OTTER

the Journal of the International Otter Survival Fund

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The International Otter Survival Fund (IOSF) was inspired by observing otters in their true natural environment in the Hebrides. Because the otter lives on land and in the water and is at the peak of the food chain it is an ambassador species to a first class environment. IOSF was set up in 1993 to protect and help the 13 species of otter worldwide, through a combination of compassion and science. It supports projects to protect otters, which will also ensure that we have a healthy environment for all species, including our own.

OTTER is the annual scientific publication of the IOSF.
The publication aims to cover a broad spectrum of papers, reports and short contributions concerning all aspects of otter biology, behaviour, ecology and conservation. It also contain information on the work of IOSF and reports on our activities.

Submission of manuscripts

OTTER is a peer-reviewed journal and a summary of the guidelines for authors may be found at the back of each Journal but please contact us for full instructions. Papers should be submitted through enquiries@otter.org.

Publication

The Journal, including back issues, is available to download free on the Media and Resources page of the IOSF website (www.otter.org). A limited number of copies are also printed and these are available for sale on the Ottershop (www.ottershop.co.uk).

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Editors
Prof Padma de Silva
Dr Paul Yoxon
Copy-editor: Dr Samantha Holland

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FOREWORD

I would like to welcome you to the latest issue of *OTTER, the Journal of the International Otter Survival Fund*.

Times have been hard lately for everyone so I hope some of the papers and reports will give a positive spin on many things. There are still a lot of people carrying out conservation work worldwide and you will read about just some of this work here.

You can read papers about otters in the Ganges, the Eurasian otter in Nepal, community attitudes in Nigeria, a survey in Uzbekistan and new techniques for otter survey work using footprints. And there is more information in the Short Communications.

We have reports from World Otter Day and about our work in Africa and Asia as well as the really positive workshop in Malaysia held in April 2022. Team Otter, the IOSF education programme, is growing and helping to develop future conservationists worldwide. We know that there is still much more to come in future years and IOSF is looking forward to helping more otter projects.

In 2022 we brought in our new Student Research Grant, which enables two students to join an experienced otter surveyor and carry out a practical project learning field techniques and post-survey work, such as spraint analysis. The aim is to encourage future otter surveyors and conservationists in fieldwork. This year we were grateful to our Board Member, Andy Rothwell, who took two students to the Isle of Barra in June, and a full report will be published in due course. We aim to continue this training project each year on a different Hebridean island and you will find more information in this issue of the IOSF *OTTER Journal*.

We would like to take this opportunity to thank everyone who enables the work of IOSF to continue: to our Trustees and Board Members who provide such valuable advice; to the various researchers and otter workers who work tirelessly in otter conservation; to the various trusts and other organisations who help to fund our projects; to our copy editor, Samantha Holland, who makes sure that each issue of the Journal is of a consistent high standard; and to our many loyal supporters who give us such encouragement.

So I hope you enjoy reading the *OTTER Journal* Number 8 for 2022.

Dr Paul Yoxon

Head of Operations

ASIAN OTTER CONSERVATION NETWORK REPORT 2022

PADMA K. DE SILVA

IOSF Asian co-ordinator and Chair of the Asian Otter Conservation Network (AOCN)

Email: padmadesilva@gmail.com

As I reported in the last issue, Covid-19 restrictions have had serious implications on otter conservation work worldwide. However, in spite of this there have been many positive activities throughout Asia. You will read more about the successful training workshop held in Malaysia in April 2022 and the various events held for World Otter Day and for Team Otter in the reports. Here we will outline other otter work.

Social media is a great tool for sharing information but also for asking people to provide information on distribution, behaviour, etc. Of course, we do not post details of locations which could pose a risk to otters but we do encourage people to send details of sightings or possible trade to enquiries@otter.org.

Unfortunately, illegal trade is still a serious threat to otters, particularly in southeast Asia. There is considerable concern about the impact of otter cafes in Japan and IOSF is working with colleagues there on the problem. There are also concerns about what to do with otters, particularly cubs, which have been rescued from the trade. Sanctuaries in Cambodia, Indonesia, Thailand, and Vietnam all do a great job in caring for these animals and IOSF continues to support this vital work.

The IOSF regional coordinators have given a summary for their areas below:

SOUTH ASIA: JYOTI BHANDARI, NEPAL

Bangladesh

The smooth-coated otter (*Lutrogale perspicillata*) is critically endangered in this country but distribution is not well understood. **Akash, Iqbal and Mondal** have published a paper in this issue of the *OTTER Journal* on records in the southwest, northwest and northern areas.

Bhutan

A new otter species for Bhutan was recorded in 2022 from the Thrumshingla

National Park (TNP) in Bumthang. The Asian small-clawed otter (*Aonyx cinereus*) was found by a farmer to the southeast of the central park ranger office in Lingmethang. The otter has been safely released and is being strictly monitored. Until now the only confirmed species was the Eurasian otter (*Lutra lutra*).

India

A ***rare photographic record of a Eurasian otter*** was obtained in the Bhagirathi Basin, of Uttarakhand State, western Himalaya. The otter was recorded during surveys by **Ranjana Pal** and her team from October 2015 to May 2019 and reported in November 2021. This confirms the presence of this species in the high-altitude temperate forest in this region. (https://threatenedtaxa.org/index.php/JoTT/article/view/6937).

Again in Uttarakhand, **Sayanti Basak** and her team published a paper on "Resource utilisation by smooth-coated otters in rivers of the Himalayan foothills" in December 2021. They found that habitat use was positively associated with channel depth, moderate vegetation, and bank substrate types. However, increasing distance to cover, sparse vegetation, channel width, and anthropogenic disturbance was a negative influence. (https://www.sciencedirect.com/science/article/pii/S2351989421004467)

Nepal

Nepal Otter Action Plan Phase I: Research Focus 2020–2022 was developed by young researcher **Sanjan Thapa** and his team. This document contains a legal and policy base, location-based habitat conservation, research strategy, education and outreach capacity building of the communities. In the first stage research aims to fill information gaps on diversity and distribution of otters throughout Nepal. (http://www.himalayanotternetwork.org/wp-content/uploads/2020/09/Nepal-Otter-Action-Plan-Research-Focus.pdf)

In January 2022, researcher **Mohan Shrestha** published the first photographic evidence of Eurasian otters in Nepal for three decades. Camera trap images came from the Barekot River, Jajarkot District, and photographic images from Tubang River, East Rukum District. (https://www.researchgate.net/publication/358221339_FIRST_EVIDENCE_OF_EURASIAN_OTTER_IN_NEPAL_IN_THREE_DECADES).

In the current issue of the IOSF *OTTER Journal*, Mohan has published further information on the "Presence of evidence, and factors affecting distribution of Eurasian otter (*Lutra lutra*) in the Pelma river, Rukum East, Nepal."

Purna Man Shrestha completed an otter survey in Khatyad River, Karnali River and Mugu Karnali River, in Mugu district. They found a few spraints in the Karnali and Mugu Karnali rivers proving the presence of otters there, but local people were totally unaware of this although seeming to support the otters. Wild animals are killed for pelts to trade to Tibet and this may include otters. No field signs were found in the Khatyad River although local people reported seeing them 1–6 months ago. Purna intends to carry out more survey work in this area.

In Bardia National Park, an otter conservation and awareness programme was held with funding from IOSF. This included publication of an otter calendar, school teaching and community awareness activities.

Sri Lanka

At present Sri Lanka is going through a really severe economic crisis with frequent power cuts, lack of fuel for vehicles and cooking, and food shortages. Nevertheless, some education and awareness work has been carried out by **Padma de Silva** in Kandy. She gave her friends and visitors a set of each of her otter-storybooks to give to schools. Many children had been working online due to Covid-19 restrictions and she is keen to encourage them to learn more about this little-known animal in the freshwaters in Sri Lanka. The books are written in English which gives the children good practice in the language and also teaches them about otters and encourages them to report any signs of otters they come across.

SOUTHEAST ASIA: ADREAN, INDONESIA

Malaysian Workshops

The first Human–Otter Conflict Workshop (Bengkel konflik memerang) was organised online by the Malaysia Otter Network (MON) and Malaysian Nature Society (MNS) on 20–22 December 2021. There were many great speakers and participants from the Department of Fisheries Malaysia, Forestry Department Peninsular Malaysia, Lembaga Urus Air Selangor and local aquaculture farmers. Various topics were covered: conserving otter habitat such as mangroves; restoration of abandoned aquaculture ponds; various mitigation measures to reduce human–otter conflict and promote human–wildlife coexistence; laws and policy. Local aquaculture farmers were also able to give their opinions on their conflict situation and suggestions.

MNS and MNO would like to express their highest gratitude to the Department of Fisheries Malaysia for this collaboration and The Conservation, Food & Health Foundation for providing funding support.

This event was followed by a training workshop organised between MNS and IOSF which was held in April 2022. A report on this is included in this issue of the *OTTER Journal*.

Myanmar Research

Myint Myint Soe, Conservation Officer, Nature Conservation Society, has been collecting otter records from throughout the country. She used interviews and questionnaires with local people, direct sightings, camera traps and preserved skins to identify 13 sites where otters have been recorded. This is reported in this issue of the *OTTER Journal*.

Publications in Journals:

Andeska, F, Novarino, W, Nurdin, J and Aadrean, 2021. Relationship between temporal environment factors and diet composition of Asian small-clawed otter (*Aonyx cinereus*) in heterogeneous paddy fields landscape in Sumatra, Indonesia. *IUCN Otter Specialist Group Bulletin* 38, 2, 106–116.

Dirgantara, AP, Megantara, EN, Husodo, T, Febrianto, P, Wulandari, I and Shanida, SS, 2021. The existence of Asian small-clawed otter (*Aonyx cinereus* Illiger, 1815) in the UCPS Hydropower, Cianjur, West Java. *Biodiversitas* 22, 4391–4401 https://www.smujo.id/biodiv/article/view/9402

Dwijayanti, E, Inayah, N, Farida, WR, Sulistiyadi, E and Saputra, S, 2021. Rapid survey for population, commercial trade of small-clawed otter (*Aonyx cinereus* Illiger, 1815) in Java and preliminary assessment of potential bacterial zoonoses. *Acta Veterinaria Indonesiana*, https://jurnal.ipb.ac.id/index.php/actavetindones/article/view/35011

Leroux, N, Roth, B and Marx, N, 2021. Monitored release of smooth-coated otters (*Lutrogale perspicillata*) in Angkor Archaeological Park, Siem Reap, Cambodia. *IUCN Otter* Specialist Group Bulletin 38, 2, 85–94.

Pianzin, A, Wong, A and Bernard, H, 2021. Riparian reserves serve as a critical refuge for Asian otters (*Aonyx cinereus* and *Lutrogale perspicillata*) in oil palm dominated landscapes of Sabah, Malaysian Borneo. *IUCN Otter Specialist Group Bulletin* 38, 3, 133–154.

Wai, L, Burger, R and Goossens, B, 2021. The first documented record of hairy–nosed otter (*Lutra sumatrana*) in the Lower Kinabatangan Wildlife Sanctuary, Sabah, Malaysia. *IUCN Otter Specialist Group Bulletin* 38, 2, 62–69.

Bachelor Theses

Anjani, AK, 2021. Studi Struktur Histologi Lidah dan SIfat Sekresi Gandula Lidah pada sugar glider (*Petaurus breviceps*) dan Asian small-clawed otter (*Aonyx cinereus*). Bachelor Thesis of Veterinary Faculty. http://etd.repository.ugm.ac.id/penelitian/detail/199485

Wijaya, ME, 2021. Perancangan buku panduan bagi pemelihara berang-berang cakar kecil yang merupakan satwa rentan. Bachelor Thesis of Visual Communication Design http://repository.unika.ac.id/26865/

Website Upgrade

Berang-berang Indonesia (berang-berang.com), an online information website, has been upgraded.

MIDDLE EAST AND CENTRAL ASIA: OMAR AL-SHEIKHLY

Iraq

An albino Eurasian otter cub was found in the River Tigris in June 2022 and Omar Al-Sheikhly contacted IOSF for advice. The otter was found in a net by a fisherman, who posted a video online and immediately received many offers to buy the cub, ranging from $50,000 to $100,000! An animal as rare as an albino otter will always command a big price from hunters or those seeking a rare pet. This just goes to show we still have a long way to go in our battle to eradicate this market.

The Iraqi Ministry of Environment arranged for the cub, now called Dijla, to be taken to Baghdad Zoo in cooperation with the Iraqi Green Climate Organization. Unfortunately, due to its colour, the otter cannot be released as it would be far too easy for hunters to spot it, meaning the risk of recapture is very high.

IOSF is in touch with the zoo keepers to help with rearing it and necessary veterinary care.

Iraq Webinar. In November 2021 Grace Yoxon of IOSF was invited to give a presentation on “Conservation of otters in the world – Iraq as a case study” for the 1st International Scientific Conference of Natural History and Wildlife. The event was organised by the Iraq Natural History Research Center and Museum, part of Baghdad University. The aim was to highlight the important role of the Museum in conservation and protection of wildlife for the future.

Lebanon

The Eurasian otter is listed as Critically Endangered in Lebanon and there is no locally applied research specifically for their conservation. The **Lebanon Reforestation Initiative** (LRI) is broadening its research to carry out a thorough study of remaining otter populations, using cost-effective and advanced techniques (i.e. eDNA, non-invasive spraint collection and camera trapping). This will provide information on population density, diet, spatial organisation, and population structure and enable them to identify and conserve key populations and prioritise restoration and conservation areas. This will be used to develop a robust conservation plan and a national decree for otter conservation.

As a part of the study, educational materials were developed to raise awareness in an interactive manner for young people and these were used on World Otter Day: See the report elsewhere in this issue of the *OTTER Journal*.

This project is funded by the Disney Conservation Fund, US Forest Service International Programs (USFS IP), and Idea Wild.

Uzbekistan

The Central Asian otter (*Lutra lutra seistanica*) is an endangered species listed in the Red Data Book of Uzbekistan as 1(EN). Formerly it inhabited all major rivers in the country, but the population declined largely because of reduction in prey availability, disturbance and poaching. However, in desert areas suitable habitat has increased with a growing network of canals and reservoirs. **Bykova, Esipov and Aromov** studied the current status in the western portion of the Hissar Range where one of the main subpopulations is found in and outside the protected area. You can read more about this work in their paper in this issue of the *OTTER Journal*.

AFRICA REPORT

BURUNDI

Association Burundaise pour la protection de la Nature visited the Rweru Lake region to find out more about otters. At first, they were unsure if otters existed in the area but after engaging with local communities found that they do exist, particularly around the Cohoha Lake. Local communities confirmed that otters were present but there is sometimes conflict when they are caught in traps.

