NOTE FROM THE EDITOR

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Dear Friends, Colleagues and Otter Enthusiasts!

We have just closed a very successful year 2024 with 5 issues going online last year. At this moment and starting 2025 we do have already 2 issues fully complete and ready to go online. So there is really a lot to look forward to.

As we start a new year I want to thank all the reviewers from last year, namely Sunita Khatiwara, Melissa Savage, Aurobindo Samal, Syed Ainul Hussain, Andreas Kranz, Reza Lubis, Paras Acharya, Sebastien Cambier, Lamia Seddiki, Pushpinder Jamwal, Sanjan Thapa, Michael Somers, Janice Reed Smith, Chris Shepard, Lam Norbu, Suraj Kumar Dash, Muntasir Akash, Max Khoo, Kannadasan Narasimmarajan, Ferdi Andeska, Niloofar Sojdeh and Nisarg Prakash and potentially some I may have missed when collecting the names. Thnaks for your critical but supporting view on the manuscripts.

We had so many articles going online last year and I want to thank Gerad Schmidt and Claudio Chehebar for translating all titles and abstracts into French and Spanish. I know that this is a lot of work so my sincere thanks for these efforts. Additionally, I want to thank those of you who provided translations into the local languages. We offer this as a service and if it helps you in your daily work, we are happy to include them also in the future.

Having done meanwhile uncountable articles over so many years together with Lesley, I want to thank you, Lesley, on my own behalf but also on behalf of all otter scientists and otter friends, as without your dedication and time, this would have never been possible. Thank you so much and it is a pleasure to work with you!

S H O R T N O T E

CONFIRMATION OF THE PRESENCE OF ASIAN SMALL-CLAWED OTTER *Aonyx cinereus* IN NEPAL AFTER 185 YEARS

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Abstract: The Asian Small-clawed Otter has not been observed in Nepal since 1839. Because of a lack of evidence of the species over such a prolonged period, it has been sometimes suggested that it is extinct in the country. Here, we present the first photographic evidence of Asian Small-clawed Otter in Nepal in 185 years. In November 2024, a juvenile Asian Small-clawed Otter was captured at the confluence of Rangun Khola and Puntara Khola of Dadeldhura District in far-western Nepal, was nurtured in the Forest Office for a week before released to the wild. The presence of a juvenile otter implies the presence of other otter individuals in the area. This rare observation is a significant confirmation of the species presence in Nepal and warrants detailed study and conservation initiatives to conserve the species.

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Keywords: Asian Small-clawed Otter, rediscovery, Rangun Khola, Puntara Khola, Nepal

INTRODUCTION

Nepal has been said to be home to three species of otters, smooth-coated otter (*Lutrogale perspicillata*), Eurasian Otter (*Lutra lutra*) and Asian Small-clawed Otter (*Aonyx cinereus*) (Acharya and Rajbhandari, 2011). Confirmed evidence for the presence of Small-clawed Otters in Nepal has been lacking since the mid-19th century. The Asian Small-clawed Otter was last reported by Hodgson in 1939 (Hodgson, 1839). The Smooth-coated Otter has been the most studied Otter species of Nepal. Studies on Eurasian Otter is gaining momentum in recent years. The species' status was ambiguous for decades till was observed in the Barekot, Roshi and Tubang Rivers (Shrestha et al., 2021), in the Pelma River (Shrestha et al., 2022) and in area of Kathmandu Valley (Shrestha et al., 2023). In contrast, Asian Small-clawed Otter have not been recorded in Nepal; for more than a century and a half since 1839 (Acharya et al., 2023). Only anecdotal records from Nepal were in from Makalu Barun National Park, Kailali and Kapilvastu Districts (Jnawali et al., 2011). Globally categorized by the IUCN as Vulnerable (Wright et al., 2021) and listed as Data deficient species in National Red List Assessment of Mammals of Nepal (Jnawali et al., 2011). Deficient information on Asian Small-clawed Otter made its status in Nepal indeterminate (Jnawali et al., 2011).

OTTER SIGHTING SITE AND SPECIES IDENTIFICATION

In November 2024, a juvenile Asian Small-clawed Otter was sighted at the river junction of the Rangun Khola and its feeder stream the Puntara Khola at Parsuram Municipality-12 of Dadeldhura District in far-western Nepal (29.132819˚N 80.335374˚ E; 401m asl) (Fig. 1). Downstream, the Rangun Khola flows into the Mahakali River (also called as Sarada River) and then into the Karnali River in India.

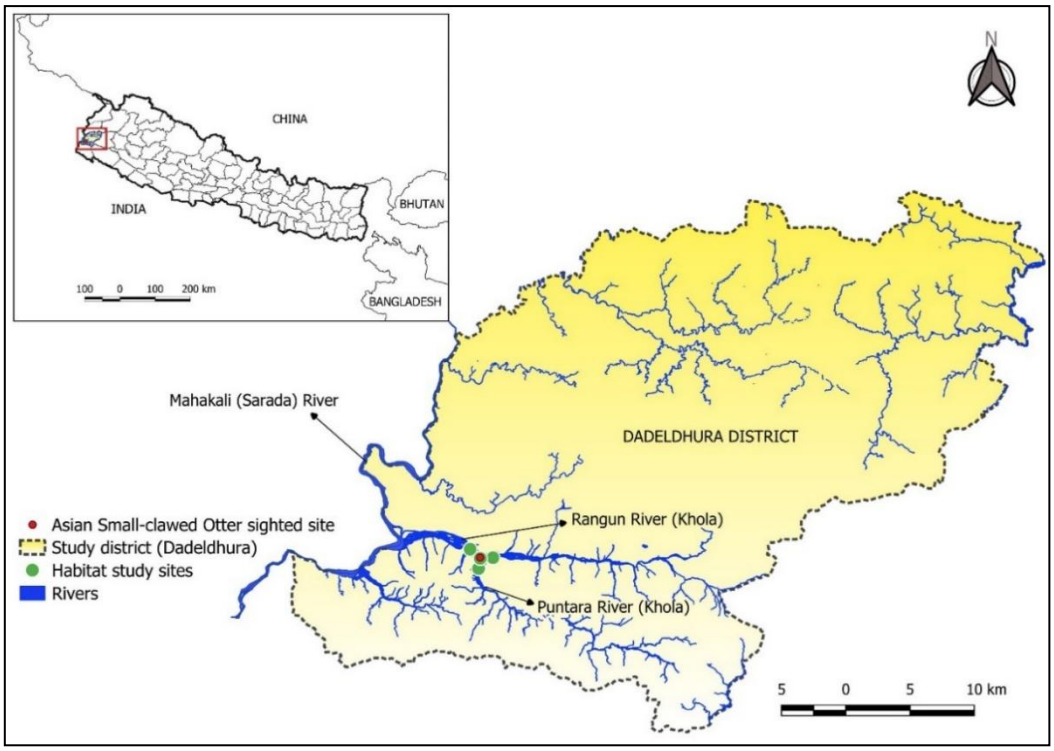

Figure 1. Location map of Asian Small-clawed Otter capture.

Morphological characteristics and species identification of the otter in photographs and videos confirmed as an Asian Small-clawed Otter by IUCN Otter

Specialist Group members (Fig. 2). The species has front paws with reduced nails, well adapted for catching small vertebrate and invertebrate prey in shallow and murky water (Hussain et al., 2011; Nicole Duplaix, *pers. comm.*). The juvenile otter was captured by a local, transferred to the nearby Sub-division Forest Office and nurtured for a week before released to the wild. The Forest Officer (co-author) shared photographs and videos with otter researchers in Nepal (primary author) for species identification, which was further forwarded to IUCN Otter Specialist Group members for the confirmation.

Figure 2. Asian Small-clawed Otter (Photograph: Rajeev Chaudary)

HABITAT NOTE

A brief habitat study was carried out 1-km upstream and downstream from the otter sighting location as a baseline for future study. The habitat characterstics of four sites were noted: the otter observation location, 1-km upstream at the Rangun Khola and at feeder stream the Puntara Khola, and 1-km downstream in the Rangun Khola (Fig. 3). The location of the otter sighting was close to the human settlements Katar and Jogbudha. The bank-to-bank river width varied from 235-750m, but the river itself was shrunken due to the marked reduction of post-monsoon flow, with a tranquil flow and shallow depth. The riverbank was composed of large stones (>10cm-0.5m), small stones (1-10cm) and sand and mud with higher cover of large stones. The bank vegetation cover was sparse with small patches of *Imperata cylindrica* and *Chromolaena odorata.* The otter was observed at the edge of leasehold forest, where mining of stone and sand, washing, bathing and fishing activities were common.

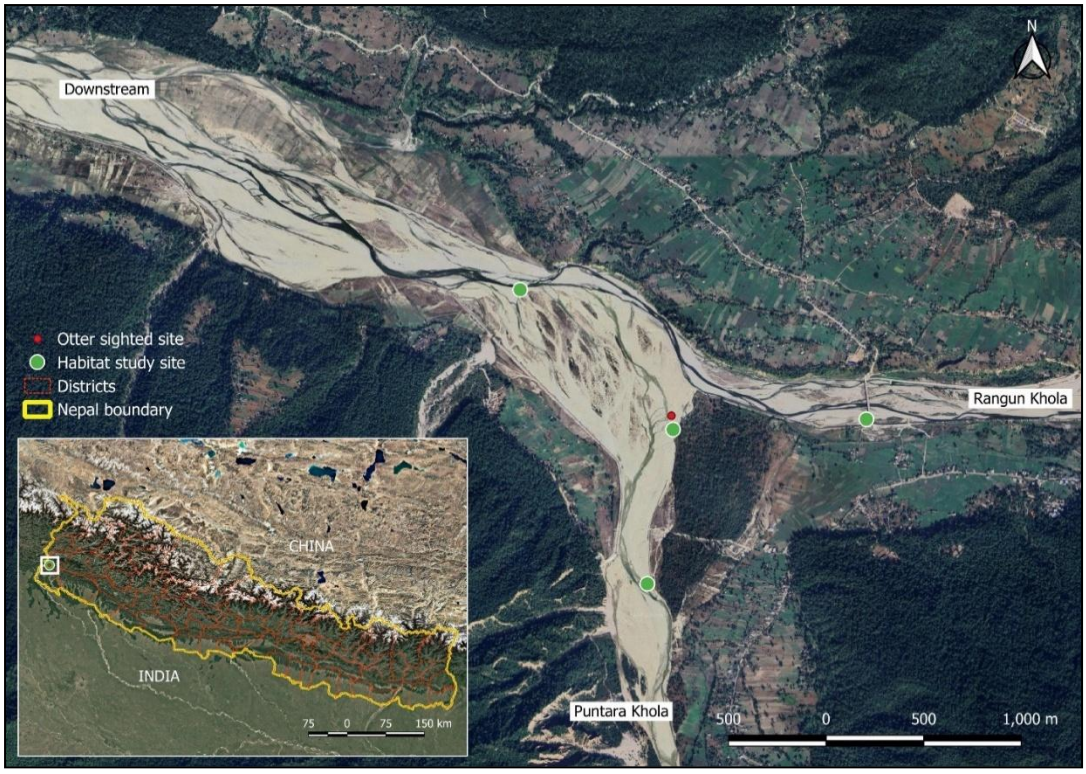

Figure 3. Sites of Asian Small-clawed Otter observation site (red circle) and habitat studies (green circle).

CONCLUSION

The sighting of an Asian Small-clawed Otter after 185 years is a remarkable discovery for conservation in Nepal, ending concerns that the species may have been extinct in the country. The sighting highlights the need for detailed study of the status of this species in Nepal and urgent implementation of conservation initiatives. Small-scale mining of construction materials from local rivers, primarily the Puntara Khola is likely to increase in the near future, with substantial impact on aquatic life. The traditional fishing practices using net casting, fishing hooks, draining water, and trapping fish in rice paddies are common. Besides, fishing using poison and explosives have been increasing. These activities will cause a decline in fish populations. Deforestation, habitat degradation, overgrazing, non-point source pollution and agricultural run-off are additional threats to the aquatic life in the area. There are five micro-hydro plants in the Rangun Khola with impacts to the aquatic biodiversity (USAID, 2018). Otters are resilient to highly modified anthropogenic landscapes (Lee, 1996; Theng and Sivasothi, 2016), flexible in habitat selection (Aadrean et al., 2010; Weinberger et al., 2016) and able to recover from low numbers (Marcelli and Fusillo, 2009; Uscamaita and Bodmer, 2010). Nevertheless, given the rare occurrence of Small-clawed Otter in Nepal, mitigation measures are urgently needed for conservation of the species int this region. National otter survey, scientific studies of ecology and phylogeny of the species and conservation measures at priority sites are called for. Nepal has shown an exemplary effort in the conservation of megafauna, resulting in significant population increases of species such as rhinoceros and tigers. A timely conservation effort for this exceptionally rare species, a keystone aquatic mesocarnivore is now urgently needed in Nepal.

ACKNOWLEDGEMENTS *- Authors are grateful to the Sub-Division Forest Office and Division Forest Office of Dadeldhura for their support providing data. We are grateful to residents of Jogbudha and*

Katar, Dadeldhura for further information. We thank Nicole Duplaix, IUCN Otter Specialist Group Co-chair for the identification of the Asian Small-clawed Otter from photographs and videos.

REFERENCES

Aadrean, Salmah, S., Salsabila, A. and Rizaldi, Janra, M. N. (2010). Tracks and other signs of otters in rice fields in Padang Pariaman, West Sumatra: A preliminary study. *IUCN Otter Spec. Group Bull.* **27** (1): 6–11. https://www.iucnosgbull.org/Volume27/Aadrean_et_al_2010.html

Acharya, P. M., Thainiramit, P., Techato, K., Baral, S., Rimal, N., Savage, M, Campos-Arceiz, A., Neupane, D. (2023). Predicting the distribution and habitat suitability of the Smooth-coated otter (*Lutrogale perspicillata*) in lowland Nepal. *Global Ecology and Conservation*. **46** e02578: 1-14. https://doi.org/10.1016/j.gecco.2023.e02578

Acharya, P., Rajbhandari, S.L. (2011). Status of otters in Nepal. Report submitted to IUCN/SSC Asian Secretariat, Sri Lanka. http://ruffordorg.s3.amazonaws.com/media/project_reports/Status%20of%20Otters%20in%20Nepal.pdf

Duplaix, N., Personal communication.

Hodgson, B. H. (1839). Summary description of four new species of otter. *Journal of the Asiatic Society of Bengal*. **8**: 319-320. https://ia600505.us.archive.org/16/items/biostor-280351/biostor-280351.pdf

Hussain, S. A., Gupta, S. K., de Silva, P.K. (2011). Biology and ecology of Asian Small-Clawed otter *Aonyx cinereus* (Illiger, 1815): A review. *IUCN Otter Spec. Group Bull.* **28** (2): 63-75. https://www.iucnosgbull.org/Volume28/Hussain_et_al_2011.html

Jnawali, S.R., Baral, H.S., Lee, S., Acharya, K.P., Upadhyay, G.P., Pandey, M., Shrestha, R., Joshi, D., Laminchhane, B.R., Griffiths, J., Khatiwada, A. P., Subedi, N. and Amin, R. (compilers) (2011). The Status of Nepal Mammals: The National Red List Series, Department of National Parks and Wildlife Conservation, Kathmandu, Nepal. https://www.ntnc.org.np/sites/default/files/doc_publication/2018-11/The%20Status%20of%20Nepal%27s%20Mammals%20-%20Red%20List.pdf

Lee, L.L. (1996). Status and distribution of river otters in Kinmen, Taiwan. *Oryx.* **30** (3): 202–206. https://doi.org/10.1017/S0030605300021645

Marcelli, M., Fusillo, R. (2009). Assessing range re-expansion and recolonization of human-impacted landscapes by threatened species: A case study of the otter (*Lutra lutra*) in Italy. *Biodiversity Conserv.* **18** (11):2941–2959. https://doi.org/10.1007/s10531-009-9618-2

Shrestha, M.B., Shrestha, G. Reule, S., Oli, S. and Ghartimagar, T.B. (2022). Presence of evidence and factors affecting distribution of Eurasian otter (*Lutra lutra*) in the Pelma River, Rukum East, Nepal. *OTTER, J. of the Int'l. Otter Survival Fund.* **8**:70-83. https://www.otter.org/s/Volume-8.pdf

Shrestha, M.B., Shrestha, G. Reule, S., Oli, S., Ghartimagar, T.B., Singh, G., Tripathi, D.M., Law, C.J., Shah, K. B. and Savage, M. (2021). 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

Shrestha, M.B., Shrestha, G., Maharjan, M. and Shah, K.B. (2023). Unusual Sighting Record of Eurasian Otter (*Lutra lutra*) in Kathmandu Valley. *OTTER, J. of the Int'l. Otter Survival Fund*. **9**: 64-71. https://www.otter.org/s/13891-IOSF-JOURNAL-2023_web.pdf

Theng, M., Sivasothi, N. (2016). The Smooth-coated otter *Lutrogale perspicillata* (Mammalia: Mustelidae) in Singapore: Establishment and expansion in natural and semi-urban environments. *IUCN Otter Spec. Group Bull*. **33** (1): 37–49 https://www.iucnosgbull.org/Volume33/Theng_Sivasothil_2016.html

USAID (2018). Rangun Khola Watershed profile: Status, challenges and opportunities for improved water resource management. USAID Paani Program, USAID/Nepal.

