# An Inventory of the birds of white-sand vegetation of the Guainía / Río Negro basin, Southern Amazonas State, Venezuela.

## Un inventario de las aves en vegetación de arenas blancas de la cuenca del Guainía / Río Negro, Sur del estado Amazonas, Venezuela.

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**Resumen**

Las regiones de arena blanca cubren inmensas áreas en el sureste de Colombia, el sur de Venezuela y el noroeste de Brasil, especialmente a lo largo de las cuencas del alto Río Negro y Guainía. Los ecosistemas de arena blanca son pobres en especies y tienen baja diversidad; sin embargo, albergan una flora distintiva que exhibe importantes endemismos y diferentes formas de vida. De igual manera, las comunidades de aves de la vegetación de arena blanca se caracterizan por la baja riqueza de especies. No obstante, estudios en la Amazonia brasileña y peruana han demostrado que la vegetación de arena blanca alberga una avifauna única. Durante tres viajes de campo en 2011-2012 se registraron todas las especies detectadas por la vista o por el sonido en varios sitios de arena blanca en el sur del Estado Amazonas, en el sur de Venezuela. Los sitios de estudio se localizaron cerca de los ríos de aguas negras que drenan áreas de arena blanca: Temi, Pimichín, Guainía, Caño San Miguel y Río Negro. Registramos 262 especies agrupadas en 47 familias; de ellas, 38 (14,5%) pertenecientes a 17 familias, están estrechamente asociados con la vegetación arenosa blanca. Además de nuestra lista de aves, completamos el inventario con 51 especies colectadas en la región por la expedición de Phelps en 1954, pero que no fueron registradas por nosotros. Esta adición llevó el número total de especies a 313; 43 (13.8%) de las cuales están estrechamente asociadas a vegetación de arena blanca en nuestra área de estudio. Adicionalmente compilamos una lista preliminar de 46 especies estrechamente asociadas a vegetación de arena blanca al sur del Orinoco. Las comunidades de aves de arena blanca en el sur de Venezuela parecen ricas en especies en comparación con localidades brasileñas y peruanas. Adicionalmente, reportamos extensiones de rangos geográficos y registros notorios para varias especies.

**Palabras clave**: Amazonia, Pimichín, ríos de aguas negras, arenas blancas, Yavita.

**Abstract**

White-sand regions cover immense areas in southeastern Colombia and southern Venezuela, especially along the upper Rio Negro and Guainía basins. White-sand ecosystems are species poor and have low diversity, yet they host a distinctive flora displaying high endemism. Likewise, bird communities of white-sand vegetation are characterized by low species richness. Nonetheless, studies in Brazilian and Peruvian Amazonia show that white-sand vegetation harbors a unique avifauna. We surveyed the bird fauna of several white-sand sites in southern Amazonas State, southern Venezuela, during three field trips in 2011-2012. Sites were located in the vicinity of blackwater rivers draining white-sand areas: Temi, Pimichín, Guainía, Caño San

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Miguel and Río Negro. We made rapid surveys of the bird fauna by conducting transects during which we recorded all species detected by sight or sound. We recorded 262 species grouped in 47 families; of these, 38 (14.5%) belonging to 17 families, were closely associated with white sandy vegetation. In addition, we complemented the bird inventory with 51 species collected in the region by the Phelps expedition in 1954, but not recorded by us. This addition brought the totalnumber of species to 313; 43 (13.8 %) of which are closely associated with white-sand vegetation in our study area. We also compiled a preliminary list of 46 species closely associated to white-sand vegetation from Venezuela south of the Orinoco. White-sand bird communities in southern Venezuela seemed species rich when compared to Brazilian and Peruvian sites. In addition, we report range extension and noteworthy records for several species.

**Keywords**: Amazonia, Pimichín, black water rivers, white sand, Yavita

## Introduction

In the lowlands of Amazonia, so-called blackwater regions are intertwined with white water ones. Most of the great rivers of Amazonia and the rivers and streams in their basins are light colored. However, these extensive areas are sometimes interrupted by regions of blackwater where a tropical world completely different from the customary one exists (Vareschi, 1992). White-sand soils drained by these tea colored streams and rivers are just a hint of the peculiar Amazonian white-sand ecosystems.

White-sand regions are patchily distributed throughout the Amazon basin where geological origin, soil characteristics and hydrological conditions are appropriate (Lleras, 1997; Dezzeo *et al.* 2000; Adeney *et al.* 2016). White-sand vegetation growing on nutrient poor sandy soils is diverse in structure and floristic composition, ranging from open grasslands/ shrublands (Campina in Brazil and Bana in Venezuela) to closed canopy, thin trunked low canopy forests (Campinarana in Brazil and Amazon Caatinga forest in Venezuela; see Borges, 2004; Aymard *et al.* 2009; 2014; Medina & Cuevas, 2011; Adeney *et al.* 2016). In contrast to other types of forests, white-sand communities are species poor and dominated by a few woody taxa (Anderson, 1981). Yet, their distinctive flora differs from that on other soils (Richards, 1952, Vareschi, 1992: Herrera, 1985; Schargel *et al.* 2000). It has low diversity, high endemism (Anderson, 1981, Klinge y Cuevas, 2000; Adeney *et al.* 2016) and displays pronounced sclerophylly and other properties found in xeromorphic plants (Sobrado & Medina, 1980). White quartz soils are typically drained by blackwater rivers that usually are very acidic, contain few inorganic ions, have low oxygen content and high concentrations of "humic acids" (Klinge, 1965; Janzen, 1974; Klinge *et al.* 1977; Klinge & Medina, 1979).

White-sand ecosystems also share distinctive characteristics in terms of faunal species composition (Janzen, 1974, Adeney *et al.* 2016). Bird communities of white-sand vegetation are characterized by low species richness, high individual dominance and elevated level of endemism (Borges, 2004, Álvarez *et al.* 2013). In fact, the small number of species is the most evident attribute of the white-sand vegetation bird assemblages (Borges *et al.* 2016b). Yet, white-sand vegetation harbors a unique avifauna (Borges 2004; Álvarez *et al.* 2013; Matos *et al.* 2016). In Amazonia, as a whole, some 35- 37 bird species closely associated to vegetation in sandy soils are rarely, or never, found in other forest types (Borges, 2004; Borges *et al.* 2016b). Bird assemblages in white-sand

vegetation are species poor but distinct (Borges, 2004; Álvarez *et al.* 2013).

In the Neotropics, white-sand vegetation is found in several countries across the Amazon basin with its distribution concentrated along the upper Rio Negro basin in northwestern Brazil, southeastern Colombia, and southern Venezuela (Anderson 1981; Aymard *et al.* 2014; Adeney *et al.* 2016). In Venezuela, the soils and vegetation of sandy soils have been extensively studied in southern Amazonas State, including the Rio Negro basin (see Huber & Medina 2000; Aymard *et al.* 2009); by contrast, to our knowledge, no study involving birds or fauna in white-sand ecosystems of Venezuela has been undertaken.

Here we present data from rapid bird surveys on white-sand localities along the upper Río Negro (including Guainía) to evaluate species richness and compile a preliminary list of bird species closely associated to white-sand vegetation in southern Venezuela. In addition, we aimed at adding to the knowledge of bird species distribution in this region of the country.

