

BIRD SPECIES RICHNESS AND CONSERVATION IN THE CERRADO REGION OF CENTRAL BRAZIL

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Abstract. The Cerrado biome of central Brazil comprises one of the most biologically diverse savannas in the world. Modern agricultural practices have led to a large-scale conversion of the region for high-yield grain production. This paper presents a preliminary analysis of among-site variation in bird species richness and turnover. Species lists for six sites ranged from 202 to 263 species per site, with the Jaccard similarity index varying from 0.326 to 0.611. All six site lists added up to 519 species, more than 50 percent of which occurred at only one or two sites. Most among-site turnover was associated with forest and aquatic faunas. Savanna and other open habitats also had substantial turnover, however, with similarity indices in the range of 0.434 to 0.734. Eighteen endemic species were recorded; those at risk were associated primarily with open grasslands. The high avian diversity and substantial human impact in this region indicate that the Cerrado should be a major priority for conservation action.

LA RIQUEZA DE ESPECIES DE AVES Y LA CONSERVACIÓN EN LA REGIÓN DEL CERRADO DEL CENTRO DE BRASIL

Sinopsis. El bioma del Cerrado del centro de Brasil comprende una de las sabanas más diversas del mundo biológicamente. Los sistemas agrícolas modernos han producido en la región una conversión en grande escala hacia una alta producción de granos. Este informe presenta un análisis preliminar de las variaciones de la riqueza y la renovación de las especies de aves. Las listas de especies para seis localidades de estudio tenían entre 202 y 263 especies por localidad, con una variación en el índice de similaridad de Jaccard de 0,326 a 0,611. La totalidad de las seis listas sumaron 519 especies, donde más del 50 por ciento de las especies estaba sólo en una o dos de las localidades. La mayoría de la renovación entre localidades se asocia con las faunas forestales y acuáticas. Sin embargo, hubo una renovación importante también en las sabanas y en otros hábitats abiertos, con índices similares de alrededor de 0,434 a 0,734. Dieciocho especies endémicas fueron registradas; aquellas en riesgo se asociaron principalmente con pastizales abiertos. La alta diversidad de aves y el considerable impacto humano en esta región indican que las actividades de conservación en el Cerrado deberían ser una prioridad.

Key Words: Brazil; Cerrado; grassland birds; species richness.

The Cerrado biome is an extensive savannalike biome extending over 1.8 million km² in central Brazil, with a small extension into Bolivia (Dias 1992; Fig. 1). It is dominated by open grasslands (campo limpo) interspersed with scattered trees and shrubs (campo sujo) and dense woodlands (cerradão woodland; Eiten 1972, 1984). Beginning in the eighteenth century, this region was sparsely inhabited by Europeans, mainly prospectors seeking gold and diamonds and ranchers who grazed cattle on an extensive scale using native pasture. Intensive agriculture was not important because of the low nutrient content and high acidity of the soils and the lack of highway or railroad access.

Since the 1950s, however, mechanization of agriculture and construction of major highways through central Brazil have dramatically increased the impact of humans in the Cerrado. The use of lime and of new fertilization techniques has made cerrado soils suitable for crops, and the deep soils on rolling terrain are easily developed for mechanized agriculture. As a result, more than 35% of the Cerrado has been

converted to agriculture, forestry, or pastureland. In São Paulo state, the cerrado vegetation has been reduced from 14 to 1.17% of the state's area (Secretaria do Meio Ambiente-SP 1997).

Further impacts on the Cerrado may result from pressure by national and international organizations to halt destruction of forests in Amazonia. The Cerrado has been viewed as a favorable area in which to develop alternative sites for intensive agriculture, especially for planting forests to produce pulp or to act as carbon sinks (Ab'Sáber et al. 1990).

The existence of scrubby vegetation in the Cerrado has been erroneously assumed to be correlated with low species diversity. In fact, these savannas are some of the richest in the world, with more than 600 woody plant species (Rizzini 1971). The bird fauna is also diverse. More than 420 species have been recorded in or near the Federal District, a 5,000-km² unit in the core of the Cerrado (Negret et al. 1984). However, fewer than 32,000 km²—in fewer than 100 parks, sanctuaries, or scientific reserves—have been protected in the Cerrado (Dias 1990).

