Otter Distribution and Occupancy along the forest streams of Pench Tiger Reserve, Maharashtra

Technical Report

2023

Pench Tiger Reserve
MAHARASHTRA

Wildlife Conservation Trust

Wildlife Conservation Trust

1103, 11th Floor P.J. Tower,
Bombay Stock Exchange,
Mumbai- 400021,
Maharashtra, India

Citation: **Gaidhani, P., Tumsare, V., Jathar, V., Krishna, A., Joshi, A., and Srinivas, V. (2023) Otter Distribution and Occupancy along the forest streams of Pench Tiger Reserve, Maharashtra. Technical Report. Wildlife Conservation Trust**

Image Credits: Anuj Krishna, Vikrant Jathar, Vivek Tumsare, Dheeraj Nagwanshi and Prasad Gaidhani

CONTENTS

ACKNOWLEDGMENTS 1
INTRODUCTION: 2
STUDY AREA: 4
OBJECTIVES 6
ACTIVITIES 6
A. Capacity building and on-field training of frontline staff on otter ecology: 7
B. Occupancy Surveys 10
C. Estimating the probability of occurrence: 14
RESULTS: 15
DISCUSSION: 19
REFERENCES 21

ACKNOWLEDGMENTS

We thank the Chief Wildlife Warden and PCCF of Maharashtra.

We express our most sincere gratitude to Dr. Prabhunath Shukla, The Field Director, of Pench Tiger Reserve, Maharashtra for giving us this opportunity to carry out this survey.

We thank the Astral Foundation and Alkyl Amines for supporting this project.

We thank Shri D. S. Bharati, ACF (West Pench), and Smt P. S. Limbgaonkar, ACF (East Pench) for their valuable assistance.

We extend our heartfelt appreciation to -

Shri V. B. Rajurkar, RFO, East Pench Forest Range

Shri P. R. Lele, RFO, Nagalwadi Forest Range

Shri V. S. Chavan, RFO, West Pench Forest Range

Shri A. B. Ilamkar, RFO, Deolapar Forest Range

Shri J. R. Tayade, RFO, Paoni Forest Range

Shri S. B. Mohod, Saleghat Forest Range

Shri R. M. Shinde, Chorbahuli Forest Range

for their invaluable and timely support, along with the logical assistance.

We thank Shri Ishwar Uikey and Shri Sohail Sheikh for their unwavering support to the WCT team during the project fieldwork.

We want to thank all the Round Officers, Forest Guards and Forest Watchers for their timely support and logistical assistance.

The dedication and cooperation of the field staff from diverse administrative units within the Pench Tiger Reserve were instrumental in facilitating the WCT field team with the necessary support, playing a crucial role in the successful completion of the tasks involved in the project. Their unwavering commitment and collaborative efforts are deeply acknowledged.

INTRODUCTION:

Otters are charismatic and elusive semi-aquatic mammals that inhabit freshwater ecosystems. Their sensitivity to environmental changes makes otters essential indicators of environmental health and thus understanding their status is crucial for conservation efforts of freshwater ecosystems.

India harbours three species of otters, namely, the smooth-coated otter (*Lutrogale perspicillata*), the Asian small-clawed otter (*Aonyx cinerea*), and the Eurasian otter (*Lutra lutra*). Two species of otters, the Smooth-coated otter and the Eurasian otter have been reported from the central Indian landscape. (Khoo et al., 2021, Joshi et al., 2016, Menon 2014). Smooth-coated otters are usually found in groups with varying sizes of the group between the different seasons (Hussain 1996) and are usually found in plain areas. Generally, the species uses large rivers and lakes, peat swamps, mangroves, estuaries, and rice fields for foraging (Foster-Turley 1992). Whereas Eurasian otters are solitary and are known to use a wide range of habitats throughout their distribution range. In India, Eurasian otters occur in cold hill and mountain streams. They prefer narrow perennial streams with a high percentage of boulder and vegetation cover on the stream banks which allows them to access the streams without exposing them to predators (Talegaonkar et al., 2021).

The recent discovery of the Eurasian otter from the Central Indian Landscape shows that the currently known geographical distribution of otters, especially in the Central Indian landscape and the drier regions of the peninsula, is due to the lack of adequate sampling coverage. This new evidence shows that there is a high likelihood of other river systems supporting otter populations in the central Indian landscape.