Uscamaita, R. M. and Bodmer, R. (2010). Recovery of the Endangered giant otter *Pteronura brasiliensis* on the Yavarí-Mirín and Yavarí Rivers: A success story for CITES. *Oryx*. **44** (1): 83–88. https://doi.org/10.1017/S0030605309990196

Weinberger, I.C., Muff, S., deJongh, A., Kranz, A., Bontadina, F. (2016). Flexible habitat selection paves the way for a recovery of otter populations in the European Alps. *Biological Conservation*. **199**: 88–95. https://doi.org/10.1016/j.biocon.2016.04.017

Wright, L., de Silva, P.K., Chan, B., Reza Lubis, I., Basak, S. (2021). *Aonyx cinereus*. *The IUCN Red List of Threatened Species* 2021: e.T44166A164580923. https://dx.doi.org/10.2305/IUCN.UK.2021-3.RLTS.T44166A164580923.en

RÉSUMÉ : CONFIRMATION DE LA PRÉSENCE DE LA LOUTRE CENDRÉE *AONYX CINEREUS* AU NÉPAL APRÈS 185 ANS

La loutre cendrée n'a plus été observée au Népal depuis 1839. En raison du manque d'indices de présence de l'espèce sur une période aussi prolongée, il a parfois été suggéré qu'elle était éteinte dans le pays. Nous présentons ici la première preuve photographique de la loutre cendrée au Népal depuis 185 ans. En novembre 2024, une loutre cendrée juvénile a été capturée au confluent de Rangun Khola et de Puntara Khola dans le district de Dadeldhura, à l'extrémité ouest du Népal. Elle a été alimentée au Forest Office pendant une semaine avant d'être relâchée dans la nature. La présence de loutres juvéniles implique l'existence d'autres individus dans la région. Cette observation rare est une confirmation significative de la présence de l'espèce au Népal et justifie une étude détaillée et des initiatives de conservation afin de protéger la loutre cendrée.

RESUMEN : CONFIRMACIÓN DE LA PRESENCIA DE LA NUTRIA DE UÑAS PEQUEÑAS ASIÁTICA *AONYX CINEREUS* EN NEPAL DESPUÉS DE 185 AÑOS

La Nutria de Uñas Pequeñas Asiática no ha sido observada en Nepal desde 1839. Debido a la falta de evidencias de la especie por un período tan prolongado, se ha sugerido algunas veces que estaba extinguida en el país. Aquí, presentamos la primer evidencia fotográfica de una Nutria de Uñas Pequeñas Asiática en Nepal, en 185 años. En Noviembre de 2024, fue capturado un juvenil de Nutria de Uñas Pequeñas Asiática en la confluencia de Rangun Khola y Puntara Khola, del Distrito Dadeldhura, en el extremo occidental de Nepal, y fue mantenido y cuidado en cautiverio por la Oficina Forestal, durante una semana, para luego liberarlo al ambiente silvestre. La presencia de una nutria juvenil implica la presencia de otros individuos de nutria en el área. Esta rara observación es una confirmación significativa de la presencia de la especie en Nepal y amerita un estudio detallado e iniciativas de conservación para proteger a la especie.

सारांश

नेपालमा १८५ वर्षपछि सानो ओत (*Aonyx cinereus*) अस्तित्वमा रहेको पुष्टि

नेपालमा सानो ओत सन् १८३९ यता लामो समयावधी सम्म देखानपर्नु र अस्तित्वको कुनै ठोस प्रमाण नभएको कारणले यस प्रजातिलाई देशबाट लोप भइसकेको आशंका गरेको थियो। हामीले १८५ वर्षपछि पहिलो पटक नेपालमा सानो ओत फेला परेको फोटो सहित प्रमाण प्रस्तुत गरेका छौ। सन् २०२४, नोभेम्बर महिना, सुदुरपश्चिम नेपालको डडेलधुरा जिल्लाको रंगुन खोला र पुन्तरा खोलाको संगममा एउटा सानो ओतको छाउरा भेटिएको थियो। एक हप्तासम्म पालनपोषण पश्चात छाउरा सानो ओतलाई पुनःबासस्थानमा स्थान्तरण गरेका थियौ। छाउरा सानो ओत भेटिनु उक्त स्थानमा अन्य ओतहरु पनि भएको जनाउँदछ। सानो ओतको यस महत्वपुर्ण अभिलेखसंगै विस्तृत अध्ययन र संरक्षणका पहलहरुको आवश्यकता छ।

O B S E R V A T I O N

PHOTOGRAPHIC RECORD OF EURASIAN OTTER (*Lutra lutra*) FROM NAMDAPHA TIGER RESERVE, ARUNACHAL PRADESH, INDIA

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Abstract: Eurasian otters (*Lutra lutra*) are classified as near threatened by the IUCN and listed under Appendix I of CITES. Despite their widespread distribution across India, documentation remains sparse. In Arunachal Pradesh, all three otter species - Eurasian otter (*Lutra lutra*), Smooth-coated otter (*Lutrogale perspicillata)*, and Asian small-clawed otter (*Aonyx cinereus*) - are present, but information on their distribution is limited. Notably, Eurasian otter sightings in Arunachal Pradesh have primarily been from western regions. This study presents the first photographic evidence of a Eurasian otter in the eastern region of Arunachal Pradesh's Namdapha Tiger Reserve.
Citation: Bida, Y.B. and Rai, M. (2025). Photographic Record of Eurasian Otter (*Lutra lutra*) from Namdapha Tiger Reserve, Arunachal Pradesh, India. *IUCN Otter Spec. Group Bull.* **42** (1): 9 – 13
Keywords: Eurasian otter (*lutra lutra*), Namdapha Tiger Reserve, Eastern Arunachal Pradesh.

Eurasian otters (*Lutra lutra*) are listed as Near Threatened by the IUCN and are under Appendix I of CITES (Loy et al., 2022). Although they are widely distributed across India, inhabiting a variety of habitat such as lakes, rivers, streams, rivers, swamps, coastal area and estuaries, their presence is poorly documented (North India - Pal et al., 2021, Jamwal et al., 2016; Central India - Jena et al., 2016, Joshi et al., 2016, Uikey, 2021, Suraj et al. 2022; Western Ghats- Mudappa et al., 2018; Eastern Ghats- Adhya and Dey, 2020; North-east India - Bhattacharya et al., 2019, Khatiwara and Bhutia, 2020, Borker et al., 2022). In Arunachal Pradesh, all three otter species - Eurasian otters, Smooth-coated otters, and Asian Small-clawed otters - have been documented (Borker et al., 2022). However, published information on their distribution

is scarce. While Eurasian otters have been recorded in Arunachal Pradesh, most sightings are from the western parts of the state (Bhattacharya et al., 2019; Borker et al., 2022). The present sighting from Namdapha Tiger Reserve, therefore, marks the first photographic record from eastern Arunachal Pradesh (Fig. 1).

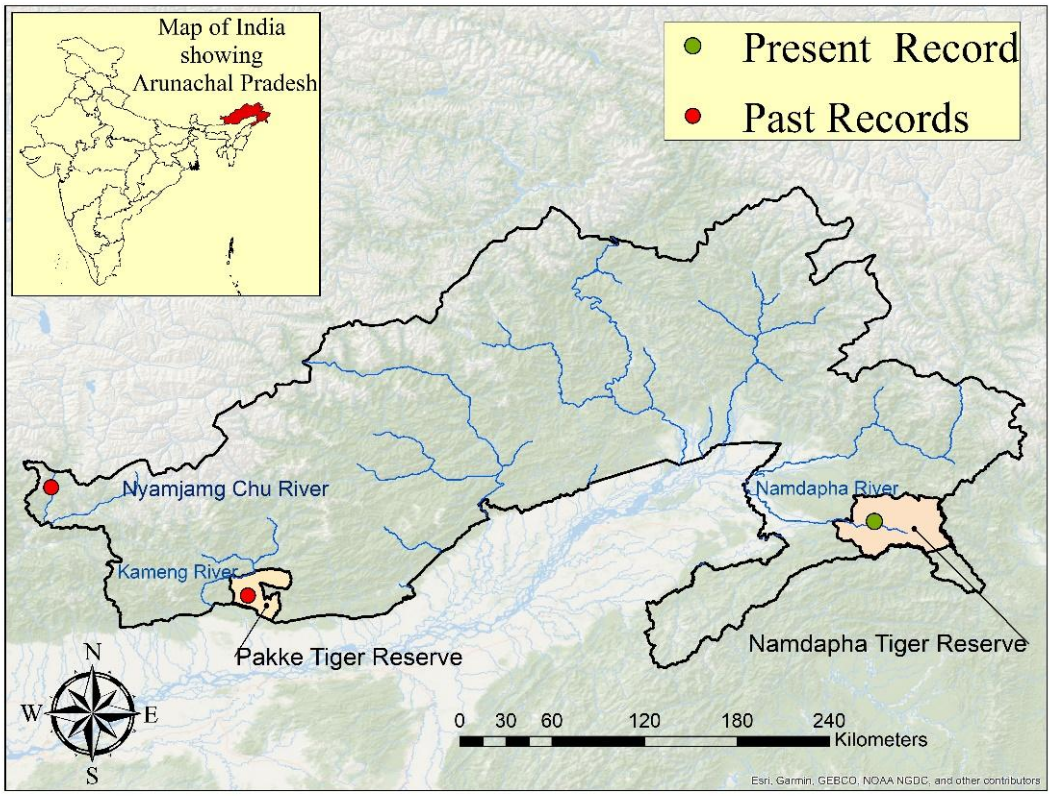

Figure 1. Map showing past and present records.

During the 2021-2024 monitoring season of the Critically Endangerd White-bellied Heron (*Ardea insignis*) in Namdapha Tiger Reserve (Fig. 2), we encountered one Eurasian otter through direct sighting.

Figure 2. Namdapha River.

On October 24, 2023, a single Eurasian Otter was observed grooming itself for about 2 minutes, on a sandy patch on the bank of the Namdapha River (27° 31′N, 96° 30′E; WGS 84; 476 m elevation) (Fig. 3). After grooming, the otter basked, walked across the sandy area, and swam along the riverbank for approximately 4 meters before diving and disappearing from view. The otter was later seen hunting around 30 meters away from its sand basking spot, spending about 40 minutes searching for fish without success. It then swam across the river, walked into the vegetation and disappeared. The area of the river where the otter was sighted had a pond-like appearance, while the section where it hunted was more riffled. This river stretch had an average riverbed width of 33.3 meters, an average river width of 20 meters, and an average depth of 28.3 cm.

Figure 3. Eurasian otter *Lutra lutra* on the sandy bank of River Namdapha.

Otters serve as excellent indicators of healthy riverine ecosystems (Madsen et al., 2001). However, their populations are declining due to habitat degradation and poaching (Savage, 2022). The Himalayas, with their extensive river drainage systems, offer potential habitats for otters. However, unprecedented intensive developmental activities in the Himalayas poses a significant threat to both the habitat and the species. This, coupled with the lack of information about their distribution, could be a major drawback in conservation efforts. Consequently, more otter-specific studies are necessary to understand their distribution and status, which is essential for effective conservation.

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staff of Namdapha Tiger Reserve are acknowledged for their support and co-operation. Financial support for fieldwork was provided by The Habitat Trust as part of the project: Saving the White-bellied Heron in Arunachal Pradesh, India.

REFERENCES

Adhya, T., Dey P. (2020). First record of Eurasian otter (*Lutra lutra*) from Chilika lagoon: A Ramsar Site situated on the East Coast of India. *OTTER, Journal of the International Otter Survival Fund.* **6**: 49 – 55. https://www.otter.org/s/Volume-6.pdf

Bhattacharya, M., Watham, T., Gopi, G.V. (2019). Photographic Records of Eurasian Otter (*Lutra lutra* Linnaeus, 1758) from Nyamjang Chu River, Arunachal Pradesh, India. *IUCN Otter Spec. Group Bull.* **36** (2): 103 – 109. https://www.iucnosgbull.org/Volume36/Bhattacharya_et_al_2019.html

Borker, A., Gogi, K., Krupa, H., Savage, M., Bhardwaj, N. (2022). Otter Survey in Pakke Tiger Reserve, Arunachal Pradesh, Eastern Himalayas of India. *IUCN Otter Spec. Group Bull.* **39** (1): 29 – 38. https://www.iucnosgbull.org/Volume39/Borker_et_al_2022.html

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

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. https://www.iucnosgbull.org/Volume33/Jena_et_al_2016.html

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. https://www.iucnosgbull.org/Volume33/Joshi_et_al_2016.html

Khatiwara, S. and Bhutia, K.C. (2020). A Distribution Survey for Otters in Sikkim, India. *IUCN Otter Spec. Group Bull.* **37** (4): 212 – 218. https://www.iucnosgbull.org/Volume37/Khatiwara_Bhutia_2020.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

Madsen, A.B., Prang, A. (2001). Habitat factors and the presence or absence of otters *Lutra lutra* in Denmark. *Acta Theriol.* **46**: 171–179. https://doi.org/10.1007/BF03192426

Mudappa, D., Prakash, N., Pawar, P., Srinivasan, K., Ram, M.S., Kittur, S., Umapathy, G. (2018). First Record of Eurasian Otter Lutra lutra in the Anamalai Hills, Southern Western Ghats, India. *IUCN Otter Spec. Group Bull.* **35** (1): 47 – 56. https://www.iucnosgbull.org/Volume35/Mudappa_et_al_2018.html

Pal, R., Sharma, A., Dubey, V.K., Bhattacharya, T., Jhonson, J.A., Sivakumar, K., Sathyakumar, S. (2021). A rare photographic record of Eurasian Otter *Lutra lutra* with a note on its habitat from the Bhagirathi Basin, western Himalaya, India. *Journal of Threatened Taxa*, **13** (13): 20072-20077. https://doi.org/10.11609/jott.6937.13.13.20072-20077

Savage, M. (2022). Otters in Northeast India: A Review of the Sparse Available Information. *IUCN Otter Spec. Group Bull.* **39** (2): 81 – 89. https://www.iucnosgbull.org/Volume39/Savage_2022.html

Suraj, M., Ahmed, M., Basak, K., Sarathi, J., Pandey, P., Khelwar, A. (2022). First Record of Eurasian Otter (*Lutra lutra*) from Chhattisgarh, Central India. *IUCN Otter Spec. Group Bull.* 39 (4): 229 - 235. https://www.iucnosgbull.org/Volume39/Suraj_et_al_2022.html

Uikey, S.K. (2021). First Photographic Record of Eurasian Otter (*Lutra Lutra*) from Kanha National Park (M.P.) India. *International Journal of Innovative Research and Advanced Studies*. **8** (9): 7-9. https://www.ijiras.com/2021/Vol_8-Issue_9/paper_2.pdf

RÉSUMÉ: ENREGISTREMENT PHOTOGRAPHIQUE DE LA LOUTRE EURASIENNE (*LUTRA LUTRA*) DE LA RÉSERVE DES TIGRES DE NAMDAPHA, DANS L'ARUNACHAL PRADESH, EN INDE

Les loutres d'Eurasie (*Lutra lutra*) sont considérées comme quasi menacées par l'UICN et inscrites à l'Annexe I de la CITES. Malgré leur large répartition en Inde, l'information reste limitée. Dans l'Arunachal Pradesh, les trois espèces de loutres - la

loutre d'Eurasie (*Lutra lutra*), la loutre à pelage lisse (*Lutrogale perspicillata*) et la loutre cendrée (*Aonyx cinereus*) - sont présentes, mais les informations sur leur répartition sont rares. Il convient de noter que les observations de loutres d'Eurasie dans l'Arunachal Pradesh ont principalement eu lieu dans les régions occidentales. Cette étude présente la première preuve photographique d'une loutre d'Eurasie dans la région orientale de la Réserve des Tigres de Namdapha dans l'Arunachal Pradesh.