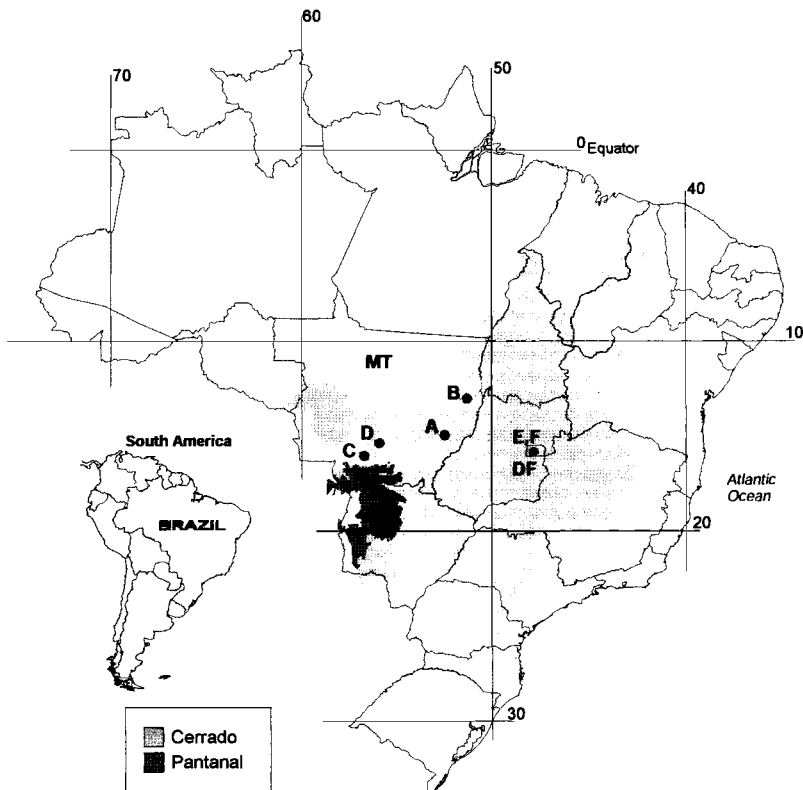


FIGURE 1. Map showing Cerrado region of central Brazil and locations of the six bird-survey sites (A–F; for references for each site, see Table 1). MT = Mato Grosso state, DF = Federal District.

Large subregions of the Cerrado, such as the newly created state of Tocantins, have only one or two reserves.

Birds are sensitive indicators of environmental degradation. Concern for South American grasslands, including the Cerrado, has been sparked by recent reports of the rarity and low numbers of grassland-dependent species (Goriup 1988, Collar et al. 1992). The disappearance of natural grasslands in South America has led to alarming declines in nesting birds associated with these habitats. Species of concern (Collar and Andrew 1988) include Lesser Nuthur (*Nothura minor*), Dwarf Tinamou (*Taoniscus nanus*), Crowned Eagle (*Harpyhaliaetus coronatus*), White-winged Nightjar (*Caprimulgus candicans*), Sickie-winged Nightjar (*Eleothreptus anomalus*), Black-and-white Monjita (*Xolmis dominicana*), Strange-tailed Tyrant (*Yetapa risoria*), Bearded Tachuri (*Polystictus pectoralis*), Sharp-tailed Tyrant (*Culicivora caudacuta*), Chaco Pipit (*Anthus chacoensis*), Ochre-breasted Pipit (*A. nattereri*), Rufous-rumped Seedeater (*Sporophila hypochroma*), Marsh Seedeater (*S. palustris*), Chestnut Seedeater (*S. cinnamomea*),

Black-masked Finch (*Coryphasiza melanotis*), Saffron-cowled Blackbird (*Xanthopsar flavus*), and Pampas Meadowlark (*Sturnella defilippii*).

These poorly known species face numerous threats, including habitat fragmentation, isolation, trapping for the cagebird trade, hunting, and environmental degradation from pesticides (Bucher and Nores 1988, Cavalcanti 1988, Willis and Oniki 1988). Because little natural habitat remains in many areas, there is serious concern whether these native birds will be able to survive in human-influenced environments. Several species may be adapting temporarily to secondary habitats but may be unable to reproduce successfully in such marginal sites.

The purpose of this paper is to review data on species richness and turnover in the Cerrado and to discuss the conservation needs of the region's avifauna.

METHODS

I conducted a review of published and unpublished data to examine the following questions: what is the species richness at individual sites in the Cerrado biome, and how similar are nearby sites?

TABLE 1. BIRD SPECIES RICHNESS FOR SIX SITES IN THE CERRADO REGION OF BRAZIL

Site	Reference	State	Species count
A	Sick 1955	Mato Grosso	245
B	Fry 1970	Mato Grosso	263
C	Silva and Oniki 1988	Mato Grosso	233
D	R. Cavalcanti and M. Marini, unpubl. data	Mato Grosso	202
E	Negret 1983	Federal District	260
F	Antas 1995	Federal District	262

Data were obtained from six lists. Four lists came from Mato Grosso state and two from the Federal District. A site was defined as an area in the range of 1,000–50,000 ha, surveyed by one or two observers. Sampling effort was not known for all sites. I considered all species recorded for species richness (Table 1). Comparisons among sites were done only for species that had been positively identified, however; hence the differences in species numbers in Tables 1 and 3.

Similarities among sites were analyzed through a cluster analysis on the Euclidean distance matrix using the UPGMA method (Kovach 1990). The Jaccard similarity index was also calculated (Kovach 1990). Birds were classified according to their habitats as mostly cerrado and open landscapes, forest, or aquatic/riverine, based on the habitat preferences cited by the authors of individual species lists and by Silva 1995a. Cerrado-region endemics were also analyzed, based on the list of Silva (1995a), to which I added three species (Rufous-sided Pygmy-Tyrant [*Euscarthmus rufomarginatus*], White-rumped Tanager [*Cypsnagra hirundinacea*], and White-banded Tanager [*Neothraupis fasciata*]) with distributions in the cerrados of central Brazil plus Amapá state and its neighboring areas.

RESULTS

SPECIES RICHNESS AND SIMILARITIES

Species richness data were remarkably consistent. All counts fell within the range of 200–270 species per site (Table 1). A total of 519 species were identified at these six sites. By comparison, Silva (1995a) listed 837 species for the entire Cerrado region, and Negret et al. (1984) found 429 species in the Federal District. These data indicate that each of the six sites for which I examined data held about 20–30% of the Cerrado regional avifauna.

TABLE 2. SPECIES DISTRIBUTION AMONG SIX SITES IN THE CERRADO REGION OF CENTRAL BRAZIL (TOTAL SPECIES 519)

Number of species	Number of sites recorded
164	1
108	2
75	3
74	4
39	5
59	6

Similarities in species composition between sites were fairly low, with a Jaccard index ranging from 0.326 between sites C and F to 0.611 between sites E and F. More than 50% of all species were recorded at only one or two sites (Table 2). In general, the similarities were related to geographical proximity and position in the Cerrado region. The cluster dendrogram grouped both sites in the Federal District apart from the Mato Grosso sites (Fig. 2). Two sites in the middle of the Cerrado, in Mato Grosso, were grouped apart from sites at the edge of the region (Fig. 2). Edge sites B and C were influenced by Amazonian forest species, as indicated by Fry 1970 and Silva and Oniki 1988.

