

## AVIFAUNA OF A PARAGUAYAN CERRADO LOCALITY: PARQUE NACIONAL SERRANÍA SAN LUIS, DEPTO. CONCEPCIÓN

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**ABSTRACT.**—We recorded 181 avian species at the Paraguayan Cerrado site, Parque Nacional Serranía San Luis, depto. Concepción, including the first record of Veery (*Catharus fuscescens*) for the country. We obtained further evidence of hybridization between White-bellied (*Basileuterus hypoleucus*) and Golden-crowned (*B. culicivorus*) warblers. Our results combined with those of earlier workers document a total of 219 species for this area. Pronounced differences in species composition exist between San Luis and a nearby Cerrado locality. Three threatened and four near-threatened species were recorded at San Luis. Since our inventory the area that we worked was traded for an adjacent, less human impacted sector of similar size. The new park boundary contains relatively pristine campo (grassland), which is an important habitat for a number of resident and migrant species suspected to be suffering serious population declines. Received 29 Jan. 1998, accepted 14 Nov. 1998.

**RESUMEN.**—Se registraron 181 especies de aves en el Parque Nacional Serranía San Luis, en el cerrado del Paraguay, depto. Concepción. La lista incluye el primer registro de *Catharus fuscescens* para el país, y más evidencia de hibridización entre los parúlidos *Basileuterus hypoleucus* y *B. culicivorus*. En combinación con los resultados de investigadores anteriores, han sido registrado 219 especies de aves para la zona. Existen diferencias marcadas en la composición avifaunística entre San Luis y otra localidad cercana en cerrado. Se registraron tres especies amenazadas y cuatro casi-amenazadas en la zona. Desde que se hizo el presente estudio, se cambió el área de estudio por otro adyacente, menos impactado y de extenso similar; esta zona abarca más del campo (pastizal) en buen estado de conservación, el cual es un refugio para varias especies residentes y migratorias que se encuentran en declives poblacionales.

The Cerrado is the second largest ecological region in South America (Ab'Saber 1977), but has only recently attracted the attention of avian biogeographers (Haffer 1985; Silva 1995a, b, c). Silva (1995a) demonstrated that about 70% of the Cerrado is inadequately sampled and that the southern component especially is poorly known and most heavily impacted by human activities. The Cerrado reaches its southern terminus in northeastern Paraguay, where it interdigitates with two other physiogeographic and biotic regions: the Chaco and the Atlantic Forest (Hayes 1995a). The lack of a quantitative inventory of this region, coupled with the potential for extensive biotic interchange among the contiguous regions, make the Paraguayan Cerrado important for its unique contribution to the biodiversity of the Cerrado. In this paper, we present a preliminary avifaunal inventory for the

10,273 ha Parque Nacional Serranía San Luis, created in 1991 to preserve a representative sample of the Paraguayan Cerrado (Dirección de Parques Nacionales y Vida Silvestre 1993). We have incorporated results from earlier work in the region to provide a more comprehensive list for this area. The San Luis list is compared to another well-surveyed Paraguayan Cerrado locality to examine avian turnover. Selected species accounts are provided where additional comment is merited to clarify status, distribution, migration, food habits, hybridization, and plumage characters.

### STUDY AREA AND METHODS

We worked at the southern end of Parque Nacional Serranía San Luis (22° 40' S, 57° 21' W; taken with Global Positioning System at park headquarters; Fig. 1) from 19–31 October 1996, and RCF revisited the site from 29 November to 7 December 1996. The park is located in the Serranía San Luis, an isolated, low-lying (max. elevation 500 m) set of limestone hills mostly covered with semihumid forest. Approximately 5,300 ha is cultivated grassland with about 70% of this habitat now occupied by the aggressive African grass *Hyparrhenia rufa* (Poaceae). The dominant savannah tree, *Tabebuia aurea* (Bignoniaceae), was often associated with *Astronium urundeuva* (Anacardiaceae), *Anadenanthera colubrina* (Leguminosae), and *Rhamnidium elasocarpum* (Rhamnaceae; Consorcio Parcel-Foragro-Porto Real, unpubl. report). Hillsides were

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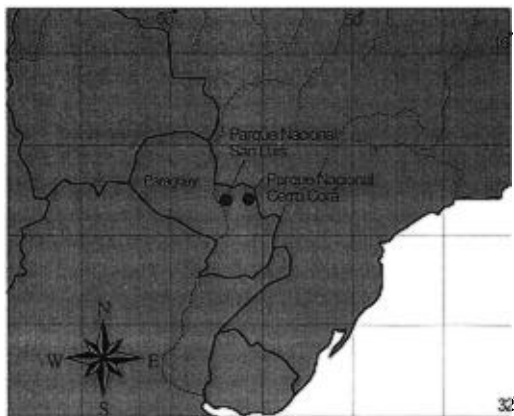


FIG. 1. Locations of Parque Nacional Serranía San Luis and Parque Nacional Cerro Corá.

covered with shallow, rocky soil, resulting in shorter, xeric forest; the more level areas along two arroyos bordering the western and eastern sides of the park held taller, more humid forest. Terrestrial bromeliads and cacti were common in the dense, thorn-covered understory on slopes and on isolated woodland in the campo (open grassland). The largest area of campo, about  $4 \times 2$  km, had a few woodlots, some only a few meters square. The upland forest and isolated woodlands had uneven canopies and were relatively short, with few trees exceeding 20 m. Prominent trees included: *Amburana cearensis* (Leguminosae), *Aspidosperma pyriforme* (Apocynaceae), *Calycophyllum multiflorum* (Rubiaceae), and *Astronium urundeuva* (Anacardiaceae). The understory was dominated by trees of the genus *Trichilia* (Meliaceae).

