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Composition of bird community in Portachuelo Pass (Henri Pittier National Park, Venezuela)

Cristina Sainz-Borgo[1], Jhonathan Miranda[2], and Miguel Lentino[3]

Abstract The purpose of this study was to describe the composition of the bird community in Portachuelo Pass, located in Henri Pittier National Park, Venezuela. Portachuelo Pass is an important route for migratory birds between northern South America and the Southern Cone. During 11 months of sampling between 2010 and 2012, we captured 1,460 birds belonging to 125 identified species, 29 families, and 9 orders. The families with the highest relative abundance and species richness were Trochilidae and Thraupidae and the most common species were the Violet-chested Hummingbird (*Sternoclyta cyanopectus*), Olive-striped Flycatcher (*Mionectes olivaceus*), Plain-brown Woodcreeper (*Dendrocincla fuliginosa*), Orange-bellied Euphonia (*Euphonia xanthogaster*), Violet-fronted Brilliant (*Heliodoxa leadbeateri*), Vaux's Swift (*Chaetura vauxi*), Red-eared Parakeet (*Pyrrhura hoematotis*), Golden-tailed Sapphire (*Chrysuronia oenone*), Black-hooded Thrush (*Turdus olivater*), and Gray-rumped Swift (*Chaetura cinereiventris*). These species represented 52.4% of total captures and 8.0% of identified species. We captured 5 endemic species and 8 migratory species. The months of greatest relative abundance and species richness were June and July 2010 and January 2011. Birds captured belonged to the following feeding guilds: insectivorous, nectarivorous-insectivorous, frugivorous, frugivorous-insectivorous, granivorous, frugivorous-folivorous, omnivorous, carnivorous, and frugivorous-granivorous. We recaptured 226 individuals, with the highest percentage of recaptures occurring between January and May 2011. Additionally, we report altitudinal range extensions for the Streaked Tuftedcheek (*Pseudocolaptes boissonneautii*) and the Oleaginous Hemispingus (*Sphenopsis frontalis*).

Keywords bird assemblage, bird banding, cloud forest, Neotropical birds

Resumen Composición de la comunidad de aves en el paso de Portachuelo (Parque Nacional Henri Pittier, Venezuela)—El propósito de este estudio fue describir la composición de la comunidad de aves en el paso de Portachuelo, ubicado en el Parque Nacional Henri Pittier, Venezuela. Este paso es una ruta importante para las aves migratorias entre el norte de América del Sur y el Cono Sur. Durante 11 meses de muestreo, entre 2010 y 2012, capturamos 1.460 individuos pertenecientes a 125 especies identificadas, 29 familias y 9 órdenes. Las familias con mayor abundancia relativa y riqueza de especies fueron Trochilidae y Thraupidae y las especies más comunes fueron *Sternoclyta cyanopectus*, *Mionectes olivaceus*, *Dendrocincla fuliginosa*, *Euphonia xanthogaster*, *Heliodoxa leadbeateri*, *Chaetura vauxi*, *Pyrrhura hoematotis*, *Chrysuronia oenone*, *Turdus olivater* y *Chaetura cinereiventris*. Estas especies representaron el 52,4% de las capturas totales y el 8,0% de las especies identificadas. Capturamos 5 especies endémicas y 8 migratorias. Los meses de mayor abundancia relativa y riqueza de especies fueron junio y julio de 2010 y enero de 2011. Las aves capturadas pertenecían a los siguientes gremios de alimentación: insectívoros, nectarívoro-insectívoros, frugívoros, frugívoro-insectívoros, granívoros, frugívoro-folívoros, omnívoros, carnívoros y frugívoro-granívoros. Recapturamos 226 individuos, con el mayor porcentaje de recapturas entre enero y mayo de 2011. Además, reportamos ampliaciones del rango altitudinal para *Pseudocolaptes boissonneautii* y *Sphenopsis frontalis*.

Palabras clave anillamiento de aves, aves neotropicales, bosque nublado, ensamble de aves

Résumé Composition de la communauté d'oiseaux du col de Portachuelo (Parc national Henri Pittier, Venezuela) — Le but de la présente étude était de décrire la composition de la communauté d'oiseaux du col de Portachuelo, situé dans le Parc national Henri Pittier, au Venezuela. Le col de Portachuelo est une voie de migration importante pour les oiseaux migrant entre le nord de l'Amérique du Sud et le sud du continent. Pendant onze mois d'échantillonnage entre 2010 et 2012, nous avons capturé 1460 oiseaux appartenant à 125 espèces identifiées, 29 familles et 9 ordres. Les Trochilidae et les Thraupidae constituaient les familles présentant l'abondance relative et la richesse spécifique les plus fortes, et les espèces les plus communes étaient le Colibri à poitrine violette (*Sternoclyta cyanopectus*), le Pipromorphe olive (*Mionectes olivaceus*), le Grimpar enfumé (*Dendrocincla fuliginosa*), l'Organiste à ventre orange (*Euphonia xanthogaster*), le Brillant à front violet (*Heliodoxa leadbeateri*), le Martinet de Vaux (*Chaetura vauxi*), la Conure à oreillons (*Pyrrhura hoematotis*), le Saphir oenone (*Chrysuronia oenone*), le Merle à froc noir (*Turdus olivater*), et le Martinet à croupion

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gris (*Chaetura cinereiventris*). Ces espèces représentaient 52,4 % du total des captures et 8,0 % des espèces identifiées. Nous avons capturé 5 espèces endémiques et 8 espèces migratrices. L'abondance relative et la richesse spécifique étaient les plus fortes en juin et juillet 2010 ainsi qu'en janvier 2011. Les oiseaux capturés appartenaient aux guildes alimentaires suivantes : insectivores, nectarivores-insectivores, frugivores, frugivores-insectivores, granivores, frugivores-folivores, omnivores, carnivores et frugivores-granivores. Nous avons recapturé 226 individus, le pourcentage le plus élevé de recaptures ayant été relevé entre janvier et mai 2011. De plus, nous signalons des extensions altitudinales de l'aire de répartition de l'Anabate de Boissonneau (*Pseudocolaptes boissonneautii*) et du Tangara ocré (*Sphenopsis frontalis*).

