

BIRDS OF THE SIBUN RIVERINE FOREST, BELIZE

Victoria D. Piaskowski¹, Mario Teul², Kari M. Williams¹, & Reynold N. Cal²

¹Birds Without Borders – *Aves Sin Fronteras*[®], Zoological Society of Milwaukee, 1421 North Water Street, Milwaukee, Wisconsin 53202, USA. *E-mail*: vickip@zoosociety.org.

²Birds Without Borders – *Aves Sin Fronteras*[®], Foundation for Wildlife Conservation, Inc., P.O. Box 97, Belmopan City, Cayo District, Belize.

Resumen. – *Aves de la selva de galería del Río Sibun, Belice.* – Con el fin de contribuir al conocimiento sobre las especies de aves de las selvas de galería, conducimos inventarios durante 39 días entre 2000 y 2003 en un área de 20 ha de selva a lo largo del Río Sibun en Belice central. Las especies presentes fueron detectadas usando redes de neblina, censos diarios de 2 h y observaciones casuales. Detectamos un total de 196 especies de aves, de las cuales 151 fueron residentes permanentes, 38 migratorias y/o de paso, 4 residentes estacionales y 3 residentes/migratorias Neotropicales. Del total, 79 especies fueron consideradas comunes en el sitio, 39 poco comunes y 78 raras. Identificamos 19 especies amenazadas y 5 especies endémicas en sus ámbitos. El estudio del hábitat ribereño provee datos fundamentales sobre las especies presentes en este tipo de selva, libres de impactos humanos, y contribuye a la información disponible sobre la avifauna que utilizan tales hábitat en Belice durante la época no reproductiva.

Abstract. – An inventory of the bird species was conducted on 39 days from 2000 to 2003 in a 20-ha study area in riverine forest along the Sibun River in central Belize. Bird species present were detected through mist-netting, a 2-h daily census period, and casual observations. We detected a total of 196 bird species, of which 151 were permanent residents, 38 were migrants and/or transients, 4 were seasonal residents, and 3 were resident/migrants. Seventy-nine species were considered common at the site, 39 were uncommon and 78 were rare. Nineteen species of conservation concern and five restricted-range endemics were identified at the site. This study provides baseline data on the bird species present in an area of riverine forest not disturbed by humans and contributes to the information available on the avian species utilizing riparian habitats in Belize during the non-breeding season. *Accepted 17 January 2006.*

Key words: Birds, riverine forest, census, mist-netting, Belize.

INTRODUCTION

Riparian habitats have been shown to be important in maintaining biodiversity (Naiman *et al.* 1993). Studies of the bird communities present in riparian areas conducted in North America (Knopf *et al.* 1994, Darveau *et al.* 1995) have shown riparian habitats to be high in bird species richness. Lovejoy (1974), Remsen & Parker (1983), and Terborgh *et al.* (1990) conducted detailed studies in riparian

habitats in South America and found them to be sites of high bird species diversity and abundance. Hutto (1980) studied bird use of 13 habitats in western Mexico from January to March and found that the greatest number of species was present in riparian gallery and second growth forests. However, the riparian forest he studied bordered cultivated fields. Morton (1980) studied migrant use of 14 habitats including a riverine forest from December to March in the Panama Canal

Zone and found that migrants concentrated in riverine forest relative to upland forest on the Pacific slope. Studies describing the bird species composition of riparian areas were conducted in undisturbed areas of southern Belize by Brokaw & Lloyd-Evans (1987) and Mallory (1991). Both described riparian areas as being high in bird species richness. Mallory *et al.* (2004) conducted mist-netting in forests in northwestern Belize (Rio Bravo Conservation and Management Area) and found that the number of species captured in riparian and palm forest were significantly higher than in upland forest sites. To add to the knowledge of the avifauna utilizing riparian areas in Belize and to provide baseline data for an area that is subject to continuing development pressure (Boles 1999), we conducted research from 2000 to 2003 in an area of riverine forest along the Sibun River that had no evidence of recent human disturbance.

Little published information is available on the bird species composition of riparian forests in central Belize. Ornithological studies contributing to the knowledge of the avifauna of Belize have been conducted there since 1857 (Russell 1964). Russell (1964) conducted field studies during 13 months in British Honduras (now Belize) from 1955 to 1963. He summarized his findings and those of prior studies conducted there in a comprehensive distributional study. The localities in his detailed species accounts included a number of riparian areas throughout the country, but did not compare the species composition of riparian areas to other habitats. Horwich & Lyon (1990) provided a list of bird species found along the edges of the Belize River that are part of the Community Baboon Sanctuary (for howler monkeys) in Belize. Miller & Miller (1998) summarized the ornithological work conducted in Belize since Russell's 1964 study. In this paper we present the results of a 4-year study on the bird species present in riv-

erine forest along the Sibun River in central Belize.

METHODS

Study area. The study was conducted along the northern edge of Runaway Creek Nature Preserve. The 2432 ha (24.3 km²) Runaway Creek Nature Preserve (RCNP) is a private protected area owned and managed by the Foundation for Wildlife Conservation, Inc. Approximately 6.4 km of the Sibun River form the northern boundary of the RCNP. The study area encompassed approximately 20 ha within the middle reaches of the Sibun River, at 17°21'N and 088°29'W, and 38 m a.s.l. Mean annual rainfall in central Belize (Belmopan) is about 2020 mm. Mean daily temperatures range from a low of 22.8°C in January to a high of 28.7°C in May (Belize NMS 2005). Mean temperature at the study site during the study was 22.6°C. Annual floods inundate the study area during the July to December rainy season. The study area is located in the transition zone between subtropical moist and subtropical wet forest life zones (Hartshorn *et al.* 1984) in Ecoregion NT0154 (the Petén-Veracruz moist forest, NGS & WWF 2005). The vegetation is described as tropical evergreen seasonal alluvial forest (Meerman 1999). The riverine forest studied was not affected by fragmentation, as it was bordered to the south, east and west by tropical evergreen seasonal forest. The study site was surrounded by approximately 210 ha of unfragmented riverine forest; an additional approximately 1097 ha of tropical evergreen seasonal forest bordered the site on the west and south. No evidence of recent human disturbance was present at the study site, but some sapodilla (*Manilkara sapota*) trees had old slash marks indicating past use by chicleiros.

Avifaunal sampling. The range of hours spent at

the site each day was 3.3–11.5 (mean \pm SD = 7.7 ± 2.3 h). Effort at the site was as follows: in 2000, 1 day in February and 2 days in March (27.5 h, 327.3 mist-net hours); in 2001, 6 days in March (51.8 h, 571.3 mist-net hours); in 2001–2002, 16 days (4 days each month) from December 2001 through March 2002 (117.7 h, 1217.6 mist-net hours); and in 2002–2003, 14 days (3–4 days each month) from December 2002 through March 2003 (103.3 h, 1055.9 mist-net hours). From 2000 through 2003, 300.4 h were spent at the site, and the total mist-net hours were 3172.1.

Because the study took place mainly during the non-breeding season and territorial singing is infrequent during this time period (Lynch 1995), we utilized a sampling technique modified from the Long Point Bird Observatory migration monitoring protocol (McCracken *et al.* 1993). The bird species present were sampled using mist-netting, a standardized census and casual observations.

