

# NOTES ON THE ECOLOGY OF THE AVIFAUNA OF CHORÉ, DEPARTMENT OF SAN PEDRO, PARAGUAY

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**ABSTRACT.**- We studied and compared the bird faunas of forest, cleared and marsh habitats at Choré, Department of San Pedro, Paraguay. Data on flock sizes, relative abundance and habitat use are summarized for 141 species of birds. Forest habitats were more species rich and unique than cleared or marsh habitats. The proportion of species belonging to foraging guilds varied between the different habitats. Gregarious species (mostly frugivores and carnivores) usually occurred in clearings and marshes, and were relatively more abundant than non-gregarious species. Forest birds occurred singly or in pairs, but often joined interspecific foraging flocks. The proportion of birds in relative abundance categories did not vary between different habitats or foraging guilds.

**RESUMEN.**- Notas sobre la Ecología de la Avifauna de Choré, Departamento de San Pedro, Paraguay.

Se estudiaron y compararon las avifaunas de bosques, capueras y esteros de Choré, Departamento de San Pedro, Paraguay. Datos sobre tamaños de bandadas, abundancia relativa y usos de hábitat fueron obtenidos a partir de 141 especies de aves. Los bosques presentaron la más rica variedad de especies comparando con las capueras o los esteros. La proporción de especies dentro de cuatro grupos de forrajeo varió entre los diferentes hábitats. Las especies gregarias (la mayoría fueron frugívoras y carnívoras) se encuentran generalmente en capueras y esteros, y relativamente fueron más abundantes que las especies no gregarias. Las aves de bosques se presentaron solitarias o en parejas, pero a menudo formando bandadas interespecíficas de forrajeo. La proporción de aves en categorías de abundancia relativa no varió entre los diferentes hábitats ni grupos de forrajeo.

In Paraguay where uncontrolled deforestation occurs at an alarming rate (see IIDMA et al. 1985:23, 130-131), many forest bird communities are being destroyed along with their habitat and replaced by bird communities characteristic of more open habitats. In spite of this, the relationships between bird faunas of forested and cleared habitats in Paraguay remain unknown. Previous studies of the avifauna of Paraguay have focused primarily on distribution and taxonomy (see bibliography in Paynter and Caperton 1977); relatively few studies on local avifaunas exist (e.g., Escobar and Salomón 1983, Contreras and Mandelburger 1985, López 1985, 1986, undated, Peris et al. 1987, Contreras and Gonzalez Romero 1988, Gonzalez Romero et al. 1988), and of these, the only study that examines the general ecology of a local avifauna is the one of Peris et al. (1987) in the Department of Presidente Hayes. In this paper we compare the feeding behavior, social systems and relative abundance of the bird faunas occurring in different habitats at Choré, Department of San Pedro, Paraguay.

## STUDY AREA

Choré is located in the Paraguay River subwatershed of eastern Paraguay at 24° 10' S, 56° 35' W. Annual temperatures at Choré average about 22.5 C, annual precipitation

averages about 1500 mm, and annual potential evapotranspiration averages about 1200 mm (IIDMA et al. 1985). According to the Thornthwaite humidity and moisture indices, the climate is humid and the soils moist (IIDMA et al. 1985).

Choré is primarily an agricultural community where the secondary forests (up to 15 m in height) have been extensively cleared, although a few relatively large tracts remain intact. The land is hilly, gently transected by small streams bordered by extensive grassy marshes, and was originally covered with deciduous subtropical forest. A study on the vegetation of Choré will be published elsewhere (Lidia Pérez de Molas, pers. comm.).

The avifauna of the Department of San Pedro is poorly known. Specimens previously collected from the department are reported by Grant (1911), Bertoni (1925), Brodkorb (1938, 1939), Laubmann (1939a, b), and Pinto (1944). No study on a local avifauna within the department exists, and no specimens were previously collected at Choré.

