R E P O R T

HABITAT FACTORS INFLUENCING THE DISTRIBUTION OF EURASIAN OTTER (*Lutra lutra*) IN MAJOR RIVERS OF MYAGDI DISTRICT, NEPAL

Pravin GIRI[1], Sara PARIYAR[2], and Purna Man SHRESTHA[3]

[1]*Agriculture and Forestry University, Faculty of Forestry, Hetauda, Nepal*
[2]*School of Forestry and Natural Resource Management, Tribhuvan University, Nepal*
[3]*Wildlife Research and Education Network, Kathmandu, Nepal*
Corresponding Author e-mail: mailto:pgarnol123@gmail.com



(Received 11th July 2024, accepted 13th November 2024)

Abstract: Increasing pressure on aquatic ecosystems in the Himalayan region has raised alarming concerns for the conservation of Eurasian otters. However, limited knowledge of their abundance, distribution, and ecology has precluded their evidence-based conservation in Nepal. In this study, we examined the habitat variables associated with the distribution of Eurasian otters in the Kali Gandaki watershed area in the Myagdi District of Nepal. A sign survey was conducted in three river channels to document the distribution of the species. In total 87 transects, each 100m in length, were surveyed and spraints detected outside of the transect were also recorded. A predictive model was developed using a logistic regression model to identify factors affecting sign encounter probability. A total of 45 spraints were detected from three rivers (Mygdi River =41, Kali Gandaki River=2, and Rahuganga River=2) and the estimated spraint density was 0.51sign/km. Elevation, escape cover distance, small and large stones were the significant variables all negatively associated with the probability of detection of spraint in the logistic regression model. Our results suggest that the population of Eurasian otters in the area is relatively low and heavily threatened by human activities. Hence, we suggest an immediate population survey aided with camera traps or genetic analysis and tailored conservation activities around the Kali Gandaki River for the species' long-term survival.

Citation: Giri, P., Pariyar, S., and Shrestha, P.M. (2025). Habitat Factors influencing the Distribution of Eurasian Otter (*Lutra lutra*) in Major Rivers of the Myagdi District, Nepal. *IUCN Otter Spec. Group Bull.* **42** (1): 27 - 36

Keywords: Aquatic ecosystem, Conservation, Eurasian otters, Myagdi District, Spraints

INTRODUCTION

Freshwaters comprise approximately 0.8% of the earth's surface, yet this tiny fraction of global water supports a high amount of biodiversity, representing 6% of all described species worldwide (Dudgeon et al., 2006). However, freshwater ecosystems are the most endangered in the world and the decline of biodiversity is far greater than in the most affected terrestrial ecosystems (Sala et al., 2000). Habitat loss and degradation, flow modification, water pollution, overexploitation, and invasive species have resulted in the severe decline of several freshwater organisms worldwide (Dudgeon et al., 2006). The impacts of these threats are further accelerated by the negative influences of global climate change resulting in increased flooding, storm events, erosion, and flash floods. These events are more frequent in the Himalayan region, making the aquatic ecosystem extremely vulnerable (Jamwal et al., 2022). The rapid surge in the construction of electricity projects in the Himalayan region to fulfill increasing clean energy demands in the South Asian market, together with water extraction for expanding agrarian economics have added further pressure on these ecosystems (Pereira et al., 2009; Chhetri and Savage, 2014).

Among the thirteen extant otter species, the Eurasian otter (*Lutra lutra)* has the widest distribution, ranging from Western Europe, across the Palearctic, Southeast Asia, Indian sub-continent, and northern Africa (Duplaix and Savage, 2022). While their population is recovering in Europe following protection, habitat conservation measures, and strict environmental regulations (Loy et al., 2022), they continue to decline across much of their remaining range. In particular, they face tremendous pressure in Asia due to ever-increasing human population, pollution, dam construction, poaching/illegal killing, decrease in prey biomass due to unsustainable fishing, and shoreline vegetation removal (de Silva, 2011; Yoxon and Yoxon, 2019; Loy et al., 2022; Duplaix and Savage, 2022). Consequently, the species is classified as Near Threatened by the International Union for Conservation of Nature (IUCN) with a declining population trend globally (Loy et al., 2021) and is listed in Appendix I of the Convention on International Trade in Endangered Species of Fauna and Flora (CITES). Eurasian otters in Asia are relatively less studied than in Europe (de Silva, 2011), hence little is known about their distribution and ecology in the region (Conroy et al., 1988; Basnet et al., 2020b).

