DIVERSITY AND GUILD STRUCTURE OF THE PETIT SAUT BIRD COMMUNITY

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RÉSUMÉ

Les peuplements d'oiseaux ont été étudiés à Saint-Eugène et sur la retenue du barrage de Petit Saut entre 1993 et 1996, à différentes échelles géographiques. La richesse totale de la zone de Petit Saut (environ 35 km^2 prospectés) est estimée à plus de 400 espèces, parmi lesquelles 342 ont effectivement été observées. La relation entre richesse observée et surface prospectée, effort d'observation et diversité des habitats est soulignée. La majorité des espèces présentent de faibles fréquences d'observation et une faible abondance numérique. Les espèces numériquement dominantes sur la terre ferme restent abondantes sur les îles, mais ces dernières possèdent un pool d'espèces dominantes différent. La proportion d'espèces migratrices dans le peuplement est très faible et concerne surtout des espèces liées au milieu aquatique, mais leur fréquence en forêt primaire pourrait être sous-estimée. L'organisation du peuplement est décrite en termes de guildes, de catégories de régime alimentaire, d'habitat et d'organisation sociale. Seize guildes ont été distinguées au sein du peuplement d'oiseaux, dominé par les insectivores. La majorité des espèces occupent la forêt de pente, mais certaines guildes sont plutôt associées à la forêt hydromorphe ou lianescente. Trente pour cent des espèces vivent en groupes, formant notamment des rondes de canopée, des rondes de sous-bois ou associées aux nappes de fourmis prédatrices. L'organisation écologique du peuplement d'oiseaux de Petit Saut est semblable à celle décrite dans d'autres stations de forêt amazonienne. La mise en eau du barrage a entraîné une très lente augmentation de la diversité et de l'abondance des espèces aquatiques, notamment du Grébifoulque (*Heliornis fulica*), tandis que celles liées aux berges sont observées moins fréquemment.

SUMMARY

Bird communities were sampled at different scales at Saint-Eugène and on the Petit Saut dam reservoir between 1993 and 1996. Global bird species richness of the Petit Saut area (*ca.* 35 sq. km investigated) was estimated to be over 400 species, of which 342 were observed. Relationships between species richness and surveyed area, sampling pressure, and habitat diversity, are described. A majority of species showed low contact frequencies and low abundance. Numerically dominant species on the mainland were also abundant on islands, but islands had a different pool of dominant species. Migrants accounted for a very small proportion of the community and were mainly aquatic birds, but the frequency of migrants in primary rainforest may be underestimated. Community organization is described in terms of guilds, feeding habits, habitats and social systems. Sixteen guilds can be identified. Insectivores are dominant in the bird community. Most species inhabit *terra firme* forest, but some guilds are preferentially associated with damp or liana forests. Thirty percent of the bird

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species live in single-species or mixed-species groups, in particular in canopy-, understory-, or ant-following flocks. The ecological organization of the Petit Saut bird community is similar to that found in other Guianan or Amazonian forest sites. Flooding of the reservoir lead to a very slow increase of aquatic bird diversity and abundance, particularly of Sungrebe (*Heliornis fulica*), while sightings of banks-dwelling species became scarce.

INTRODUCTION

Neotropical forest bird communities are among the richest in the world (Karr, 1990a). Their structure was described in many regions, especially in Panama (Karr, 1990b), Costa Rica (Blake *et al.*, 1990), Brazil (Bierregaard, 1990; Cohn-Haft *et al.*, 1997) and Peru (Robinson & Terborgh, 1990; Robinson *et al.*, 1990; Terborgh *et al.*, 1990). In French Guiana, studies of entire bird communities were made by Thiollay (1986, 1987, 1994) and Erard (1989) in several disturbed or intact forest sites. The Nouragues field station bird community is presently the best known (Thiollay, 1994; Thiollay *et al.*, 2001). Regional variations in avifaunas and habitat structure, as well as modifications induced by man, contribute to the diversity of described situations (Willis, 1979; Karr, 1990a; Karr *et al.*, 1990). Increasing threats demand an urgent study of these ecosystems before the species and their habitats vanish (Short, 1984; Brosset, 1988; Turner, 1996).

Following studies in temperate zone, and facing census difficulties (Karr, 1981; Terborgh, 1985), studies of tropical forest bird communities were for long conducted on small areas (*e.g.* Orians, 1969; Karr, 1971; Bell, 1982). Thus they underestimated the importance of forest mosaic, home ranges, and prevalence of rare species in these forests. Recent studies (Terborgh *et al.*, 1990; Thiollay, 1994; Robinson *et al.*, 2000) demonstrated the need to extend the reference area to account for the whole bird community.

Number and taxonomic distribution of species are but one aspect of a community and are not sufficient to describe its functioning. Examination of how these species share habitat and resources, *i.e.* their distribution into functional groups or guilds, should help us to understand the ecological organization (Adams, 1985; Terborgh & Robinson, 1986) and its evolution following natural or human perturbations.

As part of a study of the effects of habitat fragmentation on animal communities, birds were studied at Saint-Eugène (Claessens, 2000). Several perception levels were used: individual sites; Saint-Eugène area; and the whole Petit Saut reservoir area, at a regional scale. Considering that a bird community at the scale of a particular site cannot be well perceived out of a more global context, and prior to more precise analyses of habitat fragmentation effects (Claessens, in prep.), I present here a general picture of the whole Petit Saut bird community. Tropical forest being a mosaic of closely imbricated habitats whose communities mix and interfere, it is thus important to know which species are present in a vast area around the study plot. Species inhabiting fringing habitats, as well as casual ones, should not be neglected. Moreover, their place within the community may evolve with time or with habitat transformation (Jullien & Thiollay, 1996; Robinson, 1999).

STUDY SITES AND METHODOLOGY

The bird list presented here is based on 21 months of field work between September 1993 and December 1996. The study area covered about 35 km^2, split into several units, all of which did not receive the same attention.

Most of the data come from Saint-Eugène area where several sites were distinguished (see map and sites description in Claessens *et al.*, 2002): (i) the mainland "TF1" quadrat; (ii) other parts of the "mainland" peninsula, particularly camp surroundings; (iii) island #2; (iv) islets #5, 6, 7, 20, 21, 22, 23, 24, 27, 40, 44, 45, 46, 47 and 53, considered together in the present text; (v) the watercourse and flooded forest. These sites cover about 20 km^2. They were sampled with standardized observations based on two complementary methods: repeated series of point counts in all seasons (mainland quadrat, island 2, all islets) and mist-nets captures in dry seasons only (mainland quadrat, island 2, islets 5 and 21). Protocols are fully described in Claessens (2000). All sites benefited moreover from repeated visits during which a maximum of bird species were noted. Duration of visits to each site was adapted as well as possible to its surface. The total observation effort at Saint-Eugène rises up to more than 3,500 hours (minimum estimate). Because community features depicted here are not uniform within the whole area, I sometimes refer to mainland, island 2 or islets (considered as a whole) separately. Detailed results regarding these sites will be given elsewhere, however.

Apart from Saint-Eugène, other parts of the reservoir were subject to regular or casual observations. The river from Petit Saut dam to Saint-Eugène was surveyed several times a season and all birds encountered systematically noted. Surroundings of the Petit Saut dam (perturbed terrestrial habitats, water sheet and its margins) were investigated once or twice a month. Some observations were casually done in other parts of the reservoir: Adieu-Vat and the mouth of creek Bonne Nouvelle in the lower part of the Courcibo river; the upper part of the Courcibo river up to Saut Lucifer. These observations outside Saint-Eugène concerned an area of about 15 km^2. All the investigated sectors will be globally treated thereafter as "Petit Saut area".

Besides raw numbers of observed species, two statistical methods were applied to estimate total species richness. The first is based on the species accumulation curve (Lauga & Joachim, 1987). Although simple, it yielded satisfactory estimates (Palmer, 1990). The second, as performed by COMDYN software (Hines *et al.*, 1999), calculates a more robust Jackknife estimator (Burnham & Overton, 1979; Palmer, 1990). Its main advantage is to integrate the variability of species detectability, which can greatly affect observed richness (Boulinier *et al.*, 1998).

Guilds were defined by combination of diet (fish; carrion; flesh; insects; nectar; fruit pulp; seeds; mixed) and, for forest species, of foraging strata (ground and lower understorey; middle understorey; higher strata and canopy; trunks) specific characters. Among "insectivorous" birds are included those that occasionally catch small vertebrates, such as Bucconidae or some Furnariidae and Dendrocolaptidae; "omnivorous" applies to a mixed diet {insects + fruits} or {insects + fruits + nectar}. Trunks and main branches were assimilated to a particular vegetation strata for climbing birds (*i.e.* woodcreepers and woodpeckers). For diet and foraging strata I retained the species' preference on the basis of my empirical knowledge of the species biology, eventually complemented with published data, favouring species-level studies (for example Snow & Snow, 1971).

Considered habitats were air, water (including river banks), *terra firme* forest, damp or swamp forest (seasonally flooded forest, flats, palm-stands), liana forest, and open forest (edges and large openings) (see Claessens *et al.*, 2002 for more detailed descriptions).

RESULTS

SPECIES RICHNESS

Number of species observed in Petit Saut area from 1993 to 1996 is 342, *i.e.* 48 % of the French Guianan avifauna (see Appendix). Saint-Eugène area harbours 320 species, 9 of them requiring confirmation, 259 of them were observed on the mainland peninsula.

Number of observed species increases slowly and irregularly with investigated area, due to unequal observation effort according to site and scale (Fig. 1): because of their respective surface, mainland peninsula and Petit Saut area were not paid the same investigation effort as smaller sites. Observation effort was more important on island 2 than on the mainland quadrat. The smooth slope of cumulative curves (Fig. 2) indicates however that Petit Saut and Saint-Eugène communities were satisfactorily checked (a/n = 0.049 and 0.046 respectively, with a = number of species seen only once, n = number of days of field work). This is not the case with islets considered as a whole (a/n = 0.47).

