen II: Ecosistemas abiertos, secos, insulares, acuáticos continentales, marinos, tierras altas del Darién y Sierra Nevada de Santa Marta y bosques húmedos del centro, norte y oriente del país*. Pontificia Universidad Javeriana e Instituto Alexander von Humboldt. Bogotá, D.C., Colombia.
- RESTALL, R., RODNER, C. & LENTINO, M., 2007.- *Birds of northern South America: an identification guide*. Yale Univ. Press, New Haven.
- RESTREPO-CALLE, S., LENTINO, M. & NARANJO, L.G., 2014.- Aves: 291-309 (en) LASSO, C.A., USMA, J.S., TRUJILLO, F. & RIAL, A. (eds.) *Biodiversidad de la cuenca del Orinoco: bases científicas para la identificación de áreas prioritarias para la conservación y uso sostenible de la biodiversidad*. Investigación de Recursos Biológicos Alexander von Humboldt, WWF Colombia, Fundación Omacha, Fundación La Salle e Instituto de Estudios de la Orinoquia (Universidad Nacional de Colombia), Bogotá, D.C.
- RINCÓN-E., A.J., RANGEL-CH., J.O. & AGUIRRE-C, J., 2014.- Musgos, líquenes, helechos y afines de la Orinoquia colombiana: 447-482 (en) RANGEL-CH., J.O. (ed.) *Colombia Diversidad Biótica XIV: La región de la Orinoquia de Colombia*. Universidad Nacional de Colombia, Bogotá, D.C.
- RODRÍGUEZ-MAHECHA, J.V. & HERNÁNDEZ-CAMACHO, J.I., 2002.- *Loros de Colombia*. Tropical Field Guide Series - Conservation International, Washington D.C.
- ROJAS, R. & PIRAGUA, W., 2000.- Afinidades biogeográficas y aspectos ecológicos de la Avifauna de Caño Limón, Arauca, Colombia. *Crónica Forestal y del Medio Ambiente*, 15: 1-26.
- ROMERO, H., RANGEL-CH., J.O. & CARVAJAL-C, J.E., 2014.- Anfibios de la Orinoquia colombiana, lista con base en los registros existentes: 687-746 (en) RANGEL-CH., J.O. (ed.) *Colombia Diversidad Biótica XIV: La región de la Orinoquia de Colombia*. Universidad Nacional de Colombia, Bogotá, D.C.
- SALAMAN, P.G.W., STILES, F.G., BOHORQUEZ, C.I., ÁLVAREZ-R, M., UMAÑA, A.M., DONEGAN, T.M. & CUERVO, A.M., 2002.- New and noteworthy bird records from the East slope of the Andes of Colombia. *Caldasia*, 24: 157-189.
- SÁNCHEZ-CUERVO, A.M., AIDE, T.M., CLARK, M.L. & ETTER, A., 2012.- Land cover change in Colombia: Surprising forest recovery trends between 2001 and 2010. *PLoS One*, 7: e43943.
- SHAW, D.W., ESCALANTE, P., RAPPOLE, J.H., RAMOS, M.A., OEHLENSCHLAGER, R.J., WARNER, D.W. & WINKER, K., 2013.- Decadal changes and delayed avian species losses due to deforestation in the northern Neotropics. *PeerJ*, 1: e179.
- SILVA, C.P., GARCÍA, C.E., ESTAY, S.A. & BARBOSA, O., 2015.- Bird richness and abundance in response to urban form in a Latin American city: Valdivia, Chile as a case study. *PLoS One*, 10: e0138120.
- STILES, F.G., 2004.- Austral migration in colombia: the state of knowledge, and suggestions for action. *Ornitol. Neotrop.*, 15: 349-355.
- STILES, F.G. & BOHÓRQUEZ, C.I., 2000.- Evaluando el estado de la biodiversidad: El caso de la avifauna de la Serranía de las Quinchas, Boyacá, Colombia. *Caldasia*, 22: 61-92.
- STOTZ, D.F., FITZPATRICK, J.W., PARKER III, T.A., MOSKOVITS, D.K. & SNOW, D., 1996.- *Neotropical birds: ecology and*

conservation. The University of Chicago Press, Chicago.