In Nepal, Eurasian otters were anecdotally believed to be distributed widely in rivers and streams in the mid-hills region, solely based on people’s perceptions and key informant interviews (Basnet et al., 2020a). As a result, the status of the species was unclear and ambiguous. However, following extensive surveys in recent times, new sightings of the species have been reported from the Roshi River in Kavrepalanchok District, Barekot River in Jajarkot District, Tubang River and Pelma River in Rukum East District (Shrestha et al., 2021a,b; Shrestha et al., 2022). A dead carcass of Eurasian otter have been unexpectedly recorded recently from the Kathmandu Valley (Shrestha et al., 2023). Nonetheless, a comprehensive study on the species’ ecology and population status is yet to be done in Nepal. Available information suggests that they appear to be present in fragmented riparian habitats in reliably low population numbers (Shrestha et al., 2021b; Shrestha et al., 2022). Given that the significant proportion of their distribution occurs outside of protected areas in Nepal, they are likely more prone to human-induced threats such as poaching/killing, unsustainable fish harvesting, pollution, dam construction, and sand and boulder mining (Basnet et al., 2020a; Shrestha et al., 2022).

Research on Eurasian otters in Nepal has largely been confined to documentation of their distribution based on interviews with local communities and sign survey (Basnet et al., 2020a). However, updated and precise information on its abundance and factors limiting its distribution is fundamental in designing effective conservation measures (Romanowski et al., 2013). In this study, we examined the habitat factors associated with the distribution of Eurasian otters in the Kali Gandaki watershed area in Myagdi District. Our results will help guide future conservation actions to protect otters and their habitat in this study region.

METHODS AND METHODOLOGY

Study Area

The study was conducted in Kali Gandaki Canyon (28°42′24″N, 83°38′43″E) and its tributaries in Myagdi District of Nepal. Three rivers were surveyed, the Kali Gandaki River, Myagdi River, and Rahuganga River, in November and December 2022 (Fig. 1). In total 87 km of river sections were surveyed on the three rivers: Kali Gandaki River (38 km), Myagdi River (42 km), and Rahuganga River (7 km). The Kali Gandaki and Rahuganga Rivers were surveyed starting from their confluence point at Galeshwor (28°22′30″N, 83°34′11″E), while the Myagdi River was surveyed beginning at Beni Bazar (28°20′30″N, 83°33′46″E). The Myagdi River features a broad riverbank, predominately bordered by agricultural land, whereas the other two rivers have narrow river banks devoid of agricultural land. The terrain encompasses significant bio-diversity-rich areas, including community forests, leasehold forests, and protected areas such as the Annapurna Conservation Area and Dhorpatan Hunting Reserve. The elevation of Myagdi District ranges from 792 m above sea level to as high as 8167m, and comprises four different types of climatic conditions: sub-tropical, sub-temperate, temperate, and alpine. The major plant species along the river stretches include *Schima wallichi*, *Ficus cunia*, *Garuga pinnata*, *Alnus nepalensis*, *Imperata cylindrica*, *Eupatorium adenophorum*, *Saccharum spontaneum*, *Castanopsis indica and Bambusa spp.* at lower elevations and *Toona ciliate and Pinus wallichina* at higher elevations.