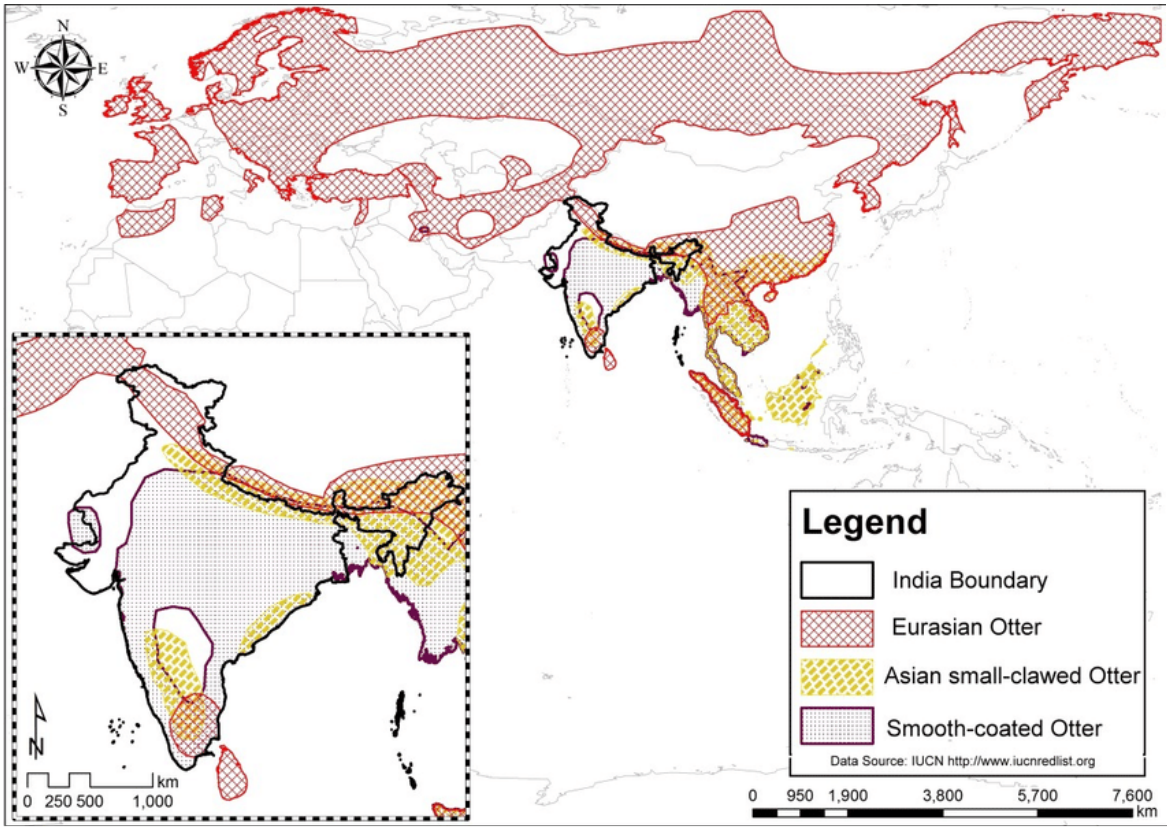


Figure 1: Map showing the distribution range for the Eurasian otter, Asian small-clawed otter, and Smooth-coated otter as per the last IUCN assessment.

Map (figure 1) shows the distribution range of Eurasian otters, Asian small-clawed otters, and Smooth-coated otters as per the IUCN data. The map doesn't show the Eurasian otter in the central Indian landscape which was later updated in the IUCN assessment amendment version 2022 (Loy et al., 2022) after the recently reported records from central India. The IUCN green status assessment shows a large decline in the Eurasian otter population. This highlights the urgent need for conservation efforts to protect this species.

The Pench Tiger Reserve lies in the heart of the central Indian tiger landscape. The network of forest streams/rivers feeding Pench and the lower Pench reservoir are potential sites for otters in this landscape. Gathering baseline information on indicator species like otters in a forest hydrological system is crucial for understanding the complex interactions between forests, water, and biodiversity. Since there are no systematic surveys carried out to document the status of otters in Pench Tiger Reserve, we started with the first phase of this project to fill this lacuna.

STUDY AREA:

Pench National Park was declared by the Government of Maharashtra in 1975. Later, in 1999 it was declared as the 25th Tiger Reserve of India with 439.42 sq. km of core and 301 sq. km of buffer area comprising a total area of 741.41 sq. km. (Yadav et al., 2023). It derived its name from the river Pench which flows through the park and divides it into two parts, East Pench and West Pench. Meghdoot dam was built on the Pench River at Totladoh which is spread across 72 sq. km area. The forest of Pench Tiger Reserve, Maharashtra, and Pench Tiger Reserve, Madhya Pradesh play a crucial role by providing the major undisturbed catchment for the dam. Pench River is also known as the lifeline of Nagpur city for providing water.

