# NOTE FROM THE EDITOR

## NOTE FROM THE EDITOR

Dear Friends, Colleagues and Otter Enthusiasts!

We have reached summer in Europe and issue 39/1 has been closed and we are opening issue 39/2. We are now in a changed world and after 2 years of a pandemic situation we experience a war in Europe. Something that has changed the life for many. I do hope that we come out of this situation in a good way.

This current issue is in fact already complete, and manuscripts will go online over the coming weeks. We have received interesting manuscripts so keep coming back every now and then.

I also want to urge all potential authors to carefully study the guidelines for authors before submitting manuscripts. Especially I want to stress that it is the responsibility of the authors to ensure completeness of the list of references used in the text and in the reference list. It is not the task on our side to try to identify missing references and we have now started to move papers down the pipeline of going online until the list is completed by the authors.

If you have not already made plans for September, you may consider now to attend the 15th IUCN/SSC OSG International Otter Congress (https://www.otterspecialistgroup.org/osg-newsite/15th-ioc/).

While it was really very exciting to see so many manuscripts arriving last year this also seriously increased the workload for Lesley. Without the efforts of Lesley, the IUCN OSG Bulletin would not be what it is today. Therefore I want to thank you Lesley for all your efforts on behalf of all of us!

**R E P O R T**

# FIRST COMMUNITY-BASED CONSERVATION FOR SMOOTH-COATED OTTERS IN PURI, ODISHA, INDIA

Aurobindo SAMAL[1*], Swarup FULLONTON[1], Rudra MAHAPATRA[2], Akash RATH[3], Shreya PANDEY[4], Kalinga Keshari JENA[5]

[1*]*Earth Crusaders Organisation (ECO), Bhubaneswar, Odisha – 751019, India.*
**Corresponding author: e-mail – aurobindo.cse@gmail.com*
[1]*Amity Institute of Forestry and Wildlife, Amity University, Noida, Uttar Pradesh – 201301, India. e-mail – fullontonswarup@gmail.com*
[2] *Wildlife Trust of India, Bhubaneswar, Odisha – 751013, India.*
*e-mail – rudra@wti.org.in*
[3]*BiraHarekrushnapur, Malatipatpur, Puri Sadar, Odisha – 752008, India.*
*e-mail – ranjan.akashrath123@gmail.com*
[4]*Amity Institute of Forestry and Wildlife, Amity University, Noida, Uttar Pradesh – 201301, India. e-mail - shreyapandey.2244@gmail.com*
[5]*Earth Crusaders Organisation (ECO), Bhubaneswar, Odisha – 751019, India.*
*e-mail – kalinga97@gmail.com*






(received 16th September 2021, accepted 23th November 2021)

**ABSTRACT:** The presence of a species in a human-modified landscape often leads to conflict situations. Any loss to local communities poses a major threat to a species in its habitat. The Smooth-coated otter is an apex predator of aquatic ecosystems and often comes into direct interactions with local communities. Conservation can only be possible when communities are made aware of and are involved in conservation programs that safeguard wildlife and habitat. This conservation project is Odisha's first community conservation project on Smooth-coated otters. For our study of Smooth-coated otters in Puri, Odisha, India, we approached local communities through social awareness campaigns in schools, government departmental sensitization, rapport building, wall paintings, fishing net compensation and local community workshops, believing that awareness is the major tool towards helping conservation programs.

Citation: **Samal, A., Fullonton, S., Mahapatra, R., Rath, A., Pandey, S., and Jena, K.K. (2022).** First Community-Based Conservation for Smooth-Coated Otters in Puri, Odisha, India. *IUCN Otter Spec. Group Bull*. **39** (1): 59 - 72

**KEYWORDS:** Social awareness campaign, rapport building, anthropogenic threats, fishing net, compensation program

## INTRODUCTION

In the present scenario of rapid human population growth, together with the high dynamism of changing environmental factors that result from human-implemented modifications of the ecosystem (Smith et al., 2018). The interaction of wildlife with humans often creates conflict situations and negatively affects the presence of the species.

Otters form a distinct group in the Mustelidae family of mammals and are placed in the Lutrinae subfamily (Sivasothi, 1995). Smooth-coated otters (*Lutrogale perspicillata*) are characterized by velvety, fine fur, and a shorter coat than the Small-clawed and Eurasian otters. Smooth-coated otter is listed as Vulnerable on the IUCN Red List, and is protected under Schedule II of Wildlife Protection Act 1972 of India. It is listed in Appendix I of CITES.

Protected areas comprise a small percentage of the landscape, and charismatic species are often the prime conservation focus in them.

A major role in the conservation of wildlife is played by communities. ‘conservation’ is often given meaning at odds with the cultural perspectives of the ‘communities’ that are expected to practice it. ‘Conservation’ covers a broad spectrum of management and benefit-sharing arrangements involving natural resource management by people who are not agents of the state but, by virtue of their location and activities, are critically placed to enhance or degrade the present and future status of natural resources. In a study of community approaches to wildlife management, IIED (1994) points out that the concept can be approached in spatial, socio-cultural and economic terms.

Economically communities can be considered as ‘groupings of people who share interests and control over particular resources’. Combining these one can derive a model of community as an entity socially bound by a common cultural identity, living within a defined spatial boundary and having a common economic interest in the resources of this area. The weight that people give to these different forms of value correlates closely with their cultural and socioeconomic location. For people in urban, industrial or post-industrial societies, wildlife has little direct economic significance (except for those employed in tourism or conservation) and emphasis is placed on its intrinsic or recreational worth. For rural peoples, for whom the presence of wildlife has important economic implications, wildlife valuations tend to be more instrumental, even where their cultures assign an intrinsic value to wildlife.

## PROBLEM STATEMENT

After combining the analysis of people perception study results and our prior knowledge of the species we were able to define the problem statements of this project:

- Habitat degradation and fragmentation occurs because of human and agricultural settlements in otter habitat; people install fishing nets and block portions of the river for their livelihood, causing major changes to the habitat, including loss of suitable habitats and habitat degradation (e.g., deforestation, aquaculture industry, mangrove removal).
- Natural calamities and landform change are a major problem in this district, which is prone to cyclones, which cause landform changes such as destroying holts and foraging grounds.
- Retaliatory killing by the fishing community occurs when otters destroy fishing

nets during foraging and they are killed in retaliation.
- Poaching, either for profit or ancient myths, for example the belief that suggests medicinal properties in otter blood, is highly detrimental to the species.
- Otters can be victimized by snares set for other species.
- Pesticide contamination of water bodies occurs near communities; since otters are primary fish-eaters, they consume contaminated fish.
- Over-fishing during off-seasons causes a reduction in prey base of otters.

## The Impact of Natural Calamities on Smooth-coated Otters

Puri, Odisha (19.8135° N, 85.8312° E) (Fig. 1) has a long history of natural disasters, mainly due to a large number of cyclonic depressions that form each year in the Bay of Bengal. This sub-basin is highly active and produces some of the deadliest tornadoes of all time. Tropical cyclones form during the months of March to June and October to December with a peak in May and November. This has become a common scenario resulting in the natural habitat of many animals being lost. Wild animals during storms often run aground, die, or come into contact with humans, resulting in human-wildlife conflict. In Puri, for example, Cyclone FANI struck Balukhand Wildlife Sanctuary, near the Eco-sensitive Nuanai area in March 2019 (Figs. 2,3), forcing otters closer to human communities and leading to otter-human conflict.

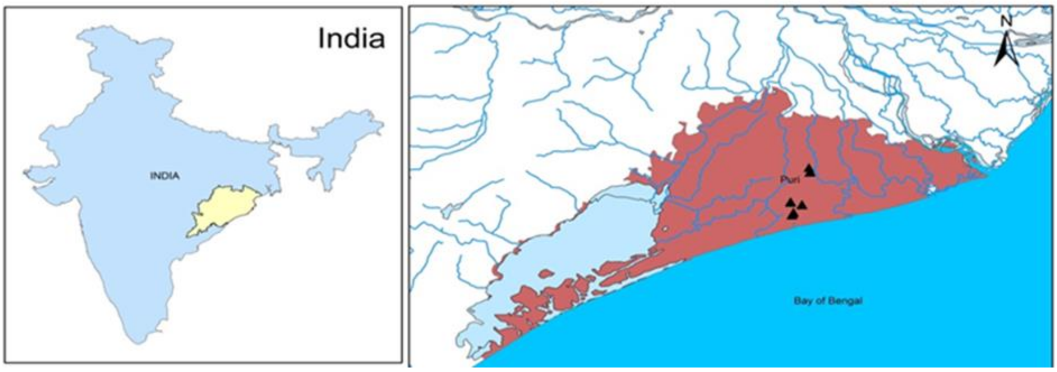



**Figure1.** Map of survey region

**Figure 2.** Aerial survey after cyclone FANI (May 2019) in the project area (Credit: Rudra Mahapatra, Wildlife Trust of India).

**Figure 3.** Aerial survey after cyclone FANI (May 2019) in the project area (Credit: Rudra Mahapatra, Wildlife Trust of India).

## STUDY AREA

River Nuanai is one of the major rivers of Odisha located near the Balukhand-Konark Wildlife Sanctuary, and flows through the District of Puri. This sanctuary is home to numerous wild flora and fauna. Nuanai is revered by local communities and highly modified for human use. The river flows through plantations, forest and paddy fields, as well as through agricultural fields flanking both sides of the river. We chose four places with both otter-human conflicts and riparian cover as our project sites, Chhaintana (Lat – 19.880112, Lon – 85.924844), Beladala (lat. 19.852205, Long. 85.90068), Ura (lat. 19.983282, long. 85.93503) and Antarkul villages (lat. 19.965642, long. 85.943455).

## METHODS

The study was conducted from March, 2020 to February, 2021. In the three months of the first phase of the survey, we tried to build rapport with local community people.

### A. Rapport Building

Building a trusting relationship with people is known as rapport building, an important step for local conservation efforts, particularly for good community participation, and enabling them to take pride in their conservation actions toward a species living alongside them. Good communication with researchers fosters better awareness of nature and encourages valuable input, even after the completion of the project.

Rapport building practices were implemented in communities across the study area (Fig. 4,5). We identified common ground that both researchers and villagers could agree on during our initial interactions with local communities. We made our intentions clear and explained to villagers the importance of otter conservation in their locality. In return, they were more than willing to participate in our activities. Understanding and body language helped garner support from the locals, as well as active listening, empathy, asking right questions and acknowledging what people say and experienced.

Because of rapport building in local communities, villagers participated in several conservation measures during this project. Apart from the several surveys conducted by our team, we depended upon information provided by locals about otter presence. With their help, we identified several threats to otters and conflict-prone locations for otters. Based on this information, we conducted awareness campaigns and anti-snare walks with the Forest Department. Rapport building with the fishing communities also helped us during our otter-human conflict mitigation program, in which we compensated fishers who had experience otter depredations with new fishing nets. Program activities like awareness campaigns in community centers and wall paintings were impossible without the support of the local communities.

**Figure 4 - 5**. Rapport building with fishing communities to identify conflicts with otters and local awareness.

## B. Social Awareness Campaigns

There is a lack of public awareness about the importance of local biodiversity and natural habitat conditions. Most local people are farmers and are poor and illiterate, and women are not allowed to work outside except on their own fields. Socioeconomic status in the communities is low.

In the second phase of the survey, we were more familiar with the study area and the condition of the habitat, and we recognized several ecological threats to otters. In this phase, we conducted education and awareness work (Fig. 6,7), by distributing pamphlets, banners, osters and conducting workshops in community centers, schools, and colleges. Issues like retaliatory killing, snaring, pollution, and myths were addressed during these campaigns, which emphasized the importance of otters in the ecosystem and how to take pride in otter conservation.

**Figure 6 – 7.** Sensitization work among fishing communities on coexistence with otters and the role of otters in the ecosystem.

We also conducted awareness education in academies across the project site (Fig. 8,9). Students were taught the basics of conservation, keeping the future of otter conservation in the area in mind. Leaflets and banners were distributed and used respectfully. We we assisted by the Forest Department and tried to reach out to all age groups, including school children. The children are the future flag bearers and their valuation of wildlife is a major step towards a successful conservation program. Children are the major stakeholders of their habitat and can help to conserve it for a better future.

**Figure 8 - 9.** Sensitization work among students about ecological value of otters.

## C. Sensitizing the Forest Department and Patrolling for Snare Removal

Extensive discussions were held with the Forest Department regarding the issues otters were facing. The Department is mainly focused on larger issues and often tend to ignore community-issues related to wildlife. Forest Department ranger are present on the ground day and night. Explaining the urgency of otter conservation through interactions and multiple walks were conducted for snare removal from otter habitat (Fig. 10,11).

**Figure 10 – 11.** Patrolling for snare removal with Forest Department in otter habitat.

## D. Fishing Net Compensation

Mitigating negative impacts is an important conservation concern. Retaliatory killing of otters can endanger their populations but prohibiting retaliation can anger communities sharing space with them (Madden, 2004; Woodroffe et al., 2005). Retaliatory killing by the fishing community occurs when otters destroy fishing nets during foraging. Most fishers in our project area use line nets and box nets for fishing, and nets remain submerged in the river for some time.

We wanted to mitigate this otter-fishing conflict and decided to introduce fishing net compensation (Figs. 12,13). During our project, we compensated several fishers across our project site who lost their nets due to otter damage, improving their attitude toward the animals.

**Figure 12 - 13.** Fishing net compensation to beneficiaries who faced otter damaget to fishing

## E. **Wall Art**

We believe that illustration amplifies the impact of conservation measures, as illustration engraves itself in hearts and minds. Illustration of otters on community centers educates people and inspires them to conserve the species. Wall art was valuable for community awareness and future care for otters (Fig. 14,15). The art is a constant reminder of the value of otters to the ecosystem and an encouragement to to the local conservation actions.


**Figure 14 – 15.** Wall art at public places and community centers for sensitization to otters

## RESULTS

A post-project assessment was conducted between April and August, 2021. We reached out to the local people and assessed the major changes seen after the project. We had prioritized awareness-based conservation during the project, the first conservation project on otters in Odisha, and we wanted gauge community participation.

Querying the local communities led us to believe that local people are more aware of the presence and value of otters in their environment, and that they have a right to survive. The fishing community now understands the value of otters and they are learning to coexist with them. Students are now more curious about otter conservation and our project inspired the next generation. Otter conservation is a buzz among villagers due to our community awareness and wall painting initiatives. Snares were removed and present less of a threat. We sensitized the locals to the impacts of pesticide contamination of water bodies. The Forest Department is also sensitized and keeping an eye on illegal activities. A handbook on Smooth-coated otters was published to guide the Department in future conservation model plans on otters (Fig. 16).

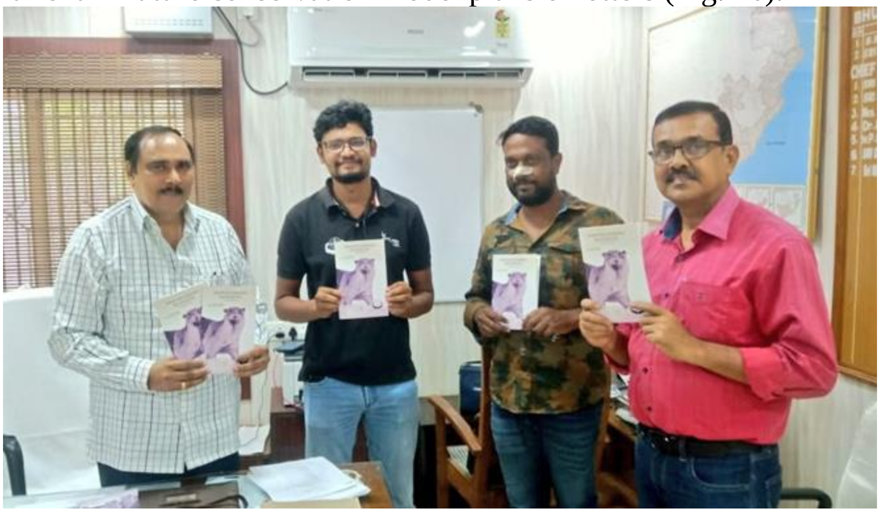


**Figure 16**. Inauguration of booklet "First Community-based Smooth-coated Otter Conservation in Odisha" by Regional Chief Conservator of Forest, Bhubaneswar.

## CONCLUSION

Often the major problem for animals is direct conflict between humans and animals, including retaliatory killing. Perceptions of otters range from positive, when they act as tourist attractions capable of generating revenue, to neutral in agricultural landscapes, where they have no impact on local economies (Norris and Michalski, 2009), to negative where otters are perceived as competitors by fishers (Gómez and Jorgenson, 1999; Recharte et al., 2008). Although some studies report correlations between the magnitude of perceived or real damages (e.g., financial losses) and implementation of lethal control measures (Kloskowski, 2011), there is often considerable disparity between the actual damage by otters of net damage or prey consumption (Gómez and Jorgenson, 1999; Freitas et al., 2007; Recharte et al., 2008; Rosas-Ribeiro et al., 2011; Vaclavikova et al., 2011). Although the Smooth-coated otter is fairly tolerant of human presence (Shariff, 1984; Anoop & Hussain, 2004) fishing and gravel or sand extraction may play a major role in excluding otters from an area. This lability in human perceptions means that environmental education and awareness programs make it possible to modify human perceptions, and directly influence human behaviors with positive outcomes, such as reducing human wildlife conflicts and promoting biodiversity conservation (Dickman, 2010). Awareness programs in Puri became a major tool to change people's mindset towards Smooth-coated otters, by promoting beneficial interactions between otters and local communities.


**Figure 17.** Illustrations prepared for social awareness through art. Credit – Sudarshan Shaw

**ACKNOWLEDGEMENTS -** We thank to PCCF (WL), Odisha for providing all necessary permission for field activity. We thank to Wildlife Trust of India for their funding support to this project. We thank to RCCF, Bhubaneswar for their active and positive response to the project. We are thankful to DFO (Puri Wildlife Division), Balukhand Forest range office, Gop Range office and all the on-ground forest staffs for their cooperation. We are also thankful to Jungle Lore Foundation for logistic support.

## REFERENCES

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

**Chackaravarthy, SD, Kamalakannan, B and Lakshminarayanan, N (2019).** The Necessity of Monitoring and Conservation of Smooth-Coated Otters (*Lutrogale perspicillata*) in Non-Perennial Rivers of South India. *IUCN Otter Spec. Group Bull.* **36** (2):83 – 87
https://www.iucnosgbull.org/Volume36/Chakaravarthy_et_al_2019.html

**Dickman, A.J. (2010).** Complexities of conflict: the importance of considering social factors for effectively resolving human–wildlife conflict. *Animal Conservation*, **13**(5): 458-466. DOI: https://doi.org/10.1111/j.1469-1795.2010.00368.x

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

**Gómez, J. R. & Jorgenson, J.P (1999)** An Overview of the Giant Otter-Fisherman Problem in the Orinoco Basin of Colombia. *IUCN Otter Spec. Group Bull.* **16**(2): 90 - 96 https://www.iucnosgbull.org/Volume16/Gomez_Jorgenson_1999.html

**Holland, A.M., Schauber, E.M., Nielsen, C.K., Hellgren, E.C. (2019).** River otter and mink occupancy dynamics in riparian systems. *The Journal of Wildlife Management*, **83**(7): 1552-1564.

**I.I.E.D. (1994).** Whose Eden? An Overview of Community Approaches to Wildlife Management. London, International Institute for Environment and Development. https://pubs.iied.org/8260iied

**Kloskowski, J. (2011).** Human–wildlife conflicts at pond fisheries in eastern Poland: perceptions and management of wildlife damage. *European Journal of Wildlife Research* **57** (2): 295-304DOI: https://doi.org/10.1007/s10344-010-0426-5

**Kranz, A. (1994)** Otters Increasing - Threats Increasing. *IUCN Otter Spec. Group Bull*. **10:** 28 – 30
https://www.iucnosgbull.org/Volume10/Kranz_1994a.html

**Lima, D., Marmontel, M. and Bernard, E. (2014).** Conflicts between humans and giant otters (Pteronura brasiliensis) in Amanã Reserve, Brazilian Amazonia. *Ambiente & Sociedade* **17**: 127-142.

**Madden F (2004)** Creating coexistence between humans and wildlife: global perspectives on local efforts to address human–wildlife conflict. *Hum Dimens Wildl* **9**(4):247–257. https://doi.org/10.1080/10871200490505675

**Mishra, SR, Mohan, M (2018).** First Photographic Documentation and Distribution of the Asian Small-Clawed Otter *Aonyx cinereus* in Similipal Tiger Reserve, Odisha, India**.** *IUCN Otter Spec. Group Bull.* **35** (4): 186 - 192
https://www.iucnosgbull.org/Volume35/Mishra_et_al_2018.html

**Norris, D. and Michalski, F. (2009).** Are Otters an Effective Flagship for the Conservation of Riparian Corridors in an Amazon Deforestation Frontier?. *IUCN Otter Spec. Group Bull.* **26** (2): 73 – 77 https://www.iucnosgbull.org/Volume26/Norris_Michalski_2009.html

**Recharte, M., Bowler, M. and Bodmer, R. (2008).** Potential Conflict between Fishermen and Giant Otter (*Pteronura brasiliensis*) Populations by Fishermen in Response to Declining Stocks of Arowana Fish (*Osteoglossum bicirrhosum*) in Northeastern Peru. *IUCN Otter Spec. Group Bull.* **25** (2): 89 – 93 https://www.iucnosgbull.org/Volume25/Recharte_et_al_2008.html

**Rheingantz, M.L., de Menezes J.F.S., de Thoisy, B. (2014).** Defining Neotropical otter Lontra longicaudis distribution, conservation priorities and ecological frontiers. *Tropical Conservation Science* **7**(2): 214-229.

**Rosas-Ribeiro, P.F., Rosas, F.C.W., Zuanon, J. (2011).** Conflict between fishermen and giant otters *Pteronura brasiliensis* in Western Brazilian Amazon. *Biotropica*, **44:** 437-444 DOI: https://doi.org/10.1111/j.1744-7429.2011.00828.x

**Shariff, S.M. (1984).** Some observations on otters at Kuala Gula, Perak and National Park, Pahang. *J. Wildl. Nat. Parks* **3**: 75 - 88**.**

**Sivasothi, N., & Nor, B. H. (1994).** A review of otters (Carnivora: Mustelidae: Lutrinae) in Malaysia and Singapore. *Hydrobiologia* **285**: 151–1704). DOI: https://doi.org/10.1007/BF00005663

**Smith CJ, Kramer RJ, Myhre G, Forster PM, Soden BJ, Andrews T, Boucher O, Faluvegi G, Fläschner D, Hodnebrog Ø, Kasoar M, Kharin V, Kirkevåg A, Lamarque JF, Mülmenstädt J, Olivié D, Richardson T, Samset BH, Shindell D, Stier P, Takemura T, Voulgarakis A, Watson-Parris D. (2018).** Understanding Rapid Adjustments to Diverse Forcing Agents. *Geophys Res Lett.* **45**(21): 12023-12031. DOI: https://doi.org/10.1029/2018GL079826

**Woodroffe R, Thirgood S, Rabinowitz A (2005)**. People and wildlife—conflict or coexistence? Cambridge University Press, Cambridge. ISBN 9780511614774. DOI: https://doi.org/10.1017/CBO9780511614774

**Václavíková M, Václavík T, Kostkan V. (2011). Otters vs. fishermen: Stakeholders' perceptions of otter predation and damage compensation in the Czech Republic.** *J Nat Conserv*, **19:** 95–102. DOI: http://dx.doi.org/10.1016/j.jnc.2010.07.001

**RESUME**

**PREMIERE CONSERVATION BASEE SUR UNE COMMUNAUTE LOCALE POUR LA LOUTRE A PELAGE LISSE A PURI, ODISHA, EN INDE**

La présence d'une espèce dans un paysage modifié par l'homme conduit souvent à des situations de conflit. Toute perte pour les communautés locales constitue une menace majeure pour une espèce dans son habitat. La loutre à pelage lisse est un prédateur au sommet des écosystèmes aquatiques et entre souvent en interaction directe avec les communautés locales. La conservation ne peut être possible que lorsque les communautés sont sensibilisées et impliquées dans des programmes de conservation qui protègent la faune et l'habitat. Ce projet de conservation est le premier projet de conservation communautaire d'Odisha sur les loutres à pelage lisse. Lors de notre étude des loutres à pelage lisse à Puri, Odisha, en Inde, nous avons approché des communautés locales grâce à des campagnes de sensibilisation sociale dans les écoles, une information des services départementaux, l'établissement de relations, les peintures murales, l'indemnisation des filets de pêche endommagés et des ateliers communautaires locaux, estimant que la sensibilisation est le principal outil pour aider les programmes de conservation.

