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Research Article

Spatial Variation in Bird Community Composition in Relation to Topographic Gradient and Forest Heterogeneity in a Central Amazonian Rainforest

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We investigated the effects of landscape features and forest structure on the avian community at the Reserva Florestal Adolpho Ducke near Manaus, in the Brazilian Amazon. We sampled the landscape and forest in 72 50 × 50 m plots systematically distributed in the reserve, covering an area of 6,400 ha. The avifauna was sampled using mist nets and acoustic surveys near the plots. We found no significant relationships between landscape features and forest components in the plots and the number of bird species and individuals sampled. Results of Principal Coordinate Analyses, however, showed that bird species composition changes along a topographic gradient (plateau-slope-valley), and also in relation to leaf litter depth and distance to forest streams. We also found compositional differences in the avian community on the eastern and western water basins that compose the reserve. Our results suggest that although most bird species occur throughout the reserve, many species track differences in the landscape and the forest structure.

1. Introduction

Understanding how the structure of the habitat influences avian populations and communities is a key factor to link habitat and niche selection with species diversity [1, 2]. Although the mechanisms that determine habitat use in tropical forests remain poorly understood [3, 4], it is clear that different species use their surrounding environment differently. This use can change over space and time due to individual movements, but also as a result of differences in habitat structure [5–9]. Several studies have focused on the factors affecting avian species richness and abundance in tropical forests, investigating the relationship between vegetation structure and bird communities [2, 8–10], but few have investigated how natural variations in the structure of the forest may affect entire species assemblages (but see [4, 7, 11]). When available, such studies are often done at small spatial scales [9, 12, 13], and the effects of habitat structure are rarely considered.

Most bird species in Amazonia are resident and sedentary [12, 14, 15], and are relatively long-lived compared to those in temperate regions [16]. Longevity can result in a more specialized use of the environment, and birds may adjust their microhabitat use according to local variation in the forest structure [7, 11, 17]. Avian community composition, microhabitat selection, and guild assemblages can be affected by landscape features such as elevation, topography (valleys, slopes, and plateaus), and proximity to water. Furthermore, the natural heterogeneity found in many components of the forest structure, such as the number of trees, the amount of light that reaches the forest understory (canopy openness), and even the amount of litter on the ground [4, 7, 11] can also affect avian communities. For example, it has been documented that the number of tree-fall gaps in a forest increases with selective logging, affecting the abundance of insectivorous and nectarivorous birds [13, 18]. Similarly, the spatial variation in the depth of forest leaf litter can affect the use of the forest floor by insectivorous birds [10]. Although in recent years a great body of knowledge has been gathered on general aspects of the biology and behaviour of many tropical species [19], little is known about the function of species in the ecosystem, and how a significant part of the bird community responds to the local variation observed in the structure of the forest.

In this study, we investigate how the natural forest heterogeneity influences avian communities. We selected seven variables, which include local topography (elevation), number of trees, fallen logs and standing dead trees (snags), depth of leaf litter, percentage of canopy openness, and the distance to the nearest stream. These variables may be important because (i) many bird species rely on a shady understory for foraging, and areas with more trees can offer a more complex structure, sustaining more species [1]; (ii) the abundance of logs and snags may provide more area for foraging and nesting, while providing a particular substrate for specialist species; (iii) the abundance of small vertebrates and large invertebrates (prime avian food resources) are directly related to the abundance of leaf litter [20]; (iv) the amount of light reaching the understory may affect fruit production, attracting arthropods and increasing food availability [17]; (v) streams are an important component of the forest, serving as a microhabitat for several avian specialists; (vi) elevation in central Amazonia is known to be directly related to soil texture (one of the best predictors of forest structure and tree composition) [21].

We tested the effect of these variables on bird species richness, abundance, and species' composition, using data based on mist-net captures and acoustic transect surveys. Specifically, we tested the hypothesis that the spatial variation in the forest structure and some landscape features should influence the occurrence, abundance, and distribution of bird species in a tropical forest. Because within and among-year seasonality can also determine the spatial distribution of bird species richness in a tropical forest [8, 12], we also tested the effect of seasonality on the avifauna.

In particular, we ask the following questions: (1) does the bird community composition change seasonally (dry versus wet season) and among years in our study area?; (2) what are the effects of some selected forest structural components on the richness, abundance, and species' composition of birds?; (3) does bird species composition change along a topographic gradient that includes plateaus, slopes, and valleys?; (4) what, if any, are the differences in bird species composition between the two main drainage basins in the study area?

2. Material and Methods

2.1. Study Area and Sampling Design. The Reserva Florestal Adolpho Ducke (RFAD), a 10,000 ha forest reserve, is located 30 km north of the city of Manaus (02°55′-03°01′ S, 59°53′-59°59′ W), in the Brazilian state of Amazonas. Although the spread of Manaus, the largest city in the Amazon basin, has reached the southern and western boundaries of the reserve in recent years, RFAD is still connected to continuous forest on its eastern side. The reserve can be divided into an eastern and a western water basin (with six microbasins: Acará, Barro Branco, Bolívia, Ipiranga, Tinga, and Ubere) divided by a central plateau. The dominant vegetation type in the reserve is primary Terra Firme forest, never inundated by seasonal river fluctuations. Oxisols are predominant in the reserve, and small streams are abundant in the area, resulting in an undulated terrain of plateaus of up to 140 m above sea level, crossed by many valleys [22]. The mean precipitation in the area is ∼2,300 mm/yr, with most of the rainfall falling between November and May, and a short dry season between June and October [22].

We sampled the avifauna of the RFAD with mist-nets from January 2002 to July 2004, monthly from January to December 2002 (except June 2002, November 2003, and January to April 2004), whereas acoustic survey data were collected during March and May 2002. The RFAD is particularly suited for studies investigating the general heterogeneity of a tropical forest because it has a 64 km^2 grid, criss-crossed by trails that allow access to the entire reserve (Figure 1). Lines of mist-nets were systematically placed across the entire grid, along the nine parallel 8 km-long trails that cross the RFAD from east to west, covering 6,400 ha (Figure 1). In total, we sampled 72 individual areas, whereas acoustic transect surveys were randomly assigned and performed in 21 of them. Components of the forest structure were sampled in each of the 72 sample areas in 2,500 m^2 (50×50 m) plots. The 72 sample areas were located at least 1 km from one another, and at least 1 km from the borders of the RFAD, reducing possible edge effects.

2.2. Bird Surveys. Bird data was obtained using two independent methods: mist-nets and acoustic surveys along predefined transects. The use of mist-nets has several advantages over other types of survey methods [23], particularly being independent of identification skills (birds are easier to identify in the hand), easier to standardize (number of nets and/or time), and are good in capturing understory species that are moving through the forest. As its downside, it neglects an entire part of the community (i.e., all birds that forage and occur above 10 m, including most canopy birds). Acoustic surveys, on the other hand, are much more dependent on the skills and experience of the observer, and therefore its results are difficult to compare to other studies, but have the advantage of potentially recording many more species of birds with a much smaller sampling effort. Additionally, species recorded are not restricted to a particular stratum of the forest, although they rely on vocalizing individuals.

We placed lines of 20 mist-nets (12 m long, 2.5 m high, and 2.5 cm of mesh size) along existing trails, covering ∼240 m. Each line started at mid-points (500 m, 1500 m, 2500 m, etc.), from the beginning of each trail that crosses the RFAD from east to west (Figure 1). Mist-nets were opened between 6 AM and 1 PM, for two consecutive days in the same place. Captured individuals were identified and marked with numbered aluminum bands (CEMAVE—Bird Migration Center, ICMBio, Brazil). Data from both days were pooled to obtain a single number of species and individuals (birds captured and marked on the first day were counted only once).

Acoustic surveys were performed by LNN along 21 1 km-transects (see Figure 1). Transects started at 5:30 AM from the mid-point of the trail and included half an hour of dawnchorus census (which are mostly conducted in the dark and are important to record some species that are vocally active only during a few minutes before dawn). From 6 AM to 10 AM the entire 1 km was surveyed twice by walking slowly through the trail. Along the trails, bird vocalizations were tape-recorded, and the approximate location of each individual bird was noted. No playback was used during the surveys. The general location of each individual was noted to avoid double counting individual birds.

2.3. Forest Structure Components and Landscape Features Sampling. We established 72 50 × 50 m plots, located in the middle of each line of mist-nets (120 m from the beginning). Within plots, we quantified the following forest structure components and features of the landscape: (i) number of trees (diameter at breast height—DBH > 10 cm); (ii) number of fallen logs (>20 cm in diameter); (iii) number of snags (standing dead trees); (iv) leaf litter depth; (v) percentage of canopy openness; (vi) distance to the nearest stream; (vii) elevation.

We used the number of trees, fallen logs, and dead snags, as a measurement of tree abundance, and these were directly counted in the plots. We measured the depth of the litter from 20 subplots of 1 m^2 located along the sides of each 50 × 50 m plot (systematically distributed every 10 m) and from an additional subplot placed in the center of the plot. Litter depth was recorded by inserting a Swiss knife blade (7 cm length, 1 cm width, and 0.1 cm thick) into the forest ground until its tip touched the forest bare soil. The number of impaled dead leaves was used as the measurement of litter depth, using the mean value of the 21 subplots in the analyses. We recorded forest canopy openness using a Spherical Crown Densiometer (Concave—Mode C—Robert E. Lemon, Forest Densiometer—Bartlesville, OK, USA). Measurements were obtained from four readings (north, south, east, and west) at the corners and one at the center of the 50 × 50 m plots. Following factory recommendations, we multiplied each reading by 1.04. We used the mean value of five readings within a subplot as a subplot measurement and the mean value of 5 subplots in the analyses. Distance of the plots to the nearest stream and elevation (meters above sea level) of the plots were collected from a detailed topographic map.

2.4. Statistical Analyses. Although complementary, mist-net and acoustic survey data are not comparable and were analysed separately. To compare species composition among the 72 mist-net lines and for the 21 acoustic survey transects, we analysed both quantitative and qualitative data matrices using Principal Coordinates Analysis (PCoA), implemented in PC-ORD [24]. This analysis summarizes more information on one to three axes than other indirect ordination techniques, and is more robust to nonlinear effects [25]. We used the Bray-Curtis distance measure to obtain values of dissimilarity between sites. When used on presence/absence data, the Bray-Curtis index is known as the Sorensen distance measure [26, 27], which has been used in ecological gradient studies [25, 28], including studies with plants [29], insects [30], and birds [6, 11, 13, 31, 32]. The resulting PCoA-scores were used as dependent variables in models of multivariate analysis of variance (MANOVA) and multiple regressions. We used two or three PCoA axes in the analyses because these generally explain most of the variance in the original variables for quantitative and qualitative data. We used *a posteriori* Pillai-Trace tests to verify whether MANOVA reveal significant differences among sites in relation to the topographic gradient (plateau-slope-valley), water basins (western and eastern sides of the RFAD, see Figure 1), and seasonality (dry and wet season and among years). For the water basin analysis we excluded mist-net lines and censuses located on the central plateau that divides the two basins (see Figure 1).