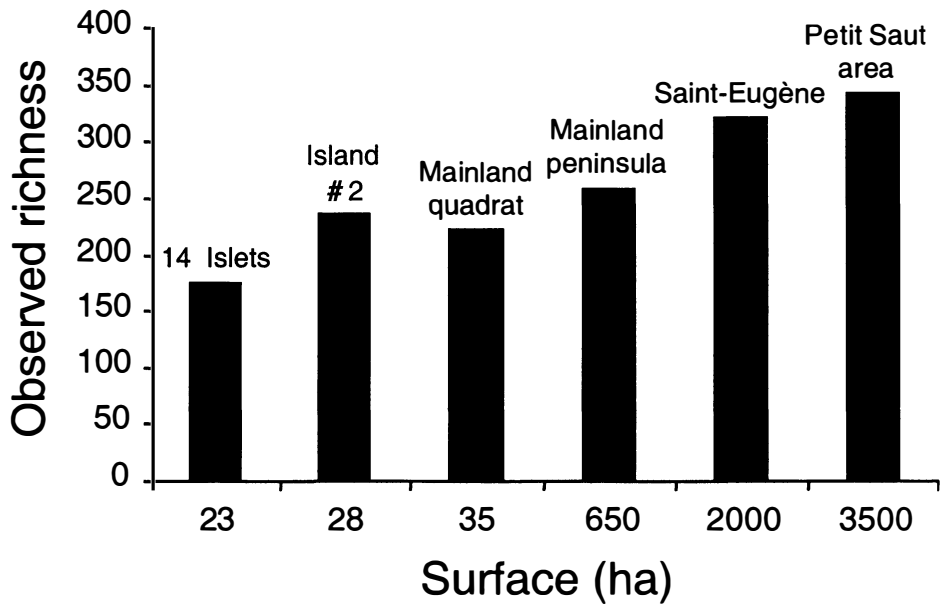

Figure 1. — Observed species richness in relation to the surface under study (note that the abscissa scale is not continuous). Islets are pooled.

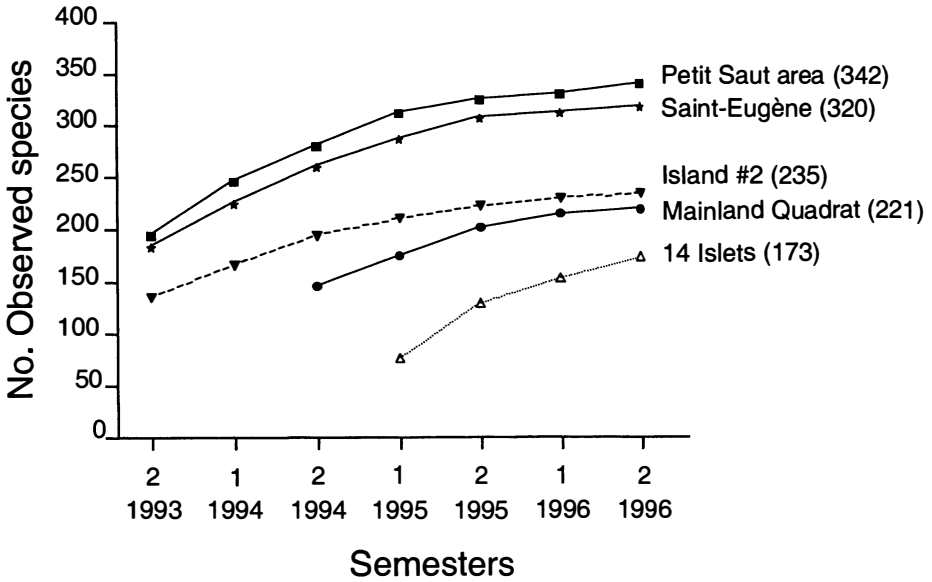

Figure 2. — Cumulative curves of species richness of the Petit Saut bird community at different spatial scales. Number of bird species into brackets. Axis legend: 1: January-June; 2: July-December.

Table I gives estimated species richness at different spatial scales. Among the 706 bird species known in French Guiana (Tostain *et al.*, 1992), 73 % of inland forest species, 15 % of coastal forest species, 14 % of open habitats species, and even as many as 9 % of shorebirds have been observed at Petit Saut. The estimate of 416 potential species for Petit Saut area obtained with COMDYN software does not seem excessive if accidental birds are taken into account.

The cormorant *Phalacrocorax olivaceus* can be added to the list, having been seen on the reservoir from 1997 onward (P. de Mercey, pers. com.). The jacana *Jacana jacana* was already along the Petit Saut road and may exist in remote parts of the reservoir with floating or herbaceous vegetation. Sixty one additional species noted by C. Erard (pers. com.) during early trips in 1991 could not be found again.

RARITY

The appendix gives a subjective index of rarity for each species, based on its record frequency. Since it also depends on the species detectability and on the agreement between its distribution and the observer's activity, this index imperfectly reflects actual species abundance. Thus, Harpy Eagle *Harpia harpyja* is by far more scarce than middle-sized species such as *Piaya melanogaster*, *Tachyphonus luctuosus* or even *Micrastur ruficollis*, though all were observed with the same frequency. This index was preferred to true density estimates, because: 1) the latter would apply only to a particular site and not to the whole area, 2) many species lack quantitative data needed for density estimate calculation, and 3) the reliability

TABLE I

Total observed and estimated (Standard Error) (Lauga & Joachim, COMDYN) species richness of the Petit Saut and Saint-Eugène areas. Reference period for estimations runs from second semester 1994 onwards for Petit Saut area and for Saint-Eugène, but from 1995 onwards for the mainland quadrat, for island 2 and for islets as a whole, most of them having been surveyed only since that date.

Species richness	Period	Petit Saut (3 500 ha)	Saint-Eugène (2 000 ha)	Mainland quadrat (35 ha)	Island 2 (28 ha)	14 islets (23 ha)
Observed	1993-1996	342	320	223	235	
	1995-1996			217	214	173
Estimated (L&J)	1994/2-1996	362	339			
	1995-1996			258	248	306
Estimated (COMDYN)	1994/2-1996	416 (19)	353 (12)			
	1995-1996			252 (13)	251 (11)	240 (14)

of such quantitative estimates varies greatly between species, so it would be misleading to give them without discussing calculation procedure and biases.

Even if the frequency of some species has been underestimated, the rarity of occurrence of a large fraction of species in the community reflects inconspiciousness, a scattered distribution or an irregular behaviour of many species. So 15 % of the species were seen occasionally (less than 1 sighting a year), 20 % rarely or very rarely (1 to 5 sightings a year), and only 42 % can be considered as common or very common (more than 15 sightings a year). Of the 115 "rare" species, only 10 % are occasional migrants in the region and are for this reason rarely recorded.

Results of point counts in different study sites show that a majority of species have very low frequencies. Dominant species differ according to site (mainland quadrat, island 2 or islets) though *Cercomacra cinerascens* (Thamnophilidae), *Lipaugus vociferans* (Cotingidae), *Xiphorhynchus pardalotus* (Dendrocolaptidae) and *Herpsilochmus stictocephalus* (Thamnophilidae) are among top species in two of the three sites or aggregate sites. These are mainly canopy species. *Coereba flaveola* and *Hypocnemis cantator*, two edge or gap species, are also among most abundant species on islets, whereas the abundance of parrots such as *Pionus* spp. and *Amazona* spp. is likely to have been overestimated because of their mobility. Among understory mist-netted species, *Glyphorynchus spirurus* (Dendrocolaptidae) is by far the most abundant on the mainland, together with *Pipra pipra* (Pipridae) on island 2.

MIGRANT SPECIES

Of the 342 bird species observed in the Petit Saut area, only 13 are long-distance migrants. This is only 4 % of the total bird community. Most of them occur casually or occasionally (less than 1 record a year) and so have an influence on species diversity but not on abundance at the community level. All migratory

species, except *Myiodynastes maculatus*, *Setophaga ruticilla*, and *Pheucticus ludovicianus*, depend on water or river banks. Almost one quarter of aquatic species encountered at Petit Saut are migrants. Most originate from North America (the duck *Anas discors*, waders, the Osprey *Pandion haliaetus*). Following watercourses and flying probably also over forest canopy, the Barn Swallow *Hirundo rustica* is abundant both in spring and fall on its way between its North-American breeding areas and its winter quarters south of Amazonia. *Setophaga ruticilla* (Parulidae) and *Pheucticus ludovicianus* (Emberizidae) occur more in forest but were recorded only once each, as was the Broad-winged Hawk *Buteo platypterus* on 18 February 1995 along the Petit Saut road outside the present study area.

South American migrants (*e.g.* Pied Lapwing *Hoploxypterus cayanus*) were scarce. *Myiodynastes maculatus* (Tyrannidae) was seen on several occasions in 1994 and 1996 and might be regular, but its migratory status remains uncertain (see discussion). The case of the American Wood-Ibis (*Mycteria americana*) which was quite frequent in 1993 and 1994 remains a mystery, although flyways seem to indicate a Brazilian origin. The capture of an exhausted Leach's Storm-Petrel (*Oceanodroma leucorhoa*), a pelagic species, on the reservoir in the 1995 wet season (J.C. Vié, pers. com.) is quite exceptional and unexplainable, considering the absence of storms along the coast.

About resident species, no seasonal variation of community structure or composition could be attributed to population movements. The single observation of a group of small macaws *Ara* sp. flying high and in formation on 10 October 1996 evidently concerned migrants, but the range and regularity of such a movement are unknown but are probably no more than regional.

FORAGING GUILDS

Sixteen guilds, including 2 to 47 species, can be distinguished within the Petit Saut bird community (Table II). Thirteen are exclusively or mainly composed of forest species, and two other (aerial insectivores and terrestrial granivores) only partially. Such a distinction is not absolute because many non-forest species enter the forest block along rivers or through natural or human-made openings. Some are regular in forest canopy and quickly colonize favourable and often ephemeral micro-habitats. Four seedeaters (Emberizidae, guild GT), *Crotophaga ani* (guild IM), and *C. major* (guild OM) were nevertheless considered as mainly non-forest species. The omnivorous duck *Anas discors* was included within "aquatic insectivores" (guild IW) which forage along watersides (waders, *Eurypyga helias*) or on water (e.g. *Heliornis fulica*).

Community is dominated by strictly insectivorous birds (50 % of all observed species, without omnivore species). Strict frugivores or granivores account for 10 % of species; 21 % are omnivores and 4 % nectarivores. Among the latter, all hummingbirds eat also insects they catch in flight (*Heliothryx aurita*, *Florisuga mellivora*), on or under foliage (*Phaethornis ruber*), or glued in spider webs (*Hylocharis sapphirina*, *Avocettula recurvirostris*, personal observations), not to mention insects captured in flowers along with nectar. So as a whole 75 % of species eat invertebrates and 35 % eat plant material. At last 8 % of species are carnivores and 6 % piscivores.

TABLE II

Habitat distribution and social organization of the bird community guilds and species (N = 342) at Petit Saut.