RESUMEN: REGISTRO FOTOGRÁFICO DE NUTRIA EURASIÁTICA (*LUTRA LUTRA*) EN LA RESERVA DE TIGRES NAMDAPHA, ARUNACHAL PRADESH, INDIA

Las nutrias Eurasiáticas (*Lutra lutra*) están clasificadas como casi amenazadas por la UICN, y están listadas en el Apéndice I del CITES. A pesar de su amplia distribución en India, la documentación permanece escasa. En Arunachal Pradesh están presentes las tres especies de nutria -nutrias Eurasiáticas (*Lutra lutra*), nutrias Lisas (*Lutrogale perspicillata*) y nutrias de uñas pequeñas Asiáticas (*Aonyx cinereus*), pero la información sobre las respectivas distribuciones es limitada. En forma notable, los avistajes de nutria Eurasiática en Arunachal Pradesh han ocurrido primariamente en las regiones ocdidentales. Este estudio presenta la primer evidencia fotográfica de una nutria Eurasiática en la región oriental de la Reserva de Tigres Namdapha, Arunachal Pradesh.

R E P O R T

OCCURRENCE, FOOD RESOURCES AND FOOD PREFERENCE OF SPOTTED-NECKED OTTERS (*Hydrictis maculicollis*) IN COASTAL AREA OF ONDO STATE, NIGERIA

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Abstract: The study examined the occurrence and food preference of Spotted-Necked Otters (*Hydrictis maculicollis*) in the riverine area of Ondo state, Nigeria. Focus group discussion (FGD), field observation and laboratory analysis were adopted for data collection. Data obtained were analysed through descriptive (tables, charts) analysis. The results revealed that Spotted-Necked Otters are present in eight (8) major rivers (Alape, Oluwa, Ufara, Oriopo, Okukaluju, Korogbene, Opuotu and Ita-Oluwa) within Ilaje and Ese-Odo local government areas of Ondo State. The respondents stated that preferred habitat of Spotted-Necked Otter is freshwater rivers and streams as well as the shallow area of water bodies with no or low current, undisturbed/calm water, areas of fish abundance and areas with vegetation cover. Seven food items (fish, crab, water snail, snake, small mammals, insects and palm cannel) were identified as being consumed by Spotted-Necked Otters in the study area. The most preferred food item of Spotted-Necked Otters are various fish species. It was reported that Spotted-Necked Otter does not feed on Bullhead catfish. Faecal analysis result revealed fish in the highest proportion of 67.19% followed by crabs with a percentage of 18.86 while rodentss/small mammal had the lowest percentage of 0.42%. A total of nine fish species were identified from the Faecal analysis of Spotted-Necked Otters: three species of Cichlidae, two species of Clariidae, and one species each of Anguillidae, Claroteidae, Gymnarchidae and Osteoglossidae. The presence of Spotted-Necked Otters was affirmed during field survey and FGD and they were reported to consume seven food items but mainly feed on fish species. It is recommended that efforts should be put in place to reduce the otter-fishermen conflict that may result from fish preference by otters in the area. Since vegetation cover is one of the factors determining habitat preference of Spotted-Necked Otter, the rate of vegetation removal should be reduced.

Citation: Odewumi, O.S. and Eniomodun. I.E. (2025). Occurrence, Food Resources and Food Preference of Spotted-Necked Otters (*Hydrictis maculicollis*) in the Coastal Area of Ondo State, Nigeria. *IUCN Otter Spec. Group Bull.* **42** (1): 14 – 27

Keywords: Spotted-Necked Otter, coastal area, food resources, food preference, preferred habitat

INTRODUCTION

Otters are carnivorous mammals in the Mustelidae family and subfamily Lutrinae. The 13 extant otter species worldwide are all semiaquatic, aquatic, or marine mammals (Amhaouch et al, 2020) and favour a range of wetland habitats. Two species are marine; the other eleven species live predominantly in fresh water throughout America, Europe, Africa, and Asia, in freshwater ecosystems that sustain an abundance of prey such as fish, crayfish, crabs, mussels, and frogs. Otters are well known to play important ecological roles in the wetland ecosystem and contribute benefits to the surrounding communities. Hence, otters have been perceived as the ambassador of wetland conservation. Even though it has this vital reputation, otters are still facing serious threats such as wetland degradation, pollution, otter-human conflict, and illegal trade for pets (Woo, 2020).

Most river otters are opportunistic feeders, feeding on whatever is most easily obtained. Diet often varies seasonally or locally, depending on which prey is available (Lariviere, 2024). However, some mustelids have specialized diets. For example, Clawless otters (genus *Aonyx*) specialise in crustaceans (especially crabs), worms and molluscs, whereas other otters (genus *Lutra*) are primarily fish eaters.

Most otter species are nocturnal and/or crepuscular carnivores and are capable of travelling long distance in search of food over most of their range (Thapa et al, 2021). The Spotted-Necked Otter requires permanent water sources with high fish densities (Hoffmann, 2008; Perrin and Carugati, 2000) and comparatively large tracts of extensively used semi-natural ecosystems (Freitas et al., 2007; Ogada, 2007). Prey is consumed either in the water or on shore. Otters shows no prey preference, adapting their diet to the fish populations that are available (Krawczyk et al., 2016; Sittenthaler et al., 2019). However, otters do show a preference for small fish (small species or juveniles of large species) (Amhaouch et al., 2020).

Faecal analysis of undigested materials is widely used to assess the diets of otters and is an important method to determine what kind of prey is present (Abdul- Patah et al., 2014). Faecal components may include fish scales, bones, feathers, arthropod chitin and mucus.

The Spotted-Necked Otter is listed on CITES Appendix II (https://cites.org/eng) and classified as Near-threatened on the IUCN Red List (Reed-Smith et al., 2015). Major threats to otter populations include habitat destruction, reduction in prey biomass, water pollution and poaching (Karami et al., 2006). Changes in habitat structure often alter the availability of food resources or acceptance of novel food resources (Contesse et al., 2004). Conflict between fishermen and fish predators is prevalent worldwide. In particular, otters are considered to be one of the main fish predators and conflict has been recorded between fishermen and otters by many authors in Europe (Kloskowski 2011; Poledníková et al., 2013; Santos-Reis et al., 2013), Brazil (Rosas-Ribeiro et al., 2011), Africa (Akpona et al., 2015, de Vos 2018, Salami et al., 2022).

A thorough understanding of the diet, food preference and feeding patterns which largely defines the ecological niche of a species is an essential element in determining what limits populations and therefore essential for effective conservation management (DWNP, 2010). For carnivores, food is often limited, and diets may vary between regions. During these periods of food shortage less preferred foods are often taken. Understanding these limitations and differences allows for planning an effective context-specific conservation strategy. In this study, therefore, we aimed to determine the food resources and preference of spotted necked otter in Ondo State, Nigeria.

MATERIALS AND METHODS

Description of the Study Area

This study was carried out in the riverine area of Ondo state, comprising four local government areas: Ilaje (with an area of 1,318 km², population figure of 277,034, major occupation is fishing), Ese Odo (an area of 762 km², a population of 154,978 at the 2006 census, major occupation is fishing, and farming), Okitipupa (land mass of 803 km², population of 234,138, major occupation is farming), and Irele (area of 963 km², population of 145,166, major occupation is farming) (Fig. 1). The area experiences a tropical climate consisting of both wet and dry seasons (Agunbiade et al., 2010). The wet and dry season average rainfall index and temperature are wet: 3000 mm, 28 °C, and dry: 800 mm, 32 °C (Agunbiade et al., 2010). Mangrove swamp is the dominant vegetation type in this area, especially the red mangrove, *Rhizophora racemose*, and the white mangrove *Avicennia* spp., typical of swamps. A striking feature of vegetation in the area is the desiccation induced by marine water incursion into about 10,000 hectares of freshwater swamp forest. The area is drained by many perennial streams and rivers (Agunbiade et al., 2010). The area supports a wide range of aquatic animals (Babatunde, 2010). These abundant aquatic resources are the primary source of livelihood for people in the area (Kabir et al., 2020).

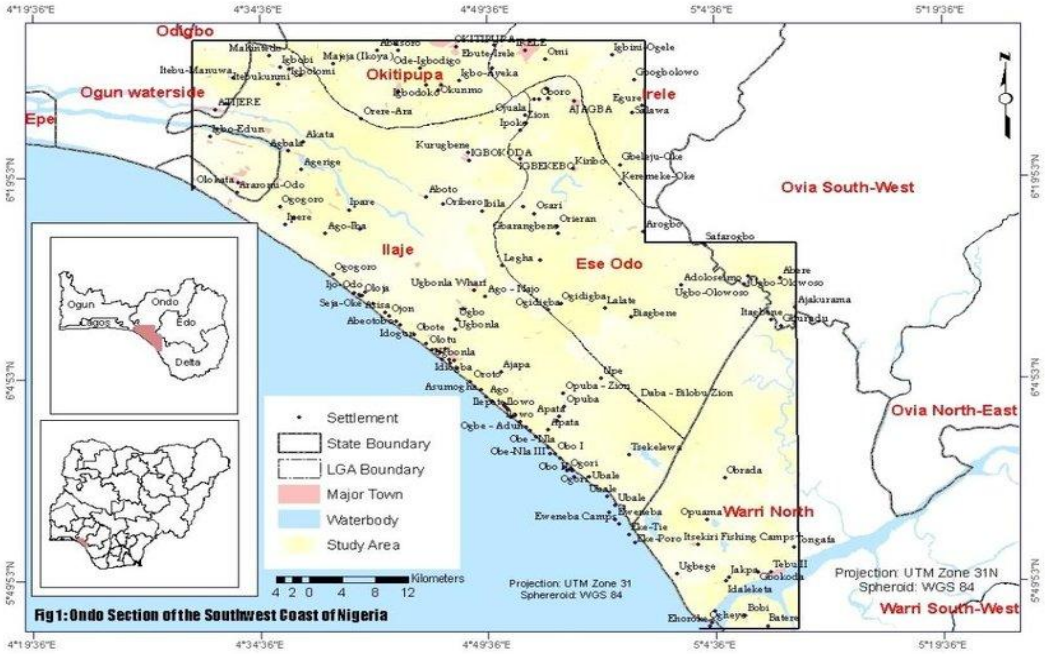

Figure 1. Map showing major communities of the southwest coast of Nigeria

Method of Data Collection

Data for the study was collected using quantitative and qualitative research techniques. The instrument used for data collection includes Focus Group Discussion (FGD), Field Observation and Laboratory Analysis.

Focus Group Discussion (FGD)

A total of 15 FGD sessions with experienced fishermen (respondents with more than ten years of fishing experience) were conducted in the following communities: Mofehintokun, Motiala, Aboto, Ago-debo, Zion-Igbokoda, Kurugbene-Igbokoda, in Ilaje Local Government Area, and Igbobini, Inikorogha, Igbekebo, Kiribo, Sabomi,

Iluagbo, Arogbo, Agadagba and Igbotu in Ese-odo Local Government Area. The group size was between 10-12 members. Interviews were conducted on subject relating to food resources and food preferences of otters in their area. Questions were asked in the simplest format using familiar terms, and translations in local language were done. Each interview session was not more than 1 hour.

Field Observation

The Reece survey method (a modified transect survey method) was adopted, in which a total of four rivers in the coastline communities in the study area were surveyed for this research. The rivers include: Taleta or Ufara, Oluwa, Korogbene/Okukaluju and Itaoluwa. The Reece survey method involves walking along the riverbank and using canoes on water to observe the animal Faecal droppings/spraint and food remnants in fish traps and nets (otters bite or partially consume the fish), otter predation (verified by the presence of teeth marks and confirmed by an experienced fisherman on each fish species captured per day) (Akpona et al., 2015). Reece transects were walked between 6am - 11am (morning) and 4pm – 6:30pm (evening) for each of the rivers. The research was done for a period of 90 days (three months from May to July 2004,). Otter spraints were collected along the four rivers where otter presence has been reported (Abdul-Patah et al., 2016).

Laboratory Analysis

A total of twelve Faecal samples (fresh and dried) were collected along the rivers surveyed, put in separate containers and labelled. Feeding remnants were also collected along with the Faecal samples. The Faecal samples collected were dried and separated according to fauna groups (such as crabs, fish, rodents, mammals and insects), and parts (such as bones, scales and feathers). For identification, the remains were photographed using a digital camera and sorted according to group and part.

Data Analysis

Data obtained were stored in Microsoft Excel and later subjected to descriptive analysis such as frequency tables and charts to further describe the information gathered from the study. Arc GIS was used to map the occurrence of otters in the study area.

RESULTS

Distribution Pattern of Spotted-Necked Otters in Coastline Communities of Ondo State, Nigeria

The result of the field survey revealed that Spotted-Necked Otter are present in eight major rivers within the Ilaje and Ese-Odo Local Government Areas of Ondo State. These rivers include the Alape, Oluwa, Ufara, and Oriopo in Ilaje Local Government Area, and Oluwa, Okukaluju, Korogbene, and Opuotu in Ese-Odo Local Government Area. Otter presence in these rivers was established through direct sighting and observation of otter activities and indicators such as footprints, fishing gear (net and trap) destruction, Faecal samples, food remnants, and otter resting points (couch/track). The GPS coordinates of Otter distributions are presented in Figures 2 and 3.

Figure 2. Areas of occurrence of Spotted-Necked Otter in the coastal area of Ondo State

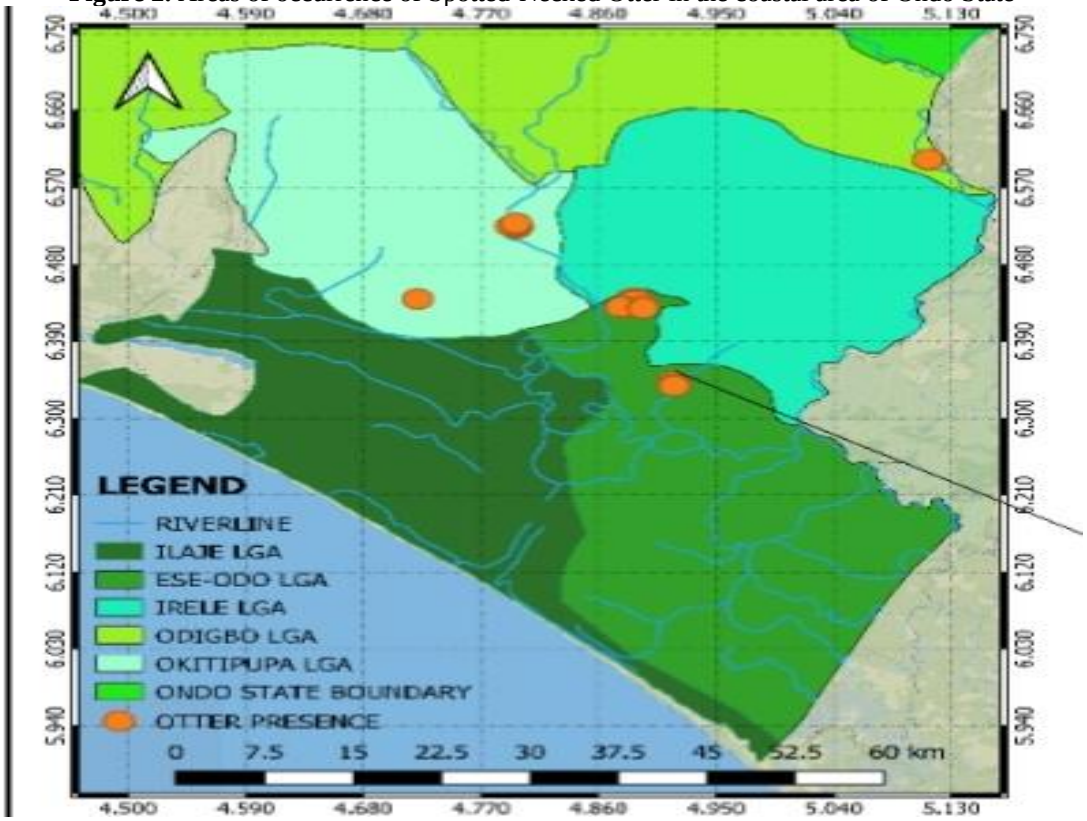

Figure 3. Locations where Otters were sighted directly during the survey

Distribution based on Focused Group Discussion

The result from the Focus Group discussions establishes the presence of Spotted-Necked Otters along these major rivers: Itaoluwa, Alape, Utara, Opuotu, Okukaluju, Korogbene, Oriopo and Oluwa in the Ilaje and Ese-odo Local Government Areas (Table 1). All the respondents said that the Spotted-Necked Otter is present in the study area. It was considered by all respondents that preferred habitat of Spotted-Necked Otter is fresh water rivers and streams. The Spotted-Necked Otter is called "Lombo" by the Ilajes and Apois while the Ijaws in Ese-Odo call it "Okosi". The majority of the respondents in the communities affirmed that they had seen otters directly. They also

said they have on many occasions seen indicators/signs of otter presence such as spraints/Faecal droppings (Fig. 5), footprints, food remnants of fish (Fig. 6), fishing gear destroyed, otter latrines and otter resting sites. Furthermore, the respondents said that otters come on land to eat crab, rest and defecate. It was also believed that Spotted-Necked Otters prefer shallow areas of water bodies with no or low current, undisturbed/calm water, areas of fish abundance and areas with vegetation cover.