STREWE, R., VILLA-DE LEÓN, C., ALZATE, J., BELTRÁN, J., MOYA, J., NAVARRO, C. & UTRIA, G., 2009.- Las aves del campus de la Universidad del Magdalena, Santa Marta, Colombia. *Intropica*, 4: 79-91.

SULLIVAN, B.L., WOOD, C.L., ILIFF, M.J., BONNEY, R.E., FINK, D. & KELLING, S., 2009.- eBird: a citizen-based bird observation network in the biological sciences. *Biol. Conserv.*, 142: 2282-2292.

TAMARIS-TURIZO, D.P., LÓPEZ-ARÉVALO, H.F. & RODRÍGUEZ, N.R., 2017.- Efecto de la estructura del cultivo de palma de aceite *Elaeis guineensis* (Arecaceae) sobre la diversidad de aves en un paisaje de la Orinoquía colombiana. *Rev. Biol. Trop.*, 65: 1569-1581.

TRUJILLO-P, A., CARVAJAL-C., J.E. & RANGEL-CH., J.O., 2014.- Reptiles de la Orinoquia colombiana: 661-686 (en) RANGEL-CH., J.O. (ed.) *Colombia Diversidad Biótica XIV: La región de la Orinoquia de Colombia*. Universidad Nacional de Colombia, Bogotá, D.C.

Appendix 1. Bird species recorded in the Barcelona campus of Universidad de los Llanos, Meta. Habitat: Urban Zones (UZ), Riparian forest (GF), Artificial Lagoons (AL), crops (C), Pastures and open areas (PO), secondary forest (SF). Frequency of detection: Very common (VC), common (C), occasional (O), rare (R). Type of record: Visual (V), Photo (P), MHNU-O (specimen at Museo de Historia Natural Unillanos). Other information: near-endemic (NE), range extension (RE), Boreal migrant (BM), Austral migrant (AM), Sporadic record (SR).

Taxon	Habitat	Frequency of detection	Type of record	Other information
Tinamidae				
<i>Crypturelus cinereus</i> (Gmelin) 1789	RF	O	V	
Anatidae				
<i>Dendrocygna viduata</i> (Linnaeus) 1766	AL	O	V, P	
<i>Dendrocygna autumnalis</i> (Linnaeus) 1758	AL	O	V, P	
Cracidae				
<i>Ortalis ruficauda</i> Jardine 1847	RF	R	V	RE
<i>Ortalis guttata</i> (Spix) 1825	UZ	O	V, P	
Odontophoridae				
<i>Colinus cristatus</i> (Linnaeus) 1766	C	C	V, P	
Phalacrocoracidae				
<i>Phalacrocorax brasilianus</i> (Gmelin) 1789	AE	R	V, P	
Ciconiidae				
<i>Mycteria americana</i> Linnaeus, 1758	AL	R	V	SR
Ardeidae				
<i>Cochlearius cochlearius</i> (Linnaeus) 1766	AL	R	V	
<i>Butorides striata</i> (Linnaeus) 1758	AL	VC	V, P	
<i>Bubulcus ibis</i> (Linnaeus) 1758	AE	VC	V, P	
<i>Ardea cocoi</i> Linnaeus 1766	AL	O	V, P	
<i>Ardea alba</i> Linnaeus 1758	AL	C	V, P	
<i>Tigrisoma lineatum</i> (Boddaert) 1783	RF	R	V	SR
<i>Syrigma sibilatrix</i> (Temminck) 1824	UZ	C	V, P	
<i>Pilherodius pileatus</i> (Boddaert) 1783	AL	O	V, P	

