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Riparian wildlife richness along the Luján River

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ABSTRACT. Riparian environments are usually characterized by high biological diversity, however, habitat degradation results from intensive use of the bank and the water course, and exploitation of the surrounding land. The Luján River basin, located in East-central Argentina, shows two distinct geomorphologic portions: the Pampean and the Deltaic portions, which in turn can be subdivided based on physiographic and land use features. Our objective was to compare riparian wildlife richness among the three zones of the Pampean portion (upper, middle, and lower), and between the two zones of the Deltaic portion (protected and antropic). From March to October 1997, 82 transects were randomly placed along the banks of the Luján River. We surveyed the presence of coypus, capybara, and Neotropical river otter based on signs of activity, and the presence of water birds (non Passeriformes) based on direct observation. In the Pampean portion, the number of species per transect in the middle zone was significantly lower than in the upper and lower zones. The middle zone is characterized by a narrow alluvial plain associated with more intense use of the land and less availability of water and hydrophilic vegetation in the surrounding habitats than the other two zones. In the Deltaic portion, the protected zone showed a larger species richness than the antropic zone, where intense use of the river and modification of its bank can negatively affect wildlife.

[Keywords: landscape scale, Pampas region, riparian mammals, waterfowl]

RESUMEN. Riqueza de fauna ribereña del río Luján: Las características de paisaje modelan los hábitats disponibles para la fauna y condicionan el uso de la tierra. Los ambientes ribereños, que se caracterizan por tener una alta diversidad biológica, han sufrido, en su mayoría, altos niveles de deterioro debido al uso intensivo del río y sus costas, y a la explotación de las tierras aledañas. La cuenca del río Luján, ubicada en el centro-este de Argentina, presenta dos porciones geomorfológicas diferentes: la porción Pampeana y la Deltaica, que a su vez pueden subdividirse sobre la base de diferencias fisiográficas y de uso de la tierra. El objetivo de nuestro trabajo fue comparar la riqueza de especies de fauna ribereña entre las tres zonas de la porción Pampeana (superior, media e inferior), y las dos zonas de la porción Deltaica (protegida y antrópica). Entre marzo-octubre de 1997, se realizó un muestreo en 82 transectas de 600 m de largo ubicadas aleatoriamente sobre las costas del río Luján (166 km de largo). La presencia de coipo, carpincho y lobito de río fue relevada mediante un método indirecto usando signos de actividad, y la presencia de aves acuáticas (no Passeriformes) mediante avistajes. En la porción Pampeana del río, la riqueza de especies por transecta en la zona media resultó significativamente menor que en las zonas inferior y superior. La zona media se caracteriza por tener un valle aluvial angosto que está asociado a una mayor perturbación humana y probablemente a una menor disponibilidad de agua y vegetación hidrófila en las tierras aledañas que las otras dos zonas. En la porción Deltaica, la zona protegida mostró mayor riqueza que la zona antrópica. El intenso uso del río y de sus costas (v.g. navegación comercial y recreativa, edificación en márgenes del río) en la zona antrópica sería una posible causa del escaso número de especies observadas.

[Palabras clave: aves acuáticas, escala de paisaje, mamíferos ribereños, región Pampeana]

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INTRODUCTION

Riparian habitats represent less than two percent of all terrestrial ecosystems and are functionally and structurally distinct from the upland ecosystems that they dissect (Hawkins 1994). Historically, riparian areas have been used by people as a source of food and water, as travel corridors, as recreational areas, and their surrounding land has been converted into rural and urban environs (Strahler & Strahler 1992; Rasmussen & Padgett 1994). Consequently, human use has resulted in severe damage of the functional health of many riparian ecosystems (e.g. habitat degradation and hydrology modification) and has affected wildlife diversity (Hawkins 1994; Giller & Malmqvist 1998). In spite of this, the effect of human activity on riparian wildlife has been largely ignored though many birds and mammals are either obligate or facultative users of riparian systems (Rasmussen & Padgett 1994; Giller & Malmqvist 1998).

