

A NEW LOOK AT THE “SPECIES-POOR” CENTRAL AMAZON: THE AVIFAUNA NORTH OF MANAUS, BRAZIL

MARIO COHN-HAFT,^{1,2} ANDREW WHITTAKER,^{1,3} AND
PHILIP C. STOUFFER^{1,4}

¹*Projeto Dinâmica Biológica de Fragmentos Florestais, INPA Ecologia,
C. P. 478, Manaus, Amazonas 69011, Brazil;*

²*Museum of Natural Science, Foster Hall 119, and Department of Zoology and Physiology,
Louisiana State University, Baton Rouge, Louisiana 70803, USA;*

³*Conjunto Acariquara Sul, Rua Samaumas 214, Manaus, Amazonas 69085, Brazil; and*

⁴*Department of Biological Sciences, Southeastern Louisiana University,
Hammond, Louisiana 70402, USA*

ABSTRACT.—The birds of the Fazendas Dimona, Porto Alegre, and Esteio, and adjacent areas, ca. 80 km north of Manaus, Amazonas, Brazil, have been intensively studied since 1979. Stotz and Bierregaard (1989) published a list of 352 species, based on seven years of study. Here we modify that list based on an additional eight years of work at the same sites. We add 49 species, revise the identification of four species, and remove seven species, for a total of 394 species. We also list 12 additional species as “hypothetical,” requiring further substantiation, and revise the status of numerous species. Additions include 22 species believed to have been overlooked previously, 15 species believed to have colonized the area recently in response to anthropogenic change, and 12 species that are probably vagrants from habitats not well represented in the study area. Status revisions reflect an increase in availability and diversity of secondary habitats or better knowledge of vocalizations of birds that are much more commonly heard than seen. Specimens indicate that *Campylorhamphus procurvoides* and *Hemitriccus zosterops*, not *C. trochilirostris* and *H. minor*, are present at the site. We also present evidence that *Hemitriccus z. zosterops* and *H. z. griseipectus* are distinct species, and we report the first Brazilian records (including specimens) of *Phylloscartes virescens*.

Comparison with the avifauna of two well-studied sites in Amazonian Peru, Manu National Park and Tambopata Reserve, reveals similar species richness in the *terra firme* forest component of all three sites. The difference in richness between the sites is because of the variety of habitat types present at each. We suggest that habitat heterogeneity, not primary productivity or rainfall as have been proposed elsewhere, is the major determinant of patterns in bird species richness within Amazonia.

RESUMO.—As aves das fazendas Dimona, Porto Alegre, e Esteio, e das áreas adjacentes, a cerca de 80 km ao norte de Manaus, Amazonas, Brasil, foram estudadas intensivamente desde 1979. Stotz e Bierregaard (1989) publicaram uma lista com 352 espécies, baseada em sete anos de estudo. Modificamos essa lista a partir de mais oito anos trabalhando nas mesmas áreas. Acrescentamos 49 espécies, corrigimos a identificação de quatro, e removemos sete, resultando num total de 394 espécies. Também listamos doze espécies adicionais como “hipotéticas,” que necessitam maiores evidências de sua ocorrência, e revisamos o status de várias espécies. Adições incluem 22 espécies provavelmente negligenciadas anteriormente, 15 espécies que acreditamos terem colonizado a área recentemente em resposta a mudanças antropogênicas, e 12 espécies que provavelmente são visitantes irregulares de ambientes pouco representados na área de estudo. As revisões de status refletem um aumento na disponibilidade e diversidade de vegetação secundária e um maior conhecimento das vocalizações de aves que são muito mais comumente ouvidas do que vistas. Espécimes indicam a presença na área de estudo de *Campylorhamphus procurvoides* e *Hemitriccus zosterops*, em vez de *C. trochilirostris* e *H. minor*. Também apresentamos evidência de que *Hemitriccus z. zosterops* e *H. z. griseipectus* são espécies distintas, e confirmamos com exemplares o primeiro registro de *Phylloscartes virescens* para o Brasil.

A comparação desta avifauna com a de duas áreas igualmente bem conhecidas na Amazônia peruana, o Parque Nacional de Manu e a Reserva Tambopata, revela uma riqueza de espécies semelhante nas áreas de floresta de *terra firme* dos três locais. A

maior riqueza total nas áreas peruanas é devido à maior variedade de tipos de habitats presentes. Sugerimos que a heterogeneidade de habitats é o maior fator determinante de padrões de riqueza de espécies de aves dentro da Amazônia, em vez da produtividade primária ou pluviosidade propostas anteriormente.

Accurate and complete avifaunal site lists are a cornerstone in improved understanding of avian biogeography and community ecology. With recent improvement in knowledge of vocalizations and with new, high-quality field guides, skilled observers can produce reasonably accurate species lists for many Neotropical sites. However, considerable research (including taxonomic revision) remains to be done before identification to species will be acceptable without tangible evidence (voucher specimens, tape-recordings, or photographs). Perhaps even more daunting than accuracy, however, in the species-rich Neotropics is completeness of species lists. Most lists are based on short-term samples and qualify only as preliminary. To enable meaningful comparison between sites or over extended time intervals, complete lists are needed; these are labor-intensive.

Until recently, all avifaunal site lists from Amazonia were preliminary in nature. One of the most-studied sites in all of South America is in Manu National Park in Amazonian Peru, where John Terborgh and his students have been working at the Cocha Cashu Research Station since 1973 (Terborgh et al. 1990). The Cocha Cashu bird list (in Karr et al. 1990) is probably the most complete published list for any South American, and certainly any Amazonian, location. The recently published list (Parker et al. 1994) for nearby Tambopata Nature Reserve, also in Peru, may rival Cocha Cashu in completeness.

The subject of our study is the reserves of the Biological Dynamics of Forest Fragments Project (BDFFP, formerly Minimum Critical Size of Ecosystems Project) north of Manaus in central Amazonian Brazil. This is probably the most intensively studied area in central Amazonia. Ecological studies began at the site in 1979, aimed at examining the effects of fragmentation of continuous forest on a wide variety of organisms and abiotic parameters (see Lovejoy and Bierregaard 1990 for a history of the project). Ornithological investigations have been a major component of the project. A program of mist-netting in the understory of continuous forest and fragments of one, 10, and 100 ha began in 1979 and has continued nearly uninterrupted since then (see Lovejoy 1985; Bierregaard and Lovejoy 1988, 1989; Bierregaard 1990a, b; Stouffer and Bierregaard 1995a, b). Other studies have dealt with focal species or groups, especially those not sampled in mist nets (Bierregaard 1984, 1988; Quintela-Almeida 1985; Bierregaard et al. 1987; Harper 1987, 1989; Quintela 1987; Klein and Bierregaard 1988a, b; Klein et al. 1988; Mesquita 1989; Powell 1989; Stotz et al. 1992; Cohn-Haft 1993, 1995; Stouffer and Bierregaard 1993; Whittaker 1993, 1995; Borges 1995), and scores of volunteer banders and visitors have contributed their observations.

Stotz and Bierregaard (1989) listed the bird species known in the BDFFP reserves as of 1987, after seven years of study. Since then, an increased emphasis on vocal recording, auditory and visual censuses, and use of a canopy tower (see Methods) have added numerous species to the project's avifauna. Habitat change within the study area, mostly in the form of abandonment of pasture and subsequent regeneration of second-growth forest, and encroaching deforestation along the road from Manaus have probably led to colonization by some species and changes in abundance of others. Finally, specimen collecting has permitted a closer examination of some difficult species, leading in some cases to reidentification of species previously listed. Here we present a modified list of bird species from the BDFFP site and adjacent areas, based on an additional six years of field work, incorporating increased knowledge of the birds, changes in abundance, and documentation of evidence for inclusion. We discuss the differences between this list and the earlier one and lists from other Amazonian sites. Our approach emphasizes the study area as a whole and any changes on a regional scale. Detailed treatment of the effect of habitat fragmentation on a local scale is covered elsewhere (e.g., Stouffer and Bierregaard 1995a, b; Bierregaard and Stouffer 1997).

STUDY AREA

The BDFFP study site, about 80 km north of Manaus, Brazil, is located on three adjacent 15,000 ha ranches partially deforested for cattle pastures (fazendas Dimona, Porto Alegre, and Esteio, 60°W, 2°20'S; Fig. 1). In addition to the fazendas, the exclusive focus of Stotz and Bierregaard's (1989) list, we include the area surrounding a 40-m tower, located on the ZF-2 road, and the intervening region (Fig. 1). We do not include a large, isolated, white-sand *campina*

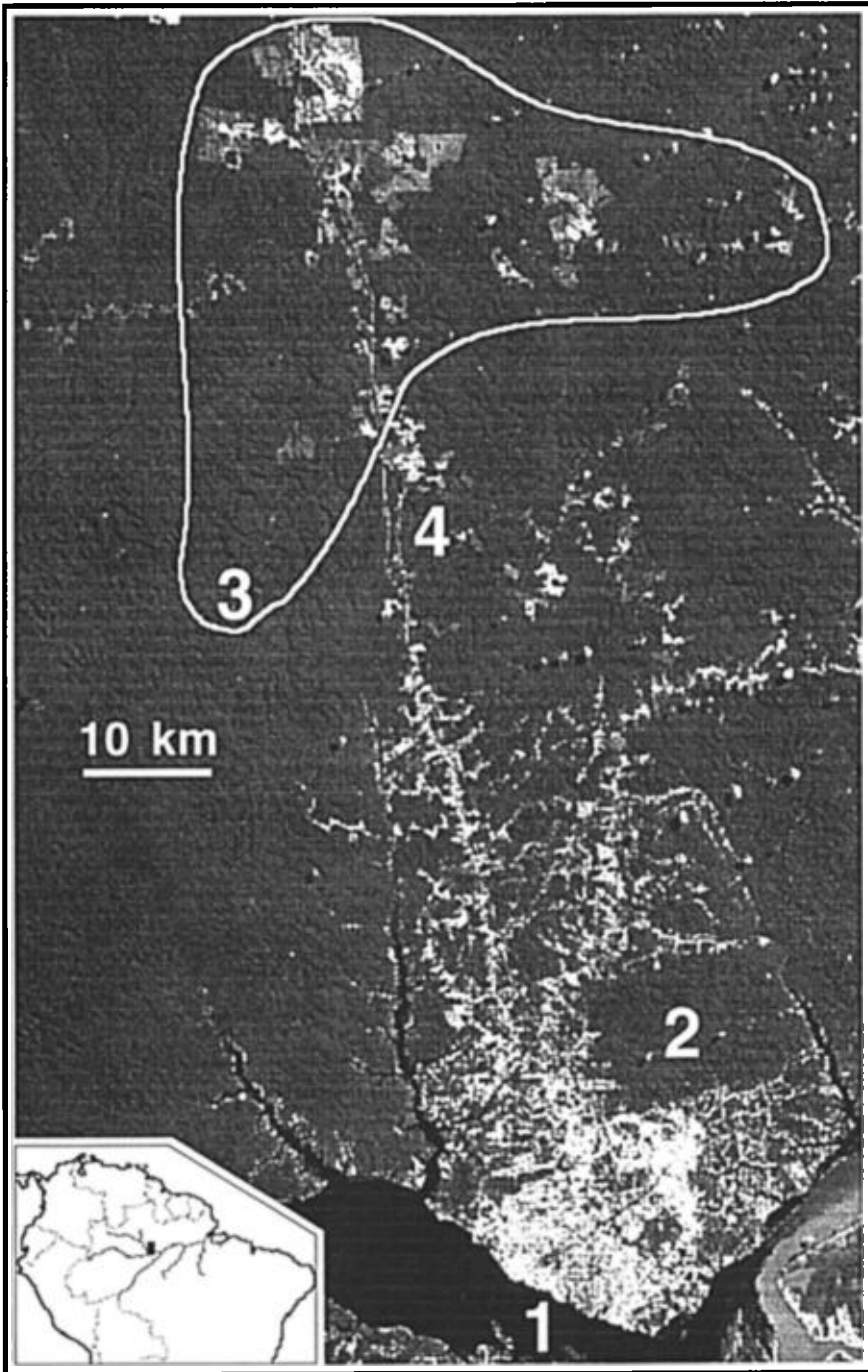


FIG. 1. Map of Manaus (1) and area to north, showing study area (outlined in white), Reserva Ducke (2), and locations of the tower on the ZF-2 road (3) and of the campina (4). Dark gray represents primary forest, light gray is secondary forest, and white represents open areas such as pastures, roads, and urban construction. The fazendas studied by Stotz and Bierregaard (1989) are in the upper part of the study area, centered around the large areas of pasture and second growth. Map based on Landsat TM image; bands 3,4,5; 22 May 1992; source INPE.

(see Fig. 1; described in Anderson 1981) that is roughly the same distance south of the fazendas as the tower, because it represents a distinct habitat, not found on the fazendas (but see *campinarana* below), with an endemic avifauna (see Willis 1977; Oren 1981). The study area does not extend farther south to avoid the direct affects of urban expansion from Manaus and to permit comparison with Reserva Ducke (Fig. 1). Records from north of the fazendas are also excluded because there is a small river (Rio Urubu) and a marked change in terrain (including the presence of rocks, greater relief, and caves) roughly 100 km north of Manaus. Several bird species known from that region that have not been recorded closer to Manaus (see Discussion).

The site was continuous forest until the late 1970s, when some development began, consisting mostly of land clearing for cattle pasture. Stotz and Bierregaard (1989) reported that 10,000 ha had been cleared from the fazendas by the middle 1980s. Since that time almost no new land has been cleared, and much pastureland has been abandoned. The second-growth forest, formed on abandoned clearings, is all less than 15 years old and of known history (R. Mesquita, unpubl. data). Disturbance is still minimal to the north, east, and west of the site, where the forest stretches for hundreds of kilometers. To the south there is increasing disturbance, including some fairly large farms, but even near Manaus clearing is only close to existing roads. Primary forest connecting the study area to Reserva Ducke and the outskirts of Manaus is interrupted in most places by only one or two narrow roads. The main road north out of Manaus, BR-174, is gradually being paved, and this will undoubtedly bring with it increasing settlement and hunting pressure. Game animals (such as monkeys and cracids) and large predators (such as jaguars, *Felis onca*, and pumas, *F. concolor*) persist in the study area in good numbers, although local ranchers and weekend hunters from Manaus exert some pressure on these species.

The study area is roughly 500 km², made up mostly of primary *terra firme* forest, but containing several "islands" of disturbed habitats connected to each other (and eventually to a larger region of disturbed habitat, Manaus, and the Rio Negro) by narrow dirt roads (Fig. 1). There are two major types of second growth present, tall second growth dominated by *Cecropia sciadophylla* and a shrubbier vegetation dominated by *Vismia* spp. Both types occur on abandoned pastures, depending on land use before abandonment, and in narrow belts fringing the dirt roads cut through primary forest. Some *Cecropia* stands are as tall as 20 m and provide a dark, open understory much like primary forest. Details of bird use of these two kinds of second growth, which are not distinguished in this study, were studied by Borges (1995). Open water is restricted to four or five (depending on rainfall) small ponds formed in the middle of pasture and one seasonal pond occurring naturally in the midst of undisturbed forest.

The primary forest in the study area has been described in detail elsewhere (Lovejoy and Bierregaard 1990). Important features are a canopy height of ca. 30 m, with occasional taller emergents, open understory dominated by stemless palms, a relatively closed canopy, except for areas of treefall gaps, high tree species diversity, and fairly low epiphyte loads. There is little macro-relief and no major watercourse, but small streams (less than 2 m across and 1 m deep) have eroded many steep valleys 10–30 m deep. Annual rainfall averages about 2,200 mm, with an annual peak in March and April and a pronounced dry season from July through September (MME 1978, Stouffer and Bierregaard 1993).

Relative to many Amazonian sites, the study area has low habitat heterogeneity. There is no equivalent to Manu's "floodplain" or bottomland forest, that is, forest on flat, ancient alluvial plain, not subject to annual flooding. There is also no seasonally flooded forest (*várzea* or *igapó*), no bamboo, nor oxbow lakes—all habitat types associated with specialized fauna. White-sand *campina* scrub and woodland ("Amazonian white-sand caatinga" of Anderson 1981) is an important and locally distributed vegetation type in the Manaus region, with a characteristic avifauna. Only one small patch of this vegetation, surrounded by typical *terra firme* forest, is known within the study area, and it is a closed-canopy woodland (*campinarana*), not a fully developed scrub (*campina*); consequently, it lacks species typical of more open *campinas* (e.g., *Elaenia ruficeps*; Oren 1981).