Mots clés baguage d'oiseaux, communauté d'oiseaux, forêt tropicale d'altitude, oiseaux néotropicaux

The dynamics of bird communities in Neotropical humid forests are a complex and changing phenomenon that depends on a series of biotic and abiotic variables (Loiselle and Blake 1992). Multiple studies have concluded that greater availability of resources (flowers, fruits, etc.) contributes to greater diversity of bird assemblages (Orians 1969, Karr 1971, Terborgh 1990, Thiollay 1994, Patten *et al.* 2010), while reductions in habitat can lead to reductions in the abundance and species richness of bird communities (Patten *et al.* 2010). In a Neotropical humid forest at the Barro Colorado Island station in Panama, a long-term study spanning more than 70 yr (1923–1996) reported that 35% of the resident bird species disappeared over the course of the study (Robinson *et al.* 2000). Several studies show that cloud forests, which face threats that include habitat fragmentation and deforestation, are among the most endangered ecosystems in the Neotropics (Bubb *et al.* 2004, Scatena *et al.* 2010).

The forest in the northwestern part of the Venezuelan Coastal Range is classified as Vulnerable by the Venezuelan non-governmental organization Provita, in collaboration with the International Union for Conservation of Nature, due to a high level of human intervention and habitat destruction for residential or agricultural land use (Rodríguez *et al.* 2010). Henri Pittier National Park (HPNP) is a 1,078-km² protected area in the northwestern region of Venezuela with a high proportion of cloud forests and the greatest number of bird species per unit area in the country—at least 578 species in total, which represents 42% of all Venezuelan bird species (Lentino *et al.* 2009). This high species richness is associated with the diverse habitats found in the park, which include more than 25 different life zones (Fernández-Badillo 1997, Verea and Solórzano 2001). There have been several reports describing the composition of bird communities in the cloud forests of HPNP (Verea *et al.* 1997, Verea *et al.* 2000, Verea and Solórzano 2001, Lentino *et al.* 2003, Verea 2004), but considering the size of the park and its high species diversity and richness, most of the avifauna remains poorly understood.

At 1,136 m above sea level (asl), Portachuelo Pass is one of the lowest points of the Venezuelan Coastal Range and serves as a passage in and out of the park for many migratory and resident birds (Schäfer and Phelps 1954, Lentino and Goodwin 1993, 1994, Lentino and Portas 1994, Lentino *et al.* 1995, 2009). As the site of banding efforts during boreal migrations for more than 20 yr (September–November 1990–2012), this locality is one of the more studied areas in Venezuela in terms of species composition. However, only partial results from these efforts have been published. These include information on several aspects of bird migration in the Venezuelan Coastal Range, such as altitudinal movements, local migrations of resident species, and differences between autumn and spring migration patterns (Lentino *et al.* 2009). Except for the data generated by these September–November banding efforts, information about the composition of the bird community is scarce. The aim of this study was to describe the composition of the bird community in Portachuelo Pass using capture data collected during different months over the course of 3 yr. The objective was to describe the abundance and richness of species, families, and feeding guilds during each month that captures and banding were conducted, as well as to generate data that would allow us to compare the bird community of HPNP with that of other areas. With this data, we hope to further understand the complex patterns of cloud forest bird communities.

Methods

Study Area

This study was conducted in Portachuelo Pass in Henri Pittier National Park, Aragua, Venezuela, approximately 300 m northwest of the Rancho Grande Biological Station (10°20'57"N, 67°41'04"W) and 50 m from the road that goes through the park (Fig. 1). Portachuelo Pass consists of a grass clearing, ~100 m × 15 m, which passes through the surrounding area of tall trees and abundant understory vegetation. The climate at HPNP is biseasonal: the dry season spans December–March and the rainy season encompasses the rest of the year (Zinck 1986, Lentino *et al.* 2009). HPNP consists of a humid forest with high rainfall (Zinck 1986) and three vertical forest layers: 1) an emergent layer represented by the tallest trees, mostly between 35 m and 40 m high, consisting mainly of *Chimarrhis microcarpa* (Rubiaceae) and *Guapira opposita* (Nyctaginaceae); 2) a middle layer between 7 m and 10 m high, with many palm species such as *Dictyocaryum fuscum*, *Socratea* spp., and *Euterpe* spp. (Arecaceae); and 3) an understory layer below 7 m, which has several herbaceous species such as *Heliconia revoluta* (Heliconaceae) and *Notopleura agostinii* (Rubiaceae) (Zinck 1986).

Sampling

Fieldwork was conducted during June–October 2010; January, February, April, and May 2011; and June and July 2012. During each of these 11 months, eight mist nets (measuring 12 m × 2 m, with 30 mm mesh) were set for four consecutive days from 0600–1730. Birds captured were identified using the field guides of Hilty (2003) and Restall *et al.* (2006). We followed largely the taxonomy of Birds of the World (2020), except for Ruddy-tailed Flycatcher (*Terenotriccus erythrurus*), which is listed with Tyran-

Fig. 1. Study area location. Portachuelo Pass, located in Henri Pittier National Park in the Venezuelan Coastal Range, Aragua State, northern Venezuela. Map credit to Alison Ollivierre.

nidae instead of Oxyruncidae. We used the resulting data to examine species richness, expressed as a percentage of the total number of species captured throughout the study, and relative abundance, i.e., (captures of either a given species or another subset of our data) / (total captures of all species) × 100%.

We conducted a Permanova analysis (using Resemblance: S17 Bray-Curtis similarity) with the program Primer version 5 (Clarke and Gorley 2006), using the number of individuals per species in a given month to determine if there was a difference between sampling months. We used the numbers of individuals per species as variables, and included months as a factor in the Permanova analysis.

We also classified captured birds into feeding guilds: insectivorous, nectarivorous-insectivorous, frugivorous, frugivorous-insectivorous, granivorous, frugivorous-folivorous, omnivorous, carnivorous, and frugivorous-granivorous. This classification was based on previously published work by Poulin *et al.* (1994a, 1994b), Verea (2001), Verea and Solórzano (2001, 2005), and Cirqueira-Faustina and Graco-Machado (2006).

Results

During this study we captured 1,460 individuals belonging to 29 families and 9 orders. In total, we identified 125 species; 4 individuals could be identified only to the genus level (Appendix 1). This represents 21.6% of the bird species reported for HPNP based on previously published data (Lentino and Goodwin 1993, Lentino *et al.* 2009). A total of 263 species have been recorded at Portachuelo Pass, including 189 species that were banded from 1993 to 2008 (Lentino *et al.* 2009). We recaptured a total of 226 birds; the highest percentage of recaptures (48.7%) occurred between January and May 2011. We report three new species for Portachuelo Pass: Green-rumped Parrotlet (*Forpus passerinus*), Streaked Tuftedcheek (*Pseudocolaptes boissonneautii*), and Oleaginous Hemispingus (*Sphenopsis frontalis*) (Appendix 1). We also document a species rarely observed in this area, the Ferruginous Pygmy-Owl (*Glaucidium brasilianum*), which has been reported only four times throughout 20 yr of sampling in Portachuelo Pass (ML pers. obs.).

