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Natural History

Lontra longicaudis (Mustelidae) in La Vieja river basin, Risaralda, Colombia

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Resumen

La nutria neotropical *Lontra longicaudis* es un objeto de conservación para el manejo de los Andes Occidentales. Esta especie es susceptible a presiones como la contaminación y la caza. Estimar su distribución y abundancia es fundamental para planificar y adaptar las estrategias de gestión de estos paisajes. Utilizando modelos de ocupación, estimamos una ocupación de 0,52 (PI95%=0,26-0,87) con una probabilidad de detección de 0,36 (PI95%=0,18-0,56). No se encontraron efectos sobre la probabilidad de ocupación por covariables seleccionadas. Recomendamos extender los programas de manejo y monitoreo a una escala más amplia con unidades de muestreo equivalentes al tamaño del área de distribución de la especie.

Palabras clave: Área usada, nutria neotropical, río Consota.

Abstract

The neotropical otter *Lontra longicaudis* is a conservation target in the management of the Western Andes. This species is susceptible to pressures such as pollution, and hunting., Estimating its distribution and abundance are essential to plan and adapt management strategies for these landscapes. Using occupancy models, we estimated occupancy of 0.52 (PI95%=0.26-0.87) with a probability of detection of 0.36 (PI95%=0.18-0.56). No effects were found on the probability of occupancy by selected covariates. We recommend extending the management and monitoring programs to a broader scale with sampling units equivalent to the home range size of the species.

Keywords: Consota river, Neotropical otter, used area.

Otters depend on the quantity and quality of water, the presence of water bodies, and the connectivity of suitable habitats to maintain viable populations (Trujillo et al. 2016). Aquatic habitats have been highly affected by different human activities (Harrison et al. 2016; Collier et al. 2019), leading to otters being among the most threatened animals on the planet (IUCN 2022). Populations in certain regions such as the Andes, Caribbean, and Orinoquia face more critical conditions, where wetland degradation is a result of land use change due to the agro-industrial and extractive industries, livestock ranching, and water diversion for human settlements (Trujillo et al. 2016). Additionally, otters have been

historically hunted for the fur trade (Roncancio-Duque and Vélez Vanegas 2019). The N*eotropical otter* (*Lontra longicaudis)* is categorized as Near Threatened A3c (Rheingantz et al. 2020), and, despite being widely distributed in Colombia, the species is listed nationally as Vulnerable to Extinction (MADS 2017).

La Vieja River basin spans 304 km^2 and includes the Consota River. This river is part of the Cauca River basin, in central-western Colombia. This landscape suffers from the degradation of the physical, chemical, and biological water conditions caused by agricultural, industrial, and domestic discharges, alteration of the channel geomorphology due to erosion in deforested areas, forest fragmentation of riparian forests, and mining for gold and construction materials (Botero-Botero et al. 2010). At the basin scale, the landscape is dominated by an agricultural matrix (livestock and crops) with small areas of native vegetation, mainly *Guadua angustifolia* forest, associated with the riverbeds (Botero-Botero et al. 2010). Currently, land cover is composed of only 11% forest, as well as 9% crop cultivations (sugarcane, coffee, and rice), 13% mosaics of other cultivations, 9% grasslands, 32% mosaics dominated by grasslands, and 11% urban and industrial areas and recreational zones (IDEAM 2021).

We estimated the occupancy under the assumption that this variable changes in function of abundance, and thus is useful for detecting population changes through a monitoring program (MacKenzie and Nichols 2004; MacKenzie et al. 2018). Occupancy is a common proxy for abundance, however, interpreting the estimated parameters properly is key to getting unbiased inferences (Andrade-Ponce et al. 2021). Additionally, we recorded the presence of some human activities as potential threats to the species.

This study was carried out in the Ukumarí Biopark and surrounding areas, in the town of Cerritos, Pereira municipality, Risaralda department, on the western slope of the Central Andes of Colombia (4º48'00''N, -75º48'30''W, Datum: WGS84) at 1174 m elevation. Ukumarí Biopark has a permeable (to otters and similar) fenced area of approximately 44.7 ha and contains 1.5 km of the Consota River and some wetlands. Altogether, the study area comprises approximately nine linear kilometers of water bodies, including streams, wetlands, lagoons, and the Consota River, which is a tributary of the La Vieja River. Ukumarí Biopark is embedded in a mosaic of riparian forests and urbanized and agricultural areas (Figure 1).