METHODS

This study includes all bird species observed in the study area during the entire 15-yr history of the BDFFP through 1994. Our own work over an 8-yr period (1987–1994) immediately follows the period (1979–1986) covered by Stotz and Bierregaard's (1989) list, and provides the basis for determination of species status and any changes believed to have occurred in the project's duration. Whittaker and Cohn-Haft began working in the area in 1987, and Stouffer began in 1991. We each worked in various parts of the study area at all times of year, focusing

on a variety of research objectives (described elsewhere), during which time the data for this paper were incidentally gathered. Cohn-Haft worked mostly in unbroken primary forest and collected specimens during a study of bird diets (Cohn-Haft 1995). Whittaker and Stouffer focused more on disturbed forest, surveying birds in isolated forest fragments and studying avian use of forest edge and second growth, respectively. All of us ran mist nets in continuous forest and isolated patches at one time or another, as well as conducted general avian surveys using tape recorders, both for playback and for documentation; we have also made over 50 morning bird surveys from the tower. Our field work was facilitated by, but not limited to, grid systems (100 or 200 m) of narrow trails in demarcated study plots and small rustic camps located within the study area. In addition to our own observations, we drew on observations of other project participants over the years, the project's database of more than 50,000 mist net captures in over 150,000 net-hours, and previously published records from the tower (Bierregaard 1982).

We expanded the study area to include the tower because it permitted a better assessment of the abundance of canopy species. Although this extended the region covered by some 15 km to the south beyond that of Stotz and Bierregaard (1989), the overall areal extent of coverage is only minimally increased by that amount visible from the tower itself and from the roads leading to it. Our extensive observations from the tower and mist-netting below it (unpubl. data) reveal that the avifauna is essentially identical to that of the BDFFP reserves. Therefore, we do not attribute any differences between our results and those of Stotz and Bierregaard (1989) to increase in area studied (see Discussion).

Status categories.—Species' abundance was determined subjectively, combining frequency of detection (visual or auditory) and capture rate to reflect our impression of actual population density in preferred habitat. This differs from the categories of Stotz and Bierregaard (1989) in having one fewer category (their "fairly common" is usually subsumed in our "common") and in not being based on quasi-quantitative rates of detection, which we believe are strongly method-biased. Thus, our ratings represent dimensionless hypotheses of density that can (and should) be tested by quantitative census techniques (e.g., Terborgh et al. 1990). "Common" is used for species believed to occur everywhere in appropriate habitat; for small passerines this probably translates to contiguous territories up to roughly 15 ha each (unpubl. data). Species listed as "uncommon" occur in most, but not all seemingly appropriate habitat and probably have densities roughly an order of magnitude lower than common species. "Rare" species appear to be absent from more appropriate habitat than that in which they occur and probably have densities an order of magnitude lower than uncommon species. These three coarse categories include all species that we consider the "core avifauna" (Remsen 1994) at our site. In addition, we use "casual" (equivalent to "extremely rare" of Stotz and Bierregaard [1989]) for species registered three or fewer times. Unlike the other abundance categories, "casual" is based strictly on number of detections and may include vagrants as well as extremely low-density or sporadic residents, which our limited data are unable to distinguish. The single abundance rating giving to each species refers to its period of greatest abundance. For species with variable annual abundance, seasonal status was rated as "austral migrant" (present April–September), "boreal migrant" (usually October–April, but shorebirds arrive much earlier; see Stotz et al. 1992), or as having "unspecified movements" of undetermined seasonality, possibly at a local scale, leading to periods of lower abundance or absence.

Birds were classed with respect to habitat and microhabitat. We distinguished five major habitat types: primary *terra firme* forest; secondary forest, of which specific types and age classes were not differentiated; pasture, often including some low bushes, solitary tall trees and snags, and fences; open water, in the form of ponds either in pasture or in forest; and *campinarana*. These categories are similar but not identical to those used by Stotz and Bierregaard (1989). We do not consider treefall gaps, edges, small woodland streams (*igarapés*), and overhead airspace as major habitats, but rather as microhabitats within the above habitat types. Other microhabitats or positions (including vertical strata) were also recognized: terrestrial, understory, midstory, canopy, water surface.

Following Stotz and Bierregaard (1989), we use "sociality" to refer to intra- and interspecific associations of each species (i.e., pairs, monospecific flocks, mixed-species flocks, etc.). To these categories, we added "lekking" for species in which males are usually gathered at communal display grounds (e.g., some hummingbirds and manakins).

Evidence documenting each species was ranked hierarchically, and only the highest quality evidence available for each species is listed (Appendix). We consider the best evidence to be a specimen. Next is a permanent record, either a photograph or tape recording, which can be used to confirm identification to species in most cases. Third is a capture record, that is, an in-hand

sight record augmented by some morphometrics (usually wing chord, tail, and weight) that could help to confirm identification. The lowest form of evidence are field observations, either sighting or vocalization heard. A few species based only on sight records are listed separately as "hypothetical," meaning that the species was positively identified by the observer, but that such an identification requires a higher category of evidence for inclusion in the main list. This is used for especially difficult field identifications or species deemed very unlikely to occur by range.

The taxonomy used here follows Morony et al. (1975 and corrigenda) except for the Ardeidae and the expanded Emberizidae, which follow the AOU Check-list (1983), and the Tyrannidae, Cotingidae, and Pipridae, which follow Traylor (1979). Other minor exceptions, including any differences in nomenclature from that used by Stotz and Bierregaard (1989), are explained in footnotes to the Appendix.

All specimens were registered at the Museu Paraense Emílio Goeldi (MPEG) in Belém and will be deposited there, at the Louisiana State University Museum of Natural Science (LSUMZ) in Baton Rouge, or at the National Museum of Natural History (USNM) in Washington, D.C. Specimens are referred to by preparator's field number, pending final deposition. Tape recordings are or will be deposited at the Cornell Library of Natural Sounds (LNS) and the Arquivo Sonoro Natural (ASN) in Campinas. Photographs are or will be deposited at Visual Resources in Ornithology (VIREO) in Philadelphia.

RESULTS

As of January 1995, 394 bird species were recorded in the study area (Appendix); in addition to these we list another 12 species as "hypothetical" (see Table 4). Seven species included in Stotz and Bierregaard's (1989) list of 352 species were removed, four were reidentified, and 49 species were added.

REMOVALS

Earlier inclusion of *Tinamus guttatus* was based on vocalizations and two mist net captures. Examination of the capture records revealed a carefully described adult *Crypturellus variegatus*, with appropriate measurements, and a small chick, doubtfully identifiable to species. Identification of tinamous by voice has improved considerably in the decade since *T. guttatus* was placed on the reserve list (although there is still much to learn and recording accompanied by playback and collection is badly needed to resolve remaining problems). We have never heard in the study area the vocalization we attribute to this species elsewhere in Amazonia, based on recordings at LNS: two clear, whistled notes. The vocalization previously ascribed to this species (D. Stotz, in litt.) may be that of *T. major*, which we hear frequently during the rainy season: a single, clear whistle followed by a tremulous descending note. Vocalizations of *C. brevirostris* (see below) may also have been attributed to *T. guttatus*. Considering that *T. guttatus* has never been seen in the reserves (despite frequent sight records of *T. major* and *C. variegatus*) in nearly 15 years of work and that it is unknown north of the Amazon and east of the Rio Negro, we doubt that the species is present in the study area. We have placed it on the hypothetical list.

The identification of *Aramides calopterus*, known in the area from a single sight record (Stotz and Bierregaard 1989), was based on the terse plumage descriptions in Meyer de Schauensee (1970) and may have been erroneous (D. Stotz and R. Bierregaard, pers. comm.). Because the species is otherwise unknown from the region east of the Negro and north of the Amazon rivers, we have listed it as hypothetical from our study area.

Nyctiphrynus ocellatus had been listed on the basis of a single vocal record (D. Stotz, pers. comm.). Although the vocalization is fairly distinctive, we suspect that the species was included erroneously, and so we list it as hypothetical. We have never heard the characteristic song despite scores of hours of night survey work in appropriate habitat. In regions where it occurs this species is normally fairly common and readily detected in primary forest, so we doubt we have overlooked it. It is not known from the Guianas or from Brazil north of the Amazon and east of the Negro rivers, so its presence at Manaus would represent a major range extension.

Myrmotherula surinamensis was included earlier based on a single record lacking habitat description (D. Stotz, pers. comm.). Considering recent discoveries of extremely similar-looking *M. klagesi* and *M. cherriei* near Manaus (Cohn-Haft, unpubl. data), and the preference by all three species for seasonally flooded river- or lake-edge habitats, we prefer to list *M. surinamensis* as hypothetical. To our knowledge, there are no specimens of *M. surinamensis* from the Manaus area (see Gyldenstolpe 1930), although its occurrence in appropriate habitat is to be expected.

Hypocnemoides melanopogon was included earlier on the basis of a single record from ca.

km 100 of the BR-174 along the Rio Urubu (D. Stotz, pers. comm.). This is outside of the study area and so we have removed the species entirely from the BDFFP avifauna. There is probably no appropriate habitat for it in the reserves, although it could appear as a vagrant.

Hylophilus brunneiceps is associated with white-sand vegetation, especially along the upper Rio Negro, and is not known from specimens near Manaus (Oren 1981). Like other *campina* specialists, it could certainly appear in our area, although we have never registered it. Given the difficulties in greenlet identification and apparently considerable earlier confusion (see "Reidentifications" below), we prefer to list D. Stotz's single sight record as hypothetical.

Conirostrum bicolor was included earlier based on a single record included among the BDFFP notes from the earliest years (D. Stotz, pers. comm.). In central Amazonia, this species occurs in seasonally flooded vegetation along white-water rivers, so we feel its appearance in the study area is very unlikely. We list it as hypothetical.

REIDENTIFICATIONS

We question the identification of *Forpus passerinus* (including one record of our own). In the city of Manaus and in disturbed and river-edge habitats nearby, we have only positively identified *F. crassirostris*. (Note, as pointed out to us by D. F. Stotz [in litt.], that *F. crassirostris* is the correct name for the species commonly called *F. xanthopterygius*; see Pinto 1978.) Although both species are possible by range (and some authors consider them conspecific), they are difficult to distinguish. We are not convinced that the few sight records of *Forpus* parrotlets from the study area refer to *F. passerinus*, best told from *F. crassirostris* by the absence of a blue rump in the male; we prefer to list "*Forpus* sp." in recognition of the need for better documentation. Bierregaard (1982) listed a single sight record of "*Forpus* cf. *sclateri*" from the tower, which we suspect refers to the same taxon as the other study-area sightings.

The scythebill found at Manaus was identified as *Campylorhamphus trochilirostris* by Stotz and Bierregaard (1989), after Willis (1977) reported *C. procurvoides* from Reserva Ducke. Manaus birds had long been recognized to bear the most conspicuous distinguishing field mark for *C. procurvoides* north of the Amazon, the unstreaked mantle (Meyer de Schauensee 1970; Hilty and Brown 1986; Ridgely and Tudor 1994); nevertheless, this identification was overruled by bill measurements of netted birds and of a single specimen (D. Stotz, pers. comm.), which we were unable to locate. A recent specimen (MCH 225) from the study site, however, is indistinguishable in plumage from a series of nominate *C. p. procurvoides* at the American Museum of Natural History. The unstreaked mantle, sagittate breast streaks (vs. long, linear stripes) not extending to the belly and lacking conspicuous dark borders, and the generally browner, less rufescent ground color clearly distinguish this form from any *C. trochilirostris* subspecies found in nearby regions. The bill chord of our specimen (63 mm, measured from base of bill) and of netted birds (BDFFP Project, unpubl. data) is longer than expected for *C. procurvoides* (46–56 mm) and within the range for *C. trochilirostris* (58–64 mm), according to Hilty and Brown (1986). Those measurements, however, may only apply to forms found in Colombia because, among central Amazonian forms of the two species, Zimmer (1934) found a considerable range of overlap (56–61 mm). Zimmer also noted that bill length, as measured along the curve of the culmen, is similar in the two species, the generally shorter chord length of *procurvoides* indicating the deeper curvature of that species' bill. We are unable to place all specimens to species by subjective estimation of bill curvature and, pending larger samples of consistently measured bills, we suggest that neither curvature nor chord length is diagnostic at the species level. Zimmer (1934) proposed that tarsus length might consistently distinguish *procurvoides* (18–20 mm) from *trochilirostris* (21–23 mm); the tarsus of our specimen (18.7 mm) supports that dichotomy.

We are confident that *C. procurvoides* is the only regularly occurring scythebill in the *terra firme* forest north of Manaus. The species has been known from Manaus since Hellmayr's (1925) accurate reidentification as *procurvoides* of a "*trochilirostris*" specimen collected by Natterer in 1833 (Natural History Museum of Vienna 15911, examined by Cohn-Haft). Zimmer (1934) apparently overlooked this but, without access to the specimen, independently suspected it might be *procurvoides*. Subsequently, Peters (1951) did not include Manaus within the range of any scythebill. To our knowledge, the Manaus area represents a gap in the central Amazonian distribution of *trochilirostris*, falling between two distinct subspecies, *C. t. notabilis* to the south and *C. t. snethlageae* occurring as close as Faro, 400 km east of Manaus on the same side of the Amazon and Negro (Zimmer 1934). In general, the distribution of *C. trochilirostris* is mostly peripheral to the Amazon basin, in which *procurvoides* is widespread (see maps in Ridgely and Tudor 1994). In areas of sympatry in central Amazonia, *trochilirostris* is apparently restricted

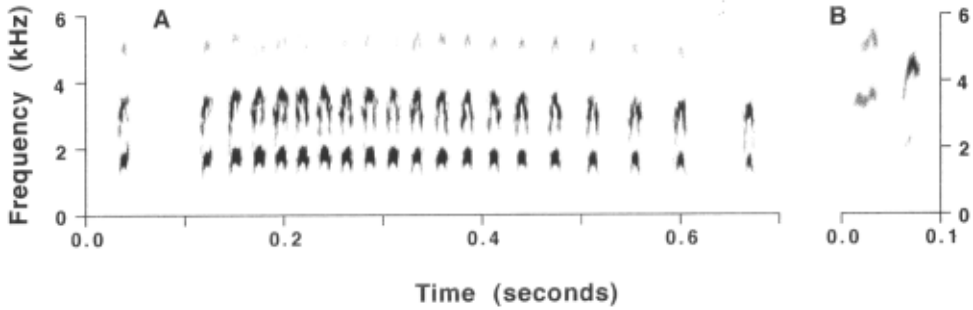


FIG. 2. Song of (A) *Hemitriccus z. zosterops* (from study site north of Manaus, Brazil; recorded by MCH) and (B) *H. z. griseipectus* (Tambopata Reserve, Madre de Dios, Peru; recorded by T. Parker; LNS 12872). Sound spectrograms were produced using Canary software of the Bioacoustics Research Program of the Cornell Laboratory of Ornithology, Ithaca, New York.

to seasonally flooded forest (E. Snethlage in Zimmer 1934). Thus, we predict that (1) if *trochilirostris* is found to occur near Manaus, it will inhabit *várzea* forest (not present at our site), and (2) *procurvoides* will prove to be resident in *terra firme* forest throughout the region between Manaus and Guyana (shown as distributional gap on map in Ridgely and Tudor 1994: 213). Although there is considerable geographic variation in both species and a thorough taxonomic revision is needed, the form occurring at our site, nominate *procurvoides*, is unlikely to be affected by revision.

Earlier identification of *Hemitriccus minor* (Bierregaard 1982, Stotz and Bierregaard 1989) was based on morphometrics of netted birds and similarity of the voice to that of *H. minor* in Rondônia. Specimens collected in the reserves (MCH 14, 56, 96, 97, 109), however, have confirmed the identification as *H. zosterops*, by such diagnostic characters as wing formula and nostril shape (Hellmayr 1927, Zimmer 1940, Cohn-Haft 1996). The form of *H. zosterops* found in the reserves is the nominate subspecies (following the taxonomy of Traylor 1979), widespread in Amazonia north of the Amazon River. This yellow-bellied form looks much like *H. minor* in plumage, but is slightly larger. Because *Hemitriccus* spp. are sexually dimorphic in size (females smaller; Zimmer 1940) and because female *zosterops* overlaps in size with male *minor* (Cohn-Haft, unpubl. data), small, sex-blind samples could easily fail to distinguish the two morphometrically. In the field they are virtually identical, nominate *zosterops* differing subtly from *minor* by more conspicuous wingbars, more distinctly streaked throat, greenish-white as opposed to beige-white iris, white versus white-to-buffy eyering, all-black mandible versus variable amounts of pale coloration at base, and flatter culmen (see also Cohn-Haft 1996). The “tip-trill” song of Manaus birds (Fig. 2A), described by Stotz and Bierregaard (1989), closely resembles songs of *H. minor*, as well as both *Lophotriccus* species found in the study area. The song of *H. zosterops*, however, differs from all of these by always beginning with a “tip” note and by gradually slowing throughout the trill (Cohn-Haft 1996). Near Manaus, *H. minor* occurs only in *igapó* (unpubl. data), and the species is unknown from the region east of the Rio Negro and north of the Amazon, except in French Guiana (Tostain et al. 1992), where we question the identification. A specimen from Surinam (Haverschmidt 1968) proved to refer to nominate *zosterops* (see Ridgely and Tudor 1994).