The family Trochilidae had the highest values for both relative abundance and species richness across the entire study period (relative abundance = 26.6% of all individuals captured, species richness = 18.4% of all identified species). The family Thraupidae had the second-highest relative abundance and species richness (11.0% of all individuals captured, 17.6% of all identified species), while the family with the third-highest relative abundance was Apodidae (9.7% of all individuals captured), and the family with the third-highest species richness was Furnariidae (10.4% of all identified species) (Fig. 2). In the nine months sampled during 2010 and 2011, the greatest abundances recorded for individual months were as follows: Apodidae (47.6% of the total captures for the month) and Thraupidae (27.2%) in June 2010, Trochilidae (28.5%) and Tyrannidae (25.0%) in July 2010, and Furnariidae (44.2%) and Turdidae (29.9%) in January 2011. Across all families, and considering only resident species during the nine sampling months in 2010 and 2011, the months of greatest relative abundance and species richness were June 2010

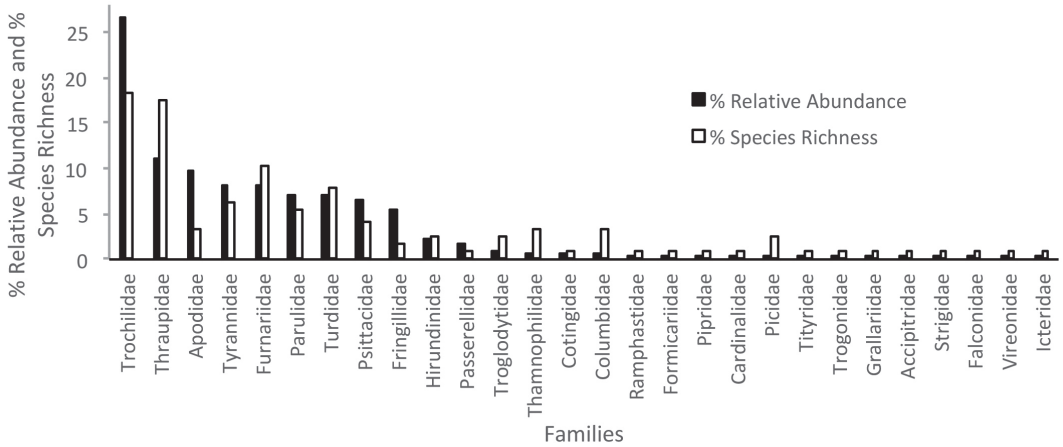

Fig. 2. Percentage of relative abundance and species richness of families found in Portachuelo Pass during our 11 months of sampling between 2010 and 2012.

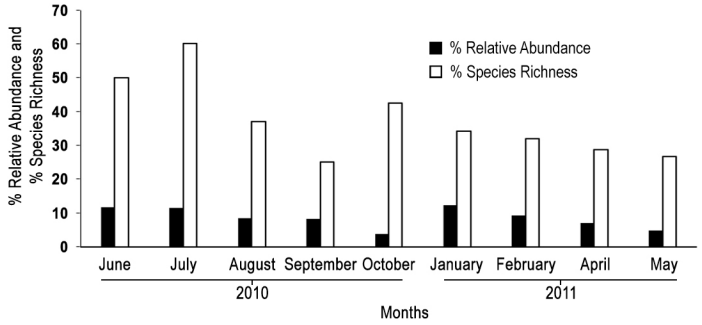

Fig. 3. Percentage of relative abundance and species richness of resident species at Portachuelo Pass during June–October 2010, and January, February, April, and May 2011.

(11.8% of all captures, 50.0% of all species), July 2010 (11.5% of all captures, 60.2% of species), and January 2011 (12.4% of all captures, 42.6% of all species) (Fig. 3). With migratory species included, the month of greatest relative abundance and species richness was September 2010 (9.7% of all captures, 48.8% of all species). Results of the Permanova analysis showed that there were significant differences among the relative abundances of the months (p = 0.001; Table 1).

The species captured most were the Violet-chested Hummingbird (*Sternoclyta cyanopectus*; 11.0% of all captures throughout the entire study period), Olive-striped Flycatcher (*Mionectes olivaceus*; 7.4%), Plain-brown Woodcreeper (*Dendrocincla fuliginosa*; 5.4%), Orange-bellied Euphonia (*Euphonia xanthogaster*; 5.4%), Violet-fronted Brilliant (*Heliodoxa leadbeateri*; 5.3%), Vaux's Swift (*Chaetura vauxi*; 4.1%), Red-eared Parakeet (*Pyrrhura hoematotis*; 3.8%), Golden-tailed Sapphire (*Chrysuronia oenone*; 3.6%), Black-hooded Thrush (*Turdus olivater*; 3.4%), and Gray-rumped Swift (*Chaetura cinereiventris*; 3.1%) (Fig. 4). These species accounted for 52.4% (765 individuals) of the total captures and 8.0% of the total identified species.

Captured species endemic to the Venezuelan Coastal Range were the Red-eared Parakeet, Guttulate Foliage-gleaner (*Synallaxis guttulata*), Venezuelan Bristle-Tyrant (*Phylloscartes venezuelanus*), Handsome Fruiteater (*Pipreola formosa*), and Rufous-cheeked Tanager (*Tangara rufigenis*), which accounted for 5.6% of all captures and 4.0% of all identified species. Migratory species captured were the Barn Swallow (*Hirundo rustica*), Cliff Swallow (*Petrochelidon pyrrhonota*), Gray-cheeked Thrush (*Catharus minimus*), Northern Waterthrush (*Parkesia noveboracensis*), Louisiana Waterthrush (*P. motacilla*), Black-and-white Warbler (*Mniotilta varia*), American Redstart (*Setophaga ruticilla*), and Yellow Warbler (*S. petechia*), accounting for 7.9% of all captures and 6.4% of all identified species (Appendix 1).

Table 1. Permanova partitioning and analysis of relative abundance of birds by month in Portachuelo Pass (p-value was based on 996 permutations, Var = component of variation).

