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ARTIGO/ARTICLE

Habitat use by Sharp-tailed Tyrant (*Culicivora caudacuta*), and Cock-tailed Tyrant (*Alectrurus tricolor*) in the Cerrado of Southeastern Brazil

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RESUMO: Uso de hábitat pelo papa-moscas-do-campo (*Culicivora caudacuta*) e o galito (*Alectrurus tricolor*) no Cerrado do sudeste do Brasil. Aves especialistas campestres são dependentes de um conjunto restrito de habitats nativos, que estão desaparecendo em quase toda parte. Examinamos o uso do microhábitat e macrohábitat de duas espécies de tiranídeos ameaçados, o papa-moscas-do-campo, *Culicivora caudacuta* e o galito, *Alectrurus tricolor,* em uma área de Cerrado preservado. Foram gerados modelos de regressão logística para explicar a presença das espécies através das variáveis de microhábitat. A ocorrência das espécies de tiranídeos foi principalmente nas áreas campestres sendo determinada pela baixa densidade de palmeiras (*Attalea geraensis*) e árvores. A presença de *Culicivora caudacuta* foi também associada com uma maior densidade de arbustos baixos (< 1 m) e solo menos exposto. A relação positiva encontrada entre a presença de *C. caudacuta* e cobertura do solo pode indicar a importância da serapilheira e da vegetação de sub-bosque para abrigo e alimentação. A conservação das espécies na área do estudo deve envolver o controle de densidade de palmeiras e a manutenção de áreas campestres com arbustos baixos.

PALAVRAS-CHAVE: Aves ameaçadas; conservação; manejo; savanas; seleção de habitat.

ABSTRACT: Habitat use by Sharp-tailed Tyrant (*Culicivora caudacuta*), and Cock-tailed Tyrant (*Alectrurus tricolor*) in the Cerrado of Southeastern Brazil. Obligatory grassland birds are dependent on a limited set of native habitats that are disappearing almost everywhere. We examined the use of macrohabitat and microhabitat by two threatened species of flycatchers, the Sharp-tailed Tyrant, *Culicivora caudacuta* and the Cock-tailed Tyrant, *Alectrurus tricolor* in a preserved area of cerrado. We generated logistic regression models to explain the presence of these species through variables of microhabitat. Both flycatchers occurred mainly in grassland areas and favored areas with a low density of palms (*Attalea geraensis*) and trees. The Sharp-tailed Tyrant also favored areas with a high density of low shrubs (< 1 m) and less exposed soil. The positive relationship found between the presence of Sharp-tailed Tyrant and soil cover may indicate the importance of litter and understory vegetation for shelter and food. The conservation of both flycatcher species in the study area should benefit from controlling palm density and the maintenance of grasslands with low shrubs.

KEY-WORDS: Conservation, grasslands, habitat selection, management, threatened birds.

The Cerrado biome is a savanna type located primarily in the Central Plateau of Brazil (Ribeiro and Walter 1998). Besides being the second largest biome in Brazil (Ab'Saber 1977), more than half of the Cerrado has been cleared or transformed for human uses (Machado 2004). It is one of the world's biodiversity hotspots (Myers *et al.* 2000), with a high richness that includes 856 species of birds in Brazil (Silva and Santos 2005).

The Brazilian Cerrado is the most threatened grassland in the world due to the expansion of cattle ranches and farmers (Stotz *et al.* 1996). The open Cerrado habitats (grasslands) are richer in flora species than forested ones (cerrado *sensu stricto*) and have been systematically ignored (Castro *et al.* 1999, Batalha *et al.* 2010). The birds of these habitats would be able to keep, on average, 59% of the functional diversity of the Cerrado (Batalha *et al.* 2010). Grassland specialist birds are dependent on a restricted set of native habitats, which are disappearing almost everywhere (Vickery *et al.* 1999, Stotz *et al.* 1996). The insectivorous Sharp-tailed Tyrant (*Culicivora caudacuta*) and Cock-tailed Tyrant (*Alectrurus tricolor*) (both belonging to the Tyrannidae family) are grassland specialists (*sensu* Vickery *et al.* 1999) common in grassland areas (Tubelis and Cavalcanti 2001, Di Giacomo 2005).