Proper identification of the Manaus birds is further complicated by the fact that *H. z. griseipectus*, the familiar “*zosterops*” to workers in southern Amazonia, looks and sounds more different from the Manaus form than does *H. minor*. White-bellied, gray-breasted *griseipectus*, found throughout Amazonia south of the Amazon River, was originally described as a full species (Snethlage 1907). It gives a distinctly different song from nominate *zosterops*: a rapid, high-pitched, metallic “ca-DEEK” (Fig. 2B), confirming the full species status of *Hemitriccus griseipectus* (as accorded without justification by Sibley and Monroe [1990]).

Stotz and Bierregaard (1989) listed *Hylophilus pectoralis*, followed by a question mark indicating doubt as to identification, as rare in primary forest. We have found *H. thoracicus* (not listed by them) at only two locations in the study area, including the one where Stotz (pers. comm.) registered the possible *pectoralis*, and we assume that this is the species in question. Our identification is based on the yellowish-white iris, complete yellow pectoral band, head lacking contrasting gray coloration, and the song (recorded) lacking the terminal trill given by

TABLE 1
SPECIES ADDED THAT WERE PROBABLY OVERLOOKED PREVIOUSLY

<i>Crypturellus brevirostris</i>	<i>Chaetura chapmani</i>	<i>Progne subis</i>
<i>Leptodon cayanensis</i>	<i>Avocettula recurvirostris</i>	<i>Riparia riparia</i>
<i>Chondrohierax uncinatus</i>	<i>Chrysolampis mosquitus</i>	<i>Vireo altiloquus</i>
<i>Accipiter poliogaster</i>	<i>Pharomachrus pavoninus</i>	<i>Piranga rubra</i>
<i>Coccyzus melacoryphus</i>	<i>Ornithion inerme</i>	<i>Tersina viridis</i>
<i>Ciccaba huhula</i>	<i>Phylloscartes virescens</i>	<i>Dendroica petechia</i>
<i>Nyctibius leucopterus</i>	<i>Tyrannus tyrannus</i>	
<i>Streptoprocne zonaris</i>	<i>Progne tapera</i>	

pectoralis (Ridgely and Tudor 1989). Both species are fairly widespread in Amazonia, but *thoracicus* is typical of forest canopy and edge (Hilty and Brown 1986), whereas in central Amazonia *pectoralis* is known only from natural savannas. Willis (1977) listed both species as occurring just south of our study area, near but not expressly in the *campina* (Fig. 1). We have recorded neither species from the *campina* itself, where *pectoralis* (and *H. brunneiceps*; see above) could theoretically occur. Outside of it, we would not be surprised to find *thoracicus* in tall forest, and similar-looking *H. semicinereus* in second growth. There is also a single record of *H. thoracicus* from the tower by J. Fitzpatrick (Bierregaard 1982).

In addition to these species, Stotz and Bierregaard (1989) questioned their identifications of *Ciccaba virgata* and *Anthracothorax nigricollis*, suggesting that the latter might be *A. viridigula*. We have found both *C. virgata* and *C. huhula* in the study area (see below). The only *Anthracothorax* species we have observed at the site is *A. nigricollis*. In the region, we find *A. viridigula* to prefer late successional vegetation on islands in the Amazon River, although both species are present in planted areas in the city of Manaus.

Also, several species listed in Bierregaard (1982) from the tower would be additions to the list, but were not included because they are surely early misidentifications of similar species now known to be regular in the area. *Trogon collaris*, otherwise unknown in the Manaus area, was reported heard on a single occasion by J. Fitzpatrick; however, this species sounds similar to *T. rufus*. *Polioptila plumbea*, which occurs near Manaus only in *igapó* (pers. obs.), was reported as uncommon in canopy flocks, exactly the role filled by *P. guianensis*. The single record of *Nasica longirostris* from the tower has since been rescinded (R. Bierregaard, pers. comm.).

ADDITIONS

To facilitate discussion of the 49 species not reported by Stotz and Bierregaard (1989), we divided them into three groups (Tables 1–3), emphasizing what we believe are the characteristics most responsible for the species being encountered in the study area.

The largest group of additions are 22 species that have probably always been present in the abundance that we encountered (Table 1). Six of these (*Crypturellus brevirostris*, *Ciccaba huhula*, *Nyctibius leucopterus*, *Chaetura chapmani*, *Ornithion inerme*, and *Phylloscartes virescens*) are relatively common forest birds, present all year. With the exception of *C. chapmani*, all these species are regularly heard and are much easier to detect by voice than by sight. All are either canopy species, nocturnal, or difficult to see or identify. Specimens support identifications of *N. leucopterus* (see Cohn-Haft 1993), *C. chapmani* (MCH 324), and *P. virescens* (MCH 38, 136, 137, 194). Our records and specimens of *P. virescens* are the first for Brazil (see Stotz 1990). *Ciccaba huhula*, first sighted in the reserves by Whittaker, is the more common *Ciccaba* owl in primary forest, judging by its characteristic calls and by sight records. Although we are not able to distinguish all of its varied vocalizations from those of *C. virgata*, the latter is also present, known from one capture and one sight record (Stouffer), and may prefer more disturbed forest habitat. *Ornithion inerme* was first reported in the study area from the ZF-2 tower (Bierregaard 1982) and is easiest to see there, but can be heard throughout the area from primary forest canopy.

Crypturellus brevirostris has been seen twice in the reserves (Whittaker). Before this, in December 1989, T. Parker identified and recorded (LNS) a tinamou vocalization as a *C. bartletti*-type song. Although we have never seen the singer, we believe the song belongs to *C. brevirostris*. This is not a radical suggestion considering that the song of *brevirostris* is undescribed, that *bartletti* is unknown north of the Amazon River, and that the two are considered close

TABLE 2

SPECIES ADDED SINCE 1986 THAT ARE TYPICAL OF OPEN OR SECOND-GROWTH VEGETATION AND ARE BELIEVED TO BE RECENT ARRIVALS TO THE STUDY AREA (SEE TEXT)

<i>Athene cunicularia</i>	<i>Thamnophilus punctatus</i>	<i>Manacus manacus</i>
<i>Phaethornis ruber</i>	<i>Camptostoma obsoletum</i>	<i>Sporophila bouvronides</i>
<i>Polytmus theresiae</i>	<i>Phaeomyias murina</i>	<i>Sporophila lineola</i>
<i>Amazilia fimbriata</i>	<i>Elaenia chiriquensis</i>	<i>Saltator maximus</i>
<i>Chelidoptera tenebrosa</i>	<i>Pachyramphus rufus</i>	<i>Euphonia chlorotica</i>

relatives (Blake 1977), even conspecific by some (Hellmayr and Conover 1942). The type specimen of *Crypturellus brevirostris* was collected in Manaus (see Hellmayr and Conover 1942), and there is one specimen (MPEG 29939, collected in 1964) from Reserva Ducke, where we have since heard the same song (although the species is not included on the Ducke list [Willis 1977]). The song is a prolonged series of evenly spaced pure tones, rising in pitch slightly throughout, and reminiscent of songs of *Microcerculus bamba* in the same region. Prior to Parker's identification we had noted this vocalization frequently in our field notes without identification as to species. Judging by voice, *C. brevirostris* is the least common of the three tinamous found principally in primary *terra firme* forest, where it occurs exclusively, and may be associated with small forest streams. We have heard this vocalization throughout the study area and presume the species to be widespread in the *terra firme* forest north of Manaus. Although larger and longer-billed, *C. variegatus* is extremely similar and would probably be difficult to distinguish from *C. brevirostris* in the field, which may explain the lack of earlier sight records or captures.

The remaining species in Table 1 are probably either resident at very low densities, vagrants from other habitats, or are scarce long-distance migrants. Many of these prefer non-forest habitats, and some (e.g., swallow spp.) are found in considerable numbers outside of our study area (Stotz et al. 1992), but within it are generally seen as they pass overhead. *Tyrannus tyrannus* and *Piranga rubra* breed in North America and winter in greatest numbers in western Amazonia (see Stotz et al. 1992). *Accipiter poliogaster* is known in our area from two sight records from the ZF-2 tower (Bierregaard 1982; Whittaker and K. Zimmer). The second record, of an immature-plumaged individual on 13 January 1995, does not fit the pattern of austral winter records noted in Amazonian Colombia (Hilty and Brown 1986). *Avocettula recurvirostris* and *Chrysolampis mosquitus* are both known at the site from single female individuals, seen on the same day (7 November 1993) from the tower by Whittaker, K. Zimmer, and V. Emanuel. *Pharomachrus pavoninus* appears to be extremely rare in *terra firme* forest north of Manaus; our record is of a single singing male, noted repeatedly over a period of several months near a camp in continuous forest. *Tersina viridis* has been seen from the tower (Whittaker) and in the canopy of undisturbed forest on one of the fazendas (T. Towles, pers. comm.).

Another group of newly added species (15 spp.) are birds of second growth and open or disturbed areas that are common in similar habitats closer to Manaus and appear to have colonized the study area since 1987 (Table 2). Colonization by these species probably reflects gradual northward expansion along roads from areas of more extensive habitat near Manaus. Roads resemble rivers—being long, narrow, and bordered by disturbed habitat—and as such may facilitate the dispersal of riverine species (e.g., *Chelidoptera tenebrosa*, *Camptostoma obsoletum*, *Pachyramphus rufus*) as well as inhabitants of secondary forest (e.g., *Phaethornis ruber*, *Saltator maximus*). During our tenure at Manaus, we have noted *Chelidoptera tenebrosa* progressively farther north along the BR-174 road (see Fig. 1), and Whittaker first noted it on one of the fazendas (Dimona) on 10 September 1991. Similarly, *Phaethornis ruber*, whose earlier absence was "particularly perplexing" to Stotz and Bierregaard (1989), and *Pachyramphus rufus* were first noted on a fazenda in 1988 and have since spread and been confirmed nesting (Whittaker). We suspect that this mode of colonization may be typical of species occupying disturbed and second-growth habitats, and all species listed in Table 2 may be expected to increase gradually in numbers at our site.

One probable exception to the dispersal pattern just described is *Athene cunicularia*. It is widespread in arid and open habitats throughout most of the New World. We are unaware of any other records from rainforest areas in Amazonia. Our record is of a single individual in a

TABLE 3
SPECIES ADDED THAT ARE TYPICAL OF WATER-RELATED AND OTHER marginally PRESENT
HABITATS

<i>Butorides striatus</i>	<i>Pipile cumanensis</i>	<i>Celeus flavus</i>
<i>Oxyura dominica</i>	<i>Aratinga leucophthalmus</i>	<i>Tachyphonus phoenicius</i>
<i>Pandion haliaetus</i>	<i>Crotophaga major</i>	
<i>Nycticorax nycticorax</i>	<i>Chloroceryle amazona</i>	
<i>Mesembrinibis cayennensis</i>	<i>Chloroceryle americana</i>	

pasture on the Fazenda Dimona, first seen by R. Bierregaard on 4 December 1992 and seen again as recently as June 1994 (Whittaker).

A third group of newly added species (12 spp.) is made up of birds that normally occupy habitats absent or only marginally present in our area, and that appear as vagrants from nearby areas, but are not expected to colonize (Table 3). All are listed as casual (known from three or fewer records), and so none is considered part of the core fauna. One, *Tachyphonus phoenicius*, is a specialist of *campina*. The two sight records, both from the tower (Bierregaard 1982, Stotz, pers. comm.), probably represent wandering individuals. Other species found mostly in *campina* (e.g., *Galbula leucogastra* and *Thamnophilus punctatus*) also occur to a lesser extent in second growth or edge situations in the study area, but *T. phoenicius* is not one of these. Nor has it appeared in the *campinarana*, the only site where the *campina*-specialist *Neopelma chrysocephalum* has been recorded in our area.

The remaining species in Table 3 are associated with aquatic environments, either open water (*Oxyura dominica*, *Pandion haliaetus*), river and lake edge (*Butorides striatus*, *Nycticorax nycticorax*, *Mesembrinibis cayennensis*, *Aratinga leucophthalmus*, *Crotophaga major*, *Chloroceryle amazona*, *C. americana*), or bottomland and flooded forest (*Pipile cumanensis*, *Celeus flavus*). The appearance of *O. dominica*, *P. haliaetus*, and *C. americana* is clearly related to the formation of the ponds in pasture where they were found. Surprisingly, *O. dominica* may have taken up residence in a single pond, where up to two males have been seen repeatedly over several years. Nevertheless, the small extent of habitat seems likely to limit any expansion in the study area by these species. *Aratinga leucophthalmus* might be expected to visit second-growth areas in the reserves, given its abundance in the city of Manaus. However, birds noted in the city seem to prefer wet areas or to be in wandering flocks, perhaps associated with the large rivers nearby. Our two records are of small groups overhead, once over primary forest from the tower and once over pasture.

Finally, the other river- and lake-edge species listed above were all recorded at camps in the middle of unbroken primary forest. *Nycticorax nycticorax* (Whittaker) and *Mesembrinibis cayennensis* (A. Martins, pers. comm.) were each noted once, heard calling at night; the latter bird apparently perched atop a snag at the edge of camp. A single *B. striatus* was found at dawn in one camp, walking nervously on the sandy ground and periodically "freezing" in response to human activity in camp; it was only seen for one day (A. Martins, pers. comm.). The one record of *C. major* (Cohn-Haft) was of an individual skulking low in dense vegetation at the edge of a camp. These records suggest dispersal, in many cases nocturnal, of species resident in aquatic habitats in the general vicinity. Seen from the air, our camps, which are more or less round breaks in the canopy, may resemble ponds, especially at night when sandy ground, camp roofs or tarps, or even pockets of mist probably reflect light differently from the relatively uniform canopy around them. Similar camp records at dawn of single *Podiceps dominicus* (W. Strickland, pers. comm.), *Gallinago gallinago* (Whittaker), an unidentified shorebird (A. Martins, pers. comm.), and a pair of *Ceryle torquata* (Cohn-Haft and Whittaker) also suggest nocturnal movement and mistaken identification of camps as ponds. Barbara Zimmerman (pers. comm.) reports that a species of *Phyllomedusa*, a nocturnal frog that normally vocalizes only around ponds or pig wallows, also commonly calls at the edge of camps with blue tarp roofs.

HYPOTHETICAL

Twelve species reported based on inadequate documentation, but possibly present, are listed as "hypothetical" (Table 4). We believe that substantiation in the form of a specimen, or at least an unambiguous tape recording or photograph, is necessary to confirm the presence of any of these species in the area. *Tinamus guttatus*, *Aramides calopterus*, *Nyctiphrynus ocellatus*, *Myr-*

TABLE 4
HYPOTHETICAL SPECIES (SEE TEXT)

<i>Tinamus guttatus</i>	<i>Nyctiphrynus ocellatus</i>	<i>Capsiempis flaveola</i>
<i>Accipiter striatus</i>	<i>Chaetura cinereiventris</i>	<i>Pipreola whitelyi</i>
<i>Falco deiroleucus</i>	<i>Popelairia langsdorffi</i>	<i>Hylophilus brunneiceps</i>
<i>Aramides calopterus</i>	<i>Myrmotherula surinamensis</i>	<i>Conirostrum bicolor</i>

motherula surinamensis, *Hylophilus brunneiceps*, and *Conirostrum bicolor* had been listed by Stotz and Bierregaard (1989). We suspect that they were identified incorrectly for reasons discussed above ("Removals"). Other hypothetical records are as follows:

Accipiter striatus is unknown from the Amazon basin. Our records of unidentified small accipiters include individuals resembling North American (Whittaker), plain-breasted (Cohn-Haft) and rusty-thighed (Cohn-Haft) forms. Unusual plumages of *A. superciliosus* or *Harpagus diodon*, an austral migrant to eastern Amazonia noted once by Willis (1977) just outside of the study area, may be involved in these sightings.

Whittaker observed a possible adult *Falco deiroleucus* at a considerable distance perched on a snag on one of the fazendas. There are several Manaus-area records for this species (Whittaker 1996), including photographs (Cohn-Haft), although the status of the species in Amazonia is poorly known. At the time of the reserve sighting (7 April 1988), the observer was unfamiliar with the species and could not positively rule out the similar *F. ruficularis*. After subsequent comparative experience, Whittaker strongly suspects that the initial identification was correct, but we would prefer better documentation.