Source	df	SS	MS	Pseudo F	p	Var
Months	8	34,882	4,360.3	1.5586	0.001	311.9
Residual	38	1.06×10^5	2,797.5			2,797.5
Total	46	1.41×10^5				

Individuals captured belonged to the following feeding guilds: insectivorous (34.1% of total captures), nectarivorous-insectivorous (29.2%), frugivorous (17.1%), frugivorous-insectivorous (14.2%), granivorous (2.7%), frugivorous-folivorous (1.3%), omnivorous (0.7%), carnivorous (0.2%), and frugivorous-granivorous (0.2%). We could not assign a feeding guild to four individuals (0.3% of total captures) because these birds were not identified to the species level. The feeding guilds with the highest species richness were insectivorous (41.6% of all identified species), nectarivorous-insectivorous (20.8%), frugivorous (12.0%), and frugivorous-insectivorous (9.6%) (Table 2).

The majority of nectarivorous-insectivorous individuals captured were of the family Trochilidae (n = 388 individuals captured, 26.6% of all captures). Other members of this guild were of the family Thraupidae: Red-legged Honeycreeper

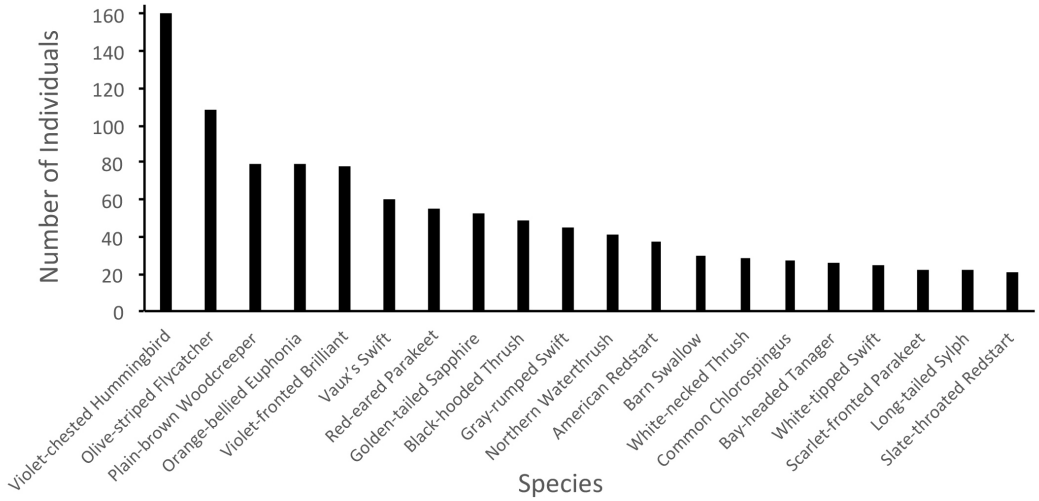

Fig. 4. Twenty most-captured species at Portachuelo Pass during our 11 months of sampling between 2010 and 2012.

Table 2. Feeding guilds in Portachuelo Pass during our 11 months of sampling between 2010 and 2012. Insectivorous (I), nectarivorous-insectivorous (NI), frugivorous (F), frugivorous-insectivorous (FI), granivorous (G), frugivorous-folivorous (FF), omnivorous (O), carnivorous (C), and frugivorous-granivorous (FG).

Guild	# Individuals (% of All Captures)	# Species (% of Identified species)
I	498 (34.1)	52 (41.6)
NI	427 (29.2)	26 (20.8)
F	249 (17.1)	15 (12.0)
FI	208 (14.2)	12 (9.6)
G	39 (2.7)	11 (8.8)
FF	19 (1.3)	2 (1.6)
O	10 (0.7)	2 (1.6)
C	3 (0.2)	3 (2.4)
FG	3 (0.2)	2 (1.6)
Unknown	4 (0.3)	–

(*Cyanerpes cyaneus*; *n* = 16, 1.1%), Purple Honeycreeper (*C. caeruleus*; *n* = 14, 1.0%), and Bananaquit (*Coereba flaveola*; *n* = 9, 0.6%). The dominant frugivorous-insectivorous species captured was the Olive-striped Flycatcher (*n* = 108, 7.4%), which is one of the most common bird species known to Portachuelo Pass (Lentino *et al.* 2009). Numerous frugivorous captures were the Orange-bellied Euphonia (*n* = 79, 5.4%), Red-eared Parakeet (*n* = 55, 3.8%), and Bay-headed Tanager (*Tangara gyrola*; *n* = 26, 1.8%). Insectivores showed the highest species richness of any feeding guild; in total, 52 insectivorous species from 15 families were recorded. The most numerous insectivorous captures were the Plain-brown Woodcreeper (*n* = 79, 5.4%), Vaux's Swift (*n* = 60, 4.1%), and Gray-rumped Swift (*n* = 45, 3.1%). Granivorous birds captured included the Sooty Grassquit (*Asemospiza fuliginosa*; *n* = 9, 0.6%), Blue-black Grosbeak (*Cyanoloxia cyanoides*; *n* = 7, 0.5%), and Chestnut-bellied Seed-Finch (*Sporophila angolensis*; *n* = 6, 0.4%). Frugivorous-folivorous species included only the Lilac-tailed Parrotlet (*Touit batavicus*; *n* = 16, 1.1%) and the Buff-throated Saltator (*Saltator maximus*; *n* = 3, 0.2%), while carnivorous species were represented by the Black-and-white Hawk-Eagle (*Spizaetus melanoleucus*; *n* = 1, 0.07%), Ferruginous Pygmy-Owl (*n* = 1, 0.07%), and Bat Falcon (*Falco rufigularis*; *n* = 1, 0.07%). Two omnivorous species were captured, the Groove-billed Toucanet (*Aulacorhynchus sulcatus*; *n* = 8, 0.5%) and the White-tipped Quetzal (*Pharomachrus fulgidus*; *n* = 2, 0.1%), and two frugivorous-granivorous species were captured, the Red-billed Parrot (*Pionus sordidus*; *n* = 2, 0.1%) and the Green-rumped Parrotlet (*n* = 1, 0.07%) (Appendix 1).

Frugivorous-insectivorous species captures peaked in September 2010 (12.4% of all captured species from this guild) and January 2011 (7.8%), insectivorous in June 2010 (25.9%) and January 2011 (17.9%), frugivorous in June 2010 (20.2%) and July 2010 (19.3%), and nectarivorous-insectivorous in July 2010 (24.2%) and February 2011 (16.1%) (Fig. 5).