In the last decade, spatial distribution of wildlife has been studied from a landscape perspective considering the effect of large scale elements, both human-related and natural, on wildlife distribution (Bissonette 1997). Landscape features, such as the size of the drainage area, geomorphology, soil type, and vegetation array, define the distribution of habitats and individuals (Wiens et al. 1993). At the same time, the physiographic characteristics of the terrain are closely related to land use and land property (either public or private) (Strahler & Strahler 1992; Wear et al. 1998). These associations among physical, biotic and human factors are difficult to disentangle but a first approximation understand landscape-wildlife relationship is to determine the spatial distribution of species in relation to landscape characteristics.

The present study analyzes the relationship between landscape features and wildlife richness along the Luján River, Argentina. We studied the presence of three medium-sized, semiaquatic mammals and water birds because of their sensitivity to habitat degradation, their conservation status, or their importance as wildlife economic resources. The coypu or nutria *Myocastor coypus* is top ranked in the wildlife furbearer trade and requires management actions to attain sustainable exploitation (DNFS 1992; Zacagnini & Venturino 1993; Merler et al. 1994). The capybara *Hydrochaerus hydrochaeris* is largely hunted for meat and fur products, and needs control programs to avoid overexploitation (Quintana et al. 1992; Holdo & García Fernández 1995). The Neotropical river otter *Lontra longicaudis* is listed as a threatened species because of intense hunting and habitat degradation (Parera 1994; Holdo & García Fernández 1995). Water birds (except Passeriformes) may act as indicators for riparian habitats because they are influenced by the nature and condition of habitats surrounding the water (Stotz et al. 1996).

The Luján River basin can be divided in two distinct geomorphologic portions: Pampean (113 km) and Deltaic (53 km) portions. The grassland steppe was the dominant vegetation of the Pampean portion (Cabrera 1971), where natural vegetation has been widely modified principally due to livestock and agricultural practices, and urbanization (Bárbaro 1994). Guichón et al. (1999) divided the Pampean portion into three zones – upper, middle, and lower – based on the slope of the river, the characteristics of the drainage system, and the width of the alluvial plain. The main physiographic difference among the three zones is the width of the alluvial plain, being larger in the upper (38 km of river and 5097 ha of alluvial plain) and lower zones (41 km of river and 6749 ha of alluvial plain) than in the middle zone (34 km of river and 1383 ha of alluvial plain), which has the largest proportion of urban and agricultural areas (Guichón et al. 1999).

The Deltaic portion of the river is characterized by many edaphic and hydrophilic communities of freshwater marshes and riparian forests (Cabrera 1971) and can be divided in two zones (Guichón 2003). The first zone of the Deltaic portion, called protected zone, includes three natural reserves: Otamendi (3000 ha), Belén de Escobar (100 ha), and Río Luján (1000 ha), covering >97% of the length of the zone (mainly on the northern margin of the river). Some sectors of the riverbank, particularly nearby Otamendi, are intensely used by fishermen in weekends. Though the effective control on these reserves is limited or null, low accessibility and modification of these lowlands favour low perturbation of the riparian environ. The last zone of the Deltaic portion, called antropic zone, is characterized by an intense use of the river for recreation purposes and transport of passengers (tourists and residents) and commercial items (e.g. wood), and by human settlements (ranging from isolated houses to large cities) along its riverbank. This Deltaic portion contains a complex network of minor water courses (rivers, streams and canals) that are close to the Luján River and provide suitable and less disturbed habitat to semiaquatic mammals and waterbirds.

Our objective was to compare riparian wildlife species richness among the three zones of the Pampean portion and between the two zones of the Deltaic portion of the Luján River. We focused on the interpretation of species distribution in relation to landscape features.

