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Bird species distribution and conservation in Serra do Cipó, Minas Gerais, Brazil

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Summary

We studied the distribution of birds along an altitudinal gradient ranging from 800 m to 1,400 m on two slopes of the Serra do Cipó, Minas Gerais, southeastern Brazil. Ornithological surveys were conducted over transects covering open (*cerrado, campo rupestre*) and forested (gallery and Atlantic forest) habitats from 1994 to 2000. We found 273 bird species belonging to 51 families. Twenty-two species were restricted to higher elevations and 84 species were detected on only one slope, depending on the vegetation type they inhabited. We recorded 104 species occurring on both slopes, while 61 species were considered altitudinal generalists. Six species, including Hyacinth Visorbearer *Augastes scutatus* and Cipó Canastero *Asthenes luizae* were restricted to the highest parts of Serra do Cipó, a fragile habitat important to endemic birds of the Espinhaço Range. In the past 10 years, the Serra do Cipó region has suffered human impacts on a large scale, and conservation action must be developed to protect the fauna and flora confined to the area.

Introduction

Although the Brazilian bird fauna is one of the most diverse in the world (Sick 1997), studies involving patterns along altitudinal gradients are limited to Holt (1928), Scott and Brooke (1985), Bencke and Kindel (1999), Goerck (1999) and Buzzetti (2000). This is especially true for the Espinhaço region, a mountainous area in southeastern Brazil, which, even though a globally important centre of plant and animal endemism (Giulietti and Pirani 1988, Harley 1988, Barros 1990, Giulietti and Hensold 1990, Wanderley 1990, Eiten 1992, Silva 1995a, 1998, Giulietti *et al.* 1997, Sick 1997, Stattersfield *et al.* 1998), has not yet been studied to the extent it deserves. Within the Espinhaço Range vegetation composition and structure change dramatically along altitudinal gradients, offering a landscape where the influence of habitat complexity upon biological diversity can be studied in detail in a small geographical area. In addition, this mountain range separates two important biomes in its central and southern portion: the Atlantic forest on the eastern slope, and the *cerrado* on the western slope (Giulietti and Pirani 1988, Harley 1995, Giulietti *et al.* 1997). The highest parts of the Espinhaço Range consist of *campo rupestre*, a rupestrian grassland with many endemic plant taxa, growing among and on rocky outcrops, with scattered shrubs and small trees (Menezes and Giulietti 1986, 2000; Eiten 1992; Giulietti *et al.* 1997).

The mountainous Serra do Cipó, particularly the southern Espinhaço Range,

lends itself to the study of species composition along altitudinal gradients and between slopes. Several studies on the distribution of insects and plants in Serra do Cipó have been carried out, in an attempt to better understand the effects of altitude (changes in temperature, moisture, and soil nutritional status) on patterns of species richness (Fernandes and Price 1988, Carneiro *et al.* 1995, Lara and Fernandes 1996, Ribeiro *et al.* 1998). The primary goal of this study was to describe bird species distribution along the altitudinal gradient of Serra do Cipó and between eastern (Atlantic Forest) and western (*cerrado*) slopes, to inform conservation action in the region.

Study area

Serra do Cipó is located in the central area of Minas Gerais State, southeastern Brazil, between 19°12′–19°34′S and 43°27′–43°38′W, in the southern portion of the Espinhaço Range. The Serra do Cipó National Park comprises 33,800 ha (Figure 1). The altitudinal range is from *c.* 800 to *c.* 1,600 m, with one peak (Pico do Breu) reaching 1,687 m (Goulart 2000). The climate is tropical montane with mean annual temperature varying between 17 and 18.5 °C, and mean annual precipitation between 1,450 and 1,850 mm (Antunes 1986). Precipitation falls primarily between December and March (Antunes 1986). Our study was conducted at the Serra do Cipó region, in the municipalities of Lagoa Santa, Jaboticatubas, Santana do Riacho, Itambé do Mato Dentro, Morro do Pilar, and Conceição do Mato Dentro and along the road (MG 010) that crosses the region (Figure 1).