Of the captures made during our 11 months of sampling (*n* = 1,460 individuals), most birds were caught between 0600 and 0959: 0600–0659 (*n* = 152 individuals, 10.4%), 0700–0759 (*n* = 193, 13.2%), 0800–0859 (*n* = 216, 14.8%), and 0900–0959 (*n* = 127, 8.7%). The most abundant families during these hours were Tyrannidae, Turdidae, Trochilidae, Furnariidae, and Thraupidae.

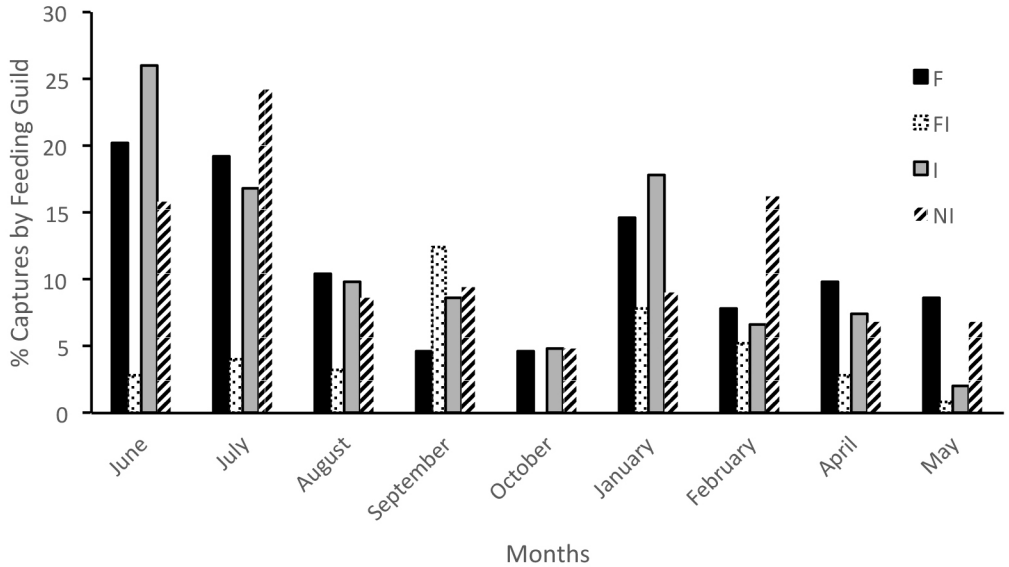

Fig. 5. Captures of four most common feeding guilds at Portachuelo Pass for the period June–October 2010 and January, February, April, and May 2011, with monthly captures for each guild expressed as a percentage of the total captures for each guild. Feeding guilds: frugivorous (F), frugivorous-insectivorous (FI), insectivorous (I), and nectarivorous-insectivorous (NI).

Discussion

High species richness is frequently associated with cloud forests, probably as a consequence of the structural complexity of this habitat (Blake and Loiselle 1991). Compared with other habitats within HPNP, such as the subtropical temperate forest of Guacamaya Peak (56 species) and an area of deciduous forest (59 species) (Verea and Solórzano 2001), Portachuelo Pass has a high species richness that is likely due to its use by migratory and resident birds as a passage through the mountains. Our results demonstrate the importance of Portachuelo Pass for bird conservation, even though it is just a few meters from a park road and is also close to both agricultural lands and Maracay, one of the largest cities in the country.

Considering only resident species, the months with the highest relative abundance and species richness were June and July 2010 and January 2011. With migratory species included, the highest relative abundance and species richness occurred in September 2010. The variation in relative abundance and species richness we observed is likely due mainly to differences in the amount of precipitation between months, as has been reported by studies in different Neotropical forests (Blake and Rouges 1997, Verea and Solórzano 2001). Variation in precipitation tends to produce differences in resource availability, such as insects, flowers, fruits, and nectar (Stiles 1978, 1985). As a result of varying food availability, some birds relocate seasonally as they search for new resources (Karr 1976). Another important variable to take into account is the seasonal movement of birds along the altitudinal gradient as they leave their breeding sites (Loiselle and Blake 1992). The dynamics of these movements are unknown for many species.

Community Composition

The bird community of Portachuelo Pass as sampled by our captures was dominated by hummingbirds, which comprise the family Trochilidae (26.6% of total captures), a result which has also been reported for bird communities in other areas of HPNP (Verea and Solórzano 2001, 2011). This may be associated with the abundance of flowering plants, as has been reported in other forests where hummingbirds dominate (Stiles 1980, 1985). Notably, we captured the Rufous-breasted Hermit (*Glaucis hirsutus*; $n = 2$ individuals) and the Copper-rumped Hummingbird (*Amazilia tobaci*; $n = 11$ individuals) during our study. Both are lowland species which we did not necessarily expect to encounter; the Copper-rumped Hummingbird has been occasionally recorded at Portachuelo Pass and the Rufous-breasted Hermit is present in Portachuelo Pass only sometimes, probably depending on a seasonal 5–7 yr population cycle (Lentino *et al.* 2009).

One of the most abundant species was from the Tyrannidae family, the Olive-striped Flycatcher, which has also been reported as abundant in previous studies in Portachuelo Pass (Lentino *et al.* 2009, Lentino 2016). Remsen and Good (1996) suggested that some species with large home ranges might have an increased likelihood of capture due to increased flight distance and frequency and because their home range could overlap with mist-net stations. This could be the case for the Olive-striped Flycatcher. Also, though relatively little is known about the biology and behavior of this species, it is known to form leks (areas in which males make competitive displays to attract female mates; Gómez-Serrano *et al.* 2009). This lekking behavior may play a role in the high levels of capture that we observed, as many females come to watch the males display.

We found that after Trochilidae, the second most abundant family was Thraupidae, followed by Apodidae, Tyrannidae, and Furnariidae; these families have also been reported as abundant in other Neotropical cloud forests (Blake 2007). At Guacamaya Peak (1,900 m asl), the most abundant family was Trochilidae, while the second was Furnariidae, followed by Thraupidae and Turdidae (Verea and Solórzano 2011). These differences in relative abundance between Guacamaya Peak and Portachuelo Pass are likely associated with the different altitudes of the two locations. Among the thraupids, we found that the most abundant species were the Bay-headed Tanager and the Golden Tanager (*Tangara arthus*). These two species are frugivorous and more common in the canopy than in the undergrowth (Greenberg 1981), likely because fruit is more abundant in the canopy (Blake and Loiselle 2001). This result—which was unexpected, given that our sampling took place near the ground—highlights the need for additional research on the frugivores of this area.

