LOCAL DETERMINANTS OF COYPU DISTRIBUTION ALONG THE LUJÁN RIVER, EASTCENTRAL ARGENTINA

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Abstract: The coypu, or nutria (*Myocastor coypus*), is a semiaquatic rodent intensively harvested for fur and damage control. We conducted a survey along the Luján River in Argentina to determine environmental factors affecting the distribution of coypu in its natural range. In each of 82 600-m transects randomly assigned along the river, we recorded the presence of coypu and habitat characteristics related to attributes of the river, nearby vegetation, and human activity. Coypu distribution was positively related to availability of grasslands used for extensive livestock production and negatively related to local human perturbations. Lowland prairies would provide an abundant and stable source of food to coypu, which could be used as a profitable natural resource in low productive areas of the Pampas region.

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The coypu, or nutria, is a semiaquatic rodent indigenous to the southern half of South America (Gosling and Baker 1991). This large rodent (6 kg) has established feral populations from escapes and introductions in North America, Europe, the Middle East, Africa, and Japan. Coypus inhabit banks of rivers, lakes, lagoons, and marsh and swamp areas with freshwater and brackish plant communities (Kinler et al. 1987, Gosling and Baker 1991).

Management of wild populations of coypu is a central issue because it is a valued furbearer and scorned pest (Kinler et al. 1987, Gosling and Baker 1991). In countries where it has been introduced, coypus destroy agricultural crops, damage natural flora and fauna, and harm banks and drainage systems. Consequently, campaigns of total eradication or control of its population were undertaken in some areas (Gosling and Baker 1987, Reggiani et al. 1993). However, in its native range, this species is among the major wildlife income sources for local inhabitants (Bo et al. 1992, Dirección Nacional de Fauna Silvestre 1992, Zacagnini and Venturino 1993).

In Argentina, the coypu is top-ranked in the furbearer trade, averaging 2.5 million exported furs per year from 1975 to 1985 (Marchetti and Morello 1991, Bárbaro 1994). Ninety-eight percent of these commercialized furs come from wild populations, and only 2% from fur farming (Zacagnini and Venturino 1993). This fact led to overexploitation of coypu populations in parts of its natural range (Gosling and Baker 1991). As a consequence, the coypu is among the fauna that requires management programs for sustainable exploitation in Argentina (Holdo and García Fernández 1995).

Understanding habitat use by a species is essential before any management efforts are initiated (Litvaitis et al. 1994). Most studies on the factors influencing abundance and distribution of coypu were conducted in the Northern Hemisphere (Kinler et al. 1987, Gosling and Baker 1991). However, the Pampas region and the delta of the Paraná River, eastcentral Argentina, represent the core of the native distribution of coypu. Our objective was to determine local environmental factors associated with distribution of coypu in a typical riparian habitat of this region.

STUDY AREA

We conducted our study along the Luján River, Province of Buenos Aires, Argentina (Fig. 1). This river begins at the confluence of 2 small streams in the Pampas plains (34°43′S, 59°37′W), and ends at de la Plata River (34°26′S, 58°32′W) near the delta of the Paraná River. Grassland steppe was the dominant vegetation, with many edaphic and hydric communities of freshwater marshes and riparian forests (Cabrera 1971). Natural vegetation has

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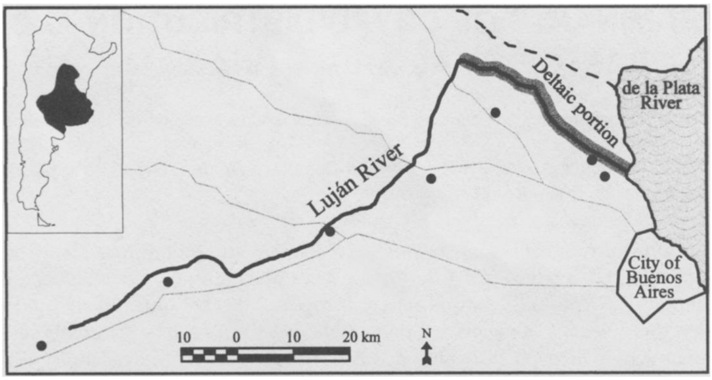

Fig. 1. The study area of coypu distribution in the Pampas region, and the Luján River of Argentina, with the principal cities (black circles) and roads located (gray lines) in its basin. The last deltaic portion of the river is shaded.

been widely modified, principally due to livestock and agricultural practices (Bárbaro 1994), and has been replaced by exotic species that are sown as crops, pastures and forestations, or that grow spontaneously. The climate is moist temperate: annual precipitation averaged 944 mm, and temperatures averaged 23.8°C in January and 9.1°C in July (Goldberg et al. 1995).