Guilds	Habitat		Social organization					Total
	Non Forest species	Forest species	Solitary	Mono-species groups	Ant-Following[1]	Permanent flocks[1]	Other multi-species groups	
Piscivores (P)	21	-	16	5				21
Carrion-eaters (CA)	-	2	2					2
Predatory carnivores (CP)	-	27	27					27
Aquatic insectivores (IW)	10	-	9	1				10
Aerial insectivores (IA)	12	8	6	14				20
Ground or lower strata insectivores (IL)	-	34	31	1	2			34
Middle strata insectivores (IM)	1	46	31			16		47
Canopy insectivores (IC)	-	37	31	1		5		37
Tree-creeping insectivores (IT)	-	25	21		2	2		25
Nectarivores (N)	-	15	14			1		15
Terrestrial granivores (GT)	4	3	7					7
Canopy granivores (GC)	-	15		15				15
Terrestrial frugivores (FT)	-	7	5	2				7
Canopy frugivores (FC)	-	13	8				5	13
Middle strata omnivores (OM)	1	22	21	2				23
Canopy omnivores (OC)	-	39	14	7		16	2	39
Total	49	293	243	48	4	40	7	342

[1] Only species that are obligate members of these flocks are numbered.

HABITATS

86 % of species recorded in the whole Petit Saut area are forest species. High (*terra firme*) forest harbours 71 % of species, large openings and edges 14 % (including the 6 open habitat species mentioned above), damp forest 7 %, and liana forest 6 %, species being likely to occur in more than one forest type. Aquatic species such as ducks, herons, waders and a few passerines account for 11 % of the overall community.

A factorial correspondance analysis was conducted by species (Fig. 3). The first two factors explain together 73 % of overall variability. The first one shows a humidity gradient from aquatic habitat and damp forest to liana forest, whereas the second one shows a gradient of habitat structure, from open forest to denser

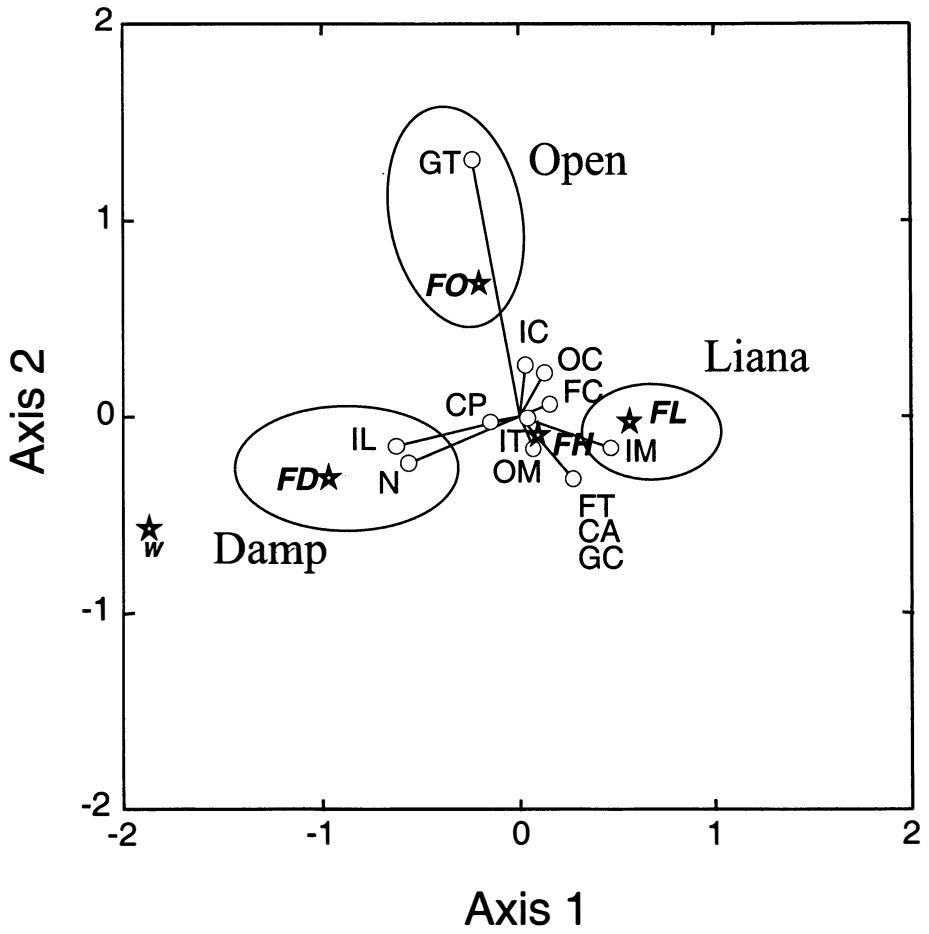

Figure 3. — Factorial Correspondance Analysis on the "guild" (normal; circle) and "habitat" (italic; star) variables, excluding guilds P, IA, and IW. See table II and text for definitions of guilds and habitats.

forest types. Based on variables contribution, one may consider three guild-habitat groups: lower-strata insectivores (particularly because of ground species) and nectarivores are closely associated with damp forest, whereas middle-strata insectivores are more clearly linked to liana forest; seed-eaters "push" the granivores guild toward open forest. Other guilds show more diffuse association to high (*terra firme*) forest.

More generally, the relation between species diet and habitat differs significantly from a random distribution, even if aerial and aquatic habitats as well as piscivores are excluded ($\chi^2 = 18.6$, df = 12, $P < 0.001$): damp forest harbours more nectarivores relatively to other forest habitats; strict frugivores account for a larger proportion of high forest or open forest communities than in other forest types, whereas liana forest harbours more omnivores (Fig. 4).

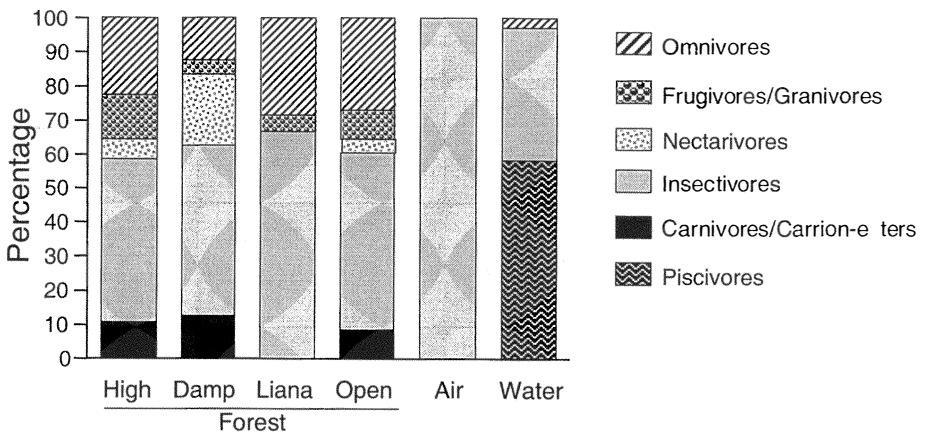

Figure 4. — Distribution of diet categories according to habitat for the Petit Saut bird species.

SOCIAL ORGANIZATION

The Petit Saut bird community includes species with varied social organizations (Table II). Almost 30 % of the species forage in single-species or in mixed-species flocks. Three kinds of permanent mixed flocks can be encountered in French Guianan mature forest:

(1) Insectivorous ant-following birds belong to 4 species from the IL or IT guilds (*Pithys albifrons*, *Gymnopithys rufigula*, *Dendrocincla fuliginosa*, *Dendrocincla merula*). They depend strictly on the presence and activity of predatory ants *Eciton burchelli* since they feed on insects that try to escape ants. Many other species that prey on insects or small vertebrates opportunistically join these permanent core species. This is the case of most terrestrial insectivores belonging to the IL guild, and especially *Hylophylax poecilonota* and *Percnostola rufifrons* which may join in large numbers.

(2) Understory flocks with stable individual and species composition and territories include 18 regular species at Petit Saut, all of them being insectivores

and belonging to guilds IM and IT. Other birds may occasionally join these flocks. A majority of understory flock members belong to families Thamnophilidae, Furnariidae, and Dendrocolaptidae. They sometimes forage up to the lower canopy where they then frequently mix with canopy flocks.

(3) Canopy flocks are restricted to upper strata and consist of more or less stable associations of 22 species; 16 of them are omnivores, 5 insectivores and 1 nectarivore (guilds OC, IC, N). Tanagers, honeycreepers and allies (Emberizidae) are dominant. Understory and canopy flocks are characterized by their species composition, diet, and vertical distribution, but also by their stability and the tightness of their social organization. Though they usually move independently, observations showed that they often travel in parallel with a short delay and that they mix when understory flocks climb to upper strata. This leads to temporary unusually large flocks of up to about forty species and one hundred birds.

Social organization differs significantly between species according to diet ($\chi^2 = 40.4$, df = 6, $P < 0.001$; Table III). Frugivores tend to live in groups, whereas insectivores, carnivores and piscivores tend to live solitarily or in pairs. Beside, twelve solitary foraging species are lekking species. They belong to the middle-strata omnivores (N = 8) and to the nectarivores guilds (N = 4).

TABLE III

Relation between diet and social organization of Petit Saut bird community (N = 342 species).

Food	In groups	%	Solitary	%
Carnivores / Carrion-eaters	0	0.0	29	100.0
Frugivores / Granivores	21	60.0	14	40.0
Insectivores	42	24.6	129	75.4
Nectarivores	1	6.7	14	93.3
Omnivores	30	42.2	41	57.8
Piscivores	5	23.8	16	76.2
Total	99	29.0	243	71.0

EFFECTS OF FLOODING ON AQUATIC BIRDS

Mean number of aquatic species observed during regular trips between Saint-Eugène and Petit Saut dam tended to increase from 5 species per trip in 1993 to 8 in 1996 (coefficient of regression r = 0.18) but mean numbers of sightings or individuals tended to decrease (r = – 0.29 and r = – 0.20, respectively). Though numbers are too small to allow significant comparisons between species or even groups of species, some trends do emerge. Native, non-breeding species likely to colonize the reservoir, such as colonial herons and Anhinga (*Anhinga anhinga*), tended to increase moderately. On the other hand, sightings of breeding and sedentary species such as kingfishers, as well as long-distance migrants such as waders, tended to become more scarce, as both are linked to banks rather than to open water.

The Sungrebe (*Heliornis fulica*) is the only species which colonized the reservoir in increasing numbers from 1995 onward. At least 14 and 25 individuals were seen at Saint-Eugène in 1995 and 1996, respectively. They were present near 12 of the 15 investigated islands. Breeding was recorded near island 2 and in the lower part of the reservoir in 1996.