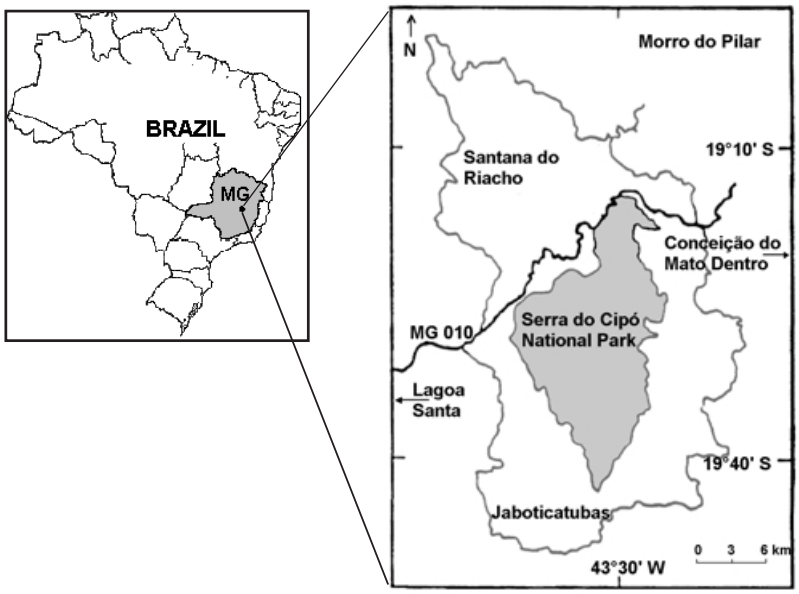

Figure 1. Map of Serra do Cipó region, Minas Gerais state, southeastern Brazil. Sites used in this study were situated in Serra do Cipó National Park, municipalities borders and along the road (MG 010).

Vegetation

On the western slope, the vegetation between 800 and 1,000 m is *cerrado*, a savanna-like vegetation typical of central Brazil (Eiten 1992), intermixed with riparian and gallery forests that occur along water courses (Ribeiro and Walter 1998). At the base of the mountain there are small lakes, marshlands, plantations, and pastures. At 1,000 m a mixed *cerrado–campo rupestre* habitat is found, as well as small areas of riparian forest.

The Atlantic forest is the predominant vegetation on the eastern slope between 800 and 1,000 m. At the base of the range there are small lakes, riverine habitats, pasture, and some plantations. At 1,000 m, there is a transition from Atlantic forest to *campos rupestres*. A typical transition forest known as *candeial* is found in places, composed predominantly of *candeia* trees (Asteraceae: *Eremanthus* spp.).

Between 1,000 m and 1,300 m on both slopes, *campo rupestre* vegetation predominates, with narrow riparian forests also occurring. Above 1,300 m, a plateau of wide, humid open grasslands lacks the rocky outcrops found at lower elevations. Marshes and small patches of *campos rupestres* also occur, and there are narrow strips of riparian gallery forests and small natural forest fragments.

Methods

Bird surveys were carried out along an altitudinal gradient between 800 m and 1,400 m over 91 days distributed amongst all seasons and elevations, between 1994 and 2000. Birds were recorded along linear transects 1.5 km in length, in the morning (06h00 to 10h30) and in the afternoon (14h00 to 18h30). Each transect was walked during a fixed time interval of about 1 h. Bird species were identified by visual observation and by their song, using recordings (Sick 1979, 1997, Richards 1981). To provide a documented database of the regional avifauna, some birds were tape-recorded and/or photographed. We also searched specimens collected in the 1970s (n = 15), deposited in the Zoology Department of the Federal University of Minas Gerais (DZUFMG).

Results

Bird species composition and distribution

We recorded 273 bird species of 51 families in the Serra do Cipó region (Table 1). Most birds were Tyrannidae and Emberizidae (n = 98, 35.9%). Ten (3.6%) of the species were endemic to Brazil (Sick 1997), 15 (5.4%) were endemic to the Cerrado region (Silva 1995a) and 14 (5.1%) to the Atlantic forest (Sick 1997). Three (1.4%) species were restricted to the *campos rupestres* of the Espinhaço Range (Silva 1995a, Stattersfield *et al.* 1998). Seven (2.5%) species were globally near-threatened, and three (1.1%) were threatened in Minas Gerais State (Collar *et al.* 1992, 1994, Machado *et al.* 1998).

Some interesting patterns in altitudinal and slope preferences of bird species emerged from this study (Appendix 1). On the western slope, 76 species (27.8%) occurred exclusively at the lowest altitudes, while on the eastern slope only seven species (2.5%) were found exclusively at lower elevations. There were 104 (38.1%) widespread species that occurred in both slopes, with six (2.1%) found

exclusively at higher elevations. A total of 31 species (11.4%) were altitudinal generalists, found along the whole altitudinal gradient.