Migratory species represented a low percentage of richness with only eight species recorded. However, during the months of boreal migration these species had high relative abundances. Interestingly, for the most abundant migratory species, the Northern Waterthrush, we observed a higher relative abundance in September and October 2010 compared to previous results from Portachuelo Pass; for other migratory species, like the Gray-cheeked Thrush, we observed a lower relative abundance in those months compared to previous research (Lentino *et al.* 2009). Although Portachuelo Pass is often used as a route for migratory species in September and October, this apparently is not the case in April and May, as no sightings or captures of migrants were made during these months. This implies that there may be another route used by these species to return to North America.

We observed only 5 endemic species in this study, which is relatively few. Elsewhere in HPNP, Verea (2001) reported 29 endemic species in wet forest habitat, and Verea and Solórzano (2011) reported 22 endemic species in the humid mossy forest habitat of Guacamaya Peak. Based on records from 1957 to 1989, Hernandez-Baños *et al.* (1995) reported that the number of endemic species in humid montane forests across Mesoamerica varies from 5 to more than 50.

We captured two upland species, the Streaked Tuftedcheek and the Oleaginous Hemispingus; these species have previously been reported from 1,600–2,300 m asl, (Hilty 2003) and 1,700–3,200 m asl (Hilty 2003, Restall *et al.* 2006, Remsen 2016), respectively. Our capture of these species at the lower altitude of Portachuelo Pass represents altitudinal range extensions (Appendix 1).

Feeding Guilds

The predominant feeding guild was insectivorous, followed by nectarivorous-insectivorous and frugivorous (Table 2). These results are similar to previous studies which show that deciduous and dry forest areas of HPNP are also dominated by insectivorous species (Verea *et al.* 2000, Verea and Solórzano 2001). However, our results contrast with those shown for the humid mossy forest of Guacamaya Peak, where the most abundant

feeding guild was nectarivorous-insectivorous (Verea and Solórzano 2011), and with cloud forests in southeastern Brazil and the western Colombian Andes, where insectivorous and frugivorous were the most abundant guilds (Willis and Schuchmann 1993). In general, insectivore abundances tend to be reduced in places with more human impact and habitat fragmentation (Canaday 1996, Ford *et al.* 2001, Laurance *et al.* 2002, Şekercioğlu *et al.* 2002). Despite the nearby park road and trails in Portachuelo Pass, we observed that insectivorous species had the highest relative abundance overall; this may be due in part to our mist-net sampling method, which could have disproportionately captured understory insectivores (Karr 1981). Nectarivorous-insectivorous species tend to be abundant in disturbed forests (Johns 1991). The frugivorous guild is one of the most common in tropical communities (Loiselle 1988, Karr *et al.* 1990, Loiselle and Blake 1991), and its abundance is usually correlated with fruit availability (Blake and Loiselle 1991) and the rainy season, when fruit production increases (Karr 1981). We did not measure fruit production, but previous studies in the area have found variation in the phenology of plants across the year (Seres and Ramírez 1990) that is correlated with the abundance of hummingbirds (Malpica-Piñeros *et al.* 2018); something similar likely occurs for frugivores. Frugivorous-insectivorous was the fourth-most abundant guild in Portachuelo Pass, according to our data, and 10 of the 12 captured species belonged to the family Turdidae. These results are similar to those found in the humid mossy forest of Guacamaya Peak (Verea and Solórzano 2001). This guild generally has lower relative abundance in fragmented habitat, likely due to sedentarism and slow breeding, among other factors (Newbold *et al.* 2013). We captured carnivorous species only very rarely. This could be because raptors may escape easily from standard mist nets; for example, CS has observed both the Osprey (*Pandion haliaetus*) and the Sharp-shinned Hawk (*Accipiter striatus*) escape from a mist net (pers. obs.). Captures of granivorous, frugivorous-folivorous, omnivorous, and frugivorous-granivorous species were also rare, results similar to those found in the humid mossy forest of Guacamaya Peak (Verea 2001).

Throughout the sampling months, we observed variation in the numbers of captured birds belonging to the three major feeding guilds. This variation is likely complex and could be influenced by a number of factors, including the characteristics of each guild and how they respond to environmental variation. Despite numerous studies on this topic, the influence of environmental variation on the abundance of birds and availability of food is little understood, though there is a consensus that the abundance of birds in general is dependent on the availability of feeding resources (Stiles 1985).

In this study, almost all nectarivorous-insectivorous species caught were hummingbirds. Hummingbirds feed mainly on the nectar of flowers, which restricts them to habitats where flowering plants are available (Wolf *et al.* 1976). However, studies of the Violet-chested Hummingbird in Portachuelo Pass do not show a correlation between the relative abundance of this species and the availability of floral resources (Malpica-Piñeros 2014). In order to explain hummingbird composition and variation in Portachuelo Pass, it would be necessary to monitor both food resources and hummingbird abundance.

Abundance During the Day

Many factors may affect the number of mist-net captures, including light intensity, visibility, temperature, territory size, vegetation, and habitat structure (Keyes and Grue 1982, Remsen and Good 1996, Pagen *et al.* 2002, Zou *et al.* 2010). For example, during the early morning at Portachuelo Pass, visibility is low because of the low angle of the sun and the presence of mist. These factors help explain the maximum in capture abundance observed between 0600 and 0900, which is consistent with reports for the bird communities in other habitats, where the morning is characterized by increased bird activity (Robbins 1981, Trnka *et al.* 2006).

Recaptures

Our results show that the highest percentage of recaptures occurred between January and May 2011, which could indicate that during these months some birds spent more time in Portachuelo Pass. It is likely that between June and October 2010 birds had decreased mobility due to molting, which results in reduced level flight speed and maneuverability and also affects the ability to take off of the ground (Swaddle and Witter 1997); this may have led to the lower number of recaptures during these months.

Summary

Despite the importance of HPNP for birds in Venezuela, few studies have evaluated the richness and abundance of the bird community in the park (Verea and Solórzano, 2001, 2011, Verea and Díaz 2004). The variation in relative abundance, species richness, and feeding guilds over the months observed in our study indicates possible variation in resources, which could be the subject of future study. Importantly, our captures of the Streaked Tuftedcheek and the Oleaginous Hemispingus could be indicative of changes in the altitudinal distribution of these species. This could be the result of factors such as climate change, land use changes, or increased human disturbance diminishing the habitat of these species and causing their displacement towards more pristine areas.