On the contrary, the two bank swallows *Atticora fasciata* and *Tachycineta albiventer* experienced the most dramatic declines. Both were initially very common. Colonies of *Atticora fasciata* were scattered all along the river, nesting in banks. As early as flooding started, both species became notably more scarce in flooded parts of the river. At the end of flooding, they were only occasionally encountered in the lower part of the reservoir. *Atticora fasciata* remained only in some flooded creeks with steep slopes, as did 20 to 30 individuals at Saint-Eugène.

DISCUSSION

SPECIES RICHNESS

With more than 320 bird species recorded and a total richness estimated to about 350, Saint-Eugène stands among the richest tropical rainforest sites studied to date (Table IV). Scale differences between studies make hazardous any comparison of published richness, however, which cannot be interpreted when isolated from their environmental and methodological contexts. Area as well as habitat fragmentation make the Petit Saut site most similar to Manaus site. At both sites, species richness is indeed very similar, though it should be adjusted according to observation effort and habitat diversity. Relatively low richnesses

TABLE IV

Compared species richness of bird communities of some Amazonian field stations.

Country	Station	Study area	Forest species	Bird richness	References
French Guiana	Nouragues	100 ha		268	Thiollay *et al.*, 2001
	Saut Pararé	200 ha	227	292	Erard, 1989
	Pic du Croissant	1,500 ha		260	Thiollay, 1986
	Saint-Eugène	2,000 ha	283	320	this study
	Belvédère	2,500 ha		291	Thiollay, 1986
	Nouragues-Arataye	3,000 ha		428	Thiollay *et al.*, 2001
	Petit Saut	3,500 ha	293	342	this study
	Saül	10,000 ha		324	Thiollay, 1986
Brazil	Manaus	3,500 ha	300	352	Stotz & Bierregaard, 1989; Karr *et al.*, 1990
	Manaus	50,000 ha	264	394	Cohn-Haft *et al.*, 1997
Peru	Cocha Cashu	97 ha	319		Terborgh *et al.*, 1990
	Cocha Cashu	280,000 ha	467	550	Robinson & Terborgh., 1990

were obtained at Croissant, Belvédère and Saül sites, but after only 2, 3, and 12 weeks respectively (Thiollay, 1986), whereas the high richness of the Nouragues station which is located 110 km south-east of Petit Saut, and that of Manaus (Cohn-Haft *et al.*, 1997), were obtained after some 15 years of field work. Richness estimates bring Petit Saut and Saint-Eugène to the level of the richest sites after western Amazonia (Robinson *et al.*, 1990; Robinson & Terborgh, 1990). Habitat diversity is another factor of divergence between sites. Aquatic habitat of Petit Saut contributes to its bird diversity. On the other hand several forest habitats which contribute to the Nouragues or to the Cocha Cashu bird diversities are lacking at Petit Saut. Considering only strictly forest species (Cohn-Haft *et al.*, 1997) does not help to eliminate the bias, at least because the "forest" character of a species may be ambiguous and may differ between authors.

Estimating theoretical overall species richness of the community is important, mainly in habitats where both bird behaviour and observational difficulties make unlikely a full survey, whatever the effort. Of course the computed value depends on the calculation method and on the data chosen as a reference. It should be considered indicative rather than true precise value. This estimate should help comparisons between study sites with different investigation effort, as is generally the case.

Increase in the number of observed species with area is much less than expected from the classic Darlington-Preston species - area relationship, which predicts that species richness doubles when area is increased tenfold. The difference can be explained by a scale effect and also by the extreme alpha diversity of tropical forests communities, a large fraction of which can be found in a relatively small area. Moreover, the species - area relationship within a mainland block is not directly comparable to that found on islands whose real (or estimated in the present case where inventories are incomplete) cumulative richness is higher. Moreover, my scores include non-resident species as well as species with home ranges larger than the actual investigated area, so it is not surprising that the present species - area curve lies well above the one estimated by Thiollay (1994).

Except for aquatic species, flooding and forest fragmentation do not seem to have had any effect on richness and species composition of the overall bird community, at least during the study. No regional extinction was noted, and most aquatic species were probably already casual visitors on the river before the dam was built.

THE PLACE OF MIGRATORY BIRDS

Despite a sustained observation effort, the number of non-resident migratory species observed at Petit Saut remains extremely low. If numbers of individual birds involved are also considered, there is no doubt that these species make up but a marginal fraction of the forest bird community. They may however be more regular in the forest than is usually presumed. As elsewhere, one can expect a regular increase of the list of migratory or casual species seen at Petit Saut with time and observational effort.

A large majority of North American migrant birds, especially passerines, winter north of Amazonia (Rappole *et al.*, 1983; Stotz *et al.*, 1992; Stotz *et al.*, 1996). Their proportion decreases from Costa Rica (Blake *et al.*, 1990) and Panama (Karr, 1990b) to Peru (Karr *et al.*, 1990) and Brazil (Stotz & Bierregaard, 1989). French Guianan coastal zone also harbours a good variety of North

American migrants (Tostain *et al.*, 1992), but they seem to avoid inland primary forest. Nevertheless, some species and individuals regularly reach innermost parts of Amazonia: the Manaus region in Brazil harbours up to 19 species of Charadriiformes (Stotz *et al.*, 1992) and no less than 14 wader species have been reported on the Manu river at Cocha Cashu, Peru (Bolster & Robinson, 1990). Obviously the forty kilometres that separate Petit Saut from the coast are not a strong barrier, as demonstrated by regular sightings at Petit Saut of coastal birds (herons, Laughing Gull, Black Skimmer).

The occurrence in French Guiana of *Setophaga ruticilla* and *Pheucticus ludovicianus*, both North American migrants, is exceptional (Tostain *et al.*, 1992) so one cannot say whether Petit Saut forest lays within their normal winter habitat. In connection with this, we can report a sighting (pers. obs.) in the forest near Saül (03° 37' N, 53° 12' W) on 24 July 1995 of the rail *Neocrex erythrops*, previously known in French Guiana only from two coastal records (Tostain *et al.*, 1992; O. Tostain, pers. com.). Clearly our knowledge of the distribution and ecology of many bird species, either migratory or not, in Amazonian forest suffers from a ridiculously low investigation effort compared to the scope of the task (Stotz *et al.* 1992; Tostain *et al.*, 1992). Other likely migrants are still lacking in my list, such as *Vireo altiloquus* (Thiollay, 1986) and migratory races of *V. olivaceus* (Bierregaard, 1990; Stotz *et al.* 1992). Observations of *Myiodynastes maculatus* at Saint-Eugène might in fact refer to the resident subspecies (*M. m. maculatus*), which is restricted to the old littoral mangrove according to Tostain *et al.* (1992), but which can sometimes settle inland along rivers (Ridgely & Tudor, 1994).

Seasonal movements of montane frugivorous and nectarivorous birds, especially hummingbirds, are known from Costa Rica, Peru and Bolivia (Feinsinger, 1976; Stiles, 1980; Karr *et al.*, 1990; Loiselle & Blake, 1992). The relative stability of climate and forest uniformity at a large scale do not favour the emergence of such migratory behaviour in French Guiana (Stouffer & Bierregaard, 1995), but some toucans and parrots, as well as White Bellbird (*Procnias alba*), may engage in seasonal movements (Tostain *et al.*, 1992; M. Théry, pers. com.). Except for a single record of unidentified macaws (*Ara severa* or *A. manilata*) in a seemingly long-distance flight, we have no evidence of intratropical migration of resident species at Petit Saut. Neither mist-netting operations (performed only during dry seasons), nor count points, revealed any seasonal population fluctuation like those described by Stouffer & Bierregaard (1993) for the Ruddy Quail-Dove (*Geotrygon montana*) in Brazil.

Guild definition and the perception of the functional organization of bird communities

Defining guilds within a community is always controversial. Putting a species into a single category may be difficult and leads to broad categories. Too much splitting of guilds by a multiplicity of criteria would remove both sense and utility from these guilds whose aim is to help analyzing community ecological organization (Adams, 1985; Terborgh & Robinson, 1986). In order to facilitate comparisons between sites or regions, a standardization of criteria for defining avian guilds would be desirable, in the same vein as Remsen & Robinson's (1990) proposals for foraging behaviour analysis.

The classification proposed here differs from those of other authors, in avoiding foraging behaviour criteria such as "probing", "gleaning", "sallying", etc.

(Terborgh, 1980; Terborgh & Robinson, 1986; Erard, 1989; Terborgh *et al.*, 1990). These behaviours have certainly an influence on prey selection and thus on ecological segregation among species, but this influence is probably less important than that of foraging strata. The role of species in seed dispersal should also be considered (Erard, 1989), and that calls to a distinction between "granivorous" species that destroy seeds and "frugivorous" species that eat pulp and disperse seeds. So my guilds are more similar to those of Thiollay (1986) or Karr *et al.* (1990) who however separate insectivores into several social or behavioural categories. Composed of ecologically close species, they go beyond taxonomic divisions, following Adam's (1985) definition. A mean of 5.6 families are represented in a guild, and up to 11 families are represented in lower strata and canopy insectivores guilds.

Multispecies permanent flocks are important within tropical forest bird communities (Munn & Terborgh, 1979; Karr *et al.*, 1990; Jullien & Thiollay, 1998) and clearly represent distinct functional units. Although each species within a flock is highly specialized in its foraging behaviour and substrate (Munn & Terborgh, 1979; Wiley, 1980; and pers. obs.), their stable association, either on a territorial or on a foraging basis (Jullien, 1997), would allow elevating them to guild level. Within the scope of a global community analysis, as done here, the position of these species with respect to other guilds would become ambiguous, however.

Despite regional differences of richness and taxonomic composition, bird community trophic structure appears to be similar within the whole Neotropics (Karr, 1990a; Karr *et al.*, 1990). Species distribution among feeding categories at Petit Saut is very similar to that described by Levey & Stiles (1994) in Costa Rica though containing less nectarivores. There are relatively fewer frugivores but more carnivores and piscivores than in Peru, other categories being in similar proportions (Robinson & Terborgh, 1990). Comparisons with other sites are problematic because the local bird community is rarely considered as a whole. Moreover, one should also take into account species abundance within guilds (Claessens, in prep.) or their biomass (Terborgh *et al.*, 1990).

CONCLUSION

The present study brings new insights into the biogeography of French Guianan birds and illuminates some aspects of their ecology, either at species or community level. This knowledge should also contribute to their conservation (Primack, 1992), although many gaps still remain in our knowledge of the distribution, abundance and ecology of tropical forest birds (Brosset, 1988; Tostain *et al.*, 1992; Bierregaard, 1995). Although the Petit Saut area does not belong to the Amazonian basin, it can be related to true Amazonian sites on the basis of its bird community structure, as well as of the undisrupted forest covert from Amazonia to the Guiana shield.