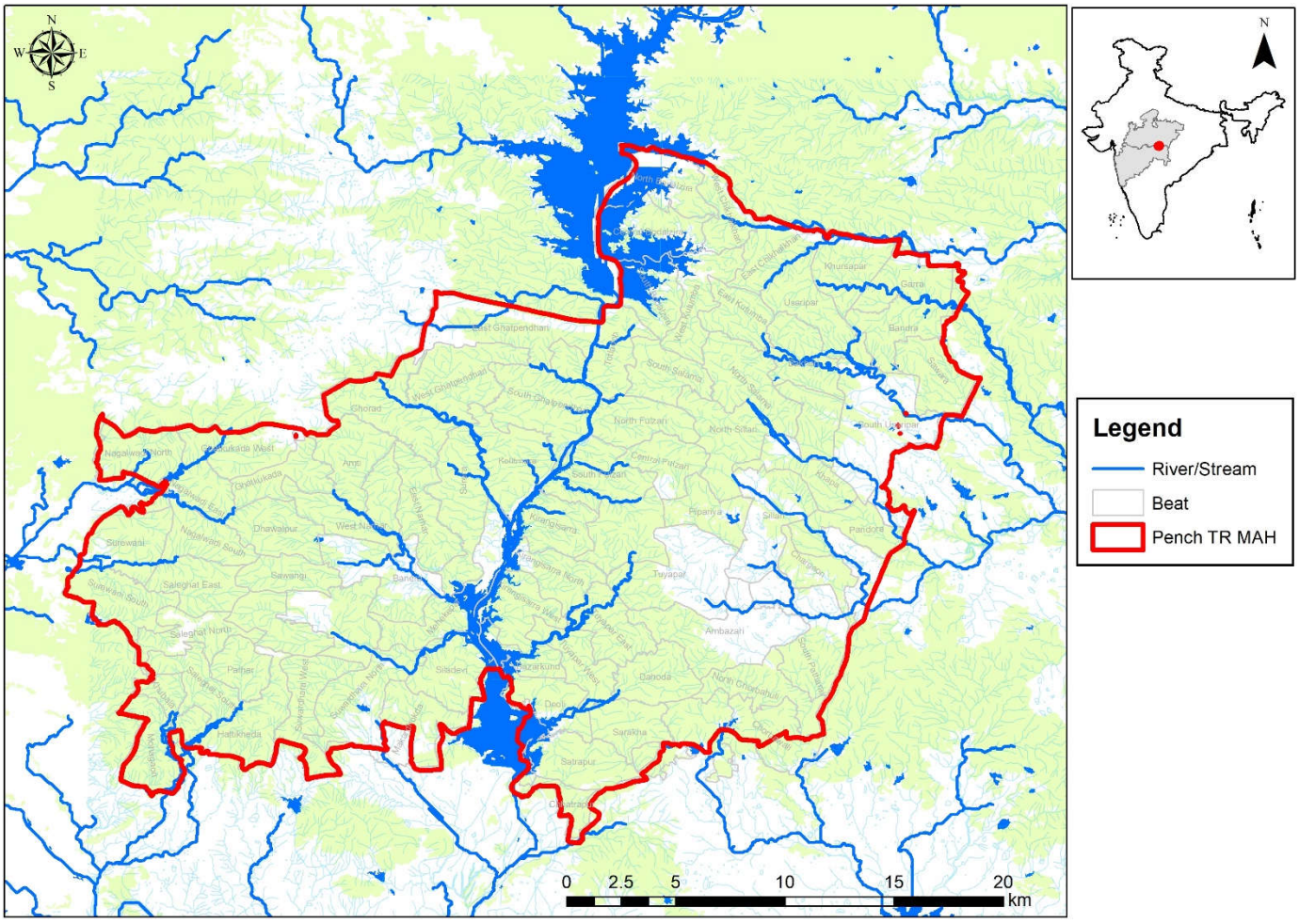


Figure 2: Map showing the rivers/streams in the Pench TR (MAH).

Pench National Park resides on the southern slopes of the Satpura ranges in the Central Indian Landscape. The undulating terrain provides a suitable mixed habitat with the composition of moist deciduous forest, Southern Tropical Dry Deciduous Forest, (Yadav et al., 2023). Heterogeneity in the habitat makes the landscape rich in wildlife. It harbours 1001 species of angiosperm, 71 species of mammal, 310 species of birds, and 53 species of reptiles have been reported. (Yadav et al., 2023).

Based on available literature and existing ecological knowledge of otters, we identified potential forest streams within the Pench TR. The study area comprises the Pench River, its tributaries, and other forest streams.

OBJECTIVES

The primary objective of Phase I of the project was to estimate the current occupancy of otters within the Pench Tiger Reserve and determine factors that influence their occupancy. Additionally, our objective was to build the capacities of front-line staff to carry out systematic scientific surveys to assess the status of otters within the tiger reserve.

ACTIVITIES

A. Capacity building and on-field training of frontline staff on otter ecology.

B. Occupancy surveys.

C. Estimating the probability of occurrence of otters in the study area.

A. Capacity building and on-field training of frontline staff on otter ecology:

Forest hydrology and surveys for aquatic/semi-aquatic species is a relatively new field for most of the staff of the Tiger Reserves in the Central India Landscape.

We conducted workshops for the frontline staff of the Pench TR focusing on otter ecology, habitats and hydrological monitoring of streams/rivers. The workshops were conducted on 20/10/2023 at Sillari and 22/10/2023 at Kolitmara.

The participants were introduced to the ecology of otters, their habitat preference, identification of tracks and signs, camera trapping techniques for studying small mammals, and habitat assessment techniques. This was followed by an open discussion where all the front-line staff shared their insights and knowledge about the otter followed by the question answer session.

The staff also collected data for the habitat assessment survey in their respective beats, where they got hands-on experience in conducting field surveys.

Figure 3: Workshops were conducted for front-line forest staff at Kolitmara.

Figure 4: Workshops were conducted for front-line forest staff at Sillari.

Frontline staff from the below-mentioned beats were involved in the workshop:

Totaladoh, South & East Ghatpendhari, North Fulzari, South Fulzari, Central Fulzari, East & West Tuyapar, Tuyapar, Deoli, Sarakha,Deoli,Sarakha, Dahoda, North & South Salama, Khapa, Bakhari, East Kutumba, Usaripar, South Usaripar, Garra, Khursapar, West & East Chikhalkhari, Kolitmara, Kirangisarra, North & West kirangisarra, Bazarkund, Hattikheda, Mohgaon, Khubala, Surewani, South, East & North Nagalwadi, West Ghatkukada, West Narhar, Amti, Ghorad.