Forests along the arroyos, especially east of Tagatlya Guazu arroyo at the headquarters, were taller and more humid, with some trees exceeding 40 m. These forests were heavily disturbed by selective logging, and tree-fall gaps with dense understory were common. Vine tangles were also more common than in the upland forest, especially about 2 km east of the park headquarters. Tall arborescent bamboo (*Guadua* spp.) was primarily restricted to disturbed areas along the arroyos.

This area is very seasonal with a cool, dry climate from April through most of September when temperatures occasionally drop to near  $0^{\circ}\text{C}$ . Temperature and rainfall increase in October and November with December through March being relatively hot and humid. Average annual rainfall is 1300 mm with considerable variation (A. Acosta, pers. comm.), and average annual temperature is  $24^{\circ}\text{C}$  (Consorcio Parcel-Foragro-Porto Real, unpubl. report). During our stay, weather was highly variable. On the evening of 19 October a major storm system from the southeast brought heavy rains (70 mm) and strong winds. Precipitation also occurred on 25 October, 12 mm; 26 October, 2 mm; and 27 October, 6 mm. Apparently it did not rain between our

October and December surveys (A. Acosta, pers. comm.); however, it rained five of nine days during the latter inventory period. Temperature highs ranged from  $24\text{--}38^{\circ}\text{C}$ . The low was  $18^{\circ}\text{C}$  at dawn on 23 October. We did not record the temperature during November and December.

Four mist-nets were opened on the afternoon of 19 October, and 6 on 20 October; 15 nets were maintained from 21–30 October, for a total of about 11,400 mist-net-hr. All mist-nets were positioned in mesic forest bordering Tagatlya Guazu arroyo; the most distant nets were about 1.5 km east of the headquarters. Most nets were moved every three to four days. Nets were typically opened at dawn and closed about noon, rarely at sunset. Our inventory was confined to about 4 km of forest trail east of the headquarters, about 5 km of dirt road to the north of the headquarters, and about 2 km of dirt road from the headquarters to the southwest entrance. On most mornings, RCF and NHR worked the nets and adjacent forest, while MBR made independent surveys of other areas from predawn until 11:00 or 12:00. Occasional forays were made in the afternoon. Nocturnal fieldwork was limited to nights with a full moon in October.

Specimens were deposited at the University of Kansas Natural History Museum (KU), Lawrence, Kansas and Museo Nacional de Historia Natural del Paraguay (MNHNP), Asunción, Paraguay. Tissue samples were taken from every nonfluid preserved specimen and deposited at KU. Tape recordings will be deposited at the Library of Natural Sounds, Cornell University, Ithaca, New York.

To provide a more complete inventory of the Serranía de San Luis region, we have integrated our species list (Appendix) with results from earlier work in San Luis de La Sierra that was conducted in September–October 1931 by Hans Krieg (referred to as “Aparberland”; summarized in Laubmann 1939, 1940). Results from Krieg’s expeditions to Zanja Morotí, Centurión, and Estrella, Concepción were not included because these areas are farther removed from San Luis, and the Estrella site was at the Río Apa. We presume that the riparian habitat and associated fauna along the Río Apa is somewhat distinct from that at San Luis. We also excluded specimens taken by Emil Kaempfer at La Fonciere, Concepción (deposited at American Museum of Natural History; Floyd Hayes and Paul Sweet, pers. comm.). Except where noted otherwise, we follow Hayes (1995a) for taxonomy and nomenclature.

## RESULTS

We recorded a total of 181 species (Appendix), of which three are designated as threatened and four as near-threatened (Collar et al. 1992, 1994). Three of the 29 species identified by Silva (1995c) as endemic to the Cerrado, Planalto Foliage-gleaner (*Philydor dimidiatus*), Curl-crested Jay (*Cyanocorax cristatellus*), and Black-throated Saltator (*Saltator*

*atricollis*), have been recorded at San Luis. We recorded four species that Silva (1995c) did not list for the Cerrado: South American Painted-Snipe (*Rostratula semicollaris*), White-naped Xenopsaris (*Xenopsaris albinucha*), Red-crested Cardinal (*Paroaria coronata*), and Golden-winged Caciue (*Cacicus chrysopterus*). Hayes (1995a) did not list *R. semicollaris*, *X. albinucha*, Golden-green Woodpecker (*Piculus chrysochloros*), nor Dark-throated Seedeater (*Sporophila ruficollis*) as occurring in his "Campos Cerrados" category.

At least 64 of the 92 species we collected had enlarged gonads indicating reproduction, and nests or recently fledged young were observed for 12 additional species that were not collected (Appendix). Based on vocal activity and behavior, breeding was suspected for several species not collected, such as Bare-faced Currasow (*Crax fasciolata*), Red-legged Seriema (*Cariama cristata*), Short-tailed Nighthawk (*Lurocalis semitorquatus*), and Crowned Slaty Flycatcher (*Griseotyrannus aurantio-trocristatus*). Hence, at least 80 species were actively nesting at the time of our studies (mid-October–early December). One Nearctic, one intratropical, and at least 32 Austral migrants were recorded (Appendix; migrant terminology follows Hayes 1995b).

Nocturnal avian vocal activity was most pronounced shortly after dusk and in the hour before dawn, with the greatest activity on nights with the brightest moon light. The Ferruginous Pymy-Owl (*Glauclidium brasilianum*) and both screech-owls (*Otus*) were heard nightly, as were Pauraque (*Nyctidromus albicollis*), Rufous Nightjar (*Caprimulgus rufus*), and Common Potoo (*Nyctibius griseus*). The Little Nightjar (*C. parvulus*) was never heard, even though individuals and a nest with an egg and a day-old young, were collected at the edge of camp.