More work needs to be done to understand otters in the area.

NIGERIA

Salami Olalekan Michael, Netlink Environmental Conservation Organisation, has been working with local fishermen in the area of Ondo State. In order to find out the attitudes of the people towards the spotted-necked otters he held 51 focus group discussions across 17 communities in Ilaje, Irele, Ese-Odo and Okitipupa local government areas. Most of the fishermen have seen otters but they generally have a negative attitude towards them because they steal the fish and destroy nets.

You can read more about this work in this current issue of the *OTTER Journal* – "The perceptions of fishermen towards the conservation of spotted-necked otters (H*ydrictis maculicollis*) and conflicts in the riverine area of Ondo State, Nigeria" by Salami, Odewumi and Hernandez-Romero.

TANZANIA

William Mgomo, IOSF's African Community Education Officer, is a passionate advocate for otters and never stops creating awareness for otters across the Lake Nyasa region of Tanzania. You will read more about his work with thousands of children in the Team Otter update, but he has also been raising awareness and working closely with fishing communities and students.

Fishing communities

During his education programmes, William always visits local fishing communities. The conflict between otters and fishermen is no secret and often leads to misconceptions about the species. First of all, fishermen often believe that otters are "stealing all the fish". As we know, otters and fish have co-existed for millions of years and it is of no benefit for otters to eat them all – otters, in fact, maintain a balance for the whole ecosystem. During his more recent visits he has been emphasising the importance of habitat protection and restoration. He has encouraged fishermen to be part of a tree-planting programme to understand the importance of preserving habitats for all species.

Furthermore, William has worked on reducing conflict with local fishermen and has even managed to persuade a number of them to remove traps for otters.

Students

William is always thinking of new, innovative ways to get more people engaging with otters and recently used one of Tanzania's main passions, football, to do this by creating an otter football competition for students. Not only did the participants and the community get the opportunity to take part in a fun, football competition but they also learned all about otters in the process through William and Professor Ndibalema.

The teams wore specially made otter conservation football tops with the slogan "Conserve Tanzania's Otters" and prizes were given to the eventual winners – Team Leopard, who beat Team Spanish 3–2 in the final. William stated that by using a true passion of the area, a lot of students are now wanting to become involved in otter conservation in the area. There are calls to create a network for the area, and IOSF has already received emails from some of the students asking how they can be involved.

William's outreach and Tanzania's otter work doesn't stop there. Fellow student, and now otter enthusiast, Ashura Talagimbudzah has also started working on her own programme. Ashura visited primary and secondary schools in the Ruvuma region – an area known to have otters. Her aim is to focus on the younger generation and encourage them to take their knowledge about otters and wetland conservation into their local communities. During her outreach programme Ashura has put an emphasis on human-otter conflict management. In the past she has focused on elephant, lion, leopard, hippopotamus, rhino, crocodile and buffalo and now wants to help people understand how important otters are too.

As many of William's students want to be involved he is planning to start a network in the area with links to all of Africa too – in time.

TOGO

Patrice Delagnon, University of Lome, held one of the country's first ever otter-based events, and the first for World Otter Day. The event was to raise awareness for an understudied species within the country and to draw attention among his fellow conservation/science-based students. You can read more about this in the World Otter Day section.

Patrice has plans to do more to gain a better understanding of otters across Togo.

TUNISIA

So little is known about the Eurasian otter (*Lutra lutra*) population in Tunisia. Faouz Kilani, together with the Tunisian Association for Wildlife (ATVS), started to work on this species from 2017 and they managed to create a scientific note and a documentary in 2019. At the end of May 2021, they were able to capture the first image of the species in its natural habitat from a camera trap in northern Tunisia.

Currently, they are working on mammals (including the Eurasian otter) of northern Tunisia in a project called “COBIOM”, funded by the Critical Ecosystem Partnership Fund (CEPF). The aim is to increase knowledge of the species in the area and produce a scientific report later in the year.

UGANDA

The Mutanda Community Conservation Organization (MUCCO) are working hard for otter and wetland conservation on Lake Mutanda, Kisoro District. They have started to create an “Otter Coffee” using the area’s famous coffee beans which can go towards funding otter conservation.

Furthermore, they are working closely with the local community to raise awareness and knowledge of the species. One aspect that they have been working on is identifying the species that occupies Lake Mutanda. Thanks to their tireless work they have identified them as spotted-necked otters (*Hydrictis maculicollis*).

ZIMBABWE

Oswald Chishanga, of Save our Environment Trust, is working to increase the knowledge of otters in his country. For World Otter Day 2021 he invited students to join IOSF in a webinar. For World Otter Day 2022 he held another webinar on 7 June and Ben Yoxon was privileged to be able to give a presentation on “Otters and their Conservation”. This is to raise awareness for a species that is often forgotten in favour of more famous African species.

Oswald and his team have also put together a questionnaire to use with local communities to gain more information from them. It is important to include these people as they have a wealth of knowledge that can provide more data on otters in the area.

TEAM OTTER PROGRAMME: RECONNECTING CHILDREN WITH NATURE

BEN YOXON

IOSF Education Officer

Ben@otter.org

IOSF's Team Otter programme is reconnecting children with nature, wildlife, and the environment and igniting a passion that will last their whole life. It is well known that we, as a race, have become disengaged from the natural world and as a result we are having a massive detrimental impact on it. IOSF's Team Otter programme is helping to change that and ensure future generations understand the role they play and the steps they can take to ensure a healthier tomorrow for all. Although we use otters as a mascot, we focus on all things in the natural world.

Guyana

Over the past few months, Yupukari Wildlife Club, run by Oswin Ambrose and Save the Giants, have been very active. They have been monitoring the local wildlife using techniques such as camera traps to observe what kind of animals can be found walking/flying through the village. They have also been birdwatching, creating arts and crafts of wildlife, and enjoying both indoor and outdoor games.

It is great to see them so active and the great work the group are doing.

Nepal

Following on from the establishment of the Team Otter club in Shuklaphanta National Park buffer zone, there has been further Team Otter work in one of Nepal's more famous national parks, Chitwan. IOSF was delighted to support Paras Acharya and his team at Resources Himalaya Foundation (RHF) during their project entitled "Education and Formation of Team Otter Clubs in Chitwan National Park, Nepal".

The RHF team visited eight schools delivering their programme covering aspects such as otter ecology, biology, habitat, behaviour and aspects of conservation issues and conservation of otters, reaching out to a total of 323 children.

Following this outreach, they discussed the possibility of the creation of Team Otter environmental clubs where children would learn more and be responsible for the environmental protection around their area. Thirty-eight children, across five schools, were involved in forming five Team Otter clubs.

The project was a huge success and children were very engaged in otter/wetland conservation talks. It was an interactive programme where children's interest increased throughout. One of the main issues faced by otters, both in Nepal and worldwide, is fishing conflict. But thanks to this programme it will help to develop a strong sense of stewardship and responsibility in otter conservation, riverine habitat and mitigating the environmental issues of river basins. Children and local communities will gain more of an understanding of the benefits of otters and therefore otters will face less persecution. The formation of the Team Otter club will enhance the awareness about values and importance of riverine indicator species and arouse the desire, commitment, dedication and motivation to help in the mitigation of aquatic mammal conservation issues in the future.

Nigeria

During Salami Olalaken's World Otter Day event he established a Team Otter club in Nigeria. You can read more about this in the World Otter Day report further in this issue of the *OTTER Journal*.

Tanzania

IOSF's African Community Education Officer, William Mgomo, has once again been engaging with children across the Lake Nyasa region of Tanzania. William's continued outreach work has been delivered to an incredible 3,711 children. William is currently working on a plan to start a club with some of the older children taking a leading role.

William continues to work hard to increase awareness of otters in the region working with fishermen, universities and other stakeholders. More of William's work can be found in the Africa report.

United Kingdom

Team Otter Broadford, run by IOSF's education officer, is very active. Having previously been focused on Broadford Primary School, the club has since expanded into two groups, spanning four schools. There is a younger, primary group with children from Broadford and Sleat Primary Schools and an older, high school group with children from Portree and Plockton High Schools. The Primary School group spend much of their time focusing on learning about wildlife through fun and interactive materials, cleaning up their local village and other similar programmes. This is to focus the children on growing their knowledge of both local and global wildlife and natural world issues, as well as taking simple steps to help.

The High School group are more issue based and have taken part in many campaigns over the last year. Before Christmas, they worked alongside “the Iron Man”, to collect crisp packets for his campaign. The Iron Man was using crisp packets to turn into survival blankets for the homeless during the winter and then later for helping in Ukraine. The children created posters, and online campaigns, and then processed the crisp packets to be sent down for production. This helped those less fortunate and also helped reduce the environmental impact in the area. More recently, the High School group have started a programme to support Team Seas. For every $1USD donated to Team Seas, they remove one pound of rubbish out of the ocean. The group created a poster, liaised with the local supermarket about a fundraiser, and made a video to promote their work online. In this way they raised a magnificent £754.10 for the Team Seas project.

Furthermore, both groups have also been busy with cleaning up local areas and particular problem areas in relation to ocean plastic. They were involved in helping to organise and clean up Camasunary Bay, one of the area’s most beautiful beaches, but worst for ocean litter, and helped remove around 3.4 tonnes of litter from there. There are plans to go back and complete the task and also visit other problem areas.

Uganda

The Team Otter club led by Mutanda Community Conservation Organization (MUCCO) is still being run by Asimwe Davis and was part of a World Otter Day event in the country.

Other clubs

These clubs are also joined by clubs in Bangladesh, Lao PDR, Montenegro, South Africa and others in Nepal.

We will continue to increase the impact of Team Otter and would love to have more clubs around the world. Should you have any interest in joining our Team Otter programme then please contact our education officer at Ben@otter.org

CONSERVATION OF ENDANGERED OTTERS AND THEIR HABITATS IN MALAYSIA THROUGH EDUCATION AND A TRAINING WORKSHOP

Workshop Report

Dates: 25–29 April 2022

Venue: Kuala Selangor Nature Park, Jalan Klinik, Taman Alam, 45000 Kuala Selangor, Selangor, Malaysia (Figure 1)

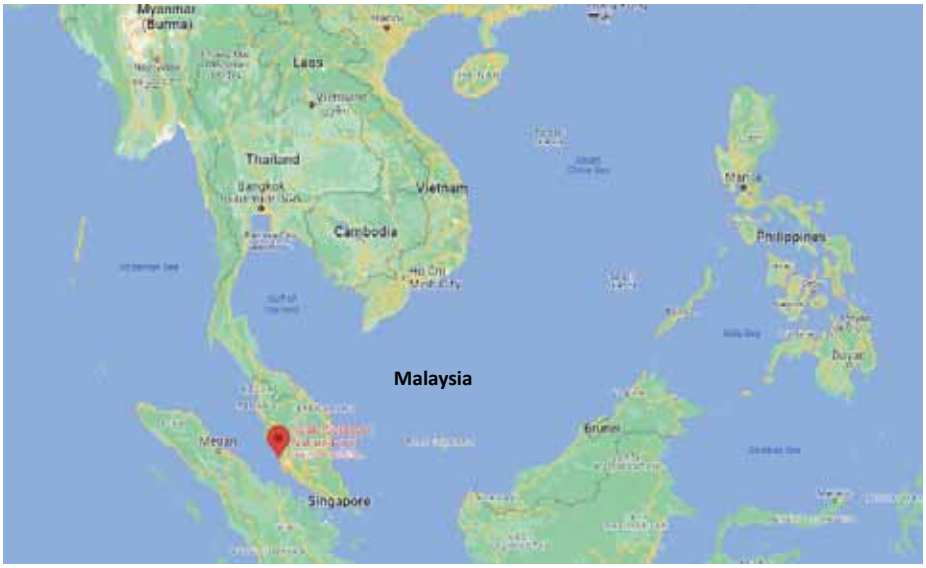

Figure 1. Location map of Kuala Selangor Nature Park.

IOSF was delighted to be able to return to its capacity building workshops following a three-year absence due to the global Covid-19 pandemic. Our workshops are aimed at training conservationists, government officials and other similar stakeholders to engage with otters, demonstrate techniques in education, research, dealing with threats and other conservation issues. Our previous workshop was held in 2019 in Guyana and the Malaysia 2022 workshop was our sixth Asian workshop and our eighth in total. This followed workshops in Cambodia, Indonesia, Bangladesh, China, Lao PDR, Tanzania and Guyana.

During the Malaysian workshop IOSF partnered with the Malaysia Nature Society (MNS) and Malaysian Otter Network (MON). The event was held at Kuala Selangor Nature Park, which is a protected area in the Selangor region of Peninsula Malaysia.

The area was chosen as it is home to three of the four species of otter in the region and allowed for practical field sessions on otter signs and spotting otters in the wild – although the latter was not guaranteed.

Through trophic cascades it has been proven that the presence of a top predator maintains the balance which is vital to the survival of the whole ecosystem. Otters are at the top of the food chain and occupy a number of habitats. Should otter populations decrease, this can have profound effects on food webs, biodiversity and their habitats.

Otters are heavily trafficked in the illegal trade but they are often overlooked, with more concern for famous fauna such as leopards, rhinos and tigers. However, their need is just as great. It is believed that for every tiger skin that is seized, 10 otter skins are also found – which emphasises the problem.

More recently, there is a growing concern over the pet trade for otters. Social media, along with some zoos, circuses and emerging "otter cafés" are driving demand for pet otters. People are shown "cute, playful" otters and immediately think that they want their own otter. Young otters are taken from the wild, while they mother is killed trying to protect them. The rearing of young otters can be difficult and if they die, they are simply replaced, therefore reducing wild populations further. Japanese otter cafés are further fuelling this issue and with Thailand–Japan now the most heavily trafficked route in the world, and given otter popularity in both countries, this is of growing concern. The trade is having serious effects on otter populations and in some cases local extinctions have already occurred.

In Asia and indeed across the world, not enough is known about otters, whether this be baseline data (such as populations, distribution etc.), habitat issues, genetics or human perceptions. IOSF started a series of workshops to train local conservationists, communities and officials in otter conservation techniques including monitoring, trade reduction and community engagement.

Southeast Asia is home to four species of otter – all of which have declining worldwide populations:

- Smooth-coated otter (*Lutrogale perspicillata*), Red List classification "Vulnerable" (Figure 2A)
- Asian small-clawed otter (*Aonyx cinereus*), Red List classification "Vulnerable" (Figure 2B)
- Hairy-nosed otter (*Lutra sumatrana*), Red List classification "Endangered" (Figure 2C)
- Eurasian otter (*Lutra lutra*), Red List classification "Near Threatened" (Figure 2D)

Figure 2. Otter species in southeast Asia: A – Smooth-coated; B – Asian small-clawed; C – Hairy-nosed; D – Eurasian.