The mist nets used in this study were nylon, 12 x 2.6 m, of 30-mm mesh size with 4 shelves. Nets were set beginning 20 m from the river in order to sample areas dominated by spiny bamboo (*Guadua longifolia*) and then spaced randomly from this net to the forest interior. In 2000 and 2001, 12–14 nets were set at ground level and two nets were elevated (Albanese & Piaskowski 1999) to 5–7 m above ground level. In addition, in 2000 and 2001, one 30-mm mesh net measuring 6 x 5.2 m was used to sample stratum starting approximately 21 m above ground level. In 2000 and 2001, mist nets were opened just before sunrise and operated for 6.2–11.5 h per day, weather permitting. During the 2001–2002 and 2002–2003 field seasons, nets were operated for 4 consecutive days each month in two different locations within the study area. On days one and two, 11 ground-level nets and one elevated net were operated. On days three and four, nine ground-level nets and one elevated net were operated. Mist nets

were operated for up to 10 h the first day of the rotation and for up to 6 h the second day of the rotation, weather permitting. We standardized mist-netting capture results using net hours. Net hours were calculated by summing the number of hours each 12 m net was operated (one net hour = one 12 m net open for one hour). We used the number of birds captured per 100 net hours to estimate the relative abundance of birds captured in mist nets. Included in these calculations were new birds captured as well as recaptured individuals that were banded at the site in previous field seasons. All North American migrants captured, except hummingbirds, were banded using a U.S. Bird Banding Laboratory aluminum leg band. All resident birds captured, except hummingbirds, also were banded with a uniquely numbered aluminum leg band. Breeding condition was determined by the presence of a brood patch or cloacal protuberance, as described in Burton & DeSante (1998). We considered only species with a brood patch or cloacal protuberance score of >1 as being in breeding condition.

To sample birds not captured in mist nets, we also recorded birds detected by visual and auditory observations using two methods. A census route traversing the study area was established. This census area started at the riverbank and moved through the entire area in which nets were set. An observer began to walk this route each day just before sunrise and before mist nets were opened, recording all bird species seen and heard. The census route took approximately 45 min to complete. In addition, researchers recorded birds detected throughout the day. Birds detected within 2 h of sunrise were counted as “censused” and those detected thereafter were recorded as “observed.” At the end of the day, all observers conferred and estimates of the total number of each species detected during the census and observation periods were compiled according to the methods of

TABLE 1. Species of conservation concern detected at the study site.

Species	PIF Combined score & status ¹	NAWCP category ²	Regional and Belize conservation concern ³	Abundance at study site ⁴	Belize seasonality ⁵
Neotropic Cormorant (<i>Phalacrocorax brasilianus</i>)		Moderate		R	R
Anhinga (<i>Anhinga anhinga</i>)		Moderate		R	R
Bare-throated Tiger-Heron (<i>Tigrisoma mexicanum</i>)		High		U	R
Snowy Egret (<i>Egretta thula</i>)		High		R	R
Little Blue Heron (<i>Egretta caerulea</i>)		High		C	M
Jabiru (<i>Jabiru mycteria</i>)		High	X	C	R
Wood Stork (<i>Mycteria americana</i>)		High	X	U	R
King Vulture (<i>Sarcoramphus papa</i>)			X	R	R
Swallow-tailed Kite (<i>Elanoides forficatus</i>)	16: Watch List			R	S
Ornate Hawk-Eagle (<i>Spizaetus ornatus</i>)			X	R	R
White-crowned Parrot (<i>Pionus senilis</i>)			X	U	R
White-fronted Parrot (<i>Amazona albifrons</i>)			X	C	R
Red-lore Parrot (<i>Amazona autumnalis</i>)			X	C	R
Wood Thrush (<i>Hylocichla mustelina</i>)	14: Watch List			C	M
Blue-winged Warbler (<i>Vermivora pinus</i>)	15: Watch List			U	M
Prothonotary Warbler (<i>Protonotaria citrea</i>)	15: Watch List			R	T
Worm-eating Warbler (<i>Helmitheros vermivorum</i>)	14: Watch List			C	M
Swainson's Warbler (<i>Limnithlypis swainsonii</i>)	14: Watch List		X	R	M
Kentucky Warbler (<i>Oporornis formosus</i>)	14: Watch List			U	M

¹These Neotropical migrant Partners in Flight (PIF) scores take into account population size (PS), breeding distribution (BD), non-breeding distribution (ND), threats to breeding (TB) and non-breeding (TN), and population trend (PT). The Combined score is calculated as follows: (highest of TB or TN scores) + (highest of BD or ND scores) + PT + PS. Combined scores can range from 4 (relatively secure) to 20 (highest concern). (Rich *et al.* 2004).

²These North American Waterbird Conservation Plan (NAWCP) categories take into account population trend, population size, threats to breeding and non-breeding, breeding and non-breeding distribution (Kushlan *et al.* 2002).

³These species are of regional conservation concern (in Mexico and/or Guatemala) and are also of conservation concern in Belize (Miller & Miller 1997). The assessment for Belize was based on each species distribution and range (Miller & Miller 1997).

⁴Abundance codes: C = Common, detected on $\geq 50\%$ of days; U = Uncommon, detected on 20%-49% of days; R = Rare, detected on $< 20\%$ of days.

⁵Belize seasonality codes: R = Resident, present year-round; M = Migrant, spends non-breeding season ("winter") in Belize, does not breed in Belize; T = Transient, present during migration; S = Seasonal resident, migrates to Belize to breed (also called breeding migrants).

McCracken *et al.* (1993), with care taken to avoid double counting of individual birds. We were able to collect data for the standard 2-h census period each day, but the length of the casual observation period varied considerably.

We estimated the abundance of each species at the site by calculating the percent of days that the species was detected by any method. Species were considered common if they were detected on $\geq 50\%$ of days, uncommon if detected on 20–49% of days and rare if detected on $< 20\%$ of days.

We used EstimateS (Colwell 2004) scaled by samples (number of sampling days) to compute species accumulation curves for the species detected by census and mist-netting. EstimateS uses repeated re-sampling of all pooled samples to calculate the sample-based rarefaction (species accumulation) curve. To compute the asymptote for the species accumulation curves, we used the Michaelis-Menton species richness estimation function (Colwell & Coddington 1994) computed by EstimateS. This method computes the estimated total species richness based on successively larger numbers of samples from the data set.

Assessing the conservation importance of the species detected at the study site. We defined Neotropical migrants or transients as those species in which all or part of their populations breed north of the Tropic of Cancer and spend the non-breeding season south of the Tropic of Cancer (DeGraaf & Rappole 1995). For Neotropical migrant landbirds, we used Partners in Flight (PIF) Combined Scores (Rich *et al.* 2004). These scores take into account population size and trends, distribution, and threats during breeding and non-breeding seasons and allow for determination of species of continental importance, such as Watch List species. Details on how the scores are calculated are listed at the bottom of Table 1.

For waterbirds we used the conservation status assessment categories of Kushlan *et al.* (2002). Information on restricted-range endemics and species that are considered to be of conservation concern in Belize was based on Miller & Miller (1997).

Vegetation. We conducted vegetation measurements at mist-net locations based on the methods of Ralph *et al.* (1993), Howe *et al.* (1997), Mallory (1997) and Martin *et al.* (1997). Ground-level mist nets were grouped according to the predominant vegetation present in the vicinity of the net, and one net was selected randomly from each of four groups for analysis. Vegetation measurements were done at both of the elevated net locations. Because vegetation was cleared in a strip approximately 1 m wide on each side of the mist net, this cleared area was not included in vegetation sampling. Except for canopy cover, which was measured at the center of the mist net lane, vegetation was sampled in an 11.3 m radius semicircle on both sides of the net lane, starting at the edge of the cleared areas.