The slow adaptation of aquatic bird guilds to the formation of a new and vast lacustrine ecosystem within the forest illustrates the long time lag needed for communities to reach equilibrium after a modification of the environment. The present study benefited from an effective protection of the site against both hunting and disturbance, which was a requirement for its success as well as animal population survival. Colonization of the lake by aquatic birds and survival of many large forest species (raptors, parrots, game birds) depend on the persistence of the

protection of the whole area. Indeed, most of these species elsewhere in French Guiana suffer an excessive hunting pressure (Tostain *et al.*, 1992) with repercussions on the whole bird community (Thiollay, 1986). A rapid deterioration of the situation at Petit Saut since this work was completed throws severe threats on the bird communities and on the future of their study.

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APPENDIX

List of bird species seen at Petit Saut (French Guiana) between 1993 and 1996. Number in parentheses following family is the number of observed species.

	Frequency[1]	Sites[2]	Guild[3]	Habitat[4]	Social[5]	Mass *(N)*[6]
TINAMIDAE (4)						
Tinamus major	VC	SE (MQ, i2, î, o), R	FT	FH	S	975 *(14)*[b]
Crypturellus cinereus	FC	SE (MQ, o), R, PSD	FT	FH	S	495 *(6)*[d]
Crypturellus soui	(VR)	SE (MQ?, i2?, î)	FT	FH	S	206 *(2)*[d]
Crypturellus variegatus	VC	SE (MQ, i2, î, o), R	FT	FH	S	353 *(3)*[a]
PODICIPEDIDAE (1)						
Tachybaptus dominicus		PSD (quarry)	P	W	S	
HYDROBATIIDAE (1)						
Oceanodroma leucorhoa	E*	R	IW	W	S	

	Frequency[1]	Sites[2]	Guild[3]	Habitat[4]	Social[5]	Mass *(N)*[6]
ANHINGIDAE (1)						
Anhinga anhinga	FC	SE (o), R	P	W	S	
ARDEIDAE (11)						
Ardea cocoi	E	R	P	W	S	
Egretta alba	R	SE (o), R	P	W	M	
Egretta caerulea	E	SE (o), R	P	W	S	
Butorides striatus	FC	SE (i2, î, o), R	P	W	S	
Agamia agami	FC	SE (i2), R	P	W	M	609[f]
Bubulcus ibis	R	SE (o), R	P	W	S	
Pilherodius pileatus	E	R	P	W	M	
Nycticorax nycticorax	E	R	P	W	S	
Nyctanassa violacea	E	SE (i2)	P	W	S	
Tigrisoma lineatum	(R)	SE (i2, î, o)	P	W	S	840[f]
Zebrilus undulatus	VR	SE (i2, î)	P	W	S	
CICONIIDAE (1)						
Mycteria americana	E*	SE (o), R	P	W	M	
CATHARTIDAE (2)						
Cathartes melambrotus	VC	SE (MQ, i2, o), R	CA	FH	S	1331 *(6)*[d]
Sarcoramphus papa	FC	SE (MQ, o), R	CA	FH	S	3125 *(1)*[d]
ANATIDAE (2)						
Anas discors	VR*	SE? (o), R	IW	W	M	
Oxyura dominica	VR	SE (o), R	P	W	M	
ACCIPITRIDAE (18)						
Elanoides forficatus	VC	SE (MQ, i2, î, o), R	IA	FH/A	M	392 *(11)*[d]
Leptodon cayanensis	(VR)	SE (o), R	CP	FD/FH	S	450 *(9)*[d]
Chondrohierax uncinatus	E	SE (o)	CP	FD	S	250 *(1)*[c]
Harpagus bidentatus	C	SE (MQ, i2, î, o), R	CP	FH	S	177 *(19)*[d]
Ictinea plumbea	VC	SE (MQ, i2, o), R	IA	FH/FO/A	S	247 *(23)*[d]
Accipiter bicolor?	(E)	SE (o)	CP	FH	S	251 *(3)*[d]
Accipiter striatus	VR	SE (MQ, i2)	CP	FH	S	
Asturina nitida		PSD	CP	FO	S	478 *(15)*[d]
Leucopternis albicollis	VC	SE (MQ, i2, î, o), R	CP	FH	S	730 *(2)*[c]
Leucopternis melanops	FC	SE (MQ, i2, î, o), R	CP	FH	S	375 *(2)*[c]
Buteogallus meridionalis	E	R	CP	FO	S	917 *(5)*[d]
Buteogallus urubutinga	FC	SE (MQ, i2, î, o), R	CP	FH	S	950 *(2)*[c]
Harpyhaliaetus solitarius	E	SE (o)	CP	FH	S	
Morphnus guianensis	R	SE (i2, o), R	CP	FH	S	1400 *(1)*[c]
Harpia harpyja	FC	SE (i2, o), R	CP	FH	S	4247 *(2)*[d]
Spizastur melanoleucus	E	SE (o)	CP	FH	S	780 *(1)*[d]
Spizaetus ornatus	VC	SE (MQ, i2, o), R	CP	FH	S	1400 *(1)*[c]
Spizaetus tyrannus	FC	SE (MQ, i2, o)	CP	FH/FO	S	1067 *(4)*[d]
PANDIONIDAE (1)						
Pandion haliaetus	R*	SE (o), R	P	W	S	
FALCONIDAE (7)						
Micrastur semitorquatus	E	SE (i2)	CP	FH	S	607 *(5)*[d]
Micrastur mirandollei	R	SE (MQ, i2?)	CP	FH	S	450 *(1)*[c]
Micrastur ruficollis	FC	SE (MQ, i2, o)	CP	FH	S	174 *(2)*[d]
Micrastur gilvicollis	VC	SE (MQ, i2, o)	CP	FH	S	179 *(9)*[a]
Daptrius americanus	VC	SE (MQ, i2, o), R	OC	FH	P	473 *(2)*[c]
Falco deiroleucus	E	R	CP	FH	S	473 *(4)*[d]
Falco rufigularis	VC	SE (i2?, o), R	CP	FH	S	120 *(1)*[c]
CRACIDAE (3)						
Ortalis motmot	(R)	SE (MQ, o)	OM	FD/FL	M	518 *(8)*[d]
Penelope marail	VC	SE (MQ, i2, î, o), R	FC	FH	S	1006 *(17)*[b]
Crax alector	VC	SE (MQ, i2, î, o)	GT	FH	S	2985 *(40)*[b]
PHASIANIDAE (1)						
Odontophorus gujanensis	C	SE (MQ, i2, o)	FT	FH	M	324 *(5)*[d]

	Frequency[1]	Sites[2]	Guild[3]	Habitat[4]	Social[5]	Mass *(N)*[6]
PSOPHIIDAE (1)						
Psophia crepitans	VC	SE (MQ, i2, o)	FT	FH	M	1071 *(36)*[b]
RALLIDAE (1)						
Aramides cajanea	FC	SE (MQ, o)	IL	FD	S	413 *(7)*[d]
HELIORNITHIDAE (1)						
Heliornis fulica	VC	SE (i2, î, o), R	IW	W	S	
EURYPYGIDAE (1)						
Eurypyga helias	(VR)	SE (i2, o)	IW	W	S	217 *(5)*[d]
CHARADRIIDAE (1)						
Hoploxypterus cayanus	E*	R	IW	W	S	
SCOLOPACIDAE (4)						
Tringa flavipes	E*	R	IW	W	S	
Tringa solitaria	(VR)*	SE (o), R	IW	W	S	
Tringa macularia	FC*	SE (o), R	IW	W	S	
Calidris melanotos	E*	SE (o)	IW	W	S	
LARIDAE (1)						
Larus atricilla	E	R	IW	W	S	
RYNCHOPIDAE (1)						
Rynchops niger	VR	R	P	W	S	
COLUMBIDAE (5)						
Columba speciosa	FC	R	GC	FH	S	278 *(8)*[c]
Columba subvinacea	VC	SE (MQ, i2, î, o), R	GC	FH	S	141 *(4)*[d]
Columba plumbea	VC	SE (MQ, i2, î, o), R	GC	FH	S	200 *(3)*[c]
Leptotila rufaxilla	VC	SE (MQ, i2, î, o), R	GT	FH	S	185 *(1)*[a]
Geotrygon montana	VC	SE (MQ, i2, o)	GT	FH	S	107 *(14)*[a]
PSITTACIDAE (15)						
Ara ararauna	E	SE? (o), R	GC	FH	M	1148 *(4)*[d]
Ara chloroptera	VC	SE (MQ, i2, î, o), R	GC	FH	M	1260 *(5)*[c]
Ara severa?	E	R	GC	FH	M	343 *(7)*[d]
Pyrrhura picta	VC	SE (MQ, i2, î, o), R	GC	FH	M	63 *(3)*[c]
Brotogeris chrysopterus	VC	SE (MQ, i2, î, o), R	GC	FH	M	51 *(1)*[c]
Touit purpurata	(FC)	SE (MQ, i2, o)	GC	FH	M	58 *(7)*[d]
Pionites melanocephala	VC	SE (MQ, i2, î, o), R	GC	FH	M	143 *(8)*[c]
Pionopsitta caica	(FC)	SE (MQ, i2, î, o), R	GC	FH	M	143 *(8)*[c]
Pionus menstruus	VC	SE (MQ, i2, î, o), R	GC	FH	M	251 *(12)*[d]
Pionus fuscus	(FC)	SE (MQ, i2, î, o), R	GC	FH	M	207 *(2)*[c]
Amazona dufresniana	(VR)	SE (MQ, i2, o)	GC	FH	M	563 *(5)*[d]
Amazona ochrocephala	(VR)	SE (i2, o)	GC	FH	M	429 *(2)*[d]
Amazona amazonica	(FC)	SE (MQ, i2, î, o), R	GC	FH	M	450 *(1)*[c]
Amazona farinosa	VC	SE (MQ, i2, î, o), R	GC	FH	M	678 *(4)*[c]
Deroptyus accipitrinus	C	SE (MQ, i2, î, o), R	GC	FH	M	222 *(5)*[c]
CUCULIDAE (4)						
Piaya cayana	C	SE (MQ, i2, î, o)	IC	FH/FL/FO	S	97 *(6)*[c]
Piaya melanogaster	FC	SE (MQ, i2, î, o), R	IC	FH	S	104 *(9)*[d]
Crotophaga major	E	R	OM	FO	M	169 *(9)*[d]
Crotophaga ani	E	SE (o)	IL	FO	M	110 *(1)*[c]
STRIGIDAE (5)						
Otus watsonii	FC	SE (MQ, i2, î, o)	CP	FH	S	148[e]
Lophostrix cristata	(R)	SE (MQ, i2, î, o)	CP	FH	S	510[f]
Pulsatrix perspicillata	R	SE (MQ, o)	CP	FH/FO/FD	S	729 *(2)*[d]
Strix virgata	R	S (i2, î)	CP	FH	S	320 *(2)*[d]
Glaucidium hardyi	(VR)	SE (i2, î, o)	CP	FH	S	*64 *(1)*[d]
NYCTIBIIDAE (2)						
Nyctibius grandis?	E	SE (i2)	IA	FH	S	547 *(12)*[d]
Nyctibius griseus	FC	SE (o)	IA	FH/FO	S	153 *(6)*[d]
CAPRIMULGIDAE (3)						
Lurocalis semitorquatus	(VR)	SE (o), R	IA	FH/FO/A	S	79 *(1)*[d]