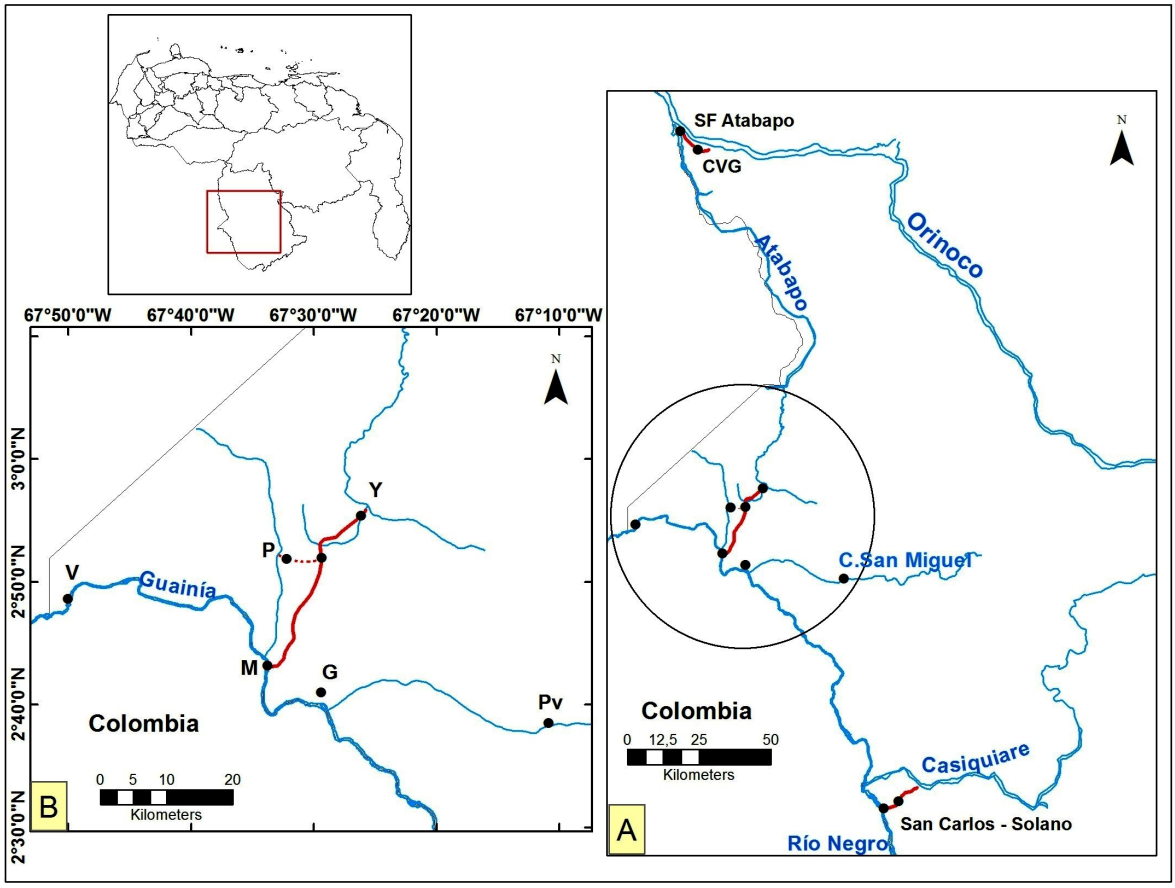


Figure 1. Study area and white-sand study sites in southern Amazonas State along the Colombian border: A) A general view of study sites in relation to blackwater rivers. Roads in red. B) A detail of the Yavita-Pimichín-Maroa isthmus and vicinity: Y= Yavita; P= Pimichín; M= Maroa; V= Victorino; G= Garza; Pv= Pavón. Yavita- Maroa road indicated by the red solid line. Pimichín- Yavita trail indicated by the red dotted line.

## Study area and study sites

We surveyed the bird fauna at several white (quartz) sandy vegetation sites in southern Amazonas state during three field trips in 2011-2012 (Table 1). Our ornithological surveys were carried out in the vicinity of the following blackwater rivers and their blackwater tributaries: Temi, Pimichín, Guainía (the name given to the upper Río Negro in Colombia), Caño San Miguel and Río Negro (Fig. 1). Most of this region is covered by lowland macrothermal humid forests (Dezzeo *et al.* 2000, Aymard, 2013), with extensive white-sand forests of low stature and plant diversity (see Fig. 1 in Adeney *et al.* 2016). In these forests, trees usually have small canopies, narrow trunks less than 20 cm diameter, and small coriaceous leaves (Oliveira-Miranda *et al.* 2010; Adeney *et al.* 2016). Mean annual precipitation in Amazonas State ranges from 1800 to 4000 mm, and elevation of our study sites ranges from 85 to 120 m. Physiognomy of the various study sites varied widely from "Banas" (shrubby campinas) to amazon Caatinga forests or capinarana forests (15-25 m), as well as disturbed areas around towns and plantations.

Table 1. Localities and sites visited in southern Amazonas State; dates visited, duration, length and starting time of transect surveys, and geographic coordinates of sites.

| Site | Date | Duration (hrs) | Distance (kms) | Starting Time | Aproxímate Coordinates |
|---|---|---|---|---|---|
| Yavita-Pimichín-Maroa Isthmus | | | | | |
| Yavita- Maroa road | 21-3-2011 | 4 | 2 | 6:00 | 02° 55' 23 " N<br>67° 26' 07" W -to<br>02° 43' 06" N<br>67° 33' 45 " W |
| Pimichín | 26-3-2011 | 3 | 5 | 16:00 | 02° 51' 51" N<br>67° 32' 12" W |
| Pimichín- Yavita trail | 27-3-2011 | 4:30 | 3 | 7:30 | 02° 51' 51" N |
| | 31-3-2011 | **9:00** | 3.9 | 12:30 | 67° 32' 12" W to- |
| | 1-4-2011 | 11:00 | 15 | 7:30 | 02° 51' 57" N<br>67° 29' 21" W |
| Maroa airstrip | 14 -1- 2011 | 2 | 3 | 8:00 | 02° 43' 10" N |
| surroundings | 22-3-2011 | 3:30 | 2 | 6:30 | 67° 33' 45" W |
| | 26-3-2011 | 3 | 3 | 6:30 | |
| Victorino | | | | | |
| Victorino and | 23-3-2011 | 3 | 3 | 6:30 | 02° 48 ' 38" N |
| surroundings | 24-3-2011 | 7 | 2 | 9:00 | 67° 50' 02" W |
| | 25-3-2011 | 3 | 3 | 6:30 | |
| | 30-3-2011 | 3 | 2 | 7:00 | |
| San Carlos De Río Negro And Vecinity | | | | | |
| San Carlos airstrip | 13-1-2011 | 3 | 2 | 8:30 | 01° 55' 18" N |
| surroundings | 21-10-2012 | 3 | 2 | 6:30 | 67° 03' 21" W |

| Site | Date | Duration (hrs) | Distance (kms) | Starting Time | Aproximate Coordinates |
|---|---|---|---|---|---|
| San Carlos- Solano road | 23-10-2012 | 6:30 | 15 | 7 | 01° 55' 18" N 67° 03' 21" W -to 01° 56' 40" N 67° 00' 34" W |
| Caño San Miguel | | | | | |
| Pavón | 28-3-2011 | 5 | 2 | 6:30 | 02° 38' 30" N |
| | 29-3-2011 | 1 | 0.5 | ?? | 67° 10' 51" W |
| Garza | 13-1-2011 | 1 | 0.5 | 15:30 | 02° 40' 36" N |
| | | | | | 67° 27' 30" W |
| San Fernando De Atabapo | | | | | |
| CVG rubber plantation | 9-1-2011 | 4 | 2 | 8:00 | 03° 59' 03" N |
| road | 15-1-2011 | 4 | 3 | 6:00 | 67° 38' 23" W |
| Totals | | 83.5 hrs | 73.5 km | | |

The following localities and sites were sampled (Fig. 1, Table 1):

*Yavita-Pimichín-Maroa "isthmus":*

South-west of the town of Yavita, near the confluence of the Guasacavi, Temi and Atacavi, lies the Yavita-Pimichín-Maroa isthmus, a land strip of approximately 26 km splitting the two largest watersheds of northern South America, the Río Negro/ Amazonas and the Orinoco (Berry y Aymard, 1997). This region was the most extensively surveyed by us. The area displays a mosaic of vegetation types having great structural and floristic diversity (Aymard *et al.*, 2009; Aymard, 2013). Terrain is mostly flat with seasonally flooded forests along rivers margins. The following sites within the isthmus were sampled:

- Yavita-Maroa road. Yavita (on the western bank of Temi) and Maroa (on the eastern bank of Guainía) are communicated by an approximately 30 Km road that cuts across a mosaic of vegetation types having great structural and floristic diversity (Aymard, 2013). The white-sand soil of this area is extensively covered by forest having emergent trees of diameter of over 40 cm (Aymard *et al.*, 2009: Aymard, 2013; Fig. 2A), and is crisscrossed by black water streams. White-sand areas are sporadically interrupted by reddish soils in which yucca and pineapple conucos are grown. Disturbance increases towards Maroa. This road was surveyed once, starting at Yavita for a short length of approximately 4 km, and once for about 12 km from the intersection of the Yavita trail (Fig. 1). The bird list includes species recorded in red soil vegetation patches also.

- Pimichín, and the Pimichín-Yavita trail. Puerto Pimichín on the eastern bank of Caño Pimichín, a small tributary of the Guanía river, used to be historically the starting point of the road to Yavita, before the Maroa-Yavita road was built in the early 70's. The trail from Pimichín runs east for approximately 6 km before intersecting the current Yavita-Maroa road. Along that sector the white-sand vegetation is generally a low canopy forest of thin trunk trees of only

approximately < 20- 25 cm diameter, reaching to 10-12 m and allowing good light penetration so that a dense understory of shrubs also develops (Fig. 2B). The soil is covered by dense accumulations of leaf litter due to the slow decomposition rate. The forest is crisscrossed by black water streams. We recorded birds here on four days, including one night (Table 1). Transects ran from Pimichín towards that intersection of the Maroa road and then to Yavita.

- Maroa airstrip surroundings. The Maroa town on the left bank of the Guainía river, is located within the extensive white-sand region encompassed on its eastern bank. In the immediate vicinity of Maroa there is a mosaic of vegetation types ranging from open grasslands/ shrublands to closed canopy forests (Fig. 2C), and disturbed areas.

*Victorino:*

- Victorino surroundings. Victorino place, is a long settled indian village on the northern bank of the Guainía river, about 4 km from the Colombian border. The area is a mosaic of white-sand vegetation types ranging in structure from open white-sand campina patches (Fig. 2D, 2E) with abundant ground bromeliads, Rapataceae and ground *Cladonia* lichens, to closed Caatinga canopy forest (Campinarana) with emergent trees of up to 20 m (Fig. 2F). Yuca and pineapple conucos are also abundant in the vicinity of the village. We recorded birds here for four consecutive days (Table 1).