Rodent eating hawks and owls were not well represented in the San Luis avifauna. A possible causal explanation is that rodent diversity and density were low. During October, we observed no evidence of rodents. Squirrels are unknown from this part of Paraguay; during seven nights in late November–early December Texas Tech University mammalogists captured few mammals in a variety of habitats (M. Gorresen, pers. comm.). Raptor species

expected, but not detected include: Great Black Hawk (*Buteogallus urubitinga*), Harris's Hawk (*Parabuteo unicinctus*), all *Buteo* species, Spectacled Owl (*Pulsatrix perspicillata*), Great Horned Owl (*Bubo virginianus*), and *Asio* spp. Only the Savannah Hawk (*Buteogallus meridionalis*) and Ornate Hawk-Eagle (*Spizaetus ornatus*) were recorded (both rarely) among the species of raptor whose diets include a relatively high percent (>25%) of rodents (Brown and Amadon 1968, del Hoyo et al. 1994).

#### SPECIES ACCOUNTS

*Snail Kite (Rostrhamus sociabilis)*.—On 22 and 23 October, we observed two flocks of 154 and 33 individuals (mostly adults), respectively, pass through the campo. The birds appeared from the north and landed on the ground, in bushes, and in isolated palm trees, flying only a few meters between each perch. When the groups came to the forested Tagatya Guazu arroyo at the south end of the park, they rose as a group into the air and disappeared to the south. Snail Kites were not observed during late November–early December. Our observations coincide with prior observations of migratory movements of this species in Paraguay (Hayes et al. 1994).

*Crowned Solitary Eagle (Harpyhaliaetus coronatus)*.—An adult with a tegu lizard (Teiidae; *Tupinambis* sp.) in its talons was flushed from a large tree at the forest/campo edge on 19 October. It landed in the top of a nearby tree where it sat for about 3 min before it disappeared with the lizard in its talons. This species is considered vulnerable ("taxa believed likely to move into the endangered category in the near future if the causal factors continue operating"; Collar et al. 1992) and has been recorded few times from Paraguay with only one prior record for depto. Concepción (Hayes 1995a). Very little is known about this eagle's prey (Collar et al. 1992), and our observation is apparently the first of it taking a tegu. It is known to take small mammals (Collar et al. 1992, del Hoyo et al. 1994), but we saw no signs of rodents. Del Hoyo and coworkers (1994) noted that this eagle has short toes characteristic of snake eaters.

*Bare-faced Curassow (Crax fasciolata)*.—Given that cracids are usually one of the first avian species to disappear because of exces-

sive hunting, we were encouraged to find at least seven territorial males calling along about 4 km of trail on the east side of Tagatlya Guazu arroyo. Males called daily in October from predawn until about 07:00, occasionally until 10:00. We did not hear males in the drier forest; however, we surveyed only a relatively small area of this forest type at the optimal time of day. No calling was heard in late November–early December.

*Reddish-bellied Parrot (Pyrrhura frontalis)*.—This species was common in both forest types. Birds collected (KU 88346, MNHNP) at San Luis were typical of the race *P. f. chiripepe*, and showed no sign of hybridization with *P. devillei* as has been reported in areas just northwest of San Luis (Short 1975).

*Rufous Nightjar (Caprimulgus rufus)*.—The single male (testes  $11 \times 6$  mm; KU 88350) obtained was not assignable to either the nominate race or to southern *C. r. rutilus*. Like birds from central Brazil (Goias, Bahia; Robbins and Parker 1997), the San Luis specimen's wing and tail measurements (173.6 and 119.7 mm, respectively) fall within the range of variation of the nominate race, but plumage color and pattern are closest to *C. r. rutilus*.

*Blue-crowned Motmot (Momotus momota)*.—Our specimens (KU 88580, MNHNP) from San Luis represent only the fifth locality in Paraguay (Hayes 1995a, Ericson and Amarilla 1997), and the first for depto. Concepción. Both specimens, a probable pair, lack the bluish-green throat of eastern Bolivian and Argentinian *M. m. pilcomajensis*; the greenish underparts were washed with cinnamon, especially on the abdomen, which is more typical of southern Brazilian *M. m. simplex*. Chapman (1923) was uncertain in assigning a specimen from western São Paulo to either of the above races and concluded that there was considerable variability in this species south of the Amazon. Ericson and Amarilla (1997) believed that specimens they obtained from Parque Nacional Defensores del Chaco, depto. Chaco were intergrades between the above forms.

*Planalto Foliage-gleaner (Philydor dimidiatus)*.—Known in most of the literature as the Russet-mantled Foliage-gleaner, we follow Ridgely's and Tudor's (1994) appropriate suggestion for an English name. Two pairs of this poorly known foliage-gleaner were encoun-

tered about 2 km east of the headquarters (KU 88362, 88363, MNHNP). Both pairs were observed foraging 2–4 m above the ground in relatively dense understory. One pair was associated with a understory mixed-species flock. Ridgely's and Tudor's (1994) description of the song and call accurately describe what we recorded, with the San Luis birds sounding very similar to birds from Patios de Minas, Minas Gerais (tape recording by Andrew Whittaker). Plumage differentiation and taxonomy of this species will be presented elsewhere.

*Bare-throated Bellbird (Procnias nudicolis)*.—San Luis lies at the western limit of this species' range (Snow 1982, Hayes 1995a). In October, two birds were recorded. An adult male (KU 88873) sang for more than 15 min during mid-morning on 24 October from a leafless, uppermost branch of one of the tallest trees (ca 40 m) in the mesic forest east of the headquarters. Only one or two other individuals were heard in October, both gave the *bock* call a few times, on two separate occasions. In November and December, RCF heard at least 12 displaying males daily along about 4 km of trail east of Tagatlya Guazu arroyo. An immature male (KU 88387; testes  $8 \times 4$  mm) was one year old based on plumage (Snow 1973) and bursa size ( $8 \times 8$  mm). The plumage of this specimen resembles closely that of an adult female (Snow 1982, Sick 1993), except that the head is entirely black and the abdomen and crissum are primarily white instead of pale yellow. It was in moderate to heavy body molt, with #5 primary in molt (primaries 1–4 fresh). Secondary 7 or 8 (one is missing on each side) was in molt. Secondary 9 was very worn, and the others appeared lightly worn. The central pair of rectrices was in molt with all other rectrices heavily worn.