### METHODS

We observed and collected birds in the vicinity of Choré for 24 days in 1987 during 9-12 March, 13-17 July, 1-5 August, 14-17 September, and 29 September to 4 October. Collected birds are deposited in the Museo Nacional de Historia Natural del Paraguay (MNHNP) in San Lorenzo. Birds were identified by using the guides of Meyer de Schauensee (1970), Dunning (1983), and Narosky and Yzurieta (1987), and cassettes of Frisch (1961, 1962, 1982) and Straneck (undated). For each identified bird we recorded the habitat in which it was observed. Habitats were simply defined as forests (> 50% ground cover by trees > 2.5 m high), clearings (< 50% ground cover by trees > 2.5 m high), and marshes (same criteria as clearings, but with a wet substrate). Roughly equal amounts of time were spent observing birds in each habitat.

To compare the feeding habits of bird faunas in each habitat, each bird species was assigned to one of four foraging guilds: frugivore (diets of fruit, seeds or nectar); insectivore (invertebrate prey); carnivore (both invertebrate and vertebrate prey); and omnivore (both plant and animal food). Data on the feeding habits of these birds were based on observations at Choré and elsewhere, stomach contents of specimens in the MNHNP, and published sources (Meyer de Schauensee and Phelps 1978, Capurro and Bucher 1986, Foster 1987).

To compare the social behavior of bird faunas in each habitat, we recorded both interspecific and intraspecific flock sizes. For interspecific (mixed species) flocks, we recorded the composition of each flock and the forest level (understory, midstory or canopy) at which each species occurred.

The relative abundance of each bird was determined as follows: abundant, more than 10 observed daily in appropriate habitat; common, observed daily in small numbers in appropriate habitat; uncommon, observed in small numbers at least twice, but not daily; and rare, observed only once. These ordinal categories were ranked to facilitate statistical comparisons between different habitats, foraging guilds and social systems.

Statistical tests utilized in analyzing the results included both one-sample and two-sample chi-square tests ( $\chi^2$ ), Jaccard coefficients of similarity (Jc), Kruskal-Wallis test (H), rank sum tests (T) and Spearman rank correlation coefficients (rs; Siegel 1956, Southerwood 1971). All tests, except for one-sample chi-square test and Jaccard coefficients of similarity, were computed with *Statistix* software (Heimsey and Nimis, 1985). All normally-approximated probabilities are two-tailed, with  $\alpha = 0.05$ .

### RESULTS

We observed 141 species of birds representing 39 families, and collected 24 specimens of 17 species (Appendix 1). In comparison with Paraguay's avifauna, waterbirds were

APPENDIX 1. Foraging guilds, relative abundance, habitats and birds of Choré. Taxonomy based on Meyer de Schauensee (1970).