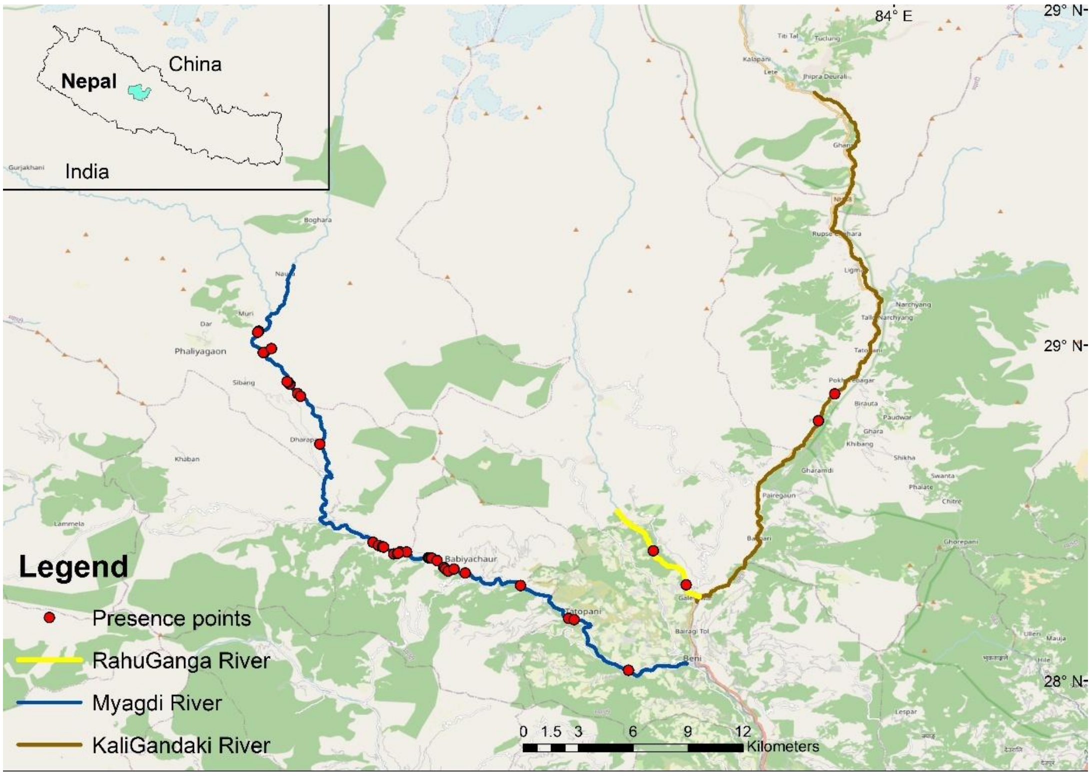

Figure 1. Map showing three stretches of rivers studied: Kali Gandaki, Myagdi, and Raguganga Rivers and occurrence points of otter spraints.

Sign Survey and Documentation of Habitat Variables

Starting from a convenient point on the riverbank, we laid 100m long river transects/segments in each of the three rivers. Adjacent river segments were separated by 900m gap to ensure sampling independence. In total the Myagdi River had 42 segments, Kali Gandaki had 38 segments and Rahuganga had seven segments. Then each segment was intensively searched to 10m away from the edge of the water (Jamwal et al., 2016; Shrestha et al., 2021b) for otter signs (spraints, tracks, dens, resting and grooming sites) on a single side for a $1000m^2$ plot (Jamwal et al., 2016). The sign survey was conducted in November and December 2022 for one month, a time of year when water levels drop and bank sides are fully exposed, increasing the likelihood of observing otter signs (Jamwal et al., 2016).

Otters are often difficult to observe directly in their natural habitat, so spraint count surveys are a commonly used approach to ascertain distribution range and habitat preference (Mason and Macdonald, 1987; Romanowski et al., 2013). The presence of fish bones, scales, and fishy odor was used as an identifying factor for spraints/latrines, and tracks were identified by a round impression of five toes and faint webbing marks (Jamwal et al., 2016). The GPS points of otter signs found along the riverbank were recorded inside and outside the transects, unless precluded by inaccessible terrain. Additionally, separate plots (100m x 10m) were laid when spraints were observed outside of transects, and data on environmental and anthropogenic variables were also recorded (Basak et al., 2021; Shrestha et al., 2022).

The data was documented in the form of presence/absence in each segment. The habitat parameters that are considered potentially important to Eurasian otters were selected based on literature prior to the survey (Prenda et al., 2001; Anoop and Hussain, 2004; Nawab and Hussain, 2012; Shrestha et al., 2022). The variables include elevation, river width, bank substrate types (sand and mud, small stone, large stone, and large boulder), escape cover distance, bank slope, distance to road, and human disturbances. Distance between shorelines was measured through a Rangefinder. The riverbank slope was measured using a clinometer. Escape cover distance is the distance between the shoreline and the nearest vegetation cover or rock pile, which provides shelter to otters (Basak et al., 2021), measured using a measuring tape of 30m length. Riverbank substrate was categorically differentiated based on diameter into four categories; sand and mud (<5mm), small stones (5-50cm), large stones (50-100 cm), and large boulders (>100cm) (Shrestha et al., 2022). The distance to the nearest road from each segment was obtained from Google Earth Pro. Habitat disturbances were categorically differentiated as none, light, moderate, and severe based on the removal of sand and boulder extraction, visible pollution, fishing activities, grazing, an abundance of cow and dog tracks, and construction works at the site (Jamwal et al., 2016; Shrestha et al., 2022).

Factors affecting Otter Presence

We ran logistics regression to identify the significant habitat variables affecting the distribution of Eurasian otters. For the model, the presence/absence of otter sign at each 100m long segment (n=87 segments) was considered as a dependent variable, while the other ten variables were treated as explanatory (predictor) variables. Prior to modelling, a multicollinearity test using Variation Inflation Factor (VIF) was run for all the independent variables using the package “CAR” and variables having a VIF> 10 were omitted from the final model (Bowerman and O’Connell, 1990). Quantitative variables were Z-transformed before performing the logistic regression analysis. Afterward, a full model logistic regression analysis containing all the independent variables was run under the family binomial with the logit link function. All possible models were constructed using the function “dredge” from the “MuMIn” package (Barton, 2009). The model-averaged beta-coefficients of covariates were examined to assess the significance of their effect on the Eurasian otter sign encounter rate. We used Akaike’s Information Criterion, adjusted for small sample sizes, (AICc) to choose the best-fit model (Burnham and Anderson, 2004). The entire analysis was conducted in R 4.0.4 (R Core Team, 2023).

RESULTS

Spatial Distribution of Spraints

A total of 45 otter spraints were detected in 87 km of river transects (Table 1). The spraint of otters was the only reported sign from the survey and no other signs such as dens, tracks, or live sightings were recorded. Sprainst were detected in only 15% of transects (13 out of 87 transects). The estimated spraint encounter rate was 0.51 sign/km. Myagdi River had highest encounter rate with 1.02 sign/km, followed by the Kali Gandaki (0.05 sign/km) and Rahuganga Rivers (0.28 sign/km) (Table 1).

Table 1. Eurasian otter signs detected inside and outside of the transect, total signs, and sign density across Myagdi, Kali Gandaki and Rahuganga Rivers

River	Survey Length (km)	Otter Signs Detected		Total Sign Number	Encounter Rate (Sign/Km)
		Within Transects	Outside Transects		
Myagdi	42	11	31	41	1.02
Kali Gandaki	38	1	1	2	0.05
Rahuganga	7	1		2	0.28
Total	87	13	32	45	0.51

Habitat Characteristics and Influencing Variables

The multi-co-linearity test conducted among ten variables indicated that the percentage of large boulders had a VIF value greater than 10, hence it was omitted from the further analysis. The model with delta AIC=0 was the top best fit model with an Akaike weight of 0.133 (Table 2). The top model included five habitat variables: human disturbance, elevation, escape cover distance, percentage of large stones, and percentage of small stone. However, model averaged coefficients (Table 3) demonstrated that elevation, escape cover distance, percentage of small stones and percentage of large stones are the significant predictors influencing the encounter rate of otter sign. Although human disturbances influence the otter distribution, the relationship was not statistically significant. All four of these variables were negatively correlated with the encounter rate of otter sign. The second-best model has an Akaike weight of 0.074 with delta AIC value 1.18, containing six variables including river width to those present in the top-fit model.

Table 2. Summary of top six models examining the factors influencing otter habitat use, with each model's Akaike information criteria adjusted for small sample sizes (AIC_c), the difference in AIC_c from a top-ranked model (delta AIC_c) and Akaike weight**.** (Note: HD = Human disturbances, EL= Elevation, ECD= Escape cover distance, LS= % Large stone, SS= % Small stone, RW= River width, DR= Distance to Road)

Models	Predictor Variables	AIC_c	ΔAIC_c	Weight
1	~HD+ EL+ ECD+ LS+ SS	108.5	0.00	0.133
2	~HD+ EL + ECD + LS+ SS+ RW	109.6	1.18	0.074
3	~DR+ HD +EL+ ECD+ LS+ SS	110.0	1.58	0.060
4	~EL+ ECD+ LS+ SS	110.3	1.84	0.053
5	~DR+HD +EL+ ECD+LS+ SS+ RW	110.3	1.87	0.052
6	~DR+ EL+ ECD+ LS+ SS+ RW	110.4	1.97	0.050

Table 3. Model-averaged coefficients of predictor variables associated with the probability of detecting otter sign in the Myagdi, Kali Gandaki and Rahuganga Rivers. The significant variables influencing Eurasian otter sign encounter rate (Pr (>|z|) <0.05) are denoted with * signs.

Predictor Variable	Estimate	z Value	Pr(>|z|)	Odd Ratio
Intercept	7.569	2.281	0.022*	1937.7
Elevation	-0.003	-2.222	0.026*	0.996
% Sand	-0.02	-0.323	0.746	0.979
% Large stone	-0.054	-2.443	0.014*	0.947
% Small stone	-0.07	-2.25	0.024*	0.931
Escape cover distance	-0.165	-3.048	0.002**	0.847
River width	0.053	1.382	0.166	1.055
Slope	0.0003	0.016	0.987	1.000
Human disturbances	-0.372	-1.824	0.068	0.688
Distance to road	0.001	1.213	0.225	1.001

DISCUSSION

Spatial Distribution of Otter Spraint

Evidence of the presence of otters was verified by the detection of spraints from all three river stretches and recent sighting records by local people; however, no direct observation of otters was made during the survey. Although positive identification of the species as Eurasian otters was not confirmed, the descriptions provided by the local people along with a previously verified image from a similar elevation range in country suggest that it is likely to be the Eurasian otter.

The scat density of 0.51 sign/km while surveying 83km of river stretch probably reflects the low population density of the species along the study area. The calculated scat density was lower than that reported in Rukum District (2.06 sign/km), and in the survey of 71 km of other river stretches (Sanibheri River: 1.14 sign/km, Pelma River: 2.38 sign/km and Utterganga River: 2.67 sign/km) (Shrestha et al., 2021a). Among the three rivers surveyed, a relatively larger number of otter spraints were collected from the Myagdi River. The presence of agricultural land adjacent to the Myagdi River, along with abundant vegetation coverage, wide riverbank, sizeable water pools, and minimal human disturbances appears to create favorable habitat conditions for otters (Prenda, 2001; Raha and Hussain, 2016); this could have led to increased detection of otter signs. The presence of spraints and latrines sites can be taken as an indicator of the intensity of use of the river stretch, but it cannot be directly used to estimate the population size of the species (Macdonald and Mason, 1983; Sittenthaler et al., 2020). However, the absence of otter spraints in a particular place does not necessarily imply the complete absence of the species (Yoxon and Yoxon, 2014).

Habitat Characteristics

We found that elevation and percentage of small stones had a negative impact on otter distribution and habitat use, which corroborates with findings of Shrestha et al. (2022). This result suggests that otters tend to use river sections at a lower elevation, likely linked with the opposite relation of prey abundance with elevation (Hutchings and White, 2000). Additionally, this survey was conducted in the winter season, when fish tend to migrate towards lower elevations to avoid the extreme cold. Otters are also likely to follow their main prey species in that season, and this could have resulted in higher detections of otter signs in lower elevation (Jamwal et al., 2016; Wang et al., 2021).

Eurasian otters, shy and elusive animals, usually avoid areas without resting sites and escape cover from terrestrial predators and hiding places from frequent human intrusion (Talegaonkar et al., 2021). As a result, vegetation coverage and a den around the riverbank are considered prerequisites for a suitable habitat for otters (Hussain and Choudhury, 1997). Raha and Hussain (2016) observed that riverbanks with tall trees and dense canopy in the lower and middle elevations are highly preferred by the Eurasian otter in India. Similarly, this study also found that the Eurasian otter had a negative association with the increasing distance to escape cover which indicates that the availability of vegetation coverage and hiding places along the water bodies are very important for otter distribution. The negative relationship between the detection of spraints with frequency of small and large stones could be linked with the habit of Eurasian otter of defecating and resting in the cavities of large boulders (Jamwal et al., 2016) they do not offer these spaces required for sprainting and rest sites, hence otters might have avoided these river substrates. Nevertheless, these suboptimal habitats may function as corridors, facilitating the movement of otters between optimal habitat patches with abundant resources (Basak et al., 2021). Contrary to our prior expectations, the presence of large boulders did not show any significant correlation with otter sign detection in this study, consistent with findings of a survey conducted in a similar physiographic zone in Nepal (Shrestha et al., 2021a; Shrestha et al., 2022).

CONCLUSION

This study has established baseline information on the species as well as their correlation with a set of habitat variables. However, this survey was conducted in a single season, winter, over a relatively short period, and such occasional surveys may miss presence information across other seasons and time frames. Repeat surveys in other seasons supplemented by camera traps or genetic analysis of spraints would be essential for better assessing the status of Eurasian otters to ensure their long-term conservation. Extensive awareness programs among local communities and local fisher folk will also be critical. Given that the otter species and riverine ecosystem are increasingly threatened by dam construction, stringent implementation of environmental policies will be important in safeguarding the remnant population of these species.

Acknowledgments - *We thank the Department of National Park and Wildlife Conservation, the Department of Forest and Soil Conservation, and the National Trust for Nature Conservation for permitting us to conduct this study. We are grateful to the Rufford Foundation for funding. Special thanks go to the Division Forest Office of Myagdi District for providing the permit and supporting our work. We are thankful to Prof. Dr. Melissa Savage, Gopal Khanal, and Mohan Bikram Shrestha for their constructive suggestions and guidance during the manuscript preparation processes. Thanks is also to the Wildlife Research and Education Network for their support.*

REFERENCES

Anoop, K.R. & Hussain, S.A. (2004). Factors affecting habitat selection by smooth-coated otters (*Lutra perspicillata*) in Kerala, India. *Journal of Zoology*. **263**: 417–423. https://doi.org/10.1017/S0952836904005461

Barton, K. (2009). MuMIn: multi-model inference. R package version 1. 0. 0. http://mumin.r-forge.r-project.org/

Basak, S., Pandav, B., Johnson, J.A. & Hussain, S.A. (2021). Resource utilization by smooth-coated otter in the rivers of Himalayan foothills in Uttarakhand, India. *Global Ecology and Conservation*. **32**: e01896. https://doi.org/10.1016/j.gecco.2021.e01896

Basnet, A., Bist, B. S., Ghimire, P., & Acharya, P. M. (2020a). Eurasian Otter (*Lutra lutra*): Exploring evidence in Nepal. *IUCN Otter Spec. Group Bull.* **37**(1): 29-37. https://www.iucnosgbull.org/Volume37/Basnet_et_al_2020.html

Basnet, A., Ghimire, P., Timilsina, Y. P., & Bist, B. S. (2020b). Otter research in Asia: Trends, biases and future directions. *Global Ecology and Conservation.* **24**: e01391. https://doi.org/10.1016/j.gecco.2020.e01391

Bowerman, B. L., & O'Connell, R. T. (1990). *Linear statistical models: An applied approach.* Duxbury Press 2nd Edn. https://lccn.loc.gov/89016367

Burnham, K. P., & Anderson, D. R. (2004). Multimodel inference: understanding AIC and BIC in model selection. *Sociological Methods & Research*. **33**(2): 261-304. https://doi.org/10.1177/0049124104268644

Chettri, P., & Savage, M. (2014). A distribution survey for otters along a river in Central Bhutan. *IUCN Otter Spec. Group Bull.* **31**(2): 65-74. https://www.iucnosgbull.org/Volume31/Chettri_Savage_2014.html

Conroy, J., Melisch, R., & Chanin, P. (1998). The distribution and status of the Eurasian Otter (*Lutra lutra*) in Asia - a preliminary review. *IUCN Otter Specs. Group Bull.* **15**(1): 15-30. https://www.iucnosgbull.org/Volume15/Conroy_et_al_1998.html

de Silva, P. K. (2011). Status of otter species in the Asian region status for 2007. In *Proceedings of Xth International Otter Colloquium, Hwacheon South Korea. IUCN Otter Spec. Group Bull.* **28A**: 97-107. https://www.iucnosgbull.org/Volume28A/de_Silva_2011.html

Dudgeon, D., Arthington, A. H., Gessner, M. O., Kawabata, Z.-I., Knowler, D. J., Lévêque, C. et al. (2006). Freshwater biodiversity: Importance, threats, status and conservation challenges. *Biological Reviews.* **81**(2): 163–182. https://doi.org/10.1017/S1464793105006950

Duplaix, N. & Savage, M. (2022). *The Global Otter Conservation Strategy.* IUCN/SSC Otter Specialist Group, Salem, Oregon, USA. https://www.otterspecialistgroup.org/osg-newsite/wp-content/uploads/2018/12/IUCN-Otter-Report-DEC%2012%20final_small.pdf

Hussain, S. A., & Choudhury, B. C. (1997). Distribution and status of the smooth-coated otter *Lutra perspicillata* in National Chambal Sanctuary, India. *Biological Conservation.* **80**(2): 199-206. https://doi.org/10.1016/S0006-3207(96)00033-X

Hutchings, M. R., & White, P. C. (2000). Mustelid scent-marking in managed ecosystems: implications for population management. *Mammal Review*. **30**(3-4): 157-169. https://doi.org/10.1046/j.1365-2907.2000.00065.x

Jamwal, P. S., Di Febbraro, M., Carranza, M. L., Savage, M., & Loy, A. (2022). Global change on the roof of the world: Vulnerability of Himalayan otter species to land use and climate alterations. *Diversity and Distributions*. **28**(8): 1635–1649. https://doi.org/10.1111/ddi.13377

Jamwal, P. S., Takpa, J., Chandan, P. & Savage, M. (2016). First systematic survey for otter (*Lutra lutra*) in Ladakh, Indian Trans Himalayas. *IUCN Otter Spec. Group Bull*. **33**(1). 79-85. https://www.iucnosgbull.org/Volume33/Jamwal_et_al_2016.html

Loy, A., Kranz, A., Oleynikov, A., Roos, A., Savage, M. & Duplaix, N. (2022). *Lutra lutra* (amended version of 2021 assessment). The IUCN Red List of Threatened Species 2022: e.T12419A218069689. https://dx.doi.org/10.2305/IUCN.UK.2022-2.RLTS.T12419A218069689.en

Loy, A., Jamwal, P.S. & Hussain, S.A. (2021). *Lutra lutra* (Green Status assessment). The IUCN Red List of Threatened Species 2021, e.T12419A1241920221. https://www.iucnredlist.org/species/12419/218069689

Macdonald, S. M., & Mason, C. F. (1983). Some factors influencing the distribution of otters (*Lutra lutra*). Mammal Review. **13**(1): 1-10. https://doi.org/10.1111/j.1365-2907.1983.tb00259.x