Noteworthy records are as follows:

King Vulture *Sarcoramphus papa* Recorded regularly at high elevations (1,100–1,400 m). Immatures were also observed in three different years, indicating that Serra do Cipó could be a regular breeding site for this near-threatened species in Minas Gerais State.

Spot-tailed Nightjar *Caprimulgus maculicaudus* A single bird was heard at dusk on 18 October 1999 in a pasture close to a marsh at the base of Serra do Cipó. A male was observed at night by spotlight on 27 October 1999 on a dirt road in the same area.

Hyacinth Visorbearer *Augastes scutatus* This endemic hummingbird was observed several times in the campos rupestres of Serra do Cipó. Breeding appears to occur in the dry season, since we found the cup-shaped nest of this species in June 1999.

Cipó Canastero *Asthenes luizae* Small and isolated populations have been reported to the north of its previously known range in the Espinhaço mountains (Cordeiro *et al.* 1998). In this study it was regularly recorded in an unprotected area frequently visited by people, covering approximately 5 km of the highway MG 010 at the top of the Serra do Cipó.

Scytalopus sp. Two records were made between 1995 and 1997 in the Fazenda Cipó region. In addition, a handful of records have been made elsewhere in the Espinhaço range, e.g. Serra do Caraça and Serra da Piedade (TAMJ and MFV pers. obs.). Cited by some authors (e.g. Willis and Oniki 1991) as *Scytalopus novacapitalis*, a species known to occur in western and southwestern Serra do Cipó region, but although the plumage pattern is similar to that species, the vocalization pattern is closest to *S. speluncae*.

Helmeted Manakin *Antilophia galeata* Regularly recorded at 800–900 m, with a few records at 1,000–1,100 m, in gallery forests. Above 1,000 m, forest fragments were sparser and less connected, possibly presenting difficulties in dispersion of this species at higher altitudes.

Golden-Crowned Warbler *Basileuterus culicivorus* One of the most frequently recorded species, represented by two subspecies, *Basileuterus culicivorus culicivorus* and *B. c. hypoleucos*, occurring sympatrically at higher elevations. We also observed and tape-recorded a hybrid individual at 1,000 m altitude.

Black-headed Goldfinch *Carduelis magellanica* Restricted to 1,100–1,200 m altitude. According to local people, this species was commonly found in former times at lower altitudes, where the human population density is higher. Its

absence below 1,000 m altitude could be linked to the pressure of capture for the cage bird trade.

Discussion

This study has shown that the Serra do Cipó region supports a high diversity of birds. Most species restricted to the western slope were typical birds of the *cerrado* vegetation (e.g. Crested Jay *Cyanocorax cristatellus*, Coal-crested Finch *Charitospiza eucosma*), while others were species associated with water courses or marshes (e.g. Cocoi Heron *Ardea cocoi*, Whistling Ducks *Dendrocygna* spp., South American Snipe *Gallinago paraguaiae*). Other *cerrado* birds (e.g. Chestnut-capped Foliage-gleaner *Hylocryptus rectirostris*, Helmeted Manakin *Antilophia galeata*) were also found in gallery forests. The species restricted to the eastern slope were Tataupa Tinamou *Crypturellus tataupa*, Striped Owl *Rhynoptynx clamator*, a unidentified Hermit *Phaethornis* sp., Tufted Antshrike *Mackenziaena severa*, Blue Manakin *Chiroxiphia caudata*, Pin-tailed Manakin *Ilicura militaris* and Violaceus Euphonia *Euphonia violacea*. Species widespread in the Serra do Cipó ranged from the Atlantic forest towards the Cerrado region, occurring in patches of forest (e.g. Serra Antwren *Formicivora serrana*, White-shouldered Fire-eye *Pyriglena leucoptera*, White-eyed Foliage-gleaner *Automolus leucophthalmus*).

Most bird species encountered in this study (91.2%) were also recorded by Parrini *et al.* (1999) at Chapada Diamantina, a northern Espinhaço range extension at Bahia State. Our results showed a similarity between the fauna of Cerro San Simon, northeastern Bolivia (Parker and Rocha 1991) and that of Serra do Cipó, with the following bird species occurring in both regions: Red-winged Tinamou *Rhynchotus rufescens*, Pale-vented Pigeon *Columba cayennensis*, Horned Sungem *Heliactin bilopha*, White-eared Puffbird *Nystalus chacuru*, Collared Crescentchest *Melanopareia torquata*, Grey Monjita *Xolmis cinerea*, Black-throated Saltator *Saltator atricollis*, and Yellow-billed Blue-Finch *Porphyrospiza caerulescens*. However, all these species are widespread in the domain of the *cerrado* (see Silva 1995a, b). Interestingly, Chapada Diamantina and Cerro San Simon also have a flora similar to that of the Serra do Cipó.