*San Carlos de Río Negro and vicinity:*

- San Carlos de Río Negro, airstrip surroundings. San Carlos de Río Negro, the largest town in southern Amazonas state, lies on the eastern bank of Río Negro approximately 11 km south of the confluence of Casiquiare and Guainía (Fig. 2G), where Río Negro gets its name. San Carlos is surrounded by "Caatinga Alta" forests growing on white-sand soils very acidic and nutrient poor (Dezzeo *et al.* 2000; Aymard *et al.* 2009). In the immediate vicinity of San Carlos the vegetation is quite disturbed and pineapple and yucca plantations are kept (Fig. 2H).

- San Carlos-Solano road. This road runs east from the town of San Carlos for about 13 km on a straight line to the village of Solano near the banks of Casiquiare. Most of the area is forested with trees ranging in height from 20 – 32 m depending on the type of forest and topography (Dezzeo *et al.* 2000). The road was sampled once.

*Caño San Miguel:*

This large black-water tributary runs into the Guainía, just south of the town of Maroa. We sampled two sites briefly on two occasions. The species recorded in both sites are presented together in a single list under "Caño San Miguel".

- Pavón. The margins of Caño San Miguel are covered by flooded forest, but farther inland, we find *terra firme* forest having a mixture of thin-trunk unbranched trees forming a close canopy forest reaching to 12-14 m, and patches of taller trees (aprox. 20 m) with abundant palms (Fig. 2I). Light penetration is good and understory is dense. There are also open patches of white-sand savannah vegetation (Fig. 2J). We explored the margins of Caño San Miguel as far as Pavón and Pozo de Tigre, approximately 40 and 75 km from its confluence respectively.

- Garza. The sampled site was a tall disturbed forest near the abandoned community of Garza (= Pueblo Viejo) on the northern bank of the river about 4 km from its outlet. This site was briefly visited once.

*San Fernando de Atabapo:*

- CVG rubber plantation road. We visited twice the area around the old rubber tree (*Hevea spp.*) plantation of Corporacion Venezolana de Guayana (CVG), roughly 7.5

km from the outskirts of San Fernando along the road that runs SE from it. This site is the most contrasting one in terms of physiognomy; its vegetation is largely an open shrubland (Bana) characterized by open areas of bare sand intermixed with scrubby areas dominated by evergreen tough sclerophyllous shrubs reaching up to 3 m (Fig. 2K). Slowly decomposing leaf litter accumulates over the soil; *Cladonia* lichens form a sparse patchly cover over the bare sand. Abandoned agriculture plots can be found alongside the road and campinarana forest surrounds the area sampled.

*Bird Sampling And Species List:*

We made rapid surveys of the bird fauna by conducting transects during which we silently walked trails or roads at a slow pace (0.5 – 0.9 km/h) and recorded all species detected by sight or sound within approximately 50 m on either side of the path. Birds were observed with binoculars (10 x 32 Kowa and 8.5 x 42 Swarowski) and recorded with a voice recorder Olympus VN-1100 PC. When necessary, we used playback of suspected species, or of those recorded *in situ* to lure birds with unknown or unfamiliar vocalizations. In total, we sampled birds on 18 days for approximately 83.5 hours and covered approximately 73.5 km of transects (Table 1). To locate sampling sites we used a Garmin Etrex GPS, when possible.

In addition to our bird sample, we complemented the bird inventory by adding to our list 51 species collected by the Phelps expedition of 1954 (led by W. H. Phelps Jr.), but not recorded by us, in Yavita – Pimichín.

From this inventory, and species descriptions in Hilty (2003), we compiled a preliminary bird list of southern (south of the Orinoco) Venezuelan birds closely associated with lowland white-sand vegetation. Species included in the list were those that met any of the criteria of the authors indicated below, as well as our own:

Álvarez *et al.* 2013:

- Strict specialist (SS); significantly associated with white-sand forests and never observed in other forest types.

-Local specialist (LS); significantly associated with white-sand forests in part of their distribution.

-Facultative specialist (FAC); common in white-sand forest but present in other forest types.

Borges *et al.* 2016.

- Species restricted to white-sand vegetation (RS).

- Species near-restricted to white-sand vegetation (NRS).

Hilty 2003.

- Sandy soil specialist (HS; Hilty's p: 12).

- Species more common in sandy soils (HC; extracted from from Hilty's species text).

Species so considered were grouped into "specialists" and "facultative". The specialists included any of the following categories: SS, RS, NRS, LS and HS. The facultative included: FAC and HC.

Our survey data is presented as presence or absent only. We did not intend comparisons between localities, vegetation types or sites because our bird sampling was opportunistic, lacking systematic rigor. Bird taxonomy follows Ascanio *et al.* (2017), and common names Verea *et al.* (2017).

**Results**

In total, we recorded the presence of 262 species grouped in 47 families (Appendix I). Of these, 38 species (14.5%) belonging to 17 families, were closely associated with white sandy vegetation (Table 2); including those restricted or nearly restricted, and species most commonly found locally in this habitat type. In addition, we included in Appendix 1, 51 species collected by the 1954 Phelps' expedition to the Yavita-Pimichín isthmus, but not recorded by us. This addition brought the total number of species to 313 in 47 families. Five of the species collected by Phelps, Fiery Topaz (*Topaza pyra* Gould), Pearly Antshrike (*Megastictus margaritatus* Sclater), Short-billed Leaftosser (*Sclerurus rufigularis* Pelzeln), Saffron-crested Tyrant-manakin (*Neopelma chrysocephalum* Pelzeln), and Plumbeous Euphonia (*Euphonia plumbea* Du Bus de Gisignies) are considered facultative specialists common in white-sand forest but also present in other forest types (Table 2). Consequently the number of species closely associated with white sandy vegetation in our study area increased to 43 (13.8 % of total species). The isthmus Yavita-Pimichin-Maroa, the region most extensively surveyed by us, had 212 species, including 161 recorded by us and 51 collected by Phelps (Appendix 1).

Our preliminary list of birds associated with lowland white-sand vegetation south of the Orinoco was complemented by the addition of three other species (see Hilty, 2003) not recorded by us or by Phelps: Blackish-gray Antshrike (*Thamnophilus nigrocinereus* Sclater), Yapacana Antbird (*Myrmeciza disjuncta* Friedmann) and Yellow-throated Antwren (*Myrmotherula ambigua* Zimmer; Table 2; Appendix 2). Hence the total number of species associated with white-sand vegetation south of the Orinoco was 46 belonging to 19 families. Twenty two of those species are considered habitat specialists, and 24 are more commonly found in white sand but also present in other habitats. Interestingly, all 46 species are present in Amazonas State, none in Bolívar State but not in Amazonas.

Species associated with white sandy vegetation (Table 2) ranged from those restricted, or nearly restricted to these habitats, such as Undulated Tinamou (*Crypturellus undulates* Temminck), Bronzy Jacamar (*Galbula leucogastra* Vieillot) and Cherrie's Antwren (*Myrmotherula cherriei* Berlepsch & Hartert), to those with a broader habitat use, but most likely found in white sand vegetation, e.g. Black-headed Parrot (*Pionites melanocephalus* L.), Orange-cheeked Parrot (*Pyrilia barrabandi* Kuhl), and Black-eared Fairy, (*Heliothryx auritus* Gmelin)], to species that use a broad range of habitats in northern Venezuela but are preferentially found In white sandy soil south of the Orinoco, e.g. Brown-throated Parakeet (*Aratinga pertinax* L.)].

Noteworthy records. Range extensions are according to Birds of Venezuela (Hilty, 2003):

Gray-bellied Antbird (*Ammonastes pelzelni* Sclater): One pair in campina habitat near Victorino (24 March 2011), and one pair in amazon caatinga forest/campinarana habitat (higher forest with high density of saplings) near the Maroa runway (30 March 2011). The Victorino record is a slight range extension N (about 100 km); however any record of this species is interesting as it is poorly known and has a very limited range in NW Brasil, E Colombia and SW Venezuela.

Burrowing Owl (*Athene cunicularia* Molina): One individual seen on top of a house in the town of Maroa (22 March 2011); approximately 200 km S of the nearest sight record at the confluence of Ventuari with Orinoco, and 350 km to the locality of the nearest collected specimen in Venezuela, at the confluence of Meta and Orinoco. Probably follows deforestation along the rivers and could also possibly spread into new

areas by help of boats. Ebird reports on the Colombian side are a bit further away but likely due to low density of birders. We suggest it is more likely to have reached Maroa from Colombia, either by boat on the Guainía river or by following the open savannah-like habitats in the Guainía Department. To the south there are no records until the vicinity of Manaus, and to the E only near Boa Vista.

White Bellbird (*Procnias albus* Hermann): One bird heard at CVG Atabapo (9 January 2011). This represents a range extension of about 400-500 km. It was collected at Cerro La Neblina (appr. 400 km S of Atabapo) and there are reports in eBird from W Bolívar state at the Tabaro river in the Caura basin appr. 500 km NE of Atabapo.