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Title Page Illustration

Golden-olive Woodpecker (*Colaptes rubiginosus*); photo taken during a bird banding project at PN Henri Pittier, Paso Portachuelo, Aragua, Venezuela, on 24 November 2019 by Pedro Ar-

turo Amaro (Macaulay Library ML190195241).

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Appendix 1. Total number of birds captured per species during our 11 months of sampling in Portachuelo Pass, Henri Pittier National Park, Venezuela, between 2010 and 2012. *Altitudinal range expansion.

Species	Feeding Guild	# Individuals	Notes
Columbidae			
Ruddy Ground Dove (*Columbina talpacoti*)	granivorous	1	
Blue Ground Dove (*Claravis pretiosa*)	granivorous	3	
Ruddy Quail-Dove (*Geotrygon montana*)	granivorous	3	
Lined Quail-Dove (*Zentrygon linearis*)	granivorous	2	
Apodidae			
White-collared Swift (*Streptoprocne zonaris*)	insectivorous	11	
Vaux's Swift (*Chaetura vauxi*)	insectivorous	60	
Gray-rumped Swift (*C. cinereiventris*)	insectivorous	45	
White-tipped Swift (*Aeronautes montivagus*)	insectivorous	25	
Trochilidae			
White-necked Jacobin (*Florisuga mellivora*)	nectarivorous-insectivorous	1	
Rufous-breasted Hermit (*Glaucis hirsutus*)	nectarivorous-insectivorous	2	
Stripe-throated Hermit (*Phaethornis striigularis*)	nectarivorous-insectivorous	1	
Sooty-capped Hermit (*P. augusti*)	nectarivorous-insectivorous	2	
Geoffroy's Daggerbill (*Schistes geoffroyi*)	nectarivorous-insectivorous	11	
Brown Violetear (*Colibri delphinae*)	nectarivorous-insectivorous	2	
Ruby-topaz Hummingbird (*Chrysolampis mosquitus*)	nectarivorous-insectivorous	1	
Black-throated Mango (*Anthracothorax nigricollis*)	nectarivorous-insectivorous	1	
Spangled Coquette (*Lophornis stictolophus*)	nectarivorous-insectivorous	1	
Long-tailed Sylph (*Aglaiocercus kingii*)	nectarivorous-insectivorous	22	
Bronzy Inca (*Coeligena coeligena*)	nectarivorous-insectivorous	13	
Booted Racket-tail (*Ocreatus underwoodii*)	nectarivorous-insectivorous	1	
Violet-fronted Brilliant (*Heliodoxa leadbeateri*)	nectarivorous-insectivorous	78	
Violet-chested Hummingbird (*Sternoclyta cyanopectus*)	nectarivorous-insectivorous	160	
Rufous-shafted Woodstar (*Chaetocercus jourdanii*)	nectarivorous-insectivorous	1	
Blue-tailed Emerald (*Chlorostilbon mellisugus*)	nectarivorous-insectivorous	4	
Blue-chinned Sapphire (*Chlorestes notata*)	nectarivorous-insectivorous	1	
Violet-headed Hummingbird (*Klais guimeti*)	nectarivorous-insectivorous	4	
Lazuline Sabrewing (*Campylopterus falcatus*)	nectarivorous-insectivorous	5	
White-vented Plumeleteer (*Chalybura buffonii*)	nectarivorous-insectivorous	13	
Glittering-throated Emerald (*Amazilia fimbriata*)	nectarivorous-insectivorous	1	
Copper-rumped Hummingbird (*A. tobaci*)	nectarivorous-insectivorous	11	
Golden-tailed Sapphire (*Chrysuronia oenone*)	nectarivorous-insectivorous	52	
Accipitridae			
Black-and-white Hawk-Eagle (*Spizaetus melanoleucus*)	carnivorous	1	
Strigidae			
Ferruginous Pygmy-Owl (*Glaucidium brasilianum*)	carnivorous	1	
Trogonidae			
White-tipped Quetzal (*Pharomachrus fulgidus*)	omnivorous	2	
Ramphastidae			
Groove-billed Toucanet (*Aulacorhynchus sulcatus*)	omnivorous	8	
Picidae			
Scaled Piculet (*Picumnus squamulatus*)	insectivorous	1	
Smoky-brown Woodpecker (*Dryobates fumigatus*)	insectivorous	2	
Golden-olive Woodpecker (*Colaptes rubiginosus*)	insectivorous	3	

Appendix 1. cont.

Species	Feeding Guild	# Individuals	Notes
Falconidae			
Bat Falcon (*Falco rufigularis*)	carnivorous	1	
Psittacidae			
Lilac-tailed Parrotlet (*Touit batavicus*)	frugivorous-folivorous	16	
Red-billed Parrot (*Pionus sordidus*)	frugivorous-granivorous	2	
Green-rumped Parrotlet (*Forpus passerinus*)	frugivorous-granivorous	1	first record
Red-eared Parakeet (*Pyrrhura hoematotis*)	frugivorous	55	endemic
Scarlet-fronted Parakeet (*Psittacara wagleri*)	frugivorous	22	
Thamnophilidae			
Great Antshrike (*Taraba major*)	insectivorous	4	
Plain Antvireo (*Dysithamnus mentalis*)	insectivorous	2	
White-streaked Antvireo (*D. leucostictus*)	insectivorous	3	
Slaty Antwren (*Myrmotherula schisticolor*)	insectivorous	1	
Grallariidae			
Plain-backed Antpitta (*Grallaria haplonota*)	insectivorous	2	
Formicariidae			
Black-faced Antthrush (*Formicarius analis*)	insectivorous	8	
Furnariidae			
Gray-throated Leaftosser (*Sclerurus albigularis*)	insectivorous	3	
Olivaceous Woodcreeper (*Sittasomus griseicapillus*)	insectivorous	1	
Plain-brown Woodcreeper (*Dendrocincla fuliginosa*)	insectivorous	79	
Black-banded Woodcreeper (*Dendrocolaptes picumnus*)	insectivorous	1	
Strong-billed Woodcreeper (*Xiphocolaptes promeropirhynchus*)	insectivorous	2	
Cocoa Woodcreeper (*Xiphorhynchus susurrans*)	insectivorous	4	
Olive-backed Woodcreeper (*X. triangularis*)	insectivorous	1	
Red-billed Scythebill (*Campylorhamphus trochilirostris*)	insectivorous	2	
Streaked Tuftedcheek (*Pseudocolaptes boissonneautii*)	insectivorous	3	first record*
Sharp-tailed Streamcreeper (*Lochmias nematura*)	insectivorous	1	
Montane Foliage-gleaner (*Anabacerthia striaticollis*)	insectivorous	7	
Guttulate Foliage-gleaner (*Syndactyla guttulata*)	insectivorous	13	endemic
Streak-capped Treehunter (*Thripadectes virgaticeps*)	insectivorous	1	
Tyrannidae			
Ruddy-tailed Flycatcher (*Terenotriccus erythrurus*)	insectivorous	1	Oxyruncidae
Mountain Elaenia (*Elaenia frantzii*)	insectivorous	1	
Marble-faced Bristle-Tyrant (*Phylloscartes ophthalmicus*)	insectivorous	1	
Venezuelan Bristle-Tyrant (*P. venezuelanus*)	insectivorous	1	endemic
Olive-striped Flycatcher (*Mionectes olivaceus*)	frugivorous-insectivorous	108	
Slaty-capped Flycatcher (*Leptopogon superciliaris*)	insectivorous	2	
White-throated Spadebill (*Platyrinchus mystaceus*)	insectivorous	2	
Golden-crowned Flycatcher (*Myiodynastes chrysocephalus*)	insectivorous	4	
Cotingidae			
Handsome Fruiteater (*Pipreola formosa*)	frugivorous	10	endemic
Pipridae			
Golden-headed Manakin (*Ceratopipra erythrocephala*)	frugivorous	7	