Mason, C. F., & Macdonald, S. M. (1987). The use of spraints for surveying otter *Lutra lutra* populations: an Evaluation. *Biological Conservation*. **41**(3): 167-177. https://doi.org/10.1016/0006-3207(87)90100-5

Nawab, A., & Hussain, S. A. (2012). Factors affecting the occurrence of smooth-coated otter in aquatic systems of the Upper Gangetic Plains, India. *Aquatic Conservation: Marine and Freshwater Ecosystems*. **22**(5). 616-625. https://doi.org/10.1002/aqc.2253

Pereira, L. S., Cordery, I. & Iacovides, I. (2009). *Coping with Water Scarcity: Addressing the Challenges*. Springer Science & Business Media. https://doi.org/10.1007/978-1-4020-9579-5

Prenda, J., Lpez-Nieves, P. & Bravo, R. (2001). Conservation of otter (*Lutra lutra*) in a Mediterranean area: The importance of habitat quality and temporal variation in water availability. *Aquatic Conservation: Marine and Freshwater Ecosystems*. **11**(5): 343–355. https://doi.org/10.1002/aqc.454

R Core Team (2023). *A Language and Environment for Statistical Computing.* R Foundation for Statistical Computing, Vienna, Austria. https://www.r-project.org/

Raha, A. & Hussain, S. A. (2016). Factors affecting habitat selection by three sympatric otter species in the southern Western Ghats, India. *Acta Ecologica Sinica.* **36**(1): 45-49. https://doi.org/10.1016/j.chnaes.2015.12.002

Romanowski, J., Brzeziński, M. & Żmihorski, M. (2013). Habitat correlates of the Eurasian otter *Lutra lutra* recolonizing Central Poland. *ActaTheriol*. **58**: 149-155. https://doi.org/10.1007/s13364-012-0107-8

Sala, O. E., Chapin, S., Iii, F., Armesto, J. J., Berlow, E., Bloomfield, J., Dirzo, R. et al. (2000). Global Biodiversity Scenarios for the Year 2100. *Science.* **287**(5459): 1770–1774. https://doi.org/10.1126/science.287.5459.1770

Shrestha, M. B., Shrestha, G., Maharjan, M. & Shah, K. (2023). An unusual sighting record of Eurasian otter (*Lutra lutra*) in Kathmandu Valley, Nepal. *OTTER*, *Journal of the International Otter Survival Fund*, **9**: 64-71. https://www.otter.org/s/13891-IOSF-JOURNAL-2023_web.pdf

Shrestha, M. B., Shrestha, G., Reule, S., Oli, S. & Ghartimagar, T. (2022). Presence of evidence and factors affecting distribution of Eurasian otter (*Lutra lutra*) in the Pelma River, Rukum East, Nepal. *OTTER, Journal of the International Otter Survival Fund*, **8:** 70-83. https://www.otter.org/s/Volume-8.pdf

Shrestha, M. B., Shrestha, G., Reule, S., Oli, S., Tripathi, D.M., & Savage, M. (2021a). Otter survey along the Sanibheri River and its Tributaries, the Pelma and Utterganga Rivers in Rukum District, Western Nepal. *IUCN Otter Spec. Group Bull.* **38** (5): 267 - 278. https://www.iucnosgbull.org/Volume38/Shrestha_et_al_2021a.html

Shrestha, M. B., Shrestha, G., Reule, S., Oli, S., Ghartimagar, T. B., Singh, G. et al. (2021b). First evidence of Eurasian Otter in Nepal in three decades. *IUCN Otter Spec. Group Bull.* **38**(5): 279–291. https://www.iucnosgbull.org/Volume38/Shrestha_et_al_2021b.html

Sittenthaler, M., Schöll, E. M., Leeb, C., Haring, E., Parz-Gollner, R. & Hackländer, K. (2020). Marking behaviour and census of Eurasian otters (*Lutra lutra*) in riverine habitats: What can scat abundances and non-invasive genetic sampling tell us about otter numbers? *Mammal Research*. **65**(2): 191-202. https://doi.org/10.1007/s13364-020-00486-y

Talegaonkar, R., Salaria, S., Bhargava, D., Jena, J., Rahul, S. K., Dhamorikar, A. et al. (2021). Habitat use by the Eurasian Otter (*Lutra lutra* Linnaeus 1758) in a Non-Protected Area of Madhya Pradesh, India. *IUCN Otter Spec. Group Bull.* **38**(4): 217-227. https://www.iucnosgbull.org/Volume38/Talegaonkar_et_al_2021.html