THE WORKSHOP

71 attendees took part in the workshop, either in person or virtually through Zoom sessions. We also welcomed a number of speakers to cover topics such as global otter conservation, surveying techniques, education and illegal trade issues. Although the workshop was based in Malaysia, we had a focus on otter conservation in the region as a whole and had attendees from Myanmar, Indonesia, Thailand, Cambodia and Singapore, as well as speakers from Canada, the United Kingdom, Germany and Sri Lanka.

Figure 3: IOSF's Paul Yoxon giving a classroom presentation

As always, our workshops were broken into two main sections: classroom sessions and fieldwork. This allows attendees the opportunity to learn from a number of speakers and then take their newly learned skills into the field with the support of field experts.

Opening speeches came from Prof. Dr Ahmad Ismail, President of Malaysia Nature Society; Grace Yoxon, Director of IOSF, and Prof. Padma de Silva, Asian Otter Conservation Network. Then the classroom sessions were split into the following sessions and talks:

Session 1: Introduction to Otters

- Otters of the world – *Dr Paul Yoxon, IOSF* (Figure 3)
- Status of otters in Asia – *Prof. Padma de Silva and Ben Yoxon, IOSF*
- Otters in Malaysia – *Prof. Dr Ahmad Ismail, Malaysia Nature Society*
- Otters in Thailand – *Pai Worata Klinsawat, King Mongkut's University of Technology Thonburi*
- Otters in Myanmar – *Prof. Dr Saw Pyone Naing, Myanmar Environmental Innovation Foundation (MEIF)*
- Otters in Indonesia – *Reza Lubis, Indonesian otter specialist*

Session 2: Otter Biology and Ecology

- Otter biology and ecology – *Dr Sivasothi, National University of Singapore*
- Otters as a symbol of wetland habitat conservation – *Mr Sonny, Malaysia Nature Society*
- MNS Otter Project: Otters of North-Central Selangor Coast and Malaysia Otter Network (MON) – *Mr Woo Chee Yoong & the late Mr Balu Perumal Malaysian Nature Society*
- Distribution of otters in Protected Areas, Myanmar – *Myint Myint Soe, Wildlife Conservation Officer (Nature Conservation Society-Myanmar)*

Session 3: Otters and People

- Otters and communities with emphasis on otter-human conflicts – *Dr Pazil bin Abdul Patah, Department of Wildlife and National Parks Peninsular Malaysia (DWNP)*
- Otters in a city environment including possible aggression/zoonoses – *Dr Sivasothi, National University of Singapore*
- Education for children – *Ben Yoxon, IOSF*
- Otter documentation and habitat mapping in Mukim Tanjung Kupang by a local youth group – *Ms Nur Syaimaa Hanisah binti Ali, Mr. Hakimi bin Bakri Kelab Alami Nature and Heritage Centre and Mr Affendi Yg Amri, University Malaya & Malaysia Otter Network (MON)*

Session 4: Illegal Trade

- Illegal trade in otters for furs and pets – *Dr Chris Shepherd, MONITOR Conservation Research Society*
- Tracing the origin of traded otters in southeast Asia and Japan – *Pai Worata Klinsawat, King Mongkut's University of Technology Thonburi*
- Caring for confiscated otters – *Nick Marx, Wildlife Alliance, Phnom Tamao Wildlife Rescue, Cambodia*

Through these initial sessions the attendees, both physical and virtual, gained a better understanding of otters as a whole, with more specific information on the countries within the area and also aspects that are causing their decline. This information gave a better idea of the status of each species within the region. For example, Eurasian otters have not been seen in Malaysia for a considerable amount of time and are believed to be no longer present on Peninsula Malaysia, as the species has been removed from protective status by the government. However, they are believed to be in parts of Thailand, Myanmar and Indonesia.

The presentations also provided more information on species distribution across the region but identified that more baseline data is needed. Clearly it is fundamentally important to do baseline surveys as unless we have this data, we cannot prepare and implement a practical conservation plan for the future. It is important to remember that much of the information offered, particularly that for Myanmar, was in relation to otters seized from illegal trade and there have been few official research projects. This, once again, emphasises the importance of encouraging more research and the importance of workshops such as this to teach correct techniques.

The second day provided an introduction into surveying techniques and offered the attendees information on how they can carry out research into the species. The session was started by Mr Woo Chee Yoong, MNS and MON, who gave an introduction to identifying the four otter species found within the region. This presentation, using MON’s Species ID card, showed how to differentiate the different species to ensure correct identification. Grace Yoxon then gave a summary of survey methods for otters looking at field research and how important accurate information can be gained. This was followed by more detailed presentations on survey methods such as spraint and diet analysis, genetic work and footprint analysis through WildTrack Footprint Identification Technology (FIT).

There was then a visit to the Park to put our newly acquired skills and techniques into practice. As mentioned, Kuala Selangor Nature Park is home to three of the four species of otter within the area and attendees were able to practice survey techniques with a particular emphasis on spraint/spraint analysis and footprint ID.

Figure 4: Examining otter spraint in the field

The group split into two, and swapped over to cover both aspects. One session was led by Larissa Slaney of Wildtrack focusing on footprint identification and how to capture and upload photographs to the Wildtrack online application. The second group was led by Ben Yoxon, IOSF, with an emphasis on spraint recognition and correct procedures for collection of spraint for laboratory analysis (Figure 4). This focused on Asian short-clawed and smooth-coated otters, as spraint was found for both species which allowed comparison. For virtual attendees, both presentations were filmed and played through Zoom preceding the final classroom session.

Figure 5: Examining otter spraint in the classroom

The final classroom session, and the final session of the day, was a practical session on spraint analysis and footprint analysis (Figure 5). Dr Paul Yoxon demonstrated spraint analysis including processing of spraints and analysis of diet. The WildTrack team showed attendees how the programme works and how to upload footprints, as well as using the prints collected to test the programme.

The following day there was another field visit to try and observe otters in their natural habitat, find signs such as slides and sprainting points and more opportunities to record footprints. The group were fortunate to see a large family of smooth-coated otters which hunted for a brief time before heading back in to the forest. Their presence had ensured that there was an abundance of recent footprints and trails to be documented to help the artificial intelligence (AI) for footprint recognition (Figure 6).

Figure 6: Left – Boat excursion to see otters; Middle – Wild smooth-coated otters; Right – Looking for footprints

The afternoon allowed an open discussion about plans moving forward to try and increase knowledge, reduce threats and increase conservation of otters across the region. MNS plan to produce a roadmap for otter conservation to encourage more involvement of other ecologists and the general public. The discussion was focused on three main sub-headings: research, education and threats. This enabled all attendees, both virtual and physical, to provide their input on what is necessary to move forward. By having attendees from a variety of different backgrounds, including government officials, universities and other conservation groups, it allowed for an open and flowing discussion.

With regards to research, it was agreed that it is most important to gain baseline data on otter distribution and presence/absence of species. This can be achieved in a number of ways and by using the training received it means that everyone can contribute. Furthermore, attendees can share their new knowledge with colleagues and acquaintances to generate more information.

Threats were identified as illegal trade, human–otter conflict and loss of habitat. Better cross-national and cross-regional co-operation is essential in order to reduce this and it is vital to work closely with local communities so that that any conflicts are kept to a minimum and addressed accordingly. By inviting community members to the workshop we received first-hand information about what the communities want and need, and how conflict resolution can be achieved.

Finally, community education and outreach were planned in a way to help individuals and stakeholders to obtain a better understanding of the benefits of otters with a special emphasis on children and local communities. It is important to empower both parties to be part of the change.

On the final morning Dr Paul Yoxon, on behalf of IOSF, formally invited MON/MNS to be a part of the Asian Otter Conservation Network which is chaired by Prof. Padma de Silva. Following discussions with MNS there are further plans on how to move the network forward and keep working towards the same common goal.

The workshop was officially closed following speeches by Dr Paul Yoxon, Dr Ahmad Ismail, Malaysia Nature Society, and YBhg. Dato' Fakhrul Hatta bin Musa, Department of Wildlife and National Parks Peninsular Malaysia (DWNP).

IOSF and MNS/MON were delighted with the success of the workshop as the aim is not to hold a talking shop but to create real action. Despite the pandemic providing many hurdles, it was great to hold the workshop together with so many positive individuals and organisations. Future plans to gain more baseline data on otter distribution and increase human interaction is in the pipeline and there will be many positive outcomes from this workshop.

Dr Paul Yoxon

Head of Operations, IOSF

List of Participants

Teoh Wan Yi, Research Assistant, MNS

Prof Ahmad bin Ismail, President, MNS

Dr Paul Yoxon, Head of Operations, IOSF

Grace Yoxon, Director, IOSF

Prof Padma de Silva, Chair, IOSF Asian Otter Conservation Network

Ben Yoxon, Education Officer, IOSF

Nick Marx, Director, Wildlife Rescue, Care and Release Programme, Phnom Tamao Wildlife Rescue, Cambodia

Nobuyuki Yamaguchi, Associate Professor, Universiti Malaysia Terengganu

Noor Hasmayana Yahaya, Government Official and Head of Marine Aquaculture Section, Department of Fisheries Malaysia (DOFM)

Mohd Yusuf bin Ismail, Fisheries Officer, Department of Fisheries Malaysia (DOFM)

Larissa Slaney, Conservation Biologist, WildTrack

Khin Ohnmar Htwe, Managing Director, Myanmar Environmental Innovation Foundation

Saw Pyone Naing, Chairman, Myanmar Environmental Innovation Foundation

Tasneem binti Rafiee, Student, University of Malaysia Kelantan

Sandeep Sharma, Conservation Biologist, iDiv (German Centre for Integrative Biodiversity Research)

Wong Choong Hay (Sonny), Wetlands Programme Manager, MNS

Noraisah Majri, Conservation Officer, Sarawak Forestry Corporation

Yonny Stanly Anyie, Conservation Officer, Sarawak Forestry Corporation

Christ Hani Lian Lee, Conservation Officer, Sarawak Forestry Corporation

Saravanan Sinniah, Environmental Educator/Marine SIG Coordinator, MNS

Myint Myint Soe, Masters Student/ Wildlife Conservationist, King Mongkut's University of Technology Thonburi, Myanmar

Maryati binti Abdullah Lakim, Government Official, Sabah Wildlife Department

Siti Nur'ain Ampuan Acheh, Wildlife Officer, Sabah Wildlife Department

Ainah Yahya, Teacher, MNS

Mohd-Azlan Jayasilan, Lecturer/ Director, Institute of Biodiversity &

Environmental Conservation UNIMAS, Malaysia

Chris Shepherd, Executive Director, MONITOR Conservation Research Society

Shaodah binti Juperi, Pengurusan Konflick Hidupan Liar, Jabatan Perlindungan Hidupan Liar Dan Taman Negara (Perhilitan) Negeri Selangor, Malaysia

Dr Pazil bin Abdul Patah, Director of Ex Situ Conservation Division, Jabatan Perlindungan Hidupan Liar& Taman Negara(Perhilitan) Semenanjung Malaysia

Sarah Shazwani Zakaria, Education/Lecturer, MNS

Manimaran A/L Vadivelu, Lecturer, Institut Pendidikan Guru Kampus Ipoh, Malaysia

Kho Mun Lu (Lulu), Freelance Tourist Guide, Sarawak Guide Associations, MNS - Kuching Branch

Enos Jeoffry, Penolong Pegawai Hidupan Liar, Jabatan Perhilitan Negeri Selangor, Malaysia

Fatin Nurulizaty binti Azmi, Trainee, Sime Darby Plantation (SDP), Malaysia

Nur Afiqah binti Affendi, Trainee, Sime Darby Plantation and Berhad Conservation & Biodiversity, Malaysia

Woo Chee Yoong, Wildlife Conservation Officer, MNS

Pia Worata Klinsawat, Lecturer, Conservation Ecology Programme, King Mongkut's University of Technology Thonburi, Thailand

Lalita Gomez, Wildlife Trade Research and Conservation, MONITOR Conservation Research Society

Leela Rajamani a/p Ramnath Rajamani, Lecturer, Universiti Sains Malaysia

Priyanka Suri, Project Coordinator, TRAFFIC Southeast Asia

Aidde bin Jamali, Pembantu Hidupan Liar, Sabah Wildlife Department Pembantu Hidupan Liar

Kanitha Krishnasamy, Director, TRAFFIC

Lim Wei Hang, Local Field Assistant, MNS

Muhammad Irfan bin Bahari, Pembantu Perikanan, Jabatan Perikanan, Malaysia

Mohd-Asfarizal bin Mohd-Masmok, Fisheries Assistant Officer, Department of Fisheries Malaysia

Muhammad Azamuddeen bin Mohammad Nasir, Treasurer, SCB Malaysia

Ler Wei Rong, Programme Executive, The Habitat Foundation Wildlife & Ecosystem Conservation, Malaysia

Affendi bin Yang Amri, Research Officer, Institute of Ocean and Earth Sciences (IOES), Universiti Malaya

Dr Mohammed Rizman bin Idid, Senior Lecturer and Scientist, Institute of Ocean and Earth Sciences, Universiti Malaya.

Hani Nabilia binti Muhd Sahimi, Pegawai Hidupan Liar, Jabatan Perlindungan Hidupan Liar Dan Taman Negara (Perhilitan), Malaysia

Zailan Firdaus, Student, Universiti Malaysia, Sabah

Muhammad Yazid bin Deraman, Environmental Education Centre Manager, MNS

Sharifah Nur Ain binti Mahiyuddin, Programme Officer, MNS

Nurain Amiera binti Abu Samah, Student/Intern, MNS

Nur Syaimaa Hanisah binti Ali, Admin, Kelab Alami Mukim Tanjung Kupang, Malaysia

Anna Wong, Senior Lecturer and Research, MNS and University of Malaysia, Sabah

Kugeneswaran A/L Tamilmany, Teacher, Sjkt Bandar Springhill, Malaysia

Haizan Anak Kamarulzaman, Local Field Assistant, MNS

Emily Lau Xing Qian, Student, Taylor's University, Malaysia

Emily Ho Xue Ling, Student, Taylor's University, Malaysia

Hakimi bin Bakri, Staff, Kelab Alami Nature and Heritage Centre, Malaysia

Ng Wai Pak, Senior Programme Officer, Global Environment Centre, Malaysia

Irdina Damia binti Muhammad Adam Mikhail Lim, Student, Taylors University, Malaysia

Iman Amanda binti Muhammad Adam Mikhail Lim, Student, Taylors University, Malaysia

Yow Yoon Yen, Lecturer, Sunway University, Malaysia

Chong Ju Lian, Lecturer, Universiti Malaysia Terengganu, Malaysia

Chia Xiao Li, Project Assistant, MNS

Kushaal Selvarajah, Secretary, Society for Conservation Biology Malaysia Chapter

Lindsay Porter, Scientist, SEAMAR, Malaysia

Hashimi bin Ismail, Coordinator Pendidikan Negeri Terengganu, MNS

Mohd Nor Azizi bin Kamarudin, Koordinator Pendidikan Negeri Terengganu, Jabatan Pendidikan Negeri Terengganu, Malaysia

Ir.Ts.Sv Kalaiselvam Velayudan, Jurutera Awam, Jabatan Pengairan

Dan Saliran Malaysia*Jenny Machau*, Wildlife Officer, Sarawak Forestry Corporation

THANKS

We are very grateful to Mr Woo Chee Yoong, Malaysia Nature Society and Malaysian Otter Network for his help in organising the workshop.