RESULTS

Avifaunal sampling. A total of 196 species was detected, including 151 (77.0%) residents, 38 (19.4%) migrants and/or transients, 4 (2.0%) seasonal residents, and 3 (1.5%) resident/migrants (Table 2). Neotropical migrants and/or transients of 36 species represented 18.4% of the total. One-hundred sixty species were detected during censuses, 95 were detected by mist-netting, 14 were detected only by mist-netting, and 17 were detected only during casual observations (Table 2). Seventy-nine species were considered common at the site, 39 were uncommon and 78 were rare.

The species most frequently detected by census were the Plain Chachalaca (*Oriolus*

TABLE 2. Species abundance, Belize seasonality and endemic status of bird species detected by census, mist-netting, and casual observations.

Species ¹	Mean number censused per day	Number of birds per 100 net-h ²	Abundance at study site ³	Belize seasonality ⁴
Great Tinamou (<i>Tinamus major</i>)	0.03	0.00	R	R
Little Tinamou (<i>Crypturellus soui</i>)	0.15	0.00	R	R
Plain Chachalaca (<i>Ortalis vetula</i>)	19.51	0.00	C	R
Least Grebe (<i>Tachybaptus dominicus</i>)*	0.00	0.00	R	R
Neotropic Cormorant (<i>Phalacrocorax brasilianus</i>)*	0.00	0.00	R	R
Anhinga (<i>Anhinga anhinga</i>)*	0.00	0.00	R	R
Bare-throated Tiger-Heron (<i>Tigrisoma mexicanum</i>)	0.13	0.00	U	R
Great Blue Heron (<i>Ardea herodias</i>)	0.08	0.00	U	R
Great Egret (<i>Ardea alba</i>)	0.13	0.00	U	R
Snowy Egret (<i>Egretta thula</i>)	0.05	0.00	R	R
Little Blue Heron (<i>Egretta caerulea</i>)	0.46	0.00	C	M
Green Heron (<i>Butorides virescens</i>)	0.03	0.00	R	R
Jabiru (<i>Jabiru mycteria</i>)	1.62	0.00	C	R
Wood Stork (<i>Mycteria americana</i>)*	0.00	0.00	U	R
Black Vulture (<i>Coragyps atratus</i>)	1.03	0.00	C	R
Turkey Vulture (<i>Cathartes aura</i>)	0.74	0.00	C	R/M
King Vulture (<i>Sarcoramphus papa</i>)	0.03	0.00	R	R
Swallow-tailed Kite (<i>Elanoides forficatus</i>)	0.08	0.00	R	S
Plumbeous Kite (<i>Ictinia plumbea</i>)	0.03	0.00	U	S
Black-collared Hawk (<i>Busarellus nigricollis</i>)*	0.00	0.00	R	R
Gray Hawk [<i>Asturina nitida (plagiata)</i>]	0.03	0.00	R	R
Common Black-Hawk (<i>Buteogallus anthracinus</i>)	0.05	0.00	R	R
Great Black-Hawk (<i>Buteogallus urubitinga</i>)*	0.00	0.00	R	R
Roadside Hawk (<i>Buteo magnirostris</i>)	0.18	0.00	C	R
Short-tailed Hawk (<i>Buteo brachyurus</i>)	0.15	0.00	U	R
Zone-tailed Hawk (<i>Buteo albonotatus</i>)*	0.00	0.00	R	M
Ornate Hawk-Eagle (<i>Spizaetus ornatus</i>)*	0.00	0.00	R	R
Collared Forest-Falcon (<i>Micrastur semitorquatus</i>)	1.13	0.00	C	R
Laughing Falcon (<i>Herpetotheres cachinnans</i>)	1.00	0.00	C	R
Aplomado Falcon (<i>Falco femoralis</i>)*	0.00	0.00	R	R
Bat Falcon (<i>Falco rufigularis</i>)	0.08	0.00	U	R
Spotted Wood-Quail (<i>Odontophorus guttatus</i>)	0.08	0.00	R	R
Ruddy Crake (<i>Laterallus ruber</i>)	1.44	0.00	C	R
Gray-necked Wood-Rail (<i>Aramides cajaneus</i>)	0.21	0.00	R	R
Sungrebe (<i>Heliornis fulica</i>)*	0.00	0.00	R	R
Killdeer (<i>Charadrius vociferus</i>)*	0.00	0.00	R	M
Spotted sandpiper (<i>Actitis macularius</i>)*	0.00	0.00	R	M
Pale-vented Pigeon (<i>Patagioenas cayennensis</i>)	4.10	0.00	C	R
Scaled Pigeon (<i>Patagioenas speciosa</i>)	2.03	0.00	C	R
Red-billed Pigeon (<i>Patagioenas flavirostris</i>)	0.08	0.00	R	R
Short-billed Pigeon (<i>Patagioenas nigrirostris</i>)	1.74	0.00	C	R

TABLE 2. Continued.

Species ¹	Mean number censused per day	Number of birds per 100 net-h ²	Abundance at study site ³	Belize seasonality ⁴
Ruddy Ground-Dove (<i>Columbina talpacoti</i>)	0.08	0.00	R	R
Blue Ground-Dove (<i>Claravis pretiosa</i>)	5.33	0.16	C	R
White-tipped Dove (<i>Leptotila verreauxi</i>)	3.00	0.00	C	R
Gray-fronted Dove [<i>Leptotila rufaxilla (plumbeiceps)</i>]	2.36	0.09	C	R
Gray-chested Dove (<i>Leptotila cassini</i>)	1.23	0.06	U	R
Ruddy Quail-Dove (<i>Geotrygon montana</i>)	0.05	0.03	R	R
Olive-throated Parakeet (<i>Aratinga nana</i>)	2.03	0.00	C	R
White-crowned Parrot (<i>Pionus senilis</i>) ^{MAE}	0.56	0.00	U	R
White-fronted Parrot (<i>Amazona albifrons</i>) ^{MAE}	3.23	0.00	C	R
Red-lored Parrot (<i>Amazona autumnalis</i>)	7.23	0.00	C	R
Squirrel Cuckoo (<i>Piaya cayana</i>)	0.64	0.00	C	R
Striped Cuckoo (<i>Tapera naevia</i>)	0.03	0.00	R	R
Groove-billed Ani (<i>Crotophaga sulcirostris</i>)	0.18	0.00	R	R
Vermiculated Screech-owl (<i>Megascops guatemalae</i>)	0.05	0.00	R	R
Mottled Owl (<i>Ciccaba virgata</i>)	0.36	0.00	U	R
Common Pauraque (<i>Nyctidromus albicollis</i>)	1.03	0.00	U	R
White-collared Swift (<i>Streptoprocne zonaris</i>)	0.05	0.00	R	R
Vaux's Swift (<i>Chaetura vauxi</i>)	0.87	0.00	R	R
Long-billed (Long-tailed) Hermit (<i>Phaethornis longirostris</i>)	0.59	0.63	C	R
Stripe-throated (Little) Hermit (<i>Phaethornis strigularis</i>)	0.62	0.28	C	R
Wedge-tailed Sabrewing (<i>Campylopterus curvipennis</i>) ^{MAE}	0.00	0.03	R	R
White-necked Jacobin (<i>Florisuga mellivora</i>) [†]	0.00	0.06	R	R
Green-breasted Mango (<i>Anthracoceros prevostii</i>)	0.00	0.03	R	R
White-bellied Emerald (<i>Amazilia candida</i>) ^{MAE}	0.79	0.69	C	R
Rufous-tailed Hummingbird (<i>Amazilia tzacatl</i>)	4.05	1.51	C	R
Buff-bellied Hummingbird (<i>Amazilia yucatanensis</i>) ^{NMAE}	0.00	0.09	R	R
Ruby-throated Hummingbird (<i>Archilochus colubris</i>) [†]	0.00	0.06	R	M
Black-headed Trogon (<i>Trogon melanocephalus</i>) ^{MAE}	1.38	0.00	C	R
Violaceous Trogon (<i>Trogon violaceus</i>)	1.67	0.00	C	R
Blue-crowned Motmot (<i>Momotus momota</i>)	1.36	0.06	C	R
Ringed Kingfisher (<i>Ceryle torquatus</i>)	0.23	0.00	U	R
Green Kingfisher (<i>Chloroceryle americana</i>)	0.00	0.03	U	R
American Pygmy Kingfisher (<i>Chloroceryle aenea</i>)	0.00	0.03	R	R
White-necked Puffbird (<i>Notharchus macrorhynchos</i>)*	0.00	0.00	R	R
Rufous-tailed Jacamar (<i>Galbula ruficauda</i>)	1.08	0.09	C	R
Collared Aracari (<i>Pteroglossus torquatus</i>)	1.51	0.00	U	R
Keel-billed Toucan (<i>Ramphastos sulfuratus</i>)	1.79	0.00	C	R
Black-cheeked Woodpecker (<i>Melanerpes pucherani</i>)	0.05	0.00	R	R
Golden-fronted Woodpecker (<i>Melanerpes aurifrons</i>)	3.03	0.09	C	R
Smoky-brown Woodpecker (<i>Veniliornis fumigatus</i>)	0.18	0.57	U	R
Golden-olive Woodpecker (<i>Piculus rubiginosus</i>)	1.72	0.03	C	R
Lineated Woodpecker (<i>Dryocopus lineatus</i>)	1.18	0.00	C	R

TABLE 2. Continued.

Species ¹	Mean number censused per day	Number of birds per 100 net-h ²	Abundance at study site ³	Belize seasonality ⁴
Pale-billed Woodpecker (<i>Campēphilus guatemalensis</i>) ^{MAE}	1.59	0.00	C	R
Rufous-breasted Spinetail (<i>Synallaxis erythrotorax</i>) ^{MAE}	11.59	1.32	C	R
Plain Xenops (<i>Xenops minutus</i>)	0.10	0.00	R	R
Tawny-winged Woodcreeper (<i>Dendrocincla anabatina</i>) ^{MAE}	0.79	0.79	C	R
Ruddy Woodcreeper (<i>Dendrocincla homochroa</i>)	0.77	0.85	C	R
Olivaceous Woodcreeper (<i>Sittasomus griseicapillus</i>)	0.28	0.00	U	R
Wedge-billed Woodcreeper (<i>Glyborynchus spirurus</i>) [†]	0.00	0.06	R	R
Northern Barred-Woodcreeper (<i>Dendrocolaptes sanctithomae</i>)	1.54	0.09	C	R
Ivory-billed Woodcreeper (<i>Xipborhynchus flavigaster</i>) ^{MAE}	2.79	0.66	C	R
Streak-headed Woodcreeper (<i>Lepidocolaptes souleyetii</i>) [†]	0.00	0.13	R	R
Great Antshrike (<i>Taraba major</i>)	4.62	0.35	C	R
Barred Antshrike (<i>Thamnophilus doliatus</i>)	10.67	0.85	C	R
Dusky Antbird (<i>Cercomacra tyrannina</i>)	9.26	0.95	C	R
Black-faced Antthrush [<i>Formicarius analis (moniliger)</i>]	0.72	0.09	U	R
Yellow-bellied Tyrannulet (<i>Ornithion semiflavum</i>) ^{MAE}	0.21	0.00	U	R
Northern Beardless-Tyrannulet (<i>Camptostoma imberbe</i>)	0.05	0.00	R	R
Greenish Elaenia (<i>Myiopagis viridicata</i>)	1.10	0.32	C	R
Yellow-bellied Elaenia (<i>Elaenia flavogaster</i>)	0.33	0.03	U	R
Ochre-bellied Flycatcher (<i>Mionectes oleagineus</i>)	0.03	0.76	U	R
Sepia-capped Flycatcher (<i>Leptopogon amaurocephalus</i>)	0.03	0.03	R	R
Northern Bentbill (<i>Oncostoma cinereigulare</i>)	3.10	0.60	C	R
Slate-headed Tody-Flycatcher (<i>Poecilatriccus sylvia</i>)	0.64	0.28	C	R
Common Tody-Flycatcher (<i>Todirostrum cinereum</i>)	1.23	0.00	C	R
Eye-ringed Flatbill (<i>Rhynchocyclus brevirostris</i>)	0.05	0.00	R	R
Yellow-olive Flycatcher (<i>Tolmomyias sulphurescens</i>)	1.28	0.57	C	R
Stub-tailed Spadebill (<i>Platyrinchus cancrominus</i>) ^{MAE}	0.23	0.00	U	R
Royal Flycatcher (<i>Onychorhynchus coronatus</i>)	0.03	0.06	R	R
Tropical Pewee (<i>Contopus cinereus</i>)	0.38	0.00	U	R
Yellow-bellied Flycatcher (<i>Empidonax flaviventris</i>) [†]	0.00	0.03	R	M
White-throated Flycatcher (<i>Empidonax albigularis</i>) ^{†MAE}	0.00	0.03	R	M
Least Flycatcher (<i>Empidonax minimus</i>) [†]	0.00	0.16	R	M
Bright-rumped Attila (<i>Attila spadiceus</i>)	3.36	0.54	C	R
Dusky-capped Flycatcher (<i>Myiarchus tuberculifer</i>)	1.64	0.32	C	R
Brown-crested Flycatcher (<i>Myiarchus tyrannulus</i>)	0.79	0.00	U	S
Great Kiskadee (<i>Pitangus sulphuratus</i>)	1.82	0.00	C	R
Boat-billed Flycatcher (<i>Megarynchus pitangua</i>)	0.49	0.00	C	R
Social Flycatcher (<i>Myiozetetes similis</i>)	1.13	0.00	C	R
Tropical Kingbird (<i>Tyrannus melancholicus</i>)	0.72	0.00	U	R
Couch's Kingbird (<i>Tyrannus couchii</i>)	0.08	0.00	R	R
Thrush-like Schiffornis (<i>Schiffornis turdina</i>)	0.05	0.03	R	R
Rose-throated Becard (<i>Pachyrhamphus aglaiae</i>)	0.10	0.06	R	R
Masked Tityra (<i>Tityra semifasciata</i>)	0.23	0.00	U	R

TABLE 2. Continued.