Table 1. Distribution and habitat preference of Spotted-Necked Otters in riverine areas of Ondo State based on Focus Group Discussions

Question(s)	Response	Communities	Associated Rivers
Presence of Spotted-Necked Otters in the area.	All the respondents confirm the presence of Spotted-Necked Otters in the area.	Ago-debo, Aboto Iluagbo, Motiala, Mofehitokun, Igbobini, Inikorogha, Kiribo, Sabomi, Agadagba, Arogbo, Igbotu	Oluwa, Ufara, Alape, Itaoluwa, Opuout, Okunkaluju, Korogbene
Habitat type where Spotted-Necked Otters are found.	All the respondents said they are found only in the freshwater rivers and streams.	All the communities above	All the rivers above
Have you ever seen live otters?	All of the respondents said they had seen otters in the study area	All the communities above	All the rivers above
Spraints, Footprints, Feeding Activities, Resting sites, Otter Latrines, Tracks	All of the respondents said they had seen indications of otter presence across the study area.	All the communities above	All the rivers above
Carcass of otter trapped in fishing gear	All respondents reported to have seen otter carcasses	All the communities above	All the rivers above
What habitat do the otter prefer?	All the respondents said they preferred shallow water with low current, undisturbed water, areas of fish abundance and areas with vegetation cover.	All the communities above	All the rivers above

Food Resources of Spotted-Necked Otter in the Coastal Area of Ondo State

In the FGD, the respondents in all communities identified seven food items consumed by Spotted-Necked Otters in the study area (Table 2). These food items include fish, crabs, water snails, snakes, small mammals, insects (beetles) and palm kernels used as bait in fish traps. All the respondents stated that the most preferred food item of Spotted-Necked Otters is fish. Some of the fish species mentioned as consumed by Spotted-Necked Otters in the area are Tilapia (e.g *Oreochronis niloticus, Tilapia zilla)*, *Clarias* species, African Bonytongue *(Heterotis niloticus)*, Ohanri *(Gymnerchus niloticus)*, etc. However, 95% of the respondents reported that Spotted-Necked Otters preferred *Clarias* species, which may be due to the fact that they have no scales, while 5% of the respondents said they preferred Tilapia species to other fish. It was reported

that Spotted-Necked Otters do not feed on the Udicat/Cory/Bullhead catfish, locally called "akokoniko", possibly due to its hard bony fins/spins (Fig. 4). The respondents stated that Spotted-Necked Otters feed on any size of fish (small, medium and big). They also reported that feeding time is early hours of the day and late hours of the night, which is when human fishing activities are reduced. In the Aboto, Motiala and Akintubuwa communities, the respondents reported that Spotted-Necked Otters feed on snakes when they are caught in fish traps.

Table 2. Food resources and preferences of Spotted-Necked Otters from FGD

Food Resources and Preferences	Responses
What type (s) of organism are eaten by Spotted-Necked Otters in your area?	The respondents said they eat fish, crabss, insects, small mammals, prawn, snakes, palm kernels.
Which of the food resources is preferred by Spotted-Necked Otters?	The respondents said they preferred fish to other food items
What are the factors responsible for their food preference?	The respondents said it is availability of the food resources
Are there any fish species otters don't eat?	The respondents said they don't eat Bullhead cat fish (Akonikoko)
Do Spotted-Necked Otters have a preference for certain sizes of fish	The respondents said they don't have preference for any size of fish

Figure 4. Bullhead catfish (Akonikoko), Less preferred prey of otters in the area

Figure 5. Spraint of Spotted-Necked Otter collected at the River Oluwa in the Iluagbo community

Figure 6. Food remnant from Spotted-Necked Otter observed At the River Utara in the Aboto community

Food Items Identified and their Relative Abundance from Spotted-Necked Otter Faecal Analysis

A total of seven food items and unidentified species were recorded in the Faecal analysis of Spotted-Necked Otter samples collected across the seven major rivers where the animal was found (Table. 3, Fig. 7). Fish had the highest proportion of 67.19%, followed by crabs with a percentage of 18.86, while rodents/small mammals had the lowest percentage of 0.42%. This indicates that fish is the most preferred food item of Spotted-Necked Otters in the study area. In the Oluwa River, five food items were identified: fish, crab, water snail, insects and palm kernels. In the River Ufara, four food items were identified: fish, crabs, water snails and insects. In the River Okukaluju/ Korogbene, five food items, fish, shrimp, crabs, snails and insects, were recorded. A total of nine fish species were identified from the Faecal analysis of Spotted-Necked Otters (Table 4). This comprised three species of the Cichlidae family, two species of the Clariidae family, and one species each of the Anguillidae, Claroteidae, Gymnarchidae and Osteoglossidae families.

Table 3. Proportion of food items identified from laboratory analysis of Spotted-Necked Otter faeces

Rivers/LGA	Food Items in Faeces	Proportion (%) Sample A	Proportion (%) Sample B	Average Proportion (%)
River Oluwa in Ago-debo	Snail shell	10	15	12.5
	Fish bones and scales	60	60	60
	Crab shell	20	20	20
	Insect carapace	10	5	7.5
River Oluwa in Motiala	Fish	80	70	75
	Crab	10	10	10
	Insect	10	10	10
	Water snail shell	0	5	2.5
	Palm kernel shell	0	5	2.5
River Oluwa in Iluagbo	Fish	80	75	77.5
	Crab	15	10	12.5
	Hairy mammal/Rat.	5	0	2.5
	Water snail	0	10	5
	Beetle carapace/Insect	0	5	2.5
River Itaoluwa in Igbotu	Beetle carapace/Insect	15	5	10
	Fish bones and scales	65	60	62.5
	Crabs	15	30	22.5
	Palm kernel shell	5	0	2.5
	Water snail shell	0	5	2.5
River Ufara in Aboto	Beetle	5	5	5
	Fish	55	65	60
	Crab	35	15	25
	Water snail shell	0	15	7.5
River Okukaluju/ Korogbene in Inikorogha	Snail	5	0	2.5
	Shrimp	10	0	5
	Insect	5	0	2.5
	Fish	65	70	67.5
	Crab	15	30	22.5

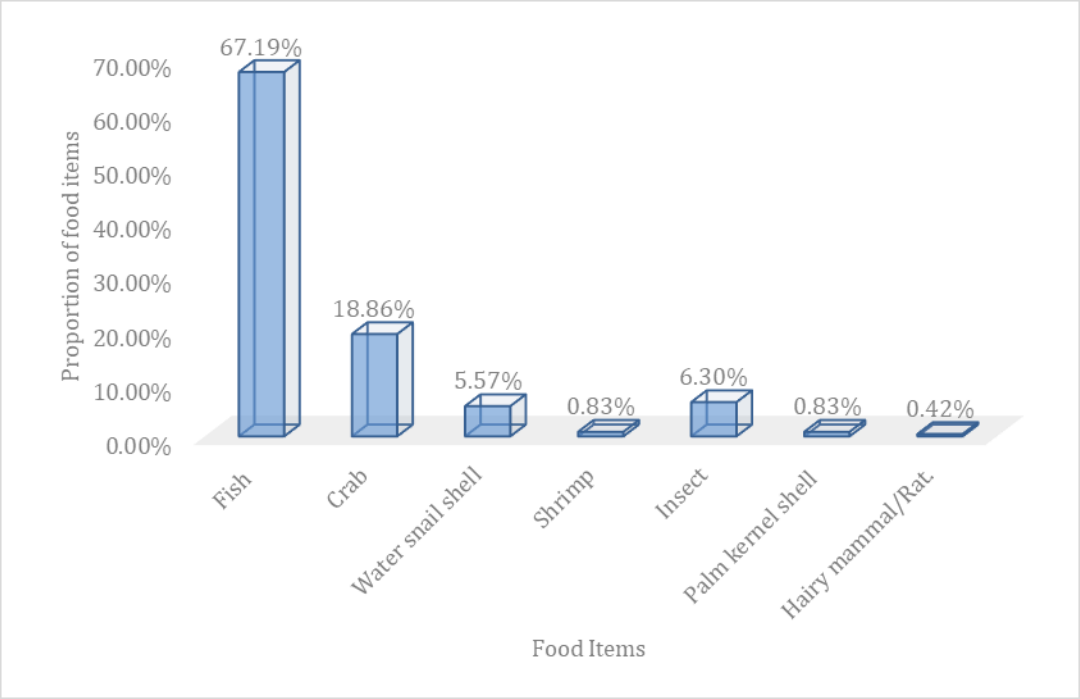

Figure 7. Proportion of each identified food item in the faecal samples of Spotted-Necked Otters in the study area

Table 4. Fish species identified from the faecal samples of Spotted-Necked Otters in the study area

Common Name	Scientific Name	Local Name	Family
Blue tilapia	*Oreochronis niloticus*	Ajikoro,	Cichlidae
Red belly Tilapia	*Tilapia zilli*	Ajepola, akororo	Cichlidae
African bony tongue	*Heterotis niloticus*	Agbadagiri,	Osteoglossidae
Frank fish	*Gymnerchus niloticus*	Ohanri	Gymnarchidae
Bagrid catfish	*Chrysichthys nigrodigitatus,*	Igulu, Igangan	Claroteidae
Black chin Tilapia	*Sarotherodon melanotheron*	Pepere	Cichlidae
African catfish/mud fish	*Heterobranchus bidorsalis,*	Aaro/Aso	Clariidae
African sharp tooth	*Clarias gariepinus*	Aso	Clariidae
Eel fish	*Anguilla anguilla*	Adagba	Anguillidae

DISCUSSION

The large amount of food groups reported by the respondents and those found in the faecal samples of Spotted-Necked Otters indicated that there is diversity of food items to select from. They were found to feed on seven food items comprising both fish and non-fish items. This suggests that Spotted-Necked Otters are opportunistic carnivores that prey on the existing available food (both aquatic and terrestrial) in their habitat, instead of being specialised hunters. This is in tandem with the study by Abdul-Patah et al. (2014) in Benin, showing that otters are amphibious carnivores which forage largely in aquatic habitats and also take terrestrial prey, which make them an opportunistic feeder able to feed on a wide range of prey species. The finding of this report is also in line with the studies conducted on other otter species such as *Lutra lutra* in Hungary with six groups of prey (Lanszki and Sallai, 2006; Lanszki et al., 2016), *Hydrictis maculicollis* in Africa with five groups of prey (Perrin and Carugati, 2000) and *Lontra longicaudis* in Brazil with eight groups of prey (Pardini, 1998).

In this study, Spotted-Necked Otter preferred fish to other food items as they consumed more than 65% of fish, with supplementary food items of shrimps/prawns, small mammals, amphibians, snails and insects etc. Despite the fact that Spotted-

Necked Otter were found to feed more on fish, the consumption of non-fish food items implies that conserving Spotted-Necked Otter in the study area can be boosted by these non-fish food items. This will also reduce the pressure of retaliatory killing by fishermen as reported by Salami et al. (2023) if Spotted-Necked Otter conservation planning is properly executed in the area and people are not allowed to fish with poison. This iis in accord with reports by Hoffmann, (2008), and Ruiz-Olmo et al. (2001), that Spotted-Necked Otters feed predominantly on fish and require permanent water sources with high fish densities. Similarly, Anoop and Hussain (2005) reported that *Lutrogale perspicillata* consumed more than 72% of fish, with supplementary diets of prawns, mammals, amphibians and birds, while Perrin and Carugati (2000) also found that *Aonyx capensis* in Africa prey mainly on crabs.

The nine different species of fish consumed by Spotted-Necked Otters in the study area showed/indicated that they are more generalist and opportunist predators, that are not very selective. This is similar to the statement by Rheingantz et al. (2017) who considered *Lontra longicaudis* as a generalist feeder due to the plasticity of its diet. However, according to the respondents, Spotted-Necked Otter do not eat a species of fish called bullhead catfish due to its hard spine that can injure them or make it difficult to swallow. This is in agreement with the finding of Foster-Turley, 1992, Burhanuddin (1989) who reported that *L. perspicillata* feed on 13 species of fish with *T. trichopterus* and *T. pectoralis* highly consumed being the most abundant and easy to catch species in the area. Similarly, Abdul-Patah et al. (2014) also said that *A. cinereus* were found to feed on five different species of fish while Guerrero, et al. (2018) reported that *Lontra longicaudis* feed on six species of fish in Mexico.

CONCLUSIONS

This study revealed that the Spotted-Necked Otter (*Hydrictis maculicollis*) is mainly found in the freshwater habitat of rivers and streams in Ilaje and Ese-odo LGAs in Ondo state. Otters were found in these major rivers: Oluwa, Itaoluwa, Utara, Opuotu, Alape, Korogbene, Oriopo and Okukaluju. The presence of Spotted-Necked Otters was confirmed through field surveys and FGD, using the presence of otter sign like footprints, faeces, couches (resting sites), food remnants and fishing gear damage, as well as direct sightings. Spotted-Necked Otters consumed seven food items but mainly fed on fish species with supplementary prey of crabs, small mammals, snakes, molluscs, insects and palm kernels. Nine fish species were found to be common in faecal analysis proportional to their availability. However, Spotted-Necked Otters were reported to avoid Bullhead catfish in the study area because of the hard fins and spines.

RECOMMENDATIONS

Based on the findings of this study, the following recommendations are made; Efforts should be put in place to reduce otter-fishermen conflict that may result from fish preference by otters in the area; since vegetation cover is one of the factors determining habitat preference of Spotted-Necked Otters, the rate of vegetation removal should be reduced; gut content analysis should be conducted to further confirm the findings of this study.

REFERENCES

Abass, K. O., Seriki, A. K., Orebiyi, E. O., Ewuyemi, O. & Adeseja, O. (2020). Socio-Economic Aspect of African Manatee (*Trichechus Senegalensis*) Hunting and Capturing in Parts of Ogun and Ondo State, Southwest Nigeria. *American Journal of Agricultural and Biological Sciences*, **15**(1): 107-117. https://doi.org/10.3844/ajabssp.2020.107.117

Abdul-Patah, P., Nur-Syuhadaa, N. Md-Nor, S. Sasakib, H. and Md-Zaina, B. M. (2014). Habitat and Food Resources of Otters (Mustelidae) in Peninsular Malaysia. *AIP Conference Proceedings* **1614**: 693–699. https://doi.org/10.1063/1.4895286

Agunbiade, F.O., Olu-Owolabi, B.I., and Adebowale, K.O. (2010). Seasonal and spatial variations analysis of pollution status of Ondo coastal environment Nigeria using principal component analysis. *Geochemical Journal*, **44**: 89-98. http://dx.doi.org/10.2343/geochemj.1.0048

Akpona, A.H., Djagouna, C.A.M.S. Harringtonc, L.A. Kabré d, A.T. Mensahe, G.A. and Sinsin, B. (2015). Conflict between Spotted-Necked Otters and fishermen in Hlan River, Benin. *Journal for Nature Conservation*, **27**: 63–71 https://doi.org/10.1016/j.jnc.2015.06.007

Amhaouch, Z., Chergui, B., and Cherkaoui S.I., (2020). The Diet of the Eurasian Otter (*Lutra lutra*) in a Southern Mediterranean Aquatic Environment. *Otter, Journal of the International Otter Survival Fund* **7**: 83-99. https://www.otter.org/s/Volume-7.pdf

Anoop, K.R. and Hussain, S.A. (2005). Food and feeding habits of smooth-coated otters (*Lutra perspicillata*) and their significance to the fish population of Kerala, India. *Journal of Zoology*, **266**: 15-23. https://doi.org/10.1017/S0952836905006540

Babatunde, A. (2010). Environmental conflict and the politics of oil in the oil-bearing areas of Nigeria's Niger Delta. *Peace & Conflict Review*, **5**(1): 1-13. https://www.academia.edu/84611257/Environmental_Conflict_and_the_Politics_of_Oil_in_the_Oil_Bearing_Areas_of_Nigerias_Niger_Delta

Burhanuddin MN (1989). Preliminary study on food preference of *Lutra perspicillata* and *Aonyx cinerea* in Tanjung Piandang, Perak. *J Wildlife Parks* **8**: 47–51

Contesse, P., Hegglin, D., Gloor, S., Botadina, F., Duplazes, P. (2004). The diet of urbant foxes (*Vulpes vulpes*) and the availability of anthropogenic food in the city of Zurich, Switzerland. *Mamm.biol.* **69** (2): 81-95 https://doi.org/10.1078/1616-5047-00123

de Vos, M. (2018). *Human-predator conflict in the South African fly-fishing industry: fish survival probabilities and stakeholder perceptions.* MSc dissertation. University of Pretoria, South Africa. http://hdl.handle.net/2263/92844

DWNP (2010). *Wildlife Conservation Act*, Department of Wildlife and National Parks, Peninsular Malaysia, 2010. https://faolex.fao.org/docs/pdf/mal107883.pdf

Foster-Turley, P. (1992). *Conservation Ecology of Sympatric Asian Otters Aonyx cinerea and Lutra perspicillata.* Ph.D. Thesis, University of Florida. https://archive.org/details/conservationecol00fost

Freitas, D., Gomes, T., Sales Luis, L., Madruga, C., Marques, G., Baptista, L. M., Rosalino, P., Antunes, R., & Santos, M. (2007). Otters and fish farms in the Sado estuary: ecological and socio-economic basis of a conflict. *Hydrobiologia*, **587**: 51–62. https://doi.org/10.1007/s10750-007-0693-7

Guerrero, S., Zalapa, S. S., Pérez-Arteaga, A., Del Río-Vélez, A. E., Camacho-Rodríguez, A., Navarrete-Heredia, J. L. (2018). Dieta de la nutria neotropical *Lontra longicaudis* (Carnivora: Mustelidae) en el Río Santiago, Nayarit-Jalisco, México. *Acta Zoológica Mexicana (nueva serie)*, **34**: 1−4. https://doi.org/10.21829/azm.2018.3412134

Hoffmann, M. (2008). *Lutra maculicollis*. In IUCN (Ed.), IUCN red list of threatened species. Version 2013.1. IUCN. Downloaded on 05 August 2013.