This bellbird has been documented as migratory in the southeastern part of its Brazilian range (Belton 1985, Sick 1993); in Misiones, Argentina it is apparently only transient (M. Barnett in Lowen et al. 1996b). In Paraguay it is thought to occur year round in depto. Cañendiyú and probably depto. Amambay (Madróño and Esquivel 1995). Its status elsewhere in Paraguay is unclear (Lowen et al. 1996b). Our limited fieldwork at San Luis suggests it may occur there only seasonally. If this bell-

bird covers great distances in its seasonal movements, then it may be especially vulnerable to habitat fragmentation. Willis (1979) regarded large canopy frugivores to be vulnerable because of their reliance on spatially and temporally patchy resources. This bellbird and the Red-ruffed Fruit Crow (*Pyroderus scutatus*) completely disappeared from forests that had been fragmented (largest fragment 198 ha) in the Lagoa Santa area of Brazil (Christiansen and Pitter 1997).

*Veery (Catharus fuscescens)*.—We netted an immature male (KU 88484) on 30 October. This record is the first for Paraguay, and represents one of the southernmost records for the continent (McFarlane 1974; Remsen and Traylor 1983; Ridgely and Tudor 1989; Willis and Oniki 1993; D. Stotz, pers. comm.). The specimen is referable to the nominate subspecies. All three Bolivian specimens originally identified as *C. f. salicicola* by Remsen and Traylor (1983) are now thought to be of either the nominate race or *C. f. fuliginosa* (V. Remsen, D. Stotz, pers. comm.). No subspecific determinations have been made for southeastern Brazilian specimens.

*White-bellied Warbler (Basileuterus hypoleucus)*.—The presence of yellow in the lower underparts of a few specimens from several areas and observation of mixed-species pairs document the occasional hybridization between *B. hypoleucus* and the Golden-crowned Warbler (*B. culicivorus*; Hellmayr 1935, Willis 1986, Remsen and Traylor 1989, Silva 1991), although this literature has been overlooked in recent paruline summations (Ridgely and Tudor 1989, Curson et al. 1994). All four specimens prepared as skins from San Luis show signs of hybridization with varying amounts of pale yellow on the center of the abdomen and lower flanks (compared with color plate and descriptions in Silva 1991). We agree with prior assessments that this color is indicative of gene flow between *B. hypoleucus* and *B. culicivorus*, and not with *B. flaveolus* as implied in Hayes (1995a) for the following reasons. Contrary to S. LaBar (in Hayes 1995a), the vocalizations of *B. hypoleucus* are not more similar to those of *B. flaveolus* than to those of *B. culicivorus*. In fact, the vocalizations of *B. hypoleucus* and *B. culicivorus* are so similar that both species respond to play-back recordings of each other's

song (Silva 1991). Neither of these taxa's song resembles those of *B. flaveolus*, whose vocalizations and behavior clearly align it with the *Phaeothlypis* assemblage (Ridgely and Tudor 1989; MBR, pers. obs.). Furthermore, the plumages and behaviors of *B. hypoleucus* and *B. culicivorus* are very similar (Silva 1991; MBR, pers. obs.), unlike the phaeothlypine-like *B. flaveolus*. We originally interpreted Hayes' (1995a) statement of "a mixed family of *B. hypoleucus* and *B. flaveolus* (two of each) at Estancia Fonciere [depto. Concepción]" as meaning mixed-species pairs; his intent, however, was to report "two of each species intermingling together" (F. E. Hayes, pers. comm.). Willis (1986) observed only a single mixed pair of *B. hypoleucus* and *B. culicivorus*; all other pairs were conspecific. Nevertheless, Silva (1991) documented more extensive hybridization in southeastern Brazil and treated the two species as conspecific. To our knowledge, all apparent hybrid morphotypes are *B. hypoleucus*-like, i.e., ventrally yellow *B. culicivorus*-like birds with some white are unknown. Presumably the situation in Paraguay is similar to that in Brazil (Willis 1986, Silva 1991), with hybridization apparently occurring only at ecotones where the dry forest inhabiting *B. hypoleucus* meets the moist forest inhabiting *B. culicivorus*. Typical *B. culicivorus* have been collected at Parque Nacional Cerro Corá, depto. Amambay, only about 130 km east of San Luis (Fig. 1), where patches of moist forest are present (MNHN specimens, Hayes and Scharf 1995).

*Screaming Cowbird (Molothrus rufoaxillaris)*.—Throughout most of its range, this brood parasite has been documented to specialize on Bay-winged Cowbirds (*Molothrus badius*; Friedmann 1963, Fraga 1986); however, Sick (1993) and Fraga (1996) demonstrated that *M. rufoaxillaris* parasitizes the Chopi Blackbird (*Gnorimopsar chopi*) in the absence of *M. badius*. Our limited observations at San Luis also suggest that *M. rufoaxillaris* is parasiting a host other than *M. badius*. Male *M. rufoaxillaris* and Shining Cowbirds (*Molothrus bonariensis*) were observed displaying within 15 m of each other to blackish-appearing female cowbirds in areas where the open forest and campo interdigitated. Given that no *M. badius* were observed at San Luis, we presume that *M. rufoaxillaris* was

parasitizing *Gnorimopsar chopi*, which was fairly common in the area. Unless male *M. rufoaxillaris* and *M. bonariensis* are vocalizing, they are extremely difficult to distinguish under field conditions (Ridgely and Tudor 1989). However, Ridgely and Tudor (1989) stated that pronounced plumage differences in females (grayish-brown in *M. bonariensis*; blackish in *M. rufoaxillaris*) could aid in identification in areas of sympatry. Our work at San Luis, coupled with museum and literature reviews, demonstrates that an unknown proportion of female *M. bonariensis* in southern South America also have blackish plumage. Two adult female *M. bonariensis* collected at San Luis (KU 88485, MNHNP; others observed) were glossy, bluish-black on all but the lower ventral surface and tail. Under field conditions, these females closely resembled accompanying males; only under excellent light conditions were plumage differences detected. This male-like plumage in female *M. bonariensis* is not limited to Paraguay, as bluish-black females that are very similar to the San Luis birds have also been collected from southeastern Brazil and extreme northeastern Argentina (Friedmann 1927, Sick 1993; KU 65019). Observers should exercise caution in identifying these cowbirds in areas of sympatry based on female plumage patterns. Data are needed on what proportion of nominate female *M. bonariensis* have male-like plumage.