Tropical Mockingbird (*Mimus gilvus* Vieillot): One individual at the Pavón community in Caño San Miguel (28 March 2011), and one at CVG Atabapo (9 January 2011). The record from CVG Atabapo is at the southern limit of its known range in Venezuela, while the record from Caño San Miguel is about 200 km S of its known range. On the Colombian side there are records from Mitu, Vaupes, about 500 km W of Caño San Miguel.

*Unusual/interesting records*:

Northern Waterthrush (*Parkesia novebaracensis* Gmelin): One or two individuals along the San Carlos-Solano road (23 October 2012), and one near the Maroa runway (29 March 2011). Few records of this boreal migrant in southern Venezuela.

Black-billed Thrush (*Turdus ignobilis arthuri* Sclater): By some authorities considered to have species status due to morphology (overall darker, less distinct coloring), habitat (white sandy soil, preferably campina) and song. We saw this species on several occasions in central San Fernando de Atabapo, CVG Atabapo (campina), and by the Maroa runway (campina).

Pale-bellied Mourner (*Rhytipterna immunda* Sclater & Salvin) Heard near the San Carlos airstrip (21 October 2012) and at CVG Atabapo (15 January 2011). Few records in Venezuela.

Black-and-white Hawk-Eagle (*Spizaetus melanoleucus* Vieillot): One adult photographed at CVG Atabapo (15 January 2011). Few records in southern Venezuela.

Great-billed Hermit (*Phaethornis malaris* Nordmann): One individual seen well at Pavón, Caño San Miguel (28 March 2011). Very restricted range in Venezuela, basically along the Río Guainía/Negro between Maroa and San Carlos de Río Negro. Very similar to more common Eastern Long-billed Hermit (*Phaethornis superciliosus* L.), with which it seems to overlap. Pale buff undertail-coverts compared to white in *P. superciliosus* and an evenly gray belly without warmer tones are the differences. According to some authorities *P. malaris* should be treated as a subsp. of *P. superciliosus*.

*Tentative species:*

Tree Swallow (*Tachycineta bicolor* Vieillot): One individual, probably immature due to its brownish back at the soccer field in Victorino (23 March 2011). This species has never been recorded in Venezuela. Not approved by the Venezuelan Rarities Committee due to lack of documentation.

Fuscous Flycatcher (*Cnemotriccus fuscatus* Wied-Neuwied): Only heard, not 100% sure of correct identification, at the edge of the San Carlos airstrip (11 January 2011). Mostly likely ssp. *duidae*, which according to some authorities should render species status due to different song, plumage, and habitat (campina).


Figure 2. A view of white-sand vegetation structure of study sites in southern Amazonas State: A) Deep white-sand in the Yavita-Maroa road cutting across low canopy forest. B) Pimichín-Yavita trail. Note the




low canopy forest, small diameter of trunks and accumulation of leaf litter. C) Nearly impenetrable understory along trail in the vicinity of Maroa. D, E) Open "campina" patch near Victorino; note ground bromeliads, rapataceas and ground *Clidonia sp*. lichens. F) Thin trunks and emergent trees in the low canopy forest in the vicinity of Victorino; slow decomposing litter accumulates on the ground. G) Aerial view of the confluence of the blackwater Guainía and the mixed-water Casiquiare; Colombia on the right (photo by Henry González). H) Pineapple plantation on white-sand soil in the vicinity of San Carlos. I,) Thin-trunk trees, palms and deep litter in the low canopy forest of Pavón. J) "Carnivorous" *Drosera* sp on the bare sandy patches of Pavón. K) Scrubland dominated by evergreen tough sclerophyllous shrubs in the Atabapo-CVG road.

White chinned Swift (*Cypseloides cryptus* Zimmer): On two consecutive days seen flying over Yavita (20 and 21 March 2011). Few records in southern Venezuela from SE Bolívar state. In general a poorly known species as it is difficult to separate conclusively from Black Swift (*C. niger* Gmelin), not yet reported from Venezuela but likely to occur. Not approved by the Venezuelan Rarities Committee due to lack of documentation.

## Discussion

*Species richness*. The total number of species recorded in white sand vegetation in southern Amazonas State by us and Phelps (313) is quite high when compared to those of other studies on white-sand vegetation (bana/ campina and amazon Caatinga forest/ campinarama) in the Brazilian (e.g., Borges *et al.* 2016a) and Peruvian Amazonian basin (Álvarez *et al.* 2013). Species richness of sandy soil vegetation avifauna in several sites in the Brazilian Amazonia varies from 77 to 111 (Borges, 2004 and references therein), and estimates suggest that only 150 bird species should be expected to occur in these habitats in the Amazon regions (Borges, 2004). Although comparisons between studies are complicated by differences in sampling methods, sampling intensity, area of study site, vegetation structure and criteria to select study sites, it is evident that the bird communities of white-sand vegetation in Amazonas State are rather rich when compared to that of central Amazonian sites. In this regard, it is relevant that in central and Peruvian Amazonia white-sand vegetation are patchily distributed within a matrix of nutrient richer forest types forming white-sand vegetation islands (Aleixo & Poletto 2007; Álvarez *et al.* 2013). In contrast, in southeastern Colombia and southern Venezuela, especially along the upper Rio Negro region, white-sand vegetation covers immense areas (Anderson 1981, Adeney *et al.* 2016). Along the Venezuelan margin of the Rio Negro and in the interfluvium between Rio Negro and Orinoco, white-sand areas and blackwater drainages are extensive. In central Amazonia, plant species richness is low compared to the upper Rio Negro region (Anderson, 1981), suggesting that species diversity is related to insularity. Likewise, the number of bird species in white sand vegetation sites increased with patch area, possibly because large patches generally present higher habitat heterogeneity (Borges, 2016b).

*Species composition*. Similar to other studies (Stotz *et al.* 1996; Borges 2004; Álvarez *et al.* 2013) bird communities in lowland white-sand vegetation of southern Venezuela have a distinct composition, including 22 habitat specialists restricted or nearly restricted to sandy-soil vegetation and 24 facultative species (Table 2). These specialists can be considered as indicators of white-sand vegetation (Borges, 2016b). Our study area, the interfluvium between Guainía/ Rio Negro and Orinoco, is contained within the Imerí refuge (Haffer, 1969, 2008), one of the eight, or nine, areas of endemism currently recognized in Amazonia (Da Silva *et al.* 2005; Borges & Da Silva, 2012). Each of these areas of endemism holds at least one white-sand vegetation bird specialist (Borges *et al.* 2016b). Our study area includes at least three endemic specialist: Barred Tinamou (*Crypturellus casiquiare* Chapman), Azure-naped Jay (*Cyanocorax heilprini* Gentry), and Gray-bellied Antbird (*Ammonastes pelzelni* Sclater). Our list of species associated with white-sand vegetation south of the Orinoco is tentative because this association may differ among regions, and because there is little knowledge on the biology of many of the species included in our bird inventory. Further knowledge on the ecology of these birds should improve this preliminary list.

*Conservation issues.* Venezuelan Amazonia white-sand areas have been little affected by deforestation, so far. Several reasons have contributed to this. First, globally, as well as locally, human population density in Amazonas State is low. Its total population was approximately 180.000 (2011 population census) distributed on a surface of 177.617 $Km^2$, or about 1 ind. /$km^2$. Second, a large proportion of the state's surface, approximately 34%, is protected by national parks. Third, nutrient-poor white-sand soils are mostly inadequate for agriculture, and only pineapple and yucca are regularly cultivated in a small scale around human settlements. Hence, low human densities, extension of protected areas and conservation favored by poor soils, have protected white-sand regions. Currently, the most threatening human activity is mining for gold, diamond, and more recently coltan. This is a tremendously destroying activity of uncertain legal status which is continuously increasing in certain areas of the state, such as around Yapacana National Park. In addition, in February 2016 a decree by the Venezuelan government established the creation of a large area south of the Orinoco to be extensively exploited for a number of minerals, "El Arco Minero" (mining arch) includes northeaster Amazonas State, as well as extensive areas of northern Bolivar State that also include extensive white-sand regions. Open mining in Venezuela has had devastating effects and the "mining arch" will probably exacerbate destructive consequences of mining.

White-sand ecosystems must be protected and preserved because of their endemism, their contribution to Amazonian diversity, and the intrinsic value and beauty of its nature. White-sand ecosystems are fragile with low capacity to regenerate after disturbance (Anderson, 1981; Schargel *et al.* 2000), thus we must keep on protecting these habitats.