IUCN (1992). *Otters*. Educational Booklets on Mammals, Species Survival Commission, IUCN, Gland, Switzerland. ISBN: 978-2-8317-0096-0

Kabir, O.A, Abiodun K.S, Emmauel O.O, Olayinka, E., Olayinka A, (2020). Socioeconomic aspect of African manatee (*Trichechus senegalensis*): Hunting and capturing in parts of Ogun and Ondo State, southwest Nigeria. *American Journal of Agricultural and Biological Sciences*, **15**(1): 107.117 https://doi.org/10.3844/ajabssp.2020.107.117

Karami M., Mirzaei R. and Hamzehpour M. (2006). Status of Eurasian Otter (*Lutra lutra*) in Iran. *IUCN Otter Spec. Group Bull.*, **23** (1): 27 – 33. https://www.iucnosgbull.org/Volume23/Karami_et_al_2006.html

Khan, W. A. Qasim, M. Ahmad, E. Chaudhry, A. A. Bux, H. and Akhtar, M. (2010). Status of Smooth coated Otter (*Lutrogale perspicillata sindica*) in Pakistan. *Pakistan J. Zool.*, **42**(6): 817-824. https://www.wildlife.org.pk/wp-content/uploads/Status-of-Smooth-coated-otter-in-Pakistan.pdf

Kloskowski J. (2011). Human–wildlife conflicts at pond fisheries in eastern Poland: perceptions and management of wildlife damage. *European Journal of Wildlife Research*, **57**: 295-304. https://doi.org/10.1007/s10344-010-0426-5

Krawczyk, A.J., Bogdziewicz, M., Majkowska, K., and Glazaczow, A. (2016). Diet composition of the Eurasian otter *Lutra lutra* in different freshwater habitats of temperate Europe: a review and meta-analysis. *Mammal Review*, **46** (2): 106 - 113. https://doi.org/10.1111/mam.12054

Lanszki, J, István, L. Antoinette, K. and Michael, S. (2016). Diet of otters (*Lutra lutra*) in various habitat types in the Pannonian biogeographical region compared to other regions of Europe. *PeerJ* **4**:e2266. https://doi.org/10.7717/peerj.2266

Lanszki, J., Sallai, Z., (2006). Comparison of the feeding habits of Eurasian otters on a fast flowing river and its backwater habitats. *Mamm. Biol.* **71**: 336–346. https://doi.org/10.1016/j.mambio.2006.04.002

Lariviere, S. (2024). Otter. Available online: https://www.britannica.com/animal/otter

Ogada, M. O. (2007). *Effects of the Louisiana crayfish invasion on the food and territorial ecology of the African clawless otter in the EwasoNgiro ecosystem*, Kenya. PhD thesis. Kenyatta University. https://ir-library.ku.ac.ke/items/df2ec411-0171-480d-83ba-d70f2dc72c33

Pardini, R. (1998) Feeding ecology of the neotropical river otter *Lontra longicaudis* in an Atlantic Forest stream, south-eastern Brazil. *Journal of Zoology*, **245**(4): 385-391. https://doi.org/10.1111/j.1469-7998.1998.tb00113.x

Perrin, M. R. and Carugati, C. (2000). Food habits of coexisting Cape clwless otter and Spotted-Necked Otter in the Kwazulu- Natal Drakensberg, South Africa. *South African Journal of Wildlife Research*, **30**(2): 85–92. https://hdl.handle.net/10520/EJC117096

Poledníková K, Kranz A, Poledník L, Myšiak J. (2013). Otters Causing Conflicts. Pp 81-106 in : **Klenke R, Ring I, Kranz A, Jepsen N, Rauschmayer F, Henle K (eds)**, Human - Wildlife Conflicts in Europe. Environmental Science and Engineering (Environmental Engineering). Berlin, Heidelberg: Springer. https://link.springer.com/chapter/10.1007/978-3-540-34789-7_5

Ponsonby DW, Schwaibold U. (2018). Country otter, city otter: The distribution patterns of two otter species in an urbanized area of Gauteng, South Africa. *African Journal of Ecology* **57**: 148–154. https://doi.org/10.1111/aje.12562

Reed-Smith, J., Jacques, H. & Somers, M.J. (2021). *Hydrictis maculicollis*. The IUCN Red List of Threatened Species 2021: e.T12420A164578992. https://dx.doi.org/10.2305/IUCN.UK.2021-3.RLTS.T12420A164578992.en

Rheingantz, M.L., de Menezes, J.F.S., Galliez, M., and dos Santos Fernandez, F.A. (2017). Biogeographic patterns in the feeding habits of the opportunist and semiaquatic Neotropical otter. *Hydrobiologia* **792**: 1–15. https://doi.org/10.1007/s10750-017-3095-5

Riesco, M, Delibes, M, Calzada, J, Esquivias, J, Qninba, A and Clavero, M, (2020). Desert otters: Distribution, habitat use and feeding ecology in arid rivers of Morocco. *Journal of Arid Environments* **178**. https://doi.org/10.1016/j.jaridenv.2020.104165

Rosas-Ribeiro PF, Rosas FCW, Zuanon J. (2012). Conflict between Fishermen and Giant Otters Pteronura brasiliensis in Western Brazilian Amazon. *Biotropica* **44**: 437-444. https://doi.org/10.1111/j.1744-7429.2011.00828.x

Ruiz-Olmo, J, Lopez-Martin, JM and Palazon, S, (2001). The influence of fish abundance on the otter (Lutra lutra) populations in Iberian Mediterranean habitats. *Journal of Zoology* **254**: 325–336. https://doi.org/10.1017/S0952836901000838

Salami, O.M. Odewumi, O.S. And Hernandez-Romero, P.C. (2022). The Perceptions of Fishermen towards the Conservation of Spotted-Necked Otters (*Hydrictis maculicollis*) and Conflicts in the Riverine Area of Ondo State, Nigeria. *OTTER, Journal of the International Otter Survival Fund*, **8**: 8-10. https://www.otter.org/s/Volume-8.pdf

Santos-Reis M, Santos R, Antunes P, Sales-Luís T, Gomes J, Freitas D, Madruga L. (2013). Reconciliation of the Conflict Between Otters and Fish Farmers. Pp 49-79 in: **Klenke R, Ring I, Kranz A, Jepsen N, Rauschmayer F, Henle K (eds)**, Human - Wildlife Conflicts in Europe. Environmental Science and Engineering (Environmental Engineering). Berlin, Heidelberg: Springer. https://link.springer.com/chapter/10.1007/978-3-540-34789-7_4

Sittenthaler, M, Koskoff, L, Pinter, K, Nopp-Mayrl, U, Parz-Gollner, R and Hacklände, K, (2019). Fish size selection and diet composition of Eurasian otters (*Lutra lutra*) in salmonid streams: Picky gourmets rather than opportunists? *Knowl. Manag. Aquat. Ecosyst.*, **420**: 29 https://doi.org/10.1051/kmae/2019020

Thapa, P., Bijaya, G.C.D., Bhandari, J., Devkota, B.P., Silwal, T., and Can, L. (2021). Distribution, threats and community perceptions of otters in Suklaphanta National Park, Nepal. *OTTER, J. of the Intl. Otter Survival Fund*, **7**: 128-142. https://www.otter.org/s/Volume-7.pdf

Woo, C. Y. (2020). Recent Records of the Endangered Hairy-nosed Otter in Selangor, Malaysia. *OTTER, Journal of the International Otter Survival Fund* **7**: 143-151 https://www.otter.org/s/Volume-7.pdf

RÉSUMÉ: RÉPARTITION, RESSOURCES ET PRÉFÉRENCE ALIMENTAIRES DE LA LOUTRE À COU TACHETÉ (Hydrictis maculicollis) DANS LA ZONE CÔTIÈRE DE L'ÉTAT D'ONDO, AU NIGÉRIA

L'étude a examiné la présence et la préférence alimentaire de la loutre à cou tacheté dans la zone fluviale de l'État d'Ondo au Nigéria. Des Groupes de Discussions (GD), des observations sur le terrain et des analyses en laboratoire ont été mises en œuvre afin de collecter les données. Celles-ci ont été étudiées grâce à une analyse descriptive (tableaux, graphiques). Les résultats ont révélé que la loutre à cou tacheté est présente dans huit (8) grandes rivières (Alape, Oluwa, Ufara, Oriopo, Okukaluju, Korogbene, Opuotu et Ita-Oluwa) des zones de gouvernement local d'Ilaje et d'Ese-Odo de l'État d'Ondo. Les personnes interrogées ont déclaré que les habitats préférés de la loutre à cou tacheté sont les rivières et ruisseaux d'eau douce ainsi que les zones peu profondes des plans d'eau stagnante ou à courant faible, les eaux calmes ou non perturbées où les poissons et la couverture végétale sont abondants. Sept aliments (poissons, crabes, escargots d'eau douce, serpents, petits mammifères, insectes et graines de palmier) ont été identifiés comme étant consommés par la loutre à cou tacheté dans la zone d'étude. L'aliment préféré de cette espèce est sans conteste le poisson. Il a été mis en évidence que la loutre à cou tacheté ne se nourrit pas de poisson-chat barbotte. Le résultat de l'analyse des épreintes a révélé que les poissons avaient la proportion la plus élevée, à savoir 67,19 %, suivis par le crabe avec un pourcentage de 18,86 %, tandis que les rongeurs/petits mammifères avaient le pourcentage le plus faible : 0,42 %. Au total, neuf espèces de poissons ont été identifiées à partir de l'analyse des épreintes de la loutre à cou tacheté. A cette occasion, trois espèces de Cichlidae, deux espèces de Clariidae et une espèce d'Anguillidae, de Claroteidae, de Gymnarchidae et d'Osteoglossidae ont été identifiées. La présence de la loutre à cou tacheté a été confirmée lors de l'enquête de terrain et dans les groupes de discussion qui ont indiqué qu'elle consomme sept aliments mais se nourrit principalement de poissons. Il est donc recommandé de mettre en œuvre des mesures destinées à réduire les conflits entre les loutres et les pêcheurs, conflits qui peuvent être liés à la prédation dominante des poissons par les loutres de la région. Attendu que la couverture végétale est un des facteurs qui détermine la préférence de l'habitat de la loutre à cou tacheté, le taux d'élimination de la végétation devrait être limité.

RESUMEN: OCURRENCIA, RECURSOS ALIMENTARIOS Y PREFERENCIAS DE ALIMENTACIÓN DE LA NUTRIA MANCHADA EN EL ÁREA COSTERA DEL ESTADO DE ONDO, NIGERIA

Este estudio examinó la ocurrencia y las preferencias alimentarias de la Nutria Manchada en el área fluvial del estado de Ondo, Nigeria. Para la colección de datos, adoptamos las discusiones en grupos focales (FGD), la observación en terreno y análisis de laboratorio. Los datos obtenidos fueron analizados mediante análisis descriptivos (Tablas, gráficos). Los resultados revelaron que la nutria manchada está presente en ocho (8) grandes ríos (Alape, Oluwa, Ufara, oriopo, Okukaluji, Korogbene, Opuotu e Ita-Oluwa) en las áreas de los gobiernos locales de Ilaje y Ese-Odo, en el estado de Ondo. Las personas que respondieron expresaron que el hábitat preferido de la Nutria manchada son los ríos y arroyos de agua dulce, así como las áreas poco profundas de los cuerpos de agua con poca o ninguna corriente, agua no-disturbada/calma, áreas de abundancia de peces y áreas con cobertura vegetal. Se identificaron siete items alimentarios que fueron consumidos por la Nutria manchada en ésta área (peces, cangrejos, caracoles acuáticos, serpientes, pequeños mamífeeros, insectos y aceite de palmiste). El item más preferido son los peces. No reportamos que se alimente del bagre cabeza de toro. Los resultados de los análisis faecales revelaron que la mayor proporción correspondía a peces (67.19%), seguidos por Cangrejos con un porcentaje de 18.86%, mientras que los Roedores/pequeños mamíferos representaron el porcentaje más bajo (0.42%). Se identificaron un total de nueve especies de peces a partir del análisis faecal de Nutria manchada. Esto incluyó tres especies de Cichlidae, dos especies de Clariidae y una especie de Anguillidae, Claroteidae, Gymnarchidae y Osteoglossidae, respectivamente. La presencia de Nutria manchada fue confirmada en los relevamientos de terreno y en los FGD, y se reportó que consume siete items alimentarios , pero principalmente se alimenta de peces. Se recomienda que deberían realizarse esfuerzos para reducir el conflicto nutrias-pescadores que puede resultar de la preferencia de peces por parte de las nutrias en esta área. Como la cobertura de vegetación es uno de los factores determinantes de la preferencia de hábitat de la Nutria manchada, se debería reducir la tasa de remoción de la vegetación.

R E P O R T

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

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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.

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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.

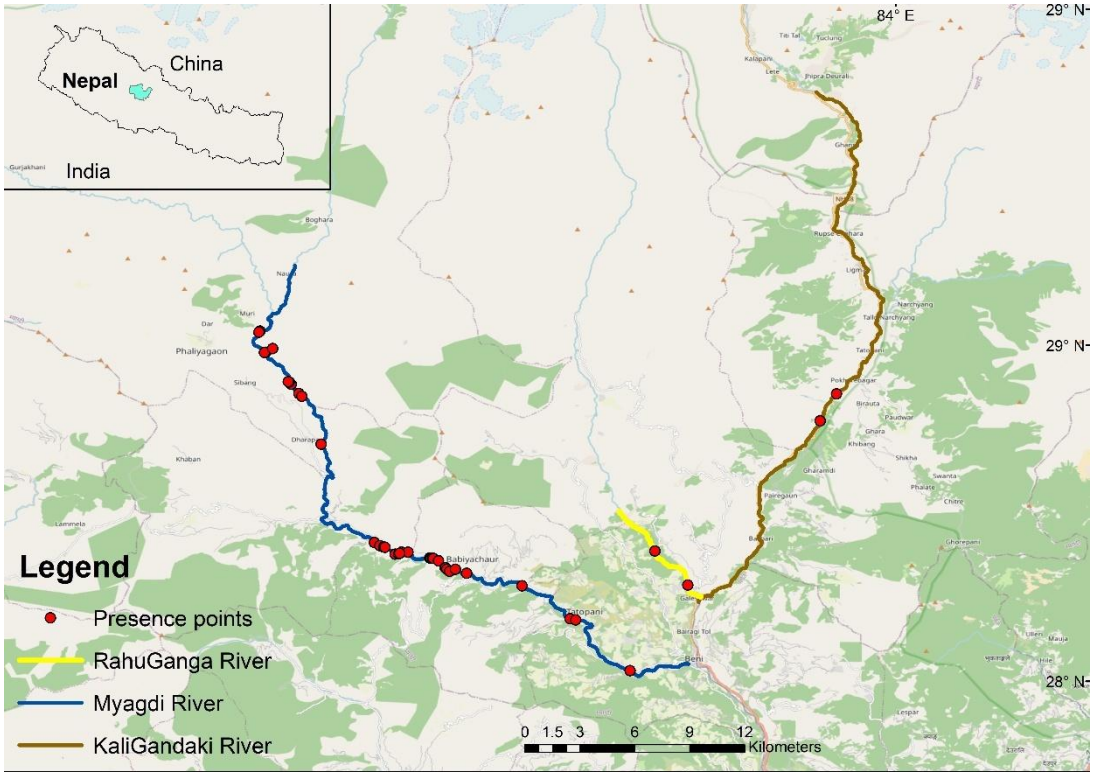

Figure 1. Map showing three stretches of rivers studied: Kali Gandaki, Myagdi, and Raguganga Rivers and occurrence points of otter spraints.