The Sharp-tailed Tyrant is small (body mass 5.8 g; Sousa and Marini 2007) eventually occurring in *campo cerrado* (Lowen *et al.* 1996, Sousa and Marini 2007), cerrado *sensu stricto* (Sousa and Marini 2007), and locations close to wetlands (Lowen *et al.* 1996). The Cock-tailed Tyrant (body mass 15.8 g; Braz 2008) is uncommon in

the vicinity of wetlands or marshes and recent fires, or heavy grazing (Ridgely and Tudor 1994, Sick 1997, Fitzpatrick *et al.* 2004).

These tyrants are considered globally vulnerable (IUCN 2010) and are critically endangered in the state of São Paulo (São Paulo 2009). Their populations are declining, due to habitat loss, conversion of grasslands into crops (Parker and Willis 1997), high frequency of fires (Ridgely and Tudor 1994), and introduction of exotic grasses (IUCN 2010). Current studies at Estação Ecológica de Itirapina (hereafter EEI), state of São Paulo, indicate that the population sizes of Cock-tailed Tyrant and Sharp-tailed Tyrant are small, *i.e.,* 26 and 73 individuals, respectively (Kanegae 2011), and are probably declining (Willis 2004). The major threats for these species at EEI are high fire frequency (every two years), expansion of exotic grasses, and invasion by exotic animals. We studied habitat use of these two threatened Cerrado species because they are easy to detect (visually or aurally), and are becoming rare in this region (Willis 2004). Our objectives were to evaluate two scales of habitat use: macrohabitat (landscape) and microhabitat (use of perches, foraging sites).

MATERIAL AND METHODS

Study Area – The natural Cerrado vegetation originally covered 14% of the state of São Paulo (SEMA 1997). Currently, it accounts for only 0.81% of the state area and occurs in small, isolated fragments (Durigan *et al.* 2007). This study was conducted in the Cerrado of EEI, a conservation units in the municipalities of Itirapina and Brotas (22°15'S; 47°49'W) comprising an area of 2,720 ha (Figure 1). The EEI maintains one of the last natural grassland Cerrado remnants in São Paulo state (Gianotti 1988), and, accordingly, supports high bird richness with 231 bird species (Motta-Junior *et al.* 2008). The main threats to the EEI are expansion of African grasses, *Urochloa decumbens* and *Melinis minutiflora,* and exotic trees, including *Pinus* spp. and *Eucalyptus* (Motta-Junior *et al.* 2008).

The Cerrado Region is characterized by the presence of dry winters and rainy summers and has a complex of habitats types ranging from forests (*cerradão*) to grasslands (*campo sujo* and *campo limpo*). Between these extremes are the intermediate ones, such as *cerrado sensu stricto* and *parque cerrado* (Ribeiro and Walter 1998). We considered