TURNOVER AND HABITAT EFFECTS

The Cerrado is a complex mixture of habitat types. In addition to the various forms of savanna and grassland that dominate the landscape in the core of the region, several types of forest are

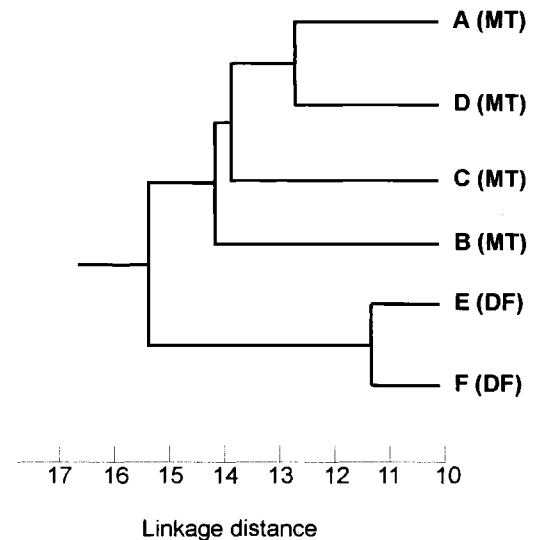


FIGURE 2. Cluster analysis dendrogram of the relationship between sites in the Cerrado region of central Brazil, based on presence/absence data of 519 bird species. All sites from Mato Grosso state (MT) are distinct from those of the Federal District (DF).

TABLE 3. BETWEEN-SITE TURNOVER IN BIRD SPECIES COMPOSITION FOR SIX SITES IN CENTRAL BRAZIL

Site	All species	Site-specific species per habitat		
		Cerrado	Forest and aquatic	% cerrado site specific
A	245	2	13	0.8
B	263	6	43	2.2
C	230	5	28	2.1
D	190	3	4	1.5
E	260	12	17	3.8
F	262	9	22	3.5

widespread, occurring most densely on rich soils or in areas of high humidity. As a result, the avifauna at any site is composed of both open-habitat and forest species. To determine whether variation among sites was due to non-savanna habitat effects, I compared the number of site-specific species per habitat.

Forest- and aquatic-associated species were the main site-specific component (Table 3). The cerrado and open-habitat species were fairly constant and in lower proportion than the site-specific birds, which ranged from 0.8 to 3.8% of the avifauna (Table 3). Similarity between sites, as measured by the Jaccard index, was always higher for the cerrado and open-habitat avifauna than for the forest and aquatic avifauna (Table 4). These results indicate that most of the turnover among sites can be attributed to variation in the forest- and aquatic-habitat components of the avifauna.

OCCURRENCE OF CERRADO-REGION ENDEMIC

Eighteen of the 32 Cerrado-region endemic species that Silva (1995a) and I considered were found at the six study sites (Table 5). Six species were recorded at only one site. With the exceptions of Blue-eyed Ground-Dove (*Columbina cyanopis*) and Brasilia Tapaculo (*Scytalopus novacapitalis*), however, most of these species do not have particularly restricted distributions; thus, one would not expect such high site specificity. It is likely that habitat and abundance factors contributed substantially to this variation. Fifteen species occurred at the Federal District sites, whereas only 10 were found at the Mato Grosso sites. Eight species were largely restricted to open grasslands or areas with scattered trees, five occurred in tree and scrub cerrado, and five were restricted to forests (Table 5).

The degree of risk to the survival of these species is correlated with the human impact on their habitats. Open grasslands are preferred sites for mechanized agriculture, and this habitat is almost gone from central Brazil. Tree and

TABLE 4. BETWEEN-SITE SIMILARITY (JACCARD INDEX) FOR OPEN-HABITAT AVIFAUNA AND FOREST- AND AQUATIC-HABITAT AVIFAUNAS IN CENTRAL BRAZIL

Sites	Cerrado/Open	Forest/Aquatic
A-B	0.562	0.412
A-C	0.493	0.308
A-D	0.518	0.414
A-E	0.489	0.258
A-F	0.480	0.310
B-C	0.493	0.313
B-D	0.529	0.283
B-E	0.464	0.178
B-F	0.438	0.206
C-D	0.481	0.352
C-E	0.460	0.201
C-F	0.494	0.178
D-E	0.515	0.248
D-F	0.515	0.255
E-F	0.734	0.462

scrub cerrado on deep, well-drained soils is also prime agricultural land. Remnants of this native vegetation survive in areas of rough terrain and in small fragments throughout the region. Gallery forests are protected by law and by natural barriers such as flooded soil. Grassland and cerrado species are of particular conservation concern; these include Lesser Nothura, Dwarf Tinamou, Campo Miner (*Geobates poecilopterus*), Blue-eyed Ground-Dove, and Yellow-faced Parrot (*Amazona xanthops*). As a group, gallery-forest species are fairly stable.