**RESUMEN**

**PRIMER CASO DE CONSERVACIÓN BASADA EN LA COMUNIDAD, PARA LA NUTRIA LISA, EN PURI, ODISHA, INDIA**

La presencia de una especie en un paisaje modificado por el ser humano, a menudo conduce a situaciones de conflicto. Cualquier pérdida de una comunidad local implica una gran amenaza para una especie en su hábitat. La Nutria Lisa es un predador tope de los ecosistemas acuáticos, y a menudo entra en interacciones directas con las comunidades locales. La conservación sólo puede ser posible cuando las comunidades conocen y se involucran en los programas de conservación que salvaguardan la fauna y el hábitat. Este proyecto de conservación es el primer proyecto comunitario de conservación de Nutrias Lisas de Odisha. Para nuestro estudio de las Nutrias Lisas en Puri, Odisha, India, nos acercamos a las comunidades locales a través de campañas de difusión y sensibilización en escuelas, sensibilización en departamentos gubernamentales, construcción de confianza, pintura de murales, compensación de redes de pesca, y talleres con la comunidad local, y creemos que la concientización y sensibilización son las principales herramientas de ayuda a los programas de conservación.

REPORT

# SMOOTH-COATED OTTER (*Lutrogale perspicillata*) PREYS ON INVASIVE FISHES IN VADUVOOR BIRD SANCTUARY, TAMIL NADU, SOUTHERN INDIA: CAN OTTERS BE POTENTIAL BIO-CONTROLLERS?

Ramesh GOWTHAM, Kamalanathan SHARMA, Selvarasu SATHISHKUMAR*

*Department of Zoology and Wildlife Biology, A.V.C. College (Autonomous), Mayiladuthurai, Tamil Nadu, India, affiliated to Bharathidasan University, Tiruchirappalli*
**Corresponding author: e-mail: ksathish605@gmail.com*



(Received 29th August 2021, accepted 1st January 2022)

**Abstract:** Alien species are menacing global biological diversity by causing significant disruption of native species. The invasive fish species *Pterygoplichthys sp*. and *Oreochromis sp.* were eaten by smooth-coated otter at Vaduvoor Bird Sanctuary, Tamil Nadu. In total, six encounters were detected by both direct and indirect (corpses) observation. The invasive species play a major and important role in the smooth-coated otter's diet. Hence, the observations showed that otter predation on invasive fish species could be as a promising potential bio-controller in inland waters and wetlands.
**Citation: Gowtham, R., Sharma, K. and Sathishkumar, S. (2022).** Smooth-Coated Otter (*Lutrogale perspicillata*) Preys on Invasive Fishes in Vaduvoor Bird Sanctuary, Tamil Nadu, Southern India: Can Otters be Potential Bio-Controllers?. *IUCN Otter Spec. Group Bull.* **39** (2): 73 - 94
**Keywords:** Bio-controller, *Lutrogale perspicillata*, Invasive fish, *Pterygoplichthys spp*. *Oreochromis spp.*, Vaduvoor Bird Sanctuary

## INTRODUCTION

Invasive species are a threat to native species, and global biological diversity by causing significant disruption of native population and fluctuating key ecosystem processes (Pejchar and Mooney, 2009). *Pterygoplichthys* spp. are considered to be potential pests, with low economic value, across global fisheries (Seshagiri et al., 2021; Nico et al., 2012). They are native to the Amazon River basin of Brazil and Peru (Weber, 2003; Page and Robins, 2006). *Pterygoplichthys* spp. are known for bony plates covering the body, sucking lips, and a flat-bottomed body (Page and Burr, 1991), and they are common aquarium fish (Hussan et al., 2016). These invasive fish were introduced into the wild either intentionally or accidentally (Seshagiri et al., 2021; Singh, 2014). The impact of these alien species on native fish species and aquatic habitat have been recorded from several Southeast Asian countries, including Singapore, Malaysian Peninsula, Java, Sumatra, Vietnam, and Taiwan (Liang et al., 2005; Page and Robins, 2006; Levin et al., 2008), Bangladesh (Hossain et al., 2008) and India (Daniels, 2006; Krishnakumar et al., 2009; Knight, 2010; Sinha et al., 2010). They are also reported in Southern India *P. multiradiatus* from Kerala (Ajithkumar *et al*., 1998), and *P. pardalis* and *P.disjunstivus* from the Cauvery basin of Tamil Nadu (Murugan Muralidharan et al., 2015). They are now becoming a notable threat to native aquaculture and inland water ecosystem (Feroz and Preetha, 2009). Similarly, Tilapia (*Oreochromis mossambicus* Peters, 1852) is also an invasive fish in Indian aquaculture, native to south-eastern Africa. Bio-invasion of tilapia was reported in Lake Jaisamand, India. Tilapia is highly invasive due to high abundance and competitiveness for food and space compared to indigenous fish fauna (Ujjania et al., 2015). The Fisheries Research Committee of India had imposed a ban on tilapia propagation in 1959. In India, tilapia is competing with native, indigenous, and endemic inland freshwater fishes in terms of growth and resource utilization (Ujjania et al., 2015). This species has higher economical value, and human and animal predation are population controlling factors. *O. mossambicus* species is a high protein resource and is therefore referred as aquatic chicken (Dauda et al., 2014). Nevertheless, these two fish are considered as a threat to the native aquatic species.

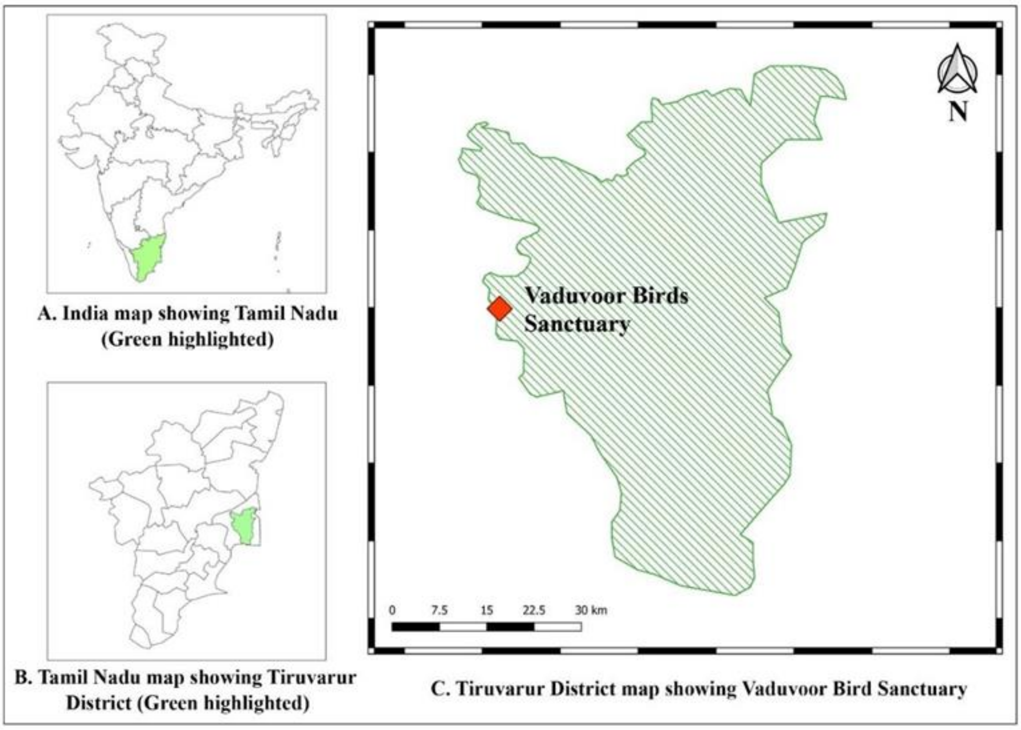
## Smooth-Coated Otter

The smooth-coated otter (SCO) (*Lutrogale perspicillata*) is the top carnivore in wetland ecosystems (Shenoy, 2005; Khan et al., 2010). Generally, it is found in freshwater wetlands, coastal mangrove forests, riverbanks, river islands, and coastal areas. Otters are medium-sized carnivores; they are highly generalised and diverse feeders. They can prey on small mammals, reptiles, aquatic invertebrates, fishes (Lanszki et al.,2015), and birds (De la Hey, 2008). They play a vital role as an indicator of a healthy aquatic ecosystem (Ruiz-Olmo et al., 1998), balancing freshwater ecosystems (Nawab and Hussain, 2012), and especially in food webs (Roemer et al., 2009). These river sailors are apex in the riparian food pyramid (Kruuk et al., 1997) and are able to prey competently on various species belonging to both aquatic and land communities (Dey et al., 2018). The present observation documented the SCO hunting and killing invasive *Pterygoplichthys* and Tilapia.

## Observation Area

Vaduvoor Bird Sanctuary is located at 10.42’-14.9” N and 79.19’-10.3” E, Tiruvarur district, Tamil Nadu, India (Fig. 1). The annual temperature ranges from a minimum of 26 °C to a maximum of 37° C. The mean annual rainfall is 1100 to 1260mm and the elevation is 28m. 0.42 sq.km of Vaduvoor lake is the main water resource of the 1.28 sq.km. sanctuary, which has a seasonal, highly fluctuating water level. The habitat comprises of highly patchy landscape with both aquatic and terrestrial zones, and has heterogeneous vegetation with floral species such as *Acacia nilotica, Prosopis juliflora, Azadirachta indica, Pongamia pinnata, Pithecellobium dulce, Delonix regia, Sphaeranthus indicus, Momordica charantia, Ipomoea carnea, Typha angustifolia, Themenda triandra,* and *Pontederia crassipes*. Commonly available fish species are Catla (*Catla catla*), Armored catfish (*Pterygoplichthys pardalis*), Tilapia (*Oreochromis mossambicus*), Catfish (*Clarias batrachus*), Murrel (*Channa striata*), Spined loach (*Cobitis taenia*), Common Eel (*Anguilla bengalensis*), and Indian Mackerel (*Rastrelliger kanagurta*). SCO was formally reported in the area by Arivoli and Narasimmarajan (2021). However, the forest officials had previously spotted SCO in 2018 during the synchronized bird census in the Vaduvoor lake.

(I)




(II)

**Figure 1.** (I) Location of Vaduvoor Bird Sanctuary and Vaduvoor lake (above), and (II) otter habitat in Tiruvarur District, Southern India.

## Observations

During the distribution survey in Vaduvoor bird Sanctuary, Tiruvarur, we were walking 1 km transacts along a six-kilometer stretch of lake bank, when we sighted an

SCO hunting Armored catfish (*P. pardalis*) and Tilapia (*O. mossambicus*); we recorded the activity with a Canon Power Shot SX430 IS camera from the distance of ca. 100m. To understand whether SCOs often feed on such invasive fish species, we enquired of residents around the study area regarding this phenomenon. Live encounters with otters feeding on *P. pardalis* and *O. mossambicus* are counted as direct sightings, and fish remains found near the otter latrine site are considered indirect signs of otters feeding on this species.

In total in our survey at Vaduvoor Bird Sanctuary, six encounters were reported, of which three were indirect sightings and three were direct observations (Table 1). On February 18, 2021, at 17:24hr, a direct observation of feeding activity lasted for about three minutes, during which the otter first brought the hunted *P. pardalis* to the shore and held it in an inverted position (Fig. 2). Then it started consuming the fish from the posterior portion and ate it up to the neck region. Finally, the head region was discarded. In three indirect observations, we were found either the head portion left discarded, or a fish carcass with marks of bite marks on tail portion was found. Both direct and indirect obversvations found that the heads of the fish were discarded rather than eaten. We infer that otters do not prefer the head portion of the *P. pardalis*; this might because head regions do not have fleshy portions but do have a hard, bony skull. Likewise, otters were also seen feeding on *O. mossambicus*.

**Table 1.** Observations of Smooth-coated otter feeding on invasive fish in Vaduvoor Sanctuary.

| Sl. No. | Observed date | Encounter type | Fish species | Observation distance (m) | Time of Encounter (hh:mm) |
|---|---|---|---|---|---|
| 1 | 02-03-2021 | Direct | *O. mossambicus* | 85 | 09:18 |
| 2 | 28-02-2021 | Indirect | *P. Pardalis* | 0.3 | 10:00 |
| 3 | 28-02-2021 | Direct | *O. mossambicus* | 72 | 10:15 |
| 4 | 19-02-2021 | Indirect | *P. Pardalis* | 0.5 | 07:26 |
| 5 | 18-02-2021 | Direct | *P. Pardalis* | 100 | 17:24 |
| 6 | 05-02-2021 | Indirect | *P. Pardalis* | 0.3 | 09:49 |

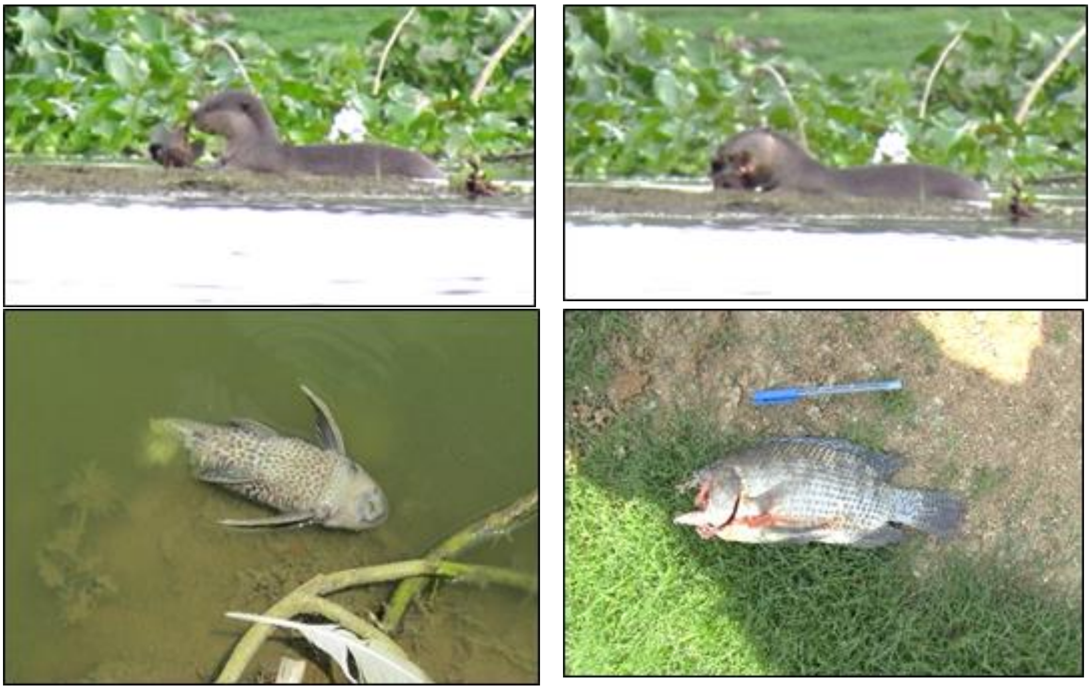


**Figure 2: a** and **b**) Otter hunting and killing armored catfish *P. pardalis*; **c**) Armored Catfish remains left by otter (*Pterygoplichthys pardalis*); **d**) Tilapia remains left by an otter (*Oreochromis mossambicus*)

## People's Perception of Otters preying on Invasive Species

The survey was made by questionnaire to fifty selected respondents, with a small number of questions and photographs of fish found around the sanctuary (Table 2). People often visit the sanctuary for various purposes like resources utilization and livestock grazing. 60% of the people indicated that they had had live encounters and were familiar with the phenomenon of otters feeding on *P. pardalis*. According to these people, *P. paradalis* is a pest species in the Vaduvoor Bird Sanctuary. Though Tilapa is also an alien species, it has economic and nutritional value, whereas *P. pardalis* has no economic value and little nutrient value (Hussan *et al*., 2016). *O. mossambicus* is taken for food by local people but they consider *P. pardalis* as an unaesthetic "weed fish".

**Table 2.** The questionnaire data on Smooth-Coated otter feeding invasive fishes in Vaduvoor Sanctuary

| S. No | Questions |
|---|---|
| 1 | Demographic questions |
| 2 | Have you seen otters before? |
| 3 | Have you seen otters feeding on fish? |
| 4 | What is the distance at which you saw the otter? |
| 5 | Identify the fish that otter was eating from the following: |
| | A  B  C  D  |

## DISCUSSION

Top predators usually have cascading effects on the population down to lower trophic levels in an ecosystem (Winnie and Creel, 2017). The presence of sea otters having such an influence on nearshore communities has been reported (Estes and Palmisano, 1974). A decline in predator species population makes an ecosystem disproportionately viable for dominant organisms at lower trophic levels (Judith, 2011). One reason behind the success of some invasive species is the absence of predators in the new environment. Invasive species like *Pterygoplichthys* spp. and *Oreochromis mossambicus* can make the environment more competitive and threaten the native biodiversity in absence of predation. Thus, they operate as a dominant community and use resources at faster rates than other coexisting native species. SCO are feeding preferentially on *P. pardalis* and this may be because of its slow mobility and easy of capture. Similarly, there are diet-based studies of other otter species that reveal feeding on this fish species. A study from the Neotropical region tells river otters' food preference has shifted towards this fish over other prey species (Juarez-Sanchez et al., 2019). Similarly, Karunarathna et al. (2008) reported water monitor (*Varanus salvator*) predation on Suckermouth Catfish (*Hypostomus plecostomus*) in Bellanwila-Attidiya Sanctuary. Thus, the otter's diet may impact the population growth of these invaders. There is a need for continuous monitoring of otter health and ecology which can be used as a tool to indicate the health of that ecosystem. Appropriate conservation protocols should be created to encourage indigenous biodiversity. Otters do not just indicate the richness of habitat structures, but also insulate them against ecological imbalances and degradation (Goedeke and Rikoon 2008; Blanco-Garrido et al., 2008; Rheingantz et al., 2014; Okes, 2017).

## CONCLUSIONS

From the observation, there is no effective control measures to prevent the spreading and massive growth of invasive *P. pardalis* and *O. mossambicus* in the sanctuary. Fortunately, the natural food-web system offers some controlling ways to prevent the growth of this invasive occupant. During the questionnaire survey, awareness was given to people especially to the children on the threat of invasive species and otter prominence. In regards to otter deeds against invasive fish species act as a potential bio-controller, future studies should concern with dietary aspects of smooth-coated otters that might be reveal the potential preying quality of smooth-coated otter against these invader fish species.

**Acknowledgements -** We acknowledge the Tamil Nadu Forest Department, especially Mr. Syed Muzammil Abbas, IFS, the PCCF & CWW, Chennai. Dr. K. Arivoli, DFO, Thiruvarur Division, Thiuruvarur district. Mr. N.V. Jayachandran, Forest Range Officers, Mannargudi range, Thiruvarur, for granting permission and for logistic support. We also thank the management and the Dr. R. Nagarajan, Principal and Dr. K. Chitra Priya, Assistant Professor, of A.V.C. College (Autonomous), Mannampandal, Mayiladuthurai, for the constant encouragement and support. We deeply thank Dr. Katrina Fernandez, Ecologist & Director, Wild Otters Research Pvt Ltd for her advice during the field surveys. We would like to thank Mr. Ramesh, APW, Mr. Shankar, APW, Mrs. Jothi and Mr. Srinivasan for their constant help during the field work.

## REFERENCES

**Ajithkumar, C.R., Biju, C.R., Thomas, R. (1998).** *Plecostomus multiradiatus* - an armored catfish from freshwater ponds near Kunnamkulam, Kerala and its possible impact on indigenous fishes. LAK News, Limnological Association of Kerala. *Wiley Black well*. pp. 1-2.

**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

**Blanco-Garrido, F., Prenda, J., Narvaez, M. (2008).** Eurasian otter (*Lutra lutra*) diet and prey selection in Mediterranean streams invaded by centrarchid fishes. *Springer*. **10**(5): 641–648.

**Daniels, R.J.R. (2006).** Introduced fishes: a potential threat to the native freshwater fishes of Peninsular India. *Journal of the Bombay Natural History Society*. **103**(2 and 3): 346-348.

**Dauda, A.B., Yakubu, SO., Oke, A.O. (2014)**. Curbing the Menace of Prolific Breeding in “Aquatic Chicken” (Tilapia): A Way out to Improve Fish Production in Nigeria. *N Y Sci. J*. **7**(4):112-118.

**de la Hey, D.C. (2008).** The importance of birds in the diet of otter *Lutra lutra* on Shapwick Heath. *Bioscience Horizons: The International Journal of Student Research*, **1**(2): 143–147. doi: https://doi.org/10.1093/biohorizons/hzn018

**Dey, S., Choudhary, S., Kelkar, N. (2018).** On the Rehabilitation of a Hand-Reared Adult Smooth-Coated Otter *Lutrogale perspicillata* in Bihar, India. *IUCN Otter Spec. Group Bull*. **35**: 71-84. https://www.iucnosgbull.org/Volume35/Dey_et_al_2018.html

**Estes, J.A. and Palmisano, J.F. (1974)**. Sea Otters: Their Role in Structuring Nearshore Communities. *Science*, **185**: 1058 - 1060. DOI: https://doi.org/10.1126/science.185.4156.1058

**Feroz Khan, M., Preetha Panikkar. (2009).** Assessment of impacts of invasive fishes on the food web structure and ecosystem properties of a tropical reservoir in India. *Elsevier*. **220**(18): 2281–2290.

**Goedeke, T.L., Rikoon, S. (2008)**. Otters as actors: scientific controversy, dynamism of networks, and the implications of power in ecological restoration. *Social Studies of Science*. **38**(1):111-32.

**Hossain, M.Y., Rahman, M.M., Ahmed, Z.F., Ohtomi, J., Islam, A.B.M.S. (2008)**. First record of the South American sailfin catfish *Pterygoplichthys multiradiatus* in Bangladesh. *Journal of Applied Ichthyology*. **24**: 718-720.

**Hussan, A., Choudhury, T.G., Das, A., Gita, S. (2016).** Suckermouth sailfin catfishes: A future threat to aquatic ecosystems of India. *Aquaculture Times*. **2:** 20-22.

**Juarez-Sanchez, D., Blake, J.G., Hellgren, E.C. (2019)**. Variation in Neotropical River otter (*Lontra longicaudis*) diet: Effects of an invasive prey species. *PLoS ONE*. **14**(10), p.e0217727. doi https://doi.org/10.1371/journal.pone.0217727

**Karunarathna, D.M.S.S., Amarasinghe, A.T., Ekanayake, E.M.K.B. (2008)**. Observed predation on a suckermouth catfish (*Hypostomus plecostomus*) by a water monitor (*Varanus salvator*) in Bellanwila-Attidiya Sanctuary. *Biawak*. **2(1)**: 37-39.

**Khan, Waseem, Qasim, M., Ahmad, E., Chaudhry, A., Bhaagat, H., and Akhtar, M. (2010).** Status of Smooth Coated Otter (*Lutrogale perspicillata sindica*) in Pakistan. *Pakistan Journal of Zoology*, **42**: 817-824.

**Knight, J.D.M. (2010)**. Invasive ornamental fish: a potential threat to aquatic biodiversity in peninsular India. *Journal of Threatened Taxa*. **2**(2): 700-704.

**Kolappan, B. (2018)**. River otters show up in Vaduvoor lake. https://www.thehindu.com/news/national/tamil-nadu/river-otters-show-up-in-vaduvoor lake/article 25415226.ece (accessed on 10th July 2021).

**Krishnakumar, K., Raghavan, R., Prasad, G., Bijukumar, A., Sekharan, M., Pereira, B., Ali, A. (2009)**. When pets become pests – exotic aquarium fishes and biological invasions in Kerala, India. *Current Science*. **97**: 4-25.

**Kruuk, H., Conroy, J.W.H., Webb, A. (1997)**. Concentrations of mercury in otters (*Lutra lutra* L.) in Scotland in relation to rainfall. *Elsevier*. **96**(1): 0–18.

**Lanszki J., Bauer-Haáz É.A., Széles L.G., Heltai M. (2015).** Diet and feeding habits of the Eurasian otter (Lutra lutra): experiences from post mortem analysis. *Mammal Study*, **40**:1–11. doi: https://doi.org/10.3106/041.040.0102 .

**Levin, B.A., Phuong, P.H., Pavlov, D.S. (2008)**. Discovery of the Amazon sailfin catfish *Pterygoplichthys pardalis* (Castelnau, 1855) (Teleostei: Loricariidae) in Vietnam. *Journal of Applied Ichthyology*. **24**: 715- 717.

**Liang, S.H., Wu, H.P., Shieh, B.S. (2005)**. Size structure, reproductive phenology, and sex ratio of an exotic armored catfish (*Liposarcus multiradiatus*) in the Kaoping River of southern Taiwan. *Zoological Studies*. **44**(2): 252-259.

**Moorthy, M., Arumugam, S., Thipramalai, T.A.K. (2016)**. Occurrence of a *Pterygoplichthys disjunctivus* (Weber, 1991) population in Cauvery River System, Tamil Nadu, South India, *Int. J. Fish. Aquac*: 2-4.

**Muralidharan, M., Manikandan, K., Gobi, M. (2015)**. Extended distribution of theinvasive Sucker catfish *Pterygoplichthys pardalis* (Pisces: Loricariidae) to Cauvery river system of Peninsular India. *Int. J. Aquat. Biol*. **3**(1):14-18.