Taxon	Habitat	Frequency of detection	Type of record	Other information
<i>Egretta thula</i> (Molina) 1782	AL	O	V, P	
<i>Egretta caerulea</i> (Linnaeus) 1758	AL	O	V, P	
Threskiornithidae				
<i>Eudocimus ruber</i> (Linnaeus) 1758	AE	R	V, P	
<i>Mesembrinibis cayennensis</i> (Gmelin) 1789	C	R	V, P	
<i>Phimosus infuscatus</i> (Lichtenstein) 1823	UZ	VC	V, P	
<i>Platalea ajaja</i> Linnaeus 1758	AE	R	V, P	
Cathartidae				
<i>Cathartes aura</i> (Linnaeus) 1758	AE	O	V, P	
<i>Cathartes burrovianus</i> Cassin 1845	AE	R	V, P	
<i>Coragyps atratus</i> (Bechstein) 1793	AE	O	V, P	
Accipitridae				
<i>Gampsonyx swainsonii</i> Vigors 1825	C	R	V, P	SR
<i>Ictinia plumbea</i> (Gmelin) 1788	RF	R	V, P, MHNU-O-497	
<i>Elanoides forficatus</i> (Linnaeus, 1758)	C	R	V	SR
<i>Geranospiza caerulescens</i> (Vieillot) 1817	AE	R	V, P	SR
<i>Buteogallus meridionalis</i> (Latham) 1790	C	R	V, P	
<i>Rupornis magnirostris</i> (Gmelin) 1788	AL	C	V, P	
<i>Spizaetus tyrannus</i> (Wied-Neuwied) 1820	AE	R	V	SR
<i>Buteo brachyurus</i> Vieillot 1816	AE	R	V	SR
<i>Buteo albicaudatus</i> (Vieillot) 1816	C	R	V	SR
<i>Buteo platypterus</i> (Vieillot) 1823	UZ	R	V, P	BM, SR
<i>Buteo swainsoni</i> Bonaparte 1838	AE	R	V	BM, SR
Aramidae				
<i>Aramus guarauna</i> (Linnaeus) 1766	PO	R	V, P	
Rallidae				
<i>Aramides cajaneus</i> (Statius Muller) 1776	AL	R	V	
Charadriidae				
<i>Vanellus chilensis</i> (Molina) 1782	AL	VC	V, P	
Haematopodidae				
<i>Himantopus mexicanus</i> (Statius Muller) 1776	AL	R	V, P	
Scolopacidae				
<i>Tringa solitaria</i> Wilson, A 1813	AL	O	V, P	BM
Jacaniidae				

Taxon	Habitat	Frequency of detection	Type of record	Other information
<i>Jacana jacana</i> (Linnaeus) 1766	AL	O	V, P	
Laridae				
<i>Phaetusa simplex</i> (Gmelin) 1789	AL	R	V, P	SR
Columbidae				
<i>Columbina minuta</i> (Linnaeus) 1766	C	O	V	
<i>Columbina talapacoti</i> (Temminck) 1810	UZ	VC	V, P	
<i>Columbina squammata</i> (Lesson) 1831	UZ	C	V, P	
<i>Columba livia</i> Gmelin 1789	UZ	R	V	
<i>Patagioenas cayennensis</i> (Bonnaterre) 1792	UZ	VC	V, P	
<i>Zenaida auriculata</i> (Des Murs) 1847	C	C	V, P	
<i>Leptotila verreauxi</i> Bonaparte 1855	C	R	V	RE
<i>Leptotila rufaxilla</i> (Richard & Bernard) 1792	RF	R	V	
Opisthocomidae				
<i>Opisthocomus hoazin</i> (Statius Muller) 1776	AL	VC	V, P	
Cuculidae				
<i>Coccyzus minuta</i> (Vieillot) 1817	AL	O	V, P	
<i>Piaya cayana</i> (Linnaeus) 1766	RF	O	V, P	
<i>Coccyzus melacoryphus</i> Vieillot 1817	RF	O	V, P	
<i>Coccyzus americanus</i> (Linnaeus) 1758	RF	O	V	BM
<i>Coccyzus pumila</i> (Strickland) 1852	PO	R	V	SR
<i>Crotophaga major</i> Gmelin 1788	AL	C	V, P	
<i>Crotophaga ani</i> Linnaeus 1758	PO	VC	V, P	
<i>Tapera naevia</i> (Linnaeus) 1766	C	O	V, P	
Strigidae				
<i>Athene cunicularia</i> (Molina) 1782	PO	R	V, P	
<i>Megascops choliba</i> (Vieillot) 1817	RF	O	V, P	
Nyctibidae				
<i>Nyctibius griseus</i> (Gmelin) 1789	AL	R	V, P	
<i>Nyctibius grandis</i> (Gmelin) 1789	RF	C	V, P	
Caprimulgidae				
<i>Chordeiles nacunda</i> (Vieillot) 1817	AL	R	V, P	
<i>Chordeiles acutipennis</i> (Hermann) 1783	UZ	R	V, P	BM, SR
<i>Nyctidromus albicollis</i> (Gmelin) 1789	AL	R	V, P	
<i>Hydropsalis cayennensis</i> (Gmelin) 1789	UZ	O	V, P	