B. Occupancy Surveys

A total of 155km of stream/river length was identified using the Geographic Information System (GIS) for the current survey. For sampling, each stream was divided into 3km segments. Each of these segments was considered as a sampling unit.

To understand the factors affecting otter presence, we collected various covariates that would influence their presence within the stream/river. This data was collected by walking along the sampling units and recording covariates that include habitat characteristics. These habitats were categorized as pool, run, riffle, and the presence of large refuge pools.

Data was collected on pool dimensions (length, width, and depth) to understand the water availability and connectivity between the upstream and downstream segments. Channel depth was recorded using depth finders for each segment. 18 depth measurements at fixed intervals were recorded within each 3 km river segment to get the mean depth of each river segment. Channel width measurement was recorded using the laser finder at 500 m intervals.

Riverbed substrate was recorded at 500 m intervals. The substrate was classified as soil and mud, sand, gravel, cobble, and rock bed.

Using ocular estimation, the bolder cover and vegetation cover were categorized into 4 categories which are “absent, sparse, moderate, and dense”.

Along with these detailed habitat covariates, we collected data on otter signs to confirm the presence of otters in each of the marked river segments. Signs such as spraint (otter scat), spoor slide (otter pug mark), halt (otter den), etc. were recorded. The sign survey helped to gain a primary insight into the distribution pattern of the animal and to identify the most suitable locations to install camera traps.

Using the information from the sign survey, we finalized camera trapping sites within each stream/river segment. IR camera traps were deployed on suitable sites where the probability of otter capture was maximum. Each segment had 2 cameras deployed equidistant from each other. Camera traps were deployed for 30 days and each day (00:00 hrs. – 23:59 hrs.) was considered as a temporal sampling replicate for occupancy analysis.