**Nawab, A., Hussain, S.A. (2012).** Prey selection by Smooth-coated otter (*Lutrogale perspicillata*) in response to variation in fish abundance in Upper Gangetic Plains, India. *Mammalia*,**76**: 57-65

**Nico, L., Cannister, M., Neilson, M. (2012)**. *Pterygoplichthys pardalis*. USGS Nonindigenous Aquatic Species Database, Gainesville, FL.

**Okes, N.C. (2017)**. Conservation ecology of the Cape clawless otter, *Aonyx capensis*, in an urban environment. (Thesis). University of Cape Town, Faculty of Science, Department of Biological Sciences.

**Page, L.M., Burr, B.M. (1991)**. A field guide to freshwater fishes of North America north of Mexico. Peterson Field Guide Series, Houghton Mifflin Company, Boston, MA. *Houghton Mifflin Harcourt*. 432 p.

**Page, L.M., Robins, H.R. (2006)**. Identification of sailfin catfishes (Teleostei: Loricaridae) in Southeastern Asia. *Raffles Bulletin of Zoology*. **54**: 455-457.

**Pejchar, L., Mooney, H. (2009)**. Invasive species, ecosystem services and human well-being. *Trends in Ecology and Evolution*. **24**(9): 0–504.

**Rheingantz, M.L., de Menezes, J.F.S., de Thoisy, B. (2014)**. Defining Neotropical otter *Lontra longicaudis* distribution, conservation priorities and ecological frontiers. *Tropical Conservation Science*. **7**(2): 214-229.

**Roemer, G. W., Gompper, M. E. and Valkengurgh, B. V. (2009)**. The ecological role of the mammalian mesocarnivore. *BioScience* **59**:165–173.

**Ruiz-Olmo, J., Delibes. M. and Zapata, S.C. (1998).** External morphometry, demography and mortality of the otter *Lutra lutra* (Linneo, 1758) in the Iberian Peninsula. *Galemys*, **10**: 239-251.
**Seshagiri, B., Swain, S.K., Pillai, B.R., Satyavati, C., Sravanti, Y., Rangacharyulu, P.V., Rathod, R., Ratnaprakash, V. (2021)**. Suckermouth armoured catfish (*Pterygoplichthys spp*.) menace in freshwater aquaculture and natural aquatic systems in Andhra Pradesh, India. *International Journal of Fisheries and Aquatic Studies*. **9**(1): 375-384.
**Shenoy, K., Varma, S., & Prasad, K. V. D. (2006).** Factors determining habitat choice of the smooth-coated otter, *Lutra perspicillata*, in a South Indian river system. *Current Science*, **91**(5): 637–643.
**Singh, A.K. (2014)**. Emerging alien species in Indian aquaculture: prospects and threats. *Journal of Aquatic Biology & Fisheries*. **2**(1):32-41.
**Sinha, R.K., Sarkar, U.K., Lakra, W.S. (2010)**. First record of the southern sailfin catfish, *Pterygoplichthys anisistsi* Eigenmann and Kennedy, 1903 (Teleostei: Loricariidae), in India. *Journal of Applied Ichthyology*. **26**: 606-608.
**Soulé, M.E., Estes, J.A., Miller, B., Honnold, D.L. (2005)**. Strongly interacting species: conservation policy, management, and ethics. *Bioscience*. **55(2)**, pp.168-176.
**Times of India. (2019)**. Smooth coated otters spotted in bird count. https://timesofindia.indiatimes.com/city/trichy/smooth-coated-otters-spotted-in-bird-count/articleshow/67949442.cms (accessed on 10th July 2021).
**Ujjania, N.C., Monika, D., Sharma, L.L., Vijay Kumar, B., Srivastva, R.M. (2015)**. Bio-invasion of exotic fish tilapia (Oreochromis mossambicus P. 1852) in Lake Jaisamand, India. *International Journal of Fisheries and Aquatic Studies*. **3**(2): 174-177.
**Weber, C. (2003)**. Subfamily Hypostominae (armored catfishes). In: **R.E. Reis, S.O. Kullander, C.J. Ferraris, Jr. (eds.)**. Check List of the Freshwater Fishes of South and Central America. *EDIPUCRS, Porto Alegre*. 729 pp.
**Weis, J.S. (2011)**. Invasion and predation in aquatic ecosystems. *Current Zoology*. **57** (5): 613−624. DOI: https://doi.org/10.1093/czoolo/57.5.613
**Winnie, J.R., John, Creel, Scott. (2016)**. The Many Effects of Carnivores on their Prey and Their Implications for Trophic Cascades, and Ecosystem Structure and Function. *FOOWEB*. **3**.

## RESUME

## LA LOUTRE À PELAGE LISSE (*Lutrogale perspicillata*) SE NOURRIT DE POISSONS ENVASIFS DANS LE SANCTUAIRE DES OISEAUX DE VADUVOOR, AU TAMIL NADU, EN INDE DU SUD. LES LOUTRES PEUVENT-ELLES ÊTRE DES BIO-CONTROLEURS POTENTIELS ?

Les espèces exotiques menacent la biodiversité mondiale causant une perturbation importante des espèces indigènes. Les espèces de poissons invasifs *Pterygoplichthys sp.* et *Oreochromis sp*. ont servi de proies aux loutres à pelage lisse dans le sanctuaire des oiseaux de Vaduvoor, au Tamil Nadu. Au total, six indices de présence ont été découverts par observation directe et indirecte (cadavres). Les espèces invasives jouent un rôle majeur et important dans le régime alimentaire de la loutre à pelage lisse. En conséquence, cette observation a montré que le comportement des loutres prédatrices des espèces de poissons invasifs joue un rôle de bio-contrôleur potentiel prometteur dans les eaux intérieures et les zones humides.

## RESUMEN

## LA NUTRIA LISA (*Lutrogale perspicillata*) DEPREDA SOBRE PECES INVASORES EN EL SANTUARIO DE AVES VADUVOOR, TAMIL NADU, SUR DE INDIA - ¿PUEDEN LAS NUTRIAS SER BIO-CONTROLADORES POTENCIALES?

Las especies introducidas están amenazando a la diversidad biológica global, causando una disrupción significativa en las especies nativas. Las especies del pez invasor *Pterygoplichthys spp.* y *Oreochromis spp.* fueron comidas por la nutria lisa en el Santuario de Aves Vaduvoor, Tamil Nadu. En total, fueron detectados seis encuentros, tanto mediante observaciones directas como indirectas (carcasas). Las especies invasoras juegan un rol grande e importante en la dieta de la nutria lisa. Por lo tanto, la observación mostró que las nutrias pueden ser un prometedor bio-control potencial sobre las especies de peces invasores en aguas y humedales interiores.

**REVIEW**

# OTTERS IN NORTHEAST INDIA A REVIEW OF THE SPARSE AVAILABLE INFORMATION

Melissa SAVAGE

*Department of Geography, University of California Los Angeles, Los Angeles 90095 USA*
*e-mail: forests@ucla.edu*

(Received 13th december 2021, accepted 1st January 2022)

**Abstract:** I review the status of our knowledge of three otter species *Lutra lutra, Lutrogale perspicillata*, and *Aonyx cinereus* (Mammalia: Carnivora: Mustelidae) reported to inhabit the Northeast region of India. I summarize the scant current documentation of otter distribution in eight Northeast states, and review human pressures on otters, which include a tradition of hunting and illegal trafficking. I searched publications that 1) record the confirmed presence of otters in states of the Northeast, and 2) report seizures of otters in the illegal wildlife trade in the states of the Northeast. I also consider the role of West Bengal, to the west of the region, in the illegal otter trade. The eight states that comprise Northeast India, are experiencing dramatic social shifts, increasing anthropogenic pressures, and decreasing regional isolation. A once highly remote and traditional region is being drawn slowly into the national and international economy, with marked consequences for wildlife. Confirmed records of otter species in the region are scarce, as are records of otter pelt seizure data.

**Citation: Savage, M. (2022).** Otters in Northeast India: A Review of the Sparse Available Information *IUCN Otter Spec. Group Bull.* **39** (2): 81 - 89

**Keywords**: Eurasian Otter, Smooth-coated Otter, Small-clawed Otter, Northeast India, hunting, illegal wildlife trade

## INTRODUCTION

The Northeast region of India lies on three international borders: Myanmar to the east, Bangladesh to the west, and China to the north (Fig. 1). It encompasses the junction of two biodiversity hotspots: the paleo-arctic flora of the Tibetan highlands and the evergreen monsoon flora of Southeast Asia. Its diverse topography ranges from the snowy peaks of the Himalayas down to the deep gorges, tropical valleys, and abundant rivers in the south. While the Northeast constitutes only 8 % of the area of India, it hosts 60% of India's endangered species and the country's highest faunal diversity (Choudhury, 2006). There are many designated protected areas, including Kaziranga, Manas, Namdapha, Ntangki, Murlen, Sirohi, Manas and Nameri National Parks (NP), and numerous wildlife and forest reserves. Yet these reserves have often experienced intense anthropogenic impacts from hunting, shifting agriculture, logging, and political turmoil.

There is very little research on otters in the region, even while an abundance of rivers and wetlands provide excellent habitat. Three species of otters have been documented, the Eurasian otter (*Lutra lutra* Linnaeus, 1758), Small-clawed otter (*Aonyx cinereus* Illiger, 1815) and Smooth-coated otter (*Lutrogale perspicillata* I. Geoffroy Saint-Hilaire 1826). The Red List of the International Union for the Conservation of Nature (IUCN) classifies the Smooth-coated otter and Small-clawed otter species as Vulnerable (Khoo et al., 2021; Wright et al., 2015) and the Eurasian otter as Near Threatened (Roos et al., 2021). All three species are decreasing across their range in Asia (Gomez and Shepherd, 2019).

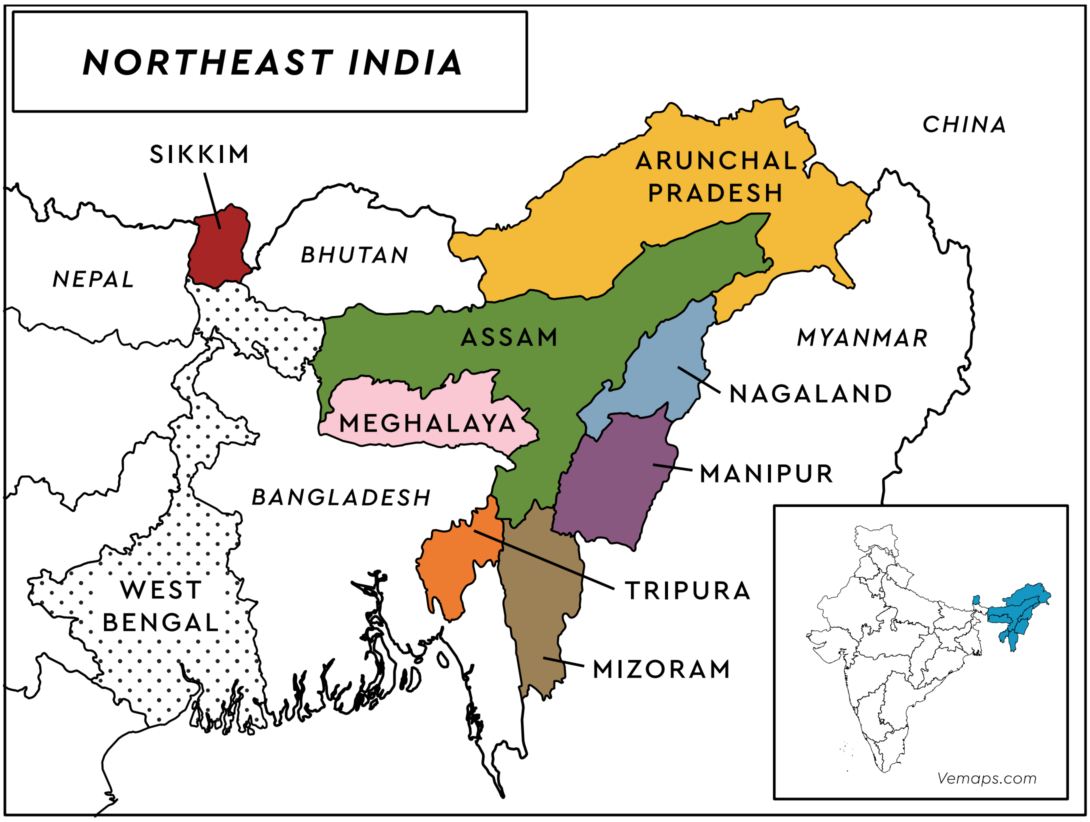



**Figure 1.** The eight states of Northeast India (color) and the adjacent state of West Bengal (dots).

The region, with a patchwork of 225 tribal groups, is an ethnically complex and sensitive area, with a tradition of local self-rule and historical resistance to national governance. In some states, such as Nagaland and Assam, there have been chronic separatist insurgencies. This has affected the management of wildlife, and protected reserves have sometimes been under the control of rebel groups and heavily hunted (Bhattacharya, 2017).

Hunting is deeply embedded in many tribal cultures of the Northeast. Much of the region bears a cultural affinity with Southeast Asia, where hunting is more traditional than in peninsular India (Aiyadurai et al., 2010). Guns are readily available and hunting is widespread, even within protected areas (Naniwadekar et al., 2013; Velho and Laurance, 2013). Animals, including otters, are killed for meat, medicine, retaliation, ceremonies and for the wildlife trade (Aiyadurai, 2007). Some tribes claim traditional management of the land and the right to hunt for subsistence and commerce (Velho and Laurance, 2013). Of 85 households surveyed in a village in Arunachal

Pradesh, for example, 54% reported hunting for subsistence, 25% for commercial trade, and 10% for medicinal purposes (Selvan et al., 2013). Hunting for consumption is slowly being replaced by hunting for income in Northeast India, that is, by the wildlife trade (Corlett, 2007).

Two features of the illegal wildlife trade in Northeast India are notable. First is the role of a history of insurgency and armed conflict in recent decades. Militant groups have been involved in hunting and poaching of wildlife, in Manipur and Assam for example, where wildlife products are sometimes traded for sophisticated arms (Guha, 2015). Secondly, international organized crime networks play a significant role in the illegal wildlife trade in parts of Northeast India (Levy and Scott-Clark, 2007). The presence in the region of organized crime syndicates based in China, Nepal and Thailand enables financial incentives, management of shipments across international borders, forgery of permits, and provision of weaponry associated with drug trafficking (Levy and Scott-Clark, 2007).

Traditional hunting in the region now takes place against a background of intensifying pressures on wildlife and while once sustainable, is now contributing to a steep decline in wildlife populations (Aiyadurai et al., 2010; Bupathy et al., 2013). Depletion of wildlife populations in Southeast Asia has increased demand from Northeast India. Prices for wild animal products have soared, as has demand in Southeast Asia and China (Niraj et al., 2012). Declines across many mammal populations near the border with Myanmar due to illegal hunting are documented in the Ziro Valley (Selvan et al., 2013) and Namdapha NP (Datta et al., 2008a) in Arunachal Pradesh, reflecting similar patterns of hunting and wildlife decline in northern Myanmar (Rao et al., 2011). Datta et al., (2008b) suggest that hunting in the area has created an "empty forest" phenomenon.

Otters are among the species hunted in the Northeast but the level of hunting pressure on otters is poorly documented. Hunting otters for the illegal trade, in contrast to traditional uses such as food or medicine, is increasing in the region because of the high value of their pelts (Datta et al., 2008b; Aiyadurai, 2011). Datta et al. (2008b) suggest that otters are highly threatened by commercial hunting in Namdapha NP, near the Myanmar border, where hunters from Myanmar and China poach otters for sale outside the region (Chetry and Medhi, 2006). The high value of otter pelts is reflected in their frequent bundling with other high value wildlife products such as tiger skins, ivory and rhino horn. Lucrative wildlife parts can also be packaged with narcotics and arms, and sent across porous international borders (Niraj et al., 2012). Despite a complete ban on trade and hunting of wildlife added to the 1972 Wildlife Protection Act of India, the conviction rate for wildlife crimes is only 2.5% (Goswami, 2016), probably much lower in the Northeast. Many of the region's protected areas are remote and poorly staffed, and wildlife protection is weak.

Cross-border trade routes have existed for centuries in the Northeast: to the east into Myanmar and China and to the west through the states of West Bengal and Sikkim to Nepal and China. Myanmar shares a 1,643 km border with Arunachal Pradesh, Nagaland, Manipur and Mizoram, a long and porous border now considered a backdoor for wildlife trafficking to China through that country (Mitral 2006). The largest city in the Northeast, Guwahati in Assam, has become a major hub for international illegal trade, handling wildlife products transshipped, often by air, from other parts of India into China via Myanmar (Megalaya Times, 2010). Trading hubs trafficking into Myanmar include Imphal and Moreh in Manipur, near the Myanmar border (Sangai Express, 2016), Dimapur in Nagaland, due to its proximity to Kaziranga NP (Megalaya Times, 2010), Aizwal in Mizoram, and Shillong in Meghalaya (Bupathy 2013).

Poachers from Myanmar cross the border into Namdapha NP in Arunachal Pradesh to take otters for the China market (Datta et al., 2008b). Otter pelts from the Northeast are also reported to travel westward to smuggling gateway cities of Siliguri and Darjeeling in West Bengal (Martin, 1999), then north to Sikkim and onwards to the Tibet Autonomous Region through the ancient trade route of the Nathula Pass (Zeigler et al., 2010).

## METHODS

Scholarly papers that included records of sightings or otter sign (tracks, scat, latrines) were searched in Google Scholar, and records of seizure of otter pelts were searched in online publications including regional newspapers and online reports (November 2021) using the search terms “otters”,“illegal otter trade”,”otter seizures”,“otter pelt” and “otter skin” for the Northeast states and West Bengal from 1994 to 2020. Records of otter pelt seizures were also searched for the adjacent state of West Bengal, because of its important role in trafficking wildlife north into China. Published papers and the database of the Wildlife Crime Database of the Wildlife Protection Society of India were also searched. Only reliable publications, survey data, or photographs from 1997 forward were included, given the rapidly shifting status of otters in South Asia. Species, origin and destination were not usually reported.

## RESULTS

### Documented otter presence

There are exceptionally few confirmed records of otter presence in the Indian Northeast. Most are from the two northern states, Assam and Arunachal Pradesh.

Das et al. (2007) and Sinha et al. (2020) reported Smooth-coated otters in Manas NP in Assam. Smooth-coated otters have been photographed numerous times in Kaziranga NP, Assam, (e.g., Bhattacharya, 2013). The release of a Small-clawed otter pup rescued from a flood in Kaziranga NP was recorded by The Assam Tribune (2015). Saikia and Saikia (2012) reported Eurasian otters observed by park staff in Nameri NP.

All three otter species have been documented in Arunachal Pradesh, a large, remote state bordering on China and Myanmar. Borker and Gogi (2019) conducted a rapid survey in Pakke Tiger Reserve, documenting 20 sign of Small-clawed otters and 23 sign of Eurasian Otters. The presence of Eurasian otters (Chetry and Madhi, 2006) in the Dibang Wildlife Sanctuary and Small-clawed otters in the Namdapha Tiger Reserve have been documented (Datta et al., 2008b; Naniwadekar et al., 2013), and Smooth-coated otters (Medhi et al., 2014) and Eurasian Otters (Bhattacharya et al., 2019) have been photographed in Nyamjang Chu Valley.

A survey by Khatiwara et al. (2020) found a meager amount of otter sign along the Teesta and Rangeet Rivers, the major rivers in Sikkim. In 2016, officers of the Forest Environment Management and Wildlife Department in Sikkim rescued, rehabilitated, and released a female Eurasian otter found in a small hill stream in northern Sikkim (Khatiwara et al., 2020). Beyond these few records, there are only unconfirmed, informal reports of otters elsewhere in the Northeastern states, in Manipur, Meghalaya, Tripura, Mizoram and Nagaland, where no systematic surveys or studies have been conducted.

### Documented seizure incidents

Fifty otter pelts seized in 8 incidents were reported from the Northeast States from 1997 to 2017 (Table 1). Half of the incidents, 4, were reported in Assam, a state adjacent to West Bengal. Three seizure incidents occurred in Arunachal Pradesh and one in Meghalaya.

**Table 1.** Seizures of otter pelts in Northeast India, 1997-2017

| Date | State | Location | Number of Pelts | Source |
|---|---|---|---|---|
| 1997 | Meghalaya | Garo Hills | 13 | TRAFFIC Bulletin (2012) |
| 1998 | Assam | Sonitpur | 1 | WPSI (2015) |
| 2001 | Arunachal Pradesh | Lohit | 3 | Banks & Newman (2004) |
| 2009 | Assam | Barpeta | 5 | WPSI (2015) |
| 2009 | Assam | Barpeta | 1 | Robin de Bois # 2 (2013) |
| 2011 | Arunachal Pradesh | Dibang Wildlife Sanctuary | 8 | Pandey (2009) |
| 2011 | Arunachal Pradesh | Dibang Wildlife Sanctuary | 15 | Arunachal Times (2011) |
| 2017 | Assam | Dhemaji District | 4 | New Indian Express (2017) |
| **Total** | | | **50** | |

The numbers of otter pelts seized in the adjacent state of West Bengal are greater than in the Northeast states, reflecting its role as a major hub for wildlife trafficking through Sikkim into Nepal and China. Many of these pelts likely originate in the Northeastern states. In 9 incidents in the West Bengal a total of 248 otters were seized, most in the large towns of Darjeeling and Siliguri (Table 2).

**Table 2.** Seizures of otter pelts in West Bengal, India, 1994-2014

| Date | State | Location | Number of pelts | Source |
|---|---|---|---|---|
| 1994 | West Bengal | Darjeeling | 9 | WPSI (2015) |
| 1995 | West Bengal | Nadia | 5 | WPSI (2015) |
| 1996 | West Bengal | Darjeeling | 94 | WPSI (2015) |
| 2000 | West Bengal | Darjeeling | 81 | WPSI (2015) |
| 2003 | West Bengal | Siliguri | 19 | Chakravorty (2003) |
| 2011 | West Bengal | Siliguri | 19 | Wildlife Trust of India (2015) |
| 2014 | West Bengal | Baikunthapur Forest | 1 | Robin de Bois #5 (2014) |
| 2014 | West Bengal | Jalpaiguri | 1 | WPSI (2015) |
| 2020 | West Bengal | Siliguri | 19 | Wildlife Trust of India (2020) |
| **Total** | | | **248** | |

## DISCUSSION AND CONCLUSION

Otter species are presumed to inhabit Northeast India, but there is little information to confirm their distribution and status there. These three otter species deserve greater research attention in the region given the quality of habitat there and the decline of otter populations across South Asia. The documented record of otter pelt seizures is also very sparse, in contrast to the numerous illegal trade seizure records for otters in the rest of India (Gomez et al., 2016). Even records from the Northeast of trafficked high-profile species such as tiger, leopard, and rhinos are relatively sparse (Goswami, 2016). Declines in numbers of otter seizure records over time may reflect the success of trafficking suppression or the prevailing weak enforcement of regional trafficking, but perhaps more likely, an increasing scarcity of otters. In any case, the vast majority of illegal wildlife trafficking likely goes undetected (Gomez et al., 2016).

The Indian Northeast is being rapidly reshaped through the development of commercial markets, road construction, communications, and hydroelectric generation projects. Cash is becoming a more necessary medium of exchange, for sending children to school or paying for medical treatment (Aiyadurai, 2011). Poaching is seen as a way to supplement income (Aiyadurai, 2007). Ever more fluid international trade patterns are changing social relationships. In some areas, otter hunting is a relatively new practice, using traps acquired in Myanmar (Aiyadurai and Velho, 2016). Hunting as an aspect of spiritual well-being of communities, including restraints such as taboos on hunting in certain seasons, appear to be eroding (Aiyadurai, 2011).

The entities in India working to reduce wildlife trafficking, including the Wildlife Control Bureau, as well as State Forest Departments, customs agents, and local police forces, need to focus more attention on the trafficking of otters in the Northeast States. Broad collaborations are useful, such as the recent formation of an interagency entity between enforcement agencies of Assam, Manipur and Nagaland to address the illegal trade.

The deep relationship of local people to their natural environment means that wildlife conservation is ultimately in the hands of the many indigenous communities of the Northeast. India has acknowledged this with the 2005 Recognition of Forest Rights legislation, which gave property and livelihood rights to tribal communities (Niraj et al., 2012), in principle strengthening local control. A large proportion of land in the region is community-managed, 62% for example in Arunachal Pradesh (Velho et al., 2016). One community-based resource success story is that of Manas NP in Assam. Bodo tribal communities felt their land rights threatened, when, in 1985, a 39,100 ha area was protected as a Natural World Heritage Site. Armed tribal rebels took control of the park in the 1990s, with negative impacts on wildlife populations, extirpating rhinos completely (Bhattacharya, 2017). A 2003 peace accord created a system of self-rule in the form of the Bodoland Territorial Council, and former guerillas now consider themselves protectors of the park and its wildlife and serve as an anti-poaching force (Bhattacharya, 2017). Indigenous communities of the Northeast must be partners in a collaborative solution if wildlife, including otters, in Northeast India is to be conserved.