Table 2. A preliminary list of birds associated to lowland white-sand vegetation in southern Venezuela. Criteria follow Álvarez *et al.* 2011 (SS: Strict Specialist, LS: Local Specialist, FAC: Facultative Specialist), Borges *et al.* 2016 (RS: Species restricted to white-sand vegetation, NRS: Species near-restricted to white-sand vegetation), and Hilty 2003 (HS: Sandy-soil specialist, HC: Species more common in sandy soils). See text for grouping categories.

| **FAMILY/ species** | **COMMON NAME** | | **CRITERIA** |
|---|---|---|---|
| | SPECIALIST SPECIES | | |
| TINAMIDAE | | | |
| *Crypturellus duidae* | Gray-legged Tinamou | Soisola Pata Gris | SS- RS |
| CAPRIMULGIDAE | | | |
| *Chordeiles pusillus* | Least Nighthawk | Aguaitacamino Menudo | NRS |
| TROCHILIDAE | | | |
| *Polytmus theresiae* | Green-tailed Goldenthroat | Garganta de Oro Coliverde | FAC- NRS |
| GALBULIDAE | | | |
| *Galbula leucogastra* | Bronzy Jacamar | Barranquero Dorado | NRS- HS |
| THAMNOPHILIDAE | | | |

| FAMILY/ species | COMMON NAME | | CRITERIA |
|---|---|---|---|
| *Thamnophilus nigrocinereus* (**) | Blackish-gray Antshrike | Choca Cenicienta | HS |
| *Thamnophilus amazonicus* | Amazonian Antshrike | Choca Gorro Gris | NRS |
| *Myrmotherula cherriei* | Cherrie's Antwren | Hormiguerito Atigrado | FAC-NRS-HS |
| *Formicivora grisea* | White-fringed Antwren | Coicorita Amazónica | NRS- HC |
| *Myrmeciza pelzelni* | Gray-bellied Antbird | Hormiguero Vientre Gris | RS- HC |
| *Myrmeciza disjuncta* (**) | Yapacana Antbird | Hormiguero de Yacapana | HS |
| TYRANNIDAE | | | |
| *Elaenia ruficeps* | Rufous-crowned Elaenia | Bobito Copetón Moño Rojo | NRS- HC |
| *Neopipo cinnamomea* | Cinnamon Manakin-Tyrant | Cantarín Canelo | LS- NRS |
| *Attila citriniventris* | Citron-bellied Attila | Atila Vientre Citrino | LS- NRS |
| *Conopias parvus* | Yellow-throated Flycatcher | Atrapamoscas Diadema | LS |
| *Rhytipterna immunda* | Pale-bellied Mourner | Plañidera de Cayena | NRS- HS |
| PIPRIDAE | | | |
| *Xenopipo atronitens* | Black Manakin | Saltarín Negro | LS- NRS-HS |
| *Heterocercus flavivertex* | Yellow-crowned Manakin | Saltarín Gargantiplateado | HS |
| VIREONIDAE | | | |
| *Hylophilus brunneiceps* | Brown-headed Greenlet | Verderón Cabecicastaño | NRS |
| CORVIDAE | | | |
| *Cyanocorax heilprini* | Azure-naped Jay | Piarro Nuca Celeste | RS |
| TURDIDAE | | | |
| *Turdus ignobilis* | Black-billed Thrush | Paraulata Pico Negro | NRS |
| THRAUPIDAE | | | |
| *Tachyphonus phoenicius* | Red-shouldered Tanager | Frutero Hombros Rojos | LS- NRS-HS |
| *Sporophila fringilloides* | White-napped Seedeater | Semillero Nuca Blanca | NRS |

| FAMILY/ species | COMMON NAME | | CRITERIA |
|---|---|---|---|
| | FACULTATIVE SPECIES | | |
| TINAMIDAE | | | |
| *Crypturellus casiquiare* | Barred Tinamou | Soisola Barreteada | FAC |
| CRACIDAE | | | |
| *Nothocrax urumutum* | Nocturnal Curassow | Paují Nocturno | HC |
| TROCHILIDAE | | | |
| *Topaza pyra* (*) | Fiery Topaz | Topacio Candela Colimorado | FAC |
| *Heliothryx auritus* | Black-eared Fairy | Colibrí Hada Orejiazul | HC |
| TROGONIDAE | | | |
| *Trogon rufus* | Black-throated Trogon | Sorocuá Amarillo | FAC |
| GALBULIDAE | | | |
| *Galbula dea* | Paradise Jacamar | Barranquero Colilargo | FAC |
| BUCCONIDAE | | | |
| *Chelidoptera tenebrosa* | Swallow-winged Puffbird | Bobito Mirasol | HC |
| PSITTACIDAE | | | |
| *Pyrilia barrabandi* | Orange-cheeked Parrot | Perico Cachete Amarillo | HC |
| *Pionites melanocephalus* | Black-headed Parrot | Perico Calzoncito | HC |
| *Eupsittula pertinax* | Brown-throated Parakeet | Perico Cara Sucia | HC |
| *Ara macao* | Scarlet Macaw | Guacamaya Bandera | HC |
| THAMNOPHILIDAE | | | |
| *Megastictus margaritatus* (*) | Pearly Antshrike | Hormiguero Margarita | FAC |
| *Myrmotherulo ambigua* (**) | Yellow-throated Antwren | Hormiguerito Gargantiamarillo | HC |
| *Willisornis poecilinotus* | Common Scale-backed Antbird | Hormiguero Lomo Escamado | HC |
| FURNARIIDAE | | | |
| *Sclerurus rufigularis* (*) | Short-billed Leaftosser | Raspahoja Pechianteado | FAC |
| TYRANNIDAE | | | |
| *Lophotriccus galeatus* | Helmeted Pygmy-Tyrant | Atrapam. Pigmeo de Casquete | FAC |

| FAMILY/ species | COMMON NAME | | CRITERIA |
|---|---|---|---|
| *Ramphotrigon ruficauda* | Rufous-tailed Flatbill | Pico Chato Barbirrufo | FAC |
| COTINGIDAE | | | |
| *Xipholena punicea* | Pompadour Cotinga | Cotinga Vino Tinto | HC |
| PIPRIDAE | | | |
| *Dixiphia pipra* | White-crowned Manakin | Saltarín Cabeciblanco | FAC |
| *Tyranneutes stolzmonni* | Dwarf Tyrant-Manakin | Saltarín Enano | HC |
| *Neopelma chrysocephalum* (*) | Saffron-crested Tyrant-Manakin | Saltarín Corona de Oro | HC |
| POLIOPTILIDAE | | | |
| *Polioptila guianensis* | Guianan Gnatcatcher | Chirito Brujito | HC |
| THRAUPIDAE | | | |
| *Sporophila fringilloides* | White-naped Seedeater | Semillero Nuca Blanca | HC |
| FRINGILLIDAE | | | |
| *Euphonia plumbea* (*) | Plumbeous Euphonia | Fruterito Plomizo | HC |

(*) Species collected by the Phelps' expedition (1954) but not recorded by us.

(**) Species not recorded by us or collected by Phelps


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Appendix 1. List of bird species on white-sand vegetation sites on the basins of Guainía/ Río Negro, southern Amazonas State, Venezuela. Sites visited in 2011-2012. Species collected in Yavita-Pimichín by the Phelps expedition in 1954, but not recorded by us, are indicated by "P".

| FAMILY/Species | LOCALITY (number of spp.) SITE | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | **YAVITA-MAROA-PIMICHIN ISTMUS (212 spp.)** | | | | | **SAN CARLOS DE RIO NEGRO (93 spp.)** | | | |
| | **Pimichin** | **Yavita-Pimichín** | **Yavita** | **Maroa Runway** | **Victorino** | **S.Carlos Runway** | **S.Carlos-Solano** | **Caño S.Miguel** | **Atabapo-CVG** |
| TINAMIDAE | | | | | | | | | |
| *Tinamus major* | X | | | | | | | | |
| *Tinamus guttatus* | X | X | | | X | | | | |
| *Crypturellus cinereus* | | | | | | | | | X |
| *Crypturellus soui* | | | | | X | | | | X |
| *Crypturellus undulatus* | | | | | X | | | | |

| | Pimichin | Yavita-Pimichín | Yavita | Maroa Runway | Victorino | S.Carlos Runway | S.Carlos-Solano | Caño S.Miguel | Atabapo-CVG |
|---|---|---|---|---|---|---|---|---|---|
| *Crypturellus duidae* | X | | | | X | | | | |
| *Crypturellus casiquiare* | X | | | | | | | | |
| CRACIDAE | | | | | | | | | |
| *Penelope jacquacu* | | X | | | | | | | |
| *Nothocrax urumutum* | | X | | | | | | | |
| ODONTOPHORIDAE | | | | | | | | | |
| *Odontophorus gujanensis* | | | | | X | | | | |
| COLUMBIDAE | | | | | | | | | |
| *Patagioenas cayennensis* | X | | X | | X | | | X | |
| *Patagioenas subvinacea* | | | X | | | | X | X | |
| *Patagioenas speciosa* | | | | | X | | | | X |
| *Columbina passerina* | | | | X | X | X | | X | X |
| *Columbina minuta* | | | X | | | | | X | X |
| *Geotrygon montana* | | | | | | | | X | |
| CUCULIDAE | | | | | | | | | |
| *Crotophaga ani* | | | | X | X | | | | |
| *Piaya cayana* | | | X | | | | | | |
| *Piaya melanogaster* | | | X | | X | | | | X |
| NYCTIBIIDAE | | | | | | | | | |
| *Nyctibius griseus* | | | X | | | | | X | |
| CAPRIMULGIDAE | | | | | | | | | |
| *Chordeiles pusillus* | | | | X | | X | | X | |
| *Nyctipolus nigrescens* | X | X | | | | | | | |
| *Nyctidromus albicollis* | | | | | X | | | X | |
| APODIDAE | | | | | | | | | |
| *Cypseloides cryptus* | | | X | | | | | | |
| *Chaetura chapmani* | | | X | | | | | | X |
| *Chaetura brachyura* | | | | | X | X | | X | X |
| *Chaetura spinicaudus* | | | | | X | | X | | X |
| *Chaetura cinereiventris* | | X | | | X | | | | |
| *Panyptila cayennensis* | | | | | | X | | | |
| *Tachornis squamata* | | | X | X | X | X | X | X | |
| TROCHILIDAE | | | | | | | | | |
| *Topaza pyra* | P | | | | | | | | |
| *Phaethornis bourcieri* | | X | | | | | X | X | |
| *Phaethornis superciliosus* | | | | | X | | | X | |
| *Phaethornis malaris* | | | | | | | | X | |
| *Phaethornis griseogularis* | | | X | | | | | | |
| *Phaethornis ruber* | | | | | | X | X | | |
| *Heliodoxa aurescens* | | P | | | | | | | |
| *Heliothryx auritus* | | | X | | X | | | X | |
| *Polytmus theresiae* | | | | X | | X | | X | |
| *Discosura langsdorffi* | | | | X | | | | X | |
| *Calliphlox amethystina* | | | | | | X | | X | X |
| *Campylopterus largipennis* | | | | | X | | | | |
| *Thalurania furcata* | X | X | X | | X | X | X | X | |
| *Amazilia versicolor* | | | | | | X | X | | |