Species	Foraging Guild <sup>1</sup>	Relative Abundance <sup>2</sup>	Habitats <sup>3</sup>			Flock Sizes <sup>4</sup> x̄ (n), range
			F	C	M	
<b>TINAMIDAE</b>						
<i>Crypturellus obsoletus</i>	O	U	X	-	-	--
<i>Crypturellus tataupa</i>	O	C	x	X	-	1.0 (6), 1
<b>ARDEIDAE</b>						
<i>Butorides striatus</i>	C	U	-	-	X	--
<i>Bubulcus ibis</i>	C	A	-	X	x	2.8 (21), 1-9
<i>*Nycticorax nycticorax</i>	C	R	-	X	-	--
<b>CATHARTIDAE</b>						
<i>Coragyps atratus</i>	C	C	x	X	x	2.1 (8), 1-4
<i>Cathartes aura</i>	C	R	-	X	x	--
<i>Cathartes burrovianus</i>	C	U	x	x	X	--
<b>ACCIPITRIDAE</b>						
<i>Elanus leucurus</i>	C	R	-	-	X	--
<i>Elanoides forficatus</i>	C	R	-	X	-	--
<i>Leptodon cayanensis</i>	C	U	x	x	X	--
<i>Ictinia mississippiensis</i>	C	R	x	X	x	--
<i>Ictinia plumbea</i>	C	U	X	x	-	--
<i>Rostrhamus sociabilis</i>	C	U	-	-	X	--
<i>Buteo magnirostris</i>	C	U	x	X	x	--
<i>Buteogallus urubitinga</i>	C	R	-	X	-	--
<i>Circus buffoni</i>	C	R	-	x	X	--
<b>FALCONIDAE</b>						
<i>Milvago chimachima</i>	C	U	-	-	X	--
<i>Polyborus plancus</i>	C	U	x	-	X	--
<i>Falco sparverius</i>	C	C	-	X	-	1.4 (10), 1-2
<b>CRACIDAE</b>						
<i>Penelope superciliaris</i>	O	R	X	-	-	--
<b>PHASIANIDAE</b>						
<i>*Odontophorus capueira</i>	O	U	X	-	-	--
<b>RALLIDAE</b>						
<i>Aramides cajanea</i>	C	R	-	-	X	--
<b>CHARADRIIDAE</b>						
<i>Vanellus chilensis</i>	C	C	-	X	x	1.8 (5), 1-3
<b>COLUMBIDAE</b>						
<i>Columba livia</i>	F	U	-	X	-	--
<i>Columba picazuro</i>	F	A	x	X	x	1.4 (30), 1-4
<i>Zenaida auriculata</i>	F	R	-	X	-	--
<i>Columbina talpacoti</i>	F	R	-	X	-	--
<i>Columbina picui</i>	F	C	-	X	-	1.8 (5), 1-3
<i>Scardafella squammata</i>	F	R	-	X	-	--
<i>Leptotila verreauxi</i>	F	U	x	X	-	--
<b>PSITTACIDAE</b>						
<i>Aratinga leucophthalmus</i>	F	U	X	-	-	--
<i>Nandayus nenday</i>	F	R	-	X	-	--
<i>**Pyrhura frontalis</i>	F	A	X	x	-	3.0 (10), 1-7

Species	Foraging Guild <sup>1</sup>	Relative Abundance <sup>2</sup>	Habitats <sup>3</sup>			Flock Sizes <sup>4</sup> x (n), range
			F	C	M	
<i>Forpus xanthopterygius</i>	F	U	-	X	-	--
<i>Brotogeris versicolurus</i>	F	A	x	X	x	2.5 (13), 1-5
<i>Pionus maximiliani</i>	F	U	X	-	-	--
* <i>Amazona aestiva</i>	F	U	X	-	-	--
CUCULIDAE						
<i>Piaya cayana</i>	C	C	X	-	-	1.3 (7), 1-2
<i>Crotophaga ani</i>	I	A	-	X	x	7.3 (20), 1-15
<i>Guira guira</i>	C	C	-	X	-	4.0 (9), 1-14
* <i>Tapera naevia</i>	C	R	-	X	-	--
TYTONIDAE						
* <i>Tyto alba</i>	C	R	-	X	-	--
STRIGIDAE						
<i>Otus choliba</i>	I	C	X	x	-	1.0 (9), 1
* <i>Glaucidium brasilianum</i>	I	R	X	-	-	--
<i>Speotyto cunicularia</i>	C	U	-	X	-	--
* <i>Strix hylophila</i>	C	R	X	-	-	--
NYCTIBIIDAE						
* <i>Nyctibius aethereus</i>	I	U	X	-	-	--
CAPRIMULGIDAE						
<i>Lurocalis semitorquatus</i>	I	U	X	-	-	--
* <i>Nyctiphrynus ocellatus</i>	I	R	X	-	-	--
* <i>Caprimulgus rufus</i>	I	C	X	x	-	1.0 (7), 1
APODIDAE						
<i>Chaetura sp.</i>	I	R	-	X	-	--
TROCHILIDAE						
<i>Phaethornis eurynome</i>	O	R	-	X	-	--
<i>Chlorostilbon aureoventris</i>	O	U	X	-	-	1.2 (5), 1-2
<i>Hylocharis chrysura</i>	O	R	X	-	-	--
MOMOTIDAE						
<i>Baryphthengus ruficapillus</i>	O	A	X	-	-	1.0 (22), 1-2
BUCCONIDAE						
<i>Notharchus macrorhynchus</i>	I	U	X	-	-	--
<i>Nonnula rubecula</i>	I	R	X	-	-	--
RAMPHASTIDAE						
<i>Pteroglossus castanotis</i>	O	R	X	-	-	--
<i>Ramphastos dicolorus</i>	O	U	x	X	x	--
PICIDAE						
<i>Picumnus cirratus</i>	I	C	X	-	-	1.0 (8), 1
<i>Colaptes campestris</i>	I	U	-	X	-	--
<i>Chrysoptilus melanochloros</i>	I	R	X	-	-	--
<i>Celeus flavescens</i>	I	R	X	-	-	--
<i>Dryocopus lineatus</i>	I	U	X	x	-	--
** <i>Melanerpes flavifrons</i>	I	U	X	-	-	--
<i>Leuconerpes candidus</i>	I	U	-	X	-	--
<i>Veniliornis passerinus</i>	I	U	X	-	x	1.0 (5), 1
<i>Phloeocastus robustus</i>	I	U	X	-	-	--
DENDROCOLAPTIDAE						
<i>Sittasomus griseicapillus</i>	I	U	X	-	-	1.1 (7), 1-2
<i>Xiphocolaptes albicollis</i>	I	U	X	-	-	1.3 (6), 1-2