**Acknowledgments -** I thank Nicole Duplaix of the IUCN Otter Specialist Group, Belinda Wright of the Wildlife Protection Society of India for sharing her otter trade database, and Mariner Padwa for graphics.

## REFERENCES

**Aiyadurai, A. (2007).** Hunting in a biodiversity hotspot: a survey on hunting practices by indigenous communities in Arunachal Pradesh, North-east India. Technical Report to Rufford Small Grants Foundation, London, UK, 43pp.

**Aiyadurai, A. (2011).** Wildlife hunting and conservation in Northeast India: a need for an interdisciplinary understanding. *Int'l J. of Galliformes Cons*. **2**: 61-73.

**Aiyadurai, A., N.J. Singh Milner-Gulland, E.J. (2010).** Wildlife hunting by indigenous tribes: a case study from Arunachal Pradesh, north-east India. *Oryx* **44**: 564-572.

**Aiyadurai, A., Velho, N. (2016).** Wildlife hunting in the North East is much more complex than the simple act of killing. https://scroll.in/article/822350/wildlife-hunting-in-the-north-east-is-much-more-complex-than-the-simple-act-of-killing .

**Assam Tribune. (2015).** Small-clawed otter released in the wild. https://assamtribune.com/small-clawed-otter-released-in-the-wild

**Banks, D., Newman, J. (2004).** The Tiger Skin Trail. Environmental Investigation Agency, Bangkok. 24pp.

**Bhattacharya, B.K. (2017).** India's Manas National Park illustrates the human dimension of rhino conservation. *Mongabay Open Access J.* https://news.mongabay.com/2017/02/indias-manas-national-park-illustrates-the-human-dimension-of-rhino-conservation/

**Bhattacharya, B.K. (2013).** http://www.arindambhattacharya.com/blog/memories-2015-photographs/otter-kaziranga-arindam-bhattacharya-ab_9383/

**Bhattacharya, B.K., Waltham, 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**: 103-109. https://www.iucnosgbull.org/Volume36/Bhattacharya_et_al_2019.html

**Borker, A., Gogi, K. (2019).** Rapid Otter Survey in Arunachal Pradesh. Final Report to the IUCN Otter Specialist Group. https://www.himalayanotternetwork.org/research/

**Bupathy, S., Kumar, S.R., Thirumalain, P., Paramanandham, J., Lemba, C. (2013).** Wildlife exploitation: a market survey in Nagaland, North-eastern India. *Tropical Cons. Sci.* **6**: 241-253. https://doi.org/10.1177/194008291300600206

**Chakravorty, K. (2003).** Haul blows lid off animal parts trade - Police seize pelts worth Rs 50 lakh. The Telegraph Online. https://www.telegraphindia.com/west-bengal/haul-blows-lid-off-animal-parts-trade-police-seize-pelts-worth-rs-50-lakh/cid/842461

**Chetry, D., Medhi, R. (2006).** Primate survey in Dibang Wildlife Sanctuary in Arunachal Pradesh, India and its conservation perspectives. Report to the Rufford Small Grants Fnd., London, UK and Aaranyak, Guwahati, Assam, India, 20pp.

**Choudhury, A. (2006).** The status of endangered species in Northeast India. J. *Bombay Nat. Hist. Soc.* **103**: 157-167.

**Corlett, R.T. (2007).** The impact of hunting on the mammalian fauna of tropical Asian forests. *Biotropica* **39**: 292-303.

**Das, C., Ahmed, M.F., Das, A., Singha, H. (2007).** Status and distribution of otters in Western Assam, India. Aaranyak Rept. Assam, India. 30pp.

**Datta, A., Anand, M.O., Naniwadekar, R. (2008a).** Empty forests: large carnivore and prey abundance in Namdapha National Park, north-east India. *Biol. Cons*. **141**: 1429-1435.

**Datta, A., Naniwadekar. R., Anand, M.O. (2008b).** Occurrence and conservation status of small carnivores in two protected areas in Arunachal Pradesh, north-east India. *Small Carniv. Cons.* **39**: 1-10.

**Gomez, L., Leupen, B.T.C., Theng, M., Fernandez, K, Savage, M. (2016).** Illegal otter trade: an analysis of seizures in selected Asian countries (1980-2015). Kuala Lumpur: TRAFFIC. Petaling Jaya, Selangor, Malaysia. 44pp.

**Gomez, L., Shepherd, C.R. (2019).** Stronger international regulations and increased enforcement effort is needed to end the illegal Trade in otters in Asia. *IUCN Otter Spec. Group Bull*. **36**: 71-76. https://www.iucnosgbull.org/Volume36/Gomez_Shepherd_2019.html

**Goswami, U. (30 July 2016).** Lesser known species like Otter, Pangolin form a large part of wildlife trade. https://economictimes.indiatimes.com/news/politics-and-nation/lesser-known-species-like-otter-pangolin-form-a-large-part-of-wildlife-trade/articleshow/53458633.cms

**Guha, N. (20 August 2015).** The tale of the flourishing multi-million wildlife trade. https://nabarunspeaks.wordpress.com/2015/08/20/the-tale-of-the-flourishing-multi-million-wildlife-trade/

**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

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

**Levy, A., Scott-Clark, C. (2007).** Poaching for Bin Laden. The Guardian, 4 May 2007. https://www.theguardian.com/world/2007/may/05/terrorism.animalwelfare

**Martin, E. (1999).** West Bengal - Committed to rhino conservation yet a major entrepot for endangered wildlife products. *Pachyderm* **27**: 105-112.

**Medhi, K., Chakraborty, R., Upadhyay, J. (2014).** Photographic record of smooth-coated otter (*Lutrogale perspicillata* Geoffroy 1826) in Nyamjang Chu Valley, Arunachal Pradesh, India. IUCN Otter Spec. Group Bull. **31**: 75-79. https://www.iucnosgbull.org/Volume31/Medhi_et_al_2014.html

**Meghalaya Times (21 June 2010).** Assam's international airport a hub for smuggling wildlife products? https://bigcatrescue.org/assams-international-airport-a-hub-for-smuggling-wildlife-products/

**Mitral, N. (7 September 2006).** Myanmar, not Nepal, is now the primary route for smuggling rhino horns from Assam. The Times of India. http://timesofindia.indiatimes.com/india/Myanmar-not-

Nepal-is-now-the-primary-route-for-smuggling-rhino-horns-from-Assam-Report/articleshow/54051431.cms
**Naniwadekar, R., Shukla, U., Viswanathanv, A., Datta. (2013).** Records of small carnivores from in and around Namdapha Tiger Reserve, Arunachal Pradesh, India. *Small Carniv. Cons.* **49**: 1-8.
**New Indian Express. (2017).** Massive seizure of animal parts in Assam. https://www.newindianexpress.com/nation/2017/aug/27/massive-seizure-of-animal-parts-in-assam-two-from-arunachal-pradesh-arrested-1648604.html
**Niraj, S.K., Krausman, P.R., Dayal, V. (2012).** A stakeholder perspective into wildlife policy in India. *J. of Wildl. Mgmt.* **76**: 10-18.
**Pandey, R.K. (2009).** Role of Bawaria gangs in poaching of tigers and leopards and their linkages in illegal trans-boundary wildlife trade. Wildlife Trust of India Archives. 21pp. http://docplayer.net/65412070-Role-of-bawaria-gangs-in-poaching-of-tigers-and-leopards-and-their-linkages-in-illegal-trans-boundary-wildlife-trade.html
**Rao, M., Zaw, T., Htun, S, Myint, T. (2011).** Hunting for a living: wildlife trade, rural livelihoods and declining wildlife in Hkakaborazi National Park, North Myanmar. *Envir. Mgmt.* **48**: 158-167.
**Robin de Bois. (2013).** On the Trail No. 2. https://www.robindesbois.org/wp-content/uploads/ON_THE_TRAIL_2.pdf
**Robin de Bois. (2014).** On the Trail No. 5. https://robindesbois.org/wp-content/uploads/ON_THE_TRAIL_5.pdf
**Roos, A., Loy, A., Savage, M. & Kranz, A. (2021).** *Lutra lutra*. The IUCN Red List of Threatened Species 2021: e.T12419A164578163. https://dx.doi.org/10.2305/IUCN.UK.2021-3.RLTS.T12419A164578163.en
**Saikia, M.K., Saikia, P.K. (2012).** Wildlife habitat evaluation and mammalian checklist of Nameri National Park, Assam, India. *Bioresearch Bull.* **4**: 185-199.
**Sangai Express. (2016).** Threats and obstacles in conservation of biodiversity in Manipur. http://e-pao.net/epSubPageExtractor.asp?src=education.Science_and_Technology.Threats_obstacles_in_conservation_of_biodiversity_in_Manipur_Part_1_By_Kh_Hitler
**Selvan, K.M., Veeraswami, G.G., Habib, B., Lyngdoh, S. (2013).** Losing threatened and rare wildlife to hunting in Ziro Valley, Arunachal Pradesh, India. *Current Sci.* **104**: 1492-1495.
**Sinha, A., Devi, N., Potter, A.B. (2020).** Sighting of a Smooth-coated Otter *Lutrogale perspicillata* in Manas National Park, Assam, India. IUCN Otter Spec. Group Bull. **37**: 136-139. https://www.iucnosgbull.org/Volume37/Sinha_et_al_2020.html
**The Arunachal Times. (11 March 2011).** Three poachers arrested, fifteen skins of endangered otters seized. http://www.arunachaltimes.in/archives/mar11%2011.html
**TRAFFIC. (2012).** TRAFFIC Bulletin Seizures and Prosecutions: **16**(3) (March 1997) to **24**(1) (April 2012).
**Velho, N., Laurance, W.F. (2013).** Hunting practices of an Indo-Tibetan Buddhist tribe in Arunachal Pradesh, north-east India. *Oryx* **47**: 389-392.
**Velho, N., Sreekar, R., Laurance, W.F. (2016).** Terrestrial species in protected areas and community-managed lands in Arunachal Pradesh, Northeast India. *Land* **5**: 35.
**Wildlife Protection Society of India. (2015).** Otter Skin Seizure Cases, 1980 to 2015. Wildlife Crime Database. Response to Request.
**Wildlife Trust of India. (2020).** Major seizure of wildlife articles made in Siliguri. https://www.wti.org.in/news/major-seizure-of-wildlife-articles-made-in-siliguri/
**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
**Zeigler, S., Gebauer, A., Melisch, R., Sharma, B.K., Ghose, P.S., Chakraborty, R., Shrestha, P., Ghose, D., Legshey, K., Pradhan, H., Bhutia, N.T., Tambe, S., Sinha, S. (2010).** Sikkim - under the sign of the red panda, pp. 79-92. In: Zeitschrift des Kolner **53**. Jahrgang, Heft 2. Appendix 1. Data Sources

## RESUME

## LES LOUTRES DANS LE NORD-EST DE L'INDE, UN APERÇU DES INFORMATIONS EPARSES DISPONIBLES

Nous avons passé en revue l'état de nos connaissances sur trois espèces de loutres *Lutra lutra*, *Lutrogale perspicillata* et *Aonyx cinereus* (*Mammalia : Carnivora : Mustelidae*) signalées comme présentes dans la région du Nord-Est de l'Inde. Ce résumé mentionne le peu d'informations actuelles sur la distribution des loutres dans huit États du Nord-

Est et passe en revue les pressions humaines sur les loutres qui incluent une tradition de chasse et de trafic illégal. La recherche a été axée sur des publications qui 1) mentionnent la présence confirmée de loutres dans les États du Nord-Est, et 2) signalent des saisies de loutres dans le commerce illégal d'espèces sauvages dans les États du Nord-Est. Le rôle du Bengale occidental, à l'ouest de la région, dans le commerce illégal de loutre est également cité. Les huit États qui composent le Nord-Est de l'Inde connaissent des changements sociaux spectaculaires, des pressions anthropiques croissantes et une réduction de l'isolement régional. Cette région, autrefois très éloignée et traditionnelle, a lentement évolué vers l'économie nationale et internationale, avec des conséquences attestées pour la faune sauvage. Les observations confirmées d'espèces de loutres dans la région sont rares, tout comme les enregistrements de données sur les saisies de peaux de loutre.

**RESUMEN**

**LAS NUTRIAS EN EL NORESTE DE INDIA – REVISIÓN DE LA INFORMACIÓN DISPERSA DISPONIBLE**

Reviso el status de nuestro conocimiento de las tres especies de nutria *Lutra lutra, Lutrogale perspicillata* y *Aonyx cinereus* (Mammalia: Carnivora: Mustelidae), que se ha informado que habitan en la región Noreste de India. Resumo la escasa documentación actual sobre la distribución de nutrias en ocho estados del Noreste, y reviso las presiones humanas sobre las nutrias, que incluyen una tradición de caza y tráfico ilegal. Realicé una búsqueda en publicaciones que 1) registren la presencia confirmada de nutrias en los estados del Noreste, y 2) informen secuestros de nutrias en el comercio ilegal en los estados del Noreste. También considero el rol de Bengala Occidental, hacia el oeste de la región, en el comercio ilegal de nutrias. Los ocho estados que comprende el Noreste de India están experimentando cambios sociales dramáticos, presiones antropogénicas en aumento, y disminución del aislamiento regional. Una región anteriormente altamente remota y tradicional está siendo integrada lentamente en la economía nacional e internacional, con marcadas consecuencias sobre la fauna. Los registros confirmados de especies de nutrias en la región son escasos, como lo son también los registros de datos sobre secuestro de cueros de nutria.

**ARTICLE**

# HAS THE RECOLONIZATION OF THE PO PLAIN BEGUN? UPDATES REGARDING THE PRESENCE OF THE EURASIAN OTTER (*Lutra lutra*) IN NORTH-EASTERN ITALY

Giacomo STOKEL[1], Marcello FRANCHINI[1], Lorenzo FRANGINI[1]*, Elisabetta PIZZUL[2], Stefano FILACORDA[1]

[1]*Dipartimento di Scienze agroalimentari, ambientali e animali, Università degli Studi di Udine, via delle Scienze 206, 33100, Udine (UD), Italy*
[2]*Dipartimento di Scienze della Vita, Università degli Studi di Trieste, via L. Giorgieri 10, 34127 Trieste (TS), Italy*
* *Corresponding author: lorenzo.frangini@uniud.it*





(Received 5th November 2021, accepted 31st January 2022)

**Abstract:** Widespread in Italy in the early 1900s, the Eurasian otter subsequently underwent a dramatic decline that led to its local extinction in many administrative regions, with the exception of a small residual nucleus in southern Italy. For a few years now, the Austrian and Slovenian populations adjacent to north-eastern Italy have been increasing sharply, leading to a recolonization of the area by the species. During 2020, in Friuli Venezia Giulia, surveys of signs of presence were carried out in 48 grid cells (10 x 10 km) to update information on the species' local distribution. The following monitoring methods were used: monitoring beneath bridges combined with transects along water courses. 17 grid cells tested positive for the presence of the species, and currently, the otter appears widely distributed in Friuli Venezia Giulia along the main waterways of the Eastern Alps and Prealps, and in some areas overlooking the plain of the Tagliamento and the transborder Isonzo-Soča basin, both included in the Po plain. These constitute the first observations of the species for more than 50 years. Compared to previous studies, 13 new grid cells involving the presence of otters were identified, including in lowland areas, suggesting a progressive expansion from the mountain ranges towards the Po-Venetian Plain. This represents, a spur to expand research

and implement new studies to improve levels of knowledge about and the consequent protection of the species. Finally, the integration of transects along riverbanks to monitoring beneath bridges, allowed us both to collect numerous observation and to compare our results with previous studies.
**Citation: Stokel, G,., Franchini, M., Frangini, L., Pizzul, E. and Filacorda, S. (2022).** Has the Recolonization of the Po Plain Begun? Updates regarding the Presence of the Otter (*Lutra lutra*) in North-Eastern Italy. *IUCN Otter Spec. Group Bull.* **39** (2): 90 - 101
**Keywords:** colonization, distribution, Friuli Venezia Giulia, monitoring, Eurasian otter

## INTRODUCTION

The Eurasian otter (*Lutra lutra*) represents the most widely distributed species belonging to the subfamily Lutrinae, being distributed from Asia to Europe, with nuclei also present in North Africa (Hung and Law, 2016). In Europe the species has suffered a severe contraction in its historical range as a result of various factors such as the extensive use of pesticides, poaching and habitat loss (Macdonald and Mason, 1994). For this reason, globally, the species is classified as ‘Near Threatened’ by the IUCN (International Union for the Conservation of Nature) (Roos et al., 2015), and ‘Endangered’ at the Italian level (Rondinini et al., 2013). Currently, at a global level, the species is in decline, while in Europe a new expansion is underway (Roos et al., 2015; Yoxon and Yoxon, 2019; Loy and Duplaix, 2020), particularly as a result of European Union regulations which provide for common courses of action for the protection of the species and the safeguarding of the environments it inhabits. In Italy, at the beginning of the 20$^{th}$ century the otter was widespread along the entire of the peninsula (Cavazza, 1911; Cassola, 1986), before it underwent a dramatic decline as a result of several factors stated above. Following these setbacks, at the end of the 20$^{th}$ century, only a small, relict population persisted in southern Italy, with the species being widespread in Basilicata and in parts of Campania, Puglia and Calabria (Cassola, 1986). Meanwhile, in the northern Italy the species went extinct across its historical distribution range, even in the north-eastern area embedding the Friuli Venezia Giulia administrative region (hereafter, FVG) (Cassola, 1986; Prigioni, 2003). However, in 2002-04 a systematic survey realized in southern Italy reported an increase in the otter distribution, compared to the national otter survey conducted in 1984-86 (Marcelli and Fusillo, 2009). Moreover, in northern Italy, two areas were recently naturally recolonized by the species from the bordering Austria: one in the Autonomous Province of Bolzano (Righetti, 2011), and another in FVG (Lapini and Bonesi, 2011; Pavanello et al., 2015). Furthermore, a small population of B-line otters, originated from a reintroduction programme, is established along the Ticino river between Lombardy and Piedmont administrative regions (Prigioni et al., 2009; Tremolada et al., 2020).

In FVG, otters were widespread in the Isonzo basin (on the border with Slovenia), throughout the southern plain, and in the middle course of the Tagliamento river and its tributaries in the central area of the region. In the Carnic and Julian Prealps the species was rarely reported and there are no relevant data for the Alps (Lapini, 1986). The last specimens in FVG were shot in the 1970s (Filacorda, pers. comm.). The first reports after the species’ disappearance referred to single observations of wandering individuals in 1984 and 2008 in which signs of presence were found along the Natisone valleys near the border with Slovenia (Lapini and Bonesi, 2011). However, after years of absence, as a result of the increase of the neighbouring Austrian population (Kranz and Poledník, 2015; Schenekar and Weiss, 2018; Kranz and Poledník, 2020), the otter expanded into some areas of north-eastern Italy along the ecological corridors of the Drava and Gail rivers. In 2011 and 2012 two individuals were run over in the area of the morainic hills and the Prealps (Lapini et al., 2020) and, subsequently, it proved possible to demonstrate a regular presence of the species in the eastern Alps (Pavanello et al., 2015; Lapini et al., 2020). In 2019, the first records were also reported from the western portion of the region (Lapini et al., 2020). Of a more fragmentary nature, however, is the data regarding the dynamics of the expansion of the populations in neighbouring Slovenia (Kryštufek, 2001; Hönigsfeld Adamič, 2010). Although the data available varies in quality and consistency, the expansion from the eastern sector to the FVG appears to be less strong. This said, the ecological corridor represented by the Isonzo-Soča river and its tributaries (the river Natisone-Nadiža *in primis*, but also the Vipacco-Vipava and Uccea-Ucja rivers) is extensive and potentially represent an optimal link between Slovenia and Italy (Pavanello et al., 2015). Based on the information collected, the purpose of this study is therefore to deepen and broaden knowledge regarding the distribution of the otter in FVG, a key area for the species' expansion and recolonization of north-eastern Italy, through the integration of transects along riverbanks to the monitoring beneath bridges.

## MATERIALS AND METHODS

### Study area

The study was conducted within the Friuli Venezia Giulia administrative region (FVG) in north-eastern Italy, bordering Austria and Slovenia. Morphologically it is a heterogeneous zone, divided into five ecoregions (Fig. 1, Tab. 1) (Poldini et al., 2006): (*i*) Alpine and (*ii*) Prealpine, with the Carnic Alps and Prealps to the west and the Julian Alps and Prealps to the east, (*iii*) the plain, which also includes the morainic hills to the north, divided into a high plain to the north and a low plain to the south, (*iv*) the Karst, and (*v*) coastal areas. Specifically, the Veneto-Friulian plain is part of the Po plain, representing its north-easter offshoot (Stoch, 2009).

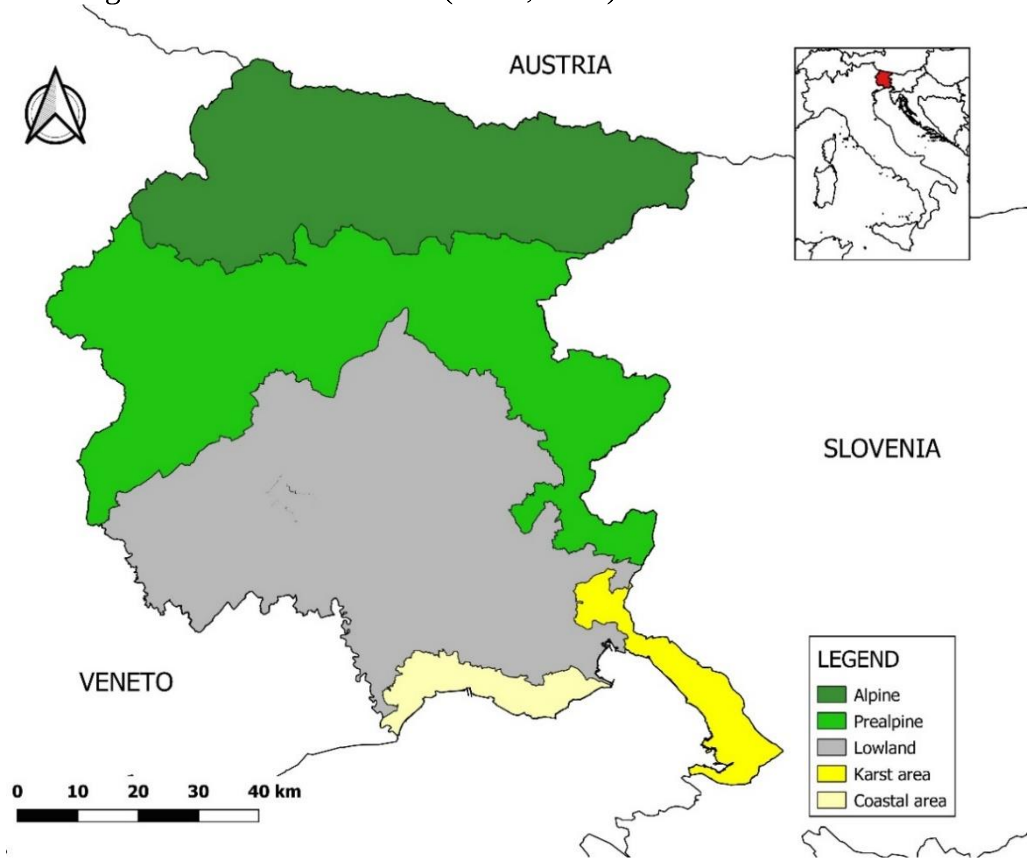



**Figure 1.** Subdivision of the study area into the various ecoregions.

**Table 1.** Characteristics of the natural areas in FVG. The main habitats are derived Corine Land Cover categories.

| Zone | Altimetric Range m a.s.l. | Main Habitat |
|---|---|---|
| Alpine | 300 – 2800 | Mixed forest |
| Prealpine | 50 – 2700 | Broad-leaved forest |
| Lowland | 0 – 500 | Non-irrigated arable land |
| Karst Area | 0 – 650 | Broad-leaved forest |
| Coast | 0 - 10 | Coastal lagoons |

From the hydrographic perspective, the two main rivers are the Tagliamento, the source of which lies in the Carnic Alps, and the Isonzo-Soča, which rises in the Julian Alps in Slovenia. Both cross the FVG and serve as important corridors to north-eastern Europe. Other important watercourses (Fig. 2) include the Livenza and the Stella, spring-fed rivers and historically inhabited by otters (Lapini, 1986), the river Fella which is in connection with the transborder Slizza-Gailitz torrent, which then crosses into Austria and enters the river Gail, the rivers Torre and the Natisone, which rise in the Julian Prealps, and the Meduna and the Cellina, two streams that originate in the Carnic Prealps.