Wang, Q.-Y., Zheng, K.-D., Han, X.-S., He, F., Zhao, X., Fan, P.-F. et al. (2021). Site-specific and seasonal variation in habitat use of Eurasian otters (*Lutra lutra*) in western China: Implications for conservation. *Zoological Research*. **42**(6): 825-832. http://dx.doi.org/10.24272/j.issn.2095-8137.2021.238

Yoxon, P. & Yoxon, K. (2014). Estimating otter numbers using spraints: Is it possible? *Journal of Marine Sciences*. **(1):** 430683. https://doi.org/10.1155/2014/430683

Yoxon, P. & Yoxon, B. (2019). Eurasian otter (*Lutra lutra*): A review of the current world status. *OTTER, Journal of the International Otter Survival Fund*. **5**: 53-73. https://www.otter.org/s/volume-5.pdf

RÉSUMÉ: FACTEURS DE L'HABITAT INFLUENÇANT LA DISTRIBUTION DE LA LOUTRE D'EURASIE (*Lutra lutra*) DANS LES PRINCIPALES RIVIÈRES DU DISTRICT DE MYAGDI, AU NÉPAL

La pression croissante sur les écosystèmes aquatiques de la région himalayenne a soulevé des inquiétudes alarmantes pour la conservation des loutres d'Eurasie. Cependant, les connaissances limitées sur leur abondance, leur distribution et leur écologie ont empêché leur conservation fondée sur des données fiables au Népal. Dans cette étude, nous avons examiné les variables d'habitat associées à la distribution des loutres d'Eurasie dans la zone du bassin versant de Kali Gandaki dans le district de Myagdi au Népal. Une étude des indices de présence a été menée dans trois rivières canalisées afin définir la distribution des espèces. Au total, 87 transects de 100 m de long chacun, ont été étudiés et les épreintes détectées en dehors des transects enregistrées. Une analyse prédictive a été développée à l'aide d'un modèle de régression logistique pour identifier les facteurs affectant la probabilité de rencontre des indices de présence. Un total de 45 épreintes ont été détectées dans trois rivières (rivière Mygdi = 41, rivière Kali Gandaki = 2 et rivière Rahuganga = 2) et la densité d'épreintes estimée à 0,51 indice/km. La proéminence, la distance de fuite vers un refuge, les petites et grosses pierres étaient les variables significatives, toutes négativement corrélées à la probabilité de détection de l'épreinte dans le modèle de régression logistique. Nos résultats suggèrent que la population de loutres eurasiennes dans la région est relativement faible et fortement menacée par les activités humaines. En conséquence, nous suggérons une étude urgente de la population à l'aide de pièges photographiques ou d'analyses génétiques et des activités de conservation adaptées dans le périmètre la rivière Kali Gandaki en vue de la survie de l'espèce à long terme.

RESUMEN: FACTORES DE HÁBITAT QUE INFLUYEN EN LA DISTRIBUCIÓN DE LA NUTRIA EURASIÁTICA (*Lutra lutra*) EN LOS PRINCIPALES RÍOS DEL DISTRITO MYAGDI, NEPAL

La creciente presión sobre los ecosistemas acuáticas en la región del Himalaya causó preocupaciones y alarma para la conservación de las nutrias Eurasiáticas. Sin embargo, el conocimiento limitado de su abundancia, distribución, y ecología ha frenado su conservación basada en evidencia, en Nepal. En este estudio, examinamos las variables de hábitat asociadas a la distribución de las nutrias Eurasiáticas en el área de la cuenca Kali Gandaki, en el Distrito Myagdi de Nepal. Fue conducido un relevamiento de signos en tres canales fluviales para documental la distribución de la especie. Se relevaron en total 87 transectas, cada una de 100m de longitud, y se registraron también las fecas detectadas por fuera de las transectas. Se desarrolló un modelo predictivo usando un modelo de regresión logística para identificar los factores que afectan a la probabilidad de encontrar signos. Se detectó un total de 45 fecas, en tres ríos (Río Mygdi=41, Río Kali Gandaki=2, y Río Rahuganga=2), y la densidad estimada de fecas fue 0.51 signos/km. Las variables significativas fueron la elevación, la distancia de escape a cobertura, y las rocas pequeñas y grandes, todas asociadas negativamente con la probabilidad de detcción de fecas en el modelo de regresión logística. Nuestros resultados sugieren que la población de nutrias Eurasiáticas en el área es relativamente baja y está severamente amenazada por las actividades humanas. Por lo tanto, sugerimos un inmediato relevamiento poblacional con ayuda de cámaras-trampa y análisis genéticos, y actividades de conservación dirigidas, en el área del Río Kali Gandaki, para la supervivencia de la especie a largo plazo.