We would also like to thank Nur Afiqah binti Affendi, Fatin Nurulizaty binti Azmi (both of Sime Darby Plantation Berhad), Lim Wei Hang and Haizan anak Kamarul Zaman (both of MNS) for their support, expertise and hard work in ensuring the workshop was run smoothly.

Thanks to all the trainers who provided their time free of charge.

We would also like to thank our sponsors: Colchester Zoo Action for the Wild, The Rufford Foundation, Dierenpark Amersfoot Wildlife Fund and Keidanren Nature Conservation Fund.

And finally, thanks to all the participants for their enthusiasm for otter conservation.

For those who wish to watch the presentations from the Workshop you will find them on YouTube at:

26th April 2022 Sessions: https://youtu.be/r0wkTMcmvho

27th April 2022 Sessions – Part 1: https://youtu.be/HEUA6HuMHv4

27th April 2022 Sessions – Part 2: https://youtu.be/ycqXHX5XJus

28th April 2022 – The Discussion: https://youtu.be/hZTAA4B8RJo

WORLD OTTER DAY REPORT

As this year's edition of the *OTTER Journal* is later, below you will find reports on both the 2021 and 2022 World Otter Day.

IOSF World Otter Day has had to adapt due to the pandemic but we have been delighted to see so many events still taking place. Of course we want to celebrate the world of otters but people's safety is always a primary concern.

WORLD OTTER DAY 2021

IOSF GRANTS

As always, we offered three grants, with a fourth made available thanks to an anonymous donation.

The 2021 grants were awarded to the following:

Adriana Belen Vallejos, Estacion Biologica Corrientes – Argentina – For research into the neotropical otter as well as the painting of a mural at the local school.

Coffi Donald Dossou, Human Nature Projects Benin, Benin – Raising awareness for otters in the Oueme Valley.

Dr Eswar Narayana, Janya Foundation – India – Awareness programme focused on children and local communities.

Sujita Dhakal, Global Youth Biodiversity Network, Nepal – Sensitisation programme involving fishing communities.

IOSF WORLD OTTER DAY WEBINAR

For World Otter Day 2021, IOSF also launched our first ever global webinar.

The webinar "Otters of the World" was held in two parts – one focusing on Europe and Asia (Morning – UK) and the other on Africa and the Americas (Evening – UK). This allowed us to have as many otter enthusiasts as possible to share their experience and knowledge with around 300 registered attendees. The sessions and speakers were as follows:

Morning Session:

Paul Yoxon, International Otter Survival Fund – "Global status of otter and the work of IOSF"

Prof. Padma de Silva, Asian Otter Conservation Network – "Otter conservation in Asia"

Woo Chee Yoong, Malaysia Nature Society – "Research on the Kuala Selangor otters (including the rare hairy-nosed otter) and the work of the Malaysian Otter Network"

Save Vietnam's Wildlife – "Rehab of rescued pet otters, the illegal trade and the threat to wild otter populations"

Omar Al-Sheikhly, University of Baghdad – "The legendary Maxwell's otter, distribution, threats and conservation work in Iraq"

Afternoon Session:

Megan Isadore, River Otter Ecology Project – "Supporting conservation, one otter sighting at a time"

Pablo Hernandez, Universidad Autónoma de Aguascalientes – "Conservation challenges for the neotropical otter in Mexico"

Bridgette San Marco, Save The Giants – "Giant otters in Guyana and the work of Save the Giants"

Ben Yoxon, International Otter Survival Fund – "Team Otter and the importance of children's environmental education"

William Mgomo, IOSF African Education Officer – "Otters, communities and reducing human–otter conflict in an important African wetland habitat"

The event proved incredibly popular among attendees and there were calls for regular, similar sessions to be held. The event is also available to watch on IOSF's YouTube page:

Morning session: https://www.youtube.com/watch?v=Y6wWGgZz_Tc

Afternoon session: https://www.youtube.com/watch?v=O86_OAzeNXI&t

Despite restrictions, there were also various other events held across the world in countries such as Uganda, Tanzania and the UK.

WORLD OTTER DAY 2022

World Otter Day 2022 was more like the pre-pandemic World Otter Days with events all across the world.

SOCIAL MEDIA

Social media is becoming a very powerful tool to get messages across to the masses. We are delighted to have had so many people interacting with IOSF online and also using the #WorldOtterDay. So much so that #WorldOtterDay was trending worldwide!

IOSF GRANTS

Once again we were delighted to be able to offer four World Otter Day grants, thanks to another anonymous donation:

Bangladesh – *Md Arafat Rahaman, Bangladesh Biodiversity Conservation Federation, Bangladesh*

Little is known about the status of the smooth-coated otter which has been sighted in a new wetland habitat in the west of Bangladesh. This project addressed the pressures on such an area regionally and nationally and involved government agencies, the Forest Department and local policymakers. This has helped to raise awareness and educate people about the otters in their area and encourage coexistence.

Mexico – *Miguel Torres, Okapia Conservación A.C.*

This event was held in a very special location, Tetecala, a beautiful little town located in Morelos state. An important river runs by and thanks to field work and other investigations evidence of the neotropical river otter (*Lontra longicaudis*) was found. Unfortunately, they also found that the river is polluted and has heavy human pressure so their mission is to reduce this and maintain an ideal habitat for the otters to live and thrive.

With the intention of making people aware of the presence of otters in their community and the importance of the species for the environment, they visited elementary schools in Tetecala two weeks before "World Otter Day" and provided the students with information to relay to their community.

For the big day itself they celebrated in Benito Juárez school and this time they also gave printed paper masks for the children to colour and personalise. Finally, a costume and drawing contest was held in which more than 150 children participated and won some incredible prizes.

Miguel Torres, Okapia Conservación A.C., who ran the event said, "*We know that for a conservation project to be successful we must include the population so that they can take action and become allies. This is why World Otter Day was the perfect day to start raising awareness and for the inhabitants of Tetecala to know the importance of our conservation project for the neotropical otter*."

Nigeria – *Salami Olalekan Michael, Netlink Environmental Conservation Organization*

Michael and his group carried out the project in Ondo State which focused on three main parts:

- Visiting the Araromi coast to work alongside fishing communities, farmers, boat/canoe transporters and using education materials on otters and their conservation, both in English and the local dialect Yoruba.
- Otter awareness campaign and conservation education programme with pupils of Ilaje High School, Royal Achievers School and Pure Wisdom College.
- Producing leaflets with information about otters, threats, conflict and the importance of otter conservation, available in both English and Yoruba.

Thanks to the passion of Michael and his team they were able to achieve a lot. Firstly, local community members offered valuable information on otter populations in the area. Real education isn't just education, it's about inclusion, and the local communities have much knowledge that we can use by working with them. Michael worked with the local community to increase their knowledge of the ecological, and potentially economic, benefits of otters in the area, raising awareness for habitat management and initiatives such as ecotourism. Furthermore, he worked alongside fishing communities to increase awareness of proper fishing practices during a two-day event for sustainable management in riverine areas.

Finally, through his work with schools the students learned more about otters and a Team Otter club was established to increase the involvement of teenagers/youth in otter conservation in the area.

Michael stated that poor perceptions of otters were one issue faced by otters but hopefully this will improve as they go forward. You will read more about this work in his own paper in this issue of the *OTTER Journal*.

He concluded by thanking IOSF for their contribution and believes that significant steps were taken for otter conservation and will continue.

Togo – *Patrice Delagnon Assou, Department of Zoology, University of Lomé*

On 28 May 2022, World Otter Day was celebrated for the first time in Togo through a scientific debate with PhD, Master and Bachelor students at the Laboratory of Ecology and Ecotoxicology (LaEE) about otter distribution and conservation status. The main objective was to highlight otters and invite students/researchers to produce the first ever rigorous data on their distribution and conservation status in Togo. We were delighted to see 28 attendees from the Laboratory.

Two species of otter, the African clawless (*Aonyx capensis*) and spotted-necked (*Hydrictis maculicollis*) have been recorded in Togo. Both are increasingly threatened by habitat degradation, loss and fragmentation, and unsustainable hunting throughout their geographic range. Currently, nothing is known on the conservation

status and distribution of otters in the country. Developing scientific knowledge and producing rigorous data on the distribution and conservation status of otters in Togo would be of paramount importance.

The talk captivated the attention of the attendees who asked a lot of questions, bringing about an interesting debate. Questions included: How can we get start with otter conservation and research actions in Togo? What is the possible distribution range of the species in Togo? Where to seek for funding to support research and conservation actions of the species in Togo?

It is great to see so many individuals passionate about otters and gaining more of an understanding across Togo.

OTHER EVENTS

Events were also held across the world to celebrate otters and raise support for their conservation. Here are some of them:

India

2021 Grant winner ***Dr Eswar Narayana*** followed up last year's event by visiting the villages of Penikeru, Kapileswaram, Kotipalli, Pillanka, and Ramannapalem along the River Godavari in Andhra Pradesh, India. The objective was to create awareness among different stakeholders, including children, fishing communities and village leaders about the conservation of otters. When working alongside fishing communities it became an interaction and sharing of knowledge between the groups.

Elsewhere, in Odisha, ***Eco Earth Crusaders***, IOSF Otter Oscar 2021 winners, ran an awareness campaign for otters in the area. Their event was in two-parts, one focusing on children in a local school, and the other focusing on the community as a whole.

Lebanon

Lebanon Reforestation Initiative (LRI) joined IOSF World Otter Day for the first time this year and invited members of the public to come and learn about Eurasian otters, particularly in their country. They used a board game (developed in English, French, and Arabic), "Help the Otters" created by Samara El-Haddad, Wildlife Conservation Specialist and designed by Palig Haroutunian (LRI) and a short presentation about otters was given to the children before playing the game. The board game, similar to the traditional snakes and ladders, represents a mother otter trying to reach her pups in their holt with "dinner".

They also used their activity booklet for children, "Ruby the Otter", and various arts and crafts focusing on otters and their habitats. During the event they managed to attract a number of families to join in with children aged 3–12 years old. The feedback was all positive and helped children learn about an animal they knew nothing about. LRI will continue to celebrate World Otter Day in the coming years and plan to visit schools across the country using their "Help the Otters" game!

Montenegro

The National Park of Montenegro held a World Otter Day event at Skadar Lake National Park. They held educational workshops for two schools within the area using some materials provided by ***Nino Djurovic, of NGO Living Green.*** Otter monitoring in Skadar Lake National Park has been carried out since 2014 and its presence and potential habitats are monitored and determined.

Paraguay

At ***Para La Tierra***, they celebrated World Otter Day with the children from their eco-club programme ***Voces de la Naturaleza***. They held an otter-themed Eco-Club event, where they told the children about otters and their conservation in general and the otter species of Paraguay in particular. They then talked about World Otter Day and its relevance before making otter masks

Peru

Parque de Las Leyendas, in Lima, held a large World Otter Day event to raise awareness of otter conservation and focus on one of Peru's most famous species, the giant otter. They used social media to draw attention to the species and its importance, including its ecological role. Their "on-site" event took place on 27 May, with two parts. The first focused around their giant otter exhibit and talks were given on characteristics, behaviour, conservation status and threats to the species, and about 100 people attended. In the afternoon, education materials were focused on children with an activity called "Elaborate your own otter craft" and they made their own otter with paper bags. During both activities, they shared information about the characteristics of the giant otter and the importance of protecting them in the wild.

Tanzania

IOSF African Community Education Officer, William Mgomo, gave a talk on otters to 103 of his fellow students, using videos and pictures to raise awareness of the species. Furthermore, assisted by Professor Ndibalema, Department of Wildlife, the group planted trees to emphasise the importance of protecting the environment.

The students really engaged with the programme and are now wanting to assist William with his otter work and become members of a group to help make a difference.

Uganda

In Uganda, there were two World Otter Day events.

The first, held by the ***Mutanda Community Conservation Organization*** (MUCCO) at Kungugu on the shores of Lake Mutanda, Nyundo Sub-County, Kisoro district. Fishing communities, government officials and other relevant stakeholders were invited to increase their awareness of the species. They focused on what could be

done to reduce conflict with fishing communities, steps to alternative livelihoods and also reduction of trade.

Government officials have promised to help to try and increase fish stocks which will reduce much of the conflict between otters and the communities. There will also be an increased presence of wildlife officers to try and reduce otter trade for skins and meat, while it was also emphasised how important otters are to the ecosystem.

Further east, on Koome Island in Lake Victoria, another World Otter Day event was taking place by ***Hope for Nature***. This was also centred around fishing communities in the area – at the Kissu Landing site, where otters are known to be present. Again the aim was to raise awareness of otters among fishing communities, the benefits of having them and how the people can participate in otter conservation in their area. The fisherfolks here suggested that it is important to have otter conservation committees in every community to raise awareness and education for those unaware of the current situation.

United Kingdom

There were various World Otter Day events across the United Kingdom.

The Fenn Bell Conservation Project celebrated World Otter Day for the entire week! They posted on social media for the week and hosted their "Otter Weekend" with a quiz on Saturday night and bingo on Sunday to raise money for otter conservation through IOSF. They put out extra posts, gave special otter talks twice daily, as well as their "mascot" who collected donations. Over 650 people joined during the week and they managed to raise a wonderful £300 for otters!

Long-time IOSF supporter ***Grace Onions*** held an event to raise support for otter conservation. It was a brilliantly simple and social event offering "wine and nibbles" in exchange for a donation to otter conservation.

Marcia Rae, Easter Ross Ranger, High Life Highland, held an otter walk around the Kessock Bridge area to draw attention to otters. During her walk, Marcia and the group managed to spot an otter and watch it fishing in the Moray Firth.