DISCUSSION

Planning a conservation strategy for a regional avifauna requires detailed knowledge of its richness, endemism, and spatial distribution. In the Cerrado region of Brazil, however, large areas remain unexplored (Silva 1995b). Under these circumstances, where habitat conversion is occurring rapidly and little is known about the spatial heterogeneity of bird distributions, a preliminary analysis of existing inventories can be useful in informing initial conservation actions and designing future surveys. Because site lists were comparable in species numbers across several locations, the present analysis suggests that comparatively small sites, in the order of tens of thousands of hectares, can harbor about a third of the Cerrado-region avifauna.

Because of the exceptional species richness and habitat diversity in the Cerrado, there were substantial turnover rates among sites at the local and regional level. I discerned effects in turnover rate attributable to local habitat composition (forest, aquatic, and cerrado) and regional (influence of Amazonian fauna) as well as other factors. In addition to demonstrating

TABLE 5. DISTRIBUTION OF CERRADO-REGION ENDEMICS AMONG SIX SITES IN CENTRAL BRAZIL

Family	Species	Habitat	Site
Tinamidae	<i>Nothura minor</i>	Cerrado	E
	<i>Taoniscus nanus</i>	Cerrado	E
Columbidae	<i>Columbina cyanopsis</i>	Cerrado	C
Psittacidae	<i>Amazona xanthops</i>	Cerrado	E, F
Furnariidae	<i>Geobates poecilopterus</i>	Cerrado	E, F
	<i>Phylidor dimidiatus</i>	Forest	E
Formicariidae	<i>Herpsilochmus longirostris</i>	Forest	A, D
Rhinocryptidae	<i>Melanopareia torquata</i>	Cerrado	A, B, C, D, E, F
	<i>Scytalopus novacapitalis</i>	Forest	E, F
Tyrannidae	<i>Euscarthmus rufomarginatus</i>	Cerrado	A
Pipridae	<i>Antilophia galeata</i>	Forest	A, B, C, D, E, F
Corvidae	<i>Cyanocorax cristatellus</i>	Cerrado	B, C, D, E, F
Parulidae	<i>Basileuterus leucophrys</i>	Forest	E, F
Emberizidae	<i>Charitospiza eucosma</i>	Cerrado	B, D, E, F
	<i>Saltator atricollis</i>	Cerrado	A, C, D, E, F
	<i>Porphyrospiza caeruleascens</i>	Cerrado	F
	<i>Neothraupis fasciata</i>	Cerrado	C, E, F
	<i>Cypsnagra hirundinacea</i>	Cerrado	C, E, F

turnover attributable to habitat mix (i.e., relative importance of aquatic habitats), I also found substantial turnover among sites in a given habitat (Tables 3 and 4). Further studies will be necessary to determine the relative importance of ecological and biogeographical effects in species turnover patterns among sites. For example, Silva (1996) has suggested that the distribution of Atlantic and Amazonian elements in the gallery-forest avifauna of the Cerrado was influenced by altitude and distance from the species' centers of distribution. Silva (1995c) also identified seven major patterns of biogeographic distribution for the avifauna associated with the Cerrado savanna vegetation.

The high local bird richness in the Cerrado region and the strong habitat preferences of many species exacerbated apparent turnover among sites that was not accounted for simply by changes in habitat. In this survey, additional sources of variation were the number of observers and different sampling methods. To rectify this problem, future studies should use a standard range of habitat types and sampling methods, and trained observers.

Grasslands and savannas are preferred habitats for human occupation. Changes in patterns of use have far-reaching consequences for species diversity as well as for other factors of importance to humans, such as frequency and intensity of fires and availability of groundwater during the dry season. Survival of Cerrado birds will depend on bringing together many forces to support the maintenance of natural landscapes and biological communities.

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