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Research Letters

Conservation of grassland birds in South Brazil: a land management perspective

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ABSTRACT

We explored how grassland birds responded to three different managements in grassland areas. Moreover, we examined whether bird's communities were different depending on the biome grasslands were inserted. We carried out bird surveys in six private farms in the Upland grasslands (Atlantic Forest biome) and the Pampas grasslands (Pampa biome). Land use included: (1) natural grasslands – paddocks with cattle stocking around 0.8 animal units/ha, without improvement/crop plantation in the last four years; (2) improved grasslands – grasslands with usage of fertilizers and forage improvement with exotic species, and (3) cultivated fields – forage/crop plantations. Threatened and restricted grassland birds were found in natural grasslands areas while more common species occurred in improved grasslands and cultivated fields. Bird community was different in the biomes with some species more related to the Upland grasslands and others to the Pampas. We highlighted the importance of natural grasslands and its management in private farms to maintain grassland bird species richness and their abundance in south Brazil.

Introduction

The Grasslands of Southeastern South America (SESA grasslands) are one of the most extensive ecosystems of temperate grasslands in the Neotropics. Its rich biodiversity is likely to experience significant loss due to land use changes, particularly overgrazing, mechanized agriculture, afforestation, and urban development coupled with the lack of natural areas under protection (Bencke, 2012). Most changes occurred in the end of the XIX century, driven by the expansion of agriculture in South America (Vickery et al., 1999).

In the state of Rio Grande do Sul (RS) grasslands within SESA encompass the Upland grasslands of the Atlantic Forest Biome (AF) and the Pampas in the Pampa Biome (P) occupying around 60% of the area of RS, holding a high biodiversity.

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However, until the past decade grasslands importance was known only for livestock production (Bilenca and Miñarro, 2004). More recently, crops and forestry have been replacing the natural grasslands and in the last decades more than 50% of its area in RS has been converted. Most important, economic activities replacing the natural grasslands do not guarantee the persistence of its biological and ecological aspects (Vélez-Martin et al., 2015a; Andrade et al., 2015). Besides crop cultivation, inadequate management of land has pushed to local extinction several open-habitat bird species (Vickery et al., 1999). Most of these species are grassland restrict, such as *Anthus nattereri*, *Polystictus pectoralis* and *Sporophila beltoni* (Azpiroz et al., 2012).

The lack of studies focusing on birds' responses to different land management of cattle ranching, coupled with little exchange of knowledge among researchers, farmers, and governmental agents, have contributed to accelerate the process of grasslands degradation in RS. Governmental and non-governmental conservation actions and plans have been neglecting grassland habitats for a long time (Overbeck et al., 2007, 2015), but recently incentives such as meat certification resulting in profit benefits for ranchers protecting native grasslands have been implemented (Vélez-Martin et al., 2015b).

Grasslands in RS encompass two biogeographic provinces: (1) Paraná province to the north includes the Upland grasslands, and (2) Pampean province to the south includes the Pampas (Cabrera and Willink, 1980). Their distinct biogeographic origins resulted in different precipitation regimes, altitude, and vegetation, with Upland grasslands characterized by megathermic grasses and the Pampas dominated by mesothermic grass species (Crawshaw et al., 2007). Avifauna composition is considered similar in the two regions although there are endemics in each Biome (Fontana et al., 2008; Develey et al., 2008).

We aimed to explore how grassland bird species respond to natural, improved, and cultivated grassland management for cattle ranching. We expected natural areas and improved grasslands to have higher species richness than cultivated fields due to the higher heterogeneity of those land management types. Moreover, we compared bird species community between Upland grasslands in AF biome and Pampas in P biome. We expected bird community composition to be different between biomes considering its different biogeographic province origins.

Material and methods

Study area

Upland grasslands are a mosaic with patches of *Araucaria* and nebular forests, marshes and bogs in the South Brazilian Plateau, with undulated relief and average altitude of 900–1000 m. Annual precipitation range is 1500–2000 mm and annual average temperatures between 16 and 22 °C. Frost and snow can occur at higher altitudes during winter. Pampas' grasslands occupy the half-southern part of RS, presenting several grassland physiognomies, marshes and gallery forests, sometimes associated with savannas and palms. Relief is less undulated than in the Upland grasslands, altitudes smaller than 600 m and annual precipitation from 1200 to 1600 mm. Average annual temperatures range is 13–17 °C.

Methods

We carried out surveys in six farms, three in the Upland and three in the Pampas. Brazilian Service to Support Small Companies agronomists instructed landowners on management practices including: (1) natural grasslands – grasslands paddocks without improvement or crop plantation in the last four years, cattle stocking around 0.8 animal units/ha (NG); (2) improved grasslands – natural grasslands using fertilizers and forage improvement with exotic species (IG), and (3) cultivated fields – forage/crop plantations (CF).