Species ¹	Mean number censused per day	Number of birds per 100 net-h ²	Abundance at study site ³	Belize seasonality ⁴
White-collared Manakin (<i>Manacus candei</i>) ^{MAE}	1.18	1.20	C	R
Red-capped Manakin (<i>Pipra mentalis</i>)	0.18	1.01	U	R
White-eyed Vireo (<i>Vireo griseus</i>)	0.44	0.00	U	M
Mangrove Vireo [<i>Vireo pallens (semiflavus)</i>] ^{MAE}	0.38	0.00	U	R
Yellow-throated Vireo (<i>Vireo flavifrons</i>)	0.05	0.00	R	M
Yellow-green Vireo (<i>Vireo flavoviridis</i>)	0.05	0.00	R	S
Lesser Greenlet (<i>Hylophobus decurtatus</i>)	2.38	0.06	C	R
Rufous-browed Peppershrike (<i>Cyclarhis gujanensis</i>)	0.26	0.00	U	R
Brown Jay (<i>Cyanocorax morio</i>) ^{MAE}	14.31	0.00	C	R
Tree Swallow (<i>Tachycineta bicolor</i>)	8.59	0.00	R	M
Northern Rough-winged Swallow (<i>Stelgidopteryx serripennis</i>)*	0.00	0.00	R	R/M
Spot-breasted Wren (<i>Troglodytes maculipectus</i>) ^{MAE}	13.79	2.30	C	R
White-bellied Wren (<i>Uropsila leucogastra</i>) ^{NMAE}	0.08	0.00	R	R
White-breasted Wood-Wren (<i>Henicorbina leucosticta</i>)	0.05	0.00	R	R
Long-billed Gnatwren (<i>Ramphocaenus melanurus</i>)	0.87	0.19	C	R
Blue-gray Gnatcatcher (<i>Poliopitila caerulea</i>)*	0.00	0.00	R	R/M
Wood Thrush (<i>Hylocichla mustelina</i>)	5.67	2.30	C	M
Clay-colored Robin (<i>Turdus grayi</i>)	3.69	0.44	C	R
Gray Catbird (<i>Dumetella carolinensis</i>)	11.15	5.30	C	M
Blue-winged Warbler (<i>Vermivora pinus</i>)	0.10	0.28	U	M
Tennessee Warbler (<i>Vermivora peregrina</i>)	0.03	0.16	R	M/T
Orange-crowned Warbler (<i>Vermivora celata</i>) [†]	0.00	0.03	R	M
Yellow Warbler (<i>Dendroica petechia</i>)	0.03	0.03	R	M
Chestnut-sided Warbler (<i>Dendroica pensylvanica</i>)*	0.00	0.00	R	M
Magnolia Warbler (<i>Dendroica magnolia</i>)	4.49	1.29	C	M
Black-throated Green Warbler (<i>Dendroica virens</i>)	0.28	0.03	U	M
Yellow-throated Warbler (<i>Dendroica dominica</i>)	0.05	0.00	R	M
Black-and-white Warbler (<i>Mniotilta varia</i>)	0.10	0.35	U	M
American Redstart (<i>Setophaga ruticilla</i>)	2.69	0.41	C	M
Prothonotary Warbler (<i>Protonotaria citrea</i>)	0.03	0.00	R	T
Worm-eating Warbler (<i>Helminthophila vermivorum</i>)	0.03	0.82	C	M
Swainson's Warbler (<i>Limothlypis swainsonii</i>) [†]	0.00	0.09	R	M
Ovenbird (<i>Seiurus aurocapilla</i>)	0.13	1.26	C	M
Northern Waterthrush (<i>Seiurus noveboracensis</i>)	1.62	0.28	C	M
Louisiana Waterthrush (<i>Seiurus motacilla</i>) [†]	0.00	0.03	R	M/T
Kentucky Warbler (<i>Oporornis formosus</i>)	0.15	0.63	U	M
Common Yellowthroat (<i>Geothlypis trichas</i>)	1.08	0.69	C	M
Hooded Warbler (<i>Wilsonia citrina</i>)	0.49	1.23	C	M
Yellow-breasted Chat (<i>Icteria virens</i>)	0.92	0.50	C	M
Gray-throated Chat (<i>Granatellus sallaei</i>) ^{†, YPE}	0.00	0.03	R	R
Gray-headed Tanager (<i>Eucometis penicillata</i>)	0.36	1.36	C	R
Red-throated Ant-Tanager (<i>Habia fuscicauda</i>)	8.72	1.13	C	R

TABLE 2. Continued.

Species ¹	Mean number censused per day	Number of birds per 100 net-h ²	Abundance at study site ³	Belize seasonality ⁴
Summer Tanager (<i>Piranga rubra</i>)	0.44	0.03	C	M
Scarlet Tanager (<i>Piranga olivacea</i>)	0.03	0.00	R	T
Crimson-collared Tanager (<i>Ramphocelus sanguinolentus</i>) ^{MAE}	0.31	0.19	U	R
Passerini's Tanager (<i>Ramphocelus passerinii</i>) ^{MAE}	0.31	0.19	U	R
Blue-gray Tanager (<i>Thraupis episcopus</i>)	0.41	0.00	U	R
Yellow-winged Tanager (<i>Thraupis abbas</i>) ^{MAE}	0.15	0.06	R	R
Red-legged Honeycreeper (<i>Cyanerpes cyaneus</i>)	1.82	0.35	U	R
Variable Seedeater (<i>Sporophila americana</i>) [†]	0.00	0.13	R	R
White-collared Seedeater (<i>Sporophila torqueola</i>)	0.13	0.09	R	R
Thick-billed Seed-Finch (<i>Oryzoborus funereus</i>)	0.28	0.13	R	R
Blue Seedeater (<i>Amaurospiza concolor</i>) [†]	0.00	0.28	R	R
Green-backed Sparrow (<i>Arremonops chloronotus</i>) ^{NMAE}	2.15	0.63	C	R
Grayish Saltator (<i>Saltator coerulescens</i>)	6.72	0.35	C	R
Buff-throated Saltator (<i>Saltator maximus</i>)	5.08	0.41	C	R
Black-headed Saltator (<i>Saltator atriceps</i>) ^{MAE}	7.64	0.16	C	R
Black-faced Grosbeak (<i>Caryothraustes poliogaster</i>) ^{MAE}	0.05	0.00	R	R
Blue-black Grosbeak (<i>Cyanocopsa cyanooides</i>)	4.44	0.44	C	R
Indigo Bunting (<i>Passerina cyanea</i>) [†]	0.00	0.09	R	M
Melodious Blackbird (<i>Dives dives</i>) ^{MAE}	0.82	0.00	R	R
Giant Cowbird (<i>Molothrus oryzivorus</i>)	0.08	0.00	R	R
Black-cowled Oriole (<i>Icterus prosthemelas</i>) ^{MAE}	1.05	0.06	C	R
Orchard Oriole (<i>Icterus spurius</i>)	0.69	0.13	U	M
Yellow-backed Oriole (<i>Icterus chrysater</i>) ^{*NMAE}	0.00	0.00	R	R
Yellow-tailed Oriole (<i>Icterus mesomelas</i>)	13.69	0.06	C	R
Baltimore Oriole (<i>Icterus galbula</i>)	0.23	0.06	U	M
Yellow-billed Caticue (<i>Amblycercus holosericeus</i>)	11.44	0.73	C	R
Montezuma Oropendola (<i>Psarocolius montezuma</i>) ^{MAE}	3.54	0.00	C	R
Scrub Euphonia (<i>Euphonia affinis</i>) ^{MAE}	0.13	0.00	R	R
Yellow-throated Euphonia (<i>Euphonia hirundinacea</i>) ^{MAE}	1.69	0.16	C	R

¹Order follows AOU (2005).

²Includes newly banded birds and recaptures from prior field seasons.

³Abundance codes: C = Common, detected on $\geq 50\%$ of days; U = Uncommon, detected on 20%–49% of days; R = Rare, detected on $< 20\%$ of days.

⁴Belize seasonality codes: R = Resident, present year-round; M = Migrant, spends non-breeding season (“winter”) in Belize, does not breed in Belize; T = Transient, present during migration; S = Seasonal resident, migrates to Belize to breed (also called breeding migrants).