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. Spraints 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.

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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.

A R T I C L E

OTTERS AND TIDES: A HABITAT STUDY OF SMOOTH-COATED OTTERS (*Lutrogale perspicillata*) IN VELLAR ESTUARY, TAMIL NADU, INDIA

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Abstract: Coastal ecosystems, particularly mudflats and estuaries, harbor diverse essential components that result in high productivity. Despite their ecological significance, these regions remain understudied compared to the adjacent seas and oceans. The smooth-coated otters (*Lutrogale perspicillata*), an apex predator yet vulnerable species, found across Asian, including Indian inland water bodies, faces population decline due to urbanization, infrastructure development, and hunting. The absence of comprehensive, even baseline studies and long-term monitoring program exacerbates the condition to study otters in India, which is essential to implement and govern conservation strategies. Limited existing research on the species impedes an inclusive understanding of relevant ecological factors. Our observations establish a benchmark directory on ecological datasets of smooth-coated otters in the Vellar estuarine complex. The research details preferred habitats and seasonal patterns, influenced by freshwater availability and tidal dynamics. The distribution of otters within the study area is influenced by substrate, with silty substrates downstream and sandy substrates upstream playing a crucial role. Human activities in the region have largely maintained a harmonious coexistence with otters.

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Key words: Habitat selection, Smooth-coated otters, Space usage, Tamil Nadu, Vellar estuary

INTRODUCTION

Studying food chain length is important for assessing energy transfer from producers to apex predators, which in turn can be helpful in analyzing the community structure of an ecosystem (Vander Zanden et al, 2007). Studying the higher trophic levels thus becomes important, but scarce datasets and the absence of benchmark studies at regional scale hinders the integration of further research. Globally, otters hold the position of apex predator in inland waterbodies, including lakes, streams, lagoons, and estuaries. Though occurrence data is clear in some cases, habitat selection and preference in many regions are still unstudied. Biomes such as rivers and estuaries, which are essential for the survival of otters, are dynamic. These ecosystems are highly productive and, in turn, the recovery rate when they are influenced by threats such as

fluctuating climatic events is very slow (Mitsch and Gosselink, 2000; Vitousek et al., 1997; Revenga et al., 2000; Khan et al., 2014).

In India, three species of otters are found: Smooth-Coated Otters (*Lutrogale perspicillata* Geoffroy), Eurasian Otters (*Lutra lutra)* and Asian Small-Clawed Otters (*Aonyx cinerea)* (Savage, 2022). Of these, smooth-coated otters are found nearly all over the country's waterbodies (Hussain et al., 2008), in freshwater (Arivoli and Narasimmarajan, 2021) and estuarine brackish water (Utthamapandian et al., 2022). Smooth coated otters are listed as 'Vulnerable' by the IUCN Red List (Savage, 2022).

Otters are confronted with severe threats stemming from modifying wetlands for settlements, river damming leading to reduced water flow, conflicts with fishermen, and heightened hunting pressure (Hussain et al., 2008). Despite such threats, a long-term monitoring program of the distribution and abundance of the three otter species is yet to be started in India (Gupta et al., 2016). Based on pre-existing data, there is a clear decline in the otter population demanding a comprehensive understanding of their habitat and behavioral patterns to devise appropriate conservation strategies (Hussain and Choudhary, 1997; Anoop and Hussain, 2004; Narasimmarajan et al., 2021).

A complex network of wetlands, estuaries, ponds and river streams exist all along the coastal stretch of the state of Tamil Nadu, India. Yet exploratory studies on otters and the interwoven aquatic system within these complex networks remains minimal. A few studies have reported the occurrence of smooth-coated otters (Narasimmarajan et al., 2021; Siva et al., 2021; Arivoli et al., 2021; Prakash et al., 2012; Shenoy et al., 2003) in the upstreams of the natural drainage tributaries of Tamil Nadu, while no systematic studies have been done in estuaries and backwaters of the coastal stretch. The present study is a non-invasive survey for otter presence and space use in relation to environmental variables, along the estuary of River Vellar, Southern Cuddalore, Tamil Nadu, India.

MATERIALS AND METHODOLOGY

Study Area

Originating from Servarayan hills of Salem district, Tamil Nadu, River Vellar runs and converges into the Bay of Bengal at Parangipettai, southeast coast of India, forming a dynamic bar-built estuary. It is also referred to as a "true estuary" since the mouth region is not permanently closed (Prakash et al., 2012). Classified as a semi-diurnal estuary due to tidal patterns occurring every six hours, it experiences high tide marks with an amplitude of approximately 90 cm and a littoral zone width ranging from 30 to 100 meters (Chertoprud et al., 2012). The Vellar estuary (Fig. 1), located at 11º29'N and 79º46'E, carries neritic waters upstream, making the ecosystem more productive, with an average depth between 2 and 5 meters (Prakash et al., 2012). While previous studies indicated the estuary distribution for 16 km, the present study reveals that saline circulation persists towards 30 km (till Sethiathope) during summer months, with a salinity of 15 PSU, favoring the inhabitation of jellyfishes.

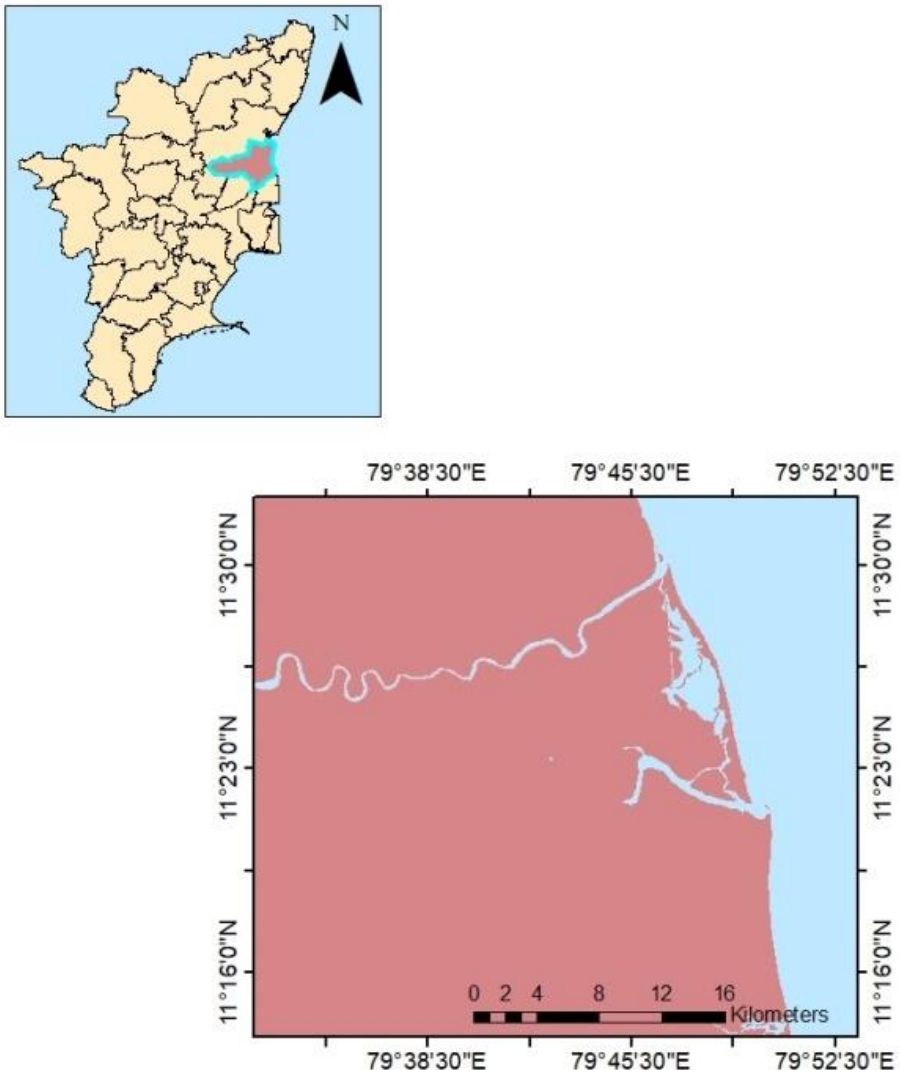

Figure 1. Vellar estuarine complex

Methods

The estuary was surveyed from the mouth to 30 km upstream as biannual seasonal time series between 2021 and 2022. The 30 km stretch was divided into 15 sections (zones) with 2 km per section (Fig. 2). To facilitate the analysis of environmental variables and to ensure the comprehensive coverage of space usage, each section was laid with five stripes (sites) of a length of 400m and breadth of 25m. Collectively the 150 sites, with 75 on each bank, were surveyed seasonally. The signature evidence that validates the presence of otters such as pugmarks, spraint sites and grooming sites, were recorded by direct walking visual observations in these sites. Direct observations of otters were opportunistic along the banks and estuary.

As suggested by *Pteronura brasiliensis* (giant otter) work (Groenendijk et al., 2005), survey interviews were conducted among local fishermen to acquire basic knowledge of the native people, mainly about interactions, using the questionnaires recommended by Groenendijk et al., 2005, modified appropriatedly for the study area. The questionnaire covered details of the native peoples' interactions in any form, and sightings including time, date, numbers, description of habitats, and feeding behavior. A total of 33 interviews were conducted.

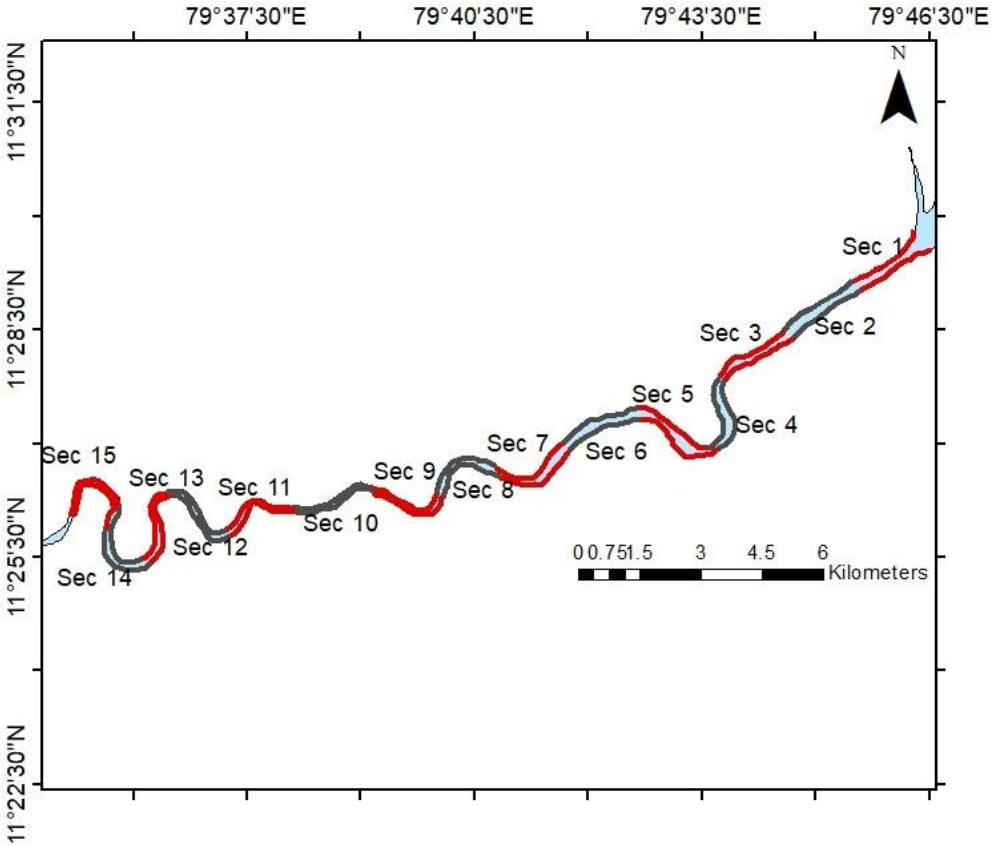

Figure 2. Study area

Statistical Analysis

Referring to the methods of Anoop and Hussain, 2004, additional estuarine variables were added for the habitat selection study. The datasets for habitat preference were collected during summer. A total of 15 variables for the sites were included for the analysis of habitat selection. The variables included average depth of the river in selected sections, angle of the slope, number of streams, mean width of the river, mean water current during high tides, mean water current during low tides, escape distance from the water course on the banks, % of vegetation cover, % of sand, % silt, % of clay, % of rockiness and boulders, presence or absence of disturbance, number of adjacent aquaculture ponds in each site in relation to the percentage of direct sightings observed during low tides. The variables were measured from the centre of all the sites and averaged for the whole section, and a total of 15 mean values were collected for each variable. Further, 12m x 12m plots were laid out at each site to measure the vegetation cover. Among the variables, 13 components, other than the percentage of rockiness and presence/absence of disturbance, were taken into account for the Principal Component Analysis. The performance was done using R studio software of version 4.0.5. on Windows platform. “Psych” groupage in R software was used to extract the PCA plots and analysis and “ggcorrplot” groupage was used to extract the correlation plot. The variables and the four principal components (PC1, PC2, PC3, PC4) were also utilized with Man-Whitney U-test.

RESULTS

Distribution and Factors influencing Distribution

During the survey, on a section basis, 46.7% of the area showed positive evidence (Fig. 3), while 53.3% had no otter evidence. Among the 75 sites, 15 sites showed positive evidence of otter presence, constituting 24%, while the remaining 76% were negative sites.

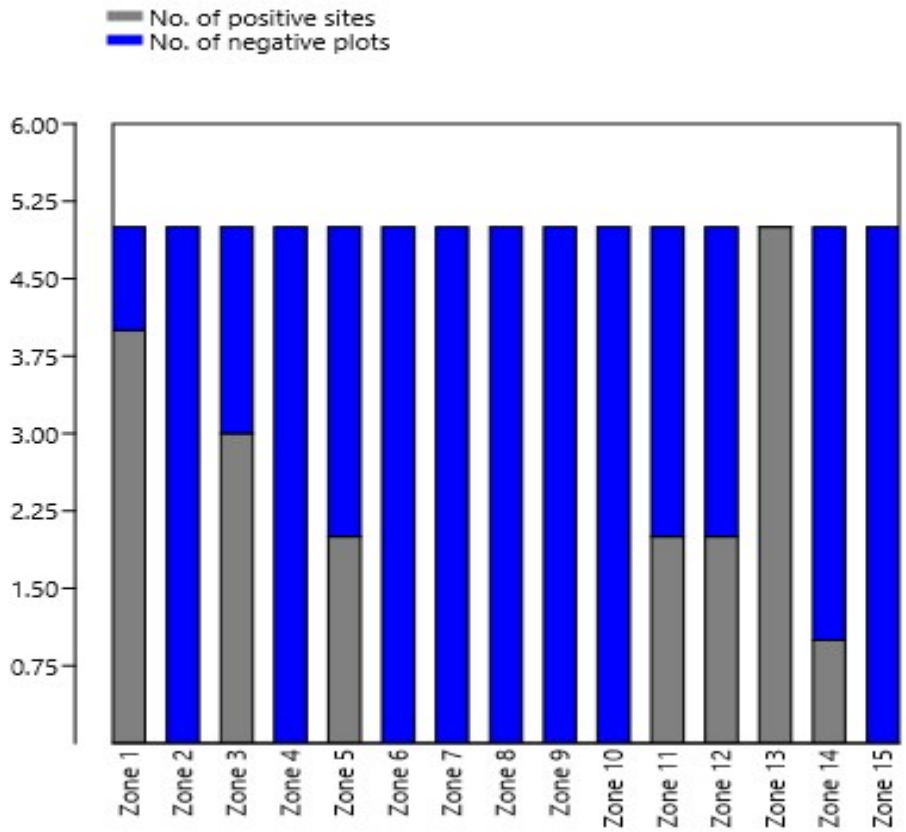

Figure 3. Percentage of positive sites

In the downstream part of the estuary, the recorded sites were predominantly located on the silty banks. Zones 1 and 3 had high silt concentrations of 94.28% and 78.01% respectively. Conversely, in the upstream banks, the utilized sites mainly featured sandy substrate. Considering the overall soil texture in positive sections, otters inhabitations were found on 34.38% silt, 61.46% sandy, and 3.86% clayey soils (Fig. 4).