| | Pimichin | Yavita-Pimichín | Yavita | Maroa Runway | Victorino | S.Carlos Runway | S.Carlos-Solano | Caño S.Miguel | Atabapo-CVG |
|---|---|---|---|---|---|---|---|---|---|
| *Hylocharis sapphirina* | | | | | X | | | | |
| *Hylocharis cyanus* | P | | | | P | | | | |
| RALLIDAE | | | | | | | | | |
| *Anurolimnas viridis* | | | | | | X | | | |
| CHARADRIIDAE | | | | | | | | | |
| *Charadrius collaris* | | | | X | | X | X | | |
| *Bartramia longicauda* | | | | X | X | X | | | |
| *Actitis macularius* | | | | | | | | X | |
| *Tringa solitaria* | | | | X | | X | X | | |
| *Calidris minutilla* | | | | X | | | | | |
| ARDEIDAE | | | | | | | | | |
| *Tigrisoma lineatum* | X | | | | | | | | |
| *Nycticorax nycticorax* | | | | | | | | X | |
| *Egretta caerulea* | | | | X | | | | | |
| *Bubulcus ibis* | | | | | X | | | | |
| THRESKIORNITHIDAE | | | | | | | | | |
| *Mesembrinibis cayennensis* | X | | | | | X | | X | |
| CATHARTIDAE | | | | | | | | | |
| *Coragyps atratus* | | | | | | | | | X |
| *Cathartes aura* | | | | X | | X | X | X | X |
| *Cathartes melambrotus* | | | | X | X | X | | | |
| PANDIONIDAE | | | | | | | | | |
| *Pandion haliaetus* | | | | | | | | X | X |
| ACCIPITRIDAE | | | | | | | | | |
| *Leptodon cayanensis* | | | X | | X | | | | |
| *Harpagus bidentatus* | | X | | | | | | | |
| *Ictinia plumbea* | | | | X | X | | | | |
| *Accipiter superciliosus* | | | | | | | | X | |
| *Buteogallus meridionalis* | | | | | | | | | X |
| *Buteogallus urubitinga* | | | | | | | X | | |
| *Rupornis magnirostris* | | | X | X | X | X | | X | X |
| *Buteo nitidus* | | | | | | | | | X |
| *Buteo platypterus* | | | | | | | X | | |
| *Spizaetus melanoleucus* | | | | | | | | | X |
| *Spizaetus ornatus* | | X | | | | | | X | |
| STRIGIDAE | | | | | | | | | |
| *Glaucidium brasilianum* | | | | | X | | | | |
| *Athene cunicularia* | | | | X | | | | | |
| TROGONIDAE | | | | | | | | | |
| *Pharomachrus pavoninus* | | X | | | | | | | |
| *Trogon melanurus* | | P | | | | | | | |
| *Trogon viridis* | | X | X | | X | X | X | X | X |
| *Trogon ramonianus* | | X | X | | X | | | | |
| *Trogon rufus* | | X | | | X | | | | |
| ALCEDINIDAE | | | | | | | | | |
| *Megaceryle torquata* | | | | | | | | | X |
| *Chloroceryle amazona* | | | | | | | | X | |

| | Pimichin | Yavita-Pimichín | Yavita | Maroa Runway | Victorino | S.Carlos Runway | S.Carlos-Solano | Caño S.Miguel | Atabapo-CVG |
|---|---|---|---|---|---|---|---|---|---|
| *Chloroceryle inda* | | | X | | | | | | |
| MOMOTIDAE | | | | | | | | | |
| *Momotus momota* | | X | | | | | X | | X |
| GALBULIDAE | | | | | | | | | |
| *Galbula albirostris* | | X | | | | | | | |
| *Galbula galbula* | | | | | X | | | | |
| *Galbula leucogastra* | | | | X | | | | | |
| *Galbula dea* | | | | | | X | | | |
| *Jacamerops aurea* | | P | | | | | | | |
| BUCCONIDAE | | | | | | | | | |
| *Bucco tamatia* | | | | | | X | | | |
| *Bucco capensis* | | P | | | | | | | |
| *Malacoptila fusca* | | X | | | | | | | |
| *Monasa morphoeus* | | P | | | | | X | | |
| *Chelidoptera tenebrosa* | X | | X | | X | X | X | X | X |
| CAPITONIDAE | | | | | | | | | |
| *Capito auratus* | X | X | X | | X | | X | X | X |
| RAMPHASTIDAE | | | | | | | | | |
| *Pteroglossus viridis* | | | | | | | | | X |
| *Pteroglossus azara* | | | | | | | | | X |
| *Ramphastos tucanus* | | X | | | X | X | X | | X |
| *Ramphastos vitellinus* | | X | | | X | X | | | |
| PICIDAE | | | | | | | | | |
| *Picumnus exilis* | | | | X | | | | | |
| *Melanerpes cruentatus* | | | X | | X | X | X | X | |
| *Veniliornis affinis* | | | | | X | | | | |
| *Piculus flavigula* | | X | | | X | | | | |
| *Piculus chrysochloros* | P | P | | | | | | | |
| *Celeus grammicus* | P | P | | | | | | | |
| *Celeus undatus* | | | | | | | X | | |
| *Celeus elegans* | | X | | | | | | | |
| *Celeus flavus* | P | P | | | | | | | |
| *Dryocopus lineatus* | | | X | X | | X | | | X |
| *Campephilus rubricollis* | | X | | | X | | | | |
| *Campephilus melanoleucos* | | | | | | | | | X |
| FALCONIDAE | | | | | | | | | |
| *Micrastur gilvicollis* | | | | | X | | | | |
| *Daptrius ater* | | | X | | | | | | X |
| *Caracara cheriway* | | | | | | | | | X |
| *Milvago chimachima* | | | | | X | | | | |
| *Herpetotheres cachinnans* | | | | | | | | | X |
| *Falco rufigularis* | | | | X | X | X | | | |
| PSITTACIDAE | | | | | | | | | |
| *Touit purpuratus* | | | | | | | | X | |
| *Touit huetii* | | | | | X | X | | | |
| *Brotogeris cyanoptera* | | X | X | X | X | X | X | X | |
| *Pyrilia barrabandi* | | | | X | | X | | X | X |