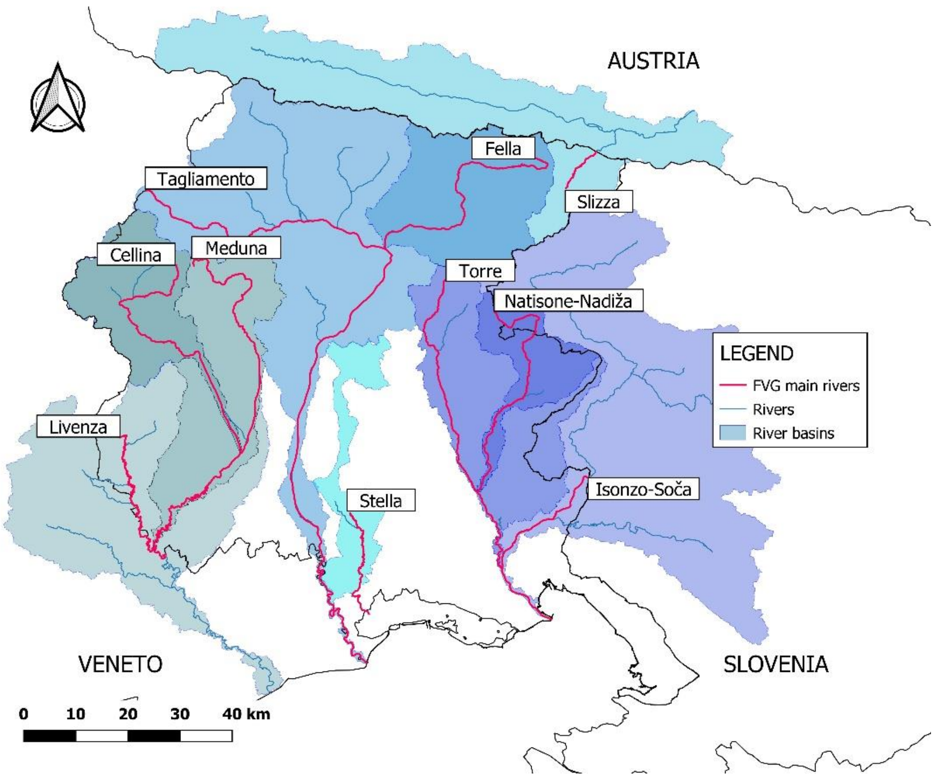



**Figure 2.** The main hydrographic network of the Region Friuli Venezia Giulia.

## Survey design

The study area was divided into 113 10 x 10 km UTM grid cells, as required by the European protocol IUCN / SSC Otter Specialist Group (Reuther et al., 2000) and in line with the provisions of the National Action Plan for the Conservation of the otter (Panzacchi et al., 2011). The survey was conducted within grid cells in which recent (less than 20 years) observations were obtained, in nearby cells, and where the species was historically distributed. Grid cells to be considered in the sampling design were chosen based on bibliographic information (Lapini et al., 2020) reporting the presence of the species, and data stored in archives of the University of Udine (Filacorda, unpub.

data), referring to both opportunistic observations and collected biological samples (mainly spraints and footprints). Moreover, suitable areas within each grid cell, able to favour the expansion of the species but not close to areas where the presence was recently ascertained, were selected based on the parameters of the land use and altitude (Loy et al., 2009; Ottaviani et al., 2009). The presence of otters was reported searching for signs of presence (spraints and jellies mainly) under 6 bridges in each cell, on average, as otters frequently mark under or near them, and footprints can often be found (Chanin, 2003), similarly to the previous systematic otter survey in FVG (Pavanello et al., 2015). Furthermore, in 20 grid cells we realized four transects of 100 or 500 m for each side of the riverbanks, and both north and southward starting from the monitored bridge. This was done to collect additional data that would provide further insights on both the presence of otters and the density of signs of presence in the study area.

The choice of bridges was made on the basis of three criteria: (*i*) the distance among them, (*ii*) the representativeness of the hydrographic bodies involved (e.g., streams, water channels, main rivers), and (*iii*) their accessibility. Following the information reported in the protocols and guidelines (Reuther et al., 2000; Panzacchi et al., 2011), an attempt was made to maintain a distance of about 5 km among the bridges in order to avoid potential pseudo-replication errors. However, given the heterogeneous morphology of the area, especially in the mountainous part, this was not always possible. The presence of different hydrographic bodies within each single grid cell was also considered, to try to obtain a good representativeness of them from the transects. Finally, the accessibility of the riverbed was a very influential factor, and thus those bridges that guaranteed easy access were chosen (Reuther et al., 2000). In summary, the bridges were considered as suitable if sufficiently distant from one another, if they were representative of the different environments for each grid cell and based on their accessibility.

Each grid cell was monitored twice, approximately one month apart, in the period between September and December 2020, for a total of 362 bridges monitored and 150 km performed. In order to visualize the distribution and intensity of the signs of presence (spraints, jellies, footprints) collected during the first monitoring session, their density was calculated using the quartic kernel method (Pennec et al., 2020), an interpolation algorithm, through the heatmap function of QGIS (Quantum Geographic Information System, v. 3.1.6). For a clearer representation on the map, a buffer of 5 km around each positive site was chosen, which is useful for discriminating the areas with greater density compared to the size of the study area.

## RESULTS

Otter presence was detected in n=17 grid cells out of 48, corresponding to 35% of those monitored. Most of the positive grid cells fell within the area of the Julian Alps and Prealps, with signs of presence in the Carnic Alps and Prealps as well, together with three positive grid cells in the lowland areas (Fig. 3). From the survey of bridges, 35 signs of presence (31 spraints and 4 footprints,) were recorded during the first monitoring session (x=2.92 ± 2.94, mean of signs per positive grid cell), while in the second session the number decreased to 18 (17 spraints and 1 footprint; x=4.50 ± 4.04). By means of transects survey, 11 signs of presence (2 spraints, 3 footprints, 2 jellies, 3 slides, 1 rest of predation) were recorded during the first campaign (x=1.57 ± 1.13), and 25 (22 spraints, 1 footprint, 1 slide) during the second one (x=2.78 ± 2.28). Finally, one carcass of a road killed individual was opportunistically discovered during the monitoring period. 52% of the signs of presence were detected in two grid cells: one (n = 25, number of observations) along the border with Austria and Slovenia in the Julian

Alps, and the other (n=22) between the Prealps and lowland, as shown in the density map (Fig. 4). The remaining signs of presence were found, in descending order of abundance: (*i*) in the Julian Alps and the Prealps, (*ii*) in the Isonzo plain, near the border with Slovenia, (*iii*) in the Prealpine area of the Natisone basin, (*iv*) in the Carnic Alps and Prealps (Fig. 4). Considering the river basins, the 86% (n=77) of positive signs fall in the Tagliamento basin (which also included the Slizza-Gailitz rivers), whereas the remaining signs were detected in the Isonzo-Soča basin. In the Tagliamento basin, the number of observations reaches its maximum in the Julian Alps, and then decreases from the mountains towards the lowlands along the course of the Fella river, increasing once again reaching the Prealps and the area of the plain including the morainic hills (Fig. 4). In the Isonzo-Soča basin, on the other hand, the remaining 14% (n=3) of the observations were recorded, mainly in the Prealpine and in the plain grid cells.

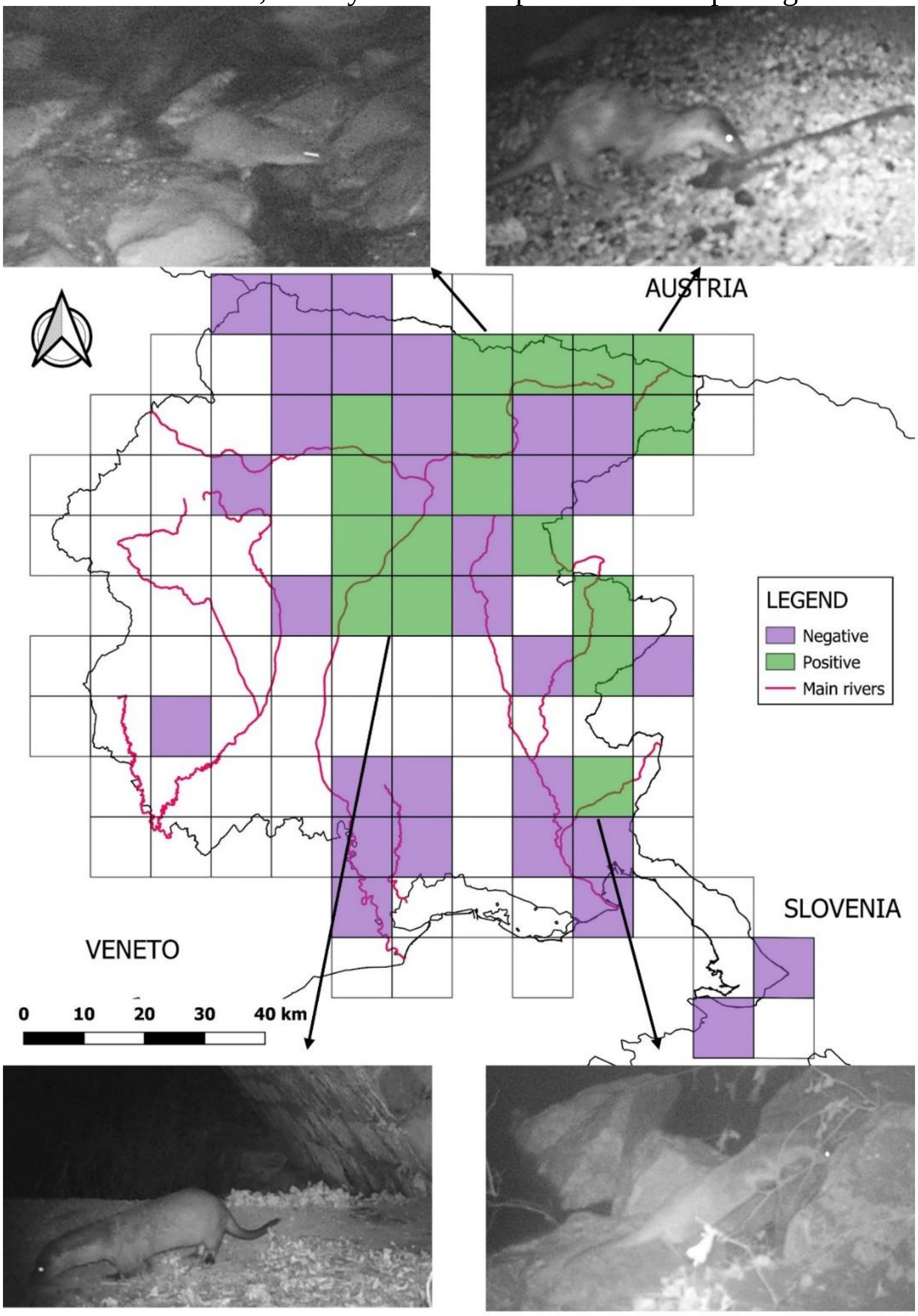



**Figure 3.** Grid cells in which the presence of the otter was detected. Images were obtained from camera traps (n = 7) deployed one per grid cell, where markings were observed at bridges or along transects after the first replication. Camera trap monitoring was performed for a total of 666 trap-nights.

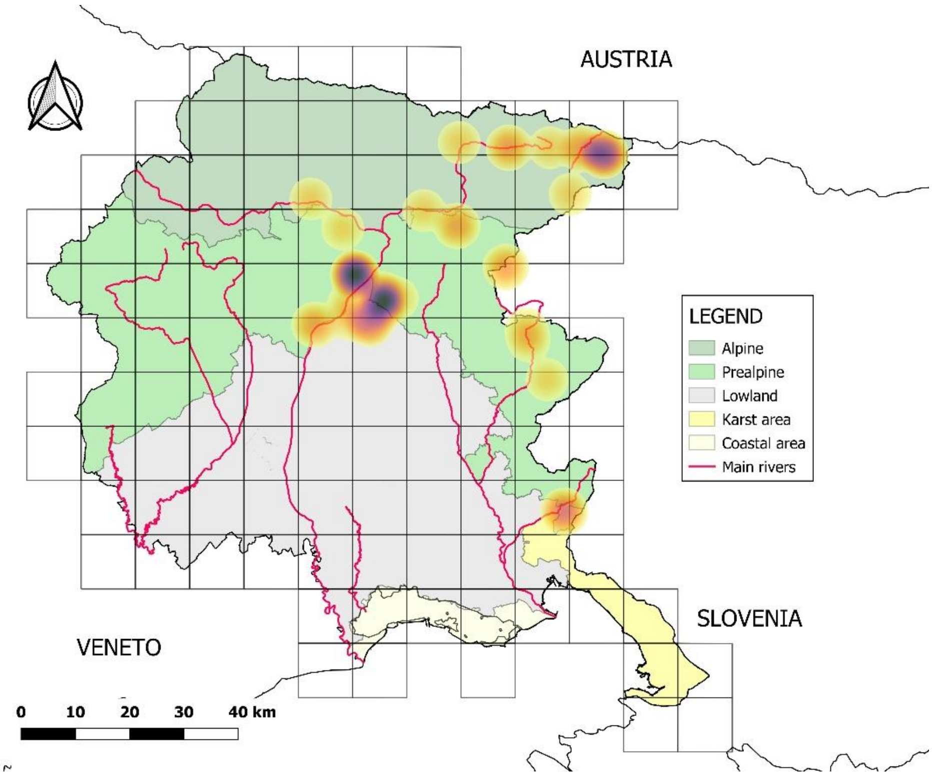



**Figure 4.** Density of signs of presence detected: the darker the colour, the greater the number of observations, and vice versa.

## DISCUSSION

The results of the large-scale survey conducted in FVG indicate that the otter is currently mainly distributed within the Alpine and Prealpine areas, but the first occurrences have also been detected in lowland areas, including the areas of the morainic hills. Therefore, it can be said that the species has begun its recolonization of the Po Plain starting from its north-easternmost area, returning to occupy territories where it had been missing for fifty years but that still appear very suitable for the species. Compared to the previous systematic survey conducted within FVG (Pavanello et al., 2015), there has been a significant expansion of the species, since it has been detected in an additional 13 grid cells. These differences in the results achieved most likely derive by the increase in terms of sampling effort in the area. Confirming this, 58% of the observations were obtained searching beneath bridges, and the 42% with the transects method. Moreover, the number of spraints found during a visit may vary as a function of a number of factors, not only in accordance with the use of the site by the otter (Mason and Macdonald, 2009). Therefore, it is very important to combine the pinpointing of bridges, useful for the low sampling effort required, with the use of transects, as this allows an increase in the probability of detecting the species, and thus obtaining a better representation of the local distribution (Romanowski et al., 1996; Reuther and Roy, 2001; Elmeros and Bussenius, 2002).

The area with the highest density of signs of presence turned out to be the north-eastern area, in the Julian Alps, likely related to the flow of individuals from the currently expanding and neighbouring Austrian population (Kranz and Poledník, 2015; Schenekar and Weiss, 2018; Kranz and Poledník, 2020), and where the first reproductive nucleus within north-eastern Italy was found (Pavanello et al., 2015). This is likely the source population for the nucleus that first colonized the Julian Alps, which then expanded along the Fella river in the Julian Prealps and, via the Tagliamento, towards the Carnic Alps and Prealps, as witnessed by the road-killed young male discovered during the survey period.

Within the Carnic Alps, recent studies (Lapini et al., 2020; Filacorda, unpub. data) have highlighted the presence of the species. Furthermore, in 2019 otter markings were also detected in the neighbouring Veneto administrative region, along the course of the Digon torrent, upstream of Sega Digon (Filacorda, unpub. data). However, in the present study the same area was extensively monitored in both survey campaigns, but the presence of the species was not detected in the course of 2020. It was hypothesized that the aforementioned negative result may be linked to the low detectability of the species in an area of recent re-expansion (Marcelli and Fusillo, 2018), along with human disturbance during the monitoring period (logging works and the restoration of the river banks following the 2019 “Vaia” natural disaster, a powerful autumn storm that destroyed millions of trees) (Udali et al., 2021). In the southernmost area of the Alps and in the Carnic Prealps, signs of the species were found in the area near the confluence between Tagliamento and Fella. This represents a new point of area of occurrence, and the discovery of the road-killed young male confirms that an expansion is taking place in the area, as are usually young males that undertake long journeys to colonize new areas (Arrendal, 2007).

In the eastern Prealpine area (the Julian Prealps), signs of otter presence were found in an already known area (Lapini et al., 2020), referring to the transborder Uccea-Učja torrent, right tributary of the Isonzo-Soča river flowing across Slovenia. The second positive area in the Prealps corresponds to the middle course of the Natisone river and some of its tributaries. In this area, the first signs of otters in FVG were recorded and attributed to wandering individuals (Lapini and Bonesi, 2011). In the present study, signs of presence were extensively detected during both campaigns, suggesting the existence of a stable population in the Natisone basin. However, during the monitoring period the banks of the Natisone and its tributaries were subjected to intensive working activities that caused severe disturbance to the ecosystem. Therefore, it was necessary to move a transect in which signs of presence were detected during the first monitoring session.

In both areas, a Slovenian origin of the individuals can be hypothesized, with particular reference to the upper reaches of the Isonzo-Soča river, including the left tributary Idria (Kryštufek, 2001; Hönigsfeld Adamič, 2010), and considering the Uccea, Natisone and Vipacco rivers as suitable ecological pathways, as hypothesized in Pavanello et al. (2015). Currently the Isonzo-Soča and its tributaries, including the Vipacco-Vipava, probably host a stable population of otters (https://www.projektvipava.si/ ), likely up to the mouth of the river itself (Filacorda, pers. comm.).

Of particular interest is the recent expansion of the species in the hills and lowlands where the species has been making a steady return after 50 years. Specifically, the otter has been found along various watercourses in the amphitheatre of the morainic hills and in the northernmost part of the Po Plain. In fact, in 2011 and 2012 two wandering otters were road-killed in the morainic hills and in the Prealpine area, respectively (Lapini et al., 2020). However, subsequent research did not confirm the presence of the species. During this study, various markings and signs of presence suggest that otters have definitely returned to their former range. Individuals in the morainic hills are largely linked to the Tagliamento river and its tributaries and probably dispersed from the Alpine region (Pavanello et al., 2015; Lapini et al., 2020), whereas otters in the plain probably come from the upper course of the Vipacco-Vipava river.

## CONCLUSIONS

Our outcomes represent the first evidence of a permanent return of the otter in the lowland of Friuli Venezia Giulia. The current distribution of the otter in FVG confirms the positive trend that the species is enjoying in Europe, with the rapidly expanding Austrian population along the Fella-Tagliamento, as well as the growing Slovenian population in the Isonzo-Soča basin. Both components show the return of the species to hilly and plains habitats, from which it had been missing since the 1970s. The distribution, even compared to recent studies, encourages further investigations and the implementation of further cross-sectional studies. Furthermore, it is also important to consider human disturbance, the primary cause of loss of suitable habitats for the species, particularly in lowland areas. This makes it necessary to study the population, together with the preparation of action strategies at an interregional level to protect the species, with a particular focus on habitat destruction and the impact of the road network. Finally, the experimental design used in this work, that is to say the integration of transects along riverbanks to monitoring beneath bridges, allowed us both to collect numerous observation and to compare our results with previous studies.

***Acknowledgements*** *- Part of the activities of this research were funded by the Nat2care Interreg V-A Italy – Slovenia 2014-2020 project. We would like to thank Mr. Paul Tout for the useful comments which improved the quality of the manuscript, and for revising the English level.*

## REFERENCES

**Arrendal, J. (2007).** Conservation Genetics of the Eurasian Otter in Sweden. Acta Universitatis Upsaliensis. *Digital Comprehensive Summaries of Uppsala Dissertations from the Faculty of Science and Technology* 278. 60 pp. Uppsala. ISBN 978-91-554-6816-3. http://www.carnivoreconservation.org/files/thesis/arrendal_2007_phd.pdf

**Cassola, F. (1986).** La lontra in Italia. Censimento, distribuzione e problemi di conservazione di una specie minacciata. *WWF Italia, Serie Atti e Studi* **5**. [in Italian]

**Cavazza, F. (1911).** Dei Mustelidi Italiani. *Ann. Mus. Civ. St. Nat. Genova* **5**: 170-204. [in Italian]

**Chanin, P. (2003).** Monitoring the Otter *Lutra lutra*. Conserving Natura 2000 Rivers Monitoring Series No. 10, English Nature, Peterborough.

**Elmeros, M., Bussenius, N. (2002).** Influence of Selection of Bank Side on the Standard Method for Otter Surveys. *IUCN Otter Specialist Group Bulletin* **19**: 67-74. https://www.iucnosgbull.org/Volume19/Elmerson_Bussenius_2002.html

**Hönigsfeld Adamič, M. (2010).** Vidra (*Lutra lutra*). Ljubljana, Lutra, Inštitut za ohranjanje naravne dediščine. [in Slovenian]

**Hung, N., Law, C.J. (2016).** *Lutra lutra* (Carnivora: Mustelidae). *Mammalian Species*, **48**: 109-122.

**Kranz, A., Poledník, L. (2015).** Fischotter in Kärnten: Verbreitung und Bestand 2014. Endbericht im Auftrag des Amtes der Kärntner Landesregierung. [in German]

**Kranz, A., Poledník, L. (2020).** Recolonization of the Austrian Alps by otters: conflicts and management. *Journal of Mountain Ecology*, **13**: 31-40.

**Kryštufek, B. (2001).** Raziskava razširjenosti evropsko pomembnih vrst v Sloveniji. Prirodoslovni muzej Slovenije, Ljubljana. Neobjavljeno poročilo za Ministrstvo za okolje in prostor: 655-657. [in Slovenian]

**Lapini, L. (1986).** La lontra in Friuli Venezia Giulia. In: La lontra in Italia - Censimento, distribuzione e problemi di conservazione di una specie minacciata. WWF Italia, Serie Atti e Studi **5**. [in Italian]

**Lapini, L., Bonesi, L. (2011).** Evidence of the natural recovery of the Eurasian otter in NE Italy. *29th European Mustelid Colloquium*, 3–4 Dec 2011, Southampton, UK.

**Lapini, L., Pontarini, R., Molinari, P., Cantarutti, G., Dorigo, L., Pecorella, S., Cesco, N., Commessatti, G., Comuzzo, C., Da Pieve, J., De Belli, E., Dreon, A.L., Giacomuzzi, D., Luca, M., Mareschi, A., Picco, G., Rossi, A. (2020).** The return of the Eurasian otter in north-eastern Italy. New challenges for biological conservation from Friuli Venenzia-Giulia Region. *Journal of Mountain Ecology*, **13**: 41-50.

**Loy, A., Carranza, M.L., Cianfrani, C., D'Alessandro, E., Bonesi, L., Di Marzio, P., Minotti, M., Regiani, G. (2009).** Otter *Lutra lutra* population expansion: assessing habitat suitability and connectivity in southern Italy. *Folia Zoologica* **58:** 309.

**Loy, A., Duplaix, N. (2020).** Decline and recovery of the otter in Europe. Lessons learned and future challenges. *Journal of Mountain Ecology,* **13**: 1-8.

**Macdonald, S.M., Mason, C.F. (1994).** Status and conservation needs of the otter (*Lutra lutra*) in the Western Palearctic. Strasbourg: Council of Europe.

**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 and Conservation* **18**: 2941–2959

**Marcelli, M., Fusillo, R. (2018).** Occupancy modelling and power analysis to detect trends in threatened species. An example with the otter (*Lutra lutra*) in Italy. *Hystrix Italian Journal of Mammology* **29** Suppl. 2018: 40.

**Mason, C.F., Macdonald, S.M. (2009**). Otters: Ecology and Conservation. Cambridge University Press, 248 pp.

**Ottaviani, D., Panzacchi, M., Jona Lasinio, G., Genovesi, P., Boitani, L. (2009).** Modelling semi-aquatic vertebrates' distribution at the drainage basin scale: The case of the otter *Lutra lutra* in Italy. *Ecological Modelling* **220** (2): 111-121.

**Panzacchi, M., Genovesi, P., Loy, A. (2011).** Piano d'Azione Nazionale per la Conservazione della Lontra (*Lutra lutra*). Quad. Cons. Natura, 35, Min. Ambiente - ISPRA. [in Italian]

**Pavanello, M., Lapini, L., Kranz, A., Iordan, F. (2015).** Rediscovering the Eurasion Otter (*Lutra lutra*) in Friuli Venezia Giulia and notes of its possible expansion in northern Italy. *IUCN Otter Specialist Group Bulletin* **32**: 12-20. https://www.iucnosgbull.org/Volume32/Pavanello_et_al_2015.html

**Pennec, F., Gérard, C., Meterreau, L., Monghiemo, C., Bokika Ngawolo, J.C., Laurent, R., Narat, V. (2020).** Spatiotemporal variation in Bonobo (*Pan paniscus*) habitat use in a forest–savanna mosaic. *International Journal of Primatology* **41**: 775-799.