The Luján River is a narrow and shallow stream-like waterway in its upper reaches. The main human activities were extensive livestock (i.e., large-scale, low-intensity cattle stocking in natural grasslands) and agriculture. Increasing urbanization, more intensive land use, and a wider and deeper river occur downstream. In the last deltaic portion, the river was used as the principal way of transport for tourists, local inhabitants, and fruit and wood products. This portion of the Luján River constituted the southeastern limit of the large Paraná River Delta region and was characterized by a network of river and canal systems surrounding freshwater marshes, resulting in high landscape heterogeneity and faunal species richness (Merler et al. 1994).

METHODS

We studied the distribution of coypu based on a methodology standardized for sampling riparian mammals (Mason and Macdonald 1986). From March to October 1997, 82 600-m transects (averaging 3 transects/5 km of river) were randomly assigned along 130 km of the Luján River. We sampled both sides of the river in each transect. Depending on water depth, we moved along the river by motorboat, by kayak, and by walking along the bank. In each transect, the presence or absence of coypu was assessed by an indirect method based on signs of activity, which included burrows, nests, remnants of food, and paths. A transect was considered positive when feces and tracks of coypu were clearly identified, so that only recent use was sampled. Fecal sampling is considered a good indicator of presence or absence of coypu (Gosling et al. 1988, Colantoni 1993).

We distinguished 3 zones parallel to the river: riverbank, border, and upland. The riverbank was defined as the land immediately adjacent to the water, normally flooded daily. The border was the portion of land, generally with no land management, between the riverbank and the upland. The upland was the land more distant from the river, with characteristic vegetation clearly different from the riparian zone, and where some human land use was almost always recognized. Habitat variables recorded in each transect were (1) the river variables of width (1–10, 10–20, 20–40, >40 m) and depth (<0.5, 0.5–1, 1–2, >2 m); (2) riverbank variables of slope (0, 1–45, 46–60, 61–90, 90°), height (m), width (m), shallow shores (%), vegetation cover (% of herbs, shrubs, and trees); (3) border variables of width (m), vegetation cover (% herbs, shrubs, trees); and (4) upland variables of vegetation cover (% herbs, shrubs, trees), land use (% land with agriculture, livestock, timber production, urban-industrial activity), and local perturbations (presence of docks, houses, roads, bridges, railways, and recreational centers near the river).

We measured slopes, heights, and widths in the middle of each transect, and we estimated percentages for the whole length of each transect in 5 categories: 0, 1–25, 26–50, 51–75, and 76–100%. Most variables were measured with an ordinal scale, except for height and width. Total width of each transect varied along the river depending on habitat characteristics. In general, we sampled 50 m perpendicular to the river (3 m of riverbank, 30 m of border, the first 20 m of upland zone, which remained constant after 20 m).

We performed a correspondence analysis to identify the principal features of the environment and associate them with coypu distribution. This type of analysis allows nonmetric ordinal and categorical variables to be included (Hair et al. 1995), so that all 26 variables sampled in the transects were used. Correspondence analysis involves using the variables with higher contribution for the first few factors (Manly 1986). We used variables or groups of variables with factor score value (called s) higher than $\pm$ 0.7, arbitrarily defined based on the arrangement of our dataset. We conducted a stepwise logistic regression analysis to determine the effect of environmental variables on coypu distribution (Manly et al. 1993). We used the first 3 factors of the correspondence analysis (which explained 60% of data variability) as independent variables, and the presence or absence of coypu as a binary dependent variable. We calculated Spearman rank correlation coefficients between distribution of coypu and variables with factor score value higher than $\pm$ 0.7, and the percentage frequency distribution of the significant correlated variables for the transects with and without coypu (Manly et al. 1993).