This study offers an initial description of bird distribution in Serra do Cipó, which has been extensively studied by botanists and entomologists, but not ornithologists. Additional detailed studies are needed to test the hypotheses involving correlations between bird species richness, altitude and habitat structure in the Serra do Cipó region.

Conservation

During the last 10 years the Serra do Cipó region has been subjected to many threats resulting from the unplanned expansion of ecotourism, road construction, fires and other developments that contribute to habitat degradation. Even though the Atlantic forest is considered an important hotspot for biodiversity (Mittermeier *et al.* 1999), the remaining patches of the eastern slope have been largely destroyed by human activity. Forest fragmentation has had negative impacts on birds in Minas Gerais State, in both the Atlantic forest (Ribon 1998, Maldonado-Coelho and Marini 2000) and the *cerrado* biomes (Christiansen and

Pitter 1997, Marini 2001). Despite being considered a high conservation priority area in Minas Gerais State due to its unique flora and fauna (Costa *et al.* 1998), there has been a lack of political effort devoted to its conservation.

Andrade (1999) showed that even small (< 1 ha) natural forest patches similar to those occurring at Serra do Cipó, support a rich fauna of forest-dependent birds, demonstrating the importance of these forests to the conservation of birds living in the Brazilian highlands.

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Appendix 1. Bird species (*n* = 273) recorded in the Serra do Cipó region, Minas Gerais, Brazil.

Key:
* Specimen deposited in the Zoology Depart., Universidade Federal de Minas Gerais.
Slope: W, western; E, eastern; T, top of the mountain.
Habitat types: 1, Atlantic forest fragments; 2, gallery forest or riparian forest; 3, small natural forest fragments on the mountaintop; 4, *cerrado*; 5, *campo rupestre*; 6, high montane humid field; 7, marsh; 8, lake; 9, area subject to human use.
Status and endemism (following Collar *et. al.* 1992, 1994, Silva 1995a, Sick 1997, Machado *et. al.* 1998): CE, endemic to *cerrado* (*n* = 15); AF, endemic to Atlantic forest (*n* = 14); ER, endemic to Espinhaço Range (*n* = 4); NT, Near–threatened in Minas Gerais State (*n* = 7); MG, Threatened in Minas Gerais State (*n* = 3).

Family/species	Altitudinal range (m)	Habitat	Slope	Status and endemism
TINAMIDAE				
Crypturellus parvirostris	800–1,100	4, 5, 9	W, E	
Crypturellus tataupa	900–1,000	1, 2, 4, 9	E	
Rhynchotus rufescens	800–1,100	4, 5	W	
Nothura maculosa	800–1,400	4–6	W, T	
PODICIPEDIDAE				
Tachybaptus dominicus	800	8	W	
Podilymbus podiceps	800	8	W	
PHALACROCORACIDAE				
Phalacrocorax brasilianus	800	8	W	
ANHINGIDAE				
Anhinga anhinga	800	8	W	
ARDEIDAE				
Ardea cocoi	800	8	W	
Casmerodius albus	800	8	W	
Egretta thula	800	8	W	
Bubulcus ibis	800	8, 9	W	
Butorides striatus	800	7, 8	W, E	
Syrigma sibilatrix	800	4, 7–9	W	
Nycticorax nycticorax	800	7, 8	W	
THRESKIORNITHIDAE				
Phimosus infuscatus	800	4, 7–9	W	
CATHARTIDAE				
Sarcoramphus papa	1100–1,400	5, 6	W, T, E	NT
Coragyps atratus	800–1,300	1–5, 9	W, T, E	
Cathartes aura	800–1,300	1–5, 9	W, T, E	
ANATIDAE				
Dendrocygna viduata	800	7, 8	W, E	
Dendrocygna autumnalis	800	7, 8	W	
Amazonetta brasiliensis	800	7, 8	W	
Cairina moschata	800	7, 8	W	