Species	Foraging Guild <sup>1</sup>	Relative Abundance <sup>2</sup>	Habitats <sup>3</sup>			Flock Sizes <sup>4</sup> x (n), range
			F	C	M	
<i>Lepidocolaptes angustirostris</i>	I	R	-	X	-	--
<b>FURNARIIDAE</b>						
<b>**Furnarius rufus</b>	I	U	-	X	-	--
<i>Philydor lichtensteini</i>	I	C	X	-	-	1.8 (8), 1-2
<i>Automolus leucophthalmus</i>	I	U	X	-	-	--
<b>FORMICARIIDAE</b>						
<b>*Thamnophilus sp.</b>	I	U	X	-	-	--
<i>Dysithamnus mentalis</i>	I	U	X	-	-	--
<i>Herpsilochmus rufimarginatus</i>	I	C	X	-	-	1.4 (7), 1-2
<i>Chamaeza campanisona</i>	I	C	X	-	-	1.0 (8), 1
<b>COTINGIDAE</b>						
<i>Pachyramphus viridis</i>	O	U	X	-	-	1.4 (5), 1-2
<i>Platypsaris rufus</i>	O	U	X	-	-	--
<i>Tityra cayana</i>	F	R	X	-	-	--
<i>Tityra inquisitor</i>	F	U	X	x	-	1.4 (8), 1-2
<b>PIPRIDAE</b>						
<b>**Pipra fasciicauda</b>	O	U	X	-	-	--
<i>Chiroxiphia caudata</i>	O	R	X	-	-	--
<i>Piprites chloris</i>	O	R	X	-	-	--
<i>Schiffornis virescens</i>	O	U	X	-	-	--
<b>TYRANNIDAE</b>						
<i>Colonia colonus</i>	I	U	X	-	-	1.5 (6), 1-2
<i>Gubernetes yetapa</i>	I	U	-	x	X	--
<i>Pyrocephalus rubinus</i>	I	U	x	X	x	1.3 (6), 1-2
<i>Satrapa icterophrys</i>	I	U	-	X	x	--
<i>Machetornis rixosus</i>	I	U	-	X	x	--
<i>Sirystes sibilator</i>	I	U	X	-	-	--
<i>Muscivora tyrannus</i>	I	R	X	-	-	--
<i>Tyrannus melancholicus</i>	O	U	x	X	-	--
<i>Conopias trivirgata</i>	I	U	X	-	-	--
<i>Megarhynchus pitangua</i>	O	U	x	X	-	1.2 (5), 1-2
<i>Myiodynastes maculatus</i>	O	U	X	x	-	1.0 (6), 1
<i>Pitangus sulphuratus</i>	O	C	x	X	x	1.4 (9), 1-2
<b>**Myiarchus ferox</b>	I	U	X	-	-	--
<i>Myiarchus tyrannulus</i>	I	U	X	-	-	--
<i>Myiornis auricularis</i>	I	U	X	-	-	1.8 (8), 1-5
<i>Elaenia sp</i>	O	U	X	-	-	--
<i>Suiriri suiriri</i>	I	U	X	-	-	--
<b>HIRUNDINIDAE</b>						
<i>Progne tapera</i>	I	R	-	X	-	--
<i>Progne chalybea</i>	I	U	-	x	X	--
<b>CORVIDAE</b>						
<i>Cyanocorax cyanomelas</i>	O	U	x	X	-	--
<b>**Cyanocorax chrysops</b>	O	C	X	x	-	2.4 (11), 1-6
<b>TROGLODYTIDAE</b>						
<b>**Trogodytes aedon</b>	I	A	-	X	-	1.1 (15), 1-2
<b>MIMIDAE</b>						
<i>Mimus saturninus</i>	I	U	-	X	-	--
<i>Donacobius atricapillus</i>	I	U	-	-	X	--