**Poldini, L., Oriolo. G., Vidali, M., Tomasella, M., Stoch, F., Orel, G. (2006).** Manuale degli habitat del Friuli Venezia Giulia. Strumento a supporto della valutazione d'impatto ambientale (VIA), ambientale strategica (VAS) e d'incidenza ecologica (VIEc). Regione Autonoma Friuli Venezia Giulia – Direz. Centrale ambiente e lavori pubblici – Servizio Valutazione Impatto Ambientale, Univ. Studi Trieste – Dipart. Biologia, 1078 pp. [in Italian]

**Prigioni, C. (2003). In: Boitani, L., Lovari, S., Taglianti, A.V. (2003).** Fauna d'Italia. Mammalia III. Carnivora - Artiodactyla. Calderini (Ed). [in Italian]

**Prigioni, C., Smiroldo, G., Remonti, L., Balestrieri, A. (2009).** Distribution and diet of reintroduced otters (*Lutra lutra*) on the river Ticino (NW Italy). *Hystrix Italian Journal of Mammology* **20**: 45-53.

**Reuther, C., Dolch, D., Green, R., Jahrl, J., Jefferies, D., Krekemeyer, A., Kucerova, M., Bo Madsen, A., Romanowsky, J., Roche, K., Ruiz-Olmo, J., Teubner, J., Trinidade, A. (2000).** Surveying and monitoring distribution and population trends of the Eurasian Otter (*Lutra lutra*): guidelines and evaluation of the standard method for surveys as recommended by the European Section of the IUCN/SSC Otter Specialist Group. *Habitat* **12**: 1-148.

**Reuther, C., Roy, A. (2001).** Some results of the 1991 and 1999 otter (*Lutra lutra*) surveys in the River Ise catchment, Lower-Saxony, Germany. *IUCN Otter Specialist Group Bulletin* **18**: 28-40. https://www.iucnosgbull.org/Volume18/Reuther_Roy_2001.html

**Righetti, D. (2011).** Return of the otter in South Tyrol (NE Italy). In: Prigioni, C., Loy, A., Balestrieri, A., Remonti, L. (eds) Abstracts 11th International Otter Colloquium. *Hystrix Italian Journal of Mammology* Supp: 122.

**Romanowski, J., Brzeziński, M. and Cygan, J. P. (1996).** Notes on the technique of the otter field survey. *Acta Theriologica* **41**: 199-204.

**Rondinini, C., Battistoni, A., Peronace, V., Teofili, C. (2013).** Lista Rossa IUCN dei Vertebrati Italiani. Comitato Italiano IUCN e Ministero dell'Ambiente e della Tutela del Territorio e del Mare. [in Italian]

**Roos, A., Loy, A., de Silva, P., Hajkova, P., Zemanová, B. (2015).** *Lutra lutra*. The IUCN Red List of Threatened Species 2015: e.T12419A21935287. https://dx.doi.org/10.2305/IUCN.UK.2015-2.RLTS.T12419A21935287.en.

**Schenekar, T., Weiss, S. (2018).** Genetische Untersuchungen der Populationsgröße des Eurasischen Fischotters in den Kärntner Fließgewässern. Final Report on behalf of Amts der Kärntner Landesregierung, 53 pp. [in German]

**Stoch, F. (2009).** Gli habitat italiani – Espressione della biodiversità. Museo Friulano di Storia Naturale, Udine, Italy. [in Italian]

**Tremolada, P., Smiroldo, G., Verduci, F., Gatti, E., Boggioni, P., Gianfranceschi, L., Prigioni, C., Capelli, E., Balestrieri, A. (2020).** The otter population of the River Ticino (N Italy) 20 years after its reintroduction. *Journal of Mountain Ecology*, **13**: 51-62.

**Udali, A., Andrighetto, N., Grigolato, S., Gatto, P. (2021).** Economic Impacts of Forest Storms - Taking Stock of After-Vaia Situation of Local Roundwood Markets in Northeastern Italy. *Forests* **12** (414).

**Vipava (2021)**. https://www.projektvipava.si/ (last accessed 1/10/2021)

**Yoxon, P. and Yoxon, B. (2019).** Eurasian otter (*Lutra lutra*): A review of the current world status. *OTTER, Journal of the International Otter Survival Fund*, 53-73.

## RESUME

## LA RECOLONISATION DE LA PLAINE DU PO A-T-ELLE COMMENCÉ? MISES À JOUR CONCERNANT LA PRÉSENCE DE LA LOUTRE EURASIENNE (*Lutra lutra*) DANS LE NORD-EST DE L'ITALIE

Répandue en Italie au début des années 1900, la loutre eurasienne a ensuite subi un déclin dramatique qui a conduit à son extinction locale dans de nombreuses régions administratives, à l'exception d'un petit noyau résiduel dans le sud de l'Italie. Depuis quelques années, les populations autrichiennes et slovènes voisines du nord-est de l'Italie sont en forte augmentation, entraînant une recolonisation de la zone par l'espèce. En 2020, dans le Frioul-Vénétie Julienne, des relevés d'indices de présence ont été effectués dans 48 carrés (10 x 10 km) pour mettre à jour les informations sur la répartition locale de l'espèce. Les méthodes de surveillance suivantes ont été utilisées : surveillance sous les ponts combinée à des transects le long des cours d'eau. 17 carrés de la grille ont été positifs pour la présence de l'espèce, et actuellement, la loutre semble largement distribuée dans le Frioul-Vénétie Julienne le long des principales voies navigables des Alpes orientales et des Préalpes, et dans certaines zones surplombant la plaine du Tagliamento et l'Isonzo- Bassin de la Soča, toutes deux incluses dans la plaine du Pô. Celles-ci constituent les premières observations de l'espèce depuis plus de 50 ans. Par rapport aux études précédentes, 13 nouveaux carrés impliquant la présence de loutres ont été identifiés, y compris dans les zones de plaine, suggérant une expansion progressive à partir des chaînes de montagnes vers la plaine du Po-vénitienne. Ces résultats sont un encouragement à étendre la recherche et à mettre en œuvre de nouvelles études pour améliorer les niveaux de connaissance et la protection conséquente de l'espèce. Enfin, l'intégration des transects le long des berges au suivi sous les ponts, nous a permis à la fois de recueillir de nombreuses observations et de comparer nos résultats avec des études antérieures.

## RESUMEN

## ¿HA COMENZADO LA RECOLONIZACIÓN DE LA PLANICIE DEL PO? ACTUALIZACIÓN ACERCA DE LA PRESENCIA DE LA NUTRIA (*Lutra lutra*) EN EL NORESTE DE ITALIA

Ampliamente distribuida en Italia a comienzos de los 1900s, la nutria Eurasiática subsiguientemente sufrió una declinación dramática que condujo a su extinción local en muchas regiones administrativas, con la excepción de un pequeño núcleo residual en el sur de Italia. Desde hace varios años, las poblaciones de Austria y Eslovenia adyacentes al noreste de Italia han estado aumentando muy significativamente, lo que condujo a una recolonización del área por parte de la especie. Durante 2020, en Friuli Venezia Giulia, se condujeron relevamientos de signos de presencia, en 48 celdas de 10 x 10 km para actualizar la información sobre la distribución local de la especie. Fueron usados los siguientes métodos de monitoreo: monitoreo debajo de puentes,

combinado con transectas a lo largo de cursos de agua. 17 celdas de la grilla resultaron positivas para la presencia de la especie, y actualmente la nutria parece estar ampliamente distribuida en Friuli Venezia Giulia, a lo largo de los principales cursos de agua de los Alpes y Prealpes Orientales, y en algunas áreas que dan a la planicie de las cuencas de Tagliamento y la transfronteriza de Isonzo- Soča, ambas incluidas en la planicie del Po. Éstas constituyen las primeras observaciones de la especie después de más de 50 años. En comparación con estudios previos, fueron identificadas 13 nuevas celdas con presencia de nutrias, incluyendo áreas bajas, lo que sugiere una progresiva expansión a partir de los cordones montañosos hacia la Planicie Po-Veneciana. Esto representa un estímulo para expandir la investigación e implementar nuevos estudios para mejorar los niveles de conocimiento acerca de la especie -y su consecuente protección. Finalmente, la integración entre las transectas a lo largo de barrancas de ríos y el monitoreo debajo de puentes, nos permitió tanto colectar numerosas observaciones como comparar nuestros resultados con estudios previos.

**S H O R T   N O T E**

# PHOTOGRAPHIC RECORD OF EURASIAN OTTER *Lutra lutra* (LINNAEUS, 1758) IN ODISHA, INDIA

Nimain Charan PALEI[1*], Himanshu Shekhar PALEI[2], Sabyasachi RATH[3], Bhakta Padarbinda RATH[1], Arun Kumar MISHRA[4]

[1]*Office of the Principal Chief Conservator of Forests (Wildlife) & Chief Wildlife Warden, Odisha, India*
[2]*Aranya Foundation, Bhubaneswar, Odisha, India*
[3]*Office of the Range Officer, Ujalpur, Sundargarh Forest Division, Odisha, India*
[4]*Office of the Regional Chief Conservator of Forest, Rourkela Circle, Odisha, India*
**Corresponding author:wildpalei@gmail.com*

**Abstract**: The Eurasian otter (*Lutra lutra*) is a rare and lesser-known top predator of the aquatic ecosystem in India. A Eurasian otter was photographed on 9 July 2021 in a village in the Sundargarh forest division in the state of Odisha during a biodiversity survey. This record is an important addition to the currently limited information available for species distribution in the state of Odisha as well as in India. Further study is warranted to assess the genetic and demographic resilience of the population.
**Citation: Palei, N.C., Palei, H.S., Rath, s., Rath, B.P., and Mishra, A.K. (2022).** Photographic Record of Eurasian Otter Lutra lutra (Linnaeus, 1758) in Odisha, India. *IUCN Otter Spec. Group Bull.* **39** (2): 102 - 109
**Keyword**: *Lutra lutra*, Eurasian otter, photographic evidence, Sundargarh Forest Division Odisha, central India

## INTRODUCTION

The Eurasian otter (*Lutra lutra*) is one of the most widely distributed Palaearctic mammals with a geographical range from Ireland in Western Europe to the Kamchatka Peninsula in eastern Asia, from the Arctic region to north Africa and as far as south as Sumatra and Indonesia in Southeast Asia (Mason and Macdonald, 1986). The Eurasian otter is a semi-aquatic mammal, a top predator in the aquatic ecosystem, and plays a crucial role in the functioning of these systems (Mason and Macdonald, 1986). The Eurasian otter inhabits a wide variety of aquatic environments, including rivers, streams, lakes, swamp forests and coastal areas (Mason and Macdonald, 1986). This species is more vulnerable to loss and degradation of habitats, as currently, wetlands are amongst the most threatened and vanishing ecosystems worldwide (Davidson, 2014). Other threats are human persecution, persistent organic pollutants, and fish community alternations due to over-fishing (Roos et al., 2015; Buglione et al., 2020). Despite its broad distribution, the species is currently categorized as "Near Threatened" by the International Union for the Conservation of Nature (IUCN), owing to population decline in the last three generations or 23 years (Roos et al., 2015). The Eurasian otter is listed on Appendix I of CITES which indicates that the species is threatened with extinction and may be affected by trade (CITES, 2017).

Out of 13 extant species of otters found worldwide, India is home to three species of otter, namely Asian small-clawed otter (*Aonyx cinerea*), Smooth-coated otter (*Lutrogale perspicillata*) and Eurasian otter (Hussain, 1999). In India, Asian small-clawed otter is found from the Himalayan foothills of Himachal Pradesh to West Bengal, Northeast India, as well as in southern Indian hill ranges of Karnataka, Tamil Nadu and Kerala (Pocock, 1941; Hussain et al., 2011) and eastern India of Odisha (Mohapatra et al., 2014a). The Smooth-coated otter is distributed throughout India from the Himalayas southwards and has been reported from the north Indian states of Himachal Pradesh, Punjab, plains of Uttar Pradesh, Madhya Pradesh, Rajasthan, Bihar, in the central Indian plateau of Madhya Pradesh, Maharashtra, Goa, Andhra Pradesh, in the east and northeast in Odisha, West Bengal, Assam through Burma, in the south in Karnataka, Kerala and Tamil Nadu (Prater, 1971; Hussain, 1999). The Eurasian otter is distributed north of the Ganges river extending throughout the Himalayas, Northeast, in the eastern region along the Odisha coast, up to Madras, and then to south India (Hussain, 1999). Recently the Eurasian otter has been recorded from central India (Jena et al., 2016; Joshi et al., 2016; Talegaonkar et al., 2021), Western Ghats (Mudappa et al., 2018), and in the coastal region of Odisha, eastern India (Adhya and Dey, 2020). Unlike the other two species of otter in India, the Eurasian otter receives little scientific attention in India because of its rarity status (Hussain, 1999). It is considered an endangered species in India, features in Schedule-I of the Indian Wildlife (Protection) Act, 1972. Overall, lack of detailed information on its conservation status has designated it as one of the poorly known species in India.

Although Odisha has numerous hill streams, an extensive network of rivers and an array of marshy and mangrove habitats along the coast (Fig. 1), oft-used habitats of the otters, information on the occurrence and distribution of all three species in the state is poorly known. Although all three species of otters have been reported from Odisha (Debata and Palei, 2020), only a few records have been published on the species historically or recently. The earliest otter (Common otter or Eurasian otter, *Lutra vulgaris*) records date back to 130 years ago from Chilika Lake (Blanford, 1888-91). Annandale (1915) reported Smooth-coated otter (*Lutra macrodus*) when mammal collection was made from Satapara, Chilika Wetland by Zoological Survey of India. Mishra et al. (1996) revealed the occurrence of Smooth-coated otters all over the state, including mangrove swamps and coastal plains. From 1964 to 1999, eleven young specimens of both sexes of smooth-coated otters were received at Nandankanan Zoological Park from coastal areas of Odisha (Acharjyo, 1999). Mohapatra et al. (2014a) reported the occurrence of Asian small-clawed otters in several locations in Odisha. Adhya and Dey (2020), for a second time, reported the occurrence of Eurasian otter in Chilika Lake, Odisha coast. In a camera trap study, Palei et al. (2020) reported Smooth-coated otter's occurrence and activity pattern in Bhitarkanika National Park, Odisha. Here we report the photographic evidence of Eurasian otter from Sundargarh forest division, Odisha, India.

The Sudargarh forest division, western Odisha shares its boundaries with Chhatisgarh and Jharkhand state of India. It covers 3776 km$^2$ and is dominated by tropical dry-deciduous, northern tropical dry-deciduous and northern dry-mixed deciduous forests (Champion and Seth, 1968). The mean minimum and maximum temperature varied from 6-20 °C in January and 35-45 °C in May. The mean annual rainfall is 1100-1500 mm during the monsoon between June and September. The terrain is undulating and hilly and the altitude ranges from 152 m to 903 m. The forest division supports the population of several large threatened mammals, such as Asian elephant (*Elephas maximus*), tiger (*Panthera tigris*), leopard (*Panthera pardus*), sloth bear (*Melursus urisinus*) and Indian grey wolf (*Canis lupus*) (Palei et al., 2018a, 2019c).

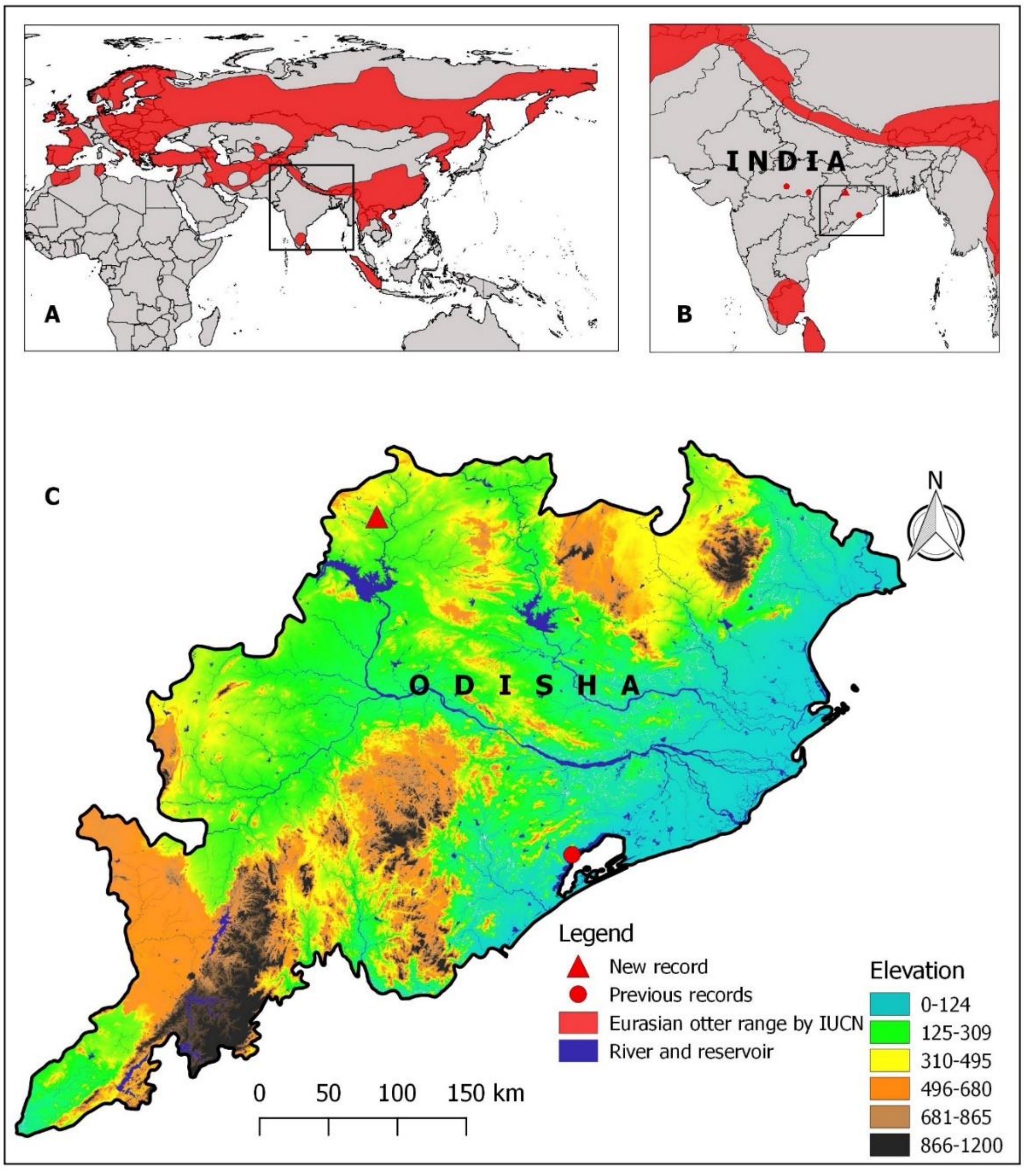



**Figure 1.** Map showing Inset: the Eurasian otter global distribution (A), distribution in India (B) and the occurrence of Eurasian otter in Odisha, India (C).

## OBSERVATIONS

During a survey of aquatic fauna in Sundargarh forest division, Odisha, India, we observed a semi-captive otter in the village Dhelsara, near river Ichha (22.06594º, 83.892243º) (Fig. 1, 2). We were able to get further details of the captured otter after enquiring the villager who has captive the otter. The villager has rescued the otter cub from the local dogs near the Ichha Nallah in December 2020. The otter group might have been left the cub and escaped away from the local dogs. After being rescued, the otter cub was fed cow's milk every day with a nipple bottle for two months. After that, the owner started feeding rice and fish, including dry fish. The 8-month year male cub was freed from any chain and control and moved freely in the house and backyards. The owner took the otter to the river every day 2-3 times. The otter swam well in the river and started searching for own food also depends on the food offered by the villager. The owner tried to release the otter into the wild several times, but the otter returned home every time. We identified as the otter was sub-adult male and took the following measurements: the weight was 2.8 kg, the head to the base of tail length was 58 cm, the tail length was 37 cm, the chest girth was 49 cm, and the height was 18 cm. The pelage was dark brown on the dorsal side and lighter on the underside. The otter had long, prominent claws and semi-webbed feet. The species was identified as a Eurasian otter based on the pronounced muzzle, zig-zag pattern, or “W” shaped naked rhinarium and cone-shaped tail (Fig. 2).

**Figure 2.** Photographs of the Eurasian otter in Sundargarh Forest Division, Odisha, India

During the survey, we encountered several spraints and footprints of otters in the river stretches. Informal discussion with villagers revealed that they confirmed the presence of the otter group in this area. However, from the otter sign, we were unable to confirm the presence of other species of otter such as Asian small-clawed otter which is reported in different parts of the state (Mohapatra et al. 2014a). Further detailed camera trap study is required to ascertain the presence of other species of otter in this area. The Ichha River is a high gradient stream with a sandy bottom and a channel width of approximately 50 meters (Fig. 3, 4). The banks of the river were sandy with sporadic vegetation. The river leads to Ib River, which is one of the major tributaries of the Mahanadi River. The study site is the human habitation area, and both sides of the river were dominated by agricultural land. We observed rampant fishing, cattle grazing and sand mining by locals in this area.


**Figure 3.** Habitat of the Eurasian otter in Sundargarh Forest Division Odisha, India


**Figure 4.** Habitat of the Eurasian otter in Sundargarh Forest Division Odisha, India

## CONCLUSION

The photographic evidence of the Eurasian otter obtained through this study further confirms the presence of this species in Odisha. Our record of the Eurasian otter from Sundargarh forest division is about 300 km from the locations of the previous report from Odisha, showing an extension from its previously known geographic location of the state. Also, it extends the known geographical range of the species in the central Indian landscape. Previous studies have likely overlooked the presence of the Eurasian otter in this area because of its elusive behaviour and lack of species-level identification skills. However, recently biologists have expanded the known distribution ranges of several species in Odisha (Mohapatra et al., 2014a; Mohapatra and Palei, 2014b; Debata et al., 2015; Palei et al., 2018a; Palei and Debata, 2019a; Palei et al., 2019a,b; Palei et al., 2021). Therefore, further targeted and intensive studies of the Eurasian otter in the possible localities are essential to better understand this rare species and formulate appropriate conservation plans for its long-term survival.

**Acknowledgements -** We are thankful to the Principal Chief Conservator of Forest (Wildlife) and Chief Wildlife Wardens, Odisha for support. We are also thankful to the forest departmentof Sundargarh forest division for their unfailing extended help during the fieldwork. We thank the editor and anonymous reviewers for valuable discussions and comments that significantly improved the quality of manuscript.

## REFERENCES

**Acharjyo, L.N. (1999).** Status of Mustelids, Viverrids and Herpestidsof Orissa. In: Envis Bulletin on Wildlife and Protected Areas. Hussain, S.A. (Eds) WII, Dehradun, **2:** 62–64.

**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 the Journal of the International Otter Survival Fund,* **6:** 49-55.

**Annandale, N. (1915).** Fauna of the Chilka Lake: Mammals, Reptiles and Batrachians. *Memoirs of Indian Museum* 5(2): 165–174.

**Blanford, W.T. (1888–1891).** *The Fauna of British India, Including Ceylon and Burma. Mammalia*. Part I & II. Taylor and Francis, RedLion Court Fleet Street, London, p. 617.

**Buglione, M., Petrelli, S., Troiano, C., Notomista, T., Rivieccio, E., Fulgione, D. (2020).** The diet of otters (*Lutra lutra*) on the Agri river system, one of the most important presence sites in Italy: a molecular approach. *PeerJ* **8:** e9606. DOI: https://doi.org/10.7717/peerj.9606

**Champion, H.G., Seth, S.K. (1968).** A Revised Study of the Forest Types of India. Government of India. New Delhi, India, p. 404.

**Davidson, N.C. (2014).** How Much Wetlands has the WorldLost? Long-term and Recent Trends in Global Wetland Area.*Marine and Freshwater Research,* **65(10):** 934-941.

**CITES, (2017).** Convention on International Trade in Endangered Species of Wild Fauna and Flora. Appendices I, II and III. http://checklist.cites.org .

**Debata, S., Palei, H.S. (2020).** An updated checklist of mammals of Odisha, India. *Journal of Threatened Taxa*, **12(10):** 16219-16229.

**Debata, S., Palei, H.S., Mohapatra, P.P., Palita, S.K. (2015).** Additionalrecords of Cantor's Leaf-nosed Bat *Hipposideros galeritus*Cantor,1846 (Mammalia: Chiroptera: Hipposideridae) in eastern India: Odisha. *Journal of Threatened Taxa*, **7(8):** 7477-7479.

**Hussain, S.A. (1999).** Status of otter conservation in India. Environmental Information System Bulletin: Wildlife and Protected Areas, Mustelids, Viverrids and Herpestids of India **2:** 92-97.