The Pillai-Trace statistics have been shown to be less sensitive to deviations from assumptions than other multivariate statistics [33, 34]. We also used multiple regressions followed by Pillai-Trace to evaluate the effects of the forest structure components on qualitative and quantitative bird community composition across the RFAD. These analyses were performed using GLM in Systat [35]. To verify potential problems of residual analysis in multiple regressions, we used a graphic method called partial residual plot, available in R (Core Development Team 2008). We also used R to verify possible linear relationships among predicting variables, estimating the variance inflation factor, which calculates the level of multicolinearity [36]. We used Mantel tests, implemented in PC-ORD [24], to verify spatial autocorrelation among variables, or the significance of relationships between assemblage matrices of similarity and distance between transects. We built Pearson correlation matrices to verify the correlation among forest structure components (independent variables). When these variables were significantly correlated, we included them in different analyses.

We built qualitative (presence/absence data) and quantitative (abundance data) matrices of species composition for the community analyses. We used regression models for qualitative and quantitative data, using PCoA axes as response variables in the regression models. In two regression models, the PCoA axes were regressed against five forest structure components as independent variables together (abundance of forest trees, abundance of fallen logs, abundance of snags, mean leaf litter depth, and proximity to the nearest stream), and in another two models, the PCoA-axes were regressed with just two independent variables together (elevation and canopy openness), because these two components were significantly correlated with the other five.

Throughout the study, we used three PCoA axes for quantitative data and two axes for qualitative data as dependent variables. For mist-net data, we found that three PCoA axes captured most of the variance in the original variables for quantitative data in the bird species matrix (Cumulative proportion of total variance, $C_{PV} = 0.63$), whereas two axes were enough for the presence/absence data matrix ($C_{PV} = 0.68$). Similarly, for the acoustic survey data three axes captured most of the variance for quantitative data ($C_{PV} = 0.60$), and two axes for presence/absence data ($C_{PV} = 0.56$).

We excluded from the analyses bird species that were captured or recorded only once. Therefore, although we captured 110 species in the mist-nets, our "bird community" was represented by 76 species, and although we recorded 162 species in the acoustic surveys, our "survey bird community" was represented by 132 species.

3. Results

3.1. Avian Surveys. We recorded a total of 191 bird species during our study, more than 50% of all species ever recorded in the RFAD (see Table 4). We captured 110 species in the 72 lines of mist-nets (average of 15.6 ± 4.1 species and 33.6 ± 12.1 individuals in a two-day sample), and detected a total of 162 species on the 21 acoustic surveys (average of 52.3 ± 7.7 species per transect). A total of 85 species recorded in the surveys were never caught in the mist-nets, whereas 32 of the species captured in the mist-nets were never recorded in the surveys (see Table 4). Most species are permanent residents and are believed to breed in the study area [37] (see Table 4).

3.2. Forest Structure Components and Landscape Features. We found a great deal of variation within plots in almost every parameter measured, showing a high heterogeneity in our 72-plot sample. The mean abundance of forest trees per plot was 136.4 (range 75–235 trees), that of fallen logs was 11 (range 3–38), and that of snags was 4.8 (range 0–11). The mean number of layers of leaf litter ranged from zero to 3.2 for the 1-m^2 subplots and 2.9 (1–7) layers for the 50 × 50 m plots. The mean percentage of canopy openness was 9.7% (range 2.6–19.4%). The mean elevation was 49.9 m above sea level (range 39.4–114.7 m), and the mean distance to the nearest stream was 318.5 m (range 0–571.4 m).

We found weak but significant correlations between the geographic location of the plots (spatial autocorrelation) for variables such as tree abundance, leaf litter depth, mean canopy openness, and elevation (Table 1). However, because these variables had very low Mantel test "r-values", or were so weakly correlated with location (geographical coordinates), we decided to include them as independent variables in the multiple regression models. Canopy openness and elevation were significantly correlated to other variables (Table 2) and were therefore analyzed in a separate regression model.

3.3. Effects of Seasonality on Bird Species Composition. The potential effect of seasonality was evaluated only for mist-net data, which were collected over several seasons and more than one year (acoustic surveys were only performed during the wet season of 2002). We found no significant differences on bird species composition between dry and wet seasons (Manova, Pillai-Trace test = 0.193; $F_{12,201}$ = 1.153; $P < 0.320$ for quantitative data; Manova, Pillai-Trace test = 0.110; $F_{8,134}$ = 0.977; $P < 0.457$ for qualitative data) or years (Manova, Pillai-Trace test = 0.055; $F_{6,136}$ = 0.644; $P < 0.695$ for quantitative data; Manova, Pillai-Trace test = 0.076; $F_{4,138}$ = 1.364; $P < 0.250$ for qualitative data).

3.4. Bird Species Composition along a Topographic Gradient. We found significant differences in the composition of bird species (qualitative data) along a plateau-slopes-valley topographic gradient (Manova, Pillai-Trace test = 0.368; $F_{6,136}$ = 5.110; $P < 0.0001$) (Figure 2). Extremes of the topographic gradient (plateaus and valleys) separated well along axis one, whereas samples from slopes (hillsides) were placed in between the two (Figure 2). On the other hand, we found no significant difference among the three topographic classes using the acoustic survey qualitative data (Manova, Pillai-Trace = 0.240; $F_{6,34}$ = 0.773; P = 0.597).

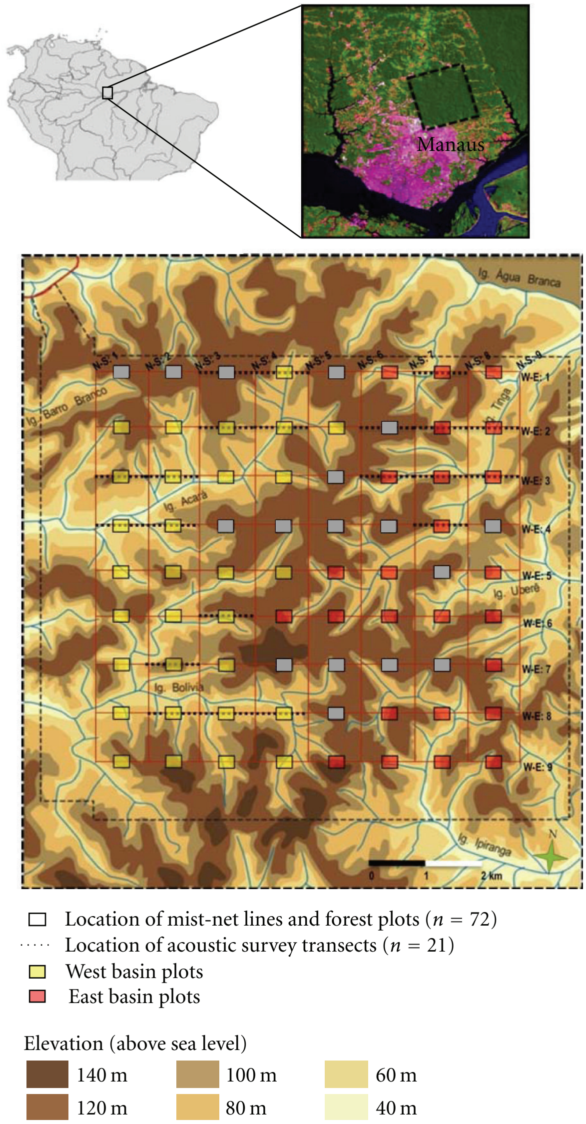


Figure 1: Location of the Reserva Florestal Adolpho Ducke (RFAD) in relation to the city of Manaus, Amazonas, Brazil (in pink), and spatial distribution of our sampling in the 8 × 8 km trail grid. Squares located every km along the east-west trails represent the place where lines of 20 mist-nets and forest plots were located. Dashed lines of 1 km represent the location of the acoustic surveys. Squares in yellow represent plots located in the western basin; squares in red represent plots located in the eastern basin. Squares in grey represents plots located along the central plateau, and were not used in the basin analysis.

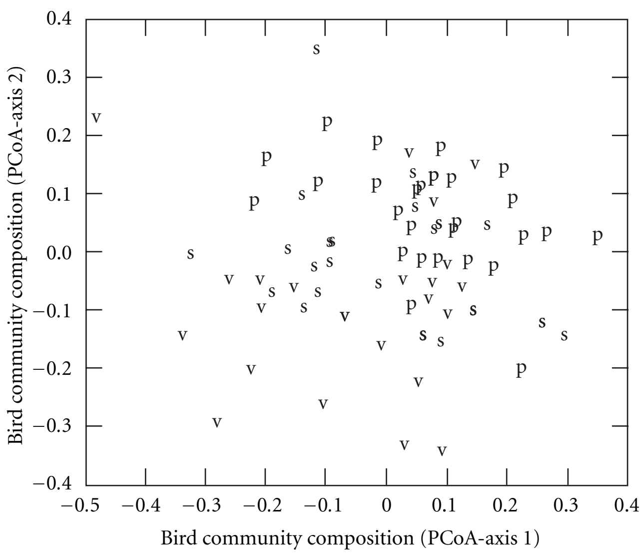


Figure 2: Results from Principal Coordinate Analysis (PCoA) used to generate a simple ordination of 72 areas at the Reserva Florestal Adolpho Ducke (RFAD), Manaus, Brazil, based on the similarity matrix of distances generated by the Sorensen index for the qualitative matrix (presence and absence data) for the entire bird community. Letters represent the 72 areas in which the bird species were sampled using 240 m mist-net lines placed throughout the RFAD (p = plateau; s = slopes; v = valleys). The closer the points are to one another in the graph, the more similar are their bird species community composition. Note that the species composition, with a group of p in the upper part, a group of s in the middle, and a group of v in the lower part, changes significantly along the topographical gradient from plateau to valleys.

3.5. Effects of Forest Structure Components on the Avifauna. We found no significant relation between the forest structure component parameters and the number of species (richness) and individuals (abundance) recorded in both mist-nets and acoustic surveys. Bird community composition (mist-net data) was significantly influenced by elevation, amount of leaf litter and distance to the nearest stream (Table 3). However, in all cases few species were strongly associated with the limits of the gradients, and most species occurred across the gradients of elevation, leaf litter and distance to stream (Figures 3(a), 3(b), and 3(c)). Changes in community composition (qualitative data) were significantly correlated with the amount of leaf litter, the distance to the nearest stream, and with terrain elevation (Table 3, Figures 4(a), 4(b), and 4(c)). When abundance of individuals was added to the community data (quantitative data), however, all relations lost significance (Table 3). Bird community composition (acoustic survey data) was also not significantly influenced by any of the seven forest structure components measured (data not shown).

3.6. Bird Species Composition between the Two Waterbasins (Eastern and Western Side). We found significant differences in the composition of bird species based on qualitative mist-net data between the two basins (eastern and western sides of the RFAD) (Manova, Pillai-Trace = 0.243; $F_{4,138} = 4.781$; $P = 0.001$), but not for quantitative data (Manova, Pillai-Trace = 0.117; $F_{6,136} = 1.403$; $P = 0.218$). We also found significant differences in the composition of bird species between the two water basins using qualitative data from the acoustic survey (Manova, Pillai-Trace test = 0.600; $F_{3,17} = 8.506$; $P < 0.001$).

Table 1: Mantel randomization tests on forest structure components in relation to position of the sampling plots (geographical coordinates) in the 72 plots at the Reserva Florestal Adolpho Ducke, Manaus, central Amazonia.