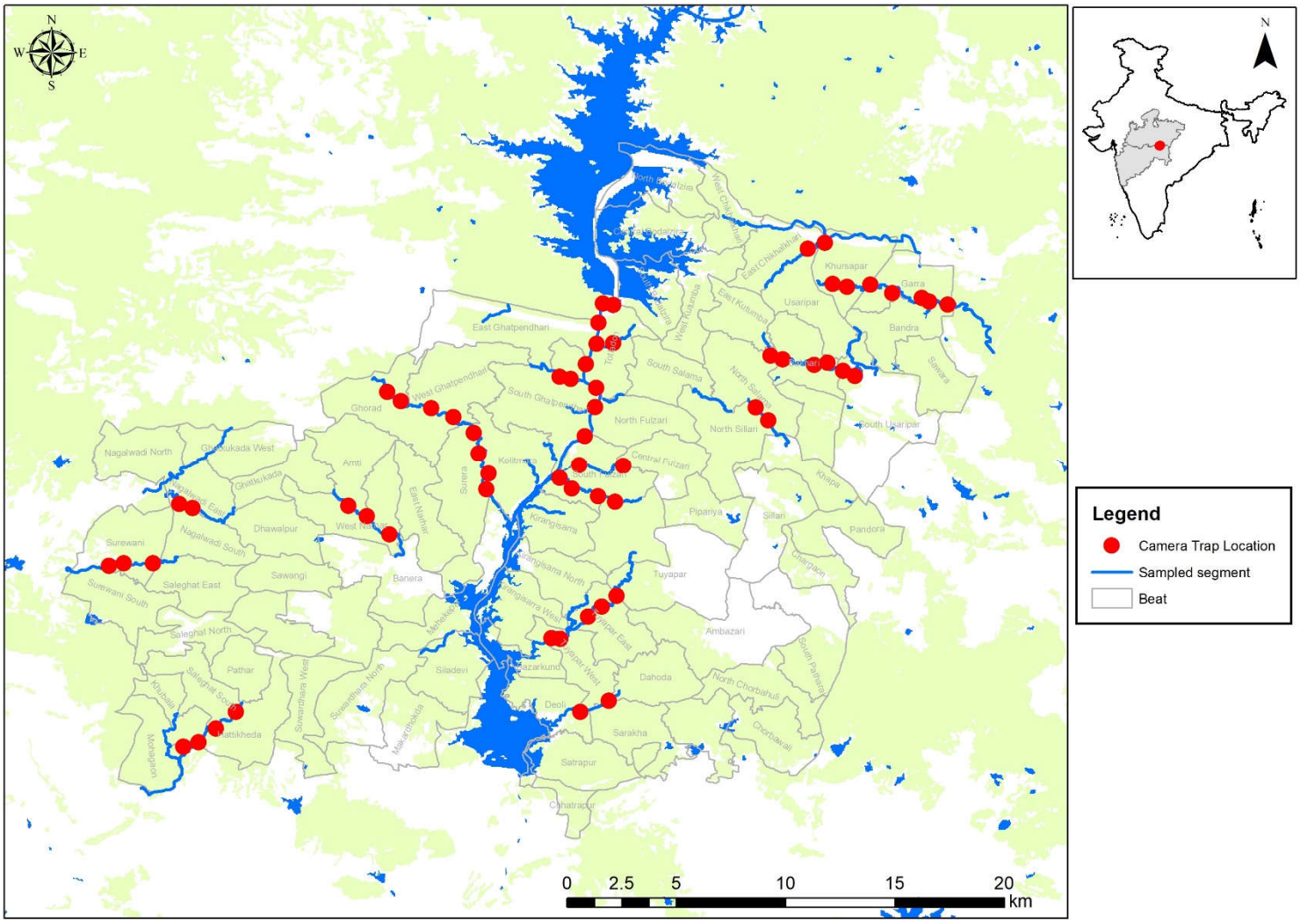


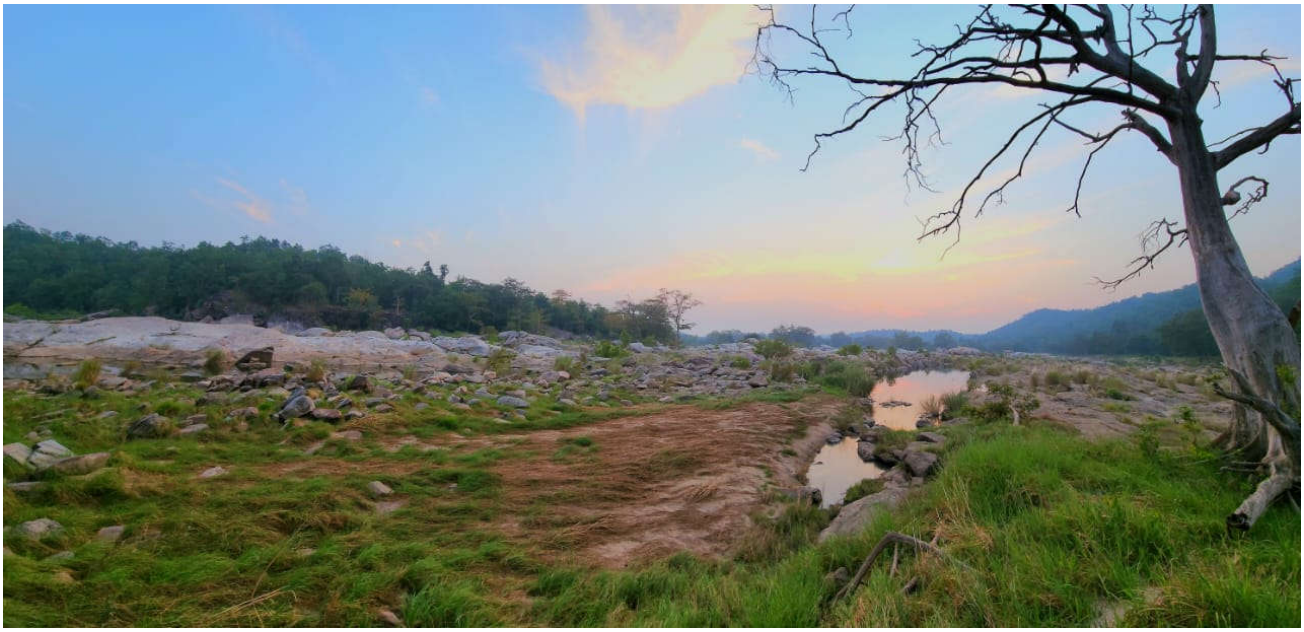
Figure 5: Map showing the sampled segments and camera trap locations.

Figure 6: Overnight, the gates of Meghdoot Dam (Totladoh) were opened without any notice due to an emergency water requirement for the lower Pench dam. This led to the flooding of the Pench River, causing unexpected damage to the camera traps installed in the river, resulting in a loss of data.

C. Estimating the probability of occurrence:

We used the occupancy framework (MacKenzie, 2006; MacKenzie et al., 2002, 2003) to estimate the probability of otter occurrence from replicated detection/non–detection data. Each sampling day was considered as a replicate for the present analysis. Under this framework, the probability of detecting a species (p) in each river segment can be estimated as a function of sampling covariates (number of functional camera traps) and the probability of use Ψ (psi) can similarly modeled as a function of site level covariates. The likelihood formulation to estimate p and psi with the use of covariates has been presented elsewhere (see MacKenzie et al., (2002) for details).

We carried out the above analyses in the statistical software R (R Core Team, 2023), using the library unmarked (Fiske & Chandler, 2011). We first modeled the detection process as a function of effort and keeping the occupancy constant. After accounting for detectability, we modeled the probability of occupancy by keeping the detection covariates constant. The top model with the lowest AIC score was used to derive robust estimates of the probability of occupancy (Burnham & Anderson, 2002). We did not consider models that did not converge due to small sample size and stepwise additive models were only explored by adding one more covariate to the best model.



RESULTS:

As per the study design, we evaluated the collected data for habitat covariate and substrate covariate at the segment level. For binary covariates, we calculated the median, and for categorical covariates, we calculated the mode. Based on this information, we developed an index ranging from 0 to 1 for binary covariates and 0 to 3 for categorical covariates. As channel width and water depth are continuous values, they were represented using an open-ended graph.

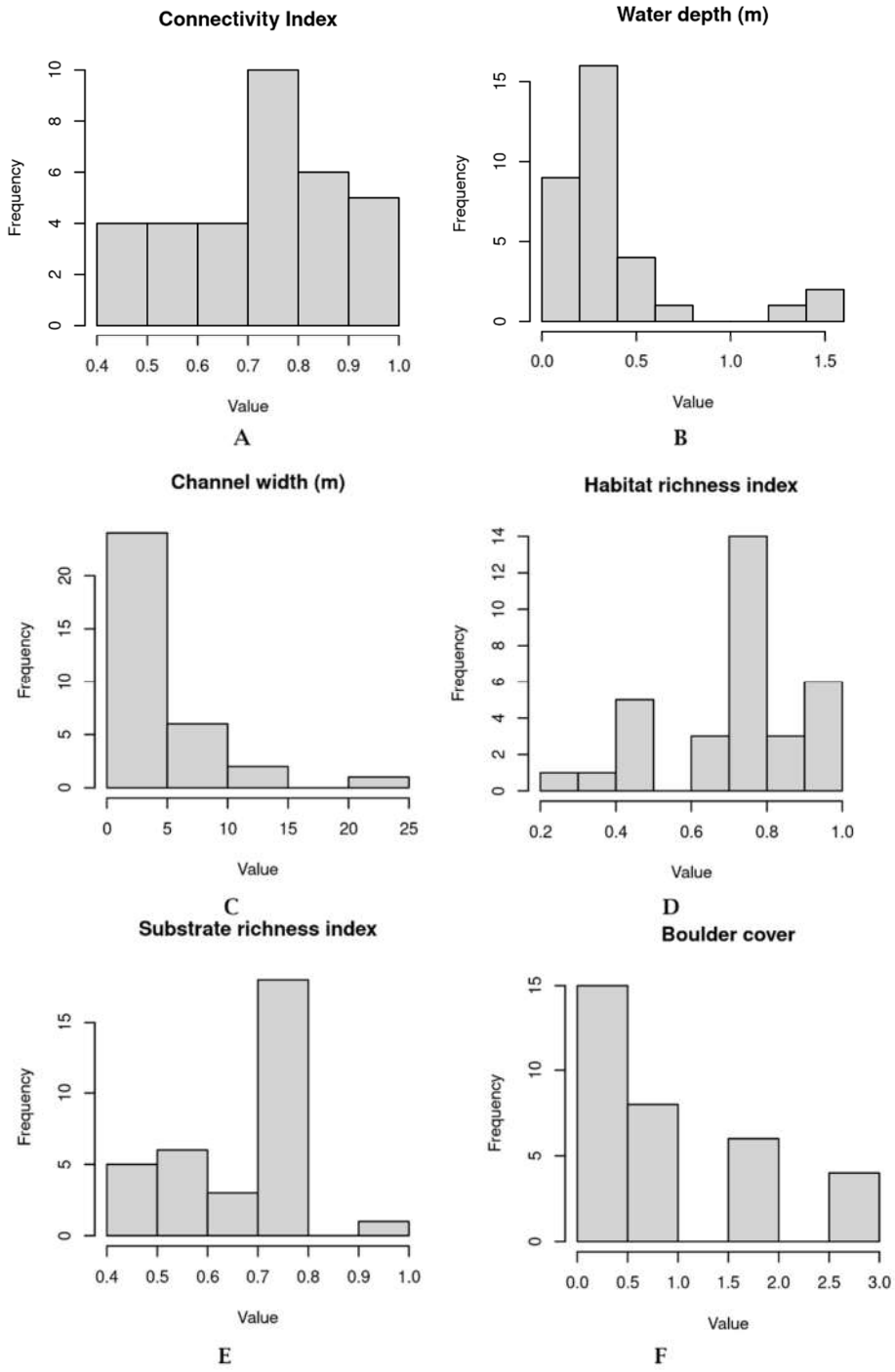


Figure 7: Histograms of various covariates recorded during the survey.

(A) Connectivity index represents the presence of flowing water availability which facilitates otter movement across the sampled rivers/streams. Based on the current post-monsoon survey, most of the streams had flowing water and provided medium connectivity for otter movement.

However, graph (B) shows that the median water depth in each segment of the sampled streams/rivers was less than half a meter. The lack of deep pools can potentially restrict the presence and movement of otters during the post-monsoon season.

Similarly, graph (C) shows the median channel width which was less than 5 meters for most of the streams/rivers in the study area.

Habitat richness (D) and substrate richness (E) were high for most of the streams/rivers in the study area.

A total of 155 km of stream network was identified to carry out occupancy surveys. Out of this only 33 segments with water during the sampling period and only those were considered for camera trap surveys. A total of 4133 photos/videos were recorded during the 30 days of camera trap surveys. We recorded 7 instances of Eurasian otters during the sampling period, which translates to a naive occupancy of 0.030. We did not record any evidence of smooth-coated otters during this survey.

Model	AIC	delta	
p(effort),psi(.)	33.55584	0	
p(effort),psi(segment width)	35.55418	1.99834	*
p(effort),psi(substrate richness)	35.5543	1.99846	*
p(effort),psi(connectivity)	35.5547	1.99886	*
p(effort),psi(segment depth)	35.55514	1.9993	
p(effort),psi(habitat richness)	35.55696	2.00112	*
p(effort),psi(connectivity + segment depth)	37.5557	3.99986	*
p(effort),psi(boulder cover)	40.05648	6.50064	*
p(.),psi(.)	40.36979	6.81395	
p(effort),psi(segment depth + segment width)	41.26975	7.71391	*
p(.),psi(connectivity)	42.3669	8.81106	

Table 1: Table showing model selection for the occupancy estimates.