Appendix 1. *continued*

Family/species	Altitudinal range (m)	Habitat	Slope	Status and endemism
ACCIPITRIDAE				
Elanus leucurus	800	4, 9	W, E	
Rosthramus sociabilis	800	8	W	
Geranoaetus melanoleucus	1,100	5	W, E	
Buteo albonotatus	1,000	4, 5	W	
Buteo albicaudatus	1,200	5	W, E	
Rupornis magnirostris	800–1,400	1–7, 9	W, T, E	
Geranospiza caerulescens	800	2	W	
Buteogallus meridionalis	800	4, 9	W, E	
FALCONIDAE				
Herpetotheres cachinnans	800	1, 2, 4, 9	W, E	
Micrastur semitorquatus	800	2	W, E	
Milvago chimachima	800–1,300	1–7, 9	W, T, E	
Polyborus plancus	800–1,000	1–7, 9	W, E	
Falco femoralis	800–900	1, 2, 4, 9	W, E	
Falco sparverius	800–1,400	5	W, T, E	
CRACIDAE				
Penelope superciliaris	800–1,000	1, 2	W, E	
ARAMIDAE				
Aramus guarauna	800	7, 8	W	
RALLIDAE				
Rallus nigricans	800	7, 8	W	
Aramides cajanea	800	1, 2, 4, 7–9	W, E	
Aramides saracura	800–900	1, 2, 7–9	W, E	AF
Porzana albicollis	800–900	7, 8	W, E	
Gallinula chloropus	800	7, 8	W	
Porphyrula martinica	800	7, 8	W	
CARIAMIDAE				
Cariama cristata	800–1,300	4–6, 9	W, T, E	
JACANIDAE				
Jacana jacana	800	7, 8	W, E	
CHARADRIIDAE				
Vanellus chilensis	800	7–9	W, E	
Charadrius collaris	800	8	W	
SCOLOPACIDAE				
Tringa flavipes	800	8	W	
Gallinago paraguaiae	800–1,000	7	W, E	
COLUMBIDAE				
Columba livia domestica	800–900	9	W, E	
Columba picazuro	800–1,200	4, 5, 7, 9	W, E	
Columba cayennensis	800–1,100	4, 5, 9	W, E	
Zenaida auriculata	800	4, 9	W	
Columbina talpacoti	800–1,000	4, 5, 9	W, E	
Claravis pretiosa	800t2, 9	W		
Scardafella squammata	800–1,000	4, 5, 9	W, E	
Leptotila verreauxi	800–1,100	1, 2, 4, 9	W, E	
Leptotila rufaxilla	1,400	3	T	

Appendix 1. *continued*

Family/species	Altitudinal range (m)	Habitat	Slope	Status and endemism
PSITTACIDAE				
Diopsittaca nobilis	800	1, 2, 9	W	
Aratinga leucophthalmus	800	1, 2, 4, 9	W, E	
Aratinga aurea	800–1,400	4–6, 9	W, T	
Pyrrhura frontalis	800	1, 2	W, E	NT, AF
Forpus xanthopterygius	800–1,200	1, 2, 4–7, 9	W, E	
Brotogeris chiriri	800–900	2, 4, 9	W	
Pionus maximiliani	800–1,100	1, 2, 4, 9	W, E	
Amazona aestiva	800	2, 4, 9	W	
CUCULIDAE				
Coccyzus americanus	800	2, 4	W	
Piaya cayana	800–1,300	1–3, 9	W, T, E	
Crotophaga ani	800–1,000	4, 5, 7, 9	W, E	
Guira guira	800	4, 5, 7, 9	W, E	
Tapera naevia	*800–1,000*	*1, 2, 4*	*W, E*	
TYTONIDAE				
Tyto alba	800	4, 9	W	
STRIGIDAE				
Otus choliba	800–900	1, 2, 4, 9	W, E	
Rhynoptynx clamator	900	4	E	
Pulsatrix perspicillata	800	2	W	
Glaucidium brasilianum	800	1, 2, 4, 9	W, E	
Speotyto cunicularia	800–1,400	4, 5, 9	W, T, E	
NYCTIBIIDAE				
Nyctibius griseus	800–1,400	1–5	W, T, E	
CAPRIMULGIDAE				
Chordeiles pusillus	800	4	W	
Lurocalis semitorquatus	800–900	1, 2, 4	W, E	
Nyctidromus albicollis	800–1,000	1, 2, 4, 9	W, E	
Caprimulgus rufus	800	1, 2, 4	W, E	
Caprimulgus longirostris	1,000–1,300	5	W, T, E	
Caprimulgus maculicaudus	800	4, 9	W	
Caprimulgus parvulus	800	4, 9	W	
Hydropsalis torquata	900–1,100	1, 2, 4, 5, 9	W, E	
APODIDAE				
Streptoprocne zonaris	800–1,300	1–6, 9	W, T, E	
Streptoprocne biscutata	800	4, 9	W, E	
Cypseloides fumigatus	800	4, 9	W	
Chaetura andrei	800–900	1, 2, 4, 9	W, E	
TROCHILIDAE				
Phaethornis pretrei *	800–1,400	1–5, 7, 9	W, T, E	
Phaethornis sp.	900	2	E	
Phaethornis ruber	800	2	W	
Eupetomena macroura	800–1,200	1, 2, 4, 5, 9	W, E	
Colibri serrirostris *	800–1,400	4, 5, 9	W, T, E	
Chlorostilbon aureoventris	800–1,400	1–5, 9	W, T, E	
Leucochloris albicollis	1,300	3	T, E	
Amazilia lactea	800–1,000	1, 2, 4, 5, 9	W, E	
Augastes scutatus *	1,100–1,300	5	T	MG, CE, ER
Heliactin bilopha	800–1,200	4, 5, 9	W	