Variable	Correlation value (r)	(Significance) P value
Tree abundance	0.048	0.040
Abundance of snags	−0.032	0.959
Abundance of fallen logs	−0.005	0.600
Mean leaf litter depth	0.065	0.020
Distance to nearest stream	0.032	0.550
Mean canopy openness	0.092	0.0001
Elevation	0.031	0.050

4. Discussion

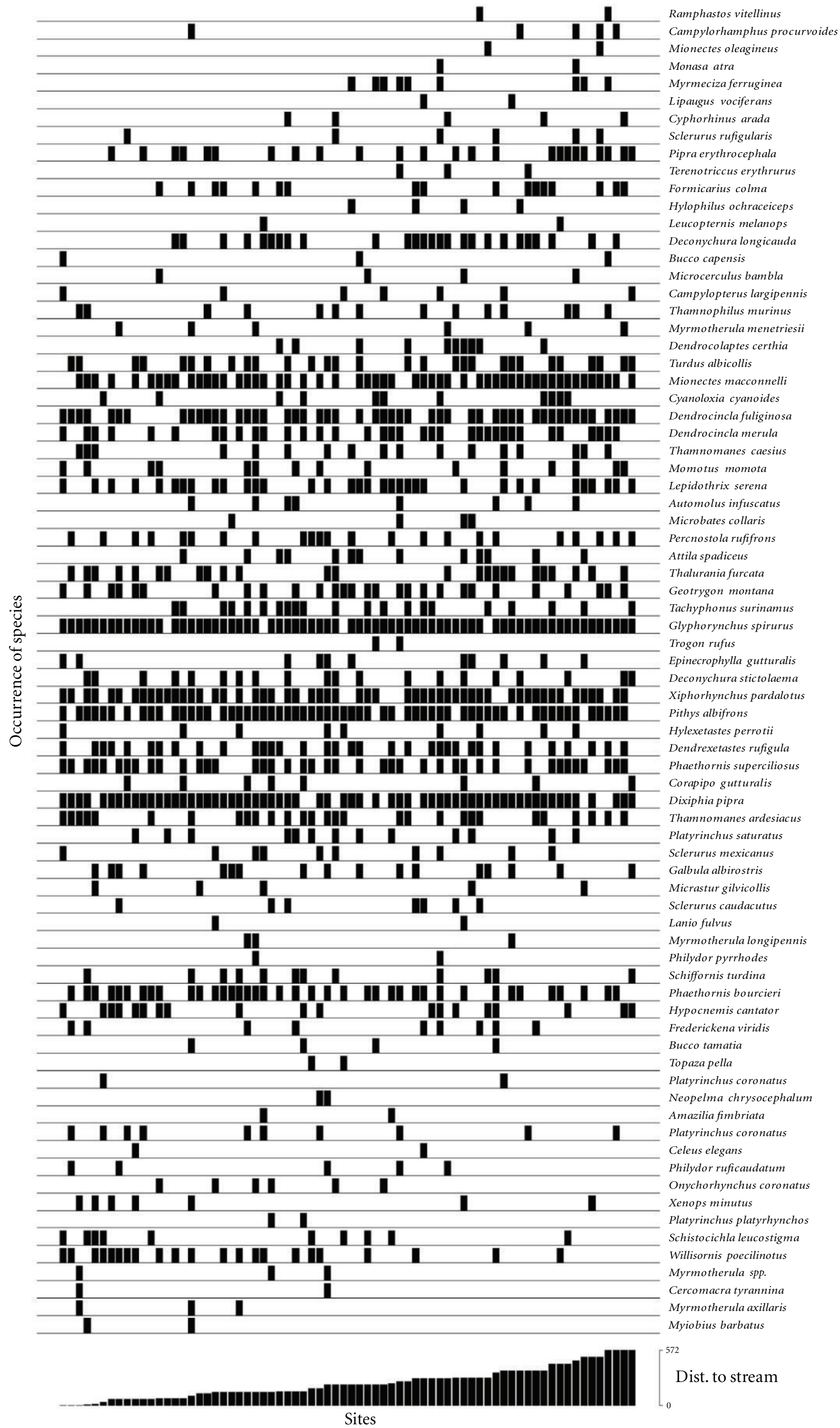
This study adds to the growing body of evidence suggesting that the natural heterogeneity found in a tropical forest can affect the local composition of animal and plant communities [17, 21, 38–48]. Although we found that none of the variables analyzed were significantly associated with the number of bird species (richness) and individuals (abundance) recorded either on mist-nets or acoustic surveys, we found significant relationships between at least three parameters (elevation, distance to the nearest stream, and depth of the leaf litter) and bird species composition. Furthermore, we also found that changes in bird community composition can, in part, be attributed to a topographic gradient (plateau-slope-valley), and the water basins within the RFAD.

Finding composition changes without variation in species richness and bird abundance can be attributed to species turnover within the study area. In this case we are not referring to biogeographical or regional variation in the avifauna, but to local changes in the avian communities. Our surveys indicate that most bird species occur throughout the RFAD (data not shown) and the central plateau, which we found to be relevant to explain changes in bird species' composition, by no means represents a biogeographical or geographic barrier. Therefore, we are confident that our results indicate that birds are tracking differences in the landscape and the structure of the forest.

Our results show a significant response of the avian community to a topographic gradient (plateau-slope-valley), even though the range in elevation within our plots was only 75 m (39–114 m above sea level). Although this variation seems negligible, it is enough to create a topographic gradient that includes "high" flat areas (plateaus), "low" areas (valleys, which often flood on rainy days), and either gentle or steep slopes connecting the two. This topographic gradient has

(a)

Figure 3: Continued.



(b)

Figure 3: Continued.

(c)

Figure 3: Bird species captured in 72 lines of mist-nets at Reserva Florestal Adolpho Ducke, near Manaus, Brazil, in relation to gradients in (a) elevation, (b) distance to the nearest stream, and (c) leaf litter depth. Species bars represent the presence of each species in a given line (presence/absence qualitative data), whereas height of bar at the bottom represents the quantitative value of those variables.

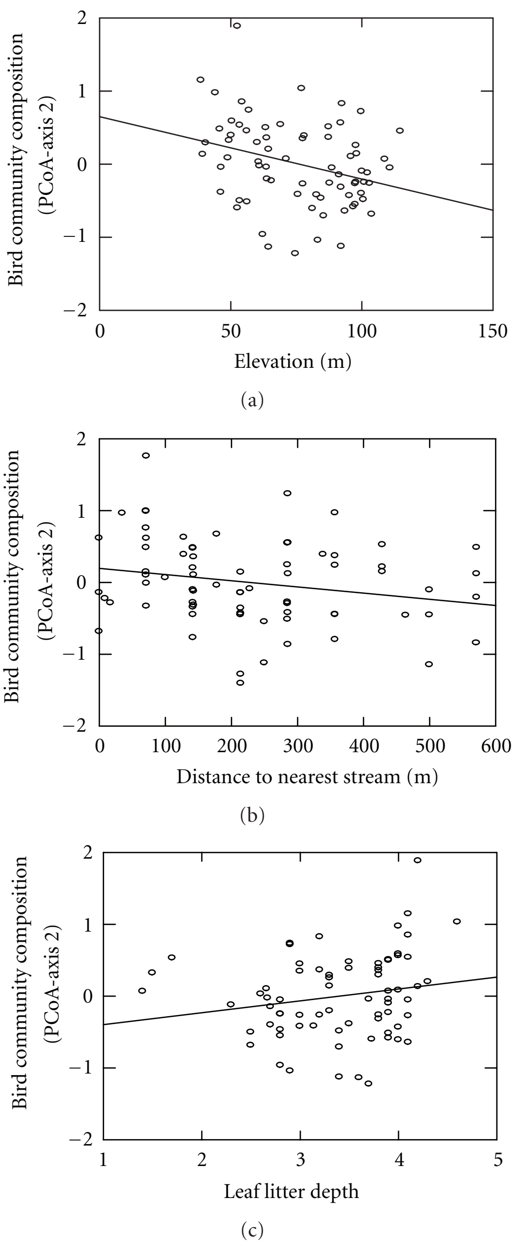


Figure 4: (a) The influence of terrain inclination (elevation), (b) stream proximity, and (c) depth of forest floor leaf litter on bird community composition in the Reserva Florestal Adolpho Ducke, Manaus, Brazil. Qualitative data (species presence/absence for the 72 transects with mist-nets), which were subjected to ordination analyses (PCoA). Only the second PCoA-axes were used to construct the graphs, the ones showing statistical significance.

been related to several soil parameters, particularly the amount of clay or sand in the soil [39], which in turn has been shown to be the best predictor of above-ground tree biomass at the RFAD [21] and other sites in central Amazonia [49]. This topographic gradient has also been shown to affect the distribution of palms [42], ants [43], and frogs [44], and is now shown for the first time in birds at the RFAD. We did not find a significant effect of the topography on the bird community sampled using acoustic surveys, and we believe that a main reason for such a difference is that, whereas lines of mist-nets covered ~240 m, acoustic surveys covered 1 km. It is more likely that several topographic classes are present in 1 km than in 0.25 km, and this may obscure possible relationships.

The depth of leaf litter on the forest ground can have several indirect effects on the avifauna, offering more substrate for small and large invertebrates for insectivorous birds, and even small vertebrates on which raptors (e.g., forest-falcons and owls) can prey [38]. Many bird species are known to actively search under dead leaves on the ground, such as leaftossers (*Sclerurus*) and foliage-gleaners (*Automolus*), and using leaf litter is a common practice in North America to attract birds to people's backyards. On the other hand, leaf litter is very dynamic, and can change dramatically in space (flat versus steep areas) and time (dry versus wet season). Hence, we are not sure which mechanisms can maintain its effect on an entire avifauna in the long term.

Forest streams are a vital component of the forest landscape and correlated to valleys. Therefore, the relationship between species composition and proximity to the microhabitats formed by the streams was expected. In fact, several bird species are restricted to valleys and streams, as shown by our ordination analysis. Within our sample, we identified almost 30 species that occur more often near streams (Figure 3(b)), including some species that are rarely recorded away from them (e.g., *Topaza pella*, *Philydor pyrrhodes*, and *Schistocichla leucostigma*). Proximity to streams is also known to influence the distribution and abundance of terrestrial herbs [41, 50] and palms [42] at the RFAD.

The number of trees, fallen logs, snags, and canopy openness are variables known to affect individual birds species [7] or groups [38], yet they had little effect on the number of species or individuals (richness and abundance), and the species composition associated with our plots. One potential problem in assessing the effect of local environmental variables on birds is that, differently from herbs, palms, or frogs, most bird species hold relatively large territories for their size. Data from throughout the Neotropics suggest that even small passerines occupy (and actively defend) between 10 and 20 ha of primary forest [2, 46]. How then can we relate landscape features and small-scale forest parameters in plots of 0.25 ha (50×50 m) with birds that may occupy an area 50 to 75 times larger? Our understanding on the use of space by tropical birds remains limited, and it is not well known how much of their territories birds actually use, or how much of their territory is actually needed for activities such as feeding or nesting. Although weak, the spatial autocorrelation that we found in variables such as tree abundance, leaf litter depth, canopy openness, and elevation may indicate that our plots may represent the forest well beyond the plots' 50×50 m boundaries and may actually describe large enough areas to hold entire territories of individual birds. Similarly, plateaus, slopes, and valleys are continuous habitats, and one can walk (or a bird fly) for several kilometers on a plateau avoiding the valleys. Whether birds do this and select their use of territory in relation to topographic gradients or simply use their entire territory is not clear yet and deserve further investigation.