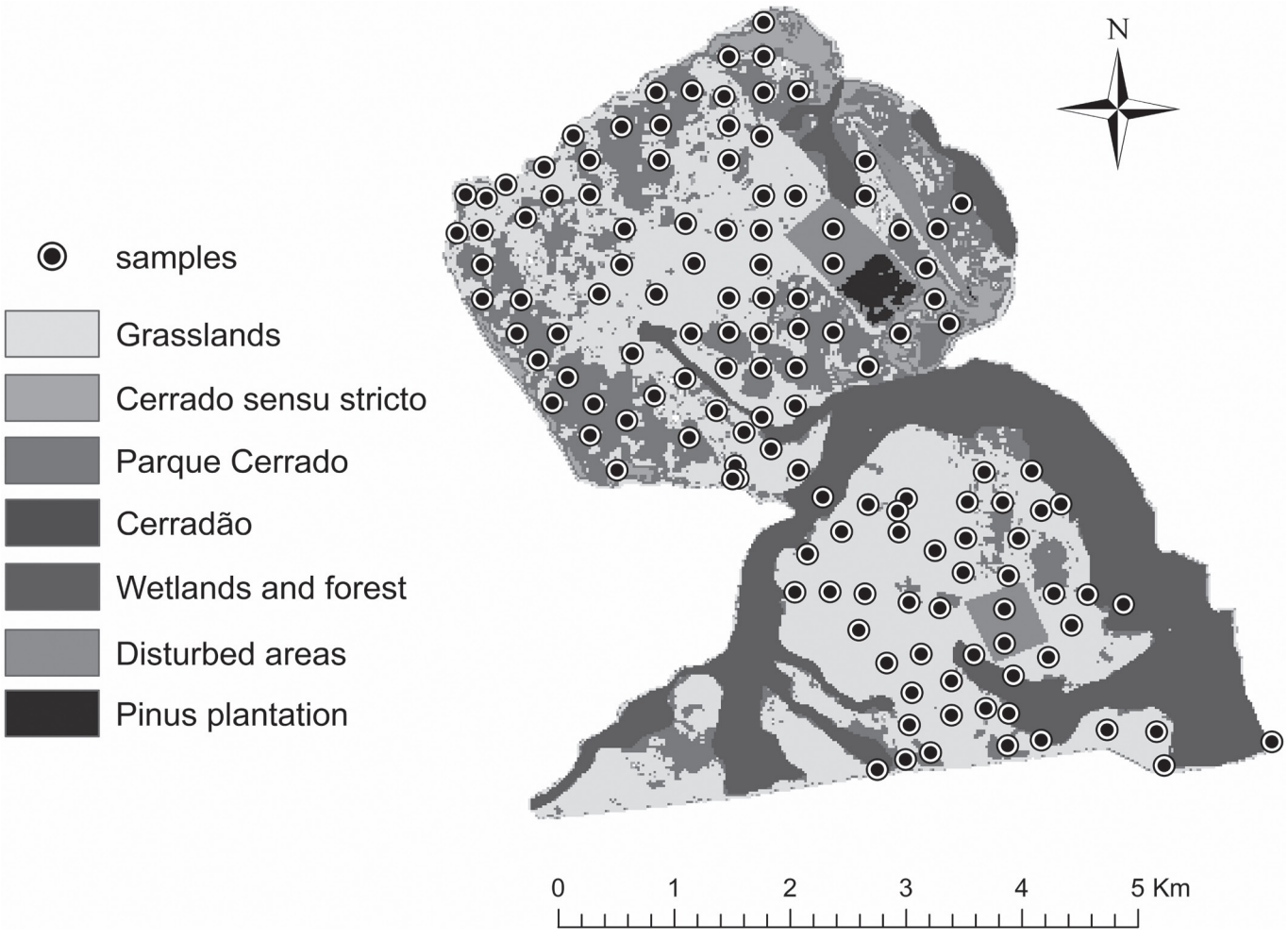

FIGURE 1: Cerrado phytophysionomies at Estação Ecológica de Itirapina (EEI), with the location of all sampling points visited in 2006.

TABLE 1: Types of habitat and number of points sampled (N), percentage of each habitat covered by sampling points (%N), and records obtained with Sharp-tailed Tyrant and Cock-tailed Tyrant at Estação Ecológica de Itirapina (EEI), between September and December 2006.

Habitats	Area (ha)	% habitat	N	% N	Sharp-tailed Tyrant	Cock-tailed Tyrant
Seasonal wetland	420.12	17.19	24	17.91	1	0
Grassland	1162.28	47.57	68	50.75	60	16
Parque cerrado	571.44	23.39	30	22.39	0	0
Cerrado *sensu stricto*	121.36	4.97	6	4.47	0	0
Cerradão	52.88	2.16	2	1.49	0	0
Altered area	115.48	4.73	4	2.99	0	0
Total	2443.26	100.00	134	100.00	61	16

TABLE 2: Bailey confidence intervals of habitat use by Sharp-tailed Tyrant at Estação Ecológica de Itirapina (EEI). Pi: proportion of actual use of each type of vegetation; (+) used more than expected, (-) used less than expected.