MATERIALS AND METHODS

Study area

The study was conducted along the Luján River (166 km long), province of Buenos Aires, Argentina (Figure 1). This river begins at the confluence of two streams in the Pampas plains (34° 43' S, 59 37' W), turns into the Southern limit of the Lower Delta Region, to finally end at de la Plata River (34° 26' S, 58 32' W), which has a strong influence on the dynamics of this Lower Delta (e.g. floods), depending on predominant winds. Climate is moist temperate, mean annual precipitation of 944 mm and mean temperature of 23.8ºC in January and 9.1ºC in July (Goldberg et al. 1995).

Data collection and analysis

From March to October 1997, eighty- two 600 m long transects were randomly assigned all along the Luján River. Both margins of the river were sampled in each transect. Fieldwork was conducted usually from 9 am to 6 pm under similar weather conditions (avoiding rainy or extremely windy days) and 2-3 days after heavy rains. Depending on water depth, we moved along the river using a motorboat, a kayak, or walking along the bank. Presence of coypu, capybara and Neotropical river otter was sampled based on a methodology standardized for riparian mammals (Mason and Macdonald 1986). In each transect, the presence/absence of each mammalian species was assessed by an indirect method based on signs of activity. Faeces and tracks of the three species are easily identifiable (Gosling & Baker 1991; Parera 1994; Quintana 1996). A transect was considered positive for each species when faeces and/or tracks were found.

Presence of water birds was determined by direct observation of non-passerine birds along the river. Water birds observed from the river course when surveying a transect or while moving (by boat, kayak or walking) between transects were assigned to the nearest transect placed for mammalian sampling. For data analysis, a conservative criteria was preferred in those cases where at least in one transect the bird species was not certainly identified, so that we worked at the level of genus (e.g. *Anas* spp.). Two species belonging to separate genus of egrets were grouped together (*Eggretta thula* and *Bulbucus ibis*).

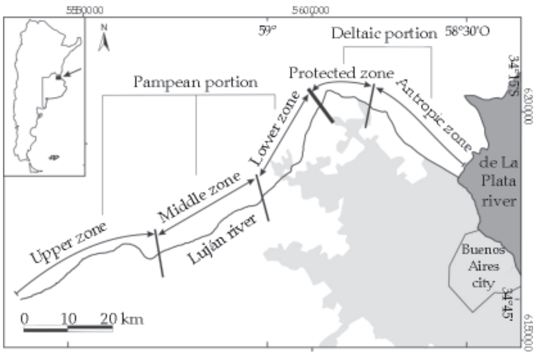

Figure 1. Location of the study area within Buenos Aires province (Argentina) and position of the Luján River with respect to the area covered by the city of Buenos Aires and its large suburbs (grey). The Pampean and Deltaic portions of the Luján River and the five zones within these portions are shown.

Figura 1. Ubicación del área de estudio dentro de la provincia de Buenos Aires (Argentina) y posición del río Luján con respecto al área cubierta por la ciudad de Buenos Aires y los suburbios (gris). Se muestran las porciones Pampeana y Deltaica del río Luján y las cinco zonas dentro de estas porciones.

Fifty-five transects were sampled in the Pampean portion: 22 in the upper zone, 14 in the middle zone, and 19 in the lower zone. In the Deltaic portion, we surveyed 27 transects: nine in the protected zone and 18 in the antropic zone. The number of transects per zone was proportional to its length (0.5 transects per km). Sampling of the five zones of the river was not sequential so that transects of each zone were surveyed in different seasons. We calculated species richness as the number of mammalian and bird species associated to each transect. We compared species richness among the three zones of the Pampean portion using the Kruskal-Wallis test and Dunn non-parametric multiple comparisons with tied ranks, and between the two zones of the Deltaic portion using the Mann-Whitney test with tied ranks (Zar 1984).

RESULTS

The most common of the three mammalian species was the coypu, registered in the two portions of the river (Table 1). Only the Deltaic portion showed signs of activity of capybara, while no signs of river otter were encountered along the Luján River. Among water birds, we observed white-faced ibis, coots, wattled jacana, South American stilt and collared plover only in the Pampean portion. The family Ardeidae had the most frequently observed species, principally due to the great, snowy, and cattle egrets, and to the black-crowned night heron.