Species	Foraging Guild <sup>1</sup>	Relative Abundance <sup>2</sup>	Habitats <sup>3</sup>			Flock Sizes <sup>4</sup> x (n), range
			F	C	M	
TURDIDAE						
<b>**Turdus rufiventris</b>	O	U	x	X	-	1.2 (5) , 1-2
<i>Turdus leucomelas</i>	O	C	x	X	-	1.6 (5) , 1-3
<i>Turdus amaurochalinus</i>	O	C	x	X	-	2.2 (5) , 1-3
<i>Turdus albicollis</i>	O	R	X	-	-	--
VIREONIDAE						
<i>Vireo olivaceus</i>	O	U	X	-	-	1.1 (9) , 1-2
ICTERIDAE						
<i>Molothrus bonariensis</i>	O	U	-	X	-	--
<i>Cacicus haemorrhous</i>	O	U	X	x	-	1.8 (6) , 1-3
<i>Gnorimopsar chopi</i>	O	A	-	X	-	4.8 (13), 2-11
<b>**Icterus cayanensis</b>	I	C	x	X	x	2.3 (9) , 1-9
<i>Pseudoleistes guirahuro</i>	O	U	-	X	x	--
PARULIDAE						
<i>Parula pitiayumi</i>	I	U	X	-	-	--
<b>**Geothlypis aequinoctialis</b>	I	U	x	-	X	--
<i>Basileuterus culicivorus</i>	I	C	X	-	-	1.5 (13) , 1-3
COEREBOIDAE						
<i>Conirostrum speciosum</i>	O	C	X	-	-	1.4 (11) , 1-2
<i>Dacnis cayana</i>	O	R	X	-	-	--
THRAUPIDAE						
<i>Euphonia chlorotica</i>	F	U	X	-	-	--
<b>**Euphonia violacea</b>	F	U	X	-	-	--
<i>Pipraeidea melanonota</i>	O	R	X	-	-	--
<b>**Tangara cayana</b>	O	R	X	-	-	--
<b>**Thraupis sayaca</b>	O	C	x	X	-	2.1 (8) , 1-5
<b>**Tachyphonus coronatus</b>	O	U	x	-	X	-
<i>Trichothraupis melanops</i>	O	C	X	-	-	1.7 (6) , 1-2
<i>Nemosia pileata</i>	I	U	X	-	-	--
<i>Hemithraupis guira</i>	O	C	X	--	-	2.0 (8) , 2
<i>Cissopis leveriana</i>	O	R	X	-	-	--
FRINGILLIDAE						
<i>Sporophila collaris</i>	F	R	-	-	X	--
<i>Sporophila caerulescens</i>	F	U	x	X	x	16.4 (5), 3-30
<b>**Oryzoborus angolensis</b>	F	U	X	-	-	--
<b>**Coryphospingus cucullatus</b>	O	U	x	X	-	2.4 (5) , 1-5
<i>Zonotrichia capensis</i>	O	U	-	X	-	--