Habitat type	Observed use	Expected use	Bailey Interval	Use
Campo limpo and *sujo*	0.983	0.676	0.968 ≤ pi ≤ 0.997	+
Seasonal wetland	0.017	0.323	0.009 ≤ pi ≤ 0.041	–

the open grasslands *campo limpo* and *campo sujo* together in the macrohabitat analysis due to their structural similarities, without the presence of trees and because it was not possible to distinguish them in the satellite image obtained (see below). More detailed descriptions of Cerrado phytophysiognomies are described in Eiten (1972, 1993) and Ribeiro and Walter (1998).

The altitude of the study area varies between 705 and 750 m (SEMA 1997). The climate is humid subtropical with a marked dry season in winter, according to Köppen (1948) classification. The mean monthly precipitation in 2006 was 109.9 mm, with a dry season between April and September (monthly precipitation ranging from 7 to 79 mm) and a rainy season between October and March (monthly precipitation ranging from 119 to 228 mm). Mean monthly temperatures ranged from 16.2°C to 20.1°C in the dry season and from 19.5°C to 22.3°C in the rainy season (Gianotti 1988).

Field procedures – We considered two scales to assess habitat use: macrohabitat (landscape) and microhabitat (use of perches, foraging sites; Hutto 1985, Block and Brennan 1993). The first scale is related to landscape features, such as the different types of habitat (phytophysiognomies) in the Cerrado. The second scale, microhabitat, is related to vegetation characteristics used during vocalization and foraging.

Macrohabitat – We evaluated 134 sampling points distributed throughout EEI during September and December 2006 (Figure 1). Each point was sampled for 10 min three times a day, twice in the morning (05:00-09:00 h) and once in the afternoon (16:00-18:00 h), when the observer remained stationary. Habitat use was assessed by acoustic and visual detection of birds at the sampling points. We evaluated six habitat types: *cerradão, cerrado sensu stricto, campo cerrado,* grasslands, wetlands and disturbed areas (Table 1). Both Sharp-tailed Tyrant and Cock-tailed Tyrant were recorded at the sampling points mostly during their activities related to territorial defense (vocalization and displays).

The types and percentages of each habitat used were obtained by analyzing the Normalized Difference Vegetation Index of a study site satellite image (CBERS 2, 17 July 2006), provided by Instituto de Pesquisas Espaciais (INPE). The spectral signature of each habitat was determined following Mesquita Jr. (1998).

The analysis of habitat use was based on information of use-availability (Garshelis 2000). The availability of each habitat type and their use was calculated according to Neu *et al.* (1974) and Canavelli *et al.* (2003). To determine the possibility of a differential habitat use, we considered the proportions of each habitat type with the confidence interval of Bailey (Canavelli *et al.* 2003).

Microhabitat – We used the same sampling points described for macrohabitat use and randomly selected 67 points to evaluate resource availability within an imaginary circle of 5 m radius from the first visual detection of a perched bird. We measured the height of the bird on the perch, total height of the perch, roost type (tree, shrub or grass), and presence of foliage. Microhabitat variables were measured as classes of percentage (0: 0-20; 1: 21-40; 2: 41-60; 3: 61-80; and 4: 81-100) within the 5 m radius circle covered by exotic and native grasses, and exposed soil. We also classified into standardized categories ranging from 0 to 5 the following microhabitat variables: density and height of shrubs, trees, and palms (*Syagrus petrea* and *Attalea geraensis*) and overall vegetation heterogeneity (Wiens 1969). We considered trees and shrubs as woody plants with stem diameter at ground level ≥ 3 cm and < 3 cm, respectively. Understory vegetation heterogeneity was evaluated using a 1 m tall graduated stick subdivided into intervals of 10 cm (Bibby *et al.* 2000). Two 10 m long strings were used from the circle center to form a perpendicular angle (Wiens 1974). Three variables of vegetation structure were obtained at the string tips: Het

TABLE 3: Regression models selected by AICc (Evidence ≤ 2) for the Cock-tailed Tyrant and Sharp-tailed Tyrant at Estação Ecológica de Itirapina (EEI).