Appendix 1. *continued*

Family/species	Altitudinal range (m)	Habitat	Slope	Status and endemism
TROGONIDAE				
Trogon surrucura aurantius	800–1,000	1, 2	W, E	AF
ALCEDINIDAE				
Ceryle torquata	800–1,000	8	W, E	
Chloroceryle amazona	800	8	W	
Chloroceryle americana	800	8	W	
MOMOTIDAE				
Baryphthengus ruficapillus	800	2	W	
GALBULIDAE				
Galbula ruficauda	800–1,000	1, 2	W, E	
BUCCONIDAE				
Nystalus chacuru	800–1,300	4, 5	W, T, E	
Nystalus maculatus	900	4	W	
Malacoptila striata	800	1, 2	W, E	
Nonnula rubecula	800	2	W	
RAMPHASTIDAE				
Ramphastos toco	800	4, 9	W	
PICIDAE				
Picumnus cirratus	800–1,200	1, 2	W, T, E	
Colaptes campestris	800–1,400	4, 5, 9	W, T, E	
Colaptes melanochloros	800–1,100	1, 2, 4, 9	W, E	
Dryocopus lineatus	800–900	4	W, E	
Picoides mixtus	900–1000	4	W	
Melanerpes candidus	800–900	4, 9	W, E	
Veniliornis passerinus	800–900	1, 2, 4, 9	W, E	
RHINOCRYPTIDAE				
Melanopareia torquata	900–1,100	4, 5	W	CE
Scytalopus sp.	1,000–1,100	3, 5	W	CE
THAMNOPHILIDAE				
Mackenziaena severa	1,000	1	E	AF
Taraba major	800–900	1, 2, 4, 9	W, E	
Thamnophilus caerulescens	800–1,400	1–3	W, T, E	
Thamnophilus torquatus	1,000–1,200	4, 5	W	
Dysithamnus mentalis	800	1, 2	W, E	
Herpsilochmus atricapillus	800–900	1, 2	W, E	
Formicivora serrana	800–900	1, 2	W, E	NT
Drymophila ochropyga	1,300	3	T, E	AF
Pyriglena leucoptera	900	1, 2	W, E	AF
FURNARIIDAE				
Furnarius rufus	800–1,300	4, 5, 9	W, T, E	
Furnarius figulus	800	7, 9	W, E	
Asthenes luizae	1,200	5	T	CE, MG, ER
Synallaxis spixi *	800–1,400	1–3, 5	W, T, E	
Synallaxis ruficapilla	1,200–1,300	3	T, E	
Synallaxis frontalis	800–1,400	1–3, 5	W, T, E	
Synallaxis albescens	800–1,200	4, 5, 7, 9	W, E	
Certhiaxis cinnamomea	800	7, 8	W, E	
Phacellodomus rufifrons	800–1,300	4, 5, 9	W, T, E	