Table 1 shows the influence of covariates on detection probability and occupancy estimates. Models which did not converge due to a small sample size have been indicated with an "*". The detection probability was influenced by the sampling effort, which is the number of operational cameras per river segment.

Based on the camera trap survey, The probability of detecting otters was 0.239 (SE =0.0853). The naive occupancy estimate improves to 0.0326 (SE = 0.0321) after accounting for imperfect detection.

Otter occupancy was influenced by all the covariates we chose for this study. However, only the model with the median water depth of the segment converged providing meaningful results for consideration.

The best model for the given data included sampling effort (number of cameras/segment) as a covariate which influenced detection and occupancy was positively influenced by the median depth of the water within the segment. The overall estimate of occupancy of otters in Pench Tiger Reserve was 0.0909 (SE = 0.0282).

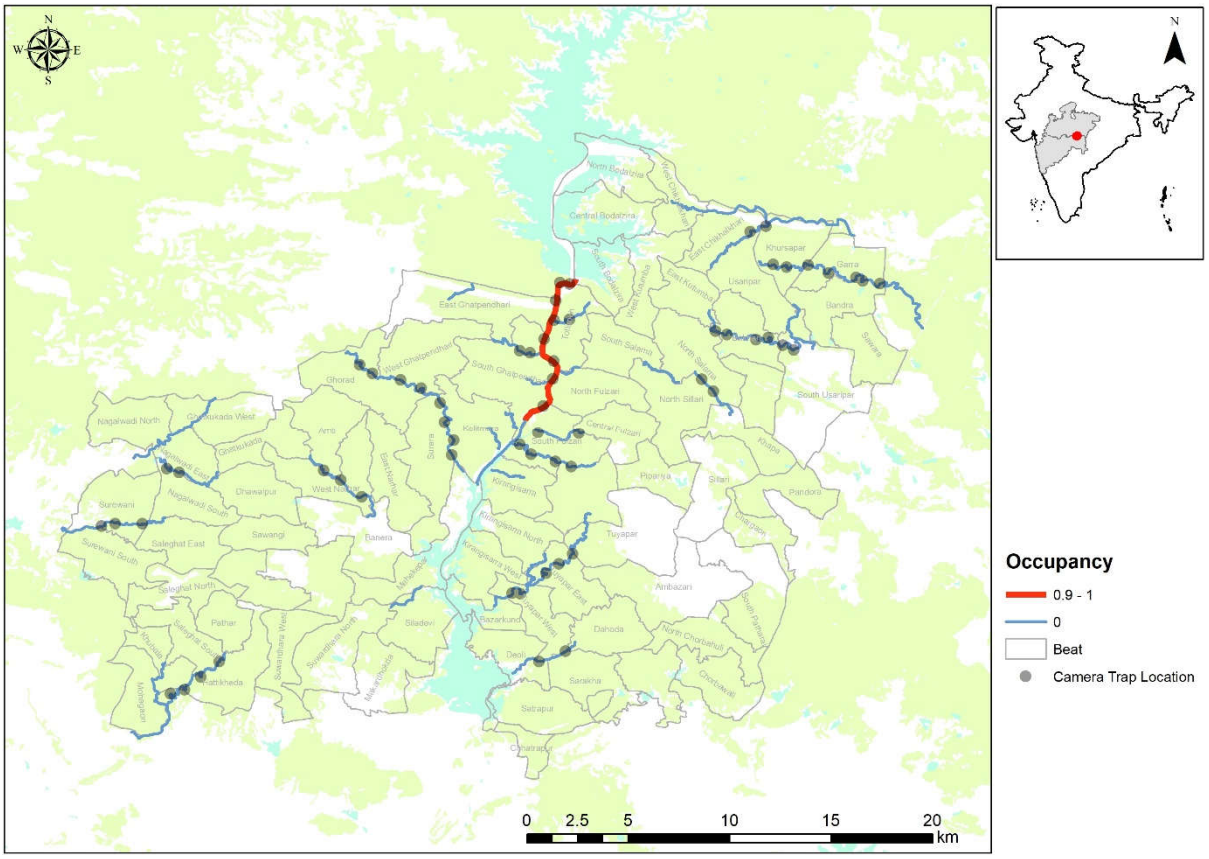


Figure 8: Map showing the otter occupancy estimates in the Pench TR.

Figure 9: Photo-captures of Eurasian otter from Pench TR (MAH)

DISCUSSION:

Eurasian otters are shy, and elusive and remained unnoticed in the Central Indian landscape for many decades. The known distribution for Eurasian otters in India was in the Himalayan foothills and the southern Western Ghats. In 2016, the first photographic record of the Eurasian otter in Central India was reported from Satpura Tiger Reserve (Joshi et al, 2016).

We sampled a length of 99 km out of 155 km of marked river segments using camera traps to estimate the occupancy of otters in the Pench Tiger Reserves. Nearly half the segments we had chosen for the camera trap survey were not sampled as they did not have flowing water/large pools.