Table 2: Pearson correlation matrix among the forest structure components recorded in 72 plots at the Reserva Florestal Adolpho Ducke, Manaus, central Amazonia, used in the avian community analyses; $^{**}P < 0.001$; $^{*}P < 0.05$ resulting from the Bonferroni probability matrix.

	Abundance of forest trees	Abundance of fallen logs	Abundance of snags	Leaf litter depth	Forest canopy openness (%)	Elevation (m)
Abundance of fallen logs	0.208					
Abundance of snags	0.083	0.315				
Leaf litter depth	0.047	0.318	0.255			
Forest canopy openness^{+}	0.134	0.560**	0.474**	0.528**		
Elevation^{+}	0.118	0.093	0.035	0.290	0.242	
Distance to nearest stream	0.053	0.129	0.019	0.020	−0.058	0.370*

$^{+}$These two were significantly correlated to other variables; therefore, canopy openness and elevation were analyzed in a separate regression model.

Table 3: Results of the multiple regression analyses performed to test the effect of the seven forest structure components on qualitative and quantitative bird composition. Analyses were performed on scores from the Principal Coordinate Analyses (PCoA).

Data (matrix)		Forest components	Qualitative (presence/absence)				Quantitative (abundance)			
			Pillai-Trace	*F*	DF	*P*	Pillai-Trace	*F*	DF	*P*
Bird community	Model 1	Tree abundance	0.084	1.958	3; 64	0.129	0.085	1.986	3; 64	0.125
		Log abundance	0.049	1.109	3; 64	0.352	0.069	1.580	3; 64	0.203
		Snag abundance	0.023	0.500	3; 64	0.683	0.043	0.961	3; 64	0.417
		Leaf litter depth	**0.111** (−)	**2.667**	**3; 64**	**0.055**	0.036	0.800	3; 64	0.498
		Distance to stream	**0.118** (−)	**2.861**	**3; 64**	**0.044**	0.088	2.062	3; 64	0.114
	Model 2	Elevation	**0.209** (+)	**5.919**	**3; 67**	**0.001**	0.079	1.928	3; 67	0.133
		Canopy openness	0.033	0.761	3; 67	0.520	0.015	0.351	3; 67	0.789

Because elevation and canopy openness were significantly correlated to other variables (see Table 1), they were analyzed in separate multiple linear regression models (see Section 3 and Figure 3). Three or two PCoA-axes were used in the models for quantitative and qualitative analysis, respectively (see Section 2). The negative and positive signals within parenthesis are just to indicate the directions of the relationships and are not related to Pillai-Trace values (see also Figure 4).

The central plateau that divides the RFAD in two halves, results in two relatively similar-sized basins with significantly different community compositions. Similar results were found for the community composition of herbs [42] and fish [45]. Therefore, it is possible that the differences in bird communities between basins are due to differences in forest biomass and soil, which is higher in the eastern part of the RFAD [21]. Higher biomass may result in more food resources and enhanced opportunities for foraging, but these indirect relationships remain speculative.

Despite the fact that the RFAD is rapidly becoming a large forest fragment, its avifauna seems to remain untouched, if compared to neighboring areas with continuous forests [14]. Not only did we record most species expected to be found in a healthy forest, but independently of being found in our standardized surveys, important species of conservation concern are known to occur at the RFAD (see Table 4). Among these are several large frugivores, such as guans, curassows, trumpeters, toucans, and macaws, which are the first species to be hunted to local extinction by surrounding human populations. Similarly important is the presence of several large-bodied top predators such as Harpy Eagle (*Harpia harpyja*), Crested Eagle (*Morphnus guianensis*), Black-and-white Hawk-Eagle (*Spizaetus melanoleucus*), *Black Hawk-Eagle* (*Spizaetus tyrannus*), and Ornate Hawk-Eagle (*Spizaetus ornatus*), many of which are known to nest in the RFAD (T.M. Sanaiotti, pers. comm.). Other species seem to be truly rare at the RFAD and were recorded only once in our surveys, for example, Crimson Topaz (*Topaza pella*), Royal Flycatcher (*Onychorhynchus coronatus*), Guianan Red-Cotinga (*Phoenicircus carnifex*), and Slaty-backed Forest-Falcon (*Micrastur mirandolleii*). These species seem to be generally rare or locally uncommon in central Amazonia [14], independently of the conservation condition of the forest. In fact, virtually all species considered vulnerable to fragmentation or sensitive to fragment area [47] were found at the RFAD [48].

Despite the good conditions of the RFAD's avifauna, which was last surveyed by us more than five years ago [7, 32, 38, 48], careful monitoring is important, particularly given the continuous pressure created by the growth of the city of Manaus. Therefore, we recommend that long-term monitoring of bird communities using standardized methods be done at the RFAD [54] in order to ensure that processes of species loss (if unavoidable) are well documented. The only active measure that can potentially delay or protect the RFAD from species loss is maintaining the connectivity of the RFAD on its eastern edge and creating a protected forest corridor from the RFAD to other large tracks of forest north of Manaus.

Table 4: Bird species recorded at the Reserva Florestal Adolpho Ducke, central Amazonia, Brazil (see codes at end). Taxonomy and systematic order follow the Comite Brasileiro de Registros Ornitologicos (CBRO) as of August 2009 [51].

Bird species	Wt. (g)	Soc.	Abund.	Diet	Br.	Str.	Rec.	Portuguese name
TINAMIDAE								
Tinamus major (Gmelin, 1789)	1100c	s	c	a, i, s, f	x	g	a	inhambu-de-cabeça-vermelha
Crypturellus soui (Hermann, 1783)	220c	s	u	a, i, s, f	x	g	o	tururim
Crypturellus variegatus (Gmelin, 1789)	384b	s	c	a, i, s, f	x	g	a	inhambu-anhangá
Crypturellus brevirostris (Pelzeln, 1863)	—	s	u	a, i, s, f	x	g	a	inhambu-carijó
CRACIDAE								
Ortalis motmot (Linnaeus, 1766)	445c	g	c	a, i, fr, s		u		aracuã-pequeno
Penelope marail (Statius Muller, 1776)	840c	s, g	c	a, i, fr, s	x	c, u	a	jacumirim
Crax alector (Linnaeus, 1766)	3100c	s, g	u	a, i, fr, s	x	g, u		mutum-poranga
ODONTOPHORIDAE								
Odontophorus gujanensis (Gmelin, 1789)	255b	g	u	a, i, fr, s	x	g	a	uru-corcovado
ARDEIDAE								
Ardea alba (Linnaeus, 1758)	885c	s	u	fo, fi		g		garça-branca-grande
CICONIIDAE								
Mycteria americana (Linnaeus, 1758)	2500c	s	r	fi		u		cabeça-seca
CATHARTIDAE								
Coragyps atratus (Bechstein, 1793)	1800c	s, g	c	d		c		urubu-de-cabeça-preta
Cathartes aura (Linnaeus, 1758)	2000c	s	c	d	x	c		urubu-de-cabeça-vermelha
Cathartes melambrotus (Wetmore, 1964)	1400c	s	u	d	x	c		urubu-da-mata
Sarcoramphus papa (Linnaeus, 1758)	3300c	s	r	d		c		urubu-rei
PANDIONIDAE								
Pandion haliaetus (Linnaeus, 1758)	1700c	s	b	fi		c		águia-pescadora
ACCIPITRIDAE								
Leptodon cayanensis (Latham, 1790)	605c	s	r	bi		c		gavião-de-cabeça-cinza
Chondrohierax uncinatus (Temminck, 1822)	300c	s	r	b, r		c		caracoleiro
Elanoides forficatus (Linnaeus, 1758)	445c	s	?	a, i		c		gavião-tesoura
Gampsonyx swainsonii (Vigors, 1825)	95c	s	r	a, i		c, u		gaviãozinho
Harpagus bidentatus (Latham, 1790)	170c	s	u	a, i, b	x	u		gavião-ripina
Ictinia plumbea (Gmelin, 1788)	280c	s	?	i		c		sovi
Accipiter superciliosus (Linnaeus, 1766)	80b	s	r	bi, ro		c, u		gavião-miudinho
Accipiter bicolor (Vieillot, 1817)	230c	s	r	bi, ro		c, u		gavião-bombachinha-grande
Leucopternis melanops (Latham, 1790)	330c	s	r	bi, sn	x	c, u	a	gavião-de-cara-preta
Leucopternis albicollis (Latham, 1790)	750c	s	c	bi, sn	x	c, u	o	gavião-branco
Buteogallus urubitinga (Gmelin, 1788)	1100c	s	u	bi, fi, sn	x	c, u		gavião-preto

Table 4: Continued.

Bird species	Wt. (g)	Soc.	Abund.	Diet	Br.	Str.	Rec.	Portuguese name
Rupornis magnirostris (Gmelin, 1788)	265c	s	c	bi, li, sn	x	c, u		gavião-carijó
Buteo nitidus (Latham, 1790)	475c	s	c	bi, li, sn	x	c, u		gavião-pedrês
Buteo platypterus (Vieillot, 1823)	450c	s	b	bi, li, sn		c, u		gavião-de-asa-larga
Morphnus guianensis (Daudin 1800)	1800c	s	r	mo, sl, ro	x	c, u		uiraçu-falso
Harpia harpyja (Linnaeus, 1758)	6500c	s	r	mo, sl, ro	x	c, u		gavião-real
Spizaetus melanoleucus (Vieillot, 1816)	815c	s	r	bi, mo, ro		c		gavião-pato
Spizaetus tyrannus (Wied, 1820)	1000c	s	r	bi, mo, ro	x	c		gavião-pega-macaco
Spizaetus ornatus (Daudin, 1800)	1200c	s	u	bi, mo, ro	x	c	a	gavião-de-penacho
FALCONIDAE								
Ibycter americanus (Boddaert, 1783)	570c	g	c	a, i, li, bi	x	c	a	gralhão
Milvago chimachima (Vieillot, 1816)	325c	s	c	a, i, li, bi		u, g		carrapateiro
Micrastur ruficollis (Vieillot, 1817)	176	s*	c	a, i, li, bi	x	u	o	falcão-caburé
Micrastur gilvicollis (Vieillot, 1817)	226	s	c	a, i, li, bi	x	u	o, a	Falcão-mateiro
Micrastur mirandollei (Schlegel, 1862)	420c	s	u	a, i, li, bi		u	a	tanatau
Micrastur semitorquatus (Vieillot, 1817)	535c	s	u	a, i, li, bi		u		falcão-relógio
Falco rufigularis (Daudin, 1800)	140c	s	c	a, i, ba, bi	x	c		cauré
Falco peregrinus (Tunstall, 1771)	600c	s	b	a, i, ba, bi		c		falcão-peregrino
PSOPHIIDAE								
Psophia crepitans (Linnaeus, 1758)	1300c	g	u	a, i, fr, s	x	g, u	o	jacamim-de-costas-cinzentas
RALLIDAE								
Aramides cajanea (Statius Muller, 1776)	410c	s	c	a, i	x	g		saracura-três-potes
Laterallus viridis (Statius Muller, 1776)	64c		u	a, i		g		sanã-castanha
EURYPIGIDAE								
Eurypyga helias (Pallas, 1781)	220c	s	r	a, i	x	g		pavãozinho-do-Pará
SCOLOPACIDAE								
Tringa solitaria (Wilson, 1813)	47c	s	b	a, i		g		maçarico-solitário
COLUMBIDAE								
Columbina passerina (Linnaeus, 1758)	32c	s	u	s	x	c, u		rolinha-cinzenta
Columbina talpacoti (Temminck, 1811)	47c	s	c	s	x	g, u		rolinha-roxa
Patagioenas cayennensis (Bonnaterre, 1792)	230c	s	u	s	x	c, u		pomba-galega
Patagioenas plumbea (Vieillot, 1818)	180c	s	c	s	x	c, u	a	pomba-amargosa

Table 4: Continued.

Bird species	Wt. (g)	Soc.	Abund.	Diet	Br.	Str.	Rec.	Portuguese name
Patagioenas subvinacea (Lawrence, 1868)	128b	s	c	s	x	c, u	a	pomba-botafogo
Leptotila verreauxi (Bonaparte, 1855)	155c	s	c	s	x	g, u		juriti-pupu
Geotrygon montana (Linnaeus, 1758)	122	s	c	S	x	g, u	o, a	pariri
PSITTACIDAE								
Ara ararauna (Linnaeus, 1758)	1100c	c, g	u	fr, s		c		arara-canindé
Ara macao (Linnaeus, 1758)	1000c	c, g	c	fr, s		c	a	araracanga
Ara chloropterus (Gray, 1859)	1250c	c, g	c	fr, s	x	c	a	arara-vermelha-grande
Orthopsittaca manilata (Boddaert, 1783)	370c	c, g	u	fr, s	x	c		maracanã-do-buriti
Aratinga leucophthalma (Statius Muller, 1776)	160c	g	u	fr, s	x	c		periquitão-maracanã
Brotogeris chrysoptera (Linnaeus, 1766)	65c	g	c	fr, s	x	c	a	periquito-de-asa-dourada
Touit purpuratus (Gmelin, 1788)	60c	g	u	fr, s		c	a	apuim-de-costas-azuis
Pyrilia caica (Latham, 1790)	130c	g	u	fr, s	x	c	a	curica-caica
Pionus menstruus (Linnaeus, 1766)	245c	g	c	fr, s	x	c	a	maitaca-de-cabeça-azul
Pionus fuscus (Statius Muller, 1776)	205c	s	u	fr, s		c	a	maitaca-roxa
Amazona autumnalis (Linnaeus, 1758)	415c	g	c	fr, s	x	c	a	papagaio-diadema
Amazona farinosa (Boddaert, 1783)	620c	g	u	fr, s		c		papagaio-moleiro
Deroptyus accipitrinus (Linnaeus, 1758)	240c	s	u	fr, s		c	a	anacã
CUCULIDAE								
Piaya cayana (Linnaeus, 1766)	95c	s	u	a, i, fo, li	x	u		alma-de-gato
Piaya melanogaster (Vieillot, 1817)	100c	s	c	a, i, fo, li	x	u	a	chincoã-de-bico-vermelho
Crotophaga ani (Linnaeus, 1758)	95c	g	c	a, i, fo, li	x	u		anu-preto
STRIGIDAE								
Megascops watsonii (Cassin, 1849)	147b	s	c	a, i, ba, ro	x	u	a	corujinha-orelhuda
Lophostrix cristata (Daudin, 1800)	545c	s	c	a, i, ba, ro	x	u		coruja-de-crista
Pulsatrix perspicillata (Latham, 1790)	850c	s	u	a, i, ba, ro	x	c		murucututu
Strix huhula (Daudin, 1800)	385c	s	u	a, i, ba, ro	x	u		coruja-preta
Strix virgata (Cassin, 1849)	260c	s	r	a, i, ba, ro	x	u		coruja-do-mato
Glaucidium hardyi (Vielliard, 1990)	55b	s	c	a, i, ba, ro	x	u	a	caburé-da-amazônia
NYCTIBIDAE								
Nyctibius grandis (Gmelin, 1789)	550c	s	r	i	x	c, u		mãe-da-lua-gigante
Nyctibius aethereus (Wied, 1820)	320	s	r	i		c, u		mãe-da-lua-parda
Nyctibius griseus (Gmelin, 1789)	35c	s	u	i	x	c, u	a	mãe-da-lua
Nyctibius leucopterus (Wied, 1821)	—	s	u	i	x	c, u		urutau-de-asa-branca
CAPRIMULGIDAE								
Lurocalis semitorquatus (Gmelin, 1789)	75c	s	u	i		g		tuju
Nyctidromus albicollis (Gmelin, 1789)	145	s	c	i	x	g		bacurau

Table 4: Continued.

Bird species	Wt. (g)	Soc.	Abund.	Diet	Br.	Str.	Rec.	Portuguese name
Caprimulgus nigrescens (Cabanis, 1848)	136	s	u	i	x	g		bacurau-de-lajeado
APODIDAE								
Streptoprocne zonaris (Shaw, 1796)	90c	g	r	i		a		taperuçu-de-coleira-branca
Chaetura spinicaudus (Temminck, 1839)	15c	g	c	i		a		andorinhão-de-sobre-branco
Chaetura chapmani (Hellmayr, 1907)	22c	g	c	i		a		andorinhão-de-chapman
Chaetura brachyura (Jardine, 1846)	20c	g	u	i		a		andorinhão-de-rabo-curto
Panyptila cayennensis (Gmelin, 1789)	18c	s	r	i		a		andorinhão-estofador
Tachornis squamata (Cassin, 1853)	11c	s	r	i	x	a		tesourinha
TROCHILIDAE								
Glaucis hirsutus (Gmelin, 1788)	4	s	r	a, i, n	x	c, u	o	balança-rabo-de-bico-torto
Phaethornis superciliosus (Linnaeus, 1766)	6	s	c	a, i, n	x	c, u	a, o	rabo-branco-de-bigodes
Phaethornis bourcieri (Lesson, 1832)	5	s	c	a, i, n	x	c, u	a, o	rabo-branco-de-bico-reto
Phaethornis ruber (Linnaeus, 1758)	2c	s	r	a, i, n	x	c, u		rabo-branco-rubro
Campylopterus largipennis (Boddaert, 1783)	6	s	c	a, i, n	x	c, u	a, o	asa-de-sabre-cinza
Florisuga mellivora (Linnaeus, 1758)	6	s	u	a, i, n	x	c, u		beija-flor-azul-de-rabo-branco
Anthracothorax nigricollis (Vieillot, 1817)	7c	s	r	a, i, n	x	c, u		beija-flor-de-veste-preta
Topaza pella (Linnaeus, 1758)	12	s	r	a, i, n	x	c, u	a, o	beija-flor-brilho-de-fogo
Discosura longicaudus (Gmelin, 1788)	3c	s	r	a, i, n		c, u		Bandeirinha
Thalurania furcata (Gmelin, 1788)	5	s	c	a, i, n	x	c, u	a, o	beija-flor-tesoura-verde
Hylocharis sapphirina (Gmelin, 1788)	3	s	u	a, i, n	x	c, u	a	beija-flor-safira
Polytmus theresiae (Da Silva Maia, 1843)	4c	s	u	a, i, n	x	c, u		beija-flor-verde
Amazilia versicolor (Vieillot, 1818)	—	s	r	a, i, n	x	c, u	o	beija-flor-de-banda-branca
Amazilia fimbriata (Gmelin, 1788)	8c	s	c	a, i, n	x	c, u	o	beija-flor-de-garganta-verde
Heliothryx auritus (Gmelin, 1788)	4	s	c	a, i, n	x	c, u	a, o	beija-flor-de-bochecha-azul
TROGONIDAE								
Trogon melanurus (Swainson, 1838)	92b	s	c	a, i, fr, s	x	c, u	a	surucuá-de-cauda-preta
Trogon viridis (Linnaeus, 1766)	49b	s	c	a, i, fr, s	x	c, u	a	s.-grande-de-barriga-amarela
Trogon violaceus (Gmelin, 1788)	54b	s	c	a, i, fr, s	x	c, u	a	surucuá-pequeno
Trogon rufus (Gmelin, 1788)	52	s	u	a, i, fr, s	x	c, u	a, o	surucuá-de-barriga-amarela

Table 4: Continued.

Bird species	Wt. (g)	Soc.	Abund.	Diet	Br.	Str.	Rec.	Portuguese name
Pharomachrus pavoninus (Spix, 1824)	—	s	r	a, i, fr, s	x	c, u	a	surucuá-pavão
ALCENIDIDAE								
Megaceryle torquata (Linnaeus, 1766)	300c	s	r	fi	x	u		martim-pescador-grande
Chloroceryle amazona (Latham, 1790)	110c	s	r	fi	x	u		martim-pescador-verde
Chloroceryle aenea (Pallas, 1764)	16	s	r	fi	x	u	o	martinho
Chloroceryle americana (Gmelin, 1788)	27	s	r	fi	x	u		martim-pescador-pequeno
Chloroceryle inda (Linnaeus, 1766)	50	s	c	fi	x	u	o	martim-pescador-da-mata
MOMOTIDAE								
Momotus momota (Linnaeus, 1766)	152	s	c	a, i	x	g, u	a, o	udu-de-coroa-azul
GALBULIDAE								
Galbula albirostris (Latham, 1790)	27	s	c	a, i	x	u	a, o	ariramba-de-bico-amarelo
Galbula leucogastra (Vieillot, 1817)	16c	s	r	a, i	x	u	a, o	ariramba-bronzeada
Galbula dea (Linnaeus, 1758)	30c	s	c	a, i	x	c, u	a, o	ariramba-do-paraíso
Jacamerops aureus (Statius Muller, 1776)	61b	s	u	a, i	x	c, u	a, o	jacamaraçu
BUCCONIDAE								
Notharchus macrorhynchos (Gmelin, 1788)	53b	s	c	a, i, fo, li	x	g, u	a	macuru-de-testa-branca
Notharchus tectus (Boddaert, 1783)	27c	s	u	a, i, fo, li		g, u		macuru-pintado
Bucco tamatia (Gmelin, 1788)	36	s	u	a, i, fo, li	x	g, u	a, o	rapazinho-carijó
Bucco capensis (Linnaeus, 1766)	52	s	r	a, i, fo, li	x	g, u	a, o	rapazinho-de-colar
Malacoptila fusca (Gmelin, 1788)	42	s	u	a, i, fo, li	x	g, u	o	barbudo-pardo
Nonnula rubecula (Spix, 1824)	21b	s	r	a, i, fo, li		g, u		macuru
Monasa atra (Boddaert, 1783)	85	s	c	a, i, fo, li	x	g, u	a, o	chora-chuva-de-asa-branca
Chelidoptera tenebrosa (Pallas, 1782)	35c	s	r	a, i, fo, li	x	g, u		urubuzinho
CAPITONIDAE								
Capito niger (Statius Muller, 1776)	55c	s	c	a, i, fr, s		c, u	a	capitão-de-bigode-carijó
RAMPHASTIDAE								
Ramphastos tucanus (Linnaeus, 1758)	600c	c, g	c	a, bi, i, fr, s	x	c, u	a	tucano-grande-de-papo-branco
Ramphastos vitellinus (Lichtenstein, 1823)	372	c, g	c	a, bi, i, fr, s	x	c, u	a, o	tucano-de-bico-preto
Selenidera piperivora (Linnaeus, 1766)	149b	c	c	a, bi, i, fr, s		c, u	a	araçari-negro
Pteroglossus viridis (Linnaeus, 1766)	140b	g	c	a, bi, i, fr, s	x	c, u	a, o	araçari-miudinho
PICIDAE								
Picumnus exilis (Lichtenstein, 1823)	9c	s, c	r	a, i, fr, s		c, u		pica-pau-anão-de-pinta-amarela
Melanerpes cruentatus (Boddaert, 1783)	58c	s, c, g	c	a, i, fr, s	x	c, u	a	benedito-de-testa-vermelha

Table 4: Continued.

Bird species	Wt. (g)	Soc.	Abund.	Diet	Br.	Str.	Rec.	Portuguese name
Veniliornis cassini (Malherbe, 1862)	33b	s, c	c	a, i, fr, s	x	c, u	a, o	pica-pau-de-colar-dourado
Piculus flavigula (Boddaert, 1783)	33b	s, c	c	a, i, fr, s	x	c, u	a, o	pica-pau-bufador
Piculus chrysochloros (Vieillot, 1818)	83c	s, c	r	a, i, fr, s	x	c, u		pica-pau-dourado-escuro
Celeus undatus (Linnaeus, 1766)	64c	s, c	r	a, i, fr, s		c, u	a	pica-pau-barrado
Celeus elegans (Statius Muller, 1776)	128	s, c	u	a, i, fr, s	x	c, u	a, o	pica-pau-chocolate
Celeus flavus (Statius Muller, 1776)	105c	s, c	u	a, i, fr, s		c, u		pica-pau-amarelo
Celeus torquatus (Boddaert, 1783)	120c	s, c	u	a, i, fr, s		c, u	a	pica-pau-de-coleira
Dryocopus lineatus (Linnaeus, 1766)	200c	s, c	c	a, i, fr, s	x	c, u		pica-pau-de-banda-branca
Campephilus rubricollis (Boddaert, 1783)	216b	s, c	c	a, i, fr, s	x	c, u	a	pica-pau-de-barriga-vermelha
THAMNOPHILIDAE								
Cymbilaimus lineatus (Leach, 1814)	35b	s	c	a, i	x	u	a	papa-formiga-barrado
Frederickena viridis (Vieillot, 1816)	66	s	r	a, i	x	u	a, o	borralhara-do-norte
Thamnophilus murinus (Sclater & Salvin, 1868)	16	s	c	a, i	x	u	a, o	choca-murina
Thamnophilus punctatus (Shaw, 1809)	20c	s	u	a, i	x	u	o	choca-bate-cabo
Thamnomanes ardesiacus (Sclater & Salvin, 1867)	20	s	c	a, i	x	c, u	a, o	uirapuru-de-garganta-preta
Thamnomanes caesius (Temminck, 1820)	18	s	c	a, i	x	c, u	a, o	ipecuá
Epinecrophylla gutturalis (Sclater & Salvin, 1881)	10	s	c	a, i	x	u	a, o	choquinha-de-barriga-parda
Myrmotherula brachyura (Hermann, 1783)	7c	s	c	a, i		u	a	choquinha-miúda
Myrmotherula guttata (Vieillot, 1825)	10b	s	u	a, i	x	u		choquinha-de-barriga-ruiva
Myrmotherula axillaris (Vieillot, 1817)	8	s	u	a, i	x	u	a	choquinha-de-flanco-branco
Myrmotherula longipennis (Pelzeln, 1868)	11	s	c	a, i	x	u	a, o	choquinha-de-asa-comprida
Myrmotherula menetriesii (d'Orbigny, 1837)	11	s	c	a, i	x	u	a, o	choquinha-de-garganta-cinza
Herpsilochmus dorsimaculatus (Pelzeln, 1868)	9c	s	c	a, i		c, u	a	chorozinho-de-costa-manchada
Terenura spodioptila (Sclater & Salvin, 1881)	6c	s	c	a, i	x	u	a	zidedê-de-asa-cinza
Cercomacra cinerascens (Sclater, 1857)	21	s	c	a, i	x	u	a	chororó-pocuá
Cercomacra tyrannina (Sclater, 1855)	17	s	r	a, i	x	u	o	chororó-escuro

Table 4: Continued.

Bird species	Wt. (g)	Soc.	Abund.	Diet	Br.	Str.	Rec.	Portuguese name
Hypocnemis cantator (Boddaert, 1783)	14	s	c	a, i	x	u	a	papa-formiga-cantador
Percnostola rufifrons (Gmelin, 1789)	30	s*	c	a, i	x	g, u	a, o	formigueiro-de-cabeça-preta
Schistocichla leucostigma (Pelzeln, 1868)	24	s	u	a, i	x	g, u	a, o	formigueiro-de-asa-pintada
Myrmeciza ferruginea (Statius Muller, 1776)	18	s	c	a, i	x	u	a, o	formigueiro-ferrugem
Myrmeciza atrothorax (Boddaert, 1783)	18b	s	u	a, i	x	u	o	formigueiro-de-peito-preto
Myrmornis torquata (Boddaert, 1783)	45b	s	u	a, i	x	g		pinto-do-mato-carijó
Pithys albifrons (Linnaeus, 1766)	22	s*	c	a, i	x	u	o	papa-formiga-de-topete
Gymnopithys rufigula (Boddaert, 1783)	34	s*	c	a, i	x	u	a, o	mãe-de-taoca-garganta-vermelha
Willisornis poecilinotus (Cabanis, 1847)	16c	s*	c	a, i	x	g, u	a, o	Rendadinho
CONOPOPHAGIDAE								
Conopophaga aurita (Hermann, 1783)	24b	s	u	a, i	x	u		chupa-dente-de-cinta
GRALLARIIDAE								
Grallaria varia (Boddaert, 1783)	128	s	c	a, i	x	g	a, o	tovacuçu
Hylopezus macularius (Temminck, 1823)	42b	s	u	a, i		g	a	torom-carijó
Myrmothera campanisona (Hermann, 1783)	48b	s	c	a, i	x	g	a	tovaca-patinho
FORMICARIIDAE								
Formicarius colma (Boddaert, 1783)	54	s	c	a, i	x	g	a, o	galinha-do-mato
Formicarius analis (d'Orbigny & Lafresnaye, 1837)	62b	s	c	a, i		g		pinto-do-mato-de-cara-preta
SCLERURIDAE								
Sclerurus mexicanus (Sclater, 1857)	28	s	u	a, i	x	u	a, o	vira-folha-de-peito-vermelho
Sclerurus rufigularis (Pelzeln, 1868)	21b	s	c	a, i	x	u	a, o	vira-folha-de-bico-curto
Sclerurus caudacutus (Vieillot, 1816)	20	s	r	a, i	x	u	o	vira-folha-pardo
DENDROCOLAPTIDAE								
Dendrocincla fuliginosa (Vieillot, 1818)	46	s*	c	a, i	x	c, u	a, o	arapaçu-pardo
Dendrocincla merula (Lichtenstein, 1829)	63	s*	c	a, i	x	c, u	o	arapaçu-da-taoca
Deconychura longicauda (Pelzeln, 1868)	31	s	c	a, i	x	c, u	o	arapaçu-rabudo
Deconychura stictolaema (Pelzeln, 1868)	18	s	c	a, i	x	c, u	a, o	arapaçu-de-garganta-pintada
Sittasomus griseicapillus (Vieillot, 1818)	14b	s	c	a, i	x	c, u	a	arapaçu-verde
Glyphorynchus spirurus (Vieillot, 1819)	12	s	c	a, i	x	c, u	a, o	arapaçu-de-bico-de-cunha
Dendrexetastes rufigula (Lesson, 1844)	70b	s	u	a, i	x	c, u	a	arapaçu-galinha
Hylexetastes perrotii (Lafresnaye, 1844)	123	s*	u	a, i	x	c, u	a, o	arapaçu-de-bico-vermelho
Dendrocolaptes certhia (Boddaert, 1783)	66	s*	c	a, i	x	c, u	a, o	arapaçu-barrado

Table 4: Continued.

Bird species	Wt. (g)	Soc.	Abund.	Diet	Br.	Str.	Rec.	Portuguese name
Dendrocolaptes picumnus (Lichtenstein, 1820)	35	s*	u	a, i	x	c, u	a, o	arapaçu-meio-barrado
Xiphorhynchus pardalotus (Vieillot, 1818)	53	s	c	a, i	x	c, u	a, o	arapaçu-assobiador
Lepidocolaptes albolineatus (Lafresnaye, 1845)	19b	s	c	a, i		c, u	a	arapaçu-de-listras-brancas
Campylorhamphus procurvoides (Lafresnaye, 1850)	42	s	u	a, i	x	c, u	a, o	arapaçu-de-bico-curvo
FURNARIIDAE								
Synallaxis rutilans (Temminck, 1823)	17b	c	u	a, i	x	u	o	joão-tenerém-castanho
Philydor erythrocercum (Pelzeln, 1859)	23b	s	c	a, i		u	a	limpa-folha-de-sobre ruivo
Philydor pyrrhodes (Cabanis, 1848)	30	s	u	a, i	x	u	a, o	limpa-folha-vermelho
Automolus ochrolaemus (Tschudi, 1844)	35b	s	c	a, i	x	u		barranqueiro-camurça
Automolus infuscatus (Sclater, 1856)	30	s	c	a, i	x	u	a, o	barranqueiro-pardo
Xenops milleri (Chapman, 1914)	11b	s	c	a, i	x	u	a, o	bico-virado-da-copa
Xenops minutus (Sparrman, 1788)	14	s	c	a, i	x	u	a, o	bico-virado-miúdo
TYRANNIDAE								
Mionectes oleagineus (Lichtenstein, 1823)	10	s	u	a, i, fr, s	x	u	o	abre-asa
Mionectes macconnelli (Chubb, 1919)	15	s	c	a, i, fr, s	x	u	a, o	abre-asa-da-mata
Corythopis torquatus (Tschudi, 1844)	22	s	u	a, i, fr, s	x	g, u	o	estalador-do-norte
Lophotriccus vitiosus (Bangs & Penard, 1921)	—	s	c	a, i, fr, s		c, u	a	maria-fiteira
Lophotriccus galeatus (Boddaert, 1783)	7c	s	r	a, i, fr, s		c, u		caga-sebinho-de-penacho
Hemitriccus zosterops (Pelzeln, 1868)	8c	s	c	a, i, fr, s		c, u	a	maria-de-olho-branco
Myiornis ecaudatus (d'Orbigny & Lafresnaye, 1837)	4c	s	u	a, i, fr, s		u	a	caçula
Todirostrum pictum (Salvin, 1897)	7c	s	c	a, i, fr, s		c, u	a	ferreirinho-de-sobrancelha
Tyrannulus elatus (Latham, 1790)	7c	s	c	a, i, fr, s		c	a	maria-te-viu
Myiopagis gaimardii (d'Orbigny, 1839)	12c	s	c	a, i, fr, s	x	c	a	maria-pechim
Myiopagis caniceps (Swainson, 1835)	10c	s	c	a, i, fr, s		c	a	guaracava-cinzenta
Elaenia parvirostris (Pelzeln, 1868)	15c	s	u	a, i, fr, s		c		guaracava-de-bico-curto
Ornithion inerme (Hartlaub, 1853)	6c	s	u	a, i, fr, s		c	a	poiaeiro-de-sobrancelha
Camptostoma obsoletum (Temminck, 1824)	7c	s	u	a, i, fr, s	x	c	o	risadinha
Phaeomyias murina (Spix, 1825)	10c	s	r	a, i, fr, s	x	c	o	bagageiro
Zimmerius gracilipes (Sclater & Salvin, 1868)	7c	s	c	a, i, fr, s		c	a	poiaeiro-de-pata-fina
Phylloscartes virescens (Todd, 1925)	—	s	c	a, i, fr, s		c	a	borboletinha-guianense
Rhynchocyclus olivaceus (Temminck, 1820)	20	s	u	a, i, fr, s	x	c, u	o	bico-chato-grande

Table 4: Continued.

