

BIRDS AS ENVIRONMENTAL INDICATORS FOR THE DESIGN OF SUSTAINABLE LIVESTOCK SYSTEMS

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1 – Introduction

Wild birds, strongly associated with vegetation structure of livestock farms, are often used as indicators of environmental health and sustainability. The study of indicator species is a valuable tool for design sustainable livestock systems since it provides information about not only the ecological condition but also, management situations (Vos et al. 2000). Vegetation structure is usually related to grazing intensity in stable grazing systems. Thus, our hypothesis is that grazing intensity is related to bird species through the effect of the former on vegetation structure. Here, we explored the relationship between birds and vegetation structure in open woodlands and savannahs, which characterize livestock farms in eastern Argentina and grasslands in Uruguay.

2 – Materials and methods

We conducted the study in 36 livestock farms in natural fields in southeast Uruguay and east Argentina (Fig. 1). Argentinian farms were located in the “Espinal” biome, characterized by the presence of varying density of shrubs and trees. Contrary, Uruguayan farms were mainly grassland with low tree cover. We registered birds and vegetation variables in the austral spring-summer (October 2017-February 2018). Birds were sampled using transects in grasslands of Uruguay and point counts in open woodlands and savannahs of Argentina. Then, we selected bird species associated with open areas (grasslands and savannahs) and examined relationships between bird occupancy and vegetation structure (grass height, herbaceous cover, presence of tall grass, presence of perches, and shrubs and tree cover). We performed analyses of four

focal grassland species (Spotted Nothura, Grassland Sparrow, Red-winged Tinamou and Southern Lapwing), four savannah species (Firewood-gatherer, Campo Flicker, Fork-tailed Flycatcher and Brown-chested Martin), and two open areas generalists species (Chalk-browed Mockingbird and Rufous-collared Sparrow). We used single species, hierarchical occupancy models, considering points/transects nested within farms, using a Bayesian approach, to estimate the influence of vegetation structure variables while assuming the imperfect detection of the species (Kéry & Schaub 2012). We assessed bird responses to vegetation structure because birds respond to vegetation structure, which is influenced by grazing intensity. We built separated models for Argentina (birds ~ grass height + grass cover + tree cover +shrub cover), and Uruguay (birds ~ grass height + tree cover + presence of tall Grass + presence of perches).

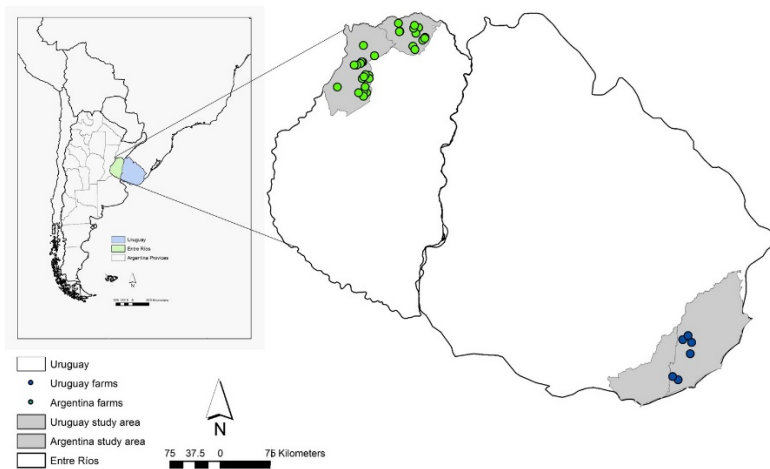


Figure 1. Location of the 36 livestock farms in Argentina and Uruguay.

3 – Results – Discussion

There were expectable differences in vegetation structure between countries. In Argentinean farms, there was some degree of shrub encroachment, absent in Uruguayan grasslands. In addition, tree cover was larger ($34 \pm 16.2\%$) in Argentina than in Uruguay ($1.6 \pm 1.9\%$). Globally, bird species were affected by vegetation structure. In Argentina, most grassland and savannah specialist birds (Spotted Nothura, Grassland Sparrow, Red-winged Tinamou, Firewood-gatherer, Campo Flicker, and Fork-tailed Flycatcher) responded positively to increasing grass height or increasing grass cover, but negatively to tree and shrub cover (Table 1). Exceptions were the Red-winged Tinamou that responded positively to shrub cover, and Southern Lapwing, that was unrelated to grass height or cover. The two open area generalist species (Chalk-browed Mockingbird and Rufous-collared Sparrow) showed different responses. The former preferred short grass whereas the last occupied sites with lower grass cover and more tree and shrub cover. In Uruguay, most species (Red-winged Tinamou, Firewood-gatherer, Campo Flicker, Fork-tailed Flycatcher, and Brown-chested Martin) responded

negatively to increasing grass height and positively to increasing tree cover, presence of tall grass and perches. The Spotted Nothura, on the contrary, responded positively to increasing grass height, while the Southern Lapwing avoided tall grass fields (Table 1).

Table 1. Species-level responses to vegetation structure variables, in woodlands and savannahs in Argentina and grasslands in Uruguay.

Species Names	Argentina - Vegetation variables*				Uruguay - Vegetation variables*			
	grass height	grass cover	tree cover	shrub cover	grass height	tree cover	presence - tall grass	presence - perches
Grassland Sparrow	+		-		^	^	^	^
Firewood-gatherer		+	-	-				+
Campo Flicker		+	-	-	-	+	+	-
Chalk-browed Mockingbird	-		-	-		+	+	
Spotted Nothura	+		-		+			
Brown-chested Martin	^	^	^	^			+	+
Red-winged Tinamou		+		+	-			
Fork-tailed Flycatcher	+	+	-	-				+
Southern Lapwing			-	-	-		-	
Rufous-collared Sparrow		-	+	+	-			

* + = positive relationship, - = negative relationship, ^ = not evaluated

4 – Conclusions

Most bird species were strongly associated with vegetation structure, and their presence brings information about grazing intensity. The Spotted Nothura was positively associated with grass height, indicating sensitivity to grazing intensity, both in Argentina and Uruguay. Campo Flicker, Red-winged Tinamou, Southern Lapwing, and Rufous-collared Sparrow in Uruguay, and the Chalk-browed Mockingbird in Argentina were related to increasing grazing intensity as they occurred mainly in sites with lower grass height. However, responses were sometimes different in more closed and heavily grazed woodlands and savannahs of Argentina, compared with the more open and less intensively grazed grasslands of Uruguay. In Argentina, some species were present in farms with high grass cover (Grassland Sparrow, Red-winged Tinamou, Firewood-gatherer, and Fork-tailed), but high tree or shrub cover precluded the presence of many specialized species in those farms. On the contrary, in the Uruguayan Grasslands, the presence of trees, perches or tall grasslands favored the occurrence of many savannah species like the Campo Flicker, Firewood-gatherer, Fork-tailed Flycatcher, Chalk-browed Mockingbird and the Brown-chested Martin. The management of the grazing intensity of livestock farms seems like an adequate tool to design livestock farms,



allowing not only increasing livestock productivity but also, to conserve the natural capital of the bird biodiversity of grassland and savannah from Uruguay and Argentina.

References

- Kéry, M., & Schaub, M. (2012). *Bayesian population analysis using WinBUGS: a hierarchical perspective*. Access Online via Elsevier.
- Vos, P et al. (2000) *Environmental Monitoring and Assessment* 61:317–344.



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