Chaetura cinereiventris was seen on one occasion (two individuals on 15 May 1990 by Whittaker); although we are familiar with the species from elsewhere in Amazonia, given the difficulty identifying swifts in the field, we would prefer specimen confirmation.

Whittaker and K. Zimmer observed a female coquette from the tower that had a pure white rump band, suggesting *Popelairia langsdorffi*. Typical buff-rumped females of *Discosura longicauda* were also present; however, the variation in female plumage in these birds appears to be poorly documented, and it is not clear if this mark is sufficient to distinguish the two species. Furthermore, several other coquette species have white rump bands, and *P. langsdorffi* is unknown from east of the Negro and north of the Amazon.

John Fitzpatrick reported seeing an adult *Capsiempis flaveola* feeding young in the canopy of primary *terra firme* forest from the tower (Bierregaard 1982). Considering that this species normally occurs in low, shrubby vegetation or bamboo and that the only Manaus-area record besides this one is from lake-edge bushes south of the Amazon (Jan Pierson and Cohn-Haft), we prefer to list the species as hypothetical in the study area. Perhaps this record refers to *Phylloscartes virescens* (J. Fitzpatrick, pers. comm.).

Pipreola whitelyi, known only from montane forest in the eastern tepuis of Venezuela and adjacent Guyana near the Brazilian border (Traylor 1979), is an unlikely candidate to appear near Manaus. Nevertheless, the male should be entirely distinctive, so we are inclined to recognize here two independent sight records of single males from the Manaus area. Jan P. Smith (pers. comm.) noted one with other canopy frugivores foraging on fruits at the edge of Camp Florestal. Outside of the reserves, in a residential neighborhood of Manaus, Randy Downer (pers. comm.) reports observing this species with other frugivores also in a fruiting tree over a stream.

STATUS CHANGES

The following types of status were evaluated for each species and assigned a separate column in the Appendix:

Abundance and seasonality.—Many species were assigned a different abundance code from that in Stotz and Bierregaard (1989). This is in part an inevitable function of the different criteria and number of categories employed. Most such changes are for greater abundance than previously estimated (e.g., most species listed as "fairly common" earlier are simply "common" here). Greater familiarity with species, especially their voices, generally led to upward revisions for a large number of species (e.g., *Micrastur ruficollis*, *Nyctibius aethereus*, *N. bracteatus*, *Frederickena viridis*, *Zimmerius gracilipes*, *Myiopagis caniceps*). The longer total period of study reflected here has given us a more accurate picture of the abundance of some rare species. Three species not seen since 1986, *Laterallus melanophaius*, *Pionites melanocephala*, and *Chordeiles*

acutipennis were reclassified as casual. Just as some of the casual species noted for the first time after 1986 may have appeared in response to changing habitats, the lack of subsequent records of these species could signify their disappearance from the area; however, there are simply too few data to know.

In certain cases, our different abundance assignment appears to reflect a real change in abundance since 1986. Many edge and secondary species have probably increased in abundance as time for colonization has elapsed. This group includes several open-country species rarely or never found in primary forest (e.g., *Heterospizias meridionalis*, *Tyrannus savana*, and *Sturnella militaris*), but is dominated by species that are occasionally encountered in disturbed areas within primary forest, but that thrive along edges and in second growth (e.g., *Melanerpes cruentatus*, *Cymbilaimus lineatus*, *Myrmeciza atrothorax*, *Tolmomyias poliocephalus*, *Myiarchus tuberculifer*, *M. ferox* and *Cyclarhis gujanensis*). Other second-growth species appear to have decreased as older and more diverse secondary habitats have developed (e.g., *Troglodytes aedon*). One unusual change is the apparent shift in color-phase predominance in *Buteo brachyura* from light in the earlier years (D. Stotz, pers. comm.) to dark phase in recent years. Perhaps this reflects founder effects.

Species whose numbers vary considerably during the year represent 12% of the avifauna. Eight species are austral migrants, 26 are boreal, and 15 engage in unspecified movements (Appendix). For certain species known to have migrant and resident populations we have not established which form is present in our area (e.g., *Empidonomus varius*, *Tyrannus savana*, *T. melancholicus*).

Several relatively common species not known to be migratory appear to vary in abundance at the fazendas, as we have indicated with an "m" after the abundance code (Appendix). Unlike Stotz and Bierregaard (1989), we agree with Willis (1977) that *Pionus* and *Amazona* spp. fluctuate greatly in numbers in the area. In particular, *P. menstruus* and *A. autumnalis* may vary from abundant to virtually absent. Many of these species, including *Geotrygon montana* and several parrots, are frugivores and may make relatively short-scale movements to track food resources. For *G. montana*, capture data indicate that abundance is highly variable and does not follow an annual cycle, although abundance peaks have occurred during the wet season (Stouffer and Bierregaard 1993). Cohn-Haft (unpubl.) noted flocks of thousands of *P. menstruus* in Roraima during August 1991 when the species was absent from the reserves.

Habitat.—Most of the revisions of habitat codes reflect our recognition of use of second growth and edges by forest birds. Some species (e.g., *Phaethornis superciliosus*, *P. bourcierii*, *Mionectes macconnelli*, *Terenotriccus erythrurus*, and *Myiarchus ferox*) have become quite common in both *Vismia*- and *Cecropia*-dominated secondary growth, although *Cecropia* forests appear to be used by more forest birds. We did not list second growth as a habitat for species that we suspect use it only in passing between areas of primary forest (see Borges 1995).

Microhabitat/position.—Although Stotz and Bierregaard (1989) did not list this category, their habitat classification included what we consider microhabitats. The most noteworthy difference in our microhabitat ratings concerns several manakin species (*Tyrannetes virescens*, *Corapipo gutturalis*, *Pipra pipra*, *Pipra erythrocephala*), which we routinely observed foraging at fruiting trees in the forest canopy. Although all of them lek (and may nest) in the understory and midstory of closed forest (Prum 1990; pers. observ.), we believe that they forage mostly in the canopy at our site. This behavior has not been observed elsewhere and could be attributed to the unusual poverty of fruits in forest understory at Manaus (Gentry and Emmons 1987). Nevertheless, the forest canopy is poorly studied at most sites, and where manakin foraging has been observed at lower strata it is most often at treefall gaps (Levey 1988). Thus, we believe that these species are not typical inhabitants of closed forest interior, despite the frequent classification of most manakins as such. Guild studies also routinely class all woodpecker species as "bark-gleaning insectivores," although we have observed several species (especially *Melanerpes cruentatus* and *Celeus grammicus*) regularly consuming large quantities of fruit in the canopy. Mesquita (1989) rated several woodpecker species as the most important dispersers of *Clusia grandiflora* (Clusiaceae) fruits at our site.

Sociality.—We made few revisions in sociality codes, but some of these changes reflect interesting behavior changes associated with use of secondary habitats. *Dendrocincla fuliginosa*, *Xiphorhynchus pardalotus*, and *Myrmotherula axillaris* are all typically found in mixed-species flocks in primary forest, but appear to persist outside of flocks in secondary areas. This change is most notable for *M. axillaris*, which is almost never found outside of flocks in continuous forest, but has persisted and even reproduced in 1- and 10-ha fragments (Stouffer and Bierregaard 1995a).

We believe that the flycatcher *Platyrinchus coronatus* normally engages in lekking behavior, although this apparently has not been noted elsewhere. We usually encounter several singing individuals (presumably males) at dependable locations and elsewhere may go several hundred meters through forest without encountering any. At these presumed leks, birds often flare their colorful crests and make short flights between perches without foraging, often accompanied by an abrupt "chirr" sound, apparently produced by their wings. We have no evidence of lekking in the other *Platyrinchus* species at our site. Species in another genus of small flycatchers, *Lophotriccus*, are purported to lek elsewhere (Hilty and Brown 1986), but do not do so at our site. Both *L. vitiensis* and *L. galeatus* appear to maintain permanent territories separated by considerable distances in favored habitat.

Evidence.—Seventy percent of all species listed in the Appendix are documented by photograph, tape, or specimen (level 2 or better). Most of the others are not controversial. Species listed as hypothetical (Table 4), as mentioned above, require better documentation and do not appear on the main list (Appendix).

DISCUSSION

A variety of techniques is clearly needed to accurately and completely survey the avifauna of a tropical forest (Terborgh et al. 1990). Our species list represents about a 14% increase in species over the list of Stotz and Bierregaard (1989). Many additions are a result of more night work, more time spent in the canopy (mostly at the tower), more emphasis on vocalizations, more collecting, and more prolonged coverage by the same people, leading inevitably to greater familiarity with the fauna. Extensive work with mist nets prior to our arrival in Manaus had produced a thorough characterization of the understory fauna. Nevertheless, one understory species, *Crypturellus brevirostris*, had gone completely undetected by mist nets (which undersample ground-walking birds like tinamous; Karr 1981) and was only recognized after it was noted by voice. Uniform coverage throughout the year is also important. More than 10% of the avifauna at our site may be seasonal to some extent; these species could be missed by incomplete seasonal coverage.

Time is also a critical component of faunal surveys (Remsen 1994), and high-diversity tropical sites seem to require at least several years to be completely characterized. Like Manaus, Manu National Park in Peru added some 40 species (and removed about five) to its list (Terborgh et al. 1984; and updated version in Karr et al. 1990), despite a much longer history of bird work than at Manaus. Very rare species or vagrants, such as the majority added to this list, may continue to be added at a slow rate nearly indefinitely, especially in the tropics, where a much larger species pool is fairly close at hand. Nevertheless, one important objective of a species list is to characterize the "core" fauna in a region. At our site only one habitat could be said to have a core fauna. This is the primary *terra firme* forest. The other three major habitat types present in some abundance (second growth, pasture, and open water) are of recent anthropogenic origin. We believe that we have characterized the core avifauna in primary *terra firme* forest at our site to greater than 99% accuracy and completeness.

Another objective of our list was to monitor change over time. Our assessments of change suggest the role of changing availability of anthropogenic habitats and varying rates of colonization. A more fine-scale approach involving censusing of bird numbers (e.g., Terborgh et al. 1990) is necessary to quantify change. Standardized mist-netting over long periods detects changing habitat use patterns by birds, although interpretation of capture rates can be complicated (Remsen and Good 1996).

Certain second-growth species were surprisingly slow to colonize the area (e.g., *Phaethornis ruber*, *Chelidoptera tenebrosa*, *Thamnophilus punctatus*, *Camptostoma obsoletum*, *Phaeomyias murina*), but we attribute their eventual arrival to gradual dispersal along roads. We predict the appearance of other species by the same means, for example, *Herpetoheres cachinnans* (seen as far north as km 30 of the BR-174 road in August 1993 by Cohn-Haft), *Megarynchus pitangua* (noted at km 45 by Whittaker), *Todirostrum maculatum*, and *Cacicus cela*—all typically river-edge species that occur along the roads and at fazendas nearer to Manaus. The last three are among the species listed for Ducke Reserve (Willis 1977) that still have not been recorded in our area (see below).

Disturbed areas, embedded in a seemingly endless expanse of forest, still make up only a tiny fraction of the habitat available north of Manaus. Nevertheless, rapid growth of Manaus and gradual paving of the BR-174 leading to Boa Vista and Venezuela will inevitably lead to greater forest fragmentation. Human disturbance processes have probably only increased species richness

at our site to date, and apparently no primary forest species have suffered for it. However, levels of habitat disturbance and hunting are extremely low and will probably increase. On a smaller spatial scale, the negative effects of habitat fragmentation on primary forest species is clear (e.g., Stouffer and Bierregaard 1995a).

More importantly, increasing local species richness by increasing habitat diversity in our area is not a meaningful conservation objective. Secondary vegetation is not an endangered habitat, nor are the species that occupy it. On the other hand, large areas of primary forest, with low habitat heterogeneity, are increasingly subject to destruction even if soon abandoned. These areas may offer a key to understanding patterns of species richness throughout the Amazon (see below) and may be important population sources for forest species.

AVIFAUNAL AFFINITIES

The avifauna north of Manaus is distinctly Guianan in affinities. All but a handful of species (and subspecies where known) also occur in the Guianas. Those not more widespread in Amazonia represent the Guianan "center of dispersal" (Haffer 1969) or "area of endemism" (Cracraft 1985), which appears to be delimited to the south by the Amazon River and to the southwest by the lower Rio Negro. In general, the pattern of range extensions found at Manaus has been of species previously known only from the Guianas (see Stotz and Bierregaard 1989), and our addition of *Phylloscartes virescens* is consistent with this pattern.

Other typically Guianan species recently found at Manaus and believed to terminate their westward distribution there have been found outside of the Guiana area. *Pachyramphus surinamensis* has been found at several sites west of the Negro and south of the Amazon (Whittaker 1995); *Haematoderus militaris* was found south of the Amazon in Rondônia (Stotz et al. 1997) and at the Urucu (Peres and Whittaker 1991); *Polioptila guianensis* occurs at the Urucu (Peres and Whittaker 1991), in Rondônia (Stotz et al. 1997), and at Borba (Cohn-Haft and B. Whitney, unpubl. data); and *Cyanicterus cyanicterus* has been noted at Borba (Silva and Willis 1986; Cohn-Haft and Stouffer, unpubl. data) and the Urucu (Peres and Whittaker 1991). *Nyctibius leucopterus* was entirely unknown in Amazonia before its discovery in the reserves (Cohn-Haft 1993). Ted Parker (in Parker et al. 1993) since found it in Guyana, indicating that it is probably widespread in the Guianas, and recent unpublished records from west of the Rio Negro (Whittaker) and south of the Amazon (Cohn-Haft and Stouffer) suggest that the species may occur throughout Amazonia. This Amazonian form of *N. leucopterus* represents an undescribed taxon (Cohn-Haft, in prep.).

One interpretation of these records is that the Negro and Amazon rivers are not insurmountable barriers for these species, all of which inhabit the canopy and lack close relatives elsewhere in the Amazon. They may occur across the great rivers as vagrants and may have established populations at low levels. This is the "center of dispersal" view espoused by Haffer (1969). Alternatively, these records may represent previously undetected established populations of equivalent stature to those in the Guiana region. In this case, these species had merely been incorrectly assigned to their "area of endemism" (*sensu* Cracraft 1985). There is simply not enough distributional information yet to know. The view that species known only from one side of a major river should not occur on the other side may have biased our opinion with respect to some of the species we list as "hypothetical" (Table 4).

The general outlines of Amazonian avian endemism proposed by Haffer (1969) have withstood well the test of time. Nelson et al.'s (1990) warning that apparent areas of endemism can be a simple function of the areas studied does not seem to apply to the broad patterns in bird distributions. Nevertheless, most of the Amazon is barely explored (Oren and Albuquerque 1991), and continued avifaunal surveys will be necessary to fill in the gaps in our understanding.

The closest area studied to ours is Reserva Ducke. Although the published list (Willis 1977) is admittedly preliminary, additions listed by Stotz and Bierregaard (1989) and our own (all included in the Appendix) indicate an avifauna very similar to that of the reserves. Of the 32 species listed for Ducke that Stotz and Bierregaard did not find in the reserves, we failed to find only 16 of them (*Agamia agami*, *Tapera naevia*, *Otus choliba*, *Glaucidium brasilianum*, *Hylocharis cyanus*, *Veniliornis passerinus*, *Nasica longirostris*, *Megarynchus pitangua*, *Attila cinnamomeus*, *Todirostrum maculatum*, *Sublegatus glaber*, *Mionectes oleagineus*, *Turdus leucomegas*, *T. ignobilis*, *Cacicus cela*, *Sporophila americana*). Of these, all appear to be absent due to a shortage of their preferred habitat in the reserves, either extensive secondary or riverine vegetation. Several species (mentioned above) are expected to colonize the reserves soon. More species occur in the reserves that have not been found yet at Ducke; however, we feel this is a

function of coverage. Our limited experiences at Ducke have led to the addition of a number of common species, and other workers (especially R. Cintra, R. Ridgely, T. Schulenberg, D. Stotz) have unpublished records that we did not include here. Thus we are confident that the core primary forest avifaunas at the two sites are actually nearly identical, although there may be differences in the relative abundances of some species.

PATTERNS OF SPECIES RICHNESS

It is generally believed that western Amazonia has the highest species richness (for most taxa, including birds) in the basin and in the world. Because species lists form the basis for such statements, care must be taken to ensure the comparability of these lists. Remsen (1994) pointed out several major potential sources of incomparability, including unequal sampling effort. The only Amazonian sites with published avifaunal lists based on surveys as thorough and complete as we believe ours to be are Cocha Cashu Biological Research Station in Manu National Park, studied by Terborgh and colleagues (in Karr et al. 1990), and the Tambopata Reserve (Parker et al. 1994), both in southeastern Peru. Total species richness at Manu is 554 and at Tambopata is 572, both substantially higher than that of our site (394), despite the considerably larger area covered at Manaus. Thus, the two western Amazonian sites clearly contain more species than one central Amazonian site.