*Detected only during the casual observation period.

†Detected only through mist-netting.

^{MAE}Middle America endemics (Miller & Miller 1997).

^{NMAE}Northern Middle America endemics (Miller & Miller 1997).

^{YPE}Yucatan Peninsula endemics (Miller & Miller 1997).

vetula), Brown Jay (*Cyanocorax morio*), Spot-breasted Wren (*Thryothorus maculipectus*), Yellow-tailed Oriole (*Icterus mesomelas*) and Rufous-breasted Spinetail (*Synallaxis erythrothorax*) (Table 2).

A total of 1167 birds of 95 species were captured in mist nets during the study, and 389 individuals were recaptured. Of the recaptures, 190 (48.8%) were banded at the site in previous field seasons. The species detected most frequently by mist-netting were the Gray Catbird (*Dumetella carolinensis*), Spot-breasted Wren, Wood Thrush (*Hylocichla mustelina*), Rufous-tailed Hummingbird (*Amazilia tzacatl*), Gray-headed Tanager (*Eucometis penicillata*), and Rufous-breasted Spinetail. Fourteen species were detected only by mist-netting (Table 2). Five species, the Wedge-tailed Sabrewing (*Campylopterus curvipennis*), Green-breasted Mango (*Anthracoceros prevostii*), Buff-bellied Hummingbird (*Amazilia yucatanensis*), Green Kingfisher (*Chloroceryle americana*) and American Pygmy-Kingfisher (*Chloroceryle aenea*) were detected by both mist-netting and casual observations but not during the census period.

Continuing observations beyond the end of the census period (2 h after sunrise) allowed for the detection of additional species. Seventeen species were detected only during the observation period (Table 2). The Wood Stork (*Mycteria americana*), Black-collared Hawk (*Busarellus nigricollis*), Zone-tailed Hawk (*Buteo albonotatus*), Aplomado Falcon (*Falco femoralis*) and Northern Rough-winged Swallow (*Stelgidopteryx serripennis*) were detected soaring over the study area only later in the day.

Operation of two elevated nets proved worthwhile as the Yellow-bellied Elaenia (*Elaenia flavogaster*), Orange-crowned Warbler (*Vermivora celata*), Black-throated Green Warbler (*Dendroica virens*), White-collared Seed-eater (*Sporophila torqueola*), and Yellow-tailed Oriole were captured only in elevated nets.

The Golden-olive Woodpecker (*Piculus rubiginosus*), Yellow Warbler (*Dendroica petechia*), Black-cowled Oriole (*Icterus prosthemelas*), Orchard Oriole (*Icterus spurius*), and Baltimore Oriole (*Icterus galbula*) were captured only in the canopy net. The Tennessee Warbler (*Vermivora peregrina*), Yellow-winged Tanager (*Thraupis abbas*), and Red-legged Honeycreeper (*Cyanerpes cyaneus*) were captured in both the elevated and canopy nets but not in nets operated at ground level.

We observed few reproductive behaviors (carrying nesting material or food, courtship behaviors) during the study period. Brown Jays were observed carrying nesting material in February 2002 and March 2003. A Bare-throated Tiger-Heron (*Tigrisoma mexicanum*) and a Jabiru (*Jabiru mycteria*) nested at the site (see Species accounts).

Table 3 shows for each species the earliest date of evident reproductive activity at the time of banding or recapture. Twenty-three individuals of 11 species had a brood patch score of 2–5, indicating that they were breeding in the area (Brewer *et al.* 1991). All were captured during March and all were Belize resident species. Five individuals of three species had a cloacal protuberance, indicating that these male birds were approaching readiness to breed or in breeding condition (Pyle 1997). All birds with cloacal protuberances were captured in March (Table 3).

The species accumulation curves for sampling by census and mist-netting are shown in Figs 1a and 1b. The curve for sampling by census (Fig 1a) approached an asymptote; the calculated asymptote was 159, indicating that sampling by census was complete. The species accumulation curve for mist-netting (Fig 1b) did not approach an asymptote. The calculated asymptote was 105, indicating that sampling by this method was not complete.

Assessing the conservation importance of the species detected at the study site. Thirty-one species

TABLE 3: Birds captured at the study site that were in reproductive condition¹.

Species	CP grade ²	BP grade ²	Earliest date in reproductive condition
Smoky-brown Woodpecker (<i>Veniliornis fumigatus</i>)	0	2	3 March 2001
Golden-olive Woodpecker (<i>Piculus rubiginosus</i>)	0	3	6 March 2001
Great Antshrike (<i>Taraba major</i>)	0	2	6 March 2001
Barred Antshrike (<i>Thamnophilus doliatus</i>)	0	2	3 March 2001
Dusky Antbird (<i>Cercomacra tyrannina</i>)	0	2	22 March 2001
Black-faced Antthrush [<i>Formicarius analis (moniliger)</i>]	0	3	4 March 2001
Yellow-olive Flycatcher (<i>Tolmomyias sulphureus</i>)	0	2	3 March 2001
Spot-breasted Wren (<i>Troglodytes maculipectus</i>)	0	3	3 March 2001
Yellow-winged Tanager (<i>Thraupis abbas</i>)	2	0	22 March 2001
Red-legged Honeycreeper (<i>Cyanerpes cyaneus</i>)	0	5	3 March 2001
Red-legged Honeycreeper (<i>Cyanerpes cyaneus</i>)	2	0	3 March 2001
Blue-black Grosbeak (<i>Cyanocopsa cyanooides</i>)	0	3	3 March 2001
Yellow-billed Caciue (<i>Amblycercus holosericeus</i>)	0	5	21 March 2000
Yellow-throated Euphonia (<i>Euphonia hirundinacea</i>)	2	0	4 March 2001

¹All of these species are resident birds, present in Belize year-round.

²Birds with a cloacal protuberance (CP) or brood patch (BP) grade > 1 are included in this list.

detected at the site are found only in Middle America (Table 2, Miller & Miller 1997). Five of these have more restricted ranges; the Buff-bellied Hummingbird, White-bellied Wren (*Uropsila leucogastra*), Green-backed Sparrow (*Arremonops chloronotus*), and Yellow-backed Oriole (*Icterus chrysater*) are northern Middle America endemics; the Gray-throated Chat (*Granatellus sallaei*) is a Yucatan Peninsula endemic.

Table 1 lists the 19 species that are of conservation concern based on Miller & Miller (1997), Kushlan *et al.* (2002), and Rich *et al.* (2004). Of the 38 species of migrants and/or transients detected during this study, seven (18.4%) are listed as being PIF Watch List species. Of the 14 species of waterbirds detected at the site, five (35.7%) are categorized as being at high risk and two at moderate risk (14.3%) by Kushlan *et al.* (2002). Eight species (4.1% of the total) are listed as being of conservation concern in both Belize and the region by Miller & Miller (1997). None of the species detected at the site are on the

IUCN red list of threatened species (IUCN 2004).

Vegetation. The riparian forest studied consisted of an area dominated by spiny bamboo near the river edge that transitioned into forested areas dominated by cohune (*Atelea cohune*) and coccoloba (*Coccoloba schiedeana*), with scattered large, emergent quamwood (*Schizolobium parahybum*) trees. A few large fig (*Ficus* sp.) trees were also present along the riverbank bordering the study area, and two large fig trees (approximately 80 cm dbh) were present within the study area. A small forest gap of approximately 20 m² was present near the center of the study area. A dense cover of wild cane (*Tripsacum andersonii*) bordered the eastern edge of the study area.