**Hussain, S.A., Gupta, S.K. and 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

**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 SCC Otter Spec. Group Bull.*, **33:** 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(2):** 73-78. https://www.iucnosgbull.org/Volume33/Joshi_et_al_2016.html

**Mason, C.F., Macdonald, S.M. (1986).** *Otters: Ecology and Conservation*. Cambridge University Press, Cambridge, UK.

**Mishra, C.G., Patnaik, S.K., Sinha, S.K., Kar, S.K., Kar, C.S., Singh, L.A.K. (1996).** *Wildlife Wealth of Orissa*. Orissa Government Press, Cuttack, p. 180.

**Mohapatra, P.M., Palei, H.S., Hussain, S.A. (2014a)**. Occurrence of Asian small-clawed otter *Aonyx cinereus*in Eastern India. *Current Science,* **107:** 367-370.

**Mohapatra, P.P., Palei, H.S. (2014b).** Further record of Large Indian Civet *Viverra zibetha* Linnaeus, 1758 from Odisha. *Journal of the Bombay Natural History Society*, **111(2):** 125.

**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

**Palei, H.S., Das, U.P., Debata, S. (2018a).** The vulnerable fishing cat *Prionailurus viverrinus* in Odisha, eastern India: status and conservation implications. *Zoology and Ecology*, **28(2):** 69-74.

**Palei, H.S., Debata, S. (2019a).** On the occurrence of Rusty-spotted Cat *Prionailurus rubiginosus* (I. Geoffroy Saint-Hilaire, 1831) (Mammalia: Carnivora: Felidae) in Odisha, Eastern India. *Proc. Zool. Soc.*, **72:** 102-105.

**Palei, H.S., Palei, N.C., Rath, B.P., Mishra, A.K. (2019b).** Records of the globally threatened rusty-spotted cat in Odisha, India. *Nature Conservation Research*, **4(3):** 112-116.

**Palei, N.C., Rath, B.P., Behura, S.,Palei, H.S. (2021).** New elevation record of fishing cat occurrence in Odisha, eastern India. *CATnews*, **72:** 16-17.

**Palei, N.C., Rath, B.P., Palei, H.S., Acharya, B.P. (2020).** Population Status and Activity Pattern of Smooth-Coated Otter (*Lutrogale perspicillata*) in Bhitarkanika National Park, Odisha, Eastern India. *IUCN Otter Spec. Group Bull*., **37(4):** 205-211. https://www.iucnosgbull.org/Volume37/Palei_et_al_2020.html

**Palei, N.C., Rath, B.P., Palei, H.S.,Mishra, A.K. (2018b).** Occurrence of melanistic leopard in Odisha, eastern India. *CAT news*, **68:** 7-8.

**Palei, N.C., Rath, B.P., Palei, H.S.,Mishra, A.K. (2019c).** Photographic evidences of Indian grey wolf (*Canis lupus pallipes*) in Sundargarh forest division, Odisha, India. *e-planet*, **17(2):** 152-156.

**Pocock, R.I. (1941).** *The Fauna of British India including Ceylon and Burma*. Vol. II. Taylor and Francis, London. p. 503.

**Prater, S.H. (1971).** *The Book of Indian Animals*. 3rd edition. B.N.H.S., Bombay, India.

**Roos, A., Loy, A., de Silva, P., Hajkova, P.,Zemanová, B. (2015).** *Lutra lutra*. *The IUCN Red List of Threatened Species* 2015: e.T12419A21935287. https://dx.doi.org/10.2305/IUCN.UK.2015-2.RLTS.T12419A21935287.en. Downloaded on 22 July 2021.

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

## RESUME

## ENREGISTREMENT PHOTOGRAPHIQUE DE LA LOUTRE EURASIENNE *Lutra lutra* (LINNAEUS, 1758) DANS L'ODISHA EN INDE

La loutre eurasienne (*Lutra lutra*) est un top prédateur rare et peu connu de l'écosystème aquatique en Inde. Une loutre eurasienne a été photographiée le 9 juillet 2021 dans un village de la division forestière de Sundargarh dans l'État d'Odisha lors d'une enquête sur la biodiversité. Cet enregistrement est une information supplémentaire importante pour les données actuellement disponibles sur la répartition des espèces dans l'État d'Odisha ainsi qu'en Inde. Une étude plus approfondie se justifie pour évaluer la résilience génétique et démographique de la population.

## RESUMEN

## REGISTRO FOTOGRÁFICO DE LA NUTRIA EURASIÁTICA *Lutra lutra* (LINNAEUS, 1758) EN ODISHA, INDIA

La Nutria Eurasiática (*Lutra lutra*) es un predador-tope raro y poco conocido de los ecosistemas acuáticos de India. El 9 de Julio de 2021 fue fotografiada una nutria Eurasiática en un poblado en la división forestal Sundargarh, en el estado de Odisha, durante un relevamiento de biodiversidad. Este registro es una adición importante a la información actualmente limitada sobre la distribución de la especie en el estado de Odisha -así como en India. Se hacen necesarios estudios ulteriores para evaluar la resiliencia genética y demográfica de la población.

## ସାରାଂଶ: ଇଉରାସିଆନ୍ ଫୋଟ୍ରୋଗ୍ରାଫିକ୍ ରେକର୍ଡ | *Lutra lutra* (Linnaeus 1758) ଭଡା, ଭାରତ

ୟୁରାସିଆନ୍ ଓଧ  (ଲୁଟ୍ରା ଲୁଟ୍ରା) ହେଉଛି ଭାରତର ଜଳଜୀବ ପରିସଂସ୍ଥାର ଏକ ବିରଳ ତଥା ବହୁତ କମ୍

ଜଣାଶୁଣା ଶୀର୍ଷ ଶିକାରୀ।  ଓଡ଼ିଶା ରାଜ୍ୟ ଅନ୍ତର୍ଗତ ସୁନ୍ଦରଗଡ ବନଖଣ୍ଡର ଜୈବବିବିଧତା ସର୍ବେକ୍ଷଣ ସମୟରେ ଏକ ଗ୍ରାମରେ ୯ ଜୁଲାଇ ୨୦୨୧ ରେ ଏକ ଇଉରାସିଆନ୍ ଓଧର ଫଟୋ ଉତ୍ତୋଳନ କରାଯାଇଥିଲା। ସାମ୍ପ୍ରତିକ ଓଡ଼ିଶା ତଥା ଭାରତରେ ଏହି ପ୍ରଜାତିର ଅବସ୍ଥିତି ଏବଂ ବିସ୍ତାରଣ ସମ୍ପର୍କରେ ସୀମିତ ସୂଚନା ଉପଲବ୍ଧ ଥିବା ସମୟରେ ଏହି ରେକର୍ଡଟି ଏଥିଲାଗି ଏକ ଗୁରୁତ୍ୱପୂର୍ଣ୍ଣ ଯୋଗଦାନ କରୁଅଛି। ଏହି ପ୍ରଜାତିର ଆନୁବଂଶିକ (ଜେନେଟିକ୍) ଅନୁଶୀଳନ ଏବଂ ଜନସଂଖ୍ୟା ସ୍ଥିରତାକୁ ଆକଳନ କରିବା ଲାଗି ପରବର୍ତ୍ତୀ ଅଧ୍ୟୟନ ଜରୁରୀ ଅଟେ।

**ARTICLE**

# INVESTIGATING THE DISTRIBUTION OF THE SMOOTH-COATED OTTER *(Lutrogale perspicillata)* USING ENVIRONMENTAL DNA: PRELIMINARY RESULTS

Alexandra C. DUKE[1,2*] and Caren S. GOLDBERG[2]

[1]*Wild Otters Research Private Limited, House NO B0001, Island Views Belbata-Chorão, Tiswadi, Panjim, Goa 403102*
[2]*School of the Environment, Washington State University, 100 Dairy Rd., Pullman, WA 99164, USA*
*Corresponding Author: Email :alexandra.c.kahler@gmail.com*

(Received 24th August 2021, accepted 22nd December 2021)

**Abstract:** The analysis of environmental DNA (eDNA) can be an effective tool for detecting the presence of elusive or low-density organisms. While this technique has been utilized in many ecosystems, it has yet to be applied in mangrove ecosystems to detect aquatic mammals. Extreme environmental conditions (heat, salinity, turbidity) pose challenges for detection of rare species using eDNA in mangrove systems. We conducted a pilot study to test the sensitivity of eDNA methods for detecting the smooth-coated otter (*Lutrogale perspicillata*; IUCN classification: vulnerable) in mangrove ecosystems in India. This species can be difficult to monitor due to their elusiveness and the challenges of working in these complex systems. Over 11 weeks, we collected 30 water samples where signs of *L. perspicillata* were noted around Chorão Island in Goa, India, filtering on-site immediately after collection. We designed and validated a species-specific probe-based quantitative PCR assay for this species and used it to detect DNA of *L. perspicillata* in the filtered samples. We found our assay to be effective in detecting *L. perspicillata* within the mangrove ecosystem of Goa. Our results show that the detection probability likely decreases with time and that detection is possible at both high and low tide. This method could provide a sensitive, efficient way to detect elusive semi aquatic or aquatic species in mangrove systems.
**Citation: Kahler, AC and Goldberg, CS (2022).** Investigating the Distribution of the Smooth-Coated Otter (*Lutrogale perspicillata*) using Environmental DNA: Preliminary Results. *IUCN Otter Spec. Group Bull.*, **39** (2): 110 - 120
**Keywords:** eDNA, mangrove, non-destructive sampling, quantitative PCR, species detection, threatened species

## INTRODUCTION

Monitoring rare or vulnerable species can be incredibly difficult. Because of the elusiveness of many species and the difficulty of working in systems with dense vegetation or rough terrain, traditional field techniques (e.g., manual tracking, camera trapping, telemetry) might not be feasible or effective for some species. The analysis of environmental DNA (eDNA) shed by species in aquatic systems can be a sensitive and effective tool for species monitoring, ecology, and conservation (Rees et al., 2015). The use of eDNA techniques has been demonstrated to be more effective at detecting small populations of wildlife than traditional monitoring methods in many systems (Pilliod et al., 2013; Biggs et al., 2015; Ushio et al., 2017; Goldberg et al., 2018; Franklin et al., 2019; Sutter and Kinziger, 2019). Additionally, eDNA surveys can help mitigate issues of limited field resources, funding constraints, restricted access to habitats, reliable species identification, and negative impacts on organisms through invasive field survey techniques (Bohmann et al., 2014).

Otters can be challenging to survey for because they are rare and elusive, can be nocturnal, sometimes live in difficult to access habitats, and have large territories and home ranges (Gorman et al., 2006; Crimmins et al., 2009; Kruuk, 2011). Because of these factors, collecting data can be expensive and labor-intensive (Kruuk, 2011). Though surveying otters is difficult, it can be of vital importance to monitor otter populations because otters are considered ecological indicators, with their presence or absence reflecting the health of a wetland (Khan et al., 2010). *Lutrogale perspicillata* (smooth-coated otter) is distributed throughout South and South-east Asia and is found in a wide variety of habitat types that include lowland riverine systems, mangrove forests along coast and estuaries, and freshwater systems which include large rivers, lakes, streams, reservoirs, canals, and flooded agricultural fields (Houghton, 1987; Hussain and Choudhury, 1997; Anoop and Hussain, 2004; Shenoy et al., 2006; de Silva et al., 2015; Gomez et al., 2017). *Lutrogale perspicillata* is protected in India under Schedule I & II of the Indian Wildlife (Protection) Act of 1972 and is listed in Appendix II of CITES which prohibits its trade, resulting in it being a protected species in almost all countries within its range (Gomez et al., 2017). The IUCN Red List categorizes *L. perspicillata* as vulnerable due to an inferred population decline caused by habitat loss and exploitation (de Silva et al., 2015). Loss of habitat caused by anthropogenic factors such as large-scale hydroelectric projects, reclamation of wetlands for settlements, agriculture and infrastructure development, reduction of prey biomass, and poaching are some of the factors that are responsible for the decline in population sizes across most of their range (Houghton, 1987; Hussain and Choudhury, 1997; Khan et al., 2010; Acharya and Lamsal, 2011).

Though *L. perspicillata* are found in a variety of habitat types, one of the most ecologically important ecosystems they reside in are mangroves. Mangroves are highly specialized ecosystems characterized by salt-resistant plants growing in intertidal areas along sheltered seacoasts and estuaries in tropical and subtropical regions. They provide a variety of goods and services to flora and fauna, including humans, both directly and indirectly. Mangroves protect and stabilize coastlines, enrich coastal waters, yield commercial forest products, and support coastal fisheries, making them a tremendous benefit to humans (Kathiresan and Bingham, 2001). Despite these ecological and economic services, mangroves globally have decreased between 0.16 and 0.39% per year from 2000 to 2012 (Hamilton and Casey, 2016). Mangroves in India are spread over an area of 4,921 km², which represents 3.3% of the global mangrove vegetation. In contrast to the global trend, the extent of mangroves in India increased up to 875 km² during 1987-2017 (Ragavan and Mandal, 2018). However, despite this overall expansion of mangroves in India, the biodiversity of mangroves has declined in many regions. On the east coast of India, the extent of the mangrove species *Heritiera fomes*, is estimated to have declined by 76% since 1959 and approximately 70% of the remaining *Heritiera* trees surveyed were affected by the 'top dying' disease (Ragavan and Mandal, 2018).

The loss of habitat and vulnerable status highlight the importance of accurate detection for an ecological indicating species such as *L. perspicillata*. We piloted an eDNA detection method to help fill in the gaps about this elusive species. Previous studies have used eDNA detection methods for otter species in freshwater ecosystems (Thomsen et al., 2012; Padgett-Stewart et al., 2015) and to evaluate microbial organisms in mangrove sediments (Andreote et al., 2012). However, this is the first study we are aware of evaluating mammal species detection using eDNA within a mangrove ecosystem.

## METHODS

### Study Area

Our study was conducted in an area of mangrove habitats along the Mandovi-Zuari estuarine complex on Chorão Island in Goa, India (Fig. 1). Goa, located on the west coast of India, is the smallest state in the country (3,702 sq. km) and has a wide range of ecosystems and habitats including forests, alluvial plains, coasts, rivers, estuaries, mangroves, and wetlands. This area is under the influence of both the marine biome of the Arabian sea and the terrestrial forest biome of the Western Ghats, leading to a high level of biodiversity (Singh and Chaturvedi, 2017). Of Goa's 37,000ha land area, 500 ha is comprised of mangrove forest; a sizable portion of this (178 ha) is found on the island of Chorão. Today, the mangroves have grown to all parts of the island and *L. perspicillata* are found throughout the island's human-dominated landscapes (K. Fernandez, personal communication, 5 September 2017).

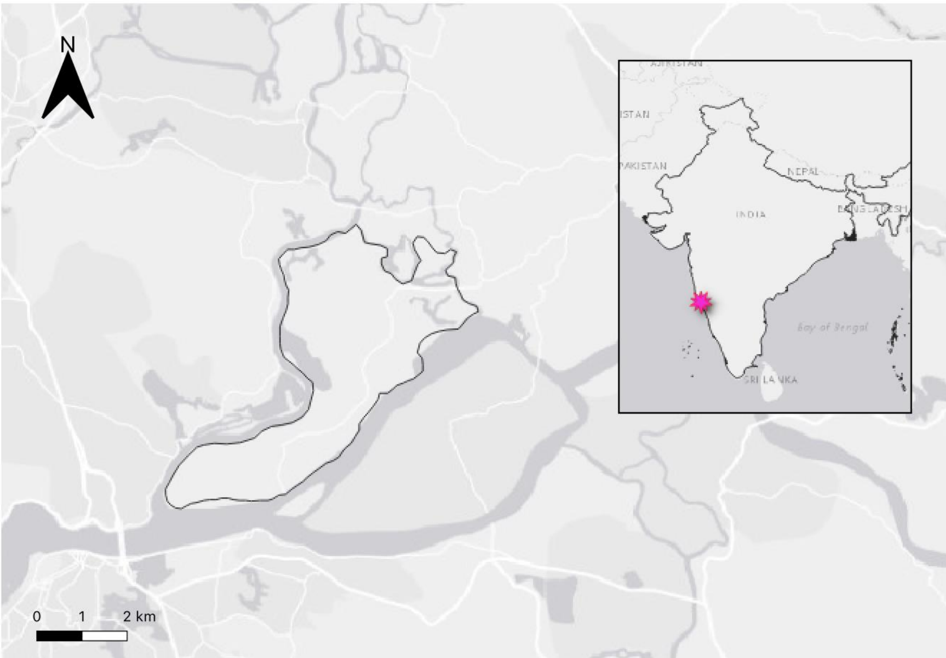



**Figure 1.** Chorão Island, Goa, India where aquatic environmental DNA samples were collected for *Lutrogale perspicillata* from October 2018 to January 2019. Imagery provided by Esri, DeLorme, HERE, MapmyIndia.

### Sample Collection

We collected 30 water samples from 6 sites around Chorão Island from areas of known *L. perspicillata* presence. Camera traps (Bushnell 6MP Trophy Cam Essential Trail Camera; Bushnell, Overland Park, KS) were placed opportunistically and fixed to a tree or sturdy surface angled towards location of known otter presence (e.g., latrine, den) within the boundary of Chorão Island to determine the time between otter presence and sample collection. Camera traps were triggered by a passive infrared sensor with an LED (Light-Emitting Diode) illuminator. In addition to camera trap data (video documentation of the exact time of otter presence at three sampling locations), positive otter presence was determined from signs (footprints, scat (spraint), tail drag marks, grooming sites, and den sightings). Samples were taken as close to otter presence time and location as possible. If not directly observed, otter presence was determined by the amount of degradation to the sign with consideration of the weather conditions (temperature, humidity, wind, precipitation, and hours of direct sunlight). The age of the sign was defined into three age categories: 1 - 24 hrs, 24 hrs - 7 days, and > 7 days. A subset of samples was collected at high and low tides to determine if tidal movement within the mangroves affected detection.

We collected 1L of surface water using clean gloves and a single-use Whirl-pak bag (Nasco, Madison, WI, USA). We manually filtered the sample immediately on-site using a hand-powered vacuum pump through 0.45-μm cellulose nitrate filter membrane in a single-use filter funnel (Sterlitech, Inc., Auburn, WA, USA) as outlined by Laramie et al. (2015). Filters were removed with a freshly gloved hand or forceps that had been decontaminated in 50% bleach solution prior to use and stored with silica beads until DNA extraction. A field negative was collected at each sampling location by filtering 1L of distilled water to test for contamination. Collection materials not in contact with the sample (vacuum flask, rubber stopper, silicone tubing, vacuum hand pump, and boots) were cleaned in a 10% bleach solution to prevent DNA contamination between sampling events. We attempted to collect environmental parameters such as temperature, pH, and salinity using the Eutech Instruments multi-parameter tester 35 series (Oakton Instruments, Vernon Hills, IL, USA). The tester had multiple malfunctions and was replaced with the Aquasol multi-parameter handheld meter (Rakiro Biotech Systems Private Limited, Navi Mumbai, India), which also immediately developed malfunctions and was unable to provide accurate readings.

## Assay Development

We developed and validated a species-specific quantitative PCR (qPCR) assay (primers and probe) for *L. perspicillata* (Table 1) based on previously published cytochrome b sequences (Koepfli et al., 2008; Omer et al., 2012; Moretti et al., 2017) obtained through GenBank (NCBI) and processed using Primer Express 3.0.1 (Applied Biosystems, Foster City, CA, USA). To validate the assay for specificity *in silico*, we used PrimerBlast (Ye et al., 2012). We then validated the assay against filtered water from fecal samples from non-target species (small-clawed otter (*Aonyx cinereus)* and brown palm civet (*Paradoxurus jerdoni)*) to confirm there was no cross-amplification.

**Table 1.** Primer and probe sequences developed and validated for *Lutrogale perspicillata* assay.

| Primer/Probe | Sequence |
|---|---|
| **LUPEF** | CCTACTTCTGGYCCTAGTACTAATAACC |
| **LUPER** | GGCGRGGGTGTAGTTGTC |
| **LUPEProbe** | 6FAM-AGGTCTGGGGAGAATAGTACT-MGBNFQ |

## DNA Extraction and Quantitative PCR Analysis

We extracted DNA from filter membranes using the QIAshredder/ Qiagen DNeasy Blood and Tissue DNA extraction method (Qiagen, Germantown, MD, USA; Goldberg et al. 2011) in a limited access clean room where no high-quality DNA extraction or PCR product has been handled. We analyzed each sample in triplicate and recorded a zero detection when all reactions showed no amplification and a positive detection if all replicates tested positive. If sample results were mixed, the sample was retested in triplicate and considered a positive if one or more replicates amplified on the second round. Reactions consisted of 1X TaqMan Environmental PCR Master Mix (Thermo Fisher Scientific, Waltham, MA, USA) and 0.4 μM of each primer and probe and were analyzed using a Bio-Rad CFX96 Real-Time System (Bio-Rad, Hercules, California, USA). The volume of each reaction was 15 µl, including 3 µl of sample. PCR cycling began with 10 minutes at 95 °C followed by 45 cycles of 95 °C for 15 s and 60 °C for 60s. All reactions included an internal positive control (Thermo Fisher Scientific, Waltham, MA, USA) to test for inhibition, all extraction sets included an extraction negative, and all reaction plates included a negative and positive control (IPC, Thermo Fisher Scientific, Waltham, MA, USA). All positive controls tested positive, and all negative controls tested negative for *L. perspicillata*.

## RESULTS

### Environmental DNA detection of *Lutrogale perspicillata*

The assay we developed detected eDNA of smooth-coated otters in 14 of the 30 total samples collected. Non-target samples and all negative control samples tested negative. One of our five field negative samples, however, tested positive for the presence of *L. perspicillata* DNA. The field negative sample that tested positive was taken approximately 5 hours after a sample that did detect *L. perspicillata* and taken immediately before a sample that did not detect *L. perspicillata*. However, the glove that was used to remove the filter was not fresh, contrary to field protocols. Supplies had run out and care was taken to try and avoid touching the filter with parts of the glove that had been previously used but this is the likely source of contamination. Positive detections occurred within seven days of otter presence, with a higher proportion of positive detections in samples collected within 24 hours of otter presence (Figure 2). All sites where otters were observed within an hour of sample collection tested positive for eDNA detection, except for one where the otter was >100 m away, with detection rate decreasing to 0.50 between 1 and 24 hours.


**Figure 2.** Number of eDNA samples for Lutrogale perspicillata presence, collected around Chorão Island, Goa from various times between October 2018 and January 2019, showing detection or no detection.
* At time 0, otter(s) were actively swimming in water during sampling

The one positive detection of *L. perspicillata* occurrence in a sample collected more than 7 days after otter observations was at an active otter den site. The last recorded footage of otters at the site occurred 11 days prior to sampling and signs such as scat were noted to be 7 days or older in age; however, the camera malfunctioned after that. At the time of sampling, the den had collapsed due to construction in the area and appeared to be abandoned by the otters. When eDNA sampling first occurred at this site, a fishing dam just upstream was under construction, allowing for a more dramatic tidal movement within the area. When the sample was collected, the dam had been completed and restricted the flow of water to the site, leaving a small amount of water near the den.

### Environmental DNA Detection of Smooth-coated Otters in Relation to Tidal Movement

We collected 16 samples at high tide and 14 samples at low tide; we did not find evidence for a difference in detection between tides, ($\chi^2{}_1 = 0.12$, $P$=0.73; Figure 3). However, a sample taken at high tide within 24 hours of otter presence tested positive; when the same location was sampled roughly 5 hours later at low tide, the sample showed no detection.

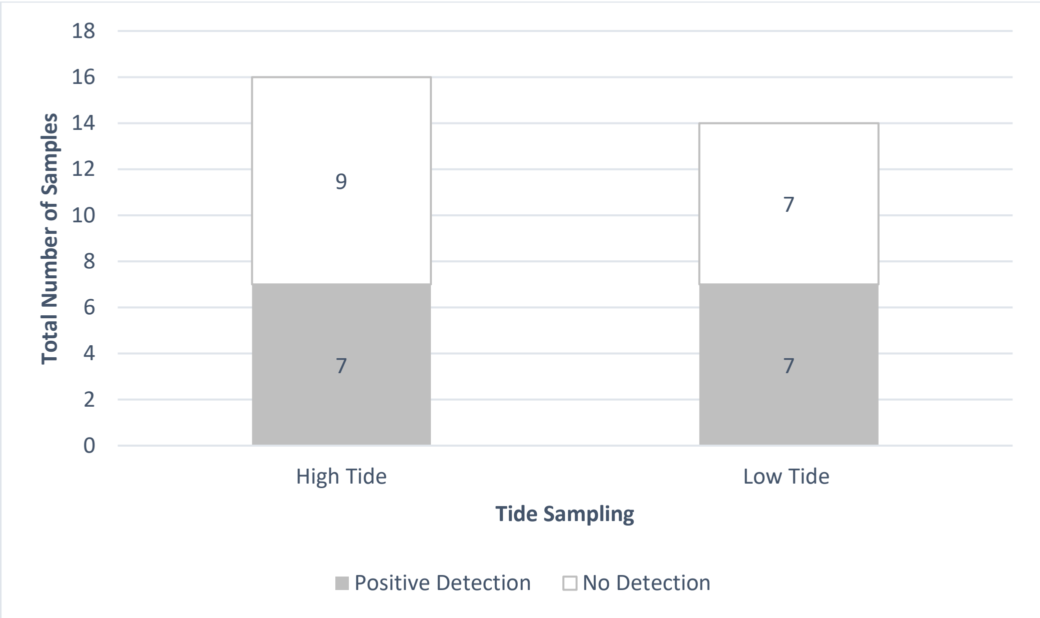



**Figure 3.** Number of eDNA samples collected for the detection of *L. perspicillata* between October 2018 and January 2019 around Chorão Island, Goa, India at low and high tide showing detection or no detection.

## DISCUSSION

We successfully detected *L. perspicillata* in mangrove systems in India using aquatic eDNA methods. The assay we developed was effective and species-specific. Our results indicate that the probability of detecting *L. perspicillata* in mangrove ecosystems was high in areas they had recently visited (<24 hours) and that this detection rate decreased with time. We also found that *L. perspicillata* can be detected at both low and high tides.

Determining the location or presence of a species in a system from aquatic environmental DNA must consider the transport of DNA within the system. Environmental DNA has been shown to travel long distances (up to 12km) in large rivers and much shorter distances in small streams (Deiner et al., 2014; Jane et al., 2015; Deiner et al., 2016; Shogren et al., 2017). The travel and detectability of eDNA are influenced by the physical structure and velocity of a stream (Jane et al., 2015; Fremier et al., 2019). For example, eDNA can be retained in substrate through adsorption to biofilms or other streambed surfaces, resulting in a decrease in eDNA concentration downstream from its source (Jerde et al., 2016; Fremier et al., 2019). Although the travel of eDNA in streams has received some research attention, the movement of eDNA in coastal environments is not as well understood. Studies have shown that nearshore eDNA detection from benthic and planktonic organismal communities (Kelly et al., 2018) and marine fishes (Lafferty et al., 2021) was not influenced by tidal flow. Not all coastal environments are equally affected by tidal flow, however, and these studies focused only on fjord and atoll ecosystems.

Because coastal ecosystems are subject to considerable effects from water movement, tropical mangrove ecosystems typically experience considerable water movement from tidal flow, conditions to which mangroves are well adapted (Mazda and Wolanski, 2009). The effects of this water flow on eDNA in mangrove ecosystems, however, is not well known, and has not yet been adequately studied. Understanding the movement of DNA in mangroves is particularly essential to determining the utility of eDNA to detect species that inhabit this ecologically important ecosystem. Some organisms of research interest in mangroves are semi-aquatic by necessity (Ong et al., 2007; Ansari et al., 2014) because mangrove ecosystems are often dry during low tide and inundated at high tide. Since semi-aquatic organisms do not spend their entire life cycle in water, successfully detecting them with eDNA techniques in mangrove ecosystems necessitates understanding ecosystem-specific impacts on DNA movement to maximize detectability. Further research is thus needed to establish this baseline understanding of DNA movement in mangrove ecosystems.

In addition to water movement, DNA can be broken down by biotic and abiotic factors such as extracellular enzymes, high temperatures, and UV radiation, all of which could affect detectability. To determine if non-detection results could be caused by abiotic factors, environmental measurements such as temperature, pH, salinity, and sun exposure should be collected at the time of sampling (Strickler et al., 2015). We attempted to collect water quality variables but were not successful due to equipment malfunction. Thus, we could not determine if our non-detection results were due to differences in environmental variables between sampling times. To eliminate this potential problem, we recommend that biologists use new equipment that is tested in the field prior to sampling.

Environmental DNA is a sensitive tool that can produce false positives if measures are not taken to decrease contamination. Although our reusable equipment that was not in contact with the sample (vacuum flask, silicone tubing, rubber stopper, boots, forceps, and vacuum pump), was cleaned in a 10% bleach solution, and single use disposable equipment (Whirl-Pak (Nasco, Madison, WI, USA), nitrile gloves, and filter funnel) was used at each sampling, our contaminated negative control sample highlights how difficult it can be to eliminate contamination in the field. As equipment was cleaned between samplings the sample taken after the field negative resulted in a non-detection, this positive result is likely due to contamination in the reused glove. Early in the study, we had difficulties with our square tipped forceps tearing filters upon removal. To avoid tearing, we resorted to removing the filters with a gloved hand but ran out of supplies and were not able to obtain more gloves by the time sampling needed to be completed. To avoid this, we recommend that consideration is taken in planning to have more supplies than needed, especially when working where supplies are difficult to replenish.

## CONCLUSION

This study demonstrates that *L. perspicillata* can be detected within the mangrove ecosystems of Goa using environmental DNA. With this information and the developed assay, biologists have a clear path to monitor the distribution of *L. perspicillata* using eDNA throughout Goa and in other mangrove ecosystems.

## REFERENCES

**Acharya, P.M., Lamsal, P. (2011).** A survey for Smooth-Coated Otter *Lutrogale perspicillata* on the river Naryani, Chitwan National Park, Nepal. Hystrix It. *J. Mammal*. **21**: 203-207.

**Andreote, F.D., Jiménez, D.J., Chaves, D., Dias, A.C.F., Luvizotto, D.M., Dini-Andreote, F., Fasanella, C.C., Lopez, M.V., Baena, S., Taketani, R.G., de Melo, I.S. (2012).** The microbiome of Brazilian mangrove sediments as revealed by metagenomics. *PLoS One*. **7**: e38600.

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

**Ansari, A.A., Trivedi, S., Saggu, S., Rehman, H. (2014).** Mudskipper: A biological indicator for environmental monitoring and assessment of coastal waters. *J. Entomol. Zool. Stud*. **2**(6): 22-33.

**Biggs, J., Ewald, N., Valentini, A., Gaboriaund, C., Dejean, T., Griffiths, R.A., Foster, J., Wilkinson, J.W., Arnell, A., Brotherton, P., Williams, P., Dunn. F. (2015).** Using eDNA to develop a national citizen science-based monitoring programme for the great crested newt (*Triturus cristatus*). *Biol. Conserv.* **183**: 19-28.

**Bohmann, K., Evans, A., Gilbert, M.T.P., Knapp, M., Yo, D.W., de Bruyn, M. (2014).** Environmental DNA for wildlife biology and biodiversity monitoring. *Trends Ecol. Evol.* **29**: 358-367.

**Crimmins, S.M., Roberts, N.M., Hamilton, D.A., Mynsberge, A.R. (2009).** Seasonal detection rates of river otters (*Lontra canadensis*) using bridge-site and random-site surveys. *Can. J. Zool.* **87**(11): 993-999.

**Deiner, K., Altermatt, F. (2014).** Transport Distance of invertebrate environmental DNA in a natural river. *PLoS One.* **9**(2), 88786.

**Deiner, K., Fronhofer, E.A., Mächler, E., Walser, J.C., Altermatt, F. (2016).** Environmental DNA reveals that rivers are conveyer belts of biodiversity information. *Nat. Commun.* **7**, 12544.

**de Silva, P., Khan, W.A., Kanchanasaka, B., Reza Lubis, I., Feeroz, M.M., Al-Sheikhly, O.F. (2015).** *Lutrogale perspicillata*. *The IUCN Red List of Threatened Species 2015*: e. T12427A21934884. https://dx.doi.org/10.2305/IUCN.UK.2021-3.RLTS.T12427A164579961.en . Downloaded on 10 September 2017.

**Fernandez, K.**, Personal Communication.

**Franklin, T.W., McKelvey, K.S., Golding, J.D., Mason, D.H., Dysthe, J.C., Pilgrim, K.L., Squires, J.R., Aubry, K.B., Long, R.A., Greaves, S.E., Raley, C.M., Jackson, S., MacKay, P., Lisbon, J., Sauder, J.D., Pruss, M.T., Heffington, D., Schwartz, M.K. (2019).** Using environmental DNA methods to improve winter surveys for rare carnivores: DNA from snow and improved noninvasive techniques. *Biol. Conserv.* **229**: 50-58.

**Fremier, A.K., Strickler, K.M., Parzych, J., Powers, S., Goldberg, C.S. (2019).** Stream transport and retention of environmental DNA pulse releases in retention to hydrogeomorphic scaling factors. *Environ. Sci. Technol.* **53**(12):6640-6649.

**Goldberg, C.S., Pilliod, D.S., Arkle, R.S., Waits, L.P. (2011).** Molecular detection of vertebrates in stream water: a demonstration using Rocky Mountain tailed frogs and Idaho giant salamanders. *PLoS One.* **6**: e22746.

**Goldberg, C.S., Strickler, K.M., Fremier, A. (2018).** Degradation and dispersion limit environmental DNA detection of rare amphibians in wetlands: Increasing efficacy of sampling designs. *Sci. Total Environ.* **633**: 695-703.

**Gomez, L., Leupen, B.T.C., Theng, M., Fernandez, K., Savage, M. (2017).** Illegal Otter Trade: An analysis of seizures in selected Asian countries (1980-2015). *TRAFFIC.* Petaling Jaya, Selangor, Malaysia.

**Gorman, T.A., Erb, J.D., McMillan, B.R., Martin, D.J. (2006).** Space use and sociality. Of river otters (*Lontra canadensis*) in Minnesota. *J. Mammal.* **87**(4): 740-747.

**Hamilton, S.E., Casey, D. (2016).** Creation of a high spatio-temporal resolution global database of continuous mangrove forest covers for the 21$^{st}$ century (CGMFC-21). *Glob. Ecol.* **25**: 729-738.

**Houghton, S.J. (1987).** The Smooth Coated Otter in Nepal. *IUCN Otter Spec. Group Bull.* **2**: 5 - 8. https://www.iucnosgbull.org/Volume2/Houghton_1987.html

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

**Hussain, S.A., Choudhury, B.C. (1997).** Distribution and status of the Smooth-Coated Otter *Lutra perspicillata* in National Chambal Sanctuary, India. *Biol. Conserv*. **80**: 199-206.

**Hussain S.A., Choudhury B.C. (1995).** Seasonal movement, home range, and habitat use by Smooth Coated Otters in National Chambal Sanctuary, India. *International Otter Colloquium Pietermaritzburg*. Pg. 45-55.

**Jane, S.F., Wilcox, T.M., McKelvey, K.S., Young, M.K., Schwartz, M.K., Lowe, W.H., Letcher, B.H., Whiteley, A.R. (2015).** Distance, flow, and PCR inhibition: eDNA dynamics in two headwater streams. *Mol.* **15**: 216-227.

**Jerde, C.L., Olds, B.P., Shogren, A.J., Andruszkiewicz, E.A., Mahon, A.R., Bolster, D., Tank, J.L. (2016).** Influence of stream bottom substrate on retention and transport of vertebrate environmental DNA. *Environ. Sci. Technol*. **50**: 8770-8779.

**Khan, W.A., Qasim, M., Ahmad, E., Chaudhry, A.A., Bhaagat, H.B., Akhtar, M. (2010).** Status of Smooth-Coated Otter (*Lutrogale perspicillata sindica*) in Pakistan. *Pak. J. Zool.* 42: 817-824.

**Kathiresan, K., Bingham, B.L. (2001).** Biology of mangroves and mangrove ecosystems. *Adv. Mar. Biol*. **40**: 81-251.

**Kelly, R.P., Gallego, R., Jacobs-Palmer, E. (2018).** The effect of tides on nearshore environmental DNA. *PeerJ*. **6**: e4521.

**Koepfli, K.P., Kanchanasaka, B., Sasaki, H., Jacques, H.L., Louie, K.D.Y., Hoai, T., Dang, N.X., Geffen, E., Gutleb, A., Han, S.Y., Heggberget, T.M., LaFontaine, L., Lee, H., Melisch, R., Ruiz-Olmo, J.J., Santos-Reis, M., Sidorovich, V.E., Stubbe, M., Wayne, R.K. (2008).** Establishing the foundation for an applied molecular taxonomy of otters in Southeast Asia. *Conserv. Genet.* **9**: 1589-1004.

**Kruuk, H. (2011).** Ecological research and conservation management of otters. Retrieved May 22, 2019, from https://www.otterspecialistgroup.org/Library/OSG_Research_Guidelines.pdf

**Lafferty, K.D., Garcia-Vedrenne, A.E., McLaughlin, J.P., Childress, J.N., Morse, M.F., Jerde, C.L. (2021).** At Palmyra Atoll, the fish-community environmental DNA signal changes across habitats but not with tides. *J. Fish Biol.* **98**(2): 415-425.

**Laramie, M.B., Pilliod, D.S., Goldberg, C.S., Strickler, K.M. (2015).** Environmental DNA sampling protocol- filtering water to capture DNA from aquatic organisms. No. 2-A13. *US Geological Survey*.

**Mazda, Y., Wolanski, E. (2009).** Hydrodynamics and modeling of water flow in mangrove areas. In: G.M.E. Perillo, E. Wolanski, D.R. Cahoon, and M.M. Brinson, (Eds.). Coastal Wetlands: An Integrated Ecosystem Approach. Elsevier. Pages 231-261.

**Moretti, B., Al-Sheikhly, O.F., Guerrini, M., Theng, M., Gupta, B.K., Haba, M.K., Khan, W.A., Khan, A.A., Barbanera, F. (2017).** Phylogeography of the smooth-coated otter (*Lutrogale perspicillata*): distinct evolutionary lineages and hybridization with the Asian small-clawed otter (*Aonyx cinereus). Sci. Rep.* **7**: 41661.

**Omer, S.A., T. Wronski, A. Alwash, M.H. Elamin, O.B. Mohammed, H. Lerp. (2012).** Evidence for persistence and a major range extension of the smooth-coated otter *(Lutrogale perspicillata maxwelli*; Mustelidae, Carnivora) in Iraq. *Acta. Zool. Fenn.* **61**(2): 172-176.

**Ong, K.J., Stevens, E.D., Wright, P.A. (2007).** Gill morphology of the mangrove killifish (*Kryptolebias marmoratus*) is plastic and changes in response to terrestrial air exposure. *J. Exp. Biol.* **210**(7): 1109-1115.

**Padgett-Stewart, T.M., T.M. Wilcox, K.J. Carim, K.S. McKelvey, M.K. Young, M.K. Schwartz. (2016).** An eDNA assay for river otter detection: a tool for surveying a semi-aquatic mammal. *Conserv.* **8**: 5-7. DOI: https://doi.org/10.1007/s12686-015-0511-x .

**Pilliod, D.S., Goldberg, C.S., Arkle R.S., Waits L.P. (2013).** Estimating occupancy and abundance of stream amphibians using environmental DNA from filtered water samples. *Can. J. Fish. Aquat.* **70**: 1123-1130.

**Ragavan, P., Mandal, R.N. (2018).** Status of Indian Mangroves. *Fish. Oceanogr.* **7**:555718. DOI: https://dx.doi.org/10.19080/OFOAJ.2018.07.555718

**Rees, H.C., Gough, K.C., Middleditch, D.J., Patmore, J.R.M., Maddison, B.C. (2015).** Applications and limitations of measuring environmental DNA as indicators of the presence of aquatic animals. *J. Appl. Ecol.* **52**: 827-831. DOI: https://doi.org/10.1111/1365-2664.12467

**Shenoy, K., Varma, S., Devi Prasad, K.V. (2006).** Factors determining habitat choice of the smooth-coated otter, *Lutra perspicillata* in a South Indian River system. *Curr. Sci.* **91**: 637-643.

**Shogren, A.J., Tank, J.L., Andruszkiewicz, E., Olds, B., Mahon, A.R., Jerde, C.L., Bolster, D. (2017).** Controls on eDNA movement in streams: transport, retention, and resuspension. *Sci. Rep.* 7: 5065.

**Singh, J.S., Chaturvedi, R.K. (2017).** Diversity of Ecosystem Types in India: A Review. *Proc. Indian. Natn. Sci. Acad*. **83**: 569-594. DOI: http://dx.doi.org/10.16943/ptinsa/2017/49027 .

**Strickler, K.M., Fremier, A.K., Goldberg, C.S. (2015).** Quantifying effects of UV-B, temperature, and pH on eDNA degradation in aquatic microcosms. *Biol. Conserv.* **183**: 85-92.

**Sutter, M., Kinziger, A. (2019).** Rangewide tidewater goby occupancy survey using environmental DNA. *Conserv. Genet*. **20**:597-613. DOI: https://doi.org/10.1007/s10592-019-01161-9 .

**Thomsen, P.F., Kielgast, J., Iversen, L.L., Wiuf, C., Rasmussen, M., Gilbert, M.T.P., Orlando, L., Willerslev, E. (2012).** Monitoring endangered freshwater biodiversity using environmental DNA. *Mol*. **21**: 2565-2573.

**Ushio, M., Fukuda, H., Inoue, T., Makoto, K., Kishida, O., Sato, K., Murata, K., Nikaido, M., Sado, T., Sato, Y., Takeshita, M., Iwasaki, W., Yamanaka, H., Kondoh, M., Miya, M. (2017).** Environmental DNA enables detection of terrestrial mammals from forest pond water. *Mol*. **17**: 63-75. DOI: https://doi.org/10.1111/1755-0998.12690

**Ye, J., Coulouris, G., Zaretskaya, I., Cutcutache, I., Rozen, S., Madden, T. (2012).** Primer-BLAST: A tool to design target-specific primers for polymerase chain reaction. *BMC Bioinform.* **13**:134.

## RESUME

### ÉTUDE DE LA RÉPARTITION DE LA LOUTRE À PELAGE LISSE *(Lutrogale perspicillata*) À L'AIDE DE L'ADN ENVIRONNEMENTAL : RÉSULTATS PRÉLIMINAIRES

L'analyse de l'ADN environnemental (ADNe) peut être un outil efficace pour détecter la présence d'organismes indécelables ou en faible densité. Bien que cette technique ait été utilisée dans de nombreux écosystèmes, elle n'a pas encore été appliquée dans les écosystèmes de mangrove pour détecter les mammifères aquatiques. Les conditions environnementales extrêmes (chaleur, salinité, turbidité) constituent des défis pour la détection d'espèces rares à l'aide de l'ADNe dans les écosystèmes de type mangrove. Nous avons mené une étude pilote pour tester la sensibilité des méthodes d'ADNe afin de détecter la loutre à pelage lisse (*Lutrogale perspicillata* ; classée vulnérable par l'IUCN) dans les écosystèmes de mangrove en Inde. Cette espèce peut être difficile à suivre en raison de son caractère insaisissable et des défis liés au travail dans ces écosystèmes complexes. Pendant 11 semaines, nous avons prélevé 30 échantillons d'eau filtrés sur place, là où des indices de présence de *L. perspicillata* ont été observés autour de l'île de Chorão à Goa, en Inde. Nous avons conçu et validé un test PCR quantitatif basé sur une sonde adaptée à l'espèce et l'avons utilisée pour détecter l'ADN de *L. perspicillata* dans les échantillons filtrés. Nous avons constaté que notre test était efficace pour détecter *L. perspicillata* dans l'écosystème mangrove de Goa. Nos résultats montrent que la probabilité de détection diminue avec le temps et que la détection est possible à la fois à marée haute et à marée basse. Cette méthode pourrait donc fournir un moyen sensible et efficace de détection des espèces semi-aquatiques ou aquatiques indécelables dans les écosystèmes des mangroves.

## RESUMEN

### INVESTIGANDO LA DISTRIBUCIÓN DE LA NUTRIA LISA *(Lutrogale perspicillata)* UTILIZANDO ADN AMBIENTAL: RESULTADOS PRELIMINARES

El análisis de ADN ambiental (eDNA) puede ser una herramienta útil para detectar la presencia de organismos elusivos o que viven en bajas densidades. Aunque ésta técnica ha sido utilizada en muchos ecosistemas, todavía no ha sido aplicada en ecosistemas de manglar para detectar mamíferos acuáticos. Las condiciones ambientales extremas (calor, salinidad, turbidez) plantean desafíos para la detección de especies raras mediante eDNA en sistemas de manglar. Condujimos un estudio piloto para testear la sensitividad de los métodos con eDNA para detectar a la nutria lisa (*Lutrogale perspicillata*; clasificación de UICN: vulnerable) en ecosistemas de manglar en India.

Esta especie puede ser difícil de monitorear debido a su elusividad y a los desafíos de trabajar en estos sistemas complejos. A lo largo de 11 semanas, colectamos 30 muestras de agua en sitios donde se habían observado signos de *L. perspicillata*, alrededor de la Isla Chorão en Goa, India, filtrando in-situ inmediatamente después de la recolección. Diseñamos y validamos un ensayo cuantitativo de PCR, especie-específico y basado en sondas, para esta especie, y lo usamos para detectar ADN de *L. perspicillata* en las muestras filtradas. Encontramos que nuestro ensayo fue efectivo para detectar *L. perspicillata* en el ecosistema de manglar de Goa. Nuestros resultados muestran que la probabilidad de detección parece disminuir con el tiempo, y que la detección es posible tanto con alta como con baja marea. Este método podría proporcionar una manera sensitiva y eficiente de detectar especies semi-acuáticas ó acuáticas elusivas en los ecosistemas de manglar.

# OSG MEMBER NEWS

Since the last issue, we have welcomed 11 new members to the OSG: you can read more about them on the Members-Only pages.

**Pazil bin Abdul Patah, Malaysia:** A Senior Wildlife Officer and the Director of the Ex Situ Conservation Division of Department of Wildlife and National Parks. I am in charge of Otter management in DWNP, and a member of the Malaysia Otter Network (MON). I monitor otter populations in peninsular Malaysia using camera traps.

**Muntasir Akash, Bangladesh**: I am a faculty member at the Department of Zoology, University of Dhaka. I work on the conservation and ecology of lesser-known carnivores, to bring conservation attention to the Small-clawed otter, dhole, Asiatic golden cat, and other small carnivores of Bangladesh. I am currently conducting a project to assess occupancy of Small-clawed otters in the northeast of Bangladesh, and the occurance and sitribuiton of Smooth-coated otters in the country.

**Swarup Fullonton, India:** I am a researcher, conservationist and photographer at Amity Institute of Forestry and Wildlife, Uttar Pradesh. I focus on conservation of lesser known carnivores, with special reference to Smooth Coated Otters in the state of Odisha, India. I have 8 years of field experience in the conservation field, with expertise on many small mammals and their behaviour.

**Pravin Giri, Nepal:** I am currently doing my Master's degree, and was recently awarded a Rufford Foundation grant for a research project entitled "Assessment of Distribution, Habitat Characteristics and Awareness of *Lutra lutra* in the Kali Gandaki River, Myagdi and Mustang Districts of Nepal".

**Noraisah Majri, Malaysia:** I am a Wildlife Officer in Sarawak Forestry Corporation, and my major undertaking is East Asian-Australasian Flyway (EAAF) conservation work. To this aim, my research mainly focuses on wetland species through biological monitoring tasks and managing the habitat. I am interested in human-otter conflict, and raising awareness of otters in the local community and relevent bodies. I a member of the Malaysia Otter Network (MON)

**Sandra Marquéz, Peru:** I am a research associate in the Anzumo project of the NGO ConservAccion, working on the Marine Otter in the north of its distribution. As well as field surveys, I have developed environmental educational activities supporting marine otter conservation, including a children's activity book and a play.

**Angela Matthews, UK:** I have been working with Smooth-Coated Otters at Colchester Zoo for aroound 6 years, overseeing their successful breeding. I have recently taken over as EAZA monitor for *Lutrogale perspicillata*, and look forward to learning more about managing a species on a population level.

**Jayasilan Mohd-Azlan, Malaysia:** I supervise students working on camera trapping otters on Borneo, and am collating the information to provide a better understanding of the distribution, ecology and conservation of otters in Sarawak. I am a member of the Malaysian Otter Network (MON).

**Leela Rajamani, Malaysia**: I am a conservation biologist who is interested in the conservation and management of large mammals such as dugong, dolphin and otter. Although my background is in marine mammals, I have been intrigued by the smooth coated otters that are found near my workplace, the Centre for marine and coastal studies in Penang National Park.. I am a member of the Malaysian Otter Network (MON).

**Nobuyuki Yamaguchi, Malaysia:** My main research interests are evolutionary biology including behavioural ecology, biogeography, and wildlife conservation. I am monitoring the spatial pattern of the group of Smooth-Coated Otters around the Universiti Malaysia Terengganu campus. I am a member of IUCN/SSC Cat Specialist Group and the the Malaysian Otter Network (MON).

**Affendi Yang Amri, Malaysia:** I am a marine ecologist and research officer at Universiti Malaya, Malaysia, and president of the Malaysian Society of Marine Sciences, and a member of the Malaysian Otter Network. I work on otters in the marine habitat in South Johor, and intend to expand to otters in the Kuala Lumpur urban habitat.

# NEW BOOK

After a lot of hard work my first children's picture book is almost finished. We are still putting everything together but I think everything will be done in a couple of months. We are already looking for promotion and people who might be interested in selling/buying.
Because everyone here loves otters of course, I thought, this is a good place to start.

For further details, you can contact me directly (eva.claeys@aspenvalley.org).

Have a wonderful day,
Eva