Dependent variables	Independent variables		AICc	wAIC	Evidence
Cock-tailed Tyrant	– *Attalea*	– trees	88.45	0.550	1.0
Sharp-tailed Tyrant	– *Attalea*	– trees	96.53	0.139	1.0
	– *Attalea*	– shrubheight	97.39	0.090	1.5
	– *Attalea*	– expsoil	97.63	0.080	1.7

trees: number of trees; shrubheight: height of shrubs; expsoil: percentage of exposed soil.
(+) = positive relationship between the dependent and independent variables.
(–) = negative relationship between the dependent and independent variables.

– index of heterogeneity (Wiens 1969), MaxHeight – maximum vegetation height, and Contact – mean number of vegetation contacts with the stick.

We generated logistic regression models to explain the presence of the species through variables of microhabitat (independent variables). We used a combination of two independent variables due to limitation in sample size. The best-fitted model was obtained by the likelihood with binomial distribution package using Generalized Linear Models (GLM) in R 2.7.1 (R Foundation for Statistical Computing 2008). Model selection was done using Akaike's Information Criterion (AIC, Burnham and Anderson 2002) with correction for small samples (AICc) following Hurvich and Tsai (1989). We sorted the best models and evaluated their performance using the AIC weight (wi) and evidence (Burnham and Anderson 2002). All combinations were analyzed using Spearman correlation to avoid problems related to multicollinearity. Independent variables with correlation ~ 60% were not included in the same model (Zar 1999).

RESULTS

Macrohabitat – Cock-tailed Tyrant occurrence was restricted to grassland areas (*campo sujo* and *campo limpo;* Table 1). Sporadic records of the species were obtained in wetland, which was dry (two records), and in a narrow strip of grassland along the road bordering the boundary of EEI (three records).

Sharp-tailed Tyrant showed preference for grassland areas (*campo sujo* and *campo limpo;* Tables 1, 2). Wetlands were avoided and there were no records in closed formations such as *parque cerrado, cerrado sensu stricto,* and *cerradão.* There was one record of the species in a wetland area with many shrubs and herbaceous plants.

Both flycatcher species were observed close together (< 30 m) on 10 occasions. These observations represent 55% of Cock-tailed Tyrant (n = 35) and 31% for the Sharp-tailed Tyrant (n = 35) records.

Microhabitat – The most relevant model that explained the presence of both flycatchers indicated low density of palms (*Attalea geraensis*) and trees as the most important variables. Other models were relevant for Sharp-tailed Tyrant, with highest density of low shrubs (< 1 m) and less exposed soil associated with a low density of palms (Table 3).

Sharp-tailed Tyrant detection occurred mainly during vocalizations. Perches used during this activity were annual herbs and shrubs with leaves (n = 8 records) and without leaves (n = 15), trees (n = 1), and stems of tall grasses (n = 5). Average perch height (mean ± SD) were 1.2 ± 0.5 m on shrubs, and 2.0 ± 0.6 m on grasses.

The detection of Cock-tailed Tyrant occurred only visually with rare emissions of sounds. Males used shrubs with leaves as perches (n = 1) and without leaves (n = 11), trees with leaves (n = 3), dead trees without leaves (n = 7) and stems of grasses (n = 4). Average perch height was 1.8 ± 0.5 m in plants with a plant total height of 2.1 ± 0.6 m. Females of Cock-tailed Tyrant have camouflage coloration, similar to the young, making visual distinction impossible. As perches, females and/or young used bushes without leaves (n = 3) and stems of grasses (n = 2). Average perch height was on average 1.3 ± 0.4 m in bushes with a total height of 1.6 ± 0.4 m.

DISCUSSION

The Sharp-tailed Tyrant and Cock-tailed Tyrant selected grassland habitats (*campo sujo* and *campo limpo*). This pattern of use seems the same as in the Cerrado of central Brazil (Tubelis and Cavalcanti 2001). However, Sousa and Marini (2007) reported that the home range of Sharp-tailed Tyrant (n = 3 groups) comprise a mosaic of habitats, including grasslands, *parque cerrado,* and eventually cerrado *sensu stricto.* Despite the regular occurrence of the Sharp-tailed Tyrant in *parque cerrado* (Tubelis and Cavalcanti 2001, Sousa and Marini 2007), this species was observed only once in this habitat at EEI.