Mangroves, dense patches of mesquites and large perennial grasses were among the variety of vegetations found at the positive sites. The vegetation also provided hiding and den spots which were strategically located within the otters' escape distance.

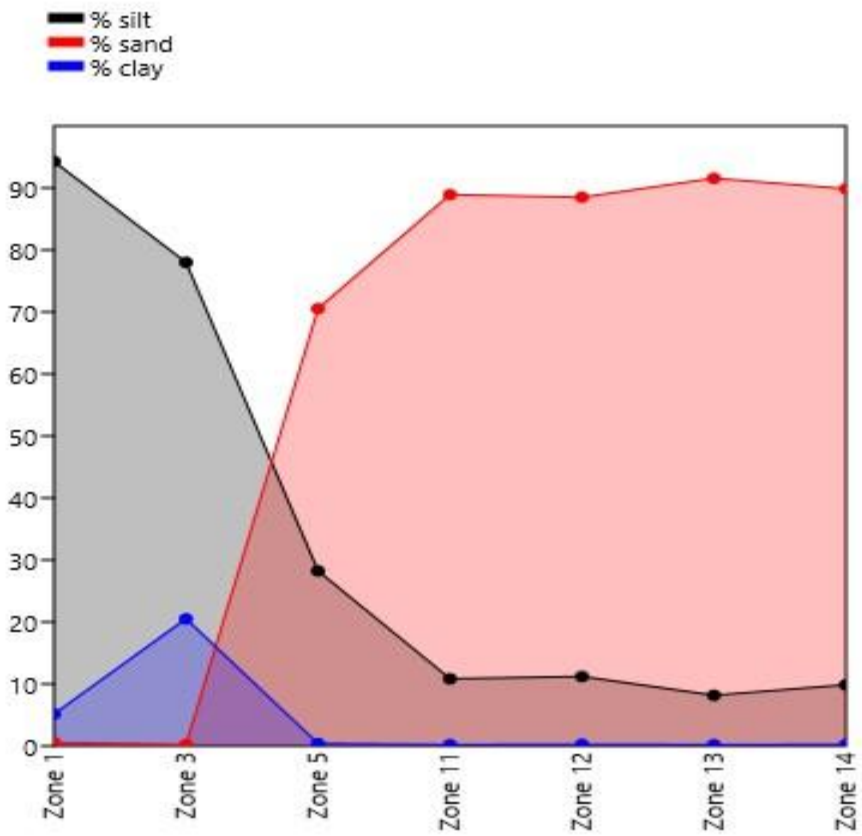

Figure 4. Soil texture in positive sites

Habitat Selection

The first two principal components (Table 1) of PCA were used for the plots and further analysis.

Table 1: Principal components loadings of Principal Component Analysis in Vellar estuary (PC1 – 55.22% and PC2 – 15.26%)

Variables	PC1	PC2
Depth	**0.90**	-0.01
Angle	**0.93**	-0.11
NoS	**0.77**	-0.40
RW	**0.95**	-0.02
WCH	**0.90**	-0.11
WCL	**0.83**	0.33
ED	**0.70**	0.06
VC	0.19	0.60
Sand	-0.08	**0.82**
Silt	**0.65**	0.35
Clay	**-0.59**	**-0.62**
NoAP	**0.82**	-0.34
SLT	**0.75**	-0.19

Depth – Average river depth; Angle – Angle of slope; NoS – No. of Streams; RW – River width; WCH – Water current during High tides; WCL – Water current during Low tides; ED – Escape distance; VC – Vegetation; Sand – Sand concentration; Silt – Silt concentration; Clay – Clay concentration; NoAP – No. of Aquaculture Ponds; SLT – Sightings during Low Tides

Cumulative percentage of variance for PC1 is 55.22, PC2 is 70, PC3 is 81, PC4 is 90. Figure 5 describes the PCA plots. PC1 represents the influence of all the parameters to the full extent of the occurrence patterns. The influence of the number of streams and aquaculture ponds on the likelihood of silt accumulation is significant and multifaceted, ultimately impacting the selection process for aquaculture sites. The water currents during high and low tides influence the occurrence. PC2 showed the impacts of tidal fluctuations as prominent constituents. The existence of aquaculture ponds results in the occurrence of favored silt texture as prominent substrata.

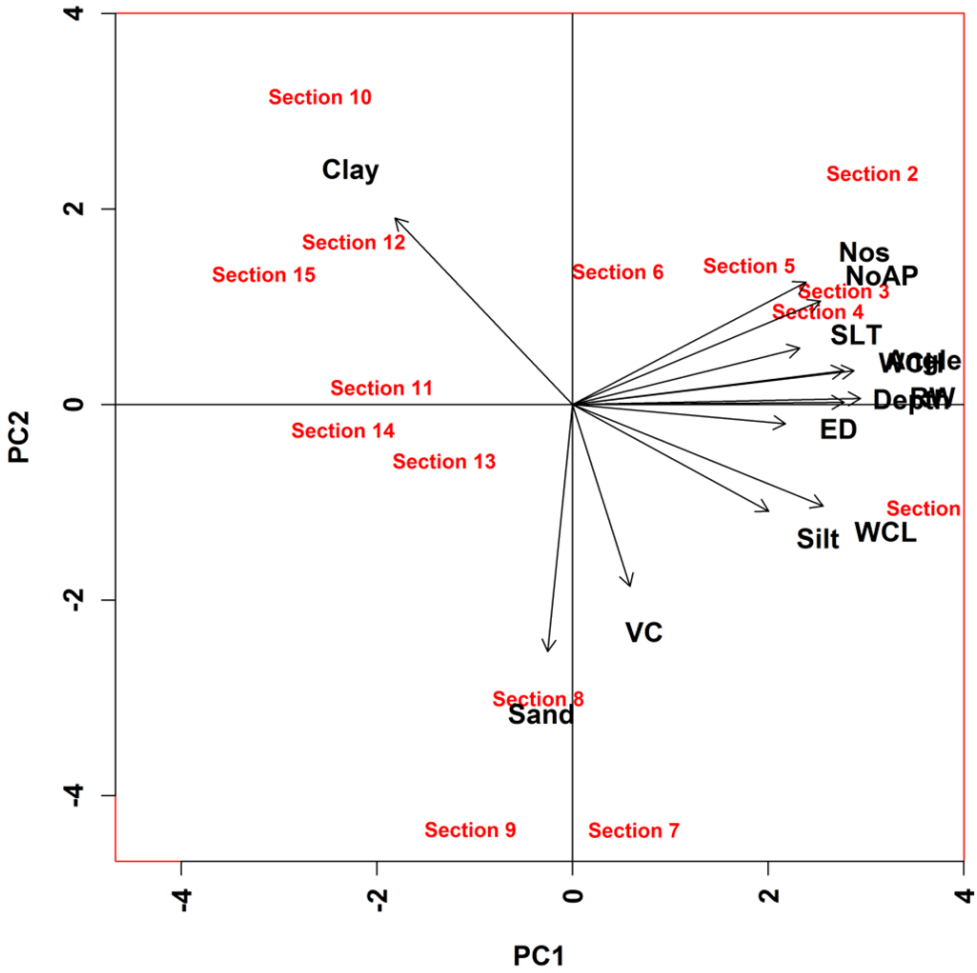

Figure 5. PCA plot for first two principal components

The selection of habitat by otters seems to be in the far corners of the study sites in the deep to shallow water regions. Based on the PCA and correlation analysis (Fig. 6), the vegetation cover moderately correlates with the occurrence, the existence of minimum escape distance, the availability of sustained low tides and silt particles. The presence of a large number of streams and aquaculture ponds determines the probability of otter occurrence significantly.

The Mann-Whitney U-tests that were done for four principal components corroborate with the results observed. The test results were W=345.5, *P*=0.898 for PC1, W=237, *P*=0.06588 for PC2, W=485, *P*= 0.007338 for PC3 and W=360, *P*=0.6871 for PC4.

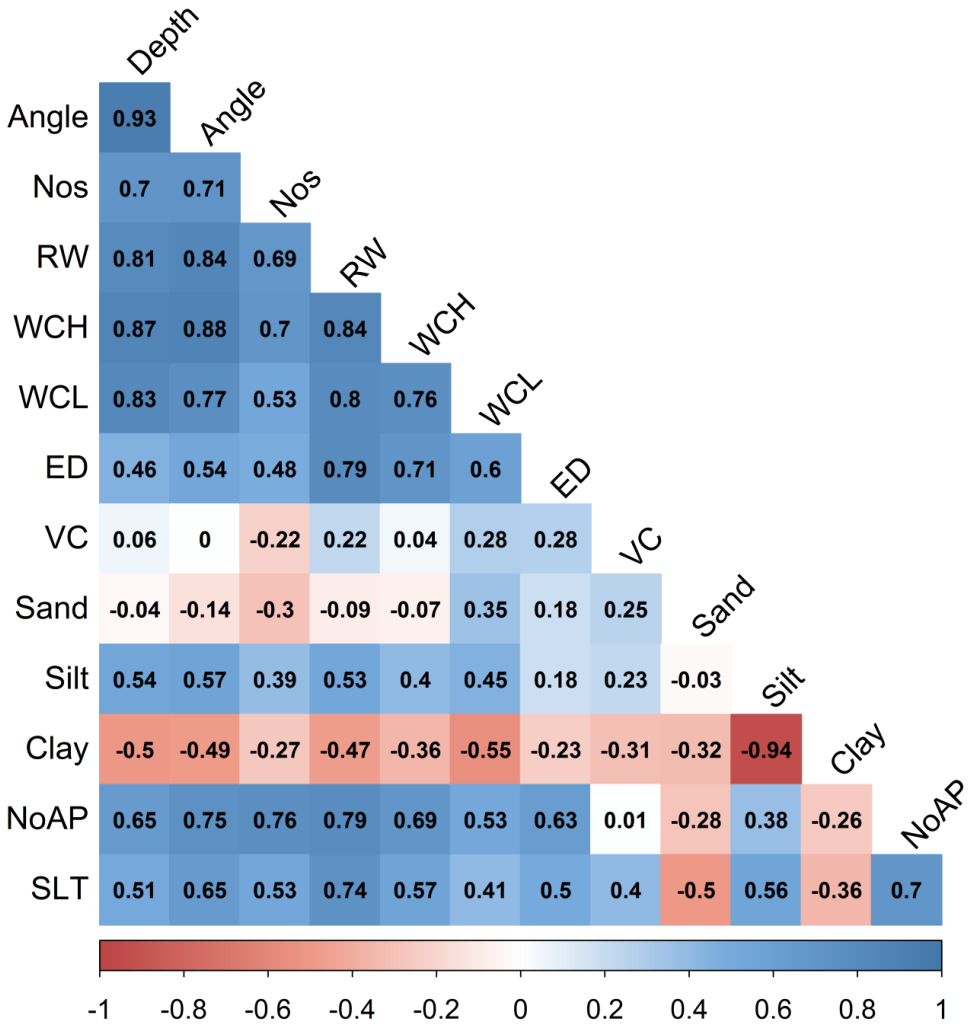

Figure 6. Correlation between the variables

Sighting Records

Zone 1, closest to the estuary mouth, is a less stratified region where abundant nutrients occur during all seasons. Evidence found in the southern and northern banks of this section included spraint sites and pugmarks. A group of otters with six individuals observed through direct sighting (Fig. 7).

Figure 7. Group of six otters foraging

In Zone 3, upstream, a group of nine otters (Fig. 8) was observed utilizing sites 2, 4 and 5 for feeding, grooming and sprainting. The otters were moving and acting in groups, foraging for fishes, and taking them from nets laid by the fishermen. The group comprised of four pups and five adults or subadults.

Figure 8. The group of nine otters foraging (Zone 3)

Space Utilization

During summer and pre-monsoon season, in site 3 of Zone 1, evidence including two major grooming sites and one major spraint site were observed during walking surveys. Opportunistic records including the group of six individuals observed utilizing the estuarine water and an aquaculture pond as feeding grounds.

During monsoon, evidence of sprainting and grooming was found on high ground around 1m higher than the previous spraint site from previous seasons, which was submerged during the monsoonal flood (Fig. 9).

Figure 9. A group of smooth-coated otters spotted in the previous spraint site which was submerged due to the monsoonal flood

During the post-monsoon season, there was no new evidence in the previous spots, but new evidence was recorded very near to the mouth, in site 1 of Zone 1, in the form of two major spraint and grooming sites, plus part-eaten fish, near a seasonal rain bed lying few meters inside the banks.

DISCUSSION

Occurrence and Distribution

The occurrence of otters can be ascertained straightforwardly by indirect evidence such as pugmarks and grooming sites, and by direct sightings. However, the process of assessing the population of otters is problematic (Melquist and Dronkert, 1987). Without finding a better way, assessing the count of otters remains entirely dependent on the primary evidence (Macdonald and Mason, 1983, 1985). Sites where no evidence was found were marked as regions with zero space usage by otters. Macdonald and Mason (1985) considered that the occurrence of less evidence can be an indicator or a sparse or declining population, as stronger populations present stronger evidence. During the study, there were sites with no, or very little, otter sign, which were not recorded as positive sites. However, in rare cases, habitats utilized by otters may not exhibit any evidence due to various factors including rare usage of those sites and human disturbance (Hussain, 1993; Jenkins and Burrows, 1980; Melquist and Hornocker, 1983; Cheheber, 1985).

Habitat Preference

The occurrence of otters in various watercourses in Tamil Nadu has been frequently reported. The datasets describing the population and distribution are insufficient to draw conclusions on the current status of otters. In the present study, sprainting and grooming sites were largely found in areas of high silt concentration, followed by sandy stretches upstream. Hence silt soil is recorded as the preferred type of habitat of otters. Water currents did not impact the activities; however, there were alterations in the choice of spraint sites during the monsoonal floods. Flexible adaptation among various aquatic habitats results in the widespread distribution of the species (Pocock, 1941). Escape distance, shallow depth and gentle slopes also correlate well with the presence of otters. The vegetation at the banks is generally composed of *Porsopis juliflora* and *Calotropis gigantea,* very small patches of mangrove species *Avicennia marine, Rhizophora apiculate* and *R. mucronata* and sand dune plant *Ipomoea pes-caprae.* They are negatively correlated to the otter occurrence as minimal activity was observed around them.

At the estuary mouth, in Zone 1, direct and indirect evidence occurred on the southern bank of the estuary. The northern bank is constructed with breakwaters which form a steep rocky substrate and is exposed to frequent anthropogenic disturbance due to the Annankoil fish landing centre. Moving upstream, in Zone 2, evidence was recorded on the northern bank where there is silty substrate and inlets that are dredged to carry saline water during high tides. The occurrence of otters in Zone 5 was recorded in abandoned aquaculture ponds which not only provide perfect escape cover but also temporarily contain trapped fish during low tides.

Seasonal Habitat Utilization

In addition to the large water bodies in the Cuddalore district, such as Veeranam Lake (Veera Narayanan Lake) and Perumal Lake, the channels which connects the large water bodies with rivers are resources for enhanced productivity. The banks in site 3 of

Zone 1 form a natural suitable habitat for otters with seasonal influence of water and nutrients. During the summer and pre-monsoon, the occurrence of brackish water fish is high in these regions, and most inland fishing happens there at that time. Otters drink fresh water, so when this part of estuary becomes saltier during summer and pre-monsoon, there is a shortage of potable water for otters; they rely on rainfall-fed sources during this time. Shifting of spraint sites to higher elevations during monsoon is observed, but shifting of the whole range towards site 1 of Zone 1 during post monsoon is a major adaptive feature. During post monsoon, the surface water of Vellar estuary is occupied by riverine input, thus providing otters with potable water and paving a way to move further seaward. In the case of the majority of adults, home range is determined by food, potable water, swimming water and shelter (Brown, 1966). The occurrence of freshwater fish on the surface makes it easy for otters to capture their prey as the fish cannot dive further depths because of high dense saline water beneath the freshwater layer. Vegetation cover also plays an important part. Most of the spraint sites and grooming sites were observed on or within the cover of escape distance from the water.

The increased water level during monsoon submerges the banks, and induces otters to search for other sites, increasing their time on land, posing additional threats (Anoop and Hussain, 2004), such as anthropogenic activities and other carnivores including Indian golden jackals (*Canis aureus)* which were spotted often during the study. Anthropogenic activities including construction of riverine dams exploit the baseline habitats (Nawab, 2007). The Vellar estuary is free of such constructions, but the major anthropogenic threat is the materials used for fishing activities.

Human-Otter Relationships

The conflict between humans and otters arises due to damage to fishing gear that can have a direct impact on human livelihoods. 33 interviews were recorded from native fishermen and aquaculture farmers; 26 of them detailed the interactions that are going on currently. The surveys reveal that damage to gear occurs when the otters forage and eat fish from the fishing nets. Due to their foraging activities around fishing nets, otters are also at risk of ingesting plastics. Spraints photographed from the sites are hard evidence of plastic accumulation.