We found significant differences in species richness within the Pampean and the Deltaic portions of the river. In the Pampean portion, the number of species per transect significantly differed among the three zones ($H = 6.86$, $p < 0.03$), with the lower zone having the larger mean rank ($R_l = 32.00$), followed by the upper ($R_u = 30.50$), and finally by the middle zone ($R_m = 18.64$) (Figure 2). Multiple comparisons tests showed significant differences between the lower and middle zones ($Q = 2.43$, $p < 0.05$) and marginally significant differences between the upper and middle zones ($Q = 2.23$, $p < 0.09$). No differences were detected between the upper and lower zones ($Q = 0.31$, $p > 0.5$). In the Deltaic portion, mean rank values between the protected ($R_p = 20.39$) and the antropic ($R_u = 10.81$) zones were significantly different ($U = 23.50$, $p < 0.01$) (Figure 2).

DISCUSSION

We found differences in species richness within the Pampean and Deltaic portions of the Luján River. Different zones had been previously identified within these two geomorphologic portions of the river based on physiography, and land use and land property of the terrains adjacent to the watercourse. We make no attempt to generalize our results, however, similar patterns could be found in other river basins of this region given that similar associations among physiography, land use and wildlife may occur. We acknowledge the limitations of our data set, particularly the effect of seasonal variation in species activity given that transects were visited only once. Nevertheless, our study involves non-migratory species and we aimed to focus on a comparative analysis, therefore, we do not pretend to show a comprehensive list of species using the Luján River.

The middle zone, which is characterized by the narrowest alluvial plain (Guichón et al. 1999), showed the lowest richness of the three zones of the Pampean portion. This negative relationship between wildlife richness and width of the alluvial plain is probably due to differences on the availability of vital resources but could also be related to the intensity of human perturbation. Lowlands of the alluvial plain are periodically flooded and mostly used for cattle raising because the soil have no aptitude for farming. When these lowlands are relatively large, as it occurs in the upper and lower zones of the Pampean portion, they would increase the quantity and quality of aquatic and semi-aquatic habitats available for riparian wildlife. At the same time, flooded lowlands difficult human access and use of the riparian environs. In contrast, when the alluvial plain is narrow, as it occurs in the middle zone, agricultural and urban areas are generally located close to the river with the concomitant effects of riverbank modification, habitat fragmentation, human perturbation, pollutants, and mortality by domestic animals and hunters or poachers (Guichón 2003).

Table 1. Relative abundance (% frequency of positive transects) of semi-aquatic mammals and water birds detected in each zone of the Pampean and Deltaic portions of the Luján River.

Tabla 1. Abudancia relativa (% frecuencia de transectas positivas) de mamíferos semi-acuáticos y aves acuáticas detectadas en cada zona de las porciones Pampeana y Deltaica del río Luján.