	Frequency[1]	Sites[2]	Guild[3]	Habitat[4]	Social[5]	Mass *(N)*[6]
Caprimulgus nigrescens	FC	SE (o), R	IA	FO/A	S	41 *(2)*[c]
Hydropsalis climacocerca?	E	SE (o)	IA	FO/W/A	S	46 *(5)*[d]
APODIDAE (5)						
Streptoprocne zonaris	E	SE (o)	IA	A	M	110[f]
Chaetura chapmani	(VR)	SE (o), R	IA	A	M	19 *(2)*[d]
Chaetura brachyura	E	SE (o), R?	IA	A	M	20 *(26)*[d]
Chaetura spinicauda	VC	SE (MQ, o), R	IA	A	M	15 *(7)*[d]
Panyptila cayennensis	(R)	SE (o)	IA	A	M	16 *(2)*[d]
TROCHILIDAE (14)						
Threnetes niger	VR	SE (MQ, i2)	N	FD	S	*5 *(1)*[d]
Phaethornis superciliosus	(FC)	SE (MQ, i2, î?, o)	N	FH	S (L)	6 *(10)*[d]
Phaethornis malaris	C	SE (MQ, i2, o)	N	FH	S (L)	8 *(2)*[d]
Phaethornis bourcieri	(C)	SE (MQ, i2, î, o)	N	FH	S (L)	4 *(7)*[d]
Phaethornis ruber	(C)	SE (MQ, i2, î, o)	N	FH/FD/FO	S	2 *(2)*[d]
Campylopterus largipennis	C	SE (MQ, i2, î, o)	N	FH/FD	S	8 *(15)*[d]
Florisuga mellivora	FC	SE (MQ, i2, î, o)	N	FH	S	7 *(31)*[d]
Avocettula recurvirostris	R	SE (MQ, i2, î, o)	N	FH	S	4 *(1)*[d]
Lophornis ornatus	R	SE (o)	N	FH	S	2 *(6)*[d]
Discosura longicauda	R	SE (o)	N	FH	S	
Thalurania furcata	VC	SE (MQ, i2, î, o)	N	FH/FD	S	3 *(22)*[d]
Hylocharis sapphirina	FC	SE (MQ, î, o)	N	FH	S	4 *(10)*[d]
Topaza pella	C	SE (MQ, i2, î, o)	N	FH/FD	S (L)	13 *(2)*[d]
Heliothryx aurita	C	SE (MQ, i2, î, o)	N	FH	S	5 *(8)*[d]
TROGONIDAE (5)						
Trogon melanurus	VC	SE (MQ, i2, î, o), R	OM	FH	S	104 *(11)*[d]
Trogon viridis	VC	SE (MQ, i2, î, o), R	OM	FH	S	83 *(33)*[d]
Trogon collaris	VC	SE (MQ, i2, î, o)	OM	FH	S	59 *(2)*[c]
Trogon rufus	VC	SE (MQ, i2, o)	OM	FH	S	53 *(7)*[d]
Trogon violaceus	FC	SE (MQ, i2, î, o), R	OM	FH	S	49 *(18)*[d]
ALCEDINIDAE (5)						
Megaceryle torquata	C	SE (i2, o), R	P	W	S	
Chloroceryle amazona	C	SE (i2, î, o), R	P	W	S	
Chloroceryle americana	FC	SE (i2, î, o), R	P	W	S	
Chloroceryle inda	FC	SE (i2, o)	P	W	S	51 [e]
Chloroceryle aenea	FC	SE (MQ, i2, î, o)	P	W	S	12 *(8)*[a]
MOMOTIDAE (1)						
Momotus momota	VC	SE (MQ, i2, î, o), R	OM	FH	S	126 *(10)*[a]
GALBULIDAE (4)						
Galbula albirostris	VC	SE (MQ, i2, î, o)	IM	FH	S	19 *(17)*[a]
Galbula leucogastra	C	SE (i2, î), R	IC	FH	S	16 *(13)*[d]
Galbula dea	VC	SE (MQ, i2, î, o), R	IC	FH	S	29 *(23)*[d]
Jacamerops aurea	FC	SE (MQ, i2, o)	IM	FH	S	62 *(7)*[d]
BUCCONIDAE (7)						
Notharchus macrorhynchus	VR	SE (i2, o)	IC	FH	S	86 *(1)*[c]
Notharchus tectus	FC	SE (MQ, i2, î, o), R	IC	FO	S	26 *(1)*[a]
Bucco tamatia	R	SE (i2, o)	IM	FH	S	36 *(8)*[d]
Bucco capensis	R	SE (MQ, i2, o)	IM	FH	S	53 *(2)*[a]
Malacoptila fusca	FC	SE (MQ, i2, î, o)	IM	FH	S	44 *(5)*[d]
Monasa atra	C	SE (MQ, i2, î, o), R	IM	FH	S	110 *(1)*[a]
Chelidoptera tenebrosa	FC	SE (o), R	IA	FO/A	M	38 *(2)*[c]
CAPITONIDAE (1)						
Capito niger	C	SE (MQ, i2, î, o)	OC	FH	P	54 *(3)*[c]
RAMPHASTIDAE (5)						
Pteroglossus aracari	(FC)	SE (MQ, i2, o), R	FC	FH/FO	P	245 *(1)*[a]
Pteroglossus viridis	FC	SE (MQ, i2, o)	FC	FH/FO	P	130 *(1)*[a]
Selenidera culik	C	SE (MQ, i2, o), R	FC	FH	P	147 *(19)*[d]
Ramphastos vitellinus	VC	SE (MQ, i2, î, o), R	FC	FH	P	354 *(5)*[c]

	Frequency[1]	Sites[2]	Guild[3]	Habitat[4]	Social[5]	Mass *(N)*[6]
Ramphastos tucanus	VC	SE (MQ, i2, î, o), R	FC	FH	P	385 *(2)*[c]
PICIDAE (14)						
Picumnus exilis	VR	SE (MQ, o)	IC	FH	S	9 *(15)*[c]
Melanerpes cruentatus	VR	SE (MQ, o)	IT	FO	M	58 *(27)*[d]
Veniliornis passerinus	(E)	SE (i2?, î, o)	IT	FH	S	
Veniliornis cassini	VC	SE (MQ, i2, î, o), R	IT	FH	S	35 *(20)*[d]
Piculus flavigula	VC	SE (MQ, i2, î, o)	IT	FH	S	55 *(27)*[d]
Piculus chrysochloros	(E)	SE (i2)	IT	FH	S	91 *(2)*[d]
Piculus rubiginosus	E	SE (MQ, o)	IT	FH	S	81 *(10)*[d]
Celeus undatus	VC	SE (MQ, i2, î, o)	IT	FH	S	58 *(1)*[a]
Celeus elegans	VC	SE (i2, î, o)	IT	FH	S	145 *(25)*[d]
Celeus flavus?	E	SE (i2)	IT	FD	S	107 *(21)*[d]
Celeus torquatus	FC	SE (i2)	IT	FH	S	113 *(3)*[c]
Dryocopus lineatus	R	SE (o), R	IT	FO	S	208 *(11)*[d]
Campephilus rubricollis	VC	SE (MQ, i2, î, o), R	IT	FH	S	199 *(15)*[d]
Campephilus melanoleucos	VR	SE (o), R	IT	FO	S	256 *(18)*[d]
FURNARIIDAE (14)						
Synallaxis macconnelli	FC	SE (o)	IL	FO	S	18 *(18)*[c]
Synallaxis gujanensis		PSD	IL	FO	S	16 *(10)*[c]
Certhiaxis gutturata	FC	SE (i2, o)	IC	FH	S	14 *(2)*[c]
Philydor ruficaudatus	(E)	SE (MQ, i2, o)	IM	FH	F	20 *(4)*[a]
Philydor erythrocercus	VC	SE (MQ, i2, î, o)	IM	FH	F	22 *(11)*[a]
Philydor pyrrhodes	FC	SE (MQ, i2, o)	IM	FH	F	37 *(1)*[a]
Automolus ochrolaemus	R	SE (MQ, i2)	IM	FH	F	34 *(4)*[a]
Automolus infuscatus	VC	SE (MQ, i2, î, o)	IM	FH	F	31 *(51)*[a]
Automolus rubiginosus	FC	SE (MQ, o)	IL	FH	S	35 *(3)*[a]
Automolus ruficaudatus?	E	SE (i2)	IM	FH	F	37 *(5)*[d]
Sclerurus mexicanus	FC	SE (MQ, i2)	IL	FH	S	22 *(18)*[a]
Sclerurus caudacutus	FC	SE (MQ, i2, o)	IL	FH	S	38 *(9)*[a]
Xenops milleri	R	SE (i2, o)	IM	FH	F	11 *(1)*[d]
Xenops minutus	VC	SE (MQ, i2, î, o)	IM	FH	F	11 *(31)*[a]
DENDROCOLAPTIDAE (11)						
Dendrocincla fuliginosa	FC	SE (i2, o)	IL	FH	A	39 *(6)*[a]
Dendrocincla merula	E	SE (i2)	IL	FH	A	48 *(1)*[a]
Deconychura stictolaema/ D. longicauda	(VR)	SE (MQ, i2, o)	IT	FH	S	18 *(2)*[a]
Glyphorynchus spirurus	VC	SE (MQ, i2, î, o)	IT	FH	S	13 *(290)*[a]
Dendrexetastes rufigula	(VR)	SE (i2?, o)	IT	FH	S	70 *(13)*[d]
Hylexetastes perrotii	R	SE (i2, o)	IT	FH	S	126 *(7)*[d]
Dendrocolaptes certhia	C	SE (MQ, i2, î, o)	IT	FH	S	65 *(2)*[a]
Dendrocolaptes picumnus	VR	SE (i2)	IT	FH	S	89 *(10)*[d]
Xiphorhynchus pardalotus	VC	SE (MQ, i2, î, o)	IT	FH	F	42 *(61)*[a]
Lepidocolaptes albolineatus	FC	SE (MQ, i2, î, o)	IT	FH	S	20 *(23)*[d]
Campylorhamphus trochilirostris/C. procurvoides	FC	SE (MQ, i2, o)	IT	FH	F	*36 *(3)*[d]
THAMNOPHILIDAE (33)						
Cymbilaimus lineatus	VC	SE (MQ, i2, î, o)	IM	FH/FL	S	36 *(17)*[d]
Frederickena viridis	R	SE (MQ, i2)	IL	FH	S	59 *(5)*[a]
Sakesphorus melanothorax	FC	SE (MQ, î, o)	IM	FL	S	31 *(8)*[c]
Thamnophilus murinus	VC	SE (MQ, i2, î, o), R	IM	FH	S	19 *(7)*[a]
Thamnophilus punctatus?	(E)	SE (MQ)	IC	FO/FL	S	22 *(11)*[c]
Thamnophilus amazonicus	VC	SE (MQ, i2, î, o), R	IC	FH/FL	S	19 *(9)*[c]
Thamnomanes ardesiacus	VC	SE (MQ, i2, î, o)	IM	FH	F	17 *(55)*[a]
Thamnomanes caesius	VC	SE (MQ, i2, î, o)	IM	FH	F	16 *(33)*[a]
Myrmotherula brachyura	C	SE (MQ, i2, î, o)	IC	FH/FL	S	6 *(7)*[c]
Myrmotherula surinamensis	C	SE (MQ, i2, î, o)	IL	FD/FO/FL	S	9 *(1)*[a]
Myrmotherula guttata	C	SE (MQ, i2, î, o)	IL	FH	S	10 *(34)*[a]