#### DISCUSSION

Silva (1995a) used two criteria—a minimum of 100 species recorded and at least 80 specimens collected—for defining a Cerrado locality as minimally sampled. Based on his criteria, our results (181 species, 220 specimens) would be classified as a relatively thorough Cerrado inventory; however, our results are clearly preliminary. The inclusion of Krieg's results (Laubmann 1939, 1940) puts the Serranía de la San Luis species list at 219. With additional work, we predict that the Parque Nacional Serranía San Luis avifauna will surpass 250 species. Surveys are needed at the drier northern end of the park, where such species as Rusty-backed Antwren (*Formicivora rufa*) and Rufous-sided Pygmy-Tyrant (*Euscarthmus rufomarginatus*) may occur. From our limited observations, it is clear

that San Luis is an important site for grassland and forest Austral migrants, and we predict that the majority of the species to be added to the San Luis list will be from this component. Year round surveys are needed to clarify the status of many species.

Although San Luis is one of the Cerrado sites closest to the Chaco, only one species primarily restricted to the Chaco was found there: the Great Rufous Woodcreeper (*Xiphocolaptes major*). Considerable plumage variation in the two specimens collected of this species obfuscates subspecific determination. For the Olivaceous Woodcreeper (*Sittasomus griseicapillus*), the nominate form, principally of the Chaco, was present; for the Narrow-billed Woodcreeper (*Lepidocolaptes angustirostris*) specimens collected were assignable to the ventrally heavily streaked nominate form than to the ventrally unmarked Cerrado form, *L. a. bivittatus*.

The Atlantic Forest avifauna is also poorly represented at San Luis, with only six species recorded: Reddish-bellied Parakeet (*Pyrrhura frontalis*), Variable Screech-Owl (*Otus atricapillus*), Rufous-capped Motmot (*Baryphthengus ruficapillus*), Ochre-breasted Foliage-gleaner (*Philydor lichtensteini*), Eared Pygmy-Tyrant (*Myiornis auricularis*), and the Bare-throated Bellbird. The minimal Atlantic Forest avifaunal contribution to San Luis contrasts with that of the only other Paraguayan Cerrado site that has been adequately inventoried. A total of 201 species have been recorded at nearby Parque Nacional Cerro Corá (Hayes and Scharf 1995; R. Clay, pers. comm.). Twenty-five Atlantic Forest species, including all six known from San Luis, have been reported from Cerro Corá. Eliminating water inhabiting species (herons, waterfowl, migratory shorebirds, kingfishers, marsh dwelling passerines), 61 Cerro Corá species have not been recorded at San Luis, whereas 62 species have been recorded at San Luis and not Cerro Corá. Additional surveys at both sites undoubtedly will reduce the uniqueness of each site; nevertheless, the presence of humid forest patches at Cerro Corá and campo at San Luis explain genuine species differences between these sites. The humid forest element at Cerro Corá is composed not only of species primarily restricted to Atlantic Forest, but also of species more widely distributed in

humid forest across much of South America, such as Plain Antvireo (*Dysithamnus mentalis*) and Red-rumped Cacique (*Cacicus haemorrhous*). Moreover, the difference in the number of hummingbird species between the two areas is striking, with ten species [Rufous-throated Sapphire (*Hylocharis sapphirina*) being added since Hayes and Scharf 1995; R. Clay, pers. comm.] known from Cerro Corá, but only two from San Luis. The pronounced avifaunal differences between these nearby localities support Silva's (1995c) assertion that additional Cerrado inventories are needed.

Only 3 of the 29 Cerrado endemic species (Silva 1995c) have been found at San Luis. We predict that additional work in the area will document at least 6 more Cerrado endemics: White-winged Nightjar (*Caprimulgus candidans*), White-lored Spinetail (*Synallaxis albilora*), Chestnut-capped Foliage-gleaner (*Hylocryptus rectirostris*), Collared Crescentchest (*Melanopareia torquata*), Reiser's Tyrannulet (*Phyllomyias reiseri*), and Helmeted Manakin (*Antilophia galeata*), which have been found at other Paraguayan Cerrado sites (Laubmann 1939, 1940; Hayes 1995a; Lowen et al. 1996a). Hence, maximum Cerrado endemic species diversity at San Luis is expected to be about nine species. Many of the remaining Cerrado endemic species have restricted geographic ranges; six have extremely small distributions (Silva 1995c). Indeed, one generalization that can be made of the Cerrado endemics is that most are not widespread in the region. Even in the Cerrado's geographic center (eastern Mato Grosso/west-central Goiás), only about two-thirds of the endemics have been found. Several factors may contribute to the somewhat reduced species diversity in Paraguay, (1) less than an estimated 5% of the total Cerrado habitat is found in Paraguay; (2) northern Paraguay is at the southern limit of this habitat's current distribution; and (3) Paraguay has not had the geographic isolating mechanisms that have promoted speciation in other parts of the Cerrado. However, comparable numbers of endemics to Paraguay are found in other peripheral Cerrado areas, such as western Mato Grosso and northern Goiás; hence, the Paraguayan Cerrado is not especially depauperate when compared across the range of the habitat.