Despite various precautionary measures, fish farms continue to experience significant otter invasions. This is due to the location of the farms. These farms are situated along the tidal areas where otters are accustomed to travel and hunt. The farmers face severe financial loss in terms of investment and profit.

CONCLUSIONS

The streams and natural tributaries in the state of Tamil Nadu, India remain highly vulnerable due to settlements and increasing commercial needs. Studies aimed at exploring vulnerable species are often constrained by narrow criteria, which limit the comprehensive understanding of the factors impacting these animals. |Our surveys were made to examine the occurrence of otters in the Vellar estuarine complex as no studies have previously been carried out on these animals, which occupy the apex trophic level of the food chain. Our results confirm the presence of smooth-coated otters and their habitat preference in the estuarine complex of river Vellar. During the study period, only smooth-coated otters were observed in the opportunistic records and no other otter species were recorded. The observations unveiled the seasonal patterns of habitat used, with the underlying causes attributed to the consistent replenishment of freshwater resources due to the continuous tidal action downstream of estuaries. The habitat selection of otters within the complex reflects their inclination to remain inconspicuous

and undisturbed, creating an intricate distribution which complicates prey accessibility. Fresh water availability is one of the key factors that play a vital role in determining their seasonal movement. In some cases, this seasonal movement involves the perilous task of crossing high traffic roads. The presence of silty substrates in the downstream and sandy substrates in the upstream play a crucial role in identifying the influence of substrate on otter distribution in the study area. Conflicts are arising due to depredation of otters on fishing nets and aquaculture ponds, and this will become an inevitable issue in the near future.

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REFERENCES

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

Arivoli, K., Narasimmarajan, K. (2021). First Record of an Elusive Predator: The Smooth-Coated Otter (*Lutrogale perspicillata*) from Vaduvoor Bird Sanctuary, Thiruvarur District, Tamil Nadu, Southern India. *IUCN Otter Spec. Group Bull.* **38** (2): 79 – 84. https://www.iucnosgbull.org/Volume38/Arivoli_Narasimmarajan_2021.html

Brown, L.E. (1966). Home range in small mammal communities. *In Survey of Biological Progress. Vol.4* (ed.B**. Glass**). Academic Press, London.

Chehebar, C.E. (1985). A survey of the southern river otter *Lutra provocax* Thomas in Nahuel Huapi National Park, Argentina. *Biol. Consen/.* **32**: 299-307. https://doi.org/10.1016/0006-3207(85)90020-5

Chertoprud E. S., Spiridonov V.A, Marin I. N., Mokievsky V.O. (2012). Brachyuran crabs (Crustacea Decapoda Brachyura) of the mangrove intertidal zone of southern Vietnam. In: **Britayev. T. A, Pavlov. D. S.** (eds) *Benthic Fauna of the Bay of Nhatrang, Southern Vietnam*. Volume 2. KMK Scientific Press Ltd., Moscow, pp. 258–295. **ISBN**: 9785873178605

Corbet, G. B., Hill, J. E. (1992). T*he Mammals of The Indomalayan Region, A Systematic Review.* Natural History Museum Publications. Oxford University Press. New York. **ISBN** 0-19-854693-9

Groenendijk, J., Wallace, R. (2005). Model for a Giant Otter Survey Questionnaire. Surveying and Monitoring Distribution and Population Trends of the Giant Otter (*Pteronura brasiliensis*) Guidelines for a Standardisation of Survey Methods as recommended by the Giant Otter Section of the IUCN/SSC Otter Specialist Group (Book) Pg: 91 – 93. https://www.researchgate.net/publication/239937956

Gupta, N., Johnson, J. A., Sivakumar, K., Mathur, V. B. (2016). The Perilous Voyage of Indian Himalayan 'Ambassadors' amidst Anthropogenic Pressures and changing Climatic Variables. *IUCN Otter Spec. Group Bull.* **33** (1): 33 – 36. https://www.iucnosgbull.org/Volume33/Gupta_et_al_2016.html

Husain, A. (1995). Pisces. In Himalayan Ecosystem Series: Fauna of Western Himalayas. Part I, Uttar Pradesh. Northern Regional Centre, Zoological Survey of India: Dehra Dun, India; 117–150. https://faunaofindia.nic.in/PDFVolumes/ess/020/index.pdf

Hussain S. A., Choudhury B. C. (1997). Status and distribution of smooth-coated otters *Lutra perspicillata* in National Chambal Sanctuary. *Biological Conservation*, **80**: 199–206. https://doi.org/10.1016/S0006-3207(96)00033-X

Hussain S. A., de Silva P. K., Mostafa F. M. (2008). *Lutrogale perspicillata*. In 2008 IUCN Red List of Threatened Species. https://dx.doi.org/10.2305/IUCN.UK.2021-3.RLTS.T12427A164579961.en

Hussain, S. A. (1993). Aspects of the ecology of smooth-coated Indian otter *Lutra perspicillata* in National Chambal Sanctuary. PhD thesis, Aligarh Muslim University. http://hdl.handle.net/10603/58828

Jenkins, D., Burrows. G. O. (1980). Ecology of otters in northern Scotland and the use of faeces as indicator of otter *Lutra lutra;* density and distribution. *J. of Anim. Ecol.* **49**: 755-744. https://doi.org/10.2307/4225

Khan, M. S., Dimri, N. K., Nawab, A., Ilyas, O., Gautam, P. (2014). Habitat use pattern and conservation status of smooth–coated otters *Lutrogale perspicillata* in the Upper Ganges Basin, India. *Animal Biodiversity and Conservation*, **37** (1): 69–76. https://doi.org/10.32800/abc.2014.37.0069

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

Macdonald, S.M., Mason, C. F. (1985). Otter, their habitat and conservation in northeast Greece. *Biol. Conserv.* **31**: 177-191. https://doi.org/10.1016/0006-3207(85)90067-9

Mason, C. F., Macdonald, S. M. (1986). *Otters: ecology and conservation*. Cambridge, Cambridge University Press. **ISBN**: 978-0521307161

Melquist, W.E., Hornocker, M. G. (1983). Ecology of river otters in west central Idaho. *Wildlife Monograph.* **83**: 3 - 60 https://www.jstor.org/stable/3830731

Mitsch, W.J., Gosselink, J.G. (2000). The Value of Wetlands: Importance of Scale and Landscape Setting. *Ecological Economics*, **35**: 25-33. https://doi.org/10.1016/S0921-8009(00)00165-8

Narasimmarajan, K., Hayward, M. W., Mathai, M. T. (2021). Assessing the Occurrence and Resource Use Pattern of Smooth-Coated Otters *Lutrogale Perspicillata* Geoffroy (Carnivora, Mustelidae) in the Moyar River of the Western Ghats Biodiversity Hotspot. *IUCN Otter Spec. Group Bull*. **38** (1): 45 – 58. https://www.iucnosgbull.org/Volume38/Narasimmarajan_et_al_2021.html

Nawab, A. (2007). *Ecology of Otters in Corbett Tiger Reserve, Uttarakhand; India*. Ph. D. Thesis, Forest Research Institute, Dehradun, India.

Pocock, R. I. (1941). The fauna of British India including Ceylon and Burma. Vol. II. London: Taylor and Francis, Ltd., 1941.

Prakash, N., Mudappa, D., Shankar Raman, T. R., Kumar, A. (2012). Conservation of the Asian small-clawed otter (*Aonyx cinereus*) in human-modified landscapes, Western Ghats, India, *Tropical Conservation Science*, **5**(1): 67-78. https://doi.org/10.1177/194008291200500107

Revenga, C., Brunner, J., Henninger, N., Kassem, K., Payne, R. (2000). Pilot analysis of global ecosystems: freshwater systems. Washington, DC: World Resources Institute. **ISBN** 1-56973-460-7

Savage, M., (2022). Otters in Northeastern India A review of the sparse available information., *IUCN OSG Bulletin*, **39** (2): 81 – 89. https://www.iucnosgbull.org/Volume39/Savage_2022.html

Shenoy, K., Varma, S., Prasad, K. V. D. (2003). Otters in Cauvery Wildlife Sanctuary, southern India; A Study on the Habitat Choice and Diet Composition of the Smooth Coated Otter (*Lutra perspicillata*). Nityata Foundation, #184, 9th cross, Indiranagar 1st Stage, Bangalore 560 038, India, and Asian Elephant Research & Conservation Centre (A Division of Asian Nature Conservation Foundation), C/o Centre for Ecological Sciences, Indian Institute of Science, Bangalore. https://www.academia.edu/103789016/Otters_in_Cauvery_Wildlife_Sanctuary_southern_India_A_Study_on_the_Habitat_Choice_and_Diet_Composition_of_the_Smooth_Coated_Otter_Lutra_perspicillata_

Siva, T., Muthusamy, A., Lakshmanan, G., Neelanarayanan, P. (2021). Smooth-coated Otter spotted in Kiliyur Lake, Tamil Nadu, India. Mammal Tales #25, In: *Zoo's Print* **36**(2): 26–29. https://zoosprint.org/index.php/zp/article/view/7187/6519

Utthamapandian, U., Dipani, S., and Saravanakumar, A., (2022). First photographic record of Smooth-coated otters (*Lutrogale perspicillata* Geoffroy 1826) in Vellar estuary, Northeast coast of Tamil Nadu, India, *IUCN OSG Bulletin*, **39** (1): 16 – 21. https://www.iucnosgbull.org/Volume39/Utthamapandian_et_al_2022.html

Vander Zanden, M.J., William, W. Fetzer, (2007). Global patterns of aquatic food chain length. *Oikos*, **116**: 1378 – 1388. https://doi.org/10.1111/j.0030-1299.2007.16036.x

Vitousek, P.M., Mooney, H.A., Lubchenco, J., and Melillo, J.M. ((1997). Human Domination of Earth's Ecosystems. *Science*, **277**: 494-499 . https://doi.org/10.1126/science.277.5325.494

RÉSUMÉ: LOUTRES ET MARÉES: ÉTUDE DE L'HABITAT DES LOUTRES À PELAGE LISSE DANS L'ESTUAIRE DU VELLAR, AU TAMIL NADU, EN INDE

Les écosystèmes côtiers, en particulier les vasières et les estuaires, abritent divers composants essentiels qui se traduisent par une productivité élevée. Malgré leur importance écologique, ces régions restent sous-étudiées par rapport aux mers et océans adjacents. Les loutres à pelage lisse (*Lutrogale perspicillata*), un prédateur au sommet de la chaîne trophique, mais une espèce vulnérable, que l'on trouve dans les plans d'eau intérieurs d'Asie, y compris en Inde, sont confrontées à un déclin de leur population en raison de l'urbanisation, du développement des infrastructures et de la chasse. L'absence d'études de base complètes et uniformes ainsi qu'un programme de surveillance à long terme aggravent les conditions d'étude des loutres en Inde, ce qui est essentiel pour mettre en œuvre et gérer les stratégies de conservation. Les recherches actuellement limitées sur l'espèce ne permettent pas une compréhension inclusive des facteurs écologiques pertinents. Notre enquête établit un répertoire de référence sur la distribution et les ensembles de données écologiques des loutres à pelage lisse dans le complexe estuarien du Vellar. La recherche détaille les habitats préférés et les schémas saisonniers, influencés par la disponibilité en eau douce et la dynamique des marées. La distribution des loutres dans la zone d'étude est influencée par les substrats avec des substrats limoneux en aval et des substrats sableux en amont qui jouent un rôle crucial. Les activités humaines dans la région ont largement maintenu une coexistence harmonieuse avec les loutres.

RESUMEN: NUTRIAS Y MAREAS: UN ESTUDIO DE HÁBITAT DE NUTRIAS LISAS EN EL ESTUARIO VELLAR, TAMIL NADU, INDIA

Los ecosistemas costeros, particularmente los llanos de inundación, albergan diversos componentes esenciales, lo que resulta en una alta productividad. A pesar de su significación ecológica, estas regiones permanecen sub-estudiadas en comparación con los mares y océanos adyacentes. Las nutrias lisas (Lutrogale perspicillata), una especie de predador tope pero al mismo tiempo vulnerable, que se encuentra en los cuerpos de agua interiores de Asia, incluyendo la India, enfrentan una declinación poblacional debido a la urbanización, el desarrollo de infraestructura, y la caza. La ausencia de un estudio de base abarcativo y de un programa de monitoreo a largo plazo exacerba la condición para estudiar las nutrias en la India, lo que es esencial para implementar una comprensión inclusiva de los factores ecológicos relevantes. Nuestra investigación establece un directorio o catálogo de referencia sobre la distribución y los sets de datos ecológicos de nutrias lisas en el complejo estuarino de Vellar. La investigación detalla los hábitats preferidos y los patrones estacionales, influenciados por la disponibilidad de agua dulce y la dinámica de mareas. La distribución de las nutrias en el área de estudio está influenciada por los sustratos, jugando un rol crucial los sustratos arcillosos corriente abajo y los sustratos arenosos corriente arriba. Las actividades humanas en la región han mantenido mayormente una coexistencia armónica con las nutrias.

சுருக்கம்: நீர்நாய்கள் மற்றும் ஓதங்கள்: இந்தியா, தமிழ்நாடு, வெள்ளாறு கரையோரத்தில் மென் - தோல் நீர்நாய்களின் (லுட்ரோகேல் பெர்ஸ்பிசில்லாட்டா) வாழ்விட ஆய்வு

கரையோர சுற்றுச்சூழல்கள், குறிப்பாக சேற்று நிலங்கள் மற்றும் முகத்துவாரங்கள் ஆகியன அதிக உற்பத்தித்திறனை விளைவிக்கும் பல்வேறு அத்தியாவசிய கூறுகளைக் கொண்டுள்ளது. அவற்றின் சுற்றுச்சூழல் முக்கியத்துவம் வாய்ந்தபோதிலும், இந்த பகுதிகள் அருகிலுள்ள கடல்கள் மற்றும் பெருங்கடல்களுடன் ஒப்பிடும்போது குறைவாகவே ஆராய்ச்சிகளுக்கு உட்படுத்தப்பட்டுள்ளன. ஸ்மூத்-கோடட் ஓட்டர்ஸ் (லுட்ரோகேல் பெர்ஸ்பிசிலாட்டா), இந்திய உள்நாட்டு நீர்நிலைகள் உட்பட ஆசிய நாடுகளில் காணப்படும் ஒரு உயர் வேட்டையாடும் ஆனால் எளிதில் பாதிக்கப்படக்கூடிய இனமாகும். இந்த இனம், நகரமயமாக்கல், உள்கட்டமைப்பு மேம்பாடு மற்றும் வேட்டையாடுதல் காரணமாக எண்ணிக்கை வீழ்ச்சியை எதிர்கொள்கின்றன. விரிவான, அடிப்படை ஆய்வுகள் மற்றும் நீண்ட கால கண்காணிப்புத் திட்டம் இல்லாமை, இந்தியாவில் நீர்நாய்களைப் படிப்பதற்கான நிலைமையை மோசமாக்குகிறது. அடிப்படை ஆராய்ச்சிகள், பாதுகாப்பு உத்திகளைச் செயல்படுத்தவும் நிர்வகிக்கவும் இன்றியமையாதது. இனங்கள் குறித்த வரையறுக்கப்பட்ட ஆராய்ச்சி, தொடர்புடைய சூழலியல் காரணிகளை உள்ளடக்கிய புரிதலைத் தடுக்கிறது. எங்கள் அவதானிப்புகள், வெள்ளாறு கழிமுக கரையோரங்களில் மென்-தோல் நீர்நாய்களின் சுற்றுச்சூழல் தரவுத்தொகுப்புகளில் ஒரு முக்கிய கோப்பகத்தை நிறுவுகிறது. ஆராய்ச்சி விவரங்களின்படி, மென்-தோல் நீர்நாய்களின் விருப்பமான வாழ்விடங்கள் மற்றும் பருவகால வடிவங்கள், நன்னீர் இருப்பு மற்றும் ஓதங்கள் ஆகியவற்றால் பாதிக்கப்படுகிறது. ஆய்வுப் பகுதிக்குள் நீர்நாய்களின் பரவல் மண்ணின் ஆதி மூலக்கூறுகளால் பாதிக்கப்படுகிறது, கீழ்நிலை வண்டல் மண் மற்றும் மேல்நிலை மணல் ஆராய்ச்சி இடத்தில் மென்-தோல் நீர்நாய்களின் பரவலில் முக்கியப் பங்கு வகிக்கின்றன. இப்பகுதியில் மனித நடவடிக்கைகள் பெரும்பாலும் நீர்நாய்களுடன் ஒரு இணக்கமான சகவாழ்வை பராமரிக்கின்றன.