\* Identified by voice only.

\*\* Specimen(s) collected.

<sup>1</sup> C = carnivorous; F = frugivorous; I = insectivorous; O = omnivorous (see methods for definitions).

<sup>2</sup> A = abundant; C = common; U = uncommon; R = rare (see methods for definitions).

<sup>3</sup> F = forests; C = clearings; M = marshes (see methods for definitions).

Large case X = preferred habitat; small case x = habitat where the species was less commonly observed.

<sup>4</sup> Only species with n > 4 are included.

poorly represented at Choré, whereas non-passerines (excluding waterbirds, raptors, scavengers and ground-dwelling birds) were proportionately numerous (Table 1).

TABLE 1. Percentage of birds occurring in Choré and Paraguay for each of five bird groups based on Short (1980)

Bird Groups <sup>1</sup>	Choré	Paraguay <sup>2</sup>
Waterbirds	35	16.5
Raptors and scavengers	14.2	10.8
Non-passerine ground birds	2.8	3.1
Other non-passerines	28.4	18.1
Passerines	51.1	51.5

<sup>1</sup>  $\chi^2 = 21.08$ ,  $df = 4$ ,  $P < 0.001$ .

<sup>2</sup> Data from Wendelken (1983).

More species occurred in forests (68.8%) than in clearings (48.2%) or marshes (23.4%;  $X^2 = 31.12$   $df = 2$ ,  $P < 0.001$ ), and more species occurred exclusively in forests (44.0%) than exclusively in clearings (19.1%) or marshes (5.0%;  $X^2 = 48.44$ ,  $df = 2$ ,  $P < 0.001$ ). Jaccard coefficients of similarity indicated that the differences were greater between avifaunas of forest and marsh habitats ( $J_c = 0.14$ ) than between forested and cleared habitats ( $J_c = 0.24$ ) and cleared and marsh habitats ( $J_c = 0.28$ ).

The proportion of species belonging to the four foraging guilds varied between the different habitats. Forest birds were primarily insectivorous or omnivorous, marsh birds were mostly insectivorous or carnivorous, and clearings were equally represented by the four foraging guilds (Table 2).

TABLE 2. Percentage of bird species in forest, clearing and marsh habitats for each of four foraging guilds. F = frugivores; I = insectivores; C = carnivores; and O = omnivores.

Habitat <sup>1</sup>	n	Foraging Guilds				$X^2$	df	P
		F	I	C	O			
Forest	97	13.4	39.2	8.2	39.2	31.86	3	0.001
Clearing	68	19.1	27.9	25.0	27.9	1.41	3	0.70
Marsh	33	12.1	30.3	45.5	12.1	10.27	3	0.001

<sup>1</sup>  $X^2 = 26.92$ ,  $df = 6$ ,  $P < 0.001$ .

Based on intraspecific flock sizes, gregarious species (average group size > 2) usually occurred in open areas (i.e., clearings and marshes), whereas birds occurring exclusively in forests occurred singly or in pairs (Table 3). Although no significant differences occurred in the proportion of gregarious and non-gregarious species belonging to different foraging guilds, frugivores and carnivores appear to form larger flocks than insectivores and omnivores based on mean flock size per species (Table 4).