The importance of Parque Nacional San Luis cannot be overly stressed. Since our inventory the area that we inventoried was traded for an adjacent, less human impacted sector, formerly known as Estancia Garay Kue (R. Clay and A. Madroño, pers. comm.). The new park boundary apparently encloses about 4500 ha of relatively pristine grassland. This takes on special conservation significance given that virtually all grassland habitat in Paraguay has been moderately impacted by humans (Clay et al. 1998). Indeed, grasslands are one of the most threatened habitats on the continent (Goriup 1988, Bates et al. 1992, Stotz et al. 1996, Silva et al. 1997). The grasslands at San Luis are critical to several avian species, both resident and migrant. Three of the near-threatened avian species are grassland-inhabiting: Greater Rhea (*Rhea americana*), Cock-tailed Tyrant (*Alectrurus tricolor*), and Dark-throated Seedeater (*Sporophila ruficollis*). Moreover, we suspect that the poorly-known and critically endangered White-winged Nightjar (*Caprimulgus candidans*) occurs in the San Luis area. This spectacular nightjar was only recently documented in Paraguay (Lowen et al. 1996a), and quite surprisingly, in eastern Bolivia (Davis and Flores 1994). Prior to these recent records it was known only from a few sites in central Brazil (Collar et al. 1992). Further surveys of this pristine grassland may yield additional grassland specialists, e.g., Bearded Tachuri (*Polystictus pectoralis*) and Sharp-tailed Tyrant (*Culicivora caudacuta*), that are declining (Collar and Wege 1995, Stotz et al. 1996, Parker and Willis 1997).

We commend the Paraguayan government for having the foresight to establish San Luis and Cerro Corá national parks. We hope that our data will help underscore the importance of these parks, and that this information may be used in setting conservation priorities for the rapidly disappearing Cerrado.

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APPENDIX. Avian species and their relative abundance in Parque Nacional Serranía San Luis, depto. Concepción, Paraguay.

	Relative abundance <sup>a</sup>	Status <sup>b</sup>	Habitat <sup>c</sup>	Documentation <sup>d</sup>
<i>Rhea americana</i> <sup>e</sup>	U	P	1	P
<i>Crypturellus undulatus</i>	C	P	2	V
<i>Crypturellus parvirostris</i>	C	P*	1	C,V
<i>Rhynchotus rufescens</i>	U	P	1	V
<i>Nothura maculosa</i>	C	P		S
<i>Phalacrocorax brasilianus</i>	R	V	4	S
<i>Syrigma sibilatrix</i>	R	P*	1	C
<i>Ardea alba</i>				L
<i>Bubulcus ibis</i>	C	V	1	S
<i>Butorides striatus</i>				L
<i>Nycticorax nycticorax</i>				L
<i>Phimosus infuscatus</i>	C	V	1	S
<i>Theristicus caudatus</i>	U	P*	2	C
<i>Mycteria americana</i>	R	V	4	S
<i>Coragyps atratus</i>	U	P	2	S
<i>Cathartes aura</i>	U	P	2	S
<i>Sarcoramphus papa</i>	U	P	3	S
<i>Cairina moschata</i>	R	P	1	S
<i>Leptodon cayanensis</i>	R	P	3	C
<i>Elanus leucurus</i>	R	P	1	S
<i>Rostrhamus sociabilis</i>	R	AM	1	S
<i>Ictinia plumbea</i>	R	B	2	S
<i>Accipiter bicolor</i>	U	P	2	C
<i>Buteogallus meridionalis</i>	X	P	1	S
<b><i>Harpyhaliaetus coronatus</i></b>	X	P	2	S
<i>Buteo magnirostris</i>				L
<i>Spizaetus ornatus</i>	R	P	3	S
<i>Caracara plancus</i>	U	P	1	S
<i>Milvago chimachima</i>	R	P	1	L
<i>Herpetotheres cachinnans</i>	R	P	2	L
<i>Micrastur ruficollis</i>				L
<i>Falco sparverius</i>	R	P	1	L
<i>Crax fasciolata</i>	U	P	3	V
<i>Aramides cajanea</i>				L
<i>Porzana albicollis</i>				L
<i>Cariama cristata</i>	U	P	1	P
<i>Vanellus chilensis</i>	U	Pn	1	P
<i>Rostratula semicollaris</i>	X	V?	1	S
<i>Tringa solitaria</i>				L
<i>Calidris fuscicollis</i>				L
<i>Gallinago paraguaiiae</i>				L
<i>Columba cayennensis</i>	C	P	3	V
<i>Columbina squammata</i>	U	P	1	S
<i>Columbina talpacoti</i>	C	P	1	V
<i>Columbina picui</i>	X	P*	1	C
<i>Claravis pretiosa</i>	C	P*	2	C,V
<i>Leptotila verreauxi</i>	C	P	1	S
<i>Leptotila rufaxilla</i>	U	P*	3	C
<b><i>Anodorhynchus hyacinthinus</i></b>	X	P	2	S
<i>Ara chloropterus</i>				L
<i>Ara maracana</i>				L
<i>Aratinga leucophthalmus</i>	C	P*	3	C,V
<i>Aratinga aurea</i>				L
<i>Pyrrhura frontalis</i>	C	P	3	C,V
<i>Brotogeris chiriri</i>				L
<i>Pionus maximiliani</i>	U	P	2	S
<i>Amazona aestiva</i>	U	P	3	V