RESULTS

The first factor of the correspondence analysis explained 26% of the variation in the data, and the second factor explained 19% (Fig. 2). Factor 1 had high positive values on width (s = 1.5) and shrub cover (s = 0.9) of the riverbank, and agricultural practices (s = 1.1). Factor 2 had high positive values on land with livestock production (s = 0.8), and high negative values on upland shrub cover (s = -0.9), timber (s = -1.0) and urban (s = -1.0) activity, and the presence of recreational areas (s = -1.5), docks (s = -1.2), houses (s = -0.8), and roads (s = -0.7).

The presence of coypu was documented in 66% of transects sampled along the river. Logistic regression analysis retained only Factor 2 as a predictor of distribution of coypu (Fig. 2; b = 7.57, improvement of goodness-of-fit by the term entered: $P_i < 0.001$; goodness-of-fit to the logistic model: $P_m > 0.6$). Most transects with coypu were located in the positive quadrats of Factor 2 (Fig. 2).

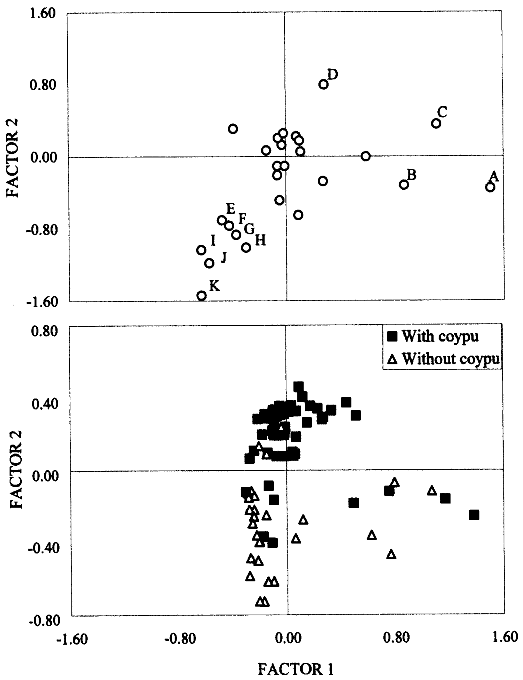

Fig. 2. Factors 1 and 2 (top) of the correspondence analysis showing the arrangement of the 26 habitat variables sampled along the river. Variables with high contribution to the factors are labeled as follows: A = riverbank width; B = riverbank shrub cover; C = agriculture activity; D = livestock production; E = roads; F = houses; G = upland shrub cover; H = urban activity; I = timber production; J = docks; and K = recreational areas. Factors 1 and 2 (bottom) showing the arrangement of the 82 transects sampled along the river. Most transects with coypu have positive values on Factor 2.

Significant Spearman rank correlation coefficients were obtained for variables of Factor 2, but not for variables of Factor 1 (Fig. 3). Consequently, those variables (e.g. livestock production, human activities) that had high contributions to Factor 2 were considered as significant correlates of the distribution of coypu along the Luján River.

DISCUSSION

The main positive correlate of coypu distribution along the Luján River was the availability of grassland used for cattle production. In the Pampas plains, extensive animal husbandry is the typical activity developed in lands with chronically flooded terrain (Marchetti and Morello 1991), because these lands do not have the capacity for intensive agricultural or timber pro-

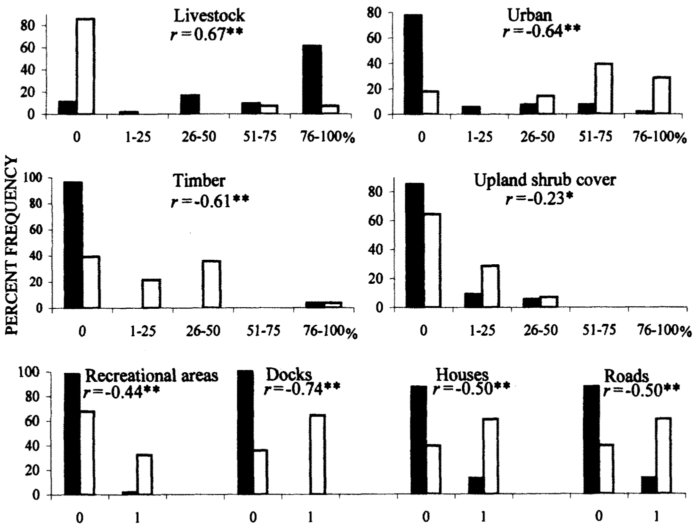

Fig. 3. Distribution of upland variables correlated with coypu distribution for transects with coypu (black bars; n = 54) and without coypu (white bars; n = 28), and Spearman rank correlation coefficients (*$P < 0.05$, **$P < 0.001$). For land uses and vegetative cover, categories represent the percentage of transects in that land use or cover. For local perturbations (docks, houses, roads, recreational areas), categories represent presence (1) or absence (0).