Appendix 1. cont.

Species	Feeding Guild	# Individuals	Notes
Tityridae			
Masked Tityra (*Tityra semifasciata*)	insectivorous	4	
Vireonidae			
Rufous-browed Peppershrike (*Cyclarhis gujanensis*)	insectivorous	1	
Hirundinidae			
Southern Rough-winged Swallow (*Stelgidopteryx ruficollis*)	insectivorous	1	
Barn Swallow (*Hirundo rustica*)	insectivorous	30	migratory
Cliff Swallow (*Petrochelidon pyrrhonota*)	insectivorous	2	migratory
Troglodytidae			
Scaly-breasted Wren (*Microcerculus marginatus*)	insectivorous	2	
Rufous-and-white Wren (*Thryophilus rufalbus*)	insectivorous	1	
Gray-breasted Wood-Wren (*Henicorhina leucophrys*)	insectivorous	10	
Turdidae			
Andean Solitaire (*Myadestes ralloides*)	frugivorous-insectivorous	2	
Gray-cheeked Thrush (*Catharus minimus*)	frugivorous-insectivorous	2	migratory
Pale-breasted Thrush (*Turdus leucomelas*)	frugivorous-insectivorous	3	
Cocoa Thrush (*T. fumigatus*)	frugivorous-insectivorous	1	
Yellow-legged Thrush (*T. flavipes*)	frugivorous-insectivorous	2	
White-necked Thrush (*T. albicollis*)	frugivorous-insectivorous	28	
Spectacled Thrush (*T. nudigenis*)	frugivorous-insectivorous	1	
Pale-eyed Thrush (*T. leucops*)	frugivorous-insectivorous	6	
Black-hooded Thrush (*T. olivater*)	frugivorous-insectivorous	49	
Glossy-black Thrush (*T. serranus*)	frugivorous-insectivorous	5	
Turdus spp.		3	
Fringillidae			
Blue-naped Chlorophonia (*Chlorophonia cyanea*)	frugivorous	1	
Orange-bellied Euphonia (*Euphonia xanthogaster*)	frugivorous	79	
Passerellidae			
Common Chlorospingus (*Chlorospingus flavopectus*)	insectivorous	27	
Icteridae			
Shiny Cowbird (*Molothrus bonariensis*)	insectivorous	1	
Parulidae			
Louisiana Waterthrush (*Parkesia motacilla*)	insectivorous	1	migratory
Northern Waterthrush (*P. noveboracensis*)	insectivorous	41	migratory
Black-and-white Warbler (*Mniotilta varia*)	insectivorous	1	migratory
American Redstart (*Setophaga ruticilla*)	insectivorous	37	migratory
Tropical Parula (*S. pitiayumi*)	insectivorous	1	
Yellow Warbler (*S. petechia*)	insectivorous	2	migratory
Slate-throated Redstart (*Myioborus miniatus*)	insectivorous	21	
Cardinalidae			
Blue-black Grosbeak (*Cyanoloxia cyanoides*)	granivorous	7	
Thraupidae			
Oleaginous Hemispingus (*Sphenopsis frontalis*)	frugivorous-insectivorous	1	first record*
Gray-headed Tanager (*Eucometis penicillata*)	insectivorous	11	

Appendix 1. cont.

Species	Feeding Guild	# Individuals	Notes
Blue-winged Mountain Tanager (*Anisognathus somptuosus*)	frugivorous	2	
Blue-gray Tanager (*Thraupis episcopus*)	frugivorous	3	
Palm Tanager (*T. palmarum*)	frugivorous	10	
Speckled Tanager *(Ixothraupis guttata)*	frugivorous	3	
Burnished-buff Tanager (*Stilpnia cayana*)	frugivorous	1	
Bay-headed Tanager (*Tangara gyrola*)	frugivorous	26	
Rufous-cheeked Tanager (*T. rufigenis*)	frugivorous	3	endemic
Golden Tanager (*T. arthus*)	frugivorous	18	
Swallow Tanager (*Tersina viridis*)	insectivorous	7	
Purple Honeycreeper (*Cyanerpes caeruleus*)	nectarivorous-insectivorous	14	
Red-legged Honeycreeper (*C. cyaneus*)	nectarivorous-insectivorous	16	
Green Honeycreeper (*Chlorophanes spiza*)	frugivorous	9	
Blue-black Grassquit (*Volatinia jacarina*)	granivorous	4	
Ruddy-breasted Seedeater (*Sporophila minuta*)	granivorous	1	
Chestnut-bellied Seed-Finch (*S. angolensis*)	granivorous	6	
Yellow-bellied Seedeater (*S. nigricollis*)	granivorous	1	
Bananaquit (*Coereba flaveola*)	nectarivorous-insectivorous	9	
Dull-colored Grassquit (*Asemospiza obscura*)	granivorous	2	
Sooty Grassquit (*A. fuliginosa*)	granivorous	9	
Buff-throated Saltator (*Saltator maximus*)	frugivorous-folivorous	3	
Saltator sp.		1	