## APPENDIX. Continued.

	Relative abundance <sup>a</sup>	Status <sup>b</sup>	Habitat <sup>c</sup>	Documentation <sup>d</sup>
<i>Coccyzus melacoryphus</i>	U	B*	2	C
<i>Playa cayana</i>	U	P	2	L
<i>Tapera naevia</i>	U	P	2	V
<i>Crotophaga major</i>	R	B	2	L
<i>Crotophaga ani</i>	C	P	1	V
<i>Guira guira</i>	C	P	1	V
<i>Otus atricapillus</i>	U	P*	3	C
<i>Otus choliba</i>	U	P	2	S
<i>Pulsatrix perspicillata</i>				L
<i>Bubo virginianus</i>				L
<i>Glauucidium brasilianum</i>	U	P*	2	C,V
<i>Speotyto cunicularia</i>	U	Py	1	P
<i>Lurocalis semitorquatus</i>	C	P?	3	V
<i>Chordeiles minor</i>				L
<i>Podager nacunda</i>				L
<i>Nyctidromus albicollis</i>	U	P*	2	C,V
<i>Caprimulgus rufus</i>	U	P*	3	C,V
<i>Caprimulgus parvulus</i>	U	P*ny	1	C
<i>Nyctibius griseus</i>	U	P*	2	C,V
<i>Chaetura meridionalis</i> <sup>f</sup>	U	IM	4	C,V
<i>Thalurania furcata</i>	R	P	3	C
<i>Hylocharis chrysura</i>	U	P	2	C,V
<i>Trogon curucui</i>	U	P	3	V
<i>Momotus momota</i>	R	P*	3	C,V
<i>Baryphthengus ruficapillus</i>	U	P*	3	C
<i>Chloroceryle americana</i>	R	P	2	S
<i>Chloroceryle inda</i>	R	P	2	S
<i>Nystalus chacuru</i>	R	P	2	V
<i>Nystalus maculatus</i>	R	P	2	C
<i>Pteroglossus castanotis</i>				L
<i>Ramphastos toco</i>	R	P	2	V
<i>Picumnus cirratus</i>	X	P	2	S
<i>Melanerpes candidus</i>	U	P	2	V
<i>Picoides mixtus</i>				L
<i>Veniliornis passerinus</i>	R	P	2	C,V
<i>Piculus chrysochloros</i>	R	P	3	S
<i>Colaptes campestris</i>	R	P	1	L
<i>Celeus lugubris</i>	R	P*	3	C
<i>Dryocopus lineatus</i>	R	P	2	L
<i>Campephilus melanoleucos</i>	R	P	3	L
<i>Furnarius rufus</i>				L
<i>Schoeniophylax phryganophila</i>	U	P	2	C,V
<i>Synallaxis albescens</i>	X	P	1	L
<i>Phacellodomus rufifrons</i>	X	P*	2	C
<b>Philydor dimidiatus</b>	R	P*	3	C,V
<i>Philydor lichtensteini</i>	U	P*	3	C,V
<i>Philydor rufus</i>	U	P*	3	C,V
<i>Sittasomus griseicapillus</i>	C	P*	3	C,V
<i>Xiphocolaptes major</i>	R	P*	2	C,V
<i>Dendrocolaptes platyrostris</i>	U	P*	3	C,V
<i>Lepidocolaptes angustirostris</i>	U	P*	2	C,V
<i>Thamnophilus caeruleus</i>	C	P*	3	C,V
<i>Herpsilochmus atricapillus</i>	U	P	3	C,V
<i>Camptostoma obsoletum</i>	U	P?y	2	C,V
<i>Phaeomyias murina</i>	U	B	2	V
<i>Suiriri suiriri</i>				L
<i>Myiopagis caniceps</i>	U	P?	3	S
<i>Myiopagis viridicata</i>	U	P?*	3	C,V
<i>Elaenia flavogaster</i>	U	P	2	V

## APPENDIX. Continued.

	Relative abundance <sup>a</sup>	Status <sup>b</sup>	Habitat <sup>c</sup>	Documentation <sup>d</sup>
<i>Elaenia albiceps</i>	R	AM	2	C
<i>Elaenia parvirostris</i>	X	P?	2	S
<i>Inezia inornata</i>	R	P?*	2	C,V
<i>Leptopogon amaurocephalus</i>	U	P*	3	C,V
<i>Corythopsis delalandi</i>	U	P*	3	C,V
<i>Myiornis auricularis</i>				L
<i>Hemitriccus margaritaceiventer</i>	U	P	2	C,V
<i>Tolmomyius sulphurescens</i>	U	P*	3	C,V
<i>Platyrinchus mystaceus</i>	C	P*	3	C,V
<i>Myiophobus fasciatus</i>	X	P?		S
<i>Contopus cinereus</i>	R	Pn	2	L
<i>Lathrotriccus eulerei</i>	U	P?*	3	C,V
<i>Cnemotriccus fuscatus</i>	U	P?*	3	C,V
<i>Pyrocephalus rubinus</i>		P*		L
<i>Xolmis cinerea</i>	U		1	C
<i>Xolmis velata</i>	U	P*	1	C
<i>Hymenops perspicillatus</i>				L
<i>Fluvicola leucocephala</i>				L
<b><i>Alectrurus tricolor</i></b>	X	P?*	1	C
<i>Gubernetes yetapa</i>	U	P*	1	C,V
<i>Machetornis rixosus</i>	U	P*	1	C,V
<i>Casiornis rufa</i>	R	P	3	C,V
<i>Syrstes sibilator</i>	U	P*	3	C,V
<i>Myiarchus swainsoni</i>	U	P?*	3	C,V
<i>Myiarchus tyrannulus</i>	C	P*	2	C,V
<i>Pitangus sulphuratus</i>	U	Pn	2	S
<i>Megarynchus pitangua</i>				L
<i>Myiodynastes maculatus</i>	C	B*	2	C,V
<i>Legatus leucophaeus</i>	U	B	2	V
<i>Empidonomus varius</i>	U	B	2	L
<i>Griseotyrannus aurantioatrocristatus</i>	U	B	2	C,V
<i>Tyrannus melancholicus</i>	C	By	1	L
<i>Tyrannus savana</i>	C	Bn	1	V
<i>Xenopsaris albinucha</i>	X	P?	3	S
<i>Pachyramphus viridis</i>	U	Pn	2	C,V
<i>Pachyramphus castaneus</i>	R	P	2	S
<i>Pachyramphus polychopterus</i>	R	Bn	2	V
<i>Pachyramphus validus</i>	R	P?n	2	V
<i>Tityra cayana</i>	R	P	3	S
<i>Tityra inquisitor</i>	U	P*	3	C,V
<i>Pyroderus scutatus</i>	U	P	3	C
<b><i>Procnias nudicollis</i></b>	R,C	P?*	3	C,V
<i>Pipra fasciicauda</i>	R	P	3	C
<i>Oxyruncus cristatus</i>	X	P	3	C
<i>Progne chalybea</i>	U	P?	1	L
<i>Phaeoprocne tapera</i>				L
<i>Tachycineta leucorrhoa</i>	R	B	1	S
<i>Stelgidopteryx ruficollis</i>	R	B	1	L
<i>Cyanocorax cyanomelas</i>	U	P	3	C,V
<i>Cyanocorax cristatellus</i>				L
<i>Cyanocorax chrysops</i>	X	P	3	C
<i>Troglodytes aedon</i>	C	P	2	V
<i>Polioptila dumicola</i>	R	P	2	C,V
<i>Turdus rufiventris</i>	U	P*	2	C,V
<i>Turdus albicollis</i>	C	P*	3	C,V
<i>Turdus amaurochalinus</i>	U	P	2	L
<i>Catharus fuscescens</i>	X	NM	3	C
<i>Mimus saturninus</i>	U	P	1	L