No differences were evident in the vegetation sampled at the ground and elevated nets (data not shown); so the data were combined for the following summaries. The mean canopy cover was 88%. Maximum tree height was 45 m. The numbers of sublayers evident

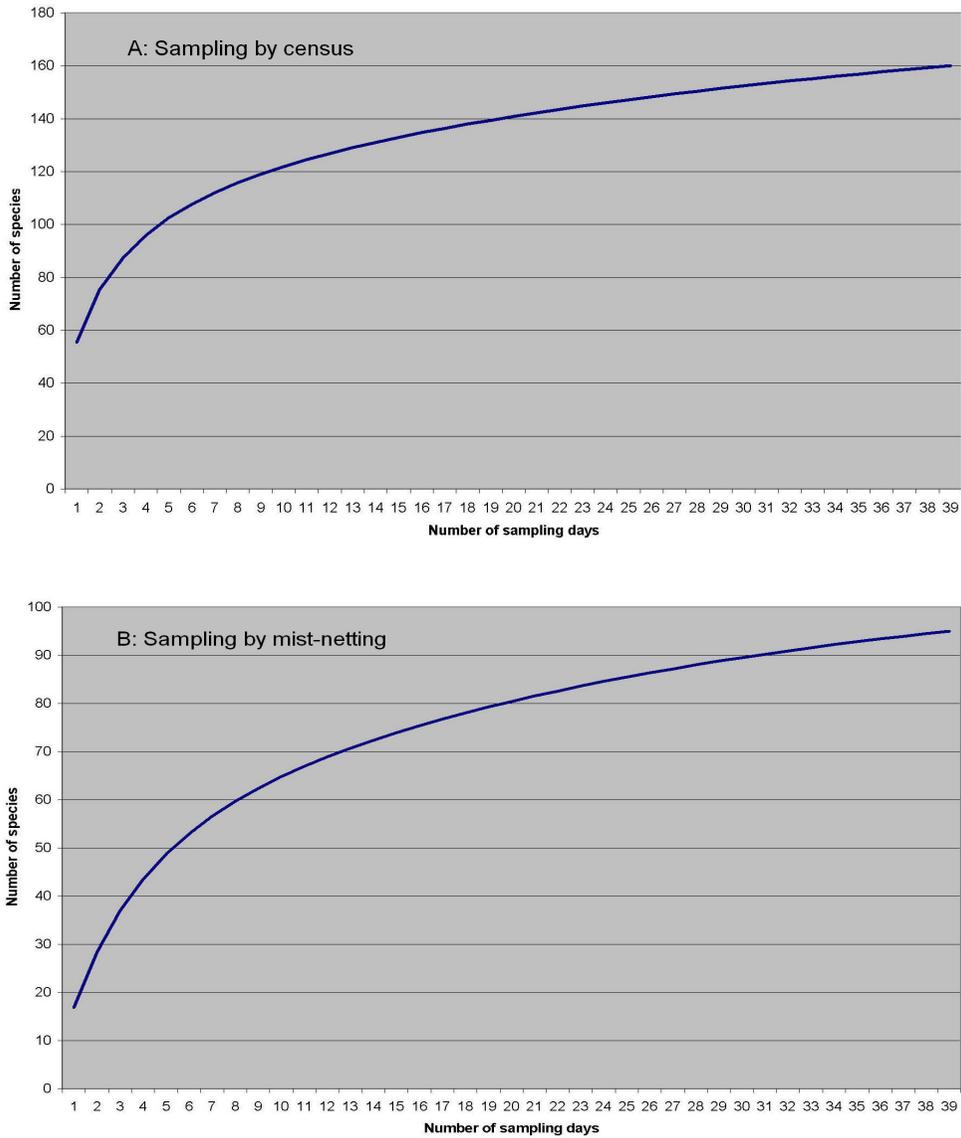


FIG. 1. Species accumulation curves for birds sampled by census and mist-netting. (a) Sampling by census, (b) Sampling by mist-netting.

for each vegetation category were as follows: trees 1–3, shrubs 2–5, and herbs 2–3. Herb cover varied from few, with small cover, to 75%. The most common herbs were ferns, *Dieffenbachia* sp., *Heliconia* sp., vines and lianas.

In areas where the vegetation was dominated by spiny bamboo, a dense concentration of thorny vines and lianas such as haul-me-back (*Mimosa* sp.) and tear coat (*Byttneria aculeata*) were also present. Graminoid (grass, sedge

and rush) cover varied from solitary, with small cover, to 50% cover. Leaf litter with cover of > 75% was present in all areas sampled. Moss cover ranged from little to < 25%.

Species accounts.

Information documenting the observations of the less common species, those nesting at the site, and those whose migration status is poorly understood appear below.

Bare-throated Tiger-Heron (*Tigrisoma mexicanum*). This species was observed on eight different dates from December through March and was categorized as rare at the site. One was observed nest building in the same tree as the Jabiru on 22 March 2002. Jones (2003) described this species as a locally fairly common resident on the Belize mainland.

Jabiru (*Jabiru mycteria*). The Jabiru had a nest in an emergent *Ceiba pentandra* tree in the study area each year from 2001 through 2003 and again in 2004 and 2005 after the study described here was completed. Jabirus were observed near the nest in December of each year when our field seasons began during this month. Birds were observed incubating in January and February and two to three nestlings were present beginning in February. Based on our monitoring of this nest through the end of each breeding season (May to June), it is believed that the nest fledged at least two young each year, suggesting the importance of this site to the reproductive success of this species in the region. Although Barnhill *et al.* (2005) state that Jabiru populations in Belize may be increasing since gaining protective status in 1973, the Jabiru is listed as a species of regional and Belize conservation concern (Miller & Miller 1997) and under "Species of concern" as a Watch List species in Belize (Jones & Valley 2001).

Zone-tailed Hawk (*Buteo albonotatus*). We

detected this species by casual observations on two consecutive days in January 2002. Jones (2003) describes this species as a very uncommon winter visitor from mid-October to mid-April. Howell & Webb (1995) describe it as a winter visitor in the Yucatan Peninsula with the status in much of the region needing clarification.

White-throated Flycatcher (*Empidonax albigularis*). We captured and banded one individual in February 2003. It was an adult not in breeding condition. Jones (2003) described this species as poorly known in Belize, a resident and local winter visitor at least in the north, with the timing of arrival in and departure from wintering areas not known.

Brown-crested Flycatcher (*Myiarchus tyrannulus*). We detected this species at the site each year by census and casual observations only during March. Jones (2003) describes the species as a common summer resident in Belize from early March to late August, with a few overwintering. However, Jones (2004) states that the Brown-crested Flycatcher is now known to be a seasonal resident only, rather than a year-round resident in Belize.

Blue Seedeater (*Amaurospiza concolor*). The Blue Seedeater, previously unrecorded in this area of Belize (Howell & Webb 1995), was detected in the study area by mist-netting in both 2000 and 2001 (Figueroa *et al.* 2004) and in 2002 and 2003. Eight individuals (four males and four females) were banded and two recaptured. A female banded on 21 January 2002 was recaptured on 9 December 2002, and a male captured on 5 December 2002 was recaptured on 22 March 2003. None of the individuals captured was in breeding condition. The Blue Seedeater is found in riverside bamboo thickets and its occurrence has also been documented in another area of the Sibun River (Jones 2003).

DISCUSSION

Since mist-netting or audio-visual methods alone can underestimate or miss some species (Rappole *et al.* 1998), we combined the techniques of censusing, casual observations and mist-netting (McCracken *et al.* 1993) to enhance our ability to detect the bird species present at the study site. This combination was effective in augmenting species detection during this study.