The Occupancy (ψ) of *L. longicaudis* was estimated using the occupancy method (MacKenzie et al. 2002). We sampled 23 transects (sites), each measuring 400 m separated by at least 100 m, and spanning the water bodies associated with the Biopark; were surveyed four times (surveys) each between April 30 and May 30, 2019. Replicate surveys of the same transect were separated by at least seven days. In addition to direct observations of otters, tracks such as footprints, feeding troughs, and scat were also considered evidence of otter presence. Confirmed records were recorded as 1, while surveys with no detection were recorded as 0. Changes in the land use of the sites (i.e., transects) were assumed to be random, and the population was considered closed during the study. The presence (0, 1) of felling, livestock, crops, and contamination were considered covariates to evaluate the effect of local human activities on otter occupancy. Considering that survey sizes were smaller than home range sizes documented for this genus (Helon et al. 2004; Nakano-Oliveira et al. 2004), we assume that we are estimating the amount of used area (Mackenzie and Royle 2005; Steenweg et al. 2018).

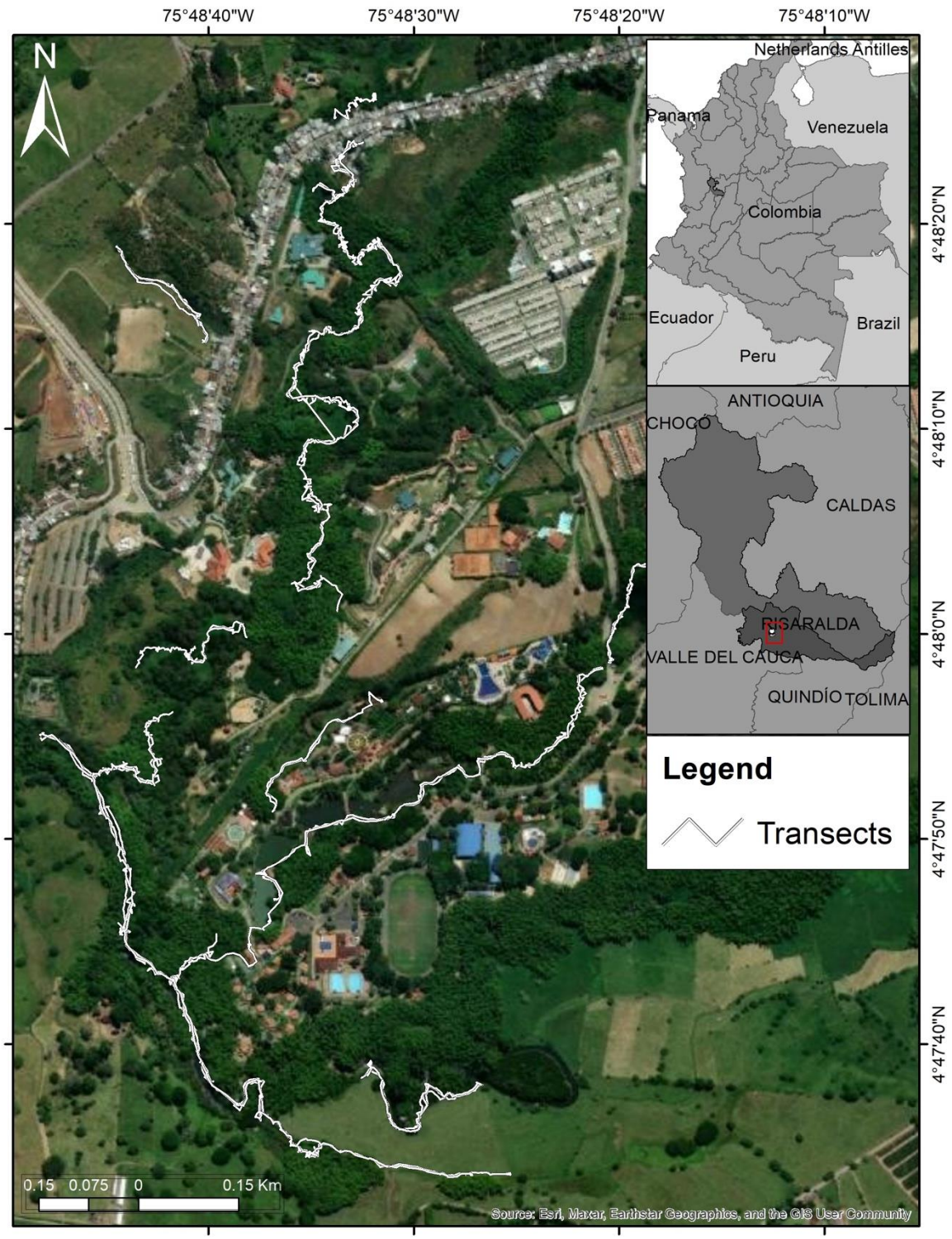

FIGURE 1. Ukumarí Biopark and surrounding area, including the Consota River, part of La Vieja river basin, Risaralda department, Colombia.