This unstartling result does not, however, shed any light on the nature or causes of the difference in species richness between sites. An obvious source of difference is the number of habitats found at each site. The Peruvian sites contain numerous habitats not present in our area, including rivers, lakes, associated successional vegetation, bamboo, *várzea*, and bottomland (floodplain) forest. All three sites contain extensive *terra firme* forest, but at our site *terra firme* is really the only extensive habitat type present; therefore, it is the only habitat type that can be validly compared (Remsen 1994).

If we compare only the *terra firme* component at each site (Table 5), the tendency for increased species richness in the western sites disappears. The *terra firme* total for Manu (271 species) is remarkably similar to that for Manaus (264 species), especially in light of the 40% greater overall site richness at Manu. Furthermore, the Manu total may be an overestimate because no abundance codes were given and so some extremely rare or accidental species may have been included, whereas only "core" species (*sensu* Remsen 1994; excluding those listed as "casual") were included for Manaus. Tambopata, which has the highest overall richness of any site, had a markedly lower richness (200 species) in its *terra firme* component. We suspect that this is a result of inadequate sampling of *terra firme* forest at Tambopata. The overall similarity between the Manu and Tambopata avifaunas and the proximity of the two sites lead us to expect their *terra firme* avifaunas also to be very similar. Support for this interpretation comes from the low totals at Tambopata for families (Table 5) that are nocturnal (Nyctibiidae), tend to stay in the canopy (Psittacidae, Trochilidae), or are otherwise inconspicuous (Bucconidae, Dendrocolaptidae, Tyrannidae); the fact that many of the species at Tambopata not listed for *terra firme* are known to occur in that habitat elsewhere; and the fact that the nearest *terra firme* to the site's lodging is nearly 2 km away (J. V. Remsen, pers. comm.). Alternatively, some species that use *terra firme* at Manu (or Manaus) might actually prefer other habitats to the exclusion of *terra firme* at Tambopata, making the *terra firme* avifauna there genuinely poorer than at these other sites. Although unlikely in our opinion, that possibility highlights the importance of comparing sites by habitat type (Remsen 1994). Whether the low total for Tambopata is real or an artifact, it is clear that the higher total species richness there and at Manu versus Manaus is due entirely to habitats other than *terra firme*. This suggests that the major cause of the difference in total richness between the sites is habitat heterogeneity (beta-diversity).

We cannot rule out the possibility that the much larger area covered at Manaus (ca. 500 km²) than at the other sites (ca. 10 km²) is responsible for Manaus not having many fewer species in *terra firme* than the other sites; however, we do not believe that size is a problem. In fact, we predict that the entire core fauna listed for Manaus can be found in an area of just a few hundred hectares. We note that the study area contains a high proportion of disturbed habitats so that a considerably smaller area of primary forest was surveyed than the overall size of the study area suggests. Also, the considerable extension of the study area to include the tower did not add any species to the core fauna. Four species (*Accipiter poliogaster*, *Avocettula recurvirostris*, *Chrysolampis mosquitus*, *Tachyphonus phoenicius*) were found only at the tower, but they are considered casual, and two others (*Leptodon cayanensis* and *Euphonia chlorotica*) seen only along the BR-174 road outside of the fazendas are also casual and so did not enter in the core fauna.

TABLE 5
SPECIES RICHNESS IN PRIMARY *Terra Firme* FOREST AT THREE AMAZONIAN SITES

Family or major subfamily	Manaus ^a	Manu ^b	Tambopata ^c
Tinamidae	4	6	3
Ardeidae	1	2	3
Cathartidae	2	2	1
Accipitridae	11	10	11
Falconidae	7	4	5
Cracidae	3	3	2
Odontophoridae	1	1	1
Psophiidae	1	1	1
Rallidae	0	1	1
Eurypygiidae	0	1	1
Columbidae	3	2	2
Psittacidae	12	12	8
Cuculidae	2	5	4
Strigidae	6	6	5
Caprimulgidae	4	2	2
Nyctibiidae	5	3	1
Apodidae	4	0	2
Trochilidae	10	13	5
Trogonidae	4	5	5
Momotidae	1	2	2
Alcedinidae	2	2	3
Bucconidae	7	6	4
Galbulidae	4	3	3
Capitonidae	1	3	1
Ramphastidae	4	4	5
Picidae	10	8	7
Dendrocolaptidae	13	13	10
Furnariidae	11	17	11
Formicariidae	29	37	24
Conopophagidae	1	1	0
Tyrannidae	37	33	27
Pipridae	7	5	6
Cotingidae	6	6	3
Hirundinidae	2	0	0
Troglodytidae	3	4	2
Turdinae	3	4	1
Poliophtilinae	3	0	0
Vireonidae	7	5	3
Emberizinae	1	1	1
Cardinalinae	3	4	2
Thraupinae	22	27	19
Parulinae	2	1	1
Icterinae	5	6	2
Total	264	271	200

^a Data from Appendix: all species containing "1" (primary *terra firme* forest) in habitat column and abundance "rare" or greater.

^b Data from Karr et al. (1990): all species containing "U" (upland forest) in habitat column.

^c Data from Parker et al. (1994): all species containing "Fh" (upland forest), "Fsm" (forest stream margins), "Fo" (forest openings), or "Fe" (forest edges), and not marked with asterisk (observed \leq 3 times).

Another line of evidence is that, if both the Manu and Tambopata faunas were likely to increase a great deal by increasing the geographic extent of the study areas, then the *terra firme* fauna of the two sites, which are only about 100 km apart, should be considerably different, representing different subsamples of the complete fauna of the area. On the contrary, however, the somewhat smaller *terra firme* fauna listed at Tambopata appears simply to be a subset of that at Manu. Unfortunately, we have no concentrated survey data from a restricted subplot of our study area to test our hypothesis, but we look forward to the results of such a study in the future. In the meantime, we assume that habitat heterogeneity is the sole explanation necessary for the results of our intersite comparison.

Near Manaus, habitat heterogeneity is also implicated in increased site richness. Balbina, the

site of a hydroelectric plant roughly 120 km north of Manaus, appears to have all of our species plus a number of others, although lists are only preliminary (Willis and Oniki 1988; Bierregaard et al., unpubl. data). This is an area at the edge of the Guiana shield with considerable relief, caves, waterfalls, and distinct soils. There is also a large river, flooded forest, and some bamboo at the site. These different habitats probably account for the addition of numerous species, such as *Zebrilus undulatus*, *Pyrrhura picta*, *Automolus rufipileatus*, *Sakesphorus melanothorax*, *Thamnophilus amazonicus*, *Microrhophias quixensis*, *Cercomacra laeta* (see Bierregaard et al. 1997), *Hemitriccus josephinae*, *Ochthornis littoralis*, *Rupicola rupicola*, *Atticora* spp., *Henicorhina leucosticta*, and *Granatellus pelzelni*.

We propose that the exceptional species richness of western relative to central Amazonia is actually a function of habitat heterogeneity. Ted Parker and J. Haffer (unpubl. data) noted remarkable constancy in *terra firme* species richness at a variety of Amazonian sites. Habitats such as bamboo (Parker et al. 1997; Kratter 1997), *campina* (Oren 1981), Amazonian savanna (Silva et al. 1997) and various river-created environments (Remsen and Parker 1983; Rosenberg 1990) are known to have specialized fauna associated with them and to contribute to species richness. Increased habitat heterogeneity at the periphery of the Amazon basin is probably a natural consequence of the geography of the region, where increased relief and erosion create a more dynamic and fine-grained environment. By contrast, the enormous size of the lower reaches of the basin's rivers and the relatively flat terrain necessarily create large expanses of single habitat types. Furthermore, broad rivers probably limit potential for mixing of forest species, making species distributional limits more clearly defined in central Amazonia.

Factors such as rainfall and primary productivity, which have been shown to correlate with patterns of species richness (e.g., Haffer 1990; reviewed by Rosenzweig and Abramsky 1993), are probably not causally related to richness in birds across Amazonia, but may be merely coincidentally related due to unique aspects of Amazonian geography. The mountains enclosing the basin to the north, west and south are responsible for higher rainfall in the west due to orographic effects and prevailing equatorial easterlies. High primary productivity is associated with high rainfall and richer montane soils. Within-habitat diversity, however, as exemplified by the above discussion of *terra firme* sites, may be independent of these factors. Rainfall probably only affects bird diversity insofar as it determines type of vegetation cover. On the other hand, absolute biomass or number of individuals on a site should be positively related to primary productivity. This says nothing about whether this biomass is distributed among many or few species. The relationship between biomass and species richness could be tested by comparing population densities of the same species between sites of differing productivity (e.g. Stouffer 1997).

CONCLUDING REMARKS

Discussions of regional distribution patterns and conservation decisions depend on accurate identification and taxonomy. Our reidentifications of common and familiar species after collecting should serve as a warning regarding sight records and an example of how much taxonomic work remains to be done in the Amazon. All lists based on sight records alone should be considered preliminary, awaiting specimen confirmation.

Most species probably have diagnostic vocalizations, and so tape recordings should serve someday soon as satisfactory documentation for nearly all species. However, the only way to sort out the relationship between forms and voice is with voucher specimens of recorded individuals. Until these correlations are better established, the only adequate documentation for some species is a specimen. The accumulation of well annotated recordings in sound libraries (such as LNS and ASN) provides a tremendously valuable resource akin to a tissue collection.

ACKNOWLEDGMENTS

This paper is dedicated to the memory of Ted Parker, who we wish were here to read it and set us straight.

We received generous financial and incomparable logistical support from the Biological Dynamics of Forest Fragments Project (BDFFP) in Manaus and from its parent organizations, the Smithsonian Institution and the Instituto Nacional de Pesquisas da Amazônia (INPA); this paper is number 160 in the BDFFP technical series. We also received support or assistance from Louisiana State University's Museum of Natural Science and Board of Regents (to MCH), Field Guides, Inc. (to MCH), and Victor Emanuel Nature Tours (to AW). MCH gratefully acknowledges the Instituto Brasileiro do Meio Ambiente (IBAMA) for collecting permits. Don Kroodsm

and the Cornell Laboratory of Ornithology's Library of Natural Sounds (LNS) both made long-term loans of field recording equipment, which provided our biggest window to understanding Amazonian birds, but which we inevitably ended up destroying; to them we extend our sheepish gratitude. LNS also provided use of recordings in its care and Canary software. Museum work was graciously facilitated by the curatorial staffs of the Louisiana State University Museum of Natural Science, American Museum of Natural History, Natural History Museum of Vienna, and Museu Paraense Emílio Goeldi; J. M. C. Silva provided data for specimens we were unable to examine. This study benefited immeasurably from the help of our field companions and the many field assistants of the BDFFP, especially S. Borges, R. Downer, V. Emanuel, A. Martins, K. Rosenberg, J. Smith, T. Towles, B. Whitney, S. Wilson, K. Zimmer, and particularly J. Pierson, who insistently questioned the earlier identifications of *Hemitriccus* and *Campylorhamphus*. Doug Stotz was extraordinarily generous with his help at every stage of this project, especially in reviewing numerous drafts of the manuscript and in answering our desperate pleas for information over the years. John Bates, R. Mesquita, T. Schulenberg, and V. Remsen offered useful criticism of the manuscript. Bruce Nelson provided the satellite image. Finally, we thank Rob Bierregaard for introducing us to Amazonian Brazil, for sharing his knowledge and data, and for encouraging our continued work there.

LITERATURE CITED

- AMERICAN ORNITHOLOGISTS' UNION. 1983. Check-list of North American Birds, 6th ed. Am. Ornithol. Union, Washington, D.C.
- AMERICAN ORNITHOLOGISTS' UNION. 1995. Fortieth supplement to the American Ornithologists' Union *Check-list of North American Birds*. Auk 112:819–830.
- ANDERSON, A. B. 1981. White-sand vegetation of Brazilian Amazonia. *Biotropica* 13:199–210.
- BIERREGAARD, R. O., JR. 1982. Levantamentos ornitológicos no dossel da mata pluvial de *terra firme*. *Acta Amazonica* 12:107–111.
- BIERREGAARD, R. O., JR. 1984. Observations on the nesting biology of the Guiana Crested Eagle (*Morphnus guianensis*). *Wilson Bull.* 96:1–5.
- BIERREGAARD, R. O., JR. 1988. Morphological data from understory birds in *terra firme* forest in the central Amazonian basin. *Rev. Bras. Biol.* 48:169–178.
- BIERREGAARD, R. O., JR. 1990a. Avian communities in the understory of Amazonian forest fragments. Pp. 333–343 in *Biography and Ecology of Forest Bird Communities* (A. Keast and J. Kikkawa, Eds.). SPB Academic, The Hague.
- BIERREGAARD, R. O., JR. 1990b. Species composition and trophic organization of the understory bird community in a central Amazonian *terra firme* forest. Pp. 217–236 in *Four Neotropical Rainforests* (A. H. Gentry, Ed.). Yale Univ., New Haven, Connecticut.
- BIERREGAARD, R. O., JR., M. COHN-HAFT, AND D. F. STOTZ. 1997. Cryptic biodiversity: An overlooked species and new subspecies of antbird (Aves: Formicariidae) with a revision of *Cercomacra tyrannina* in northeastern South America. Pp. 111–128 in *Studies in Neotropical Ornithology Honoring Ted Parker* (J. V. Remsen, Jr., Ed.), Ornithol. Monogr. No. 48.
- BIERREGAARD, R. O., JR., AND T. E. LOVEJOY. 1988. Birds in Amazonian forest fragments: Effects of insularization. Pp. 1564–1579 in *Acta XIX Congressus Internationalis Ornithologici* (H. Ouellet, Ed.). Ottawa, Ontario, 1986. National Museum of Natural Science, Ottawa.
- BIERREGAARD, R. O., JR., AND T. E. LOVEJOY. 1989. Effects of forest fragmentation on Amazonian understory bird communities. *Acta Amazonica* 19:215–241.
- BIERREGAARD, R. O., JR., D. F. STOTZ, L. H. HARPER, AND G. V. N. POWELL. 1987. Observations on the occurrence and behaviour of the Crimson Fruitcrow *Haematoderus militaris* in central Amazonia. *Bull. Brit. Ornithol. Club* 107:134–137.
- BIERREGAARD, R. O., JR., AND P. C. STOFFER. 1997. Understory birds and dynamic habitat mosaics in Amazonian rainforests. Pp. 138–155 in *Tropical Forest Remnants: Ecology, Management, and Conservation of Fragmented Communities* (W. F. Laurance and R. O. Bierregaard, Jr., Eds.). Univ. of Chicago, Chicago, Illinois.
- BLAKE, E. R. 1977. *Manual of Neotropical birds*. Vol. 1. Univ. of Chicago, Chicago, Illinois.
- BORGES, S. H. 1995. Comunidade de aves em dois tipos de vegetação secundária da Amazônia central. M. S. thesis, Instituto Nacional de Pesquisas da Amazônia and Universidade Federal do Amazonas, Manaus, Brazil.
- COHN-HAFT, M. 1993. Rediscovery of the White-winged Potoo (*Nyctibius leucopterus*). *Auk* 110:391–394.
- COHN-HAFT, M. 1995. Dietary specialization by lowland tropical rainforest birds: Forest interior versus canopy and edge habitats. M.S. thesis, Tulane Univ., New Orleans, Louisiana.
- COHN-HAFT, M. 1996. Why the Yungas Tody-Tyrant (*Hemitriccus spodiops*) is a *Sneathlaga*, and why it matters. *Auk* 113:709–714.
- CRACRAFT, J. 1985. Historical biogeography and patterns of differentiation within the South American avifauna: Areas of endemism. Pp. 49–84 in *Neotropical Ornithology* (P. A. Buckley, M. S. Foster, E. S. Morton, R. S. Ridgely, and F. G. Buckley, Eds.). Ornithol. Monogr. No. 36.

- GENTRY, A. H., AND L. H. EMMONS. 1987. Geographical variation in fertility and composition of the understory of Neotropical forests. *Biotropica* 19:216–227.
- GYLDENSTOLPE, N. 1930. Notes on ant wrens allied to *Myrmotherula surinamensis* Gmelin, together with the descriptions of two new forms. *Arkiv för Zoologi* 21A(26):1–38.
- HAFER, J. 1969. Speciation in Amazonian forest birds. *Science* 165:131–137.
- HAFER, J. 1990. Avian species richness in tropical South America. *Studies on Neotropical Fauna and Environment* 25:157–183.
- HARPER, L. H. 1987. The conservation of ant-following birds in small Amazonian forest fragments. Ph. D. dissertation, State Univ. of New York, Albany, New York.
- HARPER, L. H. 1989. The persistence of ant-following birds in small Amazonian forest fragments. *Acta Amazônica* 19:249–263.
- HAVERSCHMIDT, F. 1968. Birds of Surinam. Oliver and Boyd, Edinburgh.
- HELLMAYR, C. E. 1925. Catalogue of Birds of the Americas and the Adjacent Islands. Part 4, Furnariidae-Dendrocolaptidae. *Field Mus. Nat. Hist. Publ.* 234, Zool. Ser., vol. 13.
- HELLMAYR, C. E. 1927. Catalogue of Birds of the Americas and the Adjacent Islands. Part 5, Tyrannidae. *Field Mus. Nat. Hist. Publ.* 242, Zool. Ser., vol. 13.
- HELLMAYR, C. E., AND B. CONOVER. 1942. Catalogue of Birds of the Americas and the Adjacent Islands. Part 1, no. 1. *Field Mus. Nat. Hist. Publ.* 514, Zool. Ser., vol. 13.
- HILTY, S. L., AND W. L. BROWN. 1986. A Guide to the Birds of Colombia. Princeton Univ., Princeton, New Jersey.
- KARR, J. R. 1981. Surveying birds with mist nets. Pp. 62–67 in *Estimating Numbers of Terrestrial Birds* (C. J. Ralph and J. M. Scott, Eds.). *Stud. Avian Biol.* 6.
- KARR, J. R., S. K. ROBINSON, J. G. BLAKE, AND R. O. BIERREGAARD, JR. 1990. Birds of four Neotropical forests. Pp. 237–269 in *Four Neotropical Rainforests* (A. H. Gentry, Ed.). Yale Univ., New Haven, Connecticut.
- KLEIN, B. C., AND R. O. BIERREGAARD. 1988a. Movement and calling behavior of the Lined Forest-Falcon (*Micrastur gilvicolis*) in the Brazilian Amazon. *Condor* 90:497–499.
- KLEIN, B. C., AND R. O. BIERREGAARD. 1988b. Capture and telemetry techniques for the Lined Forest-Falcon (*Micrastur gilvicolis*). *J. Raptor Res.* 22:29.
- KLEIN, B. C., L. H. HARPER, R. O. BIERREGAARD, AND G. V. N. POWELL. 1988. The nesting and feeding behavior of the Ornate Hawk-Eagle near Manaus, Brazil. *Condor* 90:239–241.
- KRATTER, A. W. 1997. Bamboo specialization by Amazonian birds. *Biotropica* 29:100–110.
- LEVEY, D. J. 1988. Spatial and temporal variation in Costa Rican fruit and fruit-eating bird abundance. *Ecol. Monogr.* 58:251–269.
- LOVEJOY, T. E. 1985. Minimum size for birds [sic] species and avian habitats. Pp. 324–327 in *Acta XVIII Congressus Internationalis Ornithologici* (V. D. Ilyichev, and V. M. Gavrilov, Eds.). Nauka, Moscow.
- LOVEJOY, T. E., AND R. O. BIERREGAARD, JR. 1990. Central Amazonian forests and the Minimum Critical Size of Ecosystems Project. Pp. 60–71 in *Four Neotropical Rainforests* (A. H. Gentry, Ed.). Yale Univ., New Haven, Connecticut.
- MESQUITA, R. C. G. 1989. A biologia reprodutiva de *Clusia grandiflora* Split.: Variação individual e remoção de sementes. M.S. thesis, Instituto Nacional de Pesquisas da Amazônia and Universidade Federal do Amazonas, Manaus, Brazil.
- MEYER DE SCHAUENSEE, R. 1970. A Guide to the Birds of South America. Livingston, Wynnewood, Pennsylvania.
- MINISTÉRIO DE MINAS E ENERGIA (MME). 1978. Projeto Radam Brasil, Folha SA 20 Manaus. Departamento Nacional de Produção Mineral, Rio de Janeiro.
- MORONY, J. J., JR., W. J. BOCK, AND J. FARRAND, JR. 1975. Reference List of the Birds of the World. *Am. Mus. Nat. Hist.*, New York.
- NELSON, B. W., C. A. C. FERREIRA, M. F. SILVA, AND M. L. KAWASAKI. 1990. Endemism centres, refugia and botanical collection density in Brazilian Amazonia. *Nature* 345:714–716.
- OREN, D. C. 1981. Zoogeographic analysis of the white sand campina avifauna of Amazonia. Ph.D. dissertation, Harvard Univ., Cambridge, Massachusetts.
- OREN, D. C., AND H. G. ALBUQUERQUE. 1991. Priority areas for new avian collections in Brazilian Amazonia. *Goeldiana Zool.* 6.
- PARKER, T. A., III, P. K. DONAHUE, AND T. S. SCHULENBERG. 1994. Birds of the Tambopata Reserve (Explorer's Inn Reserve). Pp. 106–124 in *The Tambopata-Candamo Reserved Zone of Southeastern Perú: A Biological Assessment* (R. B. Foster, T. A. Parker III, A. H. Gentry, L. H. Emmons, A. Chicchón, T. Schulenberg, L. Rodríguez, G. Lamas, H. Ortega, J. Icochea, W. Wust, M. Romo, J. A. Castillo, O. Phillips, C. Reynal, A. Kratter, P. K. Donahue, and L. J. Barkley, Eds.). Rapid Assessment Program Working Papers No. 6. Conservation International, Washington, D.C.
- PARKER, T. A., III, R. B. FOSTER, L. H. EMMONS, P. FREED, A. B. FORSYTH, B. HOFFMAN, AND B. D. GILL. 1993. A Biological Assessment of the Kanuku Mountain Region of Southwestern Guyana. Rapid Assessment Program Working Papers No. 5. Conservation International, Washington, D.C.
- PARKER, T. A., III, D. F. STOTZ, AND J. W. FITZPATRICK. 1997. Notes on avian bamboo specialists in southwestern Amazonian Brazil. Pp. 543–547 in *Studies in Neotropical Ornithology Honoring Ted Parker* (J. V. Remsen, Jr., Ed.), *Ornithol. Monogr.* No. 48.

- PERES, C. A., AND A. WHITTAKER. 1991. Annotated checklist of the bird species of the upper Rio Urucu, Amazonas, Brazil. *Bull. Brit. Ornithol. Club* 111:156–171.
- PETERS, J. L., JR. 1951. Check-List of Birds of the World. Vol. 7. *Mus. Comp. Zool.*, Cambridge, Massachusetts.
- PINTO, O. M. O. 1978. *Novo Catálogo das Aves do Brasil*. 1ª Parte. Editora Gráfica dos Tribunais, São Paulo.
- POWELL, G. V. N. 1989. On the possible contribution of mixed species flocks to species richness in Neotropical avifaunas. *Behav. Ecol. Sociobiol.* 24:387–393.
- PRUM, R. O. 1990. Phylogenetic analysis of the evolution of display behavior in the Neotropical manakins (Aves: Pipridae). *Ethology* 84:202–231.
- QUINTELA, C. E. 1987. First report of the nest and young of the Variegated Antpitta (*Grallaria varia*). *Wilson Bull.* 99:499–500.
- QUINTELA-ALMEIDA, C. E. 1985. Forest fragmentation and differential use of natural and man-made edges by understory birds in central Amazonia. M. S. thesis, Univ. of Illinois, Chicago, Illinois.
- REMSEN, J. V., JR. 1994. Use and misuse of bird lists in community ecology and conservation. *Auk* 111: 225–227.
- REMSEN, J. V., JR., AND D. A. GOOD. 1996. Misuse of data from mist-net captures to assess relative abundance in bird populations. *Auk* 113:381–398.
- REMSEN, J. V., JR., AND T. A. PARKER III. 1983. Contribution of river-created habitats to bird species richness in Amazonia. *Biotropica* 15:223–231.
- RIDGELY, R. S., AND G. TUDOR. 1989. *The Birds of South America*. Vol. 1, The Oscine Passerines. Univ. of Texas, Austin, Texas.
- RIDGELY, R. S., AND G. TUDOR. 1994. *The Birds of South America*. Vol. 2, The Suboscine Passerines. Univ. of Texas, Austin, Texas.
- ROSENBERG, G. H. 1990. Habitat specialization and foraging behavior by birds of Amazonian river islands in northeastern Peru. *Condor* 92:427–443.
- ROSENZWEIG, M. L., AND Z. ABRAMSKY. 1993. How are diversity and productivity related? Pp. 52–65 in *Species Diversity in Ecological Communities* (R. E. Ricklefs and D. Schluter, Eds.). Univ. of Chicago, Chicago, Illinois.
- SCHWARTZ, P. 1975. Solved and unsolved problems in the *Sporophila lineola bouvronides* complex. *Ann. Carnegie Mus.* 45:277–285.
- SIBLEY, C. G., AND B. L. MONROE, JR. 1990. *Distribution and Taxonomy of Birds of the World*. Yale Univ., New Haven, Connecticut.
- SILVA, J. M. C. DA, D. C. OREN, J. C. ROMA, AND L. M. P. HENRIQUES. 1997. Composition and distribution patterns of the avifauna of an Amazonian upland savanna, Amapá, Brazil. Pp. 743–762 in *Studies in Neotropical Ornithology Honoring Ted Parker* (J. V. Remsen, Jr., Ed.), *Ornithol. Monogr.* No. 48.
- SILVA, J. M. C. DA, AND E. O. WILLIS. 1986. Notas sobre a distribuição de aves da Amazônia brasileira. *Bol. Mus. Parense Emílio Goeldi (Ser. Zool.)* 2:151–158.
- SNETHLAGE, E. 1907. Neue Vogelarten aus Südamerika. *Ornithologische Monatsberichte* 15:193–196.
- STOTZ, D. F. 1990. Corrections and additions to the Brazilian avifauna. *Condor* 92:1078–1079.
- STOTZ, D. F., AND R. O. BIERREGAARD JR. 1989. The birds of the fazendas Porto Alegre, Esteio and Dimona north of Manaus, Amazonas, Brazil. *Rev. Brasil. Biol.* 49:861–872.
- STOTZ, D. F., R. O. BIERREGAARD, M. COHN-HAFT, P. PETERMANN, J. SMITH, A. WHITTAKER, AND S. V. WILSON. 1992. The status of North American migrants in central Amazonian Brazil. *Condor* 94:608–621.
- STOTZ, D. F., S. M. LANYON, T. S. SCHULENBERG, D. E. WILLARD, A. T. PETERSON, AND J. W. FITZPATRICK. 1997. An avifaunal survey of two tropical forest localities on the middle Rio Jiparana, Rondonia, Brazil. Pp. 763–781 in *Studies in Neotropical Ornithology Honoring Ted Parker* (J. V. Remsen, Jr., Ed.), *Ornithol. Monogr.* No. 48.
- STOUFFER, P. C. 1997. Interspecific aggression in *Formicarius* antthrushes? the view from central Amazonian Brazil. In press, *Auk*.
- STOUFFER, P. C., AND R. O. BIERREGAARD, JR. 1993. Spatial and temporal abundance patterns of Ruddy Quail-Doves (*Geotrygon montana*) near Manaus, Brazil. *Condor* 95:896–903.
- STOUFFER, P. C., AND R. O. BIERREGAARD, JR. 1995a. Use of Amazonian forest fragments by understory insectivorous birds. *Ecology* 76:2429–2445.
- STOUFFER, P. C., AND R. O. BIERREGAARD, JR. 1995b. Effects of forest fragmentation on understory hummingbirds in Amazonian Brazil. *Conservation Biol.* 9:1086–1095.
- TAMPLIN, J. W., J. W. DEMASTES, AND J. V. REMSEN, JR. 1993. Biochemical and morphometric relationships among some members of the Cardinalinae. *Wilson Bull.* 105:93–113.
- TERBORGH, J. W., J. W. FITZPATRICK, AND L. EMMONS. 1984. Annotated checklist of bird and mammal species of Cocha Cashu Biological Station, Manu National Park, Peru. *Fieldiana (Zoology)* 21:1–29.
- TERBORGH, J., S. K. ROBINSON, T. A. PARKER III, C. A. MUNN, AND N. PIERPONT. 1990. Structure and organization of an Amazonian forest bird community. *Ecol. Monogr.* 60:213–238.
- TOSTAIN, O., J. L. DUJARDIN, C. H. ERARD, AND J. M. THIOLLAY. 1992. *Oiseaux de Guyane*. Societe d'Etudes Ornithologiques. Maxéville, France.
- TRAYLOR, M. A., JR (ED.). 1979. Check-list of Birds of the World, vol. 8. *Mus. Comp. Zool.*, Cambridge, Massachusetts.

- VIELLIARD, J. 1989. Uma nova espécie de *Glaucidium* (Aves, Strigidae) da Amazônia. *Rev. Bras. Zool.* 6: 685–693.
- WHITTAKER, A. 1993. Notes on the behaviour of the Crimson Fruitcrow *Haematoderus militaris* near Manaus, Brazil, with the first nesting record for the species. *Bull. Brit. Ornithol. Club* 113:93–96.
- WHITTAKER, A. 1995. Range extensions and nesting of the Glossy-backed Becard *Pachyramphus surinamus* in central Amazonian Brazil. *Bull. Brit. Ornithol. Club* 113:93–96.
- WHITTAKER, A. 1996. First records of the Orange-breasted Falcon *Falco deiroleucus* in central Amazonian Brazil, with short behavioral notes. *Cotinga* 6:65–68.
- WILLIS, E. O. 1977. Lista preliminar das aves da parte noroeste e áreas vizinhas da Reserva Ducke, Amazonas, Brasil. *Rev. Bras. Biol.* 37:585–601.
- WILLIS, E. O., AND Y. ONIKI. 1988. Aves observadas em Balbina, Amazonas e os prováveis efeitos da barragem. *Ciência e Cultura* 40:280–284.
- ZIMMER, J. T. 1934. Studies of Peruvian birds. No. 13. The genera *Dendrexetastes*, *Campyloramphus*, and *Dendrocincla*. *Amer. Mus. Novitates* 728:1–20.
- ZIMMER, J. T. 1940. Studies of Peruvian birds. No. 34. The genera *Todirostrum*, *Euscarthmornis*, *Snethlagea*, *Poecilotriccus*, *Lophotriccus*, *Myiornis*, *Pseudotriccus*, and *Hemitriccus*. *Amer. Mus. Novitates* 1066:1–23.