We surveyed birds in 400 m × 100 m line transects separated by 200 m each, distributed according to the total area of each management system in each farm (NG: 13, IG: 8, CF: 10 – Table 1). We avoided fences, woody vegetation, drainages and floodplains. Two observers (CSF and MR/CEA) counted all birds seen and listened. Transects were surveyed in the morning from sunrise to 10:00 am, and in the afternoon from 16:00 pm to sunset. Surveys were during the austral spring-summer in 2010/2011 totaling 24 days.

We used ANOVA to test for the effects of grassland management on bird species richness and abundance in two levels (1) all species recorded, and (2) grassland associated species (*sensu* Azpiroz et al., 2012). We plotted the six sites using Non-metric Multidimensional Scaling (NMDS, Bray–Curtis index) to represent any associations between grassland-associated species and sites considering management system and biome. Analyses were performed using R 3.2.2 software (R Core Team, 2015), and *vegan* 2.3-1 package (Oksanen et al., 2015).

Results

We recorded 88 bird species (NG: 68; IG: 39; and CF: 36), and 886 individuals (NG: 537; IG: 166; and CF: 183). Among species recorded, 37 were grassland associated (NG: 34, IG: 21, CF: 18), totaling 569 individuals (Table 2). Natural grasslands had the largest species richness compared to both IG and CF ($F_{2,12} = 6.08$, $p = 0.01$; Tukey: NG-IG, $p = 0.05$; NG-CF, $p = 0.02$) while no differences were found in species richness between IG and CF (Tukey: IG-CF, $p = 0.93$). Natural grasslands also had the largest total abundance compared to CF ($F_{2,12} = 3.56$, $p = 0.06$; Tukey: NG-CF, $p = 0.07$), but no differences in abundance were found comparing NG and IG (Tukey: NG-IG, $p = 0.14$) or IG and CF (Tukey: IG-CF, $p = 0.97$). A similar pattern was found for species richness looking at grassland-associated species (Fig. 1A, $F_{2,12} = 10.03$, $p = 0.003$; Tukey: NG-IG, $p = 0.03$; NG-CF, $p = 0.002$; IG-CF, $p = 0.55$); however, grassland management did not influence species overall abundance (Fig. 1B, $F_{2,12} = 2.20$, $p = 0.153$).

The NMDS axis 2 showed a separation among biomes. *Xanthopsar flavus*, *Tachycineta leucorrhoa*, and *Emberizoides ypiranganus* were more associated with the Upland grasslands, whereas a pool of species, including *Cistothorus platensis*, *Vanellus chilensis*, *Pseudoleistes virescens* and *Mimus saturninus* were linked to the Pampas. Within biomes different management systems were also separated. In the Upland grasslands,

Table 1 – Municipality, size, altitude, land use, cultivated crops, number of transects, and biome of the six farms sampled in RS.

Municipality	Size (ha)	Altitude low and high (m.a.s.l)	Land use	Cultivated crops [a]	# Transects	Biome
São Francisco de Paula 29° 4′ 2.321″ S 50° 36′ 35.463″ W	354	917–995	C, NG, IG	O, Ry, Cl	NG = 3, IG = 3	AF
Vacaria 28° 36′ 35.733″ S 50° 59′ 50.021″ W	525	788–999	C, NG, CF	Wh	NG = 2, CF = 2	AF
Monte Alegre dos Campos 28° 38′ 28.658″ S 50° 48′ 10.199″ W	624	920–955	C, NG, CF	Co, So	NG = 2, CF = 2	AF
Herval 31° 57′ 24.737″ S 53° 15′ 24.062″ W	680	96–189	C, NG, IG, CF	Mi, Ry, O	NG = 3, IG = 2, CF = 1	P
Arroio Grande 32° 5′ 26.266″ S 53° 11′ 42.018″ W	390	15–208	C, NG, IG, CF	Ry	NG = 2, IG = 1, CF = 1	P
Lavras do Sul 30° 53′ 31″ S 53° 58′ 0.05″ W	1200	306–380	C, NG, IG, CF	Mi, Ry	NG = 1, IG = 4, CF = 2	P

Land use types: C, cattle; NG, natural grassland; IG, improved grassland; CF, cultivated fields. Cultivated crops: O, oat; Ry, ryegrass; Cl, clover; Wh, wheat; Co, corn; So, soybean; Mi, millet. Biome: AF, Atlantic Forest; P, Pampa.

[a] Fertilizers: nitrogen, phosphorus and potassium.

X. flavus was associated with NG and *T. leucorrhoa* with IG. On the other hand, in the Pampas *P. virescens* and *V. chilensis* were more related to NG, *Sicalis luteola* with IG, and *M. bonariensis* and *Sturnella superciliaris* were associated with CF (Fig. 2).