Bird species	Wt. (g)	Soc.	Abund.	Diet	Br.	Str.	Rec.	Portuguese name
Tolmomyias assimilis (Pelzeln, 1868)	13b	s	c	a, i, fr, s	x	u	a, o	bico-chato-da-copa
Tolmomyias poliocephalus (Taczanowski, 1884)	11c	s	c	a, i, fr, s		u	a	bico-chato-de-cabeça-cinza
Platyrinchus saturatus (Salvin & Godman, 1882)	12	s	u	a, i, fr, s	x	u	o	patinho-escuro
Platyrinchus coronatus (Sclater, 1858)	10	s	c	a, i, fr, s	x	u	o	patinho-de-coroa-dourada
Platyrinchus platyrhynchos (Gmelin, 1788)	11c	s	u	a, i, fr, s		u		patinho-de-coroa-branca
Onychorhynchus coronatus (Statius Muller, 1776)	15	s	u	a, i, fr, s	x	u	o	maria-leque
Myiobius barbatus (Gmelin, 1789)	10b	s	c	a, i, fr, s	x	u	a, o	assanhadinho
Terenotriccus erythrurus (Cabanis, 1847)	12	s	c	a, i, fr, s	x	u	a, o	papa-moscas-uirapuru
Neopipo cinnamomea (Lawrence, 1869)	7b	s	u	a, i, fr, s		u		enferrujadinho
Contopus cooperi (Nuttall, 1831)	32c	s	b	a, i, fr, s		c		piui-boreal
Contopus virens (Linnaeus, 1766)	14c	s	b	a, i, fr, s		c		piui-verdadeiro
Pyrocephalus rubinus (Boddaert, 1783)	14c	s	a	a, i, fr, s		c		príncipe
Legatus leucophaius (Vieillot, 1818)	23c	s	u	a, i, fr, s	x	c		bem-te-vi-pirata
Myiozetetes cayanensis (Linnaeus, 1766)	26c	s	c	a, i, fr, s	x	c, u	a	bentevizinho-de-asa-ferrugínea
Pitangus sulphuratus (Linnaeus, 1766)	63c	s	c	a, i, fi, fo, fr, s	x	c, u		bem-te-vi
Conopias parvus (Pelzeln, 1868)	21c	s	c	a, i, fr, s	x	c	a	bem-te-vi-da-copa
Myiodynastes maculatus (Statius Muller, 1776)	43c	s	a	a, i, fr, s		c		bem-te-vi-rajado
Megarynchus pitangua (Linnaeus, 1766)	62c	s	u	a, i, fr, s	x	c	o	neinei
Tyrannopsis sulphurea (Spix, 1825)	54c	s	u	a, i, fr, s	x	c	o	suiriri-de-garganta-rajada
Empidonomus varius (Vieillot, 1818)	25c	s	u	a, i, fr, s	x	c		peitica
Griseotyrannus aurantioatrocristatus (d'Orbigny & Lafresnaye, 1837)	27c	s	a	a, i, fr, s		c		peitica-de-chapéu-preto
Tyrannus melancholicus (Vieillot, 1819)	39c	s	c	a, i, fr, s	x	c		suiriri
Tyrannus savana (Vieillot, 1808)	42c	s	a	a, i, fr, s		c		tesourinha
Rhytipterna simplex (Lichtenstein, 1823)	32	s	c	a, i, fr, s		c	a, o	vissiá
Sirystes sibilator (Vieillot, 1818)	32c	s	c	a, i, fr, s	x	c	a, o	gritador
Myiarchus tuberculifer (d'Orbigny & Lafresnaye, 1837)	19c	s	u	a, i, fr, s	x	u		maria-cavaleira-pequena
Myiarchus ferox (Gmelin, 1789)	24c	s	u	a, i, fr, s	x	u	o	maria-cavaleira
Ramphotrigon ruficauda (Spix, 1825)	19b	s	r	a, i, fr, s	x	c, u	a, o	bico-chato-de-rabo-vermelho

Table 4: Continued.

Bird species	Wt. (g)	Soc.	Abund.	Diet	Br.	Str.	Rec.	Portuguese name
Attila spadiceus (Gmelin, 1789)	38	s	c	a, i, fr, s	x	u	a, o	capitão-de-saíra-amarelo
COTINGIDAE								
Phoenicircus carnifex (Linnaeus, 1758)	51	s	u	a, i, fr, s	x	c, u		saurá
Cotinga cotinga (Linnaeus, 1766)	54c	s	r	a, i, fr, s		c		anambé-de-peito-roxo
Cotinga cayana (Linnaeus, 1766)	65c	s	r	a, i, fr, s		c		anambé-azul
Lipaugus vociferans (Wied, 1820)	70	s	c	a, i, fr, s	x	u	a, o	cricrió
Xipholena punicea (Pallas, 1764)	65c	s	u	a, i, fr, s	x	c	a	anambé-pompadora
Haematoderus militaris (Shaw, 1792)	—	s	r	a, i, fr, s		c		anambé-militar
Perissocephalus tricolor (Statius Muller, 1776)	340c	s	u	a, i, fr, s	x	c	a	maú
PIPRIDAE								
Neopelma chrysocephalum (Pelzeln, 1868)	10	s	u	a, i, fr, s	x	u	o	fruchu-do-carrasco
Tyranneutes virescens (Pelzeln, 1868)	7b	s	c	a, i, fr, s	x	c	a, o	uirapuruzinho-do-norte
Piprites chloris (Temminck, 1822)	17b	s	c	a, i, fr, s	x	u	a, o	papinho-amarelo
Corapipo gutturalis (Linnaeus, 1766)	12	s	c	a, i, fr, s	x	u	o	dançarino-de-garganta-branca
Lepidothrix serena (Linnaeus, 1766)	12	s	c	a, i, fr, s	x	u	a, o	uirapuru-estrela
Manacus manacus (Linnaeus, 1766)	16c	s	u	a, i, fr, s	x	u		rendeira
Dixiphia pipra (Linnaeus, 1758)	11	s	c	a, i, fr, s	x	u	a, o	cabeça-branca
Pipra erythrocephala (Linnaeus, 1758)	12	s	c	a, i, fr, s	x	u	a, o	cabeça-de-ouro
TITYRIDAE								
Schiffornis turdina (Wied, 1831)	36	s	c	a, i, fr, s	x	u	a, o	flautim-marrom
Laniocera hypopyrra (Vieillot, 1817)	49b	s	c	a, i, fr, s		c		chorona-cinza
Tityra cayana (Linnaeus, 1766)	69c	s	c	a, i, fr, s	x	c	a	anambé branco-de-rabo-preto

Table 4: Continued.

Bird species	Wt. (g)	Soc.	Abund.	Diet	Br.	Str.	Rec.	Portuguese name
Pachyramphus rufus (Boddaert, 1783)	18c	s	u	a, i, fr, s	x	c	o	caneileiro-cinzento
Pachyramphus marginatus (Lichtenstein, 1823)	18b	s	c	a, i, fr, s		c	a	caneleiro-bordado
Pachyramphus surinamus (Linnaeus, 1766)	20c	s	c	a, i, fr, s		c		caneleiro-da-guiana
Pachyramphus minor (Lesson, 1830)	—	s	u	a, i, fr, s	x	c	a	caneleiro-pequeno
VIREONIDAE								
Cyclarhis gujanensis (Gmelin, 1789)	28c	s	c	a, fr, s	x	c	a	pitiguari
Vireolanius leucotis (Swainson, 1838)	25c	s	c	a, fr, s	x	c	a	assobiador-do-castanhal
Vireo olivaceus (Linnaeus, 1766)	15c	s	b	a, fr, s		c	a	juruviara
Vireo altiloquus (Vieillot, 1808)	19c	s	b	a, fr, s		c		juruviara-barbuda
Hylophilus muscicapinus (Sclater & Salvin, 1873)	10b	s	c	a, fr, s	x	c	a	vite-vite-camurça
Hylophilus ochraceiceps (Sclater, 1860)	10	s	c	a, fr, s	x	c	a, o	vite-vite-uirapuru
HIRUNDINIDAE								
Atticora tibialis (Cassin, 1853)	—	g	u	i		a		calcinha-branca
Stelgidopteryx ruficollis (Vieillot, 1817)	15c	s	u	i		a		andorinha-serradora
Progne subis (Linnaeus, 1758)	47c	g	b	i		a		andorinha-azul
Progne chalybea (Gmelin, 1789)	39c	g	u	i		a		andorinha-doméstica-grande
Hirundo rustica (Linnaeus, 1758)	17c	g	b	i		a		andorinha-de-bando
TROGLODYTIDAE								
Microcerculus bambla (Boddaert, 1783)	14	s	c	a, i	x	g, u	a, o	uirapuru-de-asa-branca
Troglodytes musculus (Naumann, 1823)	11b	s	c	a, i	x	g, u		corruíra
Pheugopedius coraya (Gmelin, 1789)	15	c	c	a, i	x	g, u	a, o	garrinchão-coraia
Cyphorhinus arada (Hermann, 1783)	18	c	u	a, i	x	g, u	o	uirapuru-verdadeiro
POLIOPTILIDAE								
Microbates collaris (Pelzeln, 1868)	11b	s	c	a, i	x	g, u	a, o	bico-assovelado-de-coleira
Ramphocaenus melanurus (Vieillot, 1819)	9b	s	c	a, i		g, u		bico-assovelado

Table 4: Continued.