Taxon	Habitat	Frequency of detection	Type of record	Other information
Apodidae				
<i>Streptoprocne zonaris</i> (Shaw) 1796	AE	O	V	
<i>Chaetura brachyura</i> (Jardine) 1846	AE	C	V	
<i>Tachornis squamata</i> (Cassin) 1853	AE	O	V	
Trochilidae				
<i>Glaucis hirsutus</i> (Gmelin) 1788	UZ	R	V	
<i>Phaethornis hispidus</i> (Gould) 1846	UZ	R	V	
<i>Phaethornis anthophilus</i> (Bourcier, 1843)	RF	R	V	SR
<i>Anthracothorax nigricollis</i> (Vieillot) 1817	UZ	C	V	
<i>Chalybura buffonii</i> (Lesson) 1832	AL	R	V, P	
<i>Amazilia fimbriata</i> (Gmelin) 1788	UZ	C	V, P, MHNU-O-329	
<i>Chlorostilbon mellisugus</i> (Linnaeus) 1758	PO	R	V	
<i>Heliomaster logisrostris</i> (Audebert & Vieillot) 1801	UZ	R	V	SR
Alcedinidae				
<i>Megaceryle torquata</i> (Linnaeus) 1766	AL	C	V, P	
<i>Chloroceryle amazona</i> (Latham) 1790	AL	C	V, P, MHNU-O-495	
<i>Chloroceryle americana</i> (Gmelin) 1788	AL	O	V, MHNU-O-336	
Momotidae				
<i>Momotus momota</i> (Linnaeus) 1766	SF	R	V, P	
Bucconidae				
<i>Hypnelus ruficollis</i> (Wagler) 1829	UZ	O	V, P	
Ramphastidae				
<i>Ramphastos tucanus</i>	UZ	R	V	VU
<i>Pteroglossus inscriptus</i> Swainson 1822	UZ	O	V, P, MHNU-O-330	
<i>Pteroglossus castanotis</i> Gould 1834	UZ	O	V, P	
Picidae				
<i>Picumnus squamulatus</i> Lafresnaye 1854	UZ	C	V, P	
<i>Melanerpes cruentatus</i> (Boddaert) 1783	UZ	VC	V, P	
<i>Veniliornis passerinus</i> (Linnaeus) 1766	UZ	O	V, P	
<i>Colaptes punctigula</i> (Boddaert) 1783	UZ	C	V, P	
<i>Dryocopus lineatus</i> (Linnaeus) 1766	RF	O	V, P	
<i>Campephilus melanoleucus</i> (Gmelin) 1788	UZ	O	V, P	
Falconidae				
<i>Herpetotheres cachinnans</i> (Linnaeus) 1758	RF	R	V, P	