Appendix 1. *continued*

Family/species	Altitudinal range (m)	Habitat	Slope	Status and endemism
Anumbius annumbi	800–1,100	4, 5, 9	W, E	
Automolus leucophthalmus	800–900	1, 2	W, E	AF
Hylocryptus rectirostris	800	2	W	CE
Xenops rutilans	800	1, 2	W, E	
Lochmias nematura	800–1,300	1–3, 5	W, T, E	
DENDROCOLAPTIDAE				
Sittasomus griseicapillus	800–1,000	1, 2	W, E	
Lepidocolaptes angustirostris	800–1,100	4, 5, 9	W, E	
Lepidocolaptes fuscus	800	1, 2	W, E	
TYRANNIDAE				
Phyllomyias fasciatus	800–1,000	1, 2, 4, 5, 9	W, E	
Camptostoma obsoletum	800–1,300	1, 2, 4, 5, 9	W, T, E	
Phaeomyias murina	800–1,000	1, 2, 4, 5, 9	W, E	
Myiopagis caniceps	900	2	W	
Myiopagis viridicata	800–900	1, 2	W, E	
Elaenia flavogaster *	800–1,100	1, 2, 4, 5, 7, 9	W, E	
Elaenia mesoleuca	800	4	W, E	
Elaenia cristata	800–1,300	4, 5	W	
Elaenia obscura *	1,000–1,100	1, 2, 5	W, E	
Elaenia chiriquensis	800–1,300	4, 5	W, T	
Serpophaga subcristata	1,000–1,400	1–3	W, T, E	
Polystictus superciliaris	1,100–1,300	5	W, T, E	NT, CE
Leptopogon amaurocephalus	800–1,400	1–3	W, T, E	
Phylloscartes ventralis	900–1,300	2, 3	T, E	AF
Corythopis delalandi	800	2	W	
Hemitriccus nidipendulus	800–1,200	1, 2	W, E	
Todirostrum poliocephalum	800–900	1, 2, 9	W, E	AF
Todirostrum plumbeiceps	1,300	3	T, E	
Todirostrum latirostre	800	2, 4	W	
Tolmomyias sulphurescens	800–1,400	1–3	W, T, E	
Platyrinchus mystaceus	800	1, 2	W, E	
Myiophobus fasciatus	800–1,300	4, 5, 7, 9	W, T, E	
Contopus cinereus	800	2, 4	W	
Lathrotriccus euleri	800	1, 2	W, E	
Cnemotriccus fuscatus bimaculatus	800–900	1, 2	W, E	
Xolmis cinerea	800–1,400	4, 5, 9	W, T, E	
Xolmis velata *	800–1,100	4, 5, 9	W, E	
Knipolegus lophotes	800–1,300	4, 5, 9	W, T, E	
Knipolegus nigerrimus *	900–1,300	4, 5	W, T, E	AF
Knipolegus sp.	1,300	5	T	
Fluvicola nengeta	800	7–9	W, E	
Arundinicola leucocephala	800	7, 8	W, E	
Colonia colonus	800–900	4, 9	W, E	
Gubernetes yetapa	800	7	W, E	
Satrapa icterophrys	800–900	9	W, E	
Hirundinea ferruginea	800–1,000	4, 5	W, E	
Machetornis rixosus	800–900	4, 9	W, E	
Muscipipra vetula	1,100–1,300	3	T, E	
Casiornis rufa	800	2	W	
Sirystes sibilator	800	1, 2	W, E	
Myiarchus ferox	800–1,400	1–5, 9	W, T, E	
Myiarchus tyrannulus	800–900	1, 2, 9	W, E	