Bird species	Wt. (g)	Soc.	Abund.	Diet	Br.	Str.	Rec.	Portuguese name
Polioptila guianensis (Todd, 1920)	5c	c	u	a, i		g, u		balança-rabo-guianense
TURDIDAE								
Catharus fuscescens (Stephens, 1817)	28b	s*	b	a, i, fr, s		u		sabiá-norte-americano
Catharus minimus (Lafresnaye, 1848)	30b	s*	b	a, i, fr, s		u		sabiá-de-cara-cinza
Turdus leucomelas (Vieillot, 1818)	62c	s	u	a, i, fr, s	x	u		sabiá-barranco
Turdus albicollis (Vieillot, 1818)	50	s*	c	a, i, fr, s	x	u	a, o	sabiá-coleira
COEREBIDAE								
Coereba flaveola (Linnaeus, 1758)	9b	s	c	n, fr, s	x	c	a	cambacica
THRAUPIDAE								
Saltator grossus (Linnaeus, 1766)	44	s	u	s, fr	x	c	a	bico-encarnado
Saltator maximus (Statius Muller, 1776)	42	s	u	s, fr	x	c		tempera-viola
Lamprospiza melanoleuca (Vieillot, 1817)	—	s	c	a, i, n, fr, s		c	a	pipira-de-bico-vermelho
Eucometis penicillata (Spix, 1825)	29c	s	u	a, i, n, fr, s		c, u		pipira-da-taoca
Tachyphonus cristatus (Linnaeus, 1766)	18b	s	c	a, i, n, fr, s		c	a	tiê-galo
Tachyphonus surinamus (Linnaeus, 1766)	19	s	c	a, i, n, fr, s	x	c, u	a, o	tem-tem-de-topete-ferrugíneo
Lanio fulvus (Boddaert, 1783)	22	s	u	a, i, n, fr, s		c	a, o	pipira-parda
Ramphocelus carbo (Pallas, 1764)	24b	g	c	a, i, n, fr, s	x	u		pipira-vermelha
Thraupis episcopus (Linnaeus, 1766)	35c	c	c	a, i, n, fr, s	x	c, u		sanhaçu-da-amazônia
Thraupis palmarum (Wied, 1823)	35b	c	c	a, i, n, fr, s	x	c, u	a	sanhaçu-do-coqueiro
Cyanicterus cyanicterus (Vieillot, 1819)	34c	s	r	a, i, n, fr, s		c	a	pipira-azul
Tangara mexicana (Linnaeus, 1766)	20c	c	r	a, i, n, fr, s	x	c		saíra-de-bando
Tangara chilensis (Vigors, 1832)	15b	c	c	a, i, n, fr, s		c		sete-cores-da-amazônia
Tangara punctata (Linnaeus, 1766)	14b	c	c	a, i, n, fr, s		c	a	saíra-negaça
Tangara varia (Statius Muller, 1776)	10c	c	r	a, i, n, fr, s		c, u	a	saíra-carijó
Tangara gyrola (Linnaeus, 1758)	19c	c	r	a, i, n, fr, s		c		saíra-de-cabeça-castanha
Tangara velia (Linnaeus, 1758)	20c	c	c	a, i, n, fr, s		c	a	saíra-diamante
Dacnis lineata (Gmelin, 1789)	—	c	c	a, i, n, fr, s	x	c, u	a, o	saí-de-máscara-preta
Dacnis cayana (Linnaeus, 1766)	12	c	c	a, i, n, fr, s	x	c, u	a, o	saí-azul
Chlorophanes spiza (Linnaeus, 1758)	16b	c	c	a, i, n, fr, s		c, u	a	saí-verde
Cyanerpes nitidus (Hartlaub, 1847)	9c	c	u	a, i, n, fr, s		c		saí-de-bico-curto
Cyanerpes caeruleus (Linnaeus, 1758)	12c	c	c	a, i, n, fr, s		c		saí-de-perna-amarela
Cyanerpes cyaneus (Linnaeus, 1766)	14c	c	c	a, i, n, fr, s		c		saí-beija-flor
Hemithraupis flavicollis (Vieillot, 1818)	12c	s	c	a, i, n, fr, s		c	a	saíra-galega
EMBERIZIDAE								
Ammodramus aurifrons (Spix, 1825)	14b	s	c	s, fr		g, u		cigarrinha-do-campo
Volatinia jacarina (Linnaeus, 1766)	9c	s	c	s, fr		u		tiziu

Table 4: Continued.

Bird species	Wt. (g)	Soc.	Abund.	Diet	Br.	Str.	Rec.	Portuguese name
Sporophila castaneiventris (Cabanis, 1849)	8c	s	c	s, fr	x	u		caboclinho-de-peito-castanho
Sporophila angolensis (Linnaeus, 1766)	13b	s	u	s, fr	x	u		curio
Arremon taciturnus (Hermann, 1783)	22b	s	r	s, fr	x	u	a, o	tico-tico-de-bico-preto
CARDINALIDAE								
Piranga rubra (Linnaeus, 1758)	28c	c	b	a, i, n, fr, s		c		sanhaçu-vermelho
Caryothraustes canadensis (Linnaeus, 1766)	33b	s	c	s, fr		c	a	furriel
Cyanoloxia cyanoides (Lafresnaye, 1847)	28	s	c	s, fr	x	u	a, o	azulão-da-amazônia
PARULIDAE								
Dendroica striata (Forster, 1772)	10c	s	b	a, i		c		mariquita-de-perna-clara
Phaeothlypis rivularis (Wied, 1821)	12c	s	u	a, i		c		pula-pula-ribeirinho
ICTERIDAE								
Psarocolius viridis (Statius Muller, 1776)	375c	g	u	fr, i, s	x	c		japu-verde
Cacicus haemorrhous (Linnaeus, 1766)	100c	g	c	fr, i, s	x	c	a	guaxe
Cacicus cela (Linnaeus, 1776)	104c	g	u	fr, i, s	x	c	a	xexéu, japiím
Icterus chrysocephalus (Linnaeus, 1766)	42c	s	u	fr, i, s	x	c		rouxinal-do-rio-negro
Sturnella militaris (Linaues, 1758)	44c	s	u	fr, i, s		c		polícia-inglesa-do-norte
Molothrus oryzivorus (Gmelin, 1788)	180c	g	u	fr, i, s		c		irauna-grande
Molothrus bonariensis (Gmelin, 1789)	45c	g	u	fr, i, s		c		vira-bosta
FRINGILLIDAE								
Euphonia chlorotica (Linnaeus, 1766)	11c	s	u	a, i, n, fr, s	x	c		fim-fim
Euphonia chrysopasta (Sclater & Salvin, 1869)	14c	s	u	a, i, n, fr, s	x	c		gaturamo-verde
Euphonia minuta (Cabanis, 1849)	10c	s	u	a, i, n, fr, s	x	c		gaturamo-de-barriga-branca
Euphonia cayennensis (Gmelin, 1789)	13c	s	c	a, i, n, fr, s		c	a	gaturamo-preto

Codes: Wt.: body weight, b: mean value rounded data from [52]; c: mean value rounded from [53]; Diet: a: arthropods (spiders, centipedes, milipedes, etc); b: birds; ba = bats; f: flowers; fi: fish; fr: fruits; fo: frogs; i: insects; l: leaf; li: lizards; mo: monkeys; ne: nectar; r: rodents; s: seeds; sl: sloths. Str.: Forest stratum: c: canopy; g: ground; u: understory; Soc.: Sociability: c: pairs; g: groups; s: solitary (*: army-ant follower); Abund.: Abundance: c: common, u: uncommon, r: rare, a: austral migrant, b: boreal migrant; Br.: Breeding: x: nests, eggs, nestling or juveniles recorded in the Reserve; Rec.: Record (this study): a: acoustic surveys along 1 km transects; o: mist-nets (see Section 2). Species not recorded during this study but included in the table (see Rec.) were recorded by the authors at the RFAD in the past. These species were not included in the analyses. Data on weight, sociability, abundance, diet, breeding, and strata were collected by RC during the last 20 years.

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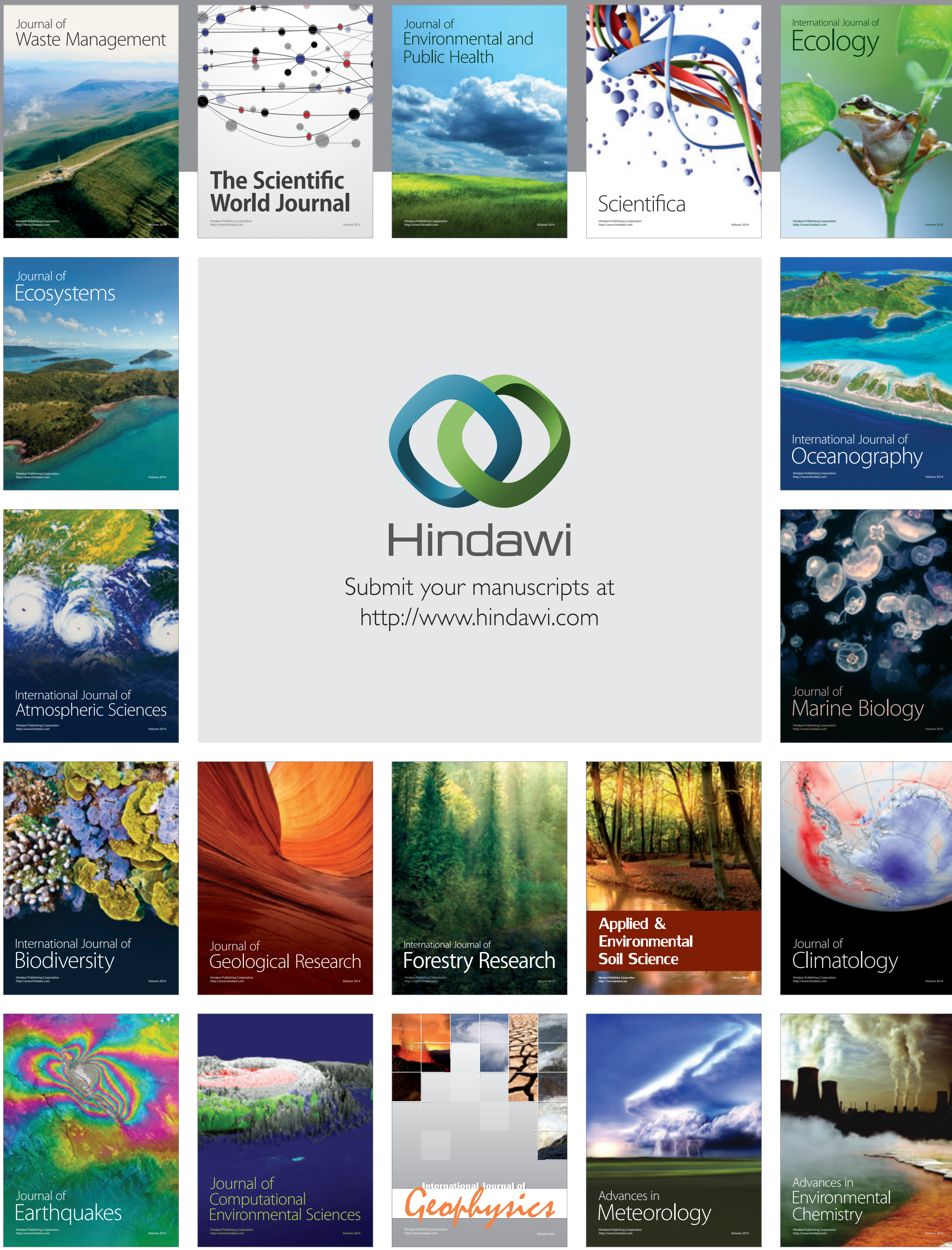
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