TABLE 3. Number of bird species occurring in different intraspecific flock size categories compared between different habitats. Only species with  $n > 4$  are included (see Appendix 1).

Habitat <sup>1</sup>	Mean Flock Size		
	1.0-2.0	>2.0-4.0	>4.0
Forest only	17	0	0
Clearing only	3	1	1
Forest + clearing	9	5	0
Forest + marsh	1	0	0
Clearing + marsh	1	1	1
Forest + clearing + marsh	3	3	1

$$^1 X^2 = 18.14, df = 10, P = 0.05.$$

TABLE 4. Number of non-gregarious and gregarious (see text for definitions) species and mean flock size per species for each of four foraging guilds.

Foraging Guild	Number of Species <sup>1</sup>		Mean Flock Size per Species <sup>2</sup>
	Non-gregarious	Gregarious	
Frugivores	3	3	4.42
Insectivores	14	2	1.71
Carnivores	3	3	2.23
Omnivores	14	5	1.73

$$^1 X^2 = 4.85, df = 3, P = 0.05.$$

$$^2 H = 7.95, df = 3, P = 0.05.$$

At least 30 species of forest birds were found occurring in mixed species flocks of five or more species (Table 5). Of these, nine occurred regularly (< 25% of the time) in mixed flocks, and four species (*Philydor lichtensteini*, *Tityra inquisitor*, *Conirostrum speciosum* and *Hemithraupis guira*), representing four different families, formed the nucleus species (occurring > 50% of the time) of mixed flocks. Most mixed flock species were either



TABLE 5. Number of birds observed in each of eight interspecific flocks of forest birds at Chocé.

Species	Flocks								PO <sup>1</sup>	FL <sup>2</sup>
	1	2	3	4	5	6	7	8		
<i>Piaya cayana</i>	-	2	-	-	-	-	-	-	13	M,C
<i>Chlorostilbon aureoventris</i>	-	-	-	1	-	1	1	-	38	M
<i>Hylocharis chrysura</i>	-	-	1	-	-	-	-	-	13	U
<i>Picumnus cirratus</i>	-	1	-	1	1	-	-	-	38	U,M
<i>Veniliornis passerinus</i>	-	-	-	-	-	1	1	-	25	M,C
<i>Phloeoeastes robustus</i>	-	-	-	-	-	2	-	-	13	M
<i>Sittasomus griseicapillus</i>	-	1	-	-	-	-	-	-	13	M
<i>Xiphocolaptes albicollis</i>	-	-	2	-	-	-	-	-	13	M
<i>Philydor lichtensteini</i>	2	2	2	1	1	-	-	2	75	M
<i>Automolus leucophthalmus</i>	-	-	-	-	-	-	1	-	13	U
<i>Herpsilochmus rufimarginatus</i>	-	-	-	-	-	-	2	-	13	M
<i>Pachyramphus viridis</i>	-	-	-	2	-	1	-	2	38	C
<i>Platypsaris rufus</i>	-	-	1	-	-	-	-	-	13	C
<i>Tityra inquisitor</i>	-	2	-	1	2	-	1	1	63	C
<i>Colonia colonus</i>	-	-	-	1	-	-	-	2	25	C
<i>Sirystes sibilator</i>	-	-	-	-	1	-	1	-	25	C
<i>Conopias trivirgata</i>	-	2	-	-	-	-	-	2	25	C
<i>Megarhynchus pitangua</i>	-	-	2	-	-	-	-	-	13	C
<i>Myiornis auricularis</i>	5	-	-	-	-	-	-	1	25	M
<i>Turdus leucomelas</i>	-	-	1	-	-	-	-	-	13	M
<i>Vireo olivaceus</i>	-	-	-	2	-	1	1	1	50	M,C
<i>Cacicus haemorrhous</i>	-	-	-	-	-	1	-	1	25	C
<i>Icterus cayanensis</i>	-	-	-	1	-	-	-	-	13	C
<i>Parula pitayumi</i>	1	-	-	-	-	-	-	-	13	C
<i>Basileuterus culicivorus</i>	-	-	-	-	1	2	-	-	25	U,M
<i>Conirostrum speciosum</i>	2	1	-	1	1	1	-	2	75	C
<i>Pipraeidea melanonota</i>	-	1	-	-	-	-	-	-	13	M
<i>Trichothraupis melanops</i>	-	-	-	2	1	1	-	2	50	M
<i>Nemosia pileata</i>	-	-	2	-	-	-	-	2	25	C
<i>Hemithraupis guira</i>	2	2	-	2	-	2	-	2	63	C
Number of species	5	9	7	11	7	10	7	12		
Number of individuals	12	14	11	15	8	13	8	20		