## APPENDIX. Continued.

	Relative abundance <sup>a</sup>	Status <sup>b</sup>	Habitat <sup>c</sup>	Documentation <sup>d</sup>
<i>Mimus triurus</i>				L
<i>Vireo olivaceus chivi</i>	C	P?*	3	C,V
<i>Cyclarhis gujanensis</i>	U	P	2	V
<i>Parula pitiayumi</i>	U	P	3	V
<i>Geothlypis aequinoctialis</i>	R	P	1	V
<i>Basileuterus flaveolus</i>	U	P*	3	C,V
<i>Basileuterus hypoleucus</i>	C	P*y	3	C,V
<i>Conirostrum speciosum</i>				L
<i>Euphonia chlorotica</i>				L
<i>Thraupis sayaca</i>	C	P	2	V
<i>Eucometis penicillata</i>	R	P*	3	C,V
<i>Tachyphonus rufus</i>	X	P*	2	C
<i>Piranga flava</i>	U	P	2	L
<i>Trichothraupis melanops</i>	R	P*	3	C
<i>Cypsnagra hirundinacea</i>				L
<i>Nemosia pileata</i>	U	P	3	V
<i>Hemithraupis guira</i>	U	P*	3	C,V
<i>Saltator similis</i>	U	P*	2	C,V
<i>Saltator atricollis</i>	U	P*	1	C,V
<i>Paroaria coronata</i>	X	P	2	S
<i>Coryphospingus cucullatus</i>	C	P*	2	C,V
<i>Arremon flavirostris</i>	R	P*	3	C,V
<i>Volatinia jacarina</i>	C	P	1	S
<i>Sporophila plumbea</i>	U	P?	1	C,V
<i>Sporophila collaris</i>				L
<i>Sporophila caeruleascens</i>	C	P?	1	C
<i>Sporophila bouvreuil</i>	R	P*	1	C
<i>Sporophila hypoxantha</i>	X	P?	1	C
<i>Sporophila ruficollis</i>	U	P?	1	C
<i>Sicalis flaveola</i>	X	P	1	S
<i>Embernagra platensis</i>				L
<i>Emberizoides herbicola</i>	C	P*	1	C,V
<i>Ammodramus humeralis</i>	C	P*	1	C,V
				S
<i>Zonotrichia capensis</i>	R	P	1	S
<i>Gnorimopsar chopi</i>	C	P	1	V
<i>Pseudoleistes guirahuro</i>				L
<i>Leistes superciliaris</i>				L
<i>Molothrus bonariensis</i>	U	P*	1	C
<i>Molothrus rufoaxillaris</i>	U	P*	1	C,V
<i>Scaphidura oryzivora</i>			2	L
<i>Icterus cayanensis</i>	U	P	2	C,V
<i>Cacicus chrysopterus</i>	U	P*		C,V
<i>Psarocolius decumanus</i>	U	Pn	2	V
<i>Carduelis magellanica</i>	U	P	1	S
<i>Passer domesticus</i>	R	P	1	S

<sup>a</sup> Relative abundance criteria based on our work: X = single observation; R = rare, not recorded daily when in appropriate habitat, and only in small numbers when recorded, <5 individuals/day; U = uncommon, recorded in small numbers daily when in appropriate habitat, 1–10 individuals/day; C = common, recorded daily in large numbers when in appropriate habitat, >10 individuals/day.

<sup>b</sup> Status: P = permanent resident; a breeder with at least a few individuals present throughout the year. Most species given this designation are not known to make seasonal movements; virtually all with P? are presumed to have Austral migrant populations present at appropriate seasons; B = breeder only, Austral migrant; \* = at least one individual/species had enlarged gonads indicative of breeding, n = nest found, y = young observed; V = visitor; nonbreeder, but may breed in adjacent areas to the park; IM = Intra-tropical migrant; AM = Austral migrant; NM = Nearctic migrant. Migrant terminology follows Hayes (1995b); ? = status uncertain. Hayes et al. (1994) and Chesser (1997) were consulted for Austral migrant status.

<sup>c</sup> Habitat based on our work: 1 = open grassland (campo); 2 = isolated woodlots in grassland, forest edge; 3 = forest; 4 = aerial.

<sup>d</sup> Documentation: C = collected; V = voice recorded; P = photographed; we use this designation only when a species was photographed but not "C" or "V". S = sight observation(s) only. L = based on specimens by the Kreig expedition to this region; referenced in Laubmann (1939, 1940); see Methods for explanation.

<sup>e</sup> Species in boldface are threatened or near-threatened (Collar et al. 1992, 1994).

<sup>f</sup> Following Marín (1997).