Three of the species recorded are threatened in the RS state (*X. flavus*, *Sporophila hypoxantha*, and *A. nattereri*, all Vulnerable) and one is near threatened (*C. platensis*). *Xanthopsar flavus* had a larger abundance in the Upland grasslands than in the Pampas and it was highly associated with NG. The other species did not show a clear association with grassland management or biome; however, *S. hypoxanta* and *A. nattereri* were more related to natural grasslands in AF whereas *C. platensis* in the natural grasslands in the P (Fig. 2).

Discussion

Our results highlighted the importance of NG and its management (i.e. cattle stocking control and no use of exotic plants) to maintain bird species richness and their abundance in the grasslands of RS. Grasslands conversion, particularly into crops, is the main cause of bird community changes, particularly in the SESA grasslands. A similar pattern was found in the grasslands of central Europe, in which higher bird richness and abundance were recorded in extensive ranching sites compared to intensive areas (Batáry et al., 2007). Likewise, species richness had a positive relationship with natural vegetation and a negative association with cultivated fields in the Argentinean Pampas (Codesido et al., 2008; Schrag et al., 2009).

Although IG may maintain a proportion of the natural habitat, bird species richness and abundance was reduced in these areas, as occurred in CF. The use of exotic plant species might be causing a change on spatial heterogeneity in the IG areas, leading to a reduction on bird richness (Robinson and Sutherland, 2002). Similarly, Filloy and Bellocq (2007) found a negative response of abundance for most grassland species as the percentage of arable area increased in the Pampa region of Argentina. Most species we recorded were in natural grasslands; however, others like *M. bonariensis* and *S. superciliaris* were tolerant to production intensification. These two species usually forage in crop habitats and form large flocks to forage or make regional migrations during post-breeding period (Belton, 1994).

A decrease on species richness has been recorded in both Upland and Pampas grasslands, and not only local population extinctions have occurred, but also species extinctions have been documented (Serafini et al., 2013). We recorded around 40% of the grassland associated bird species that occur in the open habitats of south Brazil. Among near threatened or threatened species recorded all but *Rhea americana* had higher abundance on NG. However, we highlighted that several grassland-associated species might not have been detected because the absence or reduced presence of tall grassland systems in the sampled areas. Cattle stocking averaging 0.8 animal units/ha seems to cause a high level of disturbance for the maintenance of birds restrict to dense and tall grasslands (Develey et al., 2008; Repenning et al., 2010). Dotta et al. (2015) demonstrated that a stocking rate of around 0.4 animal units/ha might be more adequate to maintain grassland-restrict birds.

Pampas and Upland grassland share some bird species and diverge in others. For instance, the two threatened grassland birds restricted to areas with tall grasses, *C. platensis* and *S. hypoxantha*, were associated to different biomes: Pampa and Atlantic Forest, respectively. On the other hand, the five threatened species shared between the biomes are less dependent on tall grasses and able to use cultivated fields for foraging (Repenning et al., 2010). Regardless of biome, bird responses

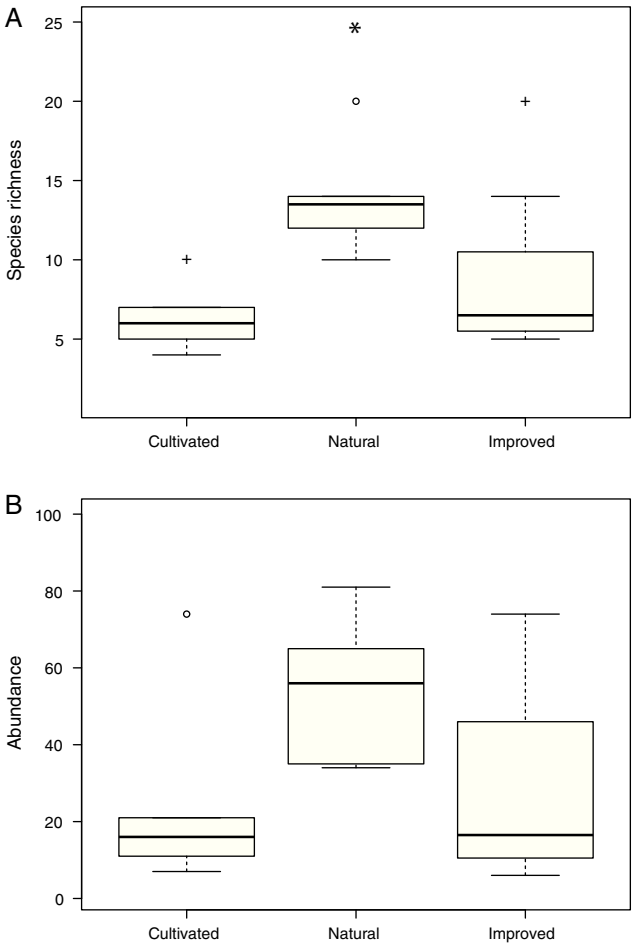

Fig. 1 – Comparison among species richness (A) and abundance (B) of bird species in each land management (cultivated, natural, and improved) studied in the grasslands of Rio Grande do Sul.