Taxon	Habitat	Frequency of detection	Type of record	Other information
<i>Caracara cheriway</i> (Jacquin) 1784	AE	O	V, P	
<i>Daptrius ater</i> Vieillot 1816	AE	R	V, P	SR
<i>Milvago chimachima</i> (Vieillot) 1816	UZ	VC	V, P	
<i>Falco femoralis</i> Temminck 1822	C	R	V, P	
<i>Falco sparverius</i> Linnaeus 1758	PO	R	V, P	SR
Psittacidae				
<i>Orthopsittaca manilatus</i> (Boddaert) 1783	UZ	C	V, P	
<i>Eupsittula pertinax</i> (Linnaeus) 1758	UZ	VC	V, P	
<i>Forpus conspicillatus</i> (Lafresnaye) 1848	UZ	VC	V, P	NE
<i>Brotogeris cyanopectera</i> (Pelzeln) 1870	UZ	C	V, P	
<i>Amazona festiva</i> (Linnaeus) 1758	AE	R	V	RE
<i>Amazona ochrocephala</i> (Gmelin) 1788	UZ	O	V, P	
<i>Amazona amazonica</i> (Linnaeus) 1766	AE	O	V, P	
<i>Psittacara leucophthalmus</i> (Statius Muller) 1776	PO	R	V	
<i>Ara severus</i> (Linnaeus) 1758	SF	R	V, P	SR
Thamnophilidae				
<i>Sakesphorus canadensis</i> (Linnaeus) 1766	UZ	C	V, P	
<i>Thamnophilus doliatus</i> (Linnaeus) 1764	RF	C	V, P	
<i>Myrmotherula multostriata</i> Sclater, PL 1858	RF	R	V	
Furnariidae				
<i>Dendrocincla fuliginosa</i> (Vieillot) 1818	UZ	O	V, P, MHNU-O-334	
<i>Dendroplex picus</i> (Gmelin) 1788	UZ	C	V, P, MHNU-O-332, 333, 505	
<i>Phacellodomus rufifrons</i> (Wied-Neuwied) 1821	RF	VC	V, MHNU-O-439	
<i>Synallaxis gujanensis</i> (Gmelin) 1789	RF	O	V, P	
Tyrannidae				
<i>Elaenia flavogaster</i> (Thunberg) 1822	UZ	C	V, P	
<i>Elaenia parvirostris</i> Pelzeln 1868	RF	R	V	AM
<i>Camptostoma obsoletum</i> (Temminck) 1824	UZ	C	V	
<i>Phaeomyias murina</i> (Spix) 1825	UZ	O	V	
<i>Mionectes oleagineus</i> (Lichtenstein) 1823	SF	R	V	
<i>Capsiempis flaveola</i> (Lichtenstein) 1823	PO	R	V	
<i>Poecilatriccus sylvia</i> (Desmarest) 1806	RF	R	V	
<i>Todirostrum cinereum</i> (Linnaeus) 1766	UZ	VC	V, P	
<i>Tolmomyias sulphureus</i> (Spix) 1825	UZ	C	V	

Taxon	Habitat	Frecuency of detection	Type of record	Other information
<i>Tolmomyias flaviventris</i> (Wied-Neuwied) 1831	RF	R	V	
<i>Pyrocephalus rubinus</i> (Boddaert) 1783	UZ	R	V	
<i>Machetornis rixosa</i> (Vieillot) 1819	C	O	V, P	
<i>Legatus leucophaeus</i> (Vieillot) 1818	UZ	O	V	
<i>Leptopogon amaurocephalus</i> Tschudi 1846	SF	R	V	
<i>Myiozetetes cayanensis</i> (Linnaeus) 1766	UZ	VC	V	
<i>Myiozetetes similis</i> (Spix) 1825	AL	O	V	
<i>Pitangus sulphuratus</i> (Linnaeus) 1766	UZ	VC	V, P, MHNU-O-506	
<i>Pitangus lictor</i> (Lichtenstein) 1823	AL	O	V	
<i>Megarhynchus pitangua</i> (Linnaeus) 1766	UZ	C	V, P	
<i>Empidonomus varius</i> (Vieillot) 1818	RF	R	V, P	AM
<i>Tyrannus melancholicus</i> Vieillot 1819	UZ	VC	V, P	
<i>Tyrannus savana</i> Daudin 1802	UZ	C	V, P	MB-MA
<i>Myiarchus ferox</i> (Gmelin) 1789	RF	O	V, P	
<i>Myiarchus tyrannulus</i> (Statius Muller) 1776	UZ	C	V	
<i>Myiarchus tuberculifer</i> (Orbigny & Lafresnaye) 1837	RF	R	V, P	
<i>Attila spadiceus</i> (Gmelin) 1789	RF	R	V	
Pipridae				
<i>Manacus manacus</i> (Linnaeus) 1766	RF	O	V	
Tityridae				
<i>Tityra inquisitor</i> (Lichtenstein) 1823	UZ	O	V, P	
<i>Tityra cayana</i> (Linnaeus) 1766	UZ	R	V, P	
<i>Tityra semifasciata</i> (Spix) 1825	SF	R	V	
<i>Pachyrhamphus polychopterus</i> (Vieillot) 1818	UZ	C	V	
Vireonidae				
<i>Cyclarhis gujanensis</i> (Gmelin) 1789	UZ	C	V, P	
<i>Vireo olivaceus</i> (Linnaeus) 1766	RF	C	V	MB
<i>Hylophilus flavipes</i> Lafresnaye 1845	RF	O	V	
Corvidae				
<i>Cyanocorax violaceus</i> Du Bus de Gisignies 1847	UZ	VC	V, P	
Hirundinidae				
<i>Stelgidopteryx ruficollis</i> (Vieillot) 1817	AE	R	V	
<i>Progne tapera</i> (Linnaeus) 1766	AE	R	V	AM
<i>Progne chalybea</i> (Gmelin) 1789	AE	R	V	

Taxon	Habitat	Frequency of detection	Type of record	Other information
<i>Tachycineta albiventer</i> (Boddaert) 1783	AE	R	V, P	
<i>Hirundo rustica</i> Linnaeus 1758	AE	R	V	BM
Troglodytidae				
<i>Troglodytes aedon</i> Vieillot 1809	UZ	VC	V, P	
<i>Campylorhynchus griseus</i> (Swainson) 1838	UZ	O	V, P	
<i>Thryophilus rufalbus</i> (Lafresnaye) 1845	UZ	O	V, P	
<i>Cantorchilus leucotis</i> (Lafresnaye) 1845	UZ	O		
Turdidae				
<i>Turdus leucomelas</i> Vieillot 1818	UZ	VC	V, P, MHNU-O-337, 338, 437, 496	
<i>Turdus nudigenis</i> Lafresnaye 1848	UZ	C	V, P	
<i>Turdus ignobilis</i> Sclater, PL 1858 PZS["1857"]	UZ	VC	V, P, MHNU-O-339	
<i>Catharus ustulatus</i> (Nuttall) 1840	RF	R	V	BM, SR
Mimidae				
<i>Mimus gilvus</i> (Vieillot) 1808	C	C	V, P	
Thraupidae				
<i>Dacnis cayana</i> (Linnaeus) 1766	C	R	V	
<i>Ramphocelus carbo</i> (Pallas) 1764	UZ	VC	V, P, MHNU-O-335, 438	
<i>Thraupis episcopus</i> (Linnaeus) 1766	UZ	VC	V, P	
<i>Thraupis palmarum</i> (Wied-Neuwied) 1821	UZ	VC	V, P	
<i>Schistochlamys melanopsis</i> (Latham) 1790	UZ	R	V	
<i>Tangara cayana</i> (Linnaeus) 1766	UZ	C	V, P, MHNU-O-340, 341	
<i>Tangara mexicana</i> (Linnaeus) 1766	UZ	O	V, P	
<i>Tersina viridis</i> (Illiger) 1811	RF	C	V, P	
<i>Conirostrum speciosum</i> (Temminck) 1824	UZ	R	V, P	RE
<i>Sicalis columbiana</i> Cabanis 1851	C	R	V	
<i>Sicalis flaveola</i> (Linnaeus) 1766	UZ	VC	V, P, MHNU-O-440	
<i>Sicalis luteola</i> (Sparrman) 1789	C	R	V, P	
<i>Volatinia jacarina</i> (Linnaeus) 1766	C	O	V	
<i>Sporophila intermedia</i> Cabanis 1851	UZ	C	V, P	
<i>Sporophila lineola</i> (Linnaeus) 1758	PO	O	V	
<i>Sporophila luctuosa</i> (Lafresnaye) 1843	C	R	V	
<i>Sporophila nigricollis</i> (Vieillot) 1823	C	O	V	
<i>Sporophila minuta</i> (Linnaeus) 1758	C	O	V, P	
<i>Sporophila angolensis</i> (Linnaeus) 1766	C	R	V	