Both tyrant species can eventually occur in areas with native and exotic grasses (Braz 2008, M. F. K. *pers. obs.*). However, they seem to avoid to areas dominated by exotic grasses (Tubelis and Cavalcanti 2001). Some reports suggested an association of these flycatchers with the occurrence of tall (~ 1 m) grasses (Ridgely and Tudor 1994, Di Giacomo 2005, Esquivel *et al.* 2007). Tall

grass selection was not observed in this study, probably because of the common occurrence of this grassland type throughout the year in all areas of occurrence.

The Sharp-tailed Tyrant and Cock-tailed Tyrant selected slightly different microhabitat characteristics. Both flycatchers selected areas with low palm (*Attalea gearensis*) and tree densities. High palm and tree densities are typically related to the *campo cerrado* habitat, from where both species were absent at EEI.

The palm *Attalea gearensis* is abundant in the Cerrado and represents a valuable resource for wildlife (Vidal 2007). *Attalea gearensis* is a no stem palm occupying a wide area, due to its large size. It can reach up to 1 m high and contain from five to six leaves ~ 1.4 m of length (Lorenzi *et al.* 1996). Its structure makes it hard for passerine to use them as perches. This palm is more frequent in *campo sujo* and *parque cerrado* (Bueno *et al.* 2004) than in *campo limpo.* Its clustered distribution (M. F. K. *pers. obs.*) at EEI can be related to the absence or rarity of a mammal, Azara's Agouti, *Cuniculus paca,* its main seed disperser (Tozetti 2002, Almeida and Galetti 2007).

The Sharp-tailed Tyrant also selected microhabitat with low shrubs and areas with a low density of palms. The positive relationship between the Sharp-tailed Tyrant and highly covered soil may indicate the importance of litter and understory vegetation for shelter and foraging. Low shrubs were frequently used as perches during territory defense. Foraging also occurred with active search for insects on shrub foliage and grass stems from perches used to attack insects in the air (Fitzpatrick 1980).

The tyrants tolerated mixed areas dominated by native grasses and smaller proportions of exotic grasses. However, in areas dominated by exotic grasses, *U. decumbens* and *M. minutiflora,* the species was not recorded, as also observed by Tubelis and Cavalcanti (2001). The richness of the herbaceous plant community in the Cerrado is high, ~ 4,700 species, including 500 species of Gramineae (Mendonça *et al.* 1998). Thus, dominance of a few exotic grasses, such as the African ones, can change dramatically the composition and microhabitat structure (Coutinho 1982, Filgueiras 1990). Currently, *U. decumbens* and *M. minutiflora* – both from Africa and introduced as fodder in Brazil – are present in almost all fragments of Cerrado, dominating large areas (Klink 1996, Pivello *et al.* 1999a). These African grasses are competitive, and a high allocation of biomass is directed towards leave production (Pivello *et al.* 1999a).

Melinis minutiflora reaches 1.5 to 2 m in height and forms a dense layer of leaves and branches (Parsons 1972), reducing light penetration to the soil by up to 99% (Hughes *et al.* 1991). This grass species has pubescent leaves that exude a substance that resembles fat (Lorenzi 1991). Moreover, it is believed the odor acts as a repellent to mosquitoes and other insects (Kissmann 1997). *Urochloa decumbens* reaches about 1 m in height (Kissmann 1997) and has a greater stratification compared with some native grasses (Pivello *et al.* 1999b). Some or all of these characteristics affect the movement of birds between clumps of grasses (E. O. Willis pers. comm.), in search of insects.

Management strategies for both tyrant flycatchers should include conservation and restoration of *campo limpo* and *campo sujo* as open grasslands with low shrub densities. We also suggest the expansion of the EEI by including surrounding areas with grasslands and the control of exotic grasses. Areas with low densities of *A. geraensis* should be maintained, and practices to control the spread of palms encouraged. Since both tyrant flycatchers selected areas with low density of palms, a study involving the population dynamics of this plant in the reserve also could help to understand the distribution of these tyrant flycatchers.

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