duction. In these lowlands, natural or seminatural grasslands consist of vegetation growing in soils normally saturated with water. Coypu feed mainly on vegetation growing close to water, such as sedges (*Carex* spp.), rushes (*Scirpus* spp., *Juncus* spp., *Eleocharis* spp.), cattail (*Typha* spp.), and marsh grasses (*Spartina* spp., *Distichlis* spp.; Warkentin 1968, Willner et al. 1979, Gosling and Baker 1991). Relative to coypu habitat requirements, these grasslands seemed to provide an abundant and stable source of food and water. The advantage for coypu using this environment would increase during dry periods and would not depend on the presence of cattle. Changes in normal feeding behavior (e.g., bark stripping) and concentration and dispersion of coypus have been related to drought and flood events (Kinler et al. 1987, Doncaster and Micol 1990).

Variables associated with human disturbance were the most important negative correlates of coypu distribution. The relation between the absence of coypu and local human perturbations (i.e., docks, houses, roads, recreational centers) and urban areas indicates human presence has a negative influence on natural populations of coypu. In contrast, the low level of human activity that occurs in natural grasslands would be another desired characteristic for the establishment of coypu populations.

We found few signs of coypu activity near the deltaic portion of the river, although the coypu has been described as a common species of the Paraná River Delta region (Bo et al. 1992). Coypus probably avoided the Luján riverbank due to human disturbance, and they preferred the less disturbed waterways and freshwater marshes of the delta where suitable food and nesting sites were common (Merler et al. 1994).

The theory of habitat selection has grown rapidly since the publication of the seminal paper on the "ideal free distribution" model by Fretwell and Lucas (1970). These ideas have influenced several areas of ecological theory, including population ecology (Sutherland 1996), structure (Rosenzweig and Abramsky 1986), and dynamics of animal communities (Fryxell and Lundberg 1998), as well as landscape ecology (e.g., Knight and Morris 1996). The success of this approach is related to the importance that heterogeneity of resource distribution has on the ecological patterns of animal populations. Our results provide baseline information indicative of resource requirements of coypu in a typical river of the Pampas plains. These results will be used in future studies on patterns of population distribution and metapopulation dynamics, within the framework provided by the theory of habitat selection.

MANAGEMENT IMPLICATIONS

Our study was developed in a river typical of the Pampas region, where intensive harvest of coypu occurs. This region comprises >50 million ha, with several rivers and streams that cross a mosaic of different land uses based on soil capability. Our results indicate coypu distribution is not homogeneous along this gradient, being more abundant in natural pastures with extensive cattle husbandry. In these economically poor areas, sustained exploitation of populations of coypu would provide additional income to local people and landowners. In contrast, hunting should be avoided in rivers and streams where coypus are less abundant (e.g., urban, timber, agriculture lands). These areas could serve as corridors connecting suitable habitats for coypu, favoring dispersal that may be needed for population recovery.

We found that coypus were not distributed as might be expected for an agricultural pest, given that cultivated lands were not associated with its distribution. In previous studies, our research group analyzed habitat use in agrosystems of the Pampas region (P. D'Adamo et al., Universidad Nacional de Luján and Universidad de Buenos Aires, unpublished data). These studies showed no evidence of an effect of coypu on agricultural crops, almost no crops were consumed, and pastures were used in a larger proportion than crops. We suggest coypus do not constitute a pest for agrosystems in their natural range. Greater availability of suitable food near water and the absence of severe winters could explain differences in crop damage reported in countries where the coypu has been introduced. Consequently, harvest of coypus in their native range should not be oriented toward eradication but toward maintaining stable populations for sustainable fur exploitation.

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