APPENDIX
LIST OF SPECIES OBSERVED IN STUDY AREA FROM 1979–1994

Family (or major subfamily)	Abundance/ seasonality	Habitat	Position/ microhabitat	Sociality	Evidence
Tinamidae					
<i>Tinamus major</i> (D)	c	1	t	s	2t
<i>Crypturellus soui</i> (D)	u	2, 1	t	s	4h
<i>Crypturellus brevirostris</i> (D)	u	1	t	s	4s (2t) ^a
<i>Crypturellus variegatus</i> (D)	c	1	t	s	2pt
Podicipedidae					
<i>Podiceps dominicus</i>	c	w	w	s	2t
Anhingidae					
<i>Anhinga anhinga</i>	x	p	o	s	4s
Ardeidae					
<i>Tigrisoma lineatum</i>	r	l, w	eit	s	4sh
<i>Ardea cocoi</i>	r	w	t	s	4s
<i>Ardea alba</i> ^b	r	w	t	s	4s
<i>Bubulcus ibis</i>	x	p, w, l	to	m	4s
<i>Butorides striatus</i>	x	l	e	s	4s
<i>Piherodias pileatus</i>	x	w	t	s	4s
<i>Nycticorax nycticorax</i>	x	l	o	s	2t
<i>Cochlearius cochlearius</i>	x	l	i	s	2p
Ciconiidae					
<i>Mycteria americana</i> (D)	x	p	o	s	4s
Threskiornithidae					
<i>Mesembrinibis cayennensis</i>	x	l	o	s	4h
Anatidae					
<i>Oxyura dominica</i>	r	w	w	s	4s
Cathartidae					
<i>Coragyps atratus</i> (D)	u	p	oct	sm	4s
<i>Cathartes aura</i> (D)	u	p, 2	oct	sm	4s
<i>Cathartes melambrotus</i> (D)	c	l, p	oct	sm	2p
<i>Sarcoramphus papa</i> (D)	u	l, p	oct	sm	2p
Accipitridae					
<i>Pandion haliaetus</i> (D)	xb	w	c	s	4s
<i>Leptodon cayanensis</i>	x	l	o	s	4s
<i>Chondrohierax uncinatus</i>	x	l	o	s	4s
<i>Elanoides forficatus</i> (D)	um?	1, 2	oc	sm	2pt
<i>Gampsonyx swainsonii</i>	r	p	c	s	4s
<i>Harpagus bidentatus</i> (D)	u	l	om	s	4s
<i>Ictinia plumbea</i> (D)	um?	1, 2	oc	sm	4s
<i>Accipiter superciliosus</i> (D)	r	l	c	s	4s
<i>Accipiter bicolor</i> (D)	r	l	mu	s	4s
T <i>Accipiter poliogaster</i>	x	l	c	s	4s
<i>Leucopternis melanops</i> (D)	r	l	c	s	3
<i>Leucopternis albicollis</i> (D)	c	1, 2	coe	s	2pt
<i>Buteogallus urubitinga</i> (D)	u	1, 2	coe	s	2pt
<i>Heterospizias meridionalis</i>	u	p	c	s	4s
<i>Buteo nitidus</i> (D)	c	2, p	ec	s	2t
<i>Buteo magnirostris</i> (D)	u	p, 2	ec	s	4sh
<i>Buteo platypterus</i> (D)	ub	2, 1	ec	s	4s
<i>Buteo brachyurus</i>	u	2, p	oc	s	2t
<i>Buteo albicaudatus</i>	r	p	oc	s	4s
<i>Morphnus guianensis</i>	r	l	cm	s	2p
<i>Harpia harpyja</i> (D)	r	l	c	s	2pt
<i>Spizastur melanoleucus</i>	x	1, p	oce	s	2p
<i>Spizaetus tyrannus</i> (D)	x	1, 2	oc	s	4sh
<i>Spizaetus ornatus</i> (D)	u	l	oc	s	2pt

APPENDIX

CONTINUED

Family (or major subfamily)	Abundance/ seasonality	Habitat	Position/ microhabitat	Sociality	Evidence
Falconidae					
<i>Daptrius ater</i>	r	1	o	sm	2t
<i>Daptrius americanus</i> (D)	c	1	c	ms	2t
<i>Polyborus plancus</i>	r	p	ct	s	2t
<i>Milyago chimachima</i>	u	p	ct	s	2t
<i>Micrastur ruficollis</i> (D)	c	1, 2	mu	s	2pt
<i>Micrastur gilvicollis</i> (D)	c	1	mu	s	1
<i>Micrastur mirandollei</i> (D)	u	1, 2	m?	s	2t
<i>Micrastur semitorquatus</i> (D)	u	1, 2	sm	s	2t
<i>Falco rufigularis</i> (D)	c	1, p	co	s	2pt
Cracidae					
<i>Ortalis motmot</i> (D)	c	2	e	ms	2t
<i>Penelope marail</i> (D)	c	1	c	sf	2t
<i>Penelope jacquacu</i> (D)	u	1	cte	sf	2t
<i>Pipile cumanensis</i> ^c	x	1	c	s	4s
<i>Crax alector</i> (D)	u	1	te	sm	2pt
Odontophoridae^d					
<i>Odontophorus gujanensis</i> (D)	u	1, 2	t	sm	2pt
Psophiidae					
<i>Psophia crepitans</i> (D)	u	1	tm	m	2pt
Rallidae					
<i>Laterallus melanophaius</i>	x	w	t	s	4s
<i>Laterallus viridis</i> (D)	u	p	t	s	2t
<i>Aramides cajanea</i>	r	1, 2	it	s	2t
Heliornithidae					
<i>Heliornis fulica</i>	x	w	w	s	2t
Eurypygidae					
<i>Eurypyga helias</i>	x	1	it	s	2t
Charadriidae					
<i>Pluvialis dominica</i>	rb	w	t	sm	4s
<i>Charadrius collaris</i>	x	w, p	t	s	4s
Jacanidae					
<i>Jacana jacana</i>	c	w	t	s	2t
Scolopacidae					
<i>Tringa melanoleuca</i>	ub	w	t	sm	4s
<i>Tringa flavipes</i>	rb	w	t	sm	4s
<i>Tringa solitaria</i> (D)	ub	w	t	sm	4s
<i>Actitis macularia</i>	ub	w	t	s	4s
<i>Calidris minutilla</i>	xb	w	t	sm	4s
<i>Calidris fuscicollis</i>	ub	w	t	sm	2pt
<i>Calidris melanotos</i>	rb	w	t	sm	2p
<i>Micropalama himantopus</i>	xb	w	t	sm	4s
<i>Gallinago gallinago</i>	x	w, 1	te	s	2p
Columbidae					
<i>Columba plumbea</i> (D)	c	1	c	sf	1
<i>Columba subvinacea</i> (D)	c	1, 2	c	sf	2t
<i>Columbina passerina</i> (D)	u	2, p	t	sm	2p
<i>Columbina talpacoti</i> (D)	u	2, p	t	s	4sh
<i>Leptotila verreauxi</i> (D)	c	2, p	t	s	4sh
<i>Geotrygon montana</i> (D)	cm	1	t	s	2pt
Psittacidae					
<i>Ara ararauna</i> (D)	c	1	co	ms	2t
<i>Ara macao</i> (D)	r	1	co	ms	2p

APPENDIX
CONTINUED

Family (or major subfamily)	Abundance/ seasonality	Habitat	Position/ microhabitat	Sociality	Evidence
<i>Ara chloroptera</i> (D)	c	1, p	co	ms	2pt
<i>Ara manilata</i>	u	p, 1	c	m	4sh
<i>Aratinga leucophthalmus</i>	x	1	o	m	4sh
<i>Forpus</i> sp. ^o	x	1, 2	ce	m	4s
<i>Brotogeris chrysopterus</i> (D)	c	1	co	m	2t
<i>Touit purpurata</i> (D)	u	1	c	m	2t
<i>Pionites melanocephala</i>	x	1	e	m	4s
<i>Piohopsitta caica</i> (D)	u	1	c	m	2t
<i>Pionus menstruus</i> (D)	cm	1	co	ms	2t
<i>Pionus fuscus</i> (D)	um	1	co	ms	2t
<i>Amazona autumnalis</i> (D)	cm	1	co	ms	2t
<i>Amazona farinosa</i> (D)	cm	1	co	ms	2t
<i>Deroptryus accipitrinus</i> (D)	c	1	c	m	2t
Cuculidae					
<i>Coccyzus eulerei</i>	ra	1	c	sc	2tp
<i>Coccyzus melacoryphus</i>	xa	2	e	s	4s
<i>Piaya cayana</i> (D)	u	2	ce	s	4sh
<i>Piaya melanogaster</i> (D)	c	1	c	cs	2pt
<i>Crotophaga major</i>	x	1	e	m	4s
<i>Crotophaga ani</i> (D)	c	p, 2	et	m	2pt
<i>Dromococcyx pavoninus</i>	x	1	u	s	2t
Tytonidae					
<i>Tyto alba</i>	r	2, p	e	s	4sh
Strigidae					
<i>Otus watsonii</i> (D)	c	1, 2	m	s	1
<i>Lophostrix cristata</i> (D)	c	1	m	s	2t
<i>Pulsatrix perspicillata</i> (D)	c	1	c	s	2t
<i>Glaucidium hardyi</i> ^f (D)	c	1, 2	c	s	1
<i>Athene cucularia</i>	x	p	t	s	4s
<i>Ciccaba virgata</i>	r	2, 1	c	s	2p
<i>Ciccaba huhula</i>	u	1, 2	cm	s	2t
Caprimulgidae					
<i>Lurocalis semitorquatus</i> (D)	u	1	oe	s	1
<i>Chordeiles acutipennis</i>	x	p	ot	s	4sh
<i>Chordeiles minor</i>	rb	1, p	o	m	4s
<i>Nyctidromus albicollis</i> (D)	c	2, 1	et	s	2t
<i>Caprimulgus nigrescens</i> (D)	u	1, 2	et	s	1
Nyctibiidae					
<i>Nyctibius grandis</i> (D)	r	2, 1	c	s	4h
<i>Nyctibius aethereus</i>	r	1, 2	me	s	2tp
<i>Nyctibius griseus</i> (D)	u	2, 1	ce	s	2t
<i>Nyctibius leucopterus</i> (D)	u	1	c	s	1
<i>Nyctibius bracteatus</i>	u	1	mu	s	1
Apodidae					
<i>Streptoprocne zonaris</i>	rm	1, p	o	sm	4s
<i>Chaetura spinicauda</i> (D)	c	1, w, p	o	m	2t
<i>Chaetura chapmani</i> (D)	c	1, w	o	m	1
<i>Chaetura brachyura</i> (D)	u	2, w, p	o	m	1
<i>Panyptila cayannensis</i> (D)	r	1	o	s	4s
<i>Tachornis squamata</i> ^s (D)	r	p	o	m	1
Trochilidae					
<i>Phaethornis superciliosus</i> (D)	c	1, 2	ue	sl	2pt
<i>Phaethornis bourcierii</i> (D)	c	1, 2	u	sl	2pt
<i>Phaethornis ruber</i> (D)	r	2	ue	s	2p
<i>Campylopterus largipennis</i> (D)	c	1, 2	ce	s	2pt

APPENDIX

CONTINUED

Family (or major subfamily)	Abundance/ seasonality	Habitat	Position/ microhabitat	Sociality	Evidence
<i>Florisuga mellivora</i> (D)	u	1, 2	c	f	2p
<i>Anthracothonax nigricollis</i> (D)	r	1	cei	s	4s
T <i>Avocettula recurvirostris</i>	x	1	c	f	4s
T <i>Chrysolampis mosquitos</i>	x	1	c	f	4s
<i>Discosura longicauda</i> (D)	r	1, 2	ce	f	4s
<i>Thalurania furcata</i> (D)	c	1, 2	umc	sf	2pt
<i>Hylocharis sapphirina</i>	u	1, 2	c	f	3
<i>Polytmus theresiae</i> (D)	x	p	c	s	4s
<i>Amazilia versicolor</i> (D)	r	2	ce	s	4s
<i>Amazilia fimbriata</i>	x	1	ce	s	4s
<i>Topaza pella</i> (D)	r	1, 2, w	cei	sl	1
<i>Heliothryx aurita</i> (D)	c	1, 2	cme	sf	2p
Trogonidae					
<i>Trogon melanurus</i> (D)	c	1	c	sc	2pt
<i>Trogon viridis</i> (D)	c	1, 2	cem	s	2t
<i>Trogon rufus</i> (D)	u	1	u	s	2pt
<i>Trogon violaceus</i> (D)	c	1	ce	sc	2t
<i>Pharomachrus pavoninus</i> (D)	x	1	mc	s	4sh
Momotidae					
<i>Momotus momota</i> (D)	c	1	mui	s	2pt
Alcedinidae					
<i>Ceryle torquata</i> (D)	r	w	c	s	4sh
<i>Chloroceryle amazona</i> (D)	x	w	c	s	4s
<i>Chloroceryle americana</i> (D)	x	1	ie	s	2t
<i>Chloroceryle inda</i> (D)	r	1	i	s	2p
<i>Chloroceryle aenea</i> (D)	r	1	i	s	2p
Bucconidae					
<i>Notharchus macrorhynchus</i> (D)	c	1	c	s	2pt
<i>Notharchus tectus</i> (D)	u	1, 2	ce	s	1
<i>Bucco tamatia</i> (D)	u	1, 2	cm	s	1
<i>Bucco capensis</i> (D)	r	1	mu	s	2pt
<i>Malacoptila fusca</i> (D)	u	1	u	s	1
<i>Nonnula rubecula</i> (D)	r	1	m	s	2p
<i>Monasa atra</i> (D)	c	1, 2	ec	m	1
<i>Chelidoptera tenebrosa</i> (D)	r	p, 2	c	sm	4s
Galbulidae					
<i>Galbula albirostris</i> (D)	c	1, 2	ue	s	1
<i>Galbula leucogastra</i> (D)	r	c, 2, 1	ce	s	2t
<i>Galbula dea</i> (D)	c	1, 2	ce	cs	1
<i>Jacamerops aurea</i> (D)	u	1	m	s	2pt
Capitonidae					
<i>Capito niger</i> (D)	c	1	c	c	2pt
Ramphastidae					
<i>Pteroglossus viridis</i> (D)	c	1, 2	c	mf	1
<i>Selenidera culik</i> (D)	c	1	c	sf	2pt
<i>Ramphastos vitellinus</i> (D)	c	1	c	sf	2pt
<i>Ramphastos tucanus</i> (D)	c	1	c	sf	2t
Picidae					
<i>Picumnus exilis</i> (D)	r	1, 2	ce	sc	2p
<i>Melanerpes cruentatus</i> (D)	c	2, 1	c	mf	2t
<i>Veniliornis cassini</i> (D)	c	1	ce	c	1
<i>Piculus flavigula</i> (D)	c	1	cm	uc	2t
<i>Piculus chrysochloros</i> (D)	x	1	ci	s	4s
<i>Celeus undatus</i> (D)	r	2, 1	c	sf	2pt
<i>Celeus grammicus</i>	c	1	ce	sf	2t

APPENDIX
CONTINUED

Family (or major subfamily)	Abundance/ seasonality	Habitat	Position/ microhabitat	Sociality	Evidence
<i>Celeus elegans</i> (D)	u	1	cm	s	2t
<i>Celeus flavus</i> (D)	x	1	ci	s	4h
<i>Celeus torquatus</i> (D)	u	1	c	s	2t
<i>Dryocopus lineatus</i> (D)	c	2, 1, p	ce	s	2t
<i>Campephilus rubricollis</i> ^b (D)	c	1	cm	s	2pt
Dendrocolaptidae					
<i>Dendrocincla fuliginosa</i> (D)	c	1, 2	u	sua	2pt
<i>Dendrocincla merula</i> (D)	c	1	u	a	1
<i>Deconychura longicauda</i> (D)	c	1	um	uc	1
<i>Deconychura stictolaema</i> (D)	c	1	u	u	1
<i>Sittasomus griseicapillus</i> (D)	c	1, 2	cem	cus	1
<i>Glyphorhynchus spirurus</i> (D)	c	1, 2	mue	us	1
<i>Dendrexetastes rufigula</i> (D)	u	1	ce	s	1
<i>Hylexetastes perrotii</i> (D)	u	1	m	sa	2pt
<i>Dendrocolaptes certhia</i> (D)	c	1	m	as	2pt
<i>Dendrocolaptes picumnus</i> (D)	u	1	m	a	2t
<i>Xiphorhynchus pardalotus</i> (D)	c	1	mu	u	1
<i>Lepidocolaptes albolineatus</i> (D)	c	1	c	c	1
<i>Campylorhamphus procurvoides</i> (D)	u	1	m	u	1
Furnariidae					
<i>Synallaxis rutilans</i>	u	1	u	s	2pt
<i>Philydor erythrocerus</i> (D)	c	1	m	u	2pt
<i>Philydor pyrrhodes</i> (D)	u	1	ic	s	1
<i>Automolus infuscatus</i> (D)	c	1	u	u	1
<i>Automolus rubiginosus</i>	u	1, 2	ue	s	2pt
<i>Automolus ochrolaemus</i> (D)	c	2, 1	eu	su	1
<i>Xenops milleri</i> (D)	c	1	c	c	2p
<i>Xenops minutus</i> (D)	c	1	m	u	1
<i>Sclerurus mexicanus</i>	u	1	t	s	2p
<i>Sclerurus rufigularis</i> (D)	c	1	t	s	1
<i>Sclerurus caudacutus</i> (D)	r	1	t	s	2pt
Formicariidae					
<i>Cymbilaimus lineatus</i> (D)	c	2, 1	me	s	2t
<i>Frederickena viridis</i> (D)	r	1, 2	u	s	1
<i>Thamnophilus murinus</i> (D)	c	1, 2	me	su	1
<i>Thamnophilus punctatus</i> (D)	u	2, c	m	s	2pt
<i>Thamnomanes ardesiacus</i> (D)	c	1	u	u	2pt
<i>Thamnomanes caesius</i> (D)	c	1	um	u	2pt
<i>Myrmotherula brachyura</i> (D)	c	1, 2	ce	c	1
<i>Myrmotherula guttata</i> (D)	u	1	u	su	1
<i>Myrmotherula gutturalis</i> (D)	c	1	u	u	1
<i>Myrmotherula axillaris</i> (D)	u	1, 2	em	us	1
<i>Myrmotherula longipennis</i> (D)	c	1	um	u	1
<i>Myrmotherula menetriesii</i> (D)	c	1	mu	u	1
<i>Herpsilochmus dorsimaculatus</i> (D)	c	1	c	c	1
<i>Terenura spodioptila</i> (D)	c	1	c	c	2t
<i>Cercomacra cinerascens</i> (D)	c	1	ce	s	2t
<i>Cercomacra tyrannina</i> (D)	r	2	e	s	2t
<i>Hypocnemis cantator</i> (D)	c	1, 2	eu	s	1
<i>Sclateria naevia</i>	x	1	it	s	2p
<i>Percnostola rufifrons</i> (D)	c	1, 2	ue	sa	1
<i>Schistocichla leucostigma</i> ⁱ (D)	u	1	it	s	1
<i>Myrmeciza ferruginea</i> (D)	c	1	te	s	1
<i>Myrmeciza atrothorax</i> (D)	u	2, 1	iet	s	2pt
<i>Pithys albifrons</i> (D)	c	1	u	a	2pt
<i>Gymnopithys rufigula</i> (D)	c	1	u	a	1
<i>Hylophylax naevia</i>	r	1, 2	u	s	2pt
<i>Hylophylax poecilnota</i> (D)	c	1	u	sa	1

APPENDIX

CONTINUED

Family (or major subfamily)	Abundance/ seasonality	Habitat	Position/ microhabitat	Sociality	Evidence
<i>Formicarius colma</i> (D)	c	1	t	s	1
<i>Formicarius analis</i> (D)	c	1	t	s	2pt
<i>Myrmornis torquata</i> (D)	u	1	tu	s	1
<i>Grallaria varia</i> (D)	c	1	t	s	2pt
<i>Hylopezus macularius</i> (D)	u	1	t	s	2pt
<i>Myrmothera companiona</i> (D)	c	1, 2	te	s	2t
Conopophagidae					
<i>Conopophaga aurita</i> (D)	u	1	u	s	2pt
Tyrannidae					
<i>Phyllomyias griseiceps</i> (D)	x	2	ce	c	4s
<i>Zimmerius gracilipes</i> (D)	c	1, 2	c	c	2t
<i>Ornithion inermis</i>	u	1	c	sc	2t
<i>Camptostoma obsoletum</i>	x	2	ce	s	2t
<i>Phaeomyias murina</i> (D)	r	2	e	s	2t
<i>Tyrannulus elatus</i> (D)	c	1, 2	ce	sc	2t
<i>Myiopagis gaimardii</i> (D)	c	1	c	c	2t
<i>Myiopagis caniceps</i> (D)	c	1	c	c	1
<i>Elaenia parvirostris</i> (D)	ra	2	e	s	4s
<i>Elaenia chiriquensis</i>	xm	2, p	c	s	1
<i>Mionectes macconnelli</i> (D)	c	1, 2	umec	lf	1
<i>Phylloscartes virescens</i> (D)	c	1	c	c	1
<i>Corythopsis torquata</i> (D)	u	1	t	s	2pt
<i>Myiornis ecaudatus</i> (D)	u	1, 2	me	s	2t
<i>Lophotriccus vitiosus</i> (D)	c	1, 2	me	s	1
<i>Lophotriccus galeatus</i> (D)	r	2	e	s	2t
<i>Hemitriccus zosterops</i> (D)	c	1, 2	m	s	1
<i>Todirostrum pictum</i> ^l (D)	c	1, 2	c	s	1
<i>Ramphotrigon ruficauda</i> (D)	r	1	m	s	2pt
<i>Rhynchocycclus olivaceus</i> (D)	u	1	m	u	2pt
<i>Tolmomyias assimilis</i> (D)	c	1	c	c	1
<i>Tolmomyias poliocephalus</i> (D)	c	1, 2	ce	sc	1
<i>Platyrinchus saturatus</i> (D)	u	1	u	s	1
<i>Platyrinchus coronatus</i>	c	1	um	sl	1
<i>Platyrinchus platyrhynchos</i> (D)	u	1	m	s	1
<i>Onychorhynchus coronatus</i> (D)	u	1	u	su	2pt
<i>Terenotriccus erythrurus</i> (D)	c	1, 2	me	su	1
<i>Myiobius barbatus</i> (D)	c	1	m	u	1
<i>Contopus borealis</i> (D)	rb	2, 1	ce	s	4s
<i>Contopus virens</i> (D)	rb	2, 1	ce	s	4sh
<i>Pyrocephalus rubinus</i> (D)	xa	2	ce	s	4s
<i>Atila spadiceus</i> (D)	c	1	c	s	2pt
<i>Rhytipterna simplex</i> (D)	c	1, 2	c	sc	2pt
<i>Laniocera hypopyrra</i> (D)	c	1	m	sl	1
<i>Sirystes sibilator</i> (D)	c	1	c	sc	1
<i>Myiarchus tuberculifer</i> (D)	u	2, 1	e	s	2t
<i>Myiarchus ferox</i> (D)	u	2	e	s	2t
<i>Pitangus sulphuratus</i> (D)	r	2, p	ec	s	4sh
<i>Myiozetetes cayanensis</i> (D)	c	2, p	ec	s	1
<i>Myiozetetes luteiventris</i> ^k	x	2	ec	s	4s
<i>Conopias parva</i> ^l (D)	c	1	c	cm	2t
<i>Myiodynastes maculatus</i> (D)	ra?	2, p	c	sc	4s
<i>Legatus leucophaius</i> (D)	u	2, 1	c	s	4sh
<i>Empidonomus varius</i> (D)	um?	2	e	s	4s
<i>Empidonomus aurocrystatus</i> (D)	ra	1	c	s	4s
<i>Tyrannopsis sulphurea</i> (D)	u	1	ci	s	2t
<i>Tyrannus melancholicus</i> (D)	cm	2, p	e	sm	2t
<i>Tyrannus savana</i> (D)	ua?	2, p	ec	sm	4s
<i>Tyrannus tyrannus</i>	xb	p	c	s	4s
<i>Pachyramphus rufus</i> (D)	x	2	e	s	2t

APPENDIX

CONTINUED

Family (or major subfamily)	Abundance/ seasonality	Habitat	Position/ microhabitat	Sociality	Evidence
<i>Pachyramphus marginatus</i> (D)	c	1	m	c	2t
<i>Pachyramphus surinamus</i> (D)	c	1	c	sc	2t
<i>Pachyramphus minor</i> (D)	u	1	cm	c	2pt
<i>Tityra cayana</i> (D)	c	1, 2	ce	c	2t
Pipridae					
<i>Schiffornis turdinus</i> (D)	c	1, 2	u	s	2pt
<i>Piprites chloris</i> (D)	c	1	c	c	1
<i>Neopipo cinnamomea</i>	x	1, 2	m	s	2p
<i>Tyrannetes virescens</i> (D)	c	1	mc	lf	1
<i>Neopelma chrysocephalum</i> (D)	u	c	m	l	2t
<i>Manacus manacus</i> (D)	x	2	u	l	3
<i>Corapipo gutturalis</i> (D)	c	1	uc	lf	2pt
<i>Pipra pipra</i> (D)	c	1	uc	lf	1
<i>Pipra serena</i> (D)	c	1	u	l	1
<i>Pipra erythrocephala</i> (D)	c	1, 2	mc	lf	2pt
Cotingidae					
<i>Phoenicircus carnifex</i> (D)	u	1	m	sl	2pt
<i>Iodopleura fusca</i>	xm?	1	ce	s	4s
<i>Lipaugus vociferans</i> (D)	c	1	m	lsc	2pt
<i>Cotinga cotinga</i>	x	1	c	f	4s
<i>Cotinga cayana</i> (D)	u	1	c	sf	4s
<i>Xipholena punicea</i> (D)	c	1	c	sfl	1
<i>Haematoderus militaris</i> (D)	u	1, 2	ce	s	2t
<i>Perissocephalus tricolor</i> (D)	u	1	cm	ls	2t
Hirundinidae					
<i>Progne tapera</i>	xa	p	o	m	4s
<i>Progne subis</i> (D)	rb	1, p	o	m	4s
<i>Progne chalybea</i> (D)	u	p, 2	oc	m	4sh
<i>Neochelidon tibialis</i> (D)	u	2, 1	eo	m	2t
<i>Stelgidopteryx ruficollis</i> (D)	u	2, p	e	m	4sh
<i>Riparia riparia</i>	xb	p	o	m	4s
<i>Hirundo rustica</i> (D)	ub	p	o	m	3
Troglodytidae					
<i>Thryothorus coraya</i> (D)	c	2, 1	eu	s	1
<i>Thryothorus leucotis</i>	x	2	e	s	4sh
<i>Troglodytes aedon</i> (D)	c	p, 2	u	s	2pt
<i>Microcerculus bamba</i> (D)	c	1	ut	s	1
<i>Cyphorhinus arada</i> (D)	u	1	tu	sm	2pt
Muscicapidae (Turdinae)					
<i>Catharus fuscescens</i> (D)	rb	1, 2	met	s	2p
<i>Catharus minimus</i> (D)	rb	1	mt	s	2p
<i>Turdus albicollis</i> (D)	c	1	mt	s	1
(Poliophtilinae)					
<i>Microbates collaris</i> (D)	c	1	ue	su	1
<i>Ramphocaenus melanurus</i>	c	1	ce	c	1
<i>Poliophtila guianensis</i> (D)	u	1	c	c	1
Vireonidae					
<i>Cyclarhis gujanensis</i> (D)	c	2, 1	ce	s	2pt
<i>Vireolanius leucotis</i> (D)	c	1	c	c	2pt
<i>Vireo olivaceus</i> ^m (D)	ub	1, 2	c	c	2p
<i>Vireo altiloquus</i>	rb	1	ce	fc	4s
<i>Hylophilus thoracicus</i>	r	1	c	cs	2t
<i>Hylophilus semicinereus</i>	x	2	me	s	4sh
<i>Hylophilus muscicapinus</i> (D)	c	1	c	c	1
<i>Hylophilus ochraceiceps</i> (D)	c	1	um	u	1

APPENDIX
CONTINUED

Family (or major subfamily)	Abundance/ seasonality	Habitat	Position/ microhabitat	Sociality	Evidence
Emberizidae (Emberizinae)					
<i>Ammodramus aurifrons</i> (D)	c	p, 2	t	s	2pt
<i>Volatinia jacarina</i> (D)	c	p, 2	te	s	2t
<i>Sporophila bouvronides</i> ^a	xm	p	et	sm	4s
<i>Sporophila lineola</i>	xm	p	et	sm	4s
<i>Sporophila castaneiventris</i> (D)	c	p	tc	s	2t
<i>Oryzoborus angolensis</i> (D)	u	2, p	ect	s	2pt
<i>Arremon taciturnis</i> (D)	r	1	te	s	2pt
(Cardinalinae)					
<i>Caryothraustes canadensis</i> (D)	c	1, 2	c	mc	2t
<i>Saltator grossus</i> ^o (D)	c	1, 2	c	cs	2t
<i>Saltator maximus</i> (D)	x	2	ce	sf	2t
<i>Cyanocompsa cyanooides</i> ^p (D)	c	1, 2	e	s	2pt
(Thraupinae)					
<i>Lamprospiza melanoleuca</i> (D)	c	1	c	mc	2t
<i>Hemithraupis flavicollis</i> (D)	c	1	c	cf	1
<i>Lanio fulvus</i> (D)	u	1	m	c	2tp
<i>Tachyphonus cristatus</i> (D)	c	1	c	cf	2pt
<i>Tachyphonus surinamus</i> (D)	c	1, 2	uemc	mc	1
T <i>Tachyphonus phoenicius</i>	x	1	c	s	4s
<i>Piranga rubra</i> (D)	xb	2	e	s	4s
<i>Ramphocelus carbo</i> (D)	c	2, p	e	ms	2pt
<i>Thraupis episcopus</i> (D)	c	2, p	ec	sm	2p
<i>Thraupis palmarum</i> (D)	c	2, 1	ec	mc	3
<i>Cyanicterus cyanicterus</i>	r	1	c	c	2t
<i>Euphonia plumbea</i>	x	1, 2	c	c	4s
<i>Euphonia chrysopasta</i> (D)	u	1, 2	c	cs	2t
<i>Euphonia chlorotica</i> (D)	x	2	ce	s	4h
<i>Euphonia minuta</i> (D)	u	1, 2	c	f	2t
<i>Euphonia cayennensis</i> (D)	c	1	c	fs	2t
<i>Tangara mexicana</i> (D)	r	2, 1	c	mfc	4sh
<i>Tangara chilensis</i> (D)	c	1	c	mfc	1
<i>Tangara punctata</i> (D)	c	1, 2	c	cf	2t
<i>Tangara varia</i> (D)	r	1	c	cf	1
<i>Tangara gyrola</i>	r	1	c	c	4sh
<i>Tangara velia</i> (D)	c	1	c	mfc	2t
<i>Dacnis lineata</i> (D)	c	1	c	fc	4sh
<i>Dacnis cayana</i> (D)	c	1	c	fc	1
<i>Chlorophanes spiza</i> (D)	c	1, 2	c	fc	2pt
<i>Cyanerpes nitidus</i> (D)	u	1	c	fc	4sh
<i>Cyanerpes caeruleus</i> (D)	c	1	c	mfc	4sh
<i>Cyanerpes cyaneus</i> (D)	c	1, 2	c	fc	4sh
<i>Tersina viridis</i>	xm	1	c	m	4sh
(Parulinae)^a					
<i>Dendroica petechia</i>	xb	1	c	c	4s
<i>Dendroica fusca</i>	xb	2	c	c	4s
<i>Dendroica striata</i> (D)	rb	2	c	c	4s
<i>Phaeothlypis rivularis</i> (D)	u	2, 1	tie	s	2t
<i>Conirostrum speciosum</i>	x	2, 1	c	c	4s
<i>Coereba flaveola</i> (D)	c	1, 2	ce	fc	2t
(Icterinae)					
<i>Psarocolius viridis</i> (D)	c	1	c	mf	2t
<i>Cacicus haemorrhous</i> (D)	u	1, 2	ce	mf	2t
<i>Icterus cayanensis</i>	r	1, 2	ce	sf	4s
<i>Icterus chryscephalus</i> (D)	u	1, 2	ce	sf	2t
<i>Sturnella militaris</i> (D)	c	p	t	s	2t
<i>Molothrus bonariensis</i> (D)	u	p, 2	ec	sm	4s
<i>Scaphidura oryzivora</i> (D)	u	p, 2, 1	coe	msf	4sh

APPENDIX
CONTINUED

-
- ^a Tape recording of voice believed to be this species; see text.
^b Called *Casmerodius alba* by Stotz and Bierregaard (1989); see AOU (1995).
^c Sometimes called *Aburria* (= *Pipile*) *pipile*; we follow Sibley and Monroe (1990).
^d Treated as subfamily of Phasianidae by Stotz and Bierregaard (1989); we follow Sibley and Monroe (1990).
^e See text, "Reidentifications."
^f Called *G. minutissimum* by Stotz and Bierregaard (1989); recently split (Vielliard 1989).
^g Called *Reinarda squamata* by Stotz and Bierregaard (1989).
^h Called *Phloeocastes rubricollis* by Stotz and Bierregaard (1989).
ⁱ Called *Pernostola leucostigma* by Stotz and Bierregaard (1989); see Ridgely and Tudor (1994).
^j Treated as subspecies of *T. chrysocrotaphum* by Stotz and Bierregaard (1989).
^k Sometimes placed in genus *Tyrannopsis*; see Ridgely and Tudor (1994).
^l Treated as subspecies of *Coryphociccus albobittatus* by Stotz and Bierregaard (1989).
^m Includes both migratory and resident forms (discussed in Stotz et al. 1992).
ⁿ Sometimes considered a subspecies of *S. lineola* (see Schwartz 1975).
^o Called *Pitylus grossus* by Stotz and Bierregaard (1989); see Tamplin et al. (1993), AOU (1995).
^p Sometimes placed in genus *Passerina*; we follow AOU (1983).
^q Including *Conirostrum* and *Coereba* (as in Morony et al. 1975).
-

Status codes (see Methods for further explanation).

Abundance (in preferred habitat): c—common, u—uncommon, r—rare, x—casual; followed by code for seasonality (if not year-round resident): a—austral migrant, b—boreal migrant, m—unspecified movements.

Habitat (more than one listed in order of decreasing preference): 1—primary *terra firme* forest, 2—secondary forest, p—pasture, w—open water (pond), c—*campinarana*.

Position/microhabitat (more than one listed in order of decreasing preference): t—terrestrial, u—understory, m—midstory, c—canopy, e—edge or treefall gap, i—small woodland stream (*igarapé*), o—overhead airspace, w—water surface.

Sociality: u—accompanies understory mixed-species flocks, c—accompanies canopy mixed-species flocks, m—in monospecific flocks, s—solitary or in pairs, f—in mixed-species assemblages at fruiting or flowering trees but not flocking, a—army-ant follower, l—lekking.

Evidence (number represents quality of evidence in descending order, only highest-quality evidence available listed): 1—specimen; 2 followed by t—tape recording, by p—photograph; 3—mist net capture record; 4 followed by s—sighting, by h—heard.

"(D)" following species—noted at Reserva Ducke by Willis (1977), Stotz and Bierregaard (1989), or by us (unpubl.)

"T" preceding species—registered at ZF-2 tower only.