| | Pimichin | Yavita-Pimichín | Yavita | Maroa Runway | Victorino | S.Carlos Runway | S.Carlos-Solano | Caño S.Miguel | Atabapo-CVG |
|---|---|---|---|---|---|---|---|---|---|
| *Pionus menstruus* | | | X | | X | | | X | X |
| *Amazona farinosa* | X | X | X | X | X | | | X | |
| *Pionites melanocephalus* | X | X | | | | | X | X | |
| *Pyrrhura melanura* | | | | | | X | | | |
| *Eupsittula pertinax* | X | | | X | X | | | | X |
| *Ara ararauna* | | | | X | | | | X | |
| *Ara macao* | X | X | | | | | | | |
| *Ara chloropterus* | | | | | X | | | | |
| THAMNOPHILIDAE | | | | | | | | | |
| *Euchrepomis spodioptila* | | | X | | | | | | |
| *Cymbilaimus lineatus* | | X | | | | | | | |
| *Taraba major* | | | | | | | | | X |
| *Thamnophilus doliatus* | | | | X | | | | | X |
| *Thamnophilus murinus* | | X | | X | X | X | X | X | |
| *Thamnophilus aethiops* | | P | | | | | | | |
| *Thamnophilus punctatus* | | | | | | | | | X |
| *Thamnophilus amazonicus* | | | | X | X | | | X | X |
| *Megastictus margaritatus* | | P | | | | | | | |
| *Thamnomanes ardesiacus* | | P | | | | | | | |
| *Thamnomanes caesius* | | X | X | | X | | | | |
| *Isleria guttata* | | X | | | | | | | |
| *Epinecrophylla pyrrhonota* | | X | | | | | | | |
| *Myrmotherula brachyura* | | X | | | | | | | |
| *Myrmotherula cherriei* | | | | X | | | | | X |
| *Myrmotherula axillaris* | | | | | | | | X | |
| *Myrmotherula longipennis* | | X | X | | | | | | |
| *Myrmotherula menetriesii* | | X | X | | X | | | | |
| *Herpsilochmus dorsimaculatus* | | | | X | | | | X | |
| *Formicivora grisea* | | | | | | | | | X |
| *Hypocnemis flavescens* | X | X | | X | X | | X | X | |
| *Cercomacroides tyrannina* | | | | | X | | | | |
| *Cercomacra cinerascens* | | X | | | | X | X | | |
| *Sclateria naevia* | | | | | | | | | X |
| *Hypocnemoides melanopogon* | X | | | | | | | | |
| *Percnostola rufifrons* | | P | | | | | | | |
| *Myrmelastes leucostigma* | | X | | | X | | | | |
| *Myrmophylax atrothorax* | | | | | | | X | | |
| *Myrmeciza pelzelni* | | | | X | X | | | | |
| *Pithys albifrons* | | X | | | | | | | |
| *Gymnopithys rufigula* | X | | | | | | | | |
| *Hylophylax naevius* | | X | | | X | | | | |
| *Willisornis poecilinotus* | | | | | X | | | | |
| *Phlegopsis erythroptera* | | X | | | | | | | |
| GRALLARIIDAE | | | | | | | | | |
| *Myrmothera campanisona* | | X | | | | | | | |
| FURNARIIDAE | | | | | | | | | |

| | Pimichin | Yavita-Pimichín | Yavita | Maroa Runway | Victorino | S.Carlos Runway | S.Carlos-Solano | Caño S.Miguel | Atabapo-CVG |
|---|---|---|---|---|---|---|---|---|---|
| *Sittasomus griseicapillus* | | | | X | | | | | |
| *Certhiasomus stictolaemus* | | P | | | | | | | |
| *Dendrocincla fuliginosa* | | X | X | | | | | | |
| *Glyphorynchus spirurus* | | X | | | X | | | | |
| *Nasica longirostris* | | | | | | | | X | |
| *Xiphorhynchus obsoletus* | | X | | | | | | X | |
| *Xiphorhynchus ocellatus* | | | | | X | | | | |
| *Xiphorhynchus guttatus* | | X | | | | | | | |
| *Lepidocolaptes albolineatus* | | P | | | | | | | |
| *Campylorhamphus procurvoides* | | P | | | | | | | |
| *Dendroplex picus* | | | | | | | | | X |
| *Microxenops milleri* | | P | | | | | | | |
| *Xenops minutus* | | X | | | X | | | | |
| *Formicarius colma* | | P | | | | | | | |
| *Sclerurus rufigularis* | | P | | | | | | | |
| *Sclerurus caudacutus* | | P | | | | | | | |
| *Philydor pyrrhodes* | | | | X | | | | | |
| *Automolus ochrolaemus* | | X | | | | | | X | |
| *Automolus infuscatus* | | X | | | | | | | |
| TYRANNIDAE | | | | | | | | | |
| *Phaeomyias murina* | | | | | | X | | X | |
| *Tyrannulus elatus* | | | X | | X | X | X | X | |
| *Myiopagis gaimardii* | | X | | | X | | X | | |
| *Myiopagis caniceps* | | P | | | | | | | |
| *Elaenia parvirostris* | | | | | | X | | | |
| *Elaenia cristata* | | | | | | | | | X |
| *Elaenia ruficeps* | | | | X | | X | | | X |
| *Ornithion inerme* | | P | | | | | | | |
| *Corythopis torquata* | | P | | | | | | | |
| *Zimmerius gracilipes* | | P | | | | | | | |
| *Mionectes oleagineus* | | | | | X | | | | |
| *Leptopogon sp.* | P | | | | | | | | |
| *Inezia subflava* | P | | | | | | | X | |
| *Myiornis ecaudatus* | | P | | | | | | | |
| *Lophotriccus galeatus* | | | X | | X | | X | | X |
| *Hemitriccus margaritaceiventer* | | | | | | | | | X |
| *Hemitriccus zosterops* | | P | | | | | | | |
| *Tolmomyias assimilis* | | P | | | | | | | |
| *Tolmomyias poliocephalus* | | | | | X | | | | |
| *Tolmomyias flaviventris* | | | | | | | | | X |
| *Platyrhynchos saturatus* | | P | | | | | | | |
| *Platyrinchus platyrhynchos* | | | | | X | | | | |
| *Onychorhynchus coronatus* | | X | | | X | | | | |
| *Terenotriccus erythrurus* | | X | | | X | | | X | |
| *Neopipo cinnamomea* | | X | | | | | | | |
| *Cnemotriccus fuscatus* | P | P | | | | | | | |

| | Pimichin | Yavita-Pimichín | Yavita | Maroa Runway | Victorino | S.Carlos Runway | S.Carlos-Solano | Caño S.Miguel | Atabapo-CVG |
|---|---|---|---|---|---|---|---|---|---|
| *Myiobius barbatus* | | X | | | | | | | |
| *Contopus virens* | | | | | | | X | | |
| *Ramphotrigon ruficauda* | | X | | | | | | | |
| *Attila cinnamomeus* | | | X | | | | | X | |
| *Attila citriniventris* | | X | | | | X | X | | |
| *Attila spadiceus* | | | | | X | | | | |
| *Rhytipterna simplex* | | X | | | | | X | | |
| *Rhytipterna immunda* **(*)** | | | | | | X | | | X |
| *Myiarchus swainsoni* | P | | | | | X | | X | X |
| *Pitangus sulphuratus* | | | | | | | | | X |
| *Myiozetetes cayanensis* | | | X | X | X | X | X | X | |
| *Conopias parvus* | | P | | | | X | | | |
| *Myiodynastes maculatus* | | | | | | X | | | |
| *Legatus leucophaius* | | | X | X | X | X | | X | X |
| *Empidonomus varius* | X | | | | | | | X | |
| *Empidonomus aurantioatrocristatus* | | | | | | X | | | |
| *Tyrannopsis sulphurea* | | | X | | X | | | X | X |
| *Tyrannus melancholicus* | X | | X | X | X | X | X | X | X |
| *Tyrannus savana* | | | X | X | X | X | | X | |
| COTINGIDAE | | | | | | | | | |
| *Cotinga cotinga* | | P | | | | | | | |
| *Cotinga cayana* | | | | | X | | X | X | |
| *Lipaugus vociferans* | | X | X | | | | X | | |
| *Perissocephalus tricolor* | | P | | | | | | | |
| *Procnias albus* | | | | | | | | | X |
| *Xipholena punicea* | | | | | | | | | X |
| PIPRIDAE | | | | | | | | | |
| *Tyranneutes stolzmanni* | X | X | | | X | X | X | | |
| *Neopelma chrysocephalum* | | P | | | | | | | |
| *Xenopipo atronitens* | | | | | | | | | X |
| *Lepidothrix coronata* | X | X | | | X | | | | |
| *Heterocercus flavivertex* | | | | | | X | | | |
| *Dixiphia pipra* | X | X | | | X | | X | X | |
| *Ceratopipra erythrocephala* | X | X | | X | X | | X | | |
| TITYRIDAE | | | | | | | | | |
| *Tityra cayana* | | | X | | X | | X | | X |
| *Schiffornis major* | | | | | X | | | X | |
| *Schiffornis turdina* | | P | | | P | | | | |
| *Laniocera hypopyrra* | | X | | | | | | | |
| *Iodopleura isabellae* | | | | | | | X | | X |
| *Pachyramphus polychopterus* | | P | | | | | X | | |
| *Pachyramphus marginatus* | | X | X | | | | | | |
| *INCERTAE SEDIS* | | | | | | | | | |
| *Piprites chloris* | | P | | | | | | | |
| VIREONIDAE | | | | | | | | | |
| *Hylophilus semicinereus* | | | | | | | | | X |