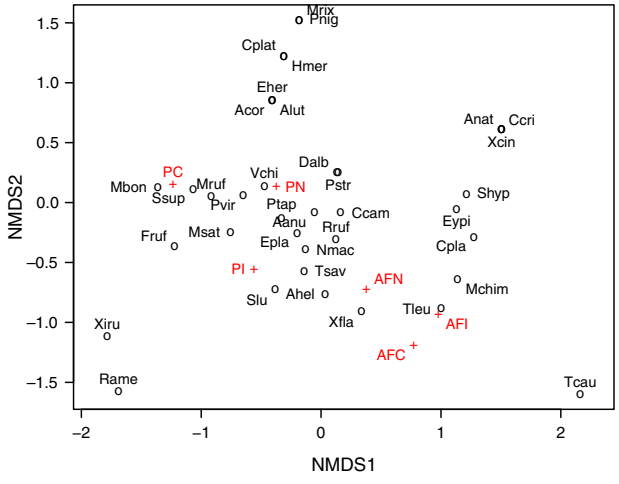

Fig. 2 – NMDS (Bray–Curtis index) showing associations among sites considering management (N = natural, I = improved, C = cultivated) and biomes (AF = Atlantic Forest; P = Pampas). Species names acronyms in Table 2.

Table 2 – Number of individuals of the 37 grassland bird species recorded on natural grasslands, improved grasslands, and cultivated fields in RS. Acronyms of Fig. 2 also shown.

Species	NG	IG	CF
Anthus correndera (Acor)	4	0	0
Anthus hellmayri (Ahel)	37	9	2
Anthus lutescens (Alut)	4	0	0
Anthus nattereri (Anat)[a]	1	0	0
Anumbius annumbi (Aanu)	6	4	2
Cariama cristata[a] (Ccri)	1	0	0
Caracara plancus (Cpla)	3	2	0
Cistothorus platensis[a] (Cplat)	2	0	0
Colaptes campestris (Ccam)	19	0	0
Donacospiza albifrons (Dalb)	12	0	0
Embernagra platensis (Epla)	22	1	3
Emberizoides herbicola (Eher)	4	0	0
Emberizoides ypiranganus (Eypi)	4	0	0
Furnarius rufus (Fruf)	1	7	5
Heterospizias meridionalis (Hmer)	2	0	0
Machetornis rixosa (Mrix)	1	0	0
Milvago chimango (Mchim)	3	3	4
Mimus saturninus (Msat)	8	13	5
Molothrus bonariensis (Mbon)	7	2	35
Molothrus rufoaxillaris (Mruf)	4	4	7
Nothura maculosa (Nmac)	14	10	5
Phacellodomus striaticolis[a] (Pstr)	11	0	0
Poospiza nigrorufa (Pnig)	1	0	0
Progne tapera (Ptap)	8	7	3
Pseudoleistes virescens (Pvir)	17	3	0
Rhea americana[a] (Rame)	0	1	0
Rhynchotus rufescens (Rruf)	20	1	3
Sicalis luteola (Slu)	41	18	15
Sporophila hypoxanta[a] (Shyp)	3	0	0
Sturnella superciliaris (Ssup)	5	1	13
Tachycineta leucorrhoa (Tleuc)	4	1	9
Theristicus caudatus (Tcau)	0	1	0
Tyrannus savanna (Tsav)	12	19	3
Vanellus chilensis (Vchi)	8	1	4
Xanthopsar flavus[a] (Xfla)	34	0	5
Xolmis cinereus (Xcin)	1	0	0
Xolmis irupero (Xiru)	0	1	1
Total	327	113	129

NG, natural grasslands; IG, improved grasslands; CF, cultivated fields.

[a] Threatened or Near-threatened species in the Brazilian SESA grasslands (Fontana and Bencke, 2015).

were similar in relation to grassland degradation, as also reported by Azpiroz et al. (2012). Nevertheless, our results should be interpreted cautiously and we cannot come out with major conclusions about priority levels for conservation of grasslands in the two biomes considering only our bird samples.

Our results demonstrated that natural grasslands had lesser negative impacts to the bird community than both improved grasslands and cultivated fields. If we are to protect the grassland birds' community, the maintenance of grassland sites with cattle stocking lesser than 0.8 animal units/ha would be important to maintain grassland-associated birds. At last, consider farm management and work in partnership with landowners might be a useful tool to protect grasslands

habitats in private land since landowners can act as important agents for the conservation of birds in the Upland and Pampas grasslands of south Brazil.

Conflicts of interest

The authors declare no conflicts of interest.

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