<sup>1</sup> PO = Percent occurrence.

<sup>2</sup> FL = Forest level: U = understory; M = midstory; C = canopy.

insectivorous (53.3%) or omnivorous (40.0%), and occurred in the middle to upper stories of the forest (Table 5). Interspecific flock sizes averaged 8.5 species (range, 5-12) and 12.6 individuals (range, 8-20) per flock; the numbers of species and individuals occurring in each flock were positively correlated ( $r_s = 0.816$ ,  $P < 0.05$ ).

The proportion of birds in relative abundance categories did not vary between different habitats ( $H = 0.25$ ,  $df = 2$ ,  $P = 0.88$ ) or foraging guilds ( $H = 1.92$ ,  $df = 3$ ,  $P = 0.59$ ). Gregarious species ( $n = 13$ ) were relatively more abundant than non-gregarious species ( $n = 34$ ;  $T = 402.5$ ,  $P = 0.03$ ).

## DISCUSSION

The avifauna of Choré is probably typical of that in the Oriental region of Paraguay where wetlands are scarce and subtropical forests have been extensively cleared for agricultural use. Forests are clearly unique and the most species rich of the three habitats; if all forests were cleared at Choré, nearly half the bird fauna would perish, and probably more since many species characteristic of open habitats are at least partially dependent on forests for cover, nesting, etc.

The social systems of birds occurring in forested and open areas at Choré are different. Gregarious species usually occur in open areas, whereas birds occurring exclusively in forests occurred singly or in pairs, but often joined interspecific foraging flocks. That frugivores and carnivores were more likely to be gregarious than insectivores and omnivores is not surprising as the social behavior of birds is often correlated with food preferences and feeding behavior (see discussion by Krebs 1987). Frugivores are especially likely to occur in groups as the spatial dispersion of fruits is usually clumped; for example, a group of parrots is more likely to encounter a fruiting tree than a single parrot. The same is likely to be true of *Coragyps atratus*, which feeds on patchily distributed carrion. For carnivorous insectivorous birds such as *Bubulcus ibis*, *Crotophaga ani*, and *Guira guira*, group foraging in open areas is advantageous as prey are more easily flushed. In forests, where insect dispersion is more likely to be random, insectivores apparently defend specific feeding territories. Although insectivorous forest birds may enhance their foraging efficiency by joining mixed species flocks, Powell (1985) cites evidence that participants in mixed species flocks more likely benefit from reduced predation, due to increased surveillance.

The data on mixed species flocks should be viewed with caution as several species (e.g., *Chlorostilbon aureoventris*, *Hylocharis chrysura*, *Phloeocastus robustus* and *Colonia colonus*) are unlikely to occur in mixed species flocks, and probably occurred coincidentally in the same area. Nevertheless, the data do indicate which species occur most commonly in mixed species flocks, and at what forest level they occur. Also, the number of species and individuals occurring in mixed species flocks appears comparable to those in Central America and southern Brazil, but less than in Amazonia (Powell 1985). These data, although preliminary, provide the only information on mixed species flocks in the subtropical forests of Paraguay. Obviously a great deal remains to be learned about the community ecology of birds in Paraguay.

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