Otter occupancy probability was estimated under a Bayesian approach using an *a priori* uninformative uniform distribution (0.0 – 1). The occupancy posterior distribution (*Psi*) and detection probability were adjusted to a Bernoulli probability distribution. To evaluate the

relationship between the covariables with the occupancy probability, logistic regression was used. The intercept and slopes were assigned uninformative *a priori* normal distributions (0, 1) (Reckhow 1990; McCarthy 2007). Multiplicative effects between covariates were not considered.

To select the most parsimonious model (i.e., the one with the highest likelihood and the least number of parameters), the Deviance Information Criteria (DIC) was used with the following formula: (DIC = deviance + 2pD), where pD is the number of parameters used (*Psi*, *p*, ß0, ß1, etc.) (McCarthy 2007). All 16 candidate models (i.e., every combination of covariates) were explored, including the null model (Doherty et al. 2012) (Table 1). All analyses were performed in the program OpenBugs 3.2.2 (Spiegelhalter et al. 2018) using Markov chains with 100,000 generations, excluding the first 10,000 as burn-in.

Table 1. DIC scores of the models assessed to determine the relationship between human activities (covariates) and the occupation probability of *Lontra longicaudis*. *No significant differences in models with equal numbers of asterisks based on δDIC < 2.

ID	Model	DIC	(δDIC)
1	Psi~1,p~1	55.29	0
2	Psi~Felling,p~1	67.33	12.04*
3	Psi~Crops,p~1	67.45	12.16*
4	Psi~Livestock,p~1	67.52	12.23*
5	Psi~Contamination,p~1	67.81	12.52*
6	Psi~Felling+Contamination,p~1	69.38	14.09**
7	Psi~Felling+Livestock,p~1	69.48	14.19**
8	Psi~Felling+Crops,p~1	69.51	14.22**
9	Psi~Livestock+Crops,p~1	69.76	14.47**
10	Psi~Crops+Contamination,p~1	69.8	14.51**
11	Psi~Livestock+Contamination,p~1	69.86	14.57**
12	Psi~Felling+Livestock+Crops,p~1	71.66	16.37***
13	Psi~Felling+Livestock+Contamination,p~1	71.76	16.47***
14	Psi~Felling+Crops+Contamination,p~1	72.07	16.78***
15	Psi~Livestock+Crops+Contamination,p~1	72.07	16.78***
16	Psi~Felling+Livestock+Crops+Contamination,p~1	73.97	18.68****

Otter occupancy probability in the study area was 0.52 (PI 95% = 0.26–0.87), with a detection probability of 0.36 (PI 95% = 0.18–0.56). The four models that included every covariable independently recorded the lowest DIC values were not significantly different from each other (δDIC < 2) (Table 1) (McCarthy 2007). Additionally, occupancy was not observed to be affected by any human activity considered as a covariate (i.e., the probability interval of β included 0) (Table 2).

Table 2. β values of the effect of human activities on occupation probability of *Lontra longicaudis* were not significant

Covariate	Mean	sd	MC_error	val2.5pc	val97.5pc
Felling	-0.321	0.922	0.011	-2.133	1.481
Crops	-0.276	0.946	0.010	-2.131	1.616
Livestock	-0.298	0.942	0.010	-2.173	1.546
Contamination	0.008	0.930	0.013	-1.853	1.832

The occupancy probability of *L. longicaudis* within the Ukumarí Biopark and vicinity is approximately half of what it potentially can be, assuming that every segment of the water body is usable (Botero-Botero et al. 2016). Despite this species being the focus of some environmental agencies, previous studies do not adjust estimates by detection probability (Mayor-Victoria and Botero-Botero 2010; Botero-Botero et al. 2016). Our result is similar to another estimation from the same La Vieja basin, whose results were explained as a

possible consequence of pollution, deforestation, mining of sand, and fishing with dynamite and poisonous plants (Botero-Botero et al. 2016).

We recommended focusing conservation and management plans on increasing the proportion of the area used. The present study was restricted to the biopark and surrounding area, which is useful for informing management actions. The management plan could be extended to a broader scope given the agreement opportunities with the department and regional environmental authorities. Establishing a sampling design with sites fitted to the species' local home range and having a larger sample size in terms of both spatial and temporal scales will allow unbiased estimations and a proper interpretation of the results as the proportion of occupied area, rather than used area (Steenweg et al. 2018). Other factors not considered here, such as quantitative or continuous covariates may better explain the species' occupancy. We hope this work will serve as the baseline for the next monitoring studies implementing robust analyses to detect changes or trends affecting the species.

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