Taxon	Habitat	Frecuency of detection	Type of record	Other information
<i>Sporophila crassirostris</i> (Gmelin) 1789	RF	R	V	
<i>Coereba flaveola</i> (Linnaeus) 1758	C	VC	V, P	
<i>Emberizoides herbicola</i> (Vieillot) 1817	C	R	V	
Emberizidae				
<i>Ammodramus aurifrons</i> (Spix) 1825	UZ	C	V, P	
<i>Arremonops conirostris</i> (Bonaparte) 1850	UZ	O	V	
<i>Arremon taciturnus</i> (Hermann, 1783)	SF	R	V, P	
Cardinalidae				
<i>Piranga rubra</i> (Linnaeus) 1758	UZ	R	V, P	BM
<i>Piranga olivacea</i> (Gmelin) 1789	UZ	R	V	BM
Parulidae				
<i>Parkesia noveboracensis</i> (Gmelin) 1789	RF	R	V	BM
<i>Setophaga ruticilla</i> (Linnaeus) 1758	UZ	O	V, P	BM
<i>Setophaga petechia</i> (Linnaeus) 1766	RF	O	V	BM
<i>Setophaga striata</i> (Forster, JR) 1772	UZ	C	V, P	BM
<i>Geothlypis philadelphia</i> (Wilson, A) 1810	RF	R	V	BM, SR
Icteridae				
<i>Psarocolius decumanus</i> (Pallas) 1769	UZ	O	V	
<i>Psarocolius bifasciatus</i> (Spix) 1824	UZ	R	V, P	
<i>Cacicus cela</i> (Linnaeus) 1758	SF	R	V, P	
<i>Icterus cayanensis</i> (Linnaeus) 1766	UZ	R	V, P	
<i>Icterus galbula</i> (Linnaeus) 1758	RF	R	V	BM
<i>Molothrus oryzivorus</i> (Gmelin) 1788	C	R	V, P	SR
<i>Molothrus bonariensis</i> (Gmelin) 1789	UZ	O	V	
<i>Quiscalus lugubris</i> Swainson 1838	UZ	C	V, P	
<i>Gymnomystax mexicanus</i> (Linnaeus) 1766	UZ	VC	V, P	
<i>Sturnella militaris</i> (Linnaeus) 1758	C	C	V, P	
<i>Sturnella magna</i> (Linnaeus) 1758	C	O	V, P	
Fringillidae				
<i>Euphonia chlorotica</i> (Linnaeus) 1766	UZ	O	V	
<i>Euphonia lanirostris</i> Orbigny & Lafresnaye 1837	UZ	O	V, P	
<i>Euphonia chrysopasta</i> Sclater, PL & Salvin 1869	UZ	R	V	