			Pampean portion			Deltaic portion	
Family	Species	Common name	Upper	Middle	Lower	Protected	Antropic
Myocastoridae	*Myocastor coypus*	Coypu	100	28.6	100	100	0
Hydrochaeridae	*Hydrochaerus hydrochaeris*	Capybara	0	0	0	11.1	22.2
Mustelidae	*Lutra longicaudis*	Neotropical river otter	0	0	0	0	0
Phalacrocoracidae	*Phalacrocorax olivaceus*	Neotropic cormorant	18.2	7.1	5.3	66.7	44.4
Ardeidae	*Egretta alba,*	Great Egret,					
	E. thula,	Snowy Egret,					
	Bulbucus ibis	Cattle Egret	45.5	50.0	31.6	44.4	33.3
	Butorides striatus	Striated heron	0	7.1	10.5	11.1	22.2
	Nycticorax nycticorax	Black-crowned night heron	13.6	0	21.1	33.3	16.7
Ciconiidae	*Ciconia maguari*	Maguari stork	4.5	28.6	10.5	22.2	5.6
Threskiornithidae	*Plegadis chihi*	White-faced ibis	4.5	0	5.3	0	0
Anatidae	*Anas spp.*	Ducks	36.4	7.1	47.4	22.2	0
Rallidae	*Aramides ypecaha*	Giant wood-rail	0	0	10.5	11.1	0
	Fulica armillata,	Red-gartered coot,					
	F. leucoptera,	White-winged coot,					
	F. rufifrons	Red-fronted coot	9.1	7.1	0.0	0.0	0.0
Jacanidae	*Jacana jacana*	Wattled jacana	0.0	7.1	5.3	0.0	0.0
Recurvirostridae	*Himantopus melanurus*	South American stilt	9.1	0.0	0.0	0.0	0.0
Charadriidae	*Charadrius collaris*	Collared plover	9.1	0.0	0.0	0.0	0.0
Alcedinidae	*Ceryle torquata*	Ringed kingfisher,					
	Chloroceryle amazona,	Amazon kingfisher,	4.5	0.0	10.5	0.0	11.1
	C. americana	Green kingfisher	13.6	14.3	21.1	22.2	5.6

Differences in species richness in the Deltaic portion of the river can be explained in relation to land use pattern. The Deltaic portion is characterised by a complex landscape pattern composed by a network of rivers and canals surrounding freshwater marshes and forests (Merler et al. 1994). However, the protected zone, which had higher species richness, had natural reserves along most of its riverbank. Even if effective control in these protected lands is extremely poor, these hydrophilic grasslands are primarily protected from human perturbation because of its constrained accessibility, given that there are no roads or bridges, and only sparse cattle can be found. In contrast, the antropic zone showed an intense human activity along the river course (mainly, for recreation and transport of passengers and commercial products), and the destruction of the natural riparian environs by urban settlements and commercial plantations. This modification and use of natural habitats could explain why the antropic zone showed the lowest value of wildlife richness. Nevertheless, it must be noted that in the Deltaic portion semi-aquatic mammals and birds may use other less disturbed watercourses and wetlands avoiding the Luján River, as it has been previously found for otters (Bó et al. 1992) and capybaras (Quintana 1996).

Retaining natural remnant corridors of habitat is often considered a useful conservation measure that can diminish the negative effects of habitat loss and fragmentation on wildlife (Saunders & Hobbs 1991; Puth & Wilson 2001). Our data suggest that the distribution of wildlife richness appears to be associated with the intensity of human activity and/or the destruction of riparian habitats. Lowlands usually have poor accessibility that restricts habitat modification, and human perturbation and poaching. However, construction of urbanizations on these lowlands, improvement of roads, and use of river has dramatically increased in the last decade (Daniele et al. 2006). If this trend continues, delineation of key conservation areas and effective control of protected areas will be needed in order to preserve riparian wildlife.

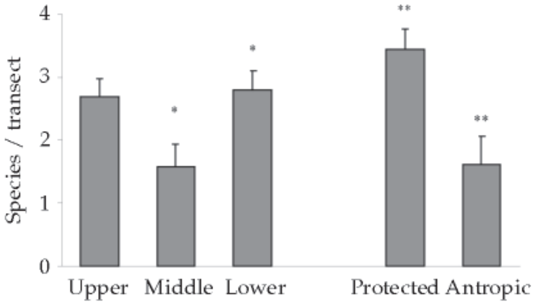

Figure 2. Mean number of species per transect (± S.E.) in each zone of the Pampean (upper, n=22; middle, n=14; lower, n=19) and Deltaic portions (protected, n=9; antropic, n=18). *p<0.05, **p<0.01.

Figura 2. Número promedio de especies por transectas (± E.E.) en cada zona de la porción Pampeana (superior, n=22; media, n=14; inferior, n=19) y Deltaica (protegida, n=9; antrópica, n=18). *p<0.05, **p<0.01.

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