	Frequency[1]	Sites[2]	Guild[3]	Habitat[4]	Social[5]	Mass *(N)*[6]
Myrmotherula gutturalis	VC	SE (MQ, i2, î, o)	IM	FH	F	9 *(77)*[a]
Myrmotherula axillaris	VC	SE (MQ, i2, î, o)	IM	FH	F	7 *(55)*[a]
Myrmotherula longipennis	VC	SE (MQ, i2, î, o)	IM	FH	F	8 *(37)*[a]
Myrmotherula menetriesii	VC	SE (MQ, i2, î, o)	IM	FH	F	8 *(23)*[a]
Herpsilochmus stictocephalus	VC	SE (MQ, i2, î, o), R	IC	FH	S	*8 *(2)*[c]
Microrhopias quixensis	C	SE (MQ, o)	IM	FL	S	9 *(1)*[a]
Terenura spodioptila	FC	SE (i2, î, o)	IC	FH	F	6 *(3)*[d]
Cercomacra cinerascens	VC	SE (MQ, i2, î, o), R	IC	FH	S	14 *(11)*[d]
Cercomacra tyrannina	E	SE (MQ)	IM	FL	S	16 *(32)*[d]
Cercomacra nigrescens	VR	SE (MQ, o)	IM	FL	S	19 *(1)*[c]
Hypocnemis cantator	VC	SE (MQ, i2, î, o), R	IM	FH	S	11 *(41)*[a]
Hypocnemoides melanopogon	FC	SE (MQ, i2, î, o)	IL	FD/W	S	13 *(2)*[a]
Percnostola rufifrons	VC	SE (MQ, i2, î, o), R	IL	FH	S	28 *(60)*[a]
Percnostola leucostigma	C	SE (MQ, i2, î, o)	IL	FD	S	23 *(2)*[a]
Sclatera naevia	R	SE (î?, o)	IL	FD	S	25 *(26)*[d]
Myrmeciza ferruginea	VC	SE (MQ, i2, î, o)	IL	FH	S	26 *(25)*[a]
Myrmeciza atrothorax	FC	SE (MQ? î, o)	IL	FO	S	16 *(15)*[d]
Pithys albifrons	(R)	SE (MQ, i2, o)	IL	FH	A	20 *(120)*[a]
Gymnopithys rufigula	VC	SE (MQ, i2, î, o)	IL	FH	A	29 *(38)*[a]
Hylophylax naevia	VC	SE (MQ, i2, î, o)	IL	FH	S	13 *(24)*[a]
Hylophylax poecilonota	VC	SE (MQ, i2, î, o)	IL	FH	S	17 *(102)*[a]
Myrmornis torquata	VC	SE (MQ, i2, î, o)	IL	FH	S	43 *(33)*[a]
FORMICARIIDAE (5)						
Formicarius colma	C	SE (MQ, i2, o)	IL	FH	S	47 *(9)*[a]
Formicarius analis	VC	SE (MQ, i2, o), R	IL	FH	S	61 *(2)*[a]
Grallaria varia	R	SE (MQ, i2, o)	IL	FH	S	126 *(1)*[d]
Hylopezus macularius	VC	SE (MQ, i2, î, o), R	IL	FH	S	42 *(5)*[a]
Myrmothera campanisona	VC	SE (MQ, i2, î, o), R	IL	FD	S	51 *(1)*[a]
CONOPOPHAGIDAE (1)						
Conopophaga aurita	FC	SE (MQ, i2, î)	IL	FH	S	23 *(7)*[a]
COTINGIDAE (8)						
Phoenicircus carnifex	VC	SE (MQ, i2, î, o)	FC	FH	S	82 *(6)*[d]
Iodopleura fusca	R	SE (o)	OC	FH	M	15 *(1)*[d]
Cotinga cotinga	R	SE (MQ, o), R	FC	FH	S	53 *(1)*[d]
Cotinga cayana	FC	SE (MQ, i2, o), R	FC	FH	S	69 *(2)*[c]
Xipholena punicea	FC	SE (i2, o), R	OC	FH	S	63 *(2)*[c]
Lipaugus vociferans	VC	SE (MQ, i2, î, o), R	OM	FH	S (L)	69 *(15)*[d]
Querula purpurata	VC	SE (MQ, i2, î, o), R	OC	FH/FD	M	107 *(6)*[c]
Perissocephalus tricolor	VC	SE (MQ, i2, î, o), R	OM	FH	S (L)	306 *(5)*[c]
OXYRUNCIDAE (1)						
Oxyruncus cristatus	E	SE (i2)	OC	FH	S	43 *(2)*[d]
PIPRIDAE (9)						
Pipra erythrocephala	VC	SE (MQ, i2, î, o)	OM	FH	S (L)	12 *(79)*[a]
Pipra pipra	VC	SE (MQ, i2, î, o)	OM	FH	S (L)	12 *(157)*[a]
Pipra serena	VC	SE (MQ, i2, o)	OM	FH/FL	S (L)	10 *(51)*[a]
Corapipo gutturalis	(FC)	SE (MQ, i2, î, o)	OM	FH	S (L)	9 *(30)*[a]
Manacus manacus	C	SE (MQ, i2, î, o)	OM	FL	S (L)	16 *(22)*[a]
Neopipo cinnamomea	R	SE (MQ, i2, î, o)	OM	FH	S	7 *(1)*[d]
Tyranneutes virescens	VC	SE (MQ, i2, î, o)	OM	FH/FD	S	9 *(4)*[a]
Piprites chloris	VC	SE (MQ, i2, î, o)	OC	FH/FL	F	16 *(6)*[d]
Schiffornis turdinus	VC	SE (MQ, i2, î, o)	IL	FH/FD	S	31 *(46)*[a]
TYRANNIDAE (40)						
Zimmerius gracilipes	VC	SE (MQ, i2, î, o), R	IC	FH	S	6 *(1)*[c]
Ornithion inerme	E	SE (o)	IC	FH/FD	S	6 *(3)*[d]
Camptostoma obsoletum	VC	SE (MQ, i2, î, o), R	IC	FH	S	7 *(6)*[c]
Mionectes macconnelli	VC	SE (MQ, i2, î, o)	OM	FH	S (L)	12 *(146)*[a]
Corythopis torquata	VC	SE (MQ, i2, î, o)	IL	FH	S	14 *(25)*[a]