Because mist nets operated at ground level sample avifauna that moves within 2–3 m above the ground (Remsen & Good 1996), we devised an elevated net system that sampled areas within 5–7 m of the ground (Albanese & Piaskowski 1999) and operated these nets throughout the study. In 2000 and 2001, we also operated one net in the canopy where the top of the net was at a height of approximately 21 m. Due to staffing changes after 2001, we were not able to operate the canopy net in the 2001–2002 and 2002–2003 field seasons. As described above, 13 species were captured only in the elevated or canopy nets.

Overestimation of species abundance may have occurred due to several factors. Hummingbirds and manakins are opportunistic feeders at ephemeral resources (Terborgh *et al.* 1990) and therefore may have been overestimated. Overestimation was more likely in the case of hummingbirds because we did not mark the individuals captured. Species such as parrots and toucans that occur in flocks are also more likely to be overestimated (Terborgh *et al.* 1990), as well as Plain Chachalacas, which were observed mainly in vocal groups that moved through the study area. Some of the species that were common at the site such as the Rufous-breasted Spinetail, Spot-breasted Wren, Gray Catbird, and Yellow-tailed Oriole vocalized considerably and were therefore easier to detect than other species. Underestimation of abundance may have

occurred for some of the more secretive species, especially those that were detected only by mist-netting.

Seventy-eight species (39.8% of the total) were estimated to be rare at the site as they were detected on fewer than 20% of sampling days. Rare species may have been wanderers from other habitats, difficult-to-observe canopy species, large species with large home ranges, or naturally rare due to food or feeding behavior (Karr 1977). In addition, some may be difficult to detect because they vocalize little during the non-breeding season (winter), such as some of the Neotropical migrants.

In a study of habitat associations of Neotropical migrants in Belize during the non-breeding season (Piaskowski *et al.* 2005), the Wood Thrush, Gray Catbird, Worm-eating Warbler (*Helmintheros vermivorum*) and Hooded Warbler (*Wilsonia citrina*) had a statistically significant higher proportion of individuals captured in the Sibun riverine forest than in the other five habitats studied. Robbins *et al.* (1992) found that Gray Catbirds had a strong preference for gallery forest (forests occurring along rivers) in the tropics. They also found that the relative abundance of the Wood Thrush, Kentucky Warbler (*Oporornis formosus*), and Hooded Warbler was highest in rain forests, but that many individuals were also found in gallery forests. Based on these studies, it appears that riverine forest provides important non-breeding habitat for some species of Neotropical migrants.

A number of other studies of Neotropical migrants have been conducted in Belize and other parts of Central America during the non-breeding season (Kricher & Davis 1986, 1992; Mills & Rogers 1992, Petit *et al.* 1992, and Rappole *et al.* 1994). None studied birds in riparian forests and therefore their results cannot be compared to those of this study. Lynch (1989) studied the distribution of Neotropical migrants in the Yucatan Peninsula in

tall floodplain forest and other habitats; however, he stated that tall floodplain forest was not censused frequently enough to permit detailed statistical analysis.

The species richness in this study (196) is higher than that in two studies of birds in riparian study sites conducted in Belize southern hardwood forests (Brokaw & Lloyd-Evans 1987, Mallory 1991). Brokaw & Lloyd-Evans (1987) detected 178 species in three riparian sites in the Bladen Branch Wilderness during March; Mallory (1991) detected 146 species in the Upper Raspaculo area during January and February. The higher species richness in the Sibun riverine forest may be due to more sampling effort or to a true higher diversity of species utilizing the site. The composition of migrants in the three studies was similar: 18.4% in the Sibun, 15.9–18.8% in the three Bladen Branch riparian areas, and 16.4% in the Raspaculo. To quantify the community similarity among the three sites, we used the Jaccard coefficient of community (Mueller-Dombois & Ellenberg 1974). The community similarity of the Sibun riverine forest and Bladen Branch riparian sites was 0.490 (123 species in common, 251 total species between the two); for the Sibun and Raspaculo, it was 0.437 (104 species in common, 238 species between the two). In contrast, the community similarity of the Raspaculo and Bladen Branch was 0.685 (148 species in common, 216 species between the two) (Mallory 1991). The lower community similarity among the Sibun, the Bladen Branch and the Raspaculo is likely due to the differences in the ecological life zones sampled and the resultant differences in rainfall and vegetation. The Sibun riverine forest is located in the transition zone between subtropical moist and subtropical wet forest life zones (Hartshorn *et al.* 1984), the Bladen Branch in subtropical wet forest and subtropical lower montane wet forest and the Raspaculo in subtropical moist forest.

England (2000) assessed the resident and migrant bird species present at Lamanai, Belize, and listed the species detected in a marsh category that included waterbirds and birds seen in the vegetation adjacent to water. However, the site had a large lagoon, which is a very different habitat than riparian forest, so our results are not comparable. Valley & Whitman (1997) studied the bird species present at Hill Bank in northern Belize. Their broadleaf forest category contained what they described as two swamp broadleaf forest types: riparian and “bajo,” but the bird species encountered in these were not listed separately from those of the upland broadleaf forest, and so were not comparable to the riverine forest of our study.

The Sibun study area and surrounding forests provided expanses of habitat that were utilized by resident and migratory species of conservation concern (Table 1) and regional endemics (Table 2). Seven species of Neotropical migrants detected at the site are listed as Watch List species by PIF (Rich *et al.* 2004). Watch List species have range-wide concerns and are in need of conservation attention throughout their range (Rich *et al.* 2004). Five waterbirds categorized as at high risk and two of moderate risk (Kushlan *et al.* 2002) were detected at the site. Other species detected at the site that do not appear in the two above lists include five that are of conservation concern in both the region and Belize (Miller & Miller 1997). Thirty-one species detected at the site are endemic to Middle America but only five have more restricted ranges (Table 2). Stotz (1996) states that “saving endemics means saving many species.” This could also pertain to other species of conservation concern. Preserving riverine forests along the Sibun River would protect not only these species of conservation concern and restricted range endemics but also the other bird species found there.

Belize has nine resident parrot species

(Jones & Vallely 2001), many of which are captured for use in the local pet trade. Four parrot species were recorded during the study, three of which are listed as being of regional and Belize conservation concern (Table 1). The study area is difficult to access due to a dense border of spiny bamboo along the river, and this may provide these parrots with some level of protection from poaching.

Unlike the rivers in less developed and more remote areas of Belize, the forests of the Sibun River are undergoing environmental pressures from citrus farms, residential areas, in-stream gravel mining, and logging (Boles 1999). Another threat is the invasion of non-native bamboo (*Bambusa vulgaris*) in some areas of riparian forest along the Sibun River. Eleven villages with populations of 25–1000 occur throughout the watershed. Although these villages do have an impact on the river, many are also involved in its protection through the Sibun Watershed Association (Boles 1999).

This study provides baseline data on the bird species present in a section of riverine forest on the Sibun River that has not been subjected to recent human disturbance. It also contributes to the information available on the avian species utilizing riparian habitats in central Belize. The 196 bird species detected in the 20 ha study area of riverine forest represent 34.1% of the 574 bird species present in Belize (Jones 2003), indicating the diversity of species that utilize this riparian habitat. Included in this species assemblage are 19 species of conservation concern and 5 restricted-range endemic species. Efforts to preserve the riparian habitat of the Sibun River will protect habitat for these species as well as for the many other bird species found there.

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