| | Pimichin | Yavita-Pimichín | Yavita | Maroa Runway | Victorino | S.Carlos Runway | S.Carlos-Solano | Caño S.Miguel | Atabapo-CVG |
|---|---|---|---|---|---|---|---|---|---|
| *Hylophilus brunneiceps* | | | X | X | | | | | X |
| *Tunchiornis ochraceiceps* | | X | | | | | | | |
| *Pachysylvia hypoxantha* | | X | | | X | | | | |
| *Vireo olivaceus* | | | X | X | | | | X | |
| CORVIDAE | | | | | | | | | |
| *Cyanocorax violaceus* | | | | | | | X | | |
| *Cyanocorax heilprini* | P | P | | X | | | | | |
| HIRUNDINIDAE | | | | | | | | | |
| *Pygochelidon melanoleuca* | | | | | X | | | | |
| *Stelgidopteryx ruficollis* | X | | X | | X | | | X | X |
| *Progne chalybea* | | | | X | X | | | | X |
| *Progne tapera* | | | | | | | | X | X |
| *Tachycineta bicolor* **(*)** | | | | | X | | | | |
| *Tachycineta albiventer* | | | | | X | | | X | |
| *Hirundo rustica* | | | | X | X | | | | |
| TROGLODYTIDAE | | | | | | | | | |
| *Microcerculus marginatus* | | X | | | | | | | |
| *Microcerculus bambla* | | | | | X | | | | |
| *Troglodytes aedon* | | | X | X | X | | X | | X |
| *Pheugopedius coraya* | | X | X | X | X | X | X | | X |
| *Microbates collaris* | | X | | | X | | | | |
| POLIOPTILIDAE | | | | | | | | | |
| *Polioptila plumbea* | P | | | | | | | | X |
| *Polioptila guianensis* | | X | | | | | | | |
| TURDIDAE | | | | | | | | | |
| *Catharus fuscescens* | | P | | | | | | | |
| *Catharus minimus* | X | X | | | | | X | | |
| *Turdus ignobilis* | | | | X | | | | | X |
| *Turdus albicollis* | X | X | | | X | X | | | |
| MIMIDAE | | | | | | | | | |
| *Mimus gilvus* | | | | | | | | X | X |
| THRAUPIDAE | | | | | | | | | |
| *Tachyphonus cristatus* | | P | | | | | | | |
| *Tachyphonus surinamus* | | P | | | | | X | | |
| *Tachyphonus phoenicius* | | | | X | | | | | X |
| *Ramphocelus carbo* | | | X | X | X | X | X | X | X |
| *Thraupis episcopus* | | | | X | X | X | X | | X |
| *Thraupis palmarum* | | | X | X | | X | X | X | X |
| *Tangara chilensis* | | | X | | | | | | |
| *Tangara velia* | | P | | | | | | | |
| *Tangara gyrola* | | P | | | | | | | |
| *Dacnis cayana* | | X | | X | | X | X | X | |
| *Cyanerpes nitidus* | | | | X | X | X | | | |
| *Cyanerpes caeruleus* | | X | X | | | | | | |
| *Cyanerpes cyaneus* | | X | X | | X | | | X | |
| *Emberizoides herbicola* | P | | | | | | | | |
| *Saltator maximus* | | | | | X | X | X | X | X |

| | Pimichin | Yavita-Pimichín | Yavita | Maroa Runway | Victorino | S.Carlos Runway | S.Carlos-Solano | Caño S.Miguel | Atabapo-CVG |
|---|---|---|---|---|---|---|---|---|---|
| *Saltator grossus* | | X | | | | X | X | | |
| *Volatinia jacarina* | | | | | X | | | X | |
| *Sporophila plumbea* | | P | | | | | | | |
| *Sporophila castaneiventris* | | | | X | | X | X | | |
| *Sporophila angolensis* | | | X | X | X | | X | X | |
| *Sporophila fringilloides* | X | | | X | X | | | | |
| *Chlorophanes spiza* | | P | | | | | | | |
| *Hemithraupis flavicollis* | P | P | | | | | | | |
| *Coereba flaveola* | | X | X | X | X | X | X | X | X |
| EMBERIZIDAE | | | | | | | | | |
| *Ammodramus aurifrons* | | | X | X | X | X | X | | |
| *Arremon taciturnus* | | | | | X | | | | |
| CARDINALIDAE | | | | | | | | | |
| *Caryothraustes canadensis* | | | X | X | X | | | | |
| *Cyanocompsa cyanoides* | | | X | | | | | | |
| PARULIDAE | | | | | | | | | |
| *Parkesia noveboracensis* | | | | X | | | X | | |
| *Setophaga striata* | | | | X | | | | | |
| ICTERIDAE | | | | | | | | | |
| *Molothrus oryzivorus* | | | | X | | | | | |
| *Icterus cayanensis* | X | | X | | X | | X | | |
| *Cacicus cela* | | | X | X | X | X | X | | |
| *Cacicus haemorrhous* | | | X | X | X | X | | | |
| *Psarocolius bifasciatus* | | X | X | X | | | | | |
| FRINGILLIDAE | | | | | | | | | |
| *Euphonia chrysopasta* | | | | | | | | | X |
| *Euphonia plumbea* | P | | | | | | | | |
| *Euphonia rufiventris* | | P | | | | | | | |
| TOTAL NUMBER OF SPECIES | 43 | 122 | 60 | 66 | 111 | 63 | 60 | 74 | 74 |

(*) Tentative identification.

Appendix 2. Species considered being closely associated with sandy soil vegetation in southern Venezuela on the basis of Hilty (2003; p: 12), and text of species descriptions.

| COMMON NAME | SPECIES | OBSERVATIONS FROM HILTY'S TEXT DESCRIPTION |
|---|---|---|
| WHITE SANDY SOIL SPECIALISTS | | |
| Bronzy Jacamar | *Galbula leucogastra* | Almost always associated with wooded habitats on white sandy soils |
| Yapacana Antbird | *Myrmeciza disjuncta* | An extreme habitat specialist seasonally saturated white sandy soil shrubby campina. |
| Pale-bellied Mourner | *Rhytipterna immunda* | Savanna woodland and borders in white sandy soil and scrubby low canopy várzea woodland. |

| COMMON NAME | SPECIES | OBSERVATIONS FROM HILTY'S TEXT DESCRIPTION |
|---|---|---|
| Red-shouldered Tanager | *Tachyphonus phoenicius* | White sandy soil savanna with scattered high bushes. |
| Yellow-crested Manakin | *Heterocercus flavivertex* | Dense, scrubby, and usually seasonally flooded and low-canopied forest or woodland on sandy or white sandy soils. |
| Blackish-gray Antshrike | *Thamnophilus nigrocinereus* | White sandy soil forest or woodland, especially in zones that are seasonally flooded. |
| Cherrie 's Antwren | *Myrmotherula cherriei* | Seasonally flooded low-canopied, and fairly dense scrub forest on white sandy soil. |
| Black Manakin | *Xenopipo atronitens* | Almost always in white sandy soil region. |
| MORE COMMON IN WHITE SANDY SOILS | | |
| Nocturnal Curassow | *Nothocrax urumutum* | Common in humid lowland forest in white sandy soil and blackwater regions of Amazonas. |
| Scarlet Macaw | *Ara macao* | Common in white sandy soil areas in Southern Venezuela. Present in other habitats. |
| Brown-throated Parakeet | *Eupsittula pertinax* | Occurs widely s of Orinoco in white sandy soil savannas. |
| Black-headed Parrot | *Pionites melanocephalus* | Humid lowland forest; especially numerous in blackwater/white sandy soil forests. |
| Orange-cheeked Parrot | *Pionops barrabandi* | Most numerous in white sandy soil regions of mixed forest, and savanna across w Amazonas. |
| Black-eared Fairy | *Heliothryx auritus* | Most numerous in white sandy soil regions with blackwater rivers. |
| Swallow-winged Puffbird | *Chelidoptera tenebrosa* | Most numerous in white sandy soil areas in w Amazonas. |
| Yellow-throated Antwren | *Myrmotherulo ambigua* | Most numerous in areas of poor or white sandy soil. Known from just a few specimen localities in s Amazonas. |
| Southern White-fringed Antwren | *Formicivora grisea* | Fairly common resident in thickets and bushes in white sandy soil savannas. |
| Scale-backed Antbird | *Willisornis poecilinotus* | Most numerous in white sandy soil forests of upper Orinoco and Rio Negro. |
| Gray-bellied Antbird | *Myrmeciza pelzelni* | A variety of sandy soil habitats from tall forest with fairly open understory to dense low canopied " campina" woodland on pure white sandy soil. |

| COMMON NAME | SPECIES | OBSERVATIONS FROM HILTY'S TEXT DESCRIPTION |
|---|---|---|
| Rufous-crowned Elaenia | *Elaenia ruficeps.* | Mainly sandy soil and white sand regions. |
| Helmeted Pygmy-Tyrant | *Lophotriccus galeatus* | Most numerous in slighter drier, scrubbier forest of white sandy soil regions. |
| Cinnamon Neopipo | *Neopipo cinnamomea* | Most records are from white sandy soil forests in *terra firme* regions. |
| Pompadour Cotinga | *Xipholena punicea* | Sandy soil forests, especially white sand areas of mixed savanna and woodland. |
| Dwarf Tyrant-Manakin | *Tyranneutes stolzmonni* | Very common in white sandy soil forests of Amazonas. |
| Saffron-crested Tyrant-Manakin | *Neopelma chrysocepha* | White sandy soil forests and scrubby forest mixed with savanna. |
| Guianan Gnatcatcher | *Polioptila guianensis* | Restricted to white sandy soil forest. Few records. |
| Plumbeous Euphonia | *Euphonia plumbea* | Open woodland, savanna forest borders, bushes in savanna, and scrub vegetation around edges of large rock outcrops in white sandy soil regions. |
| White-naped Seedeater | *Sporophila fringilloides.* | White sandy soil forest or wet openings along savanna/ forest interfaces. |