Appendix 1. *continued*

Family/species	Altitudinal range (m)	Habitat	Slope	Status and endemism
Pitangus sulphuratus	800–1,200	1, 2, 4, 5, 9	W, E	
Megarhynchus pitangua	800–1,000	1, 2, 4, 9	W, E	
Myiozetetes similis	800–900	1, 2, 4, 9	W, E	
Myiodynastes maculatus	800	1, 2, 4, 9	W, E	
Empidonomus varius	800–900	1, 2, 4, 9	W, E	
Griseotyrannus aurantioatrocristatus	800	4	W	
Tyrannus savana	800–1,100	1, 2, 4, 9	W, E	
Tyrannus melancholicus	800–1,100	1, 2, 4, 5, 7, 9	W, E	
Tyrannus albogularis	800	4	W	
Pachyramphus viridis	800	2	W	
Pachyramphus polychopterus	800–900	1, 2	W, E	
Pachyramphus validus	800	2	W	
Tityra cayana	800	2	W	
PIPRIDAE				
Antilophia galeata	800–1,100	2	W	CE
Chiroxiphia caudata	800–1,000	1	E	
Ilicura militaris	900	1	E	AF
Neopelma pallescens	800	2	W	
COTINGIDAE				
Pyroderus scutatus	1,300	3	T, E	MG, AF
HIRUNDINIDAE				
Tachycineta leucorrhoa	800	2, 8	W	
Notiochelidon cyanoleuca	800–1,000	1, 2, 4, 5, 7–9	W, E	
Alopochelidon fucata	1,200–1,400	5, 6	T	
Stelgidopteryx ruficollis	800–1,200	4–7, 9	W, E	
CORVIDAE				
Cyanocorax cristatellus	800–1,300	4, 5, 9	W, T, E	CE
TROGLODYTIDAE				
Donacobius atricapillus	800	7, 8	W, E	
Troglodytes aedon	800–1,300	1–7, 9	W, T, E	
MUSCICAPIDAE				
Turdus rufiventris	800–1,400	1–5, 9	W, T, E	
Turdus leucomelas	800–1,400	1–5, 9	W, T, E	
Turdus amaurochalinus	800–1,400	1–5, 9	W, T, E	
MIMIDAE				
Mimus saturninus	800–1,300	4, 5, 9	W, T, E	
MOTACILLIDAE				
Anthus cf hellmayri *	1,400	5, 6	T	NT
Anthus lutescens	800	4, 7–9	W	
VIREONIDAE				
Cyclarhis gujanensis	800–1,400	1–3, 5	W, T, E	
Vireo chivi	800–900	1, 2	W, E	
Hylophilus amaurocephalus	800–900	1, 2	W, E	
EMBERIZIDAE				
Parula pitiayumi	800–900	2	W	
Geothlypis aequinoctialis	800–1,300	5–7, 9	W, T, E	
Basileuterus flaveolus	800–1,100	1, 2	W, E	
Basileuterus culicivorus culicivorus	1,000–1,400	1–3	W, T, E	

Appendix 1. *continued*

Family/species	Altitudinal range (m)	Habitat	Slope	Status and endemism
Basileuterus culicivorus hypoleucus	800–1,400	1–3	W, T, E	
Coereba flaveola	800–1,400	1–5, 9	W, T, E	
Schistochlamys ruficapillus *	800–1,300	4–6	W, T, E	
Neothraupis fasciata	800–900	4	W	CE
Cypsnagra hirundinacea	1,100	5	W	NT, CE
Hemithraupis ruficapilla	800–1,300	1–3	W, T, E	AF
Nemosia pileata	800–900	2, 4	W	
Piranga flava	800–1,400	2, 5	W, T, E	
Thraupis sayaca	800–1,400	1–5, 9	W, T, E	
Euphonia violacea	800		E	
Euphonia chlorotica	800–1,300	1–5, 9	W, T, E	
Tangara cayana	800–1,400	1–5, 9	W, T, E	
Dacnis cayana	800–1,000	1, 2, 9	W, E	
Conirostrum speciosum	800	1, 2	W, E	
Tersina viridis	800–900	2	W	
Zonotrichia capensis	800–1,400	4–6, 9	W, T, E	
Ammodramus humeralis *	800–1,400	4–6, 9	W, T, E	
Sicalis citrina *	800–1,400	4, 5, 9	W, T, E	
Sicalis luteola	800	9	W	
Emberizoides herbicola	800–1,300	6, 7, 9	W, T, E	
Embernagra longicauda *	1,000–1,400	5	W, T, E	CE, ER
Volatinia jacarina	800–1,100	4, 5, 9	W, E	
Sporophila nigricollis	800–1,300	4–6, 9	W, T, E	
Sporophila caerulescens	800–1,100	4, 5, 9	W, E	
Sporophila bouvreuil bouvreuil	800	7	W	
Arremon flavirostris	800	2	W	
Charitospiza eucosma	900	4	W	NT, CE
Coryphospingus pileatus	800–1,400	4, 5, 7, 9	W, T, E	
Saltator similis	800–1,400	1–3	W, T, E	
Saltator atricollis *	900–1,300	4, 5	W, T, E	CE
Passerina brissonii	800–1,000	4, 7, 9	W, E	
Porphyrospiza caerulescens *	800–1,300	4, 5	W, T	CE
Psarocolius decumanus	800	1, 2, 4, 9	W, E	
Cacicus haemorrhous	800	1, 2	W, E	AF
Agelaius ruficapillus	800	7, 8	W	
Leistes superciliaris	800	7, 9	W	
Pseudoleistes guirahuro	1,200–1,400	2, 5, 6	W, T	
Gnorimopsar chopi	800–1,400	4–6, 9	W, T, E	
Molothrus bonariensis	800–1,200	4, 5, 9	W, E	
FRINGILLIDAE				
Carduelis magellanicus	1,100–1,200	5	W	
PASSERIDAE				
Passer domesticus	800–900	9	W, E	

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