The estimated occupancy (0.09) translates to ~ 9km of stream being occupied by otters, which is very low compared to the available habitat during the sampling period. The current result shows that the presence of deep pools or stream segments with deeper waters is the most preferred habitat by Eurasian otters. The median water depth in each segment of the sampled streams/rivers was less than half a meter. The lack of deep pools restricts the presence and movement of otters during the post-monsoon season.

Compared to the null model, the model without any covariates, most models with covariates did not converge due to the small sample size and due to the nature of detection. Detection of old spraints during the survey suggests that otters are relatively widely distributed during/just after the monsoon season. This suggests that the study can be improved by beginning the survey immediately after the monsoon when more streams are likely to have flowing water with more depth, improving the spatial distribution of otters.

The otter presence was recorded in the ~9km segment of the Pench River downstream of the Meghdoot dam. The seepage from the dam leads to flowing water and deep pools in the downstream region even in the dry season. In the dry season, this leads to a small stretch of suitable habitat available for otters between the Meghdoot and the Lower Pench dam.

In the monsoon season, better habitat connectivity and depth of water in the stream network leads to otter movement between the streams in the Madhya Pradesh section of Pench and the Bawanthadi Reservoir.

This finding of Eurasian otter from Pench Tiger Reserve is the first record of this species for the state of Maharashtra. These surveys have helped to understand the habitat preferences and

status of otters and their habitats in the Pench Tiger Reserve. Dry-deciduous forests are already characterized by limited water resources, and climate change exacerbates this scarcity.

We recommend multi-season long-term monitoring of otters and hydrological monitoring of streams/rivers in the Pench Tiger Reserve Maharashtra which will help us to understand the seasonal variation in the distribution pattern of otters and changes in water flow/discharge.

By examining the hydrological processes within these forests, we can identify how changing precipitation patterns and rising temperatures impact water availability. Monitoring indicator aquatic species like the Eurasian otter is critical for assessing the health and resilience of aquatic ecosystems within these dry-deciduous forest landscapes.

REFERENCES

Joshi, A.S., Tumsare, V.M., Nagar, A.K., Mishra, A.K., Pariwakam, M. P. (2016). Photographic Records of Eurasian Otter *Lutra lutra* from the Central Indian Landscape. IUCN Otter Spec. Group Bull. 33(1): 73-78.

Jena, J., Bhargava, D., Borah, J., Dey, S. (2016). Notes on the Occurrence of the Eurasian Otter (*Lutra lutra L.*) in the Forest of Balaghat, Madhya Pradesh, India. IUCN Otter Spec. Group Bull, 33(2): 59-63.

Menon, V. 2014. Indian Mammals: A Field Guide. Hachette Book Publishing India Pvt. Ltd.

Hussain, S.A. 1996. Group size, group structure and breeding in smooth-coated otter *Lutra perspicillata* Geoffroy in National Chambal Sanctuary. Mammalia 60(2): 289-297.

Foster-Turly, P. 1992. Conservation ecology of sympatric Asian otters *Aonyx cinerea* and *Lutra perspicillata*. Ph.D. Dissertation, University of Florida.

Talegaonkar, R., Salaria, S., Bhargava, D., Jena, J., Rahul, S.K., Dhamorikar, A. and Chanchani, P. (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

Yadav, S.P., Tiwari, V.R., Mallick, A, Garawad, R, Talukdar, G., Sultan, S., Ansari, N.A., Banerjee, K. and Das, A, 2023. Management Effectiveness Evaluation of Tiger Reserves in India, Fifth Cycle, 2022. Wildlife Institute of India, Dehradun and National Tiger Conservation Authority, Government of India.

Khoo, M., Basak, S., Sivasothi, N., de Silva, P.K. & Reza Lubis, I. 2021. *Lutrogale perspicillata*. The IUCN Red List of Threatened Species 2021: e.T12427A164579961. https://dx.doi.org/10.2305/IUCN.UK.2021-3.RLTS.T12427A164579961.en

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

Burnham, K. P., & Anderson, D. R. (2002). Model selection and multimodel inference: A practical information-theoretic approach. Springer Science & Business Media.

Fiske, I., & Chandler, R. (2011). unmarked: An R Package for Fitting Hierarchical Models of Wildlife Occurrence and Abundance. Journal of Statistical Software, 43(10). https://doi.org/10.18637/jss.v043.i10

MacKenzie, D. I. (2006). Occupancy estimation and modeling: Inferring patterns and dynamics of species occurrence. Academic Press.

MacKenzie, D. I., Nichols, J. D., Hines, J. E., Knutson, M. G., & Franklin, A. B. (2003). Estimating site occupancy, colonization, and local extinction when a species is detected imperfectly. Ecology, 84(8), 2200–2207.

MacKenzie, D. I., Nichols, J. D., Lachman, G. B., Droege, S., Andrew Royle, J., & Langtimm, C. A. (2002). Estimating site occupancy rates when detection probabilities are less than one. Ecology, 83(8), 2248–2255. https://doi.org/10.1890/0012-9658(2002)083[2248:ESORWD]2.0.CO;2

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

Wildlife Conservation Trust

www.wildlifeconservationtrust.org