	Frequency[1]	Sites[2]	Guild[3]	Habitat[4]	Social[5]	Mass *(N)*[6]
Myiornis ecaudatus	C	SE (MQ, i2, î, o)	IC	FH	S	5 *(5)*[d]
Lophotriccus vitiosus	VC	SE (MQ, i2, î, o), R	IM	FH	S	6 *(3)*[a]
Lophotriccus galeatus	FC	SE (MQ, î)	IM	FL	S	7 *(15)*[d]
Hemitriccus josephinae	FC	SE (MQ)	IM	FL	S	8 *(1)*[a]
Hemitriccus zosterops	VC	SE (MQ, i2, î, o)	IM	FH	S	9 *(5)*[a]
Todirostrum pictum	VC	SE (MQ, i2, î, o)	IC	FH	S	6 *(1)*[c]
Ramphotrigon ruficauda	FC	SE (i2, î)	IM	FH	S	18 *(13)*[d]
Rhynchocyclus olivaceus	FC	SE (MQ, i2, î, o)	IM	FH	S	19 *(2)*[a]
Tolmomyias assimilis	VC	SE (MQ, i2, î, o), R	IM	FH	S	13[e]
Tolmomyias sp.	VR	SE (î)	IC	FH/FO	S	
Platyrhynchus saturatus	C	SE (MQ, i2, î)	IL	FH	S	10 *(45)*[a]
Platyrhynchus coronatus	VC	SE (MQ, i2, î, o)	IM	FH	S	9 *(23)*[a]N
Onychorhynchus coronatus	VR	SE (MQ, o)	IM	FH	S	14 *(7)*[d]
Terenotriccus erythrurus	VC	SE (MQ, i2, î)	IM	FH	S	8 *(7)*[a]
Myiobius barbatus	VC	SE (MQ, i2, î, o)	IM	FH	S	10 *(53)*[a]
Contopus albogularis	R	SE (MQ, o)	IC	FH	S	10 *(13)*[d]
Colonia colonus	E	SE (o), PSD	IC	FH	S	18 *(21)*[d]
Attila cinnamomeus?	E	SE (o)	IC	FD	S	39 *(21)*[d]
Attila spadiceus	C	SE (MQ, i2, î, o), R	IM	FH	S	36 *(2)*[a]
Rhytipterna simplex	VC	SE (MQ, i2, î, o), R	IM	FH	S	32 *(38)*[d]
Laniocera hypopyrrha	FC	SE (MQ, i2, î), R	IM	FH	S	44 *(1)*[a]
Sirystes sibilator	VR	SE (MQ, i2, o)	IC	FH	S	32 *(2)*[d]
Myiarchus swainsoni	(FC)	SE (MQ, i2, î, o)	IC	FH/FO	S	24 *(1)*[a]
Pitangus sulphuratus		PSD	IM	FO	S	
Myiozetetes similis	R	SE (o), R	IC	FO	S	
Myiozetetes luteiventris	C	SE (MQ, i2, î, o), R	IC	FH/FL	S	17 *(8)*[d]
Conopias albovittata	VC	SE (MQ, i2, î, o), R	IC	FH	S	21 *(1)*[c]
Myiodynastes maculatus	E*[7]	SE (i2, o)	IC	FD/FO	S	43 *(18)*[d]
Legatus leucophaius	FC	SE (MQ, i2, î, o), R	IC	FO	S	20 *(2)*[c]
Tyrannus melancholicus	FC	SE (o), R	IC	FO	S	45 *(2)*[c]
Pachyramphus marginatus	(VR)	SE (i2, o)	OC	FH	S	18 *(19)*[d]
Pachyramphus surinamus	R	SE (i2, î?, o)	OC	FH	S	20 *(7)*[d]
Pachyramphus minor	FC	SE (MQ, i2, î, o)	OC	FH	S	37 *(24)*[d]
Tityra cayana	FC	SE (MQ, i2, o)	OC	FH/FO	S	68 *(20)*[d]
Tityra inquisitor	E	SE (i2)	OC	FH	S	38 *(7)*[d]
HIRUNDINIDAE (7)						
Tachycineta albiventer	C	SE (o), R	IA	W/A	M	
Phaeoprogne tapera	R	SE (o), R	IA	A	M	
Progne chalybea	FC	SE (o), R	IA	A	M	
Atticora fasciata	(C)	SE (o), R	IA	W/A	M	
Atticora melanoleuca	E	R	IA	W/A	M	
Stelgidopteryx ruficollis	E	SE (o)	IA	A	M	
Hirundo rustica	(FC)*	SE (o), R	IA	A	M	
TROGLODYTIDAE (4)						
Thryothorus coraya	VC	SE (MQ, i2, î, o), R	IM	FH/FL	S	18 *(7)*[a]
Troglodytes aedon	R	SE (o)	IM	FO	S	13 *(14)*[d]
Microcerculus bambla	C	SE (MQ, i2, o)	IL	FH	S	17 *(10)*[a]
Cyphorinus arada	C	SE (MQ, i2, î, o)	IL	FH	S	20 *(5)*[a]
TURDIDAE (2)						
Turdus fumigatus?	E	SE (o)	OM	FD/FL	S	65 *(8)*[c]
Turdus albicollis	VC	SE (MQ, i2, î, o)	OM	FH	S	46 *(147)*[a]
SYLVIIDAE (2)						
Microbates collaris	C	SE (MQ, i2, î, o)	IL	FH	S	10 *(14)*[a]
Ramphocaenus melanurus	VC	SE (MQ, i2, î, o)	IC	FH	S	9 *(7)*[d]
VIREONIDAE (6)						
Cyclarhis gujanensis	R	SE? (o?), R	OC	FL	S	26 *(11)*[c]
Vireolonius leucotis	FC	SE (MQ, i2, o)	IC	FH	F	24 *(2)*[c]

	Frequency[1]	Sites[2]	Guild[3]	Habitat[4]	Social[5]	Mass *(N)*[6]
Vireo olivaceus	VC	SE (MQ, i2, î, o), R	OC	FH	S	15 *(14)*[d]
Hylophilus pectoralis	VC	SE (MQ, i2, î, o), R	IC	FH	F	11 *(21)*[d]
Hylophilus muscicapinus	VC	SE (MQ, i2, î, o)	IC	FH	F	11 *(8)*[d]
Hylophilus ochraceiceps	VC	SE (MQ, i2, î, o)	IM	FH	F	9 *(32)*[a]
PARULIDAE (3)						
Parula pitiayumi	FC	SE (MQ, o)	IC	FH	F	
Setophaga ruticilla	E*	PSD ("rescue area")	IM	FH	S	7 *(1)*[d]
Basileuterus rivularis	C	SE (MQ, i2, o)	IL	FD	S	13 *(6)*[c]
ICTERIDAE (5)						
Scaphidura oryzyvora	E	SE (o), R	OC	FO	S	154 *(7)*[d]
Psarocolius viridis	VC	SE (MQ, i2, î, o), R	OC	FH	S	245 *(4)*[c]
Cacicus cela	(R)	SE (MQ, o), R	OC	FO	M	94 *(2)*[c]
Cacicus haemorrhous	FC	SE (MQ, i2, î, o), R	OC	FO	M	69 *(3)*[c]
Icterus cayanensis	R	SE (MQ, i2)	OC	FH	S	45 *(4)*[d]
EMBERIZIDAE (32)						
Coereba flaveola	VC	SE (MQ, i2, î, o), R	N	FH/FO	P	9 *(3)*[a]
Dacnis cayana	FC	SE (MQ, i2, î, o), R	OC	FH	P	12 *(24)*[d]
Dacnis lineata	R	SE (MQ, î, o)	OC	FH	P	11 *(10)*[d]
Cyanerpes caeruleus	VC	SE (MQ, i2, î, o), R	OC	FH	P	12 *(1)*[a]
Cyanerpes cyaneus	C	SE (MQ, i2, î, o), R	OC	FH	P	13 *(12)*[c]
Chlorophanes spiza	C	SE (MQ, i2, î, o), R	OC	FH	P	16 *(7)*[a]
Tangara velia	R	SE (MQ, i2, î, o), R	OC	FH	P	18 *(4)*[d]
Tangara chilensis	C	SE (MQ, i2, î, o), R	OC	FH	P	17 *(6)*[d]
Tangara punctata	FC	SE (MQ, i2, î, o)	OC	FH	P	14 *(14)*[d]
Tangara gyrola	C	SE (MQ, i2, î, o)	OC	FH	P	18 *(1)*[c]
Euphonia cayennensis	VC	SE (MQ, i2, î, o), R	OM	FH	S	14 *(9)*[e]
Thraupis episcopus	(R)	SE (o), R	OC	FO	M	36 *(2)*[c]
Thraupis palmarum	R	SE (o), R	OC	FO	M	37 *(18)*[d]
Ramphocelus carbo	(FC)	SE (MQ, î, o), R	IC	FO	M	26 *(15)*[d]
Cyanicterus cyanicterus		PSD ("rescue area")	OC	FH	F	35 *(4)*[d]
Lanio fulvus	C	SE (MQ, i2, î, o)	IM	FH	F	26 *(11)*[a]
Tachyphonus cristatus	FC	SE (MQ, i2, î, o)	OC	FH	F	19 *(16)*[d]
Tachyphonus surinamus	VC	SE (MQ, i2, î,, o)	OC	FH	P	21 *(45)*[a]
Tachyphonus luctuosus	FC	SE (MQ, o)	OC	FL	P	14 *(2)*[a]
Hemithraupis flavicollis	FC	SE (MQ, i2, î, o)	OC	FH	P	13 *(10)*[d]
Lamprospiza melanoleuca	(E)	SE (MQ, o)	OC	FH	M	32 *(21)*[d]
Cyanocompsa cyanoides	FC	SE (MQ, i2, o)	OM	FH/FO	S	24 *(2)*[a]
Saltator maximus	FC	SE (MQ, î, o), R	OC	FO	S	43 *(1)*[a]
Periporphyrus erythromelas	FC	SE (i2)	FC	FH	S	46 *(1)*[a]
Pitylus grossus	VC	SE (MQ, i2, î, o), R	OM	FH	S	45 *(1)*[a]
Caryothraustes canadensis	VC	SE (MQ, i2, î, o)	OC	FH	P	33 *(17)*[d]
Pheucticus ludovicianus	E*	SE(o)	OC	FO	S	
Arremon taciturnus	(FC)	SE (MQ, i2, î, o)	FT	FH	S	25 *(11)*[a]
Oryzoborus angolensis	(E)	R	GT	FO	S	12 *(9)*[d]
Sporophila lineola	VR	SE (o)	GT	FO	S	10 *(2)*[c]
Sporophila castaneiventris	FC	SE (o), R	GT	FO	S	8 *(6)*[d]
Volatinia jacarina		PSD	GT	FO	S	10 *(2)*[c]

[1] Frequency: E: exceptional (< 1 obs./year); VR: very rare (1-2 obs./year); R: rare (3-5 obs./year); FC: fairly common (6-15 obs./year); C: common (16-30 obs./year); VC: very common (> 30 obs./year); in parentheses ( ): frequency probably under-estimated; * migrant.

[2] Sites: SE: Saint-Eugène, including MQ: mainland quadrat, i2: island #2; î: at least one of the 14 islets under study; o: other sectors of Saint-Eugène (including mainland outside quadrat and flooded area, from Saut Kawène to creek Saint-Eugène).

R = river and other parts of the reservoir, outside Saint-Eugène.

PSD = Petit Saut dam and surroundings (but the lake). Except special case, PSD is mentioned only for species not seen elsewhere.

[3] Guild: CA: carrion-eaters; CP: predatory carnivores; FC: canopy frugivores; FT: terrestrial

frugivores; GC: canopy granivores; GT: terrestrial granivores; IA: aerial insectivores; IC: canopy insectivores; IL: ground or lower strata insectivores; IM: middle strata insectivores; IT: tree-creeping insectivores; IW: aquatic insectivores or omnivores; N: nectarivores; OC: canopy omnivores; OM: middle strata omnivores; P: piscivores.

[4] Habitat: FH: high (*terra firme*) forest (on slopes or crests); FD: damp forest (flats, seasonally flooded forest); FL: liana forest; FO: large openings in the forest, edges; W: water (including forest streamlets); A: air.

[5] Social: S: solitary; M: mono-species groups; P: multi-species groups, excluding permanent flocks; F: permanent flocks; A: ant-following; L: leks.

[6] Mass: mean values in grams, according to (in priority order): [a] personal data, birds caught at Saint-Eugène; [b] Erard *et al.* (1991); [c] collections of the Muséum National d'Histoire Naturelle (Paris), specimens from French Guiana (missions Dorst - Chauvancy - Gros in 1971 and 1975); [d] Haverschmidt & Mees (1994); [e]Bierregaard (1988); [f] Terborgh *et al.* (1990); * mass of a close congeneric species (*Glaucidium brasilianum* for *G. hardyi, Threnetes leucurus* for *T. niger, Campylorhamphus procurvoides* for *C. trochilirostris, Herpsilochmus sticturus* for *H. stictocephalus*).