Effects of cattle grazing on the diversity of emergent plants in the Rio Tempisque marsh

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Abstract: We examined the effects of cattle reintroduction on emergent plant diversity in the Río Tempisque marsh in Palo Verde National Park, Costa Rica. Park managers assumed that physical disturbance by cattle would reduce the abundance of the dominant species, *Typha dominguensis* (Typhaceae), while increasing plant diversity and the amount of open water, remediating the habitat for waterfowl that use the marsh. The reintroduction of cattle reduced *T. dominguensis* and *Brachiaria mollis* (Poaceae) abundance, but allowed two different species, *Neptunia plena* (Mimosaceae)and *Oxycaryum cubense* (Cyperaceae), to dominate. Contrary to management objectives, the percent open water was similar between the grazed and ungrazed areas. In our study area, the physical disturbance created by cattle reintroduction generated a shift in emergent plant species composition but had little affect on species diversity.

Key Words: Typha dominguensis, *Palo Verde, park management*

Introduction

Historically, the Río Tempisque marsh has been one of the most important areas for migratory and breeding birds in Costa Rica (McCoy and Rodriguez, 1994). For most of this century, the marsh was grazed by cattle. In 1981, with the creation of Palo Verde National Park, cattle were excluded from the marsh (Gill, 1989). Consequently, *Typha dominguensis* came to dominate the vegetation. Managers assumed that the reduction in open water generated the decline in bird abundance that was observed in the 1980s. Cattle were reintroduced in 1987 in an attempt to reduce *T. dominguensis* dominance, increase the area of open water, and restore bird diversity (Heckmann, 1997).

Although a greater diversity of bird species was observed in grazed areas of the marsh after the reintroduction (Manville and Tossas, 1997), effects on vegetation have not been reported. Our study examined the effect of the grazing policy on the diversity of emergent plants and available open water. We predicted lower abundance of *T. dominguensis* in the grazed area, due mainly to the physical disturbance of the cattle. We also predicted that a decrease in abundance of *T. dominguensis* would lead to greater diversity of emergent plants and a greater percentage of open water.

Methods

On Jan. 12-13, 1999, three 25 m transects were randomly placed within 50 m of the shore in grazed and ungrazed areas of the Río Tempisque marsh, 200 m south of the Palo Verde OTS research station. Emergent plant abundances were estimated in three ways, depending on how common each species was, and whether individuals were distinguishable. First, individuals of the two dominant plant species (each contributing > 10% of total density) that touched the 25 m transect line were counted, and their abundances compared by expressing each as a percentage of the total count for these two species. The remaining species were counted in a 1m-wide band beside each transect line (25 m^2 per transect). When individual plants could not be distinguished because of growth form, percent cover within each 1 m^2 in the 1m-wide band was quantified, instead of a density measurement. The percentage of open water, defined as free of all vegetation, was also estimated over the entire 25 m^2 band in each transect.

Results

Five species of emergent vegetation occurred in both the grazed and ungrazed habitats. Five species were found only in the ungrazed area and three others only in the grazed (Table 1).

Table 1. Emergent plant species encountered in grazed and ungrazed areas in Río Tempisque marsh of Palo Verde National Park, Costa Rica.

EXCLUSIVE TO UNGRAZED	IN COMMON	EXCLUSIVE TO GRAZED
Aniseia martinicensis (Convolvulaceae)	*Hymenachne amplexicaulis* (Poaceae)	*Brachiaria mollis* (Poaceae)
Echinodorus andrieuxii (Alismataceae)	*Neptunia plena* (Mimosaceae)	*Eichhornia crassipes* (Pontederiaceae)
Sesbania emerus (Fabaceae)	*Nymphaea sp.* (Nymphaeaceae)	*Oxycaryum cubense* (Cyperaceae)
Typha dominguensis (Typhaceae)	*Pistia stratiotes* (Araceae)	
Parkinsonia aculeata (Fabaceae)	*Thalia geniculata* (Marantaceae)	

Table 2. Relative abundances of dominant, and densities of rare plant species (mean ± 1 SE) along three 25 m transects in each of grazed and ungrazed areas in the Río Tempisque marsh. See text for details of abundance measures.

UNGRAZED		GRAZED	
Dominant species	Relative percent	Dominant species	Relative percent
T. dominguensis	74%	*N. plena*	53%
B. mollis	26%	*O. cubense*	47%
Rare species	Density (ind./m^2)	Rare species	Density (ind./m^2)
T. geniculata	0.52 ± 0.19	*H. amplexicaulis*	7.74 ± 5.33
N. sp.	0.51 ± 0.23	*N. sp.*	0.14 ± 0.07
N. plena	0.31 ± 0.25	*T. geniculata*	0.11 ± 0.01
P. stratiotes	0.31 ± 0.31	*P. stratiotes*	0.08 ± 0.04
S. emerus	0.08 ± 0.04	*E. crassipes*	0.04 ± 0.02
P. aculeata	0.01 ± 0.01		
	Percent cover		
E. andrieuxii	4.33 ± 3.84		
A. martenicensis	3.80 ± 1.68		

Grazing appeared to cause a shift in the most abundant plant species; *T. dominguensis* and *Brachiaria mollis* dominated the ungrazed areas, while *Neptunia plena* and *Oxycaryum cubense* dominated the grazed areas (Table 2).

The change in percent open water from 4.1 ± 2.0 (mean ± 1 SE) in the ungrazed area to 0.04 ± 0.04 in the grazed area, was not significant (ANOVA, F=3.92, df=1,4, P=0.12).

Discussion

Grazing decreased the abundance of *T. dominguensis* and *B. mollis*, but did not increase emergent plant diversity or the availability of open water in our samples. Physical disturbance by cattle probably reduced the dominance of *T. dominguensis*, while cattle grazing was probably responsible for the reduction in dominance of the grass, *B. mollis* (Heckmann, 1997). Although the reintroduction of cattle generated a shift in the species composition, each habitat remained dominated by two species.

Plant distribution in the marsh appears patchy, especially in the grazed area. Patches of palo verde trees, *Parkinsonia aculeata*, and patches of *T. dominguensis* were seen in the grazed area, but they were not encountered in our transects.

The difference in plant species composition in the two areas has important implications for habitat structure and quality for the waterfowl using the marsh. Vegetation in the ungrazed area rises more than 1 m above the surface of the water, providing fewer nesting sites for wading birds than the floating mat of vegetation in the grazed area. Since the two habitats support different assemblages of emergent plants, bird and plant diversity could be best maintained by preserving both grazed and ungrazed areas.

Literature Cited

LITERATURE CITED

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