United States of America

For one of the teachers at ***Argonauta Academy***, the day started on a sad note when they were called to a road casualty, unfortunately a juvenile female otter.

The class still had their plans to celebrate World Otter Day and they used this sad event to help educate children and emphasise how we can affect otters. They discussed mitigation opportunities, such as wildlife corridors, and how they can help prevent road strikes. The theme of the day allowed children to use recycled materials to create safe crossings for otters and emphasise how they could help.

One pupil of Argonauta Academy even created a new species of otters, the Pink Eared Otter, using IOSF's otter mask!

There were a number of other events across the USA.

In total, there were events held in 39 countries, including Spain, Germany, Costa Rica, Australia, Taiwan and Japan. It is impossible to mention them all but our special thanks go to each and every one of you for joining us and helping people to be more aware of otters.

Webinar

Following the success of the webinar in 2021, and positive feedback, we decided to hold our second World Otter Day webinar. We invited various speakers on different topics and we are very grateful for their invaluable contribution to the success of the workshop:

Morning:

Dr Paul Yoxon, International Otter Survival Fund – "Otter spraint surveys and spraint analysis and their limitations"

Dr Eleanor Kean, http://www.eleanorkean.com/ – "Unexpected results from a nation-wide otter survey of Wales"

Frederick Kistner, Karlsruhe Institute of Technology (KIT) and Wildtracks – "What you can learn by looking at otter footprints: An introduction to the Footprint Identification Technology (FIT) for otters"

Mohan Birkam Shrestha, Otter Researcher, Nepal – "Eurasian otter in Nepal: Unveiling their presence after three decades"

Klaudja Koci/Bledi Hoxha, Protection and Preservation of the Natural Environment in Albania – "An overview of European otter research and monitoring in the Prespa Lakes, Albania"

Evening:

Claire Taylor, Two Oceans Aquarium – "Urban wildlife conflict: *Aonyx capensis*, our biggest challenge yet"

Heather Barrett, Sea Otter Savvy – "Being sea otter savvy"

Javier Trivelli and Valentina Diaz Savaria, OBC Chinchimen – "Chungungo: Re-ottering Chile"

Adriana Belen Vallejos, Ranger with Provincial Parks Direction from Corrientes Government – "The distribution of neotropical otters and the climate crisis: A study case in northern Argentina"

Ana Maria Montes Ferro, from Colombia – "Giant otter conservation and community involvement"

We were delighted to be joined by over 200 attendees from over 40 nations worldwide. If you missed the Webinar you can catch up on YouTube:

Morning Session: https://youtu.be/09jUAqf0_GU

Evening Session: https://youtu.be/MTAuzKS6ufw

Conclusions

World Otter Day 2022 was a huge success and increased the knowledge of otters across the world. In 2022, we had the most countries involved, with a total of 39 countries across every continent, bar Antarctica.

We are delighted with everyone's involvement and look forward to more people holding events and increasing the knowledge of otters for World Otter Day 2023 (31 May).

Thank you all.

IOSF OTTER OSCARS

Our 2021 IOSF Otter Oscars resulted in many submissions being received from a wide range of countries and projects. We are always impressed by the scope of the projects involved and the challenges confronted. Consequently, deciding the winners of the Otter Oscars is also a challenge for us. We appreciate the work and efforts people are making for otters and hope this continues, as does your support for these Awards.

The 2021 winners are:

Special Award – Rita Chapman, Democratic Republic of Congo/USA

In 2010 Rita and her husband Glen received a tiny Congo clawless otter cub which they named Mazu. Mazu rose to stardom and even Government officials came just to see this fascinating creature, whose name and face became a catalyst for change. People no longer saw otters as bushmeat or for poaching, and started to care for and protect them.

Since then Rita has cared for many otters and the Kikongo Otter Sanctuary was formed. Along with her loyal Congolese helpers, Delphin and Sico, they have cared for various otters and helped them return to the wild.

The impact of Rita's work in D.R. Congo and Kikongo will be timeless and her actions have helped otters be seen in a new light across the nation. Now that she has retired back to USA she is leaving these beautiful otters behind, safe in the knowledge, that the local people, led by Delphin and Sico, now truly care about them.

Image ©Rita Chapman

Research – Omar Al-Sheikhly, Iraq

Omar is a researcher and wildlife ecologist at the University of Baghdad. He is a passionate conservationist and has spent much time studying "Maxwell's Otter", a subspecies of the smooth-coated otter that only habituates Iraq and Iran. He has published several papers in the IOSF *OTTER Journal*, including a paper in the 2021 issue, "Art as a conservation tool in the Mesopotamian

marshes, Southern Iraq, using Maxwell's otter (*Lutrogale perspicillata maxwelli*) as an example". This unique project involved training a number of wildlife photographers to document wildlife sightings to help with monitoring and identifying otter species.

Image: ©Omar Al-Sheikhly

Group or Organisation – Cork Nature Network, Ireland

This project raised the profile of otters across Ireland. Five otter trails have been developed and surveys carried out looking at diet, presence and habitat. The Network created a film on their native Cork otters and over 500 people attended the "premiere". Now their "blueprint" is to be adopted by other areas and other cities.

Image: ©Cork Nature Network

Photography/Artwork – Stephane Raimond, France

Stephane won this award for his amazing picture of an underwater otter.

Once a fish farmer, Stephane developed a passion for the otters that inhabited his fish farm. In 2010, he gave up fish farming and instead found ways and protocols to help fish farms protect their fish but also have thriving otter populations. Stephane regularly studies the otters and their behaviour at his home where he and the otters peacefully reside alongside each other.

Image: ©Stephane Raimond

Community Achievement – ECO-Earth Crusaders Organisation, India

The ECO-Earth Crusaders team managed to find a compensation scheme for fishermen's nets to reduce any potential conflict. They have also produced a book called *Community-Based Conservation of Smooth-Coated Otters at Nuanai*.

Image ©Eco-Earth Crusaders

Young Person's Award – Prentice Cunningham, Scotland

At the Youth Climate Film Awards, a video produced by Prentice and his friends "Climate Justice? We Need Otters!" won a prize. In this way they managed to bring the video, and the importance of otters, to a wider audience.

Image: ©Blair Cunningham

IOSF STUDENT RESEARCH GRANT

The IOSF Student Research Grant was launched in 2022 to help students carry out an otter field survey under the guidance of a trained and experienced ecological surveyor, Andrew Rothwell. There were a number of applications but eventually two students (*Ron Pasieczna* from Sheffield University, and *Rachel Wick* from Brighton University) were selected for the project on the Isle of Barra with the aim of learning the various techniques involved, including post-survey work such as diet analysis.

The training survey took place in June 2022 and accommodation was provided so that the students just had to arrange their travel to the island and food.

The group arrived on Barra in beautiful weather – "*that surreal tropical island feel*". An excellent ferry crossing brought "*a multitude of common dolphin pods, eight minke whales and five basking sharks*". In the first few good days, nine otters were seen (two family groups and a single otter) and they were able to observe the otters in their natural habitat; mothers bringing fish to feed the cubs, grooming and swimming. Unfortunately the weather then changed which reduced opportunities to look for otters directly, but the field survey work continued, finding and mapping signs of otter activity within several habitat types found on the Island.

Ron and Rachel examining a sprainting site © Andrew Rothwell

A full report on the training programme will be produced in due course.

IOSF will be repeating this training project in 2023 elsewhere in the Hebrides. Students of zoology, biology and ecology are all welcome to apply. They must be recommended by their lecturer and once a short list has been drawn up they will be called for interview.

Applications will open on 1 November 2022 and must be received by 1 February 2023.

For more information contact enquiries@otter.org

OTTER SURVEY OF THE ISLAND OF CORFU 2021

Graham Roberts

Ecologist (Retired)

email: gbroberts51@gmail.com

Whilst holidaying in May 2019, the author of this preliminary report walked large sections of easily accessed coastline of the north and northeast coast of Corfu (Ionian Sea, Greece). During this activity it was noted that considerable signs of the Eurasian otter (*Lutra lutra*) were found all along this section of coast. Some local contacts were established, and an interest expressed to return to the island to carry out a more detailed independent otter survey of the whole island. After discussions with the International Otter Survival Fund (IOSF) the author returned to Corfu in September 2021, to undertake the survey. It was not possible to return earlier due to international Covid restrictions.

The island provides a diversity of wetland and coastal habitats. The majority of the rivers are relatively small, with any permanent water of significant depth nearer to the estuaries. Many upland reaches are ephemeral streams, often completely dry by mid-summer and only becoming temporary torrents following heavy rainfall. There are also four significant wetlands linked to coastal areas, all designated as Natura 2000 sites: Antiniotissa, Chalkiopoulou, Lake Korisson and the Alikes Wetland. The coastal peninsula from Kassiopi in the northeast ranging south to Agni provides a variety of relatively undisturbed bays, with much pristine back up forest and many potential lying up sites inaccessible to humans amongst rocky shoreline and cliffs. There are three permanent small wetland lagoons within this area providing freshwater marshland habitats set back from the coast.

Otter distribution was assessed by adopting identical principles of standard otter surveys carried out in the UK and many other European countries (**Mason and Macdonald 1986**). The survey was undertaken by two people working together due to time constraints and difficulties of access and personal safety. On assessing each site wherever possible riverbanks were surveyed for 600 metres and only curtailed if positive otter signs were found. Many sites encountered did not have easy access, with steeply incised riverbanks, and virtually impenetrable bankside vegetation, often dominated by Giant Reed (*Arundo donax*). High resolution binoculars were an invaluable aid at several sites where access was clearly private or impossible to achieve safely. The access of habitats surrounding the coastal lagoons concentrated on easy access points and freshwater entry or discharge points from the wetlands themselves to the sea. Many sites were accessible from roads, tracks and bridges, where access was clearly private or fenced off, and permission was sought if local people were approached. No access was denied. Where rivers or streams were completely dry, both up- and downstream, only the actual check site was thoroughly surveyed.

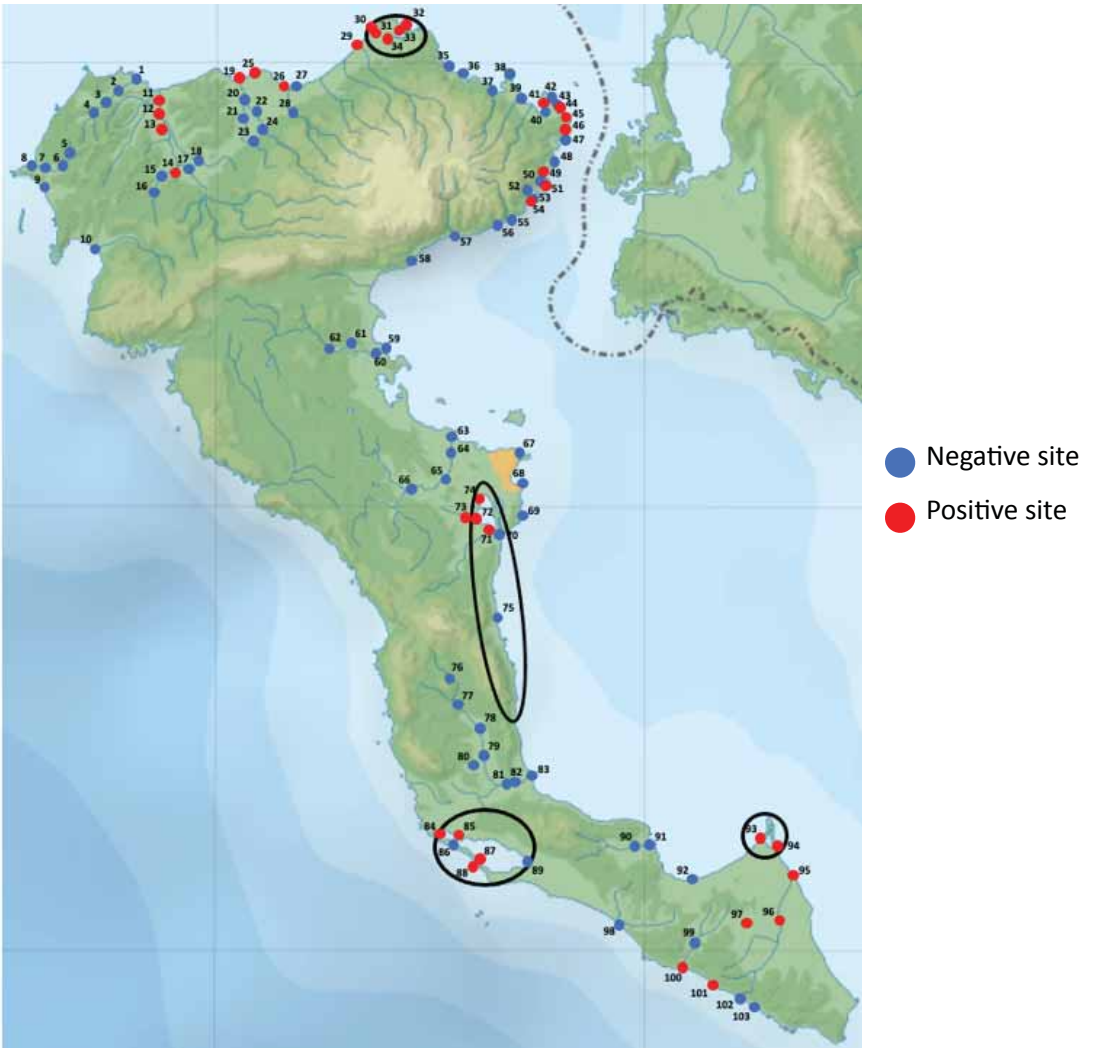

Figure 1. Otter distribution on the island of Corfu, October 2021.

Out of the 103 selected sites that were surveyed, positive otter signs were found at 33 (32%) (Figure 1). These results are very similar to two principal surveys previously carried out on Corfu Island by **Ruiz-Olmo (2006)** and **Galanaki et al. (2019)**. However, there are some definite subtle changes in distribution which may reflect that this more recent survey was conducted in the autumn period after an extensive period of drought. There had been no rainfall for the previous 166 days, and so many river courses were completely dry or devoid of running water. It is likely from the clusters of evidence that the population is not large; possibly consisting of just a few individuals utilising large areas of the island, particularly the coast, at varying times of the year.

The small, undeveloped sections of coast, particularly in the north, with small river estuaries appear to be important refuge sites. The largely unspoilt peninsula around the northeast coast, from Kassiopi to Kouloura, provides pristine associated wetlands and dense undisturbed forest habitat. This area would provide otters with many

potential breeding sites and coastal feeding opportunities. The area is also very close to the Albanian coast and it is highly likely that otters move naturally between the two countries. This could well be a factor in sustaining a viable small and mobile island population. The three principal wetland systems of Antiniotissa, Chalkiopoulou and Lake Korisson all contained fresh otter evidence, as did the Alikes wetland in the far south.

Of considerable concern throughout the undertaking of this survey was the degradation of many of the coastal wetland areas and particularly the small river estuaries that provide otters with essential access to freshwater riparian habitats, food prey and quiet refuge areas. The presence of extensive areas of fly tipping, particularly of plastics, the over-abstraction of freshwater in general from virtually all river catchments, and ongoing development are all significant pressures. Fish farms and angling interests are also likely to cause considerable disturbance to sensitive areas and lead to possible/perceived conflicts between humans and otters. Accidental persecution of otters is likely to happen in the trapping of non-native species, particularly the introduced coypu (*Myocastor coypus*), which is widespread around the island.

It is understood that otters possibly survive on only six of the 6,000 Greek islands and unlike most of the Greek islands, Corfu has a range of naturally occurring and varied wetland resources. This makes the very presence of otters on Corfu of national importance to Greece’s natural biodiversity and it is imperative that the importance of safeguarding the future of this native mammal is recognised at all levels.

The aim of the survey is to inform the local people of Corfu and interested environmental organisations about the importance of otters on the island. Hopefully, the local authorities, and potentially the Greek Government, will be further motivated to safeguard this legally protected endangered mammal by ensuring sensitive habitats are fully protected and even enhanced. Furthermore, local, national and international recognition could add to the many recognised natural resources of Corfu that are so greatly valued by locals and tourists alike.

A further survey of the north coast. an important area between Kassiopi and Kouloura, together with some neighbouring islands, is planned for Spring 2022. The results will then be integrated with the 2021 survey to form the basis of the final publication.

Disclosure Statement

No potential conflict of interest was reported by the author.

Author Biography

GRAHAM ROBERTS is a retired ecologist who has worked on otter recovery for southern Britain for nearly 40 years. He worked with the County Wildlife Trusts of Hampshire and Isle of Wight, Sussex and Kent and represented the Wildlife Trust on the National Otter Steering Group for many years. He has a passion for chalk rivers and all wetlands across the southeast. Currently he is an active Trustee for the Vitacress Conservation Trust and Chair of the Upper Itchen Initiative.

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OTTER RECORDS IN MYANMAR

MYINT MYINT SOE

Conservation Officer, Nature Conservation Society, Myanmar

Email: myintmyintsoe.wildlife@gmail.com

Myanmar is located in mainland southeast Asia and is bordered by Bangladesh and India, the People's Republic of China, Lao PDR, and Thailand. To the south and west are the Bay of Bengal and the Andaman Sea. Mountainous terrain makes up more than 40% of the country and Myanmar's principal rivers include the Ayeyawady, Thanlwin/Salween, Chindwin, Sittaung, and Kaladan. Myanmar has a land area of 676,577 km^2 and is located in a zone where three biogeographic areas meet. These transitional zones give rise to distinctive and varied species assemblages. Surveys continue to find new endemic species and range expansions of globally endangered species, even if certain places and taxa are relatively understudied. (**Sesega, 2015**).

RECORDS

Otters are significant biological markers of the health of wetlands because they are top predators and keystone species in freshwater and coastal marine environments (**Kruuk, 2006; Bhandari and Dhurba Bijaya, 2008**). Four different otter species may be found in southeast Asia – smooth-coated otter (*Lutrogale perspicillata*), hairy-nosed otter (*Lutra sumatrana*), Asian small-clawed otter (*Aonyx cinereus*), and Eurasian otter (*Lutra lutra*). Despite the lack of data on the distribution of all four species in this area, it is generally accepted that otter populations are declining as a result of shrinking suitable habitats, the effects of pesticides on their wetland biomes, and human–otter conflicts brought on by perceived or real threats to local and commercial fisheries (**Gomez and Bouhuys, 2018**).

Myanmar is believed to have all four of the species of southeast Asia, but the evidence is not clear. The Eurasian otter was only identified in the country from a single museum specimen (**Duckworth and Hills, 2008**), and its existence in the Irrawaddy delta is unconfirmed (**Hussain et al., 2008**). According to the IUCN Red List of Threatened Species 2020, two of these species: the smooth-coated and Asian small-clawed otters are considered Vulnerable, while the hairy-nosed otter is listed as Endangered, and the Eurasian otter is classified as being Near Threatened.

An online interview survey and some sightings records provide some evidence. Even though there is nothing about their current population, density, habitat use pattern, and their current impact, otters appear to be widely distributed in Myanmar except in the central dry zone. The presence of otters was recorded at 13 localities, and there will no doubt be more information in other places. Otter presence was confirmed through photo records and personal communications in ten protected areas, two reserve forests, and one island in the Myeik Archipelago. During the field survey

with Professor Ohnishi from Kyoto University at Smart Island in the Myeik Archipelago, the smooth-coated otter was detected three times and one spraint was found (Figure 1).

Figure 1. Smooth-coated otter spraint found at Smart Island (Photo: Author).

RESULTS

The details of the otter records are shown below:

- ***Lampi Island Marine National Park, Bokpyin Township, Tanintharyi Region:*** Smooth-coated otters were recorded in the 2015–2017 camera trap survey by the Forest Department.
- ***Yebyu and Dawei Township in Tanintharyi Nature Reserve in the same division:*** Two otter species – Eurasian otter and Asian small-clawed otter – were recorded (Figure 2).
- ***Meinmahla Kyun Wildlife Sanctuary, Bogale Township, Ayeyarwady Region:*** A Eurasian otter juvenile was recorded with a camera photo in 2019 (Figure 3).
- ***Rakhine State, Thandwe and Gwa Township:*** Otters can be found in the Rakhine Yoma Elephant Range. There are some photos of a Eurasian otter taken in the sanctuary in February 2019 (Figure 4) and 2022.
- ***Inlay Lake Wetland Sanctuary, Nyaungshwe, Pinlaung, and Pekon Township, Shan State:*** There is information about otters here, but the author cannot access any evidence.

- ***Htamanthi Wildlife Sanctuary, Homalin, and Kamti Township, Sagaing Division:*** From records in 2018 and June 2021 the sanctuary is believed to have Asian small-clawed otter and Eurasian otter and otter prints were found. (Figure 5).
- ***Indawgyi Lake Wildlife Sanctuary, Mohnyin Township, Kochin State:*** On 19 September 2014, a hunter was arrested by the staff of the sanctuary being in possession of an otter skin and carcass (Figure 6).
- ***Hukaung Valley Wildlife Sanctuary, Tanaing Township, Kachin State:*** In 2015, foresters received a dead otter, and the skin is on show in the small museum until now (Figure 7). Also in 2020. foresters spotted an otter in the sanctuary during a patrol.
- ***Kachin State:*** Information was obtained on three areas by personal communication - ***Imawbum National Park, Hponkanrazi Wildlife Sanctuary, and Hkakaborazi National Park***. Information by personal communication was also obtained about otters in ***Bogale Township, Ayeyarwady Region, Ka Don Ka Ni Island*** (reserve forest) but there is no photo record and no evidence.

Figure 2. Left – Eurasian otter; Right – Asian small-clawed otter (Photos: Aung Soe Than).

Figure 3. Young Eurasian otter (Photo Zaw Htue Aung).

Figure 4. Eurasian otters? (Photo: Rakhine Yoma Elephant Range).

Figure 5. Left – Asian small-clawed otter, Location N 25˚ 29.692" E 95˚ 25.919; Right – Otter spp footprint, Location N 25˚ 25.09195" E 95˚ 24.747, June 2021 (Photos: Myo Khaing).

Figure 6. Left – Otter spp, 2014 (Photo Aung Ko Lin); Right – Eurasian otter (Photo fisherman).

Figure 7. Skin of otter spp on display in museum in Hukaung Valley Wildlife Sanctuary (Photo Saw Min Thein).

THREATS TO OTTERS IN MYANMAR

The threats were identified based on the author's personal experience and the information obtained during the surveys. The main threat comes from hunting and the illegal wildlife trade because some local people carry out hunting as their main business and otter skins and carcasses are sold in wildlife markets (**Shepherd and Nijman, 2014**) and sex organs and bones are sold illegally online. For hunting, locals used the jaw trap, snare, and man-made gun (Figure 8).

***Figure 8. Locally used hunting equipment* (*Photo: Saw Min Thein*).**

DISCUSSION

Otter species are surviving in Myanmar (Table 1) but in some places, they are very hard to find, because of the declining population. It is difficult to say the current status of the species because of habitat loss or hunting or other threats, and no one has surveyed many areas.

Table 1: Otter distribution in Myanmar (X= detection and information)

Site name	Asian small-clawed otter	Smooth-coated otter	Eurasian otter	Hairy-nosed otter	Record type, person, and year
Hkakaborazi National Park	X		X		Personal communication (2021)
Hponkanrazi Wildlife Sanctuary	X				Personal communication (2016)
Imawbum National Park	X				Personal communication (2016)
Hukaung Valley Wildlife Sanctuary	X				Direct sighting by Saw Min Thein (2015 and 2020)
Indawgyi Lake Wildlife Sanctuary			X		Skin by Aung Ko Lin (2014), carcass by fisherman (2020)
Htamanthi Wildlife Sanctuary	X		X		Direct sighting by Myo Khaing (2018 and June 2021)
Inlay Lake Wetland Sanctuary	X				Personal communication (2021)
Rakhine Yoma Elephant Range			X		Direct sighting by Rakhine Yoma Elephant Range's staff (2019 and 2022)
Meinmahla Kyun Wildlife Sanctuary		X			Direct sighting by Zaw Htoo Aung (2018)
Tanintharyi Nature Reserve	X	X			Direct sighing by Aung Soe Than (2019)
Lampi Island Marine National Park		X			Camera trap (2015–2017) (Forest Department)
Smart Island, Myeik archipelago		X			Direct sighting by author (2020)
Ka Don Ka Ni Island (reserved forest)		X			Personal communication (2018)
Mong La Wildlife Market	X			X	Shepherd and Nijman (2014) (publication)

There is also the problem that even conservationists have little knowledge about the otter species, even though they are at similar risk to other endemic species, such as elephants and tigers. Similarly, awareness or education programmes for otters are very rare in Myanmar.

The illicit wildlife trade is a significant factor in the loss of wildlife worldwide and is accelerating the extinction of many species. Otter body parts and organs are sold on social media (**Nijman et al., 2019**). Myanmar serves as both a source and a conduit for illegal wildlife trafficking across Asia (**McEvoy et al., 2019**).

RECOMMENDATIONS

Firstly, it is important to select the location for research to find out more about otter populations, habitat use patterns, and their status in Myanmar. After that, we can share knowledge and education awareness with the local people.

Disclosure Statement

No potential conflict of interest was reported by the author.

Author Biography

MYINT MYINT SOE started as a forester with Chatthin Wildlife Sanctuary, Nature and Wildlife Conservation Division (NWCD) under the Forest Department, Ministry of Natural Resources and Environmental Conservation, and was there from 1 July 1998 to 14 September 2018. Myint has been collecting otter data since 2015. She is now working freelance with Myanmar Environmental Innovation in Research and Wildlife Conservation. At present, she is an M.Sc. student, in Natural Resource Management, Conservation Ecology Program, King Mongkut's University of Technology Thonburi, Thailand. At the same time, she is working as a Conservation Officer, at the Nature Conservation Society, Myanmar.

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MALAYSIAN NATURE SOCIETY OTTER PROJECT: SAFEGUARDING THE MALAYSIAN OTTERS

C.Y. WOO*[a] and B. PERUMAL[b]

[a]Wildlife Conservation Officer, Malaysian Nature Society (MNS)

[b]Head of Conservation Division, Malaysian Nature Society (MNS)

*Corresponding author: wildlife@mns.org.my

Malaysia is ranked 12th among the megadiverse countries and is better known for its large mammals found in the country such as the Malayan tiger, Asiatic elephant, Malayan tapir and Orang utan. Small mammals often do not receive much conservation resources and effort. The general public is also unaware of our small mammals including otters, a unique semi-aquatic carnivore. Instead, the public often mistakes them as sea otters or beavers which are not found in Malaysia.

All four species of otter that occur in Malaysia are both freshwater and coastal species. They are the smooth-coated otter (*Lutrogale perspicillata*), Asian small-clawed otter (*Aonyx cinereus*), hairy-nosed otter (*Lutra sumatrana*) and Eurasian otter (*Lutra lutra*). The first three species are globally threatened: specifically, the smooth-coated otter and Asian small-clawed otter are classified as "Vulnerable" while the hairy-nosed otter is "Endangered". The Eurasian otter is classified as "Near Threatened" but this species has not been found in Malaysia for a significant amount of time. It is worth noting that the hairy-nosed otter is endemic to southeast Asia and is considered the rarest otter species in the world.

The Malaysian Nature Society (MNS) was established in 1940 and is the oldest membership-based environmental NGO in Malaysia. Wetland conservation is one of MNS's priority conservation work areas and otters have been identified as the flagship species for its wetland conservation work. Thus, the MNS Otter Project was established in 2019 to advocate for otter conservation along the North-Central Selangor Coast (NCSC), Selangor State in Peninsular Malaysia. NCSC is recognised as one of the Important Bird and Biodiversity Areas (IBAs) and a potential East Asian-Australasian Flyway site. The Kuala Selangor Nature Park (KSNP) is situated at the centre of NCSC which is currently managed by MNS as a mangrove education centre. It is also the first protected area managed by an NGO in Malaysia. KSNP and other mangrove forests within the NCSC and the subcoastal areas up to the North Selangor Peat Swamp Forest complex are crucial habitats for three Asian otter species (*L. perspicillata, A. cinereus and L. sumatrana*).

The MNS Otter Project is also the first project in Malaysia that specifically promotes otters as the flagship species to

protect and conserve both coastal and freshwater wetlands. In this project, MNS engages with government agencies, local communities etc. and conducts ecological research on the otters to address knowledge gaps.

Throughout the first two years (2020-2022) of the project, we have achieved the following:

1) Produced a preliminary otter distribution map along NCSC;
2) Developed a novel PCR-RFLP genetic technique for identifying three Asian otter species using their spraints with the manuscript in preparation;
3) Identified three species of otter (*L. perspicillata, A. cinereus and L. sumatrana*) through spraint analysis, camera trapping and direct observation;
4) Trained 10 local people in surveying and monitoring otter populations;
5) Initiated human-otter conflict documentation;
6) The first human-otter conflict workshop was held virtually with the collaboration from the Department of Fisheries Malaysia;
7) Founded the Malaysia Otter Network (MON), consisting of 13 otter/mammal professionals who are experts in otter research, education and lead otter conservation in different regions (Sabah/ Sarawak/Peninsular Malaysia) in Malaysia.
8) Celebrated World Otter Day 2021 with an otter webinar.
9) Successfully held the Malaysia Otter Workshop in collaboration with the International Otter Survival Fund in April 2022.
10) Continued with otter pet trade documentation in collaboration with the Department of Wildlife and National Parks Peninsular Malaysia.

In the next phase of the project, we plan to:

(i) Complete the spatial distribution map.
(ii) Initiate a radio-tracking study.
(iii) Initiate urban otter studies and conflict documentation in collaboration with the Kuala Lumpur City Council.
(iv) Produce a human-otter conflict hotspot map.
(v) Form a group of multi-stakeholders consisting of government agencies and local aquaculturists for human-otter conflict mitigation.

MNS would like to thank The Rufford Foundation, MSIG, Conservation International Asia Pacific, The Conservation, Food and Health Foundation and Keidanren Nature Conservation Fund for their support. For those who would like to contribute to our project, please join MNS as a member (https://www.mns.my/join-us/) or visit the International Otter Survival Fund to donate (https://www.otter.org/public/IOSFCurrentProjects_Asia.aspx).

OBITUARY

MNS is saddened to inform you that Balu Perumal, Head of Conservation of the Malaysian Nature Society (MNS) and co-founder of the MNS Otter Project and Malaysia Otter Network, passed away peacefully on 6 August 2021 as a result of COVID-19-related complications. He was 54. He was an exceptional mentor to Woo Chee Yoong during his early conservationist career in MNS and a strong supporter of otter conservation in Malaysia.

All of us at IOSF would like to send our condolences to Balu Perumal's family, the MNS team and everyone close to him.

Author Biographies

WOO CHEE YOONG is a Wildlife Conservation Officer in the Malaysian Nature Society (MNS) and a member of the Malaysia Otter Network (MON). He has past experience in assisting various wildlife conservation projects in MNS, such as hornbill and water birds. Currently he is leading the MNS Otter Conservation Project focusing on coastal and urban wild otters through ecological research, community and multi-stakeholder work, and documentation of otter-human conflict. He graduated from the Universiti Malaysia Sarawak with a degree in Animal Resource Science and Management. At present he is studying for his MSc at Sunway University with research into spatial distribution among three sympatric otter species along the Selangor coastline, Peninsular Malaysia.

BALU PERUMAL (21 October 1966 to 6 August 2021) was the Head of MNS Conservation Division. He obtained a Bachelor of Science majoring in Botany in 1990 from the University Kebangsaan Malaysia and continued his academic studies with an MSc in Plant and Fungal Taxonomy in 1993 from the University of Reading, England. He started his conservation career with WWF Malaysia and managed multiple international conservation programmes in Lao PDR, Vietnam and Indonesia. He was with the Global Environmental Centre for eight years and lastly affiliated to MNS from 2012-2021. He had 30 years of experience in nature conservation, within the realm of non-governmental and not for profit organisations, the last 15 years being at senior management level.

THE CURRENT STATUS OF THE MANAGEMENT OF CAPTIVE ASIAN SMALL-CLAWED OTTERS (*Aonyx cinereus*) WITHIN THE EUROPEAN REGION

J. PALMER

New Forest Wildlife Park, UK

Email: jason@newforestwildlifepark.co.uk

There is so much good, positive and widely distributed work going on in the field around the globe for otters of all species. Surveys, raising awareness, habitat protection monitoring, and that is just as it should be. We do however have a vast network and resource in our good zoos around the world to promote, raise awareness and funds for projects on a global scale, an opportunity which is often missed. For what are good zoos for if not for saving species and working on the conservation and education of the public in all matters of species survival?

Asian small-clawed otters (*Aonyx cinereus*) are the most numerous otter species in the zoos of the world with currently 1894 living individuals in 450 zoos worldwide.

The story of Asian small-clawed otters in our zoos is quite an interesting one and a lot of work has been done recently to ensure we are better at managing, looking after and promoting the species and its needs and its plight in the wild.

So, where did it all start …?

The first recorded Asian small-clawed otter (ASCO) to come into captivity was a male called "Tommy". He was collected on a National Geographic expedition in 1937 and sent to Smithsonian National Zoo, Washington DC, USA.

Species historical records indicate that these otters were relatively late entrants to our zoos. It was not until towards the end of the 1960s and into the early 1970s that the species were introduced into a few European collections in any great number.

The majority were direct imports from southeast Asia, mainly from Malaya and Indonesia and via a few dealers/importers such as "Ravensden" in the UK. Initially, many otters did not survive long and were not inclined to breed, possibly due to the lack of basic husbandry and insufficient environmental knowledge for the species. The only collection to have some success in managing the husbandry, diet and environmental factors was "The Otter Trust" at Bungay in Norfolk, UK.

Phillip Wayre (1921–2014), founder of The Otter Trust, and champion of the native UK otter (*Lutra lutra*) had an instrumental role in the popularity and numbers of ASCOs in captivity not only in the UK and Europe but globally. This ensured the future of this species as a numerous and popular zoo exhibit.

At his breeding centres in Bungay and Tamar in Cornwall he successfully imported approximately 12 ASCOs and commenced a well-planned and organised UK breeding facility. Regrettably, this blueprint for ASCOs in captivity was not adopted by all zoo

collections. Had it been followed we would have inherited an excellent and comprehensive lineage easily traced back to wild-caught individuals and the species would have been managed very differently and more successfully.

Phillip Wayre's otters were initially sent to a few private keepers in the UK including Elisabeth Joy and Roger and Carol Heap, and also to some of our leading zoos such as Zoological Society of London (ZSL) in the UK, and into Europe.

The species' social nature and diurnal behaviour made them an instant and successful exhibit for zoos and the public. The Eurasian otter (*Lutra lutra*) is largely solitary and has more nocturnal behaviour.

As their popularity increased and there appeared to be abundant numbers over a large geographical range across southeast Asia, the thoughts of the future or management of the species seem to have been ignored, as so often is the case with the "small brown jobs".

The only real effort to record the species and its captive management was a single edition in 1989 by the Federation of Zoos UK, later to become British and Irish Association of Zoos and Aquariums (BIAZA). This studbook was created and compiled by Frank Wheeler of ZSL. It appears that there was only one edition commissioned and very few copies remain. However, it is this work that has provided us with an insight into the status of the species in the UK in 1989.

Phillip Wayre maintained accurate records for his breeding programmes until The Otter Trust started to close down at the end of the 1990s. These records were kept and archived and have only recently been rediscovered. They provide an important addition to the current data on our European captive population. Most of this vital information has been added to Single Population Animal Record Keeping System (SPARKS) giving us a better foundation and understanding of our European population.

Once the many attributes of the species were known – i.e., playfulness, sociable, easy to manage with an active disposition – many zoos included ASCOs in their collection plan. However, it would appear in the rush to incorporate the species into European zoos the basic husbandry skills and species management programmes were somewhat neglected, consequently having a detrimental effect on the captive animals.

Throughout the late 1970s, 1980s and early 1990s breeding appeared to be uncontrolled to cater for the growing zoo requirements. Sadly, as ASCOs are no longer considered an important zoo exhibit they have ended up in private hands, farm parks and garden centres as a popular attraction where they are often kept in unnatural group dynamics, e.g. single sex groups and sibling groups. The recognised natural group structure consists of an alpha male plus an alpha female and their consecutive litters of cubs numbering an average of 15 or so in an average wild family group.

At the very cornerstone of this is the UK. Currently, within Europe every ASCO has a direct lineage which can be traced back to otters bred or sourced from the UK, mostly

from a small pool of collections, zoological collections and private breeders including Phillip Wayre and Elizabeth Joy.

Obviously, in some circumstances this has caused mismanagement and inbreeding within the captive population. It is my opinion that a few of the issues we experience in the captive population, such as renal calculi (uroliths), low litter numbers and high cub mortality, may be due to previous poor husbandry and interbreeding.

Currently, the situation is grave for ASCOs in captivity. We have a large captive population in Europe that requires urgent and responsible management to ensure its future well-being. There is also a collective responsibility of all concerned to provide a captive ark for this species as the wild population declines.

Historically there was little concern for the wild population until recently. The last IUCN Red List survey was conducted in 2014 and found that the population was declining and its "vulnerable" status should remain. Deforestation, habitat loss and recently the increase in illegal wildlife trade are having a massive impact on the species and its demise. So much so that in July 2019 the species was upgraded by CITES to Appendix 1 for international trade.

Asian small-clawed otter has most recently been assessed for The IUCN Red List of Threatened Species in 2020 and is listed as "Vulnerable" under Criteria A2cde+3cde (**Wright et al., 2021**). At the time of the Red List assessment in 2014, I received an email from Sarah Duncan, the International Studbook Keeper for ASCO. In this role Sarah supervises the global data for the species and coordinates the various regions so the information can be added to the World Association of Zoos and Aquariums (WAZA) International Studbook (ISB) for *Aonyx cinereus*.

It was apparent that most regions were in good order and adding to the combined ISB data set with the exception of the European region. Sarah requested information from the three collections where I am Animal Curator, i.e. New Forest Wildlife Park in Hampshire, The Chestnut Centre in Derbyshire and Battersea Park Children's Zoo in London. It was the first communication I had received from the ISB and I was unaware of the European position on the species. That was about to change!

It appears the European Association of Zoos and Aquarium (EAZA) had considered the European situation to be too inconclusive – as most data was either incorrect or indeed missing – for it to be of any value to be included in the global data. There was no concerted effort to make the European region data inclusive as the rest of the world. Therefore, Sarah Duncan decided to contact all known holders directly and hope they would respond with their relevant information on the species.

Upon examination the data provided for our three centres on the ISB suggested we had just three otters, and only two of the three otters were in fact correct in terms of recorded data!

After retrieving and collating all the information in our records we went from the original three listed and added 200+ living, transferred and deceased otters to the ISB

dataset. This information was only for the three centres under my control. This work has continued and over the last eight years we now have a comprehensive and complete set of records of the European and EAZA populations from the 1960s through to the present day. There are approximately 299 zoos, aquariums, collections holding the species in the European region, including 126 EAZA collections.

After an initial lack of enthusiasm from governing organisations and the notion that we were attempting the unachievable, we now have a viable and progressive work and an official EAZA monitoring programme for the species.

We are contributing to the global studbook and every entry made is checked and cross checked. We now have over 7,750 otters on the ZIMS (Zoological Information Management System) which is run by Species360. This global database can be used by zoos use to add and collate information they hold on the animals in their care. We have catalogued all 1,173 living individuals in our European zoos.

SPARKS (Single Population Animal Record Keeping System) is a now outdated and superseded computer programme that works out the relatedness of captive animals in zoos, so better genetic integrity and breeding efficiency can be coordinated. This ensures we have no validation concerns and zero errors resulting in a comprehensive clear data set for the entire captive living population in Europe and enables the future captive management of the species to be positive and responsible.

The work has expanded to provide us with a viable and working data set that can be useful to the wider zoo community. Work continues on the possible sequencing of the species DNA to ascertain any distinct subspecies. Already five sub-species have been suggested in **Harris** (**1968**).

We are continuing to work with organisations such as “Save Vietnam’s Wildlife” in situ with help and advice on otter rehabilitation and husbandry and we advise on the identification of otter species seen in social media adverts offering cubs for sale in many countries.

Hopefully, this will all lead to a good and solid foundation for the future. The captive otters in our care deserve excellent and responsible husbandry for the individuals and the captive population as a whole.

I have been privileged to work and will continue to work in this field which has proved that if the species (any species) has been mismanaged and disregarded in the past that by continuous and dedicated work it is possible to change the course of captive care to ensure the future of all species.

Author Biography

JASON PALMER is currently curator of two zoos in the UK and works globally with otters of all species but mainly with Eurasian otters and Asian small-clawed otters. He is mainly focused on captive zoo otters and ensuring better welfare and care and also works with rescue and rehabilitation of otters both in the UK and abroad. He has spent his career so far either working in conservation and zoos or travelling and living abroad.

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ONLY SOUTH OF THE GANGES? ON RECENT OCCURRENCES AND DISTRIBUTION OF SMOOTH-COATED OTTERS IN BANGLADESH

M. AKASH[*a], F. IQBAL[b], and S. MONDAL[c]

[a]Department of Zoology, University of Dhaka, Dhaka 1000, Bangladesh; [b]Department of Geography and Environmental Studies, University of Rajshahi, Rajshahi 6205, Bangladesh; [c]Church of Bangladesh, Kushtia Diocesan Office, 94 N.S. Road, Thanapara, Kushtia 7000, Bangladesh

*Corresponding author: akashmuntasir10@gmail.com

ABSTRACT

The smooth-coated otter (Lutrogale perspicillata) *is critically endangered in Bangladesh. However, because of the dearth of empirical evidence, its distribution in the country is not scientifically understood. Obtained from personal observations, social media platforms, and bird-watching and trekking groups, this study provided five incidental records of the species in southwestern, northwestern, and northern Bangladesh. All of the observations came from south of the Ganges River. Smooth-coated otters appeared to be present in the Sundarbans mangrove and other coastal mangroves but the region is yet to be accredited in the global assessment. The complete stretch of the Ganges River also supports a population but the region is not included in the country-level assessment. The current work also highlights the absence of any confirmed records of the smooth-coated otter in the grassland-sandbar mosaics of the Brahmaputra River which is a highly potential habitat for the species, and also the mixed evergreen forests of eastern Bangladesh, a region marked as its range in both global and country-level assessment. To date, we found only two works that studied the species in Bangladesh whereas, in total, there are only six studies on the three otter species of Bangladesh. Elusive otters are not receiving any research and conservation investment in the country and are likely to be the silent victims of anthropogenic threats.*

Keywords: Lutrogale perspicillata*; Sundarbans; coastal mangroves; Lower Ganges; distribution*

INTRODUCTION

Bangladesh is the range country for three of the four Oriental otter species i.e., Asian small-clawed otter (*Aonyx cinereus*), smooth-coated otter (*Lutrogale perspicillata*), and Eurasian otter (*Lutra lutra*) (**IUCN Bangladesh, 2015; Duplaix and Savage, 2021**). Despite the presence of a remarkable otter assemblage in such a small country, research and conservation investments in otters are meagre; similar to the way other lesser-known carnivores of Bangladesh are being treated (**Akash and Zakir, 2020**).

The absence of studies has long been considered a hurdle to the conservation mainstreaming of Asian otters (**Foster-Turley and Santiapillai, 1990; Basnet et al., 2020**). The problems with inadequate data become glaring as the distribution of otters in Bangladesh reflects the paucity of accurate and precise information (**Akash**

et al., 2022). The appraisal by **Basnet et al. (2020)** showed that, out of 244 research works on Asian otters, only 54 exclusively studied smooth-coated otters. To date, only five peer-reviewed publications are available that were explicitly carried out on the country's otters; of which, two were on small-clawed otters (**Aziz, 2018; Akash et al., 2022**), and three featured smooth-coated otters (**Feeroz et al., 2011 a, 2011b; Shashoto and Yoxon, 2020**).

The smooth-coated otter is present in multiple range countries in south and southeast Asia with an isolated population along the Iran–Iraq border (Figure 1A). According to The International Union for Conservation of Nature (IUCN) Red List of Threatened Species (**Khoo et al., 2021**), this species is globally vulnerable. Owing to a myriad of threats such as poaching, hunting, habitat loss, severe conflict with commercial fish farming, etc., the IUCN Bangladesh Red List of Threatened Species (**Feeroz, 2015**) evaluated the smooth-coated otter as Critically Endangered.

Until the 1980s, the species occurred in and around all the wetlands and forested areas of Bangladesh (**de Silva, 2011; Feeroz, 2015**). However, its population has now declined by more than 90% (**Feeroz, 2015**). The species is currently thought to be restricted to the hilly areas of the northeast and southeast and the coastal districts of the country (**Feeroz, 2015**). However, the generally secretive nature of otters, and lack of updated information and conservation initiatives eventually contribute to great inconsistencies between sources concerning the perceived otter distribution in Bangladesh.

Here, we provide a collection of recent incidental observations of the smooth-coated otter and comment on its distribution in Bangladesh.

METHODS

To review the range of smooth-coated otters in Bangladesh, we consulted **Duplaix and Savage (2021)**, **Hunter and Barrett (2020)**, **Khoo et al. (2021)**, **Feeroz (2015)**, **Chakma (2016)**, and **Khan (2018)**. We followed a regional classification scheme adapted from **Khan (2018)** and divided the country into seven regions: central, north, northeast, northwest, south, southeast, and southwest (Figure 1).

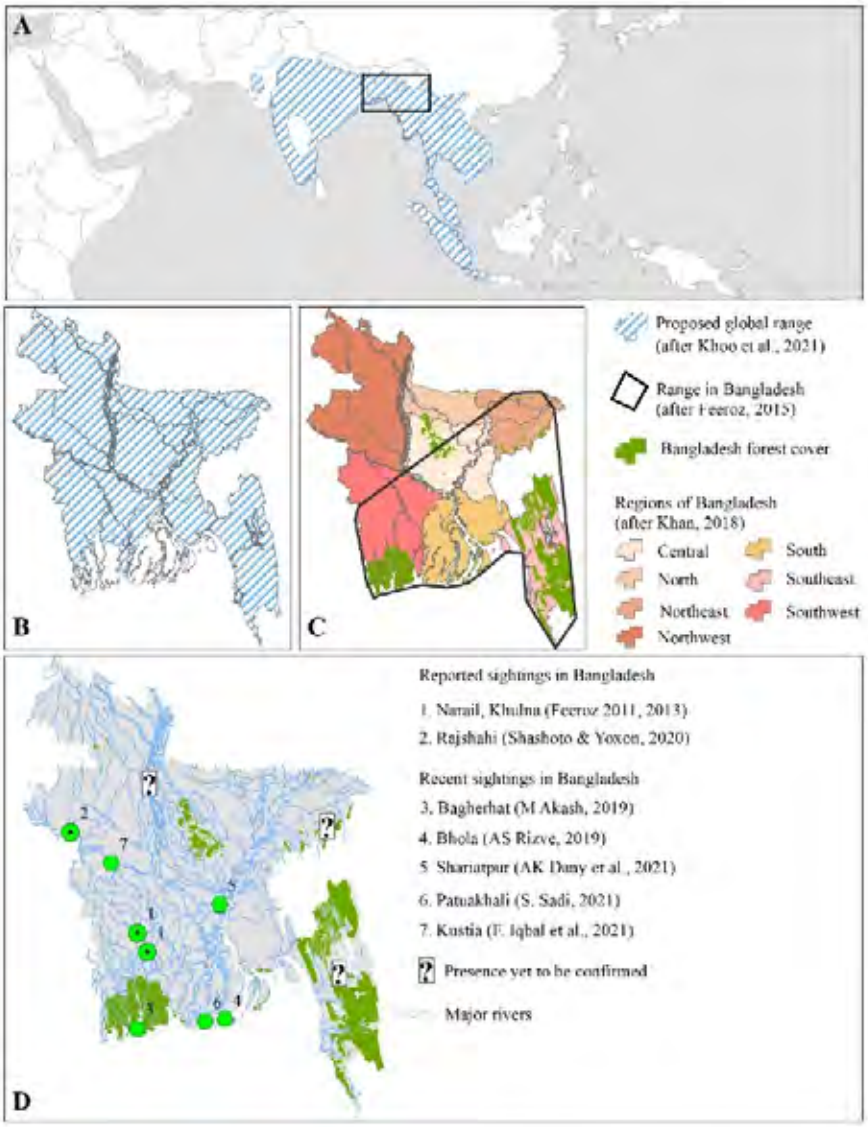

Figure 1A. Proposed global range (blue cross-hatched area) of the smooth-coated otter (*Lutrogale perspicillata*) (after Khoo et al., 2021); B. Range of the species in Bangladesh (after Khoo et al., 2021); C. Range of the species in Bangladesh (after Khan, 2018); and D. overview of reported and recent records in the country.

To obtain unreported sighting records of the smooth-coated otter, we looked through the database of the "Deep Ecology and Snake Rescue Foundation" (https://www.facebook.com/groups/959896627527624) – a Facebook-based wildlife rescue and welfare group in Bangladesh. In addition to that, we approached bird-watchers and trekkers for any potential observations of the species. We also included our own incidental observations. Each of the observations was provided with images, which, in turn, were shared with "Otters of the Himalayas" (https://www.facebook.com/groups/3139987209403938) – a Facebook-based platform for people who are

working on otters of the Indian Subcontinent. An observation was considered valid only when the otter had been positively identified as the smooth-coated otter.

To plot the validated observations, we traced them up to the district level (a second-order administrative unit in Bangladesh). Whenever available, we provided the number of individuals observed during each incident, the habitat where they were observed, and the timeline of observation.

RESULTS AND DISCUSSION

Distribution of smooth-coated otters in Bangladesh

Local assessments (**Feeroz, 2015**) and works (**Feeroz et al., 2011a, 2011b; Aziz, 2018**) recognised the Sundarbans and coastal mangroves of southeast and southern Bangladesh, and mixed evergreens of eastern Bangladesh as a species range in the country. **Feeroz (2015)** also drew the northern limit of the extent of occurrence of smooth-coated otters in Bangladesh by partially including central Bangladesh (Figure 1C). However, **Feeroz (2015)**, **Feeroz et al. (2011a, 2011b)** and **Aziz (2018)** did not show northwest or northern Bangladesh as the species range; the regions are characterised by vast grassland-sandbar mosaics of the Ganges and the Brahmaputra River – a habitat known to be suitable for the species (**Khoo et al., 2021**). Interestingly, in 2018–2019, **Shashoto and Yoxon (2020)** described a population of the species from northwest Bangladesh (24.329396°N 88.615638°E) for the first time.

In contrast, global assessment (**Khoo et al., 2021**) and works (**Duplaix and Savage, 2021; Hunter and Barrett, 2020**) considered almost the whole of Bangladesh as the species range (Figure 1B). However, the Bangladesh part of the Sundarbans mangrove forest (Indian part was marked positively), and the country's coastal mangroves were not marked as the species range in the latest global assessment (**Khoo et al., 2021**).

Of all works reviewed, only **Khan (2018)** noted the whole of Bangladesh as a potential range of the smooth-coated otter but the species was described as rare. This differs markedly from **de Silva (2011)** as the species there was described as relatively more common than the small-clawed otter; this possibly stands as a testament to the dwindling status of the species in Bangladesh.

Although northern, northeast, northwest, and southeast Bangladesh are mentioned as the otter range in literature, we found no contemporary or distant records of smooth-coated otters from these regions. Recent camera-trapping surveys on terrestrial carnivore mammals failed to detect this species from the mixed evergreen, riparian forests of eastern Bangladesh (**S. Chakma pers. comm., 2021; Akash et al., 2022**). There is no concerted study to discern its full distribution in Bangladesh. Thus,

accounts of the distribution of this species in Bangladesh reflect the problems with the paucity of accurate and precise information (Table 1).

Table 1. A brief review of major regions of Bangladesh regarded as smooth-coated otter (*Lutrogale perspicillata*) habitat in different literature. Tick-mark (✓) indicates that the region is stated as the species range while cross-mark (×) indicates that the region is not presented as the species range in the relevant study. Tick-mark with an asterisk (✓*) indicates that the region is partially presented as the species range in the relevant study.

Regions	Duplaix & Savage (2018)	Hunter & Barrett (2018)	Khoo et al. (2021)	Feeroz (2015)	Khan (2018)	Aziz (2018)	Remarks
Northern	✓	✓	✓	×	✓	×	No contemporary records
Northeastern	✓	✓	✓	✓	✓	✓	
Southeastern	✓	✓	✓	✓	✓	✓	
Central	✓	✓	✓	✓*	✓	×	Sighted in 2021
Southern	×	×	×	✓	✓	×	Sighted in 2019
South-western	✓*	✓*	✓*	✓	✓	×	Sighted in 2019, 2021
North-western	✓	✓	✓	×	✓	×	Shashoto and Yoxon (2020)

Recent records in Bangladesh

Table 2. Summary of the observations of smooth-coated otters in Bangladesh

	Date/Year	District	Region	Approx. coordinates	References/ Observers	Remarks
Reported sighting records						
1	2003–2005	Narail, Khulna	South-western	23.100403°N 89.584385°E	Feeroz (2011a,b)	176 otters were recorded in captivity being used in fishing
2	2020	Rajshahi	North-western	24.329396°N 88.615638°E	Shashoto and Yoxon (2020)	Presence of 50–60 individual otters was estimated in 90 km² of the sandbar-grassland mosaic of the Ganges River
New sighting records						
3	22 January 2019	Bagherhat	South-western	21.772249°N 89.477664°E	Akash	Three individuals near a creek of Dublar char island, the Sundarbans

4	2019	Bhola	Southern	21.931671°N 90.653701°E	Rizve	One solitary individual at Char Kukri-Mukri Wildlife Sanctuary
5	2 December 2021	Shariatpur	Central	23.424605°N 90.549215°E	Dany, Siddique	One solitary individual in a tributary of the Ganges River
6	18 December 2021	Patuakhali	Southern	21.890235°N 90.417063°E	Sadi	One solitary individual on the bank of a mangrove creek
7	26 December 2021	Kustia	North-western	23.941410°N 89.134495°E	Iqbal, Mondal, Newaz, Nooshra	Three individuals near a duck farm on sandbars of the Ganges River

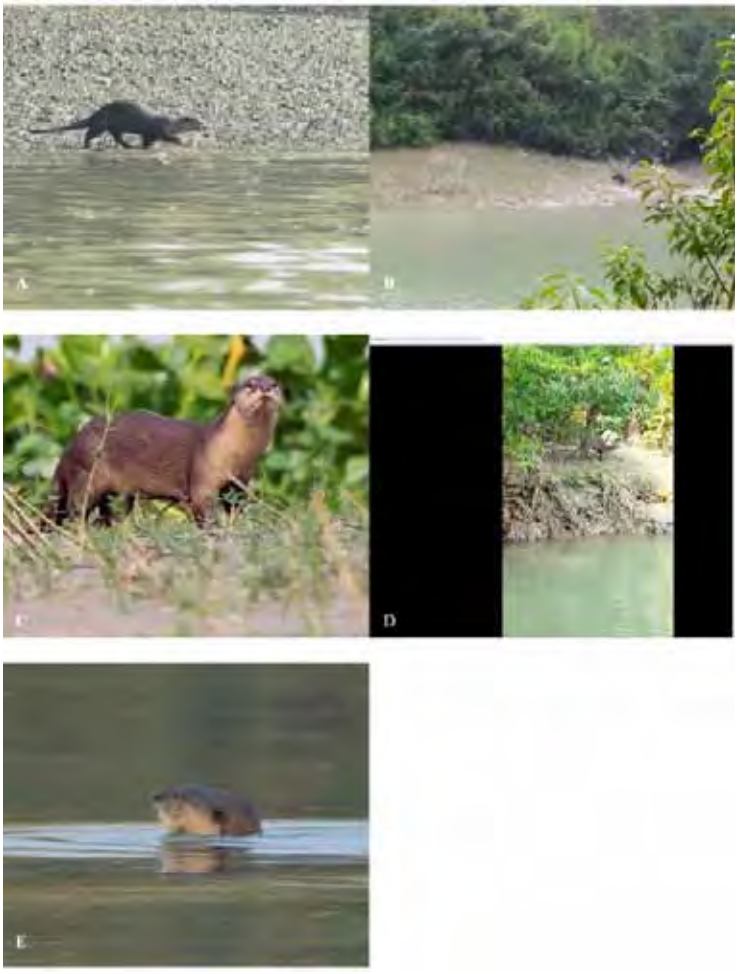

Figure 2. Photographs of the smooth-coated otter (*Lutrogale perspicillata*) referred to in Table 2. A. Sundarbans, Pashur River (21.772249 89.477664; 22 January 2019; photographed by Akash); B. Char Kukri Mukri Wildlife Sanctuary (21.931671 90.653701; 2019; video by Rizve); C. Shariatpur, Ganges River (23.424605 90.549215; 2 December 2021; photographed by Dany); D. Patuakhali, Rangabali River (21.890235 90.417063; 18 December 2021; video by Sadi); E. Kustia, Ganges River (23.941410 89.134495; 26 December 2021; photographed by Mondal)

Sundarbans, Pashur River (21.772249 89.477664; 22 January 2019)

On 22 January 2019, at about 10:30 am, during the onset of the low tide, three individuals were spotted swimming near the bank of a mangrove creek (21.772249 89.477664) of the Sundarbans (Table 2; Figures 1D, 2A). All three individuals started running apparently with a small rhythm. After a while, they went into the creek again, swimming briefly and finally disappeared into the mangrove. The observation was made from a vessel and lasted for 1.5 minutes. Initially, the otters seemed unaware of human presence, but later they became more cautious. Before this observation was made, a small group of Asian small-clawed otters was spotted. The creek is a tributary of the Pashur River and separates the site from an important seasonal fishing and fish-drying ground called Dublar Char. Dublar Char is also a popular tourist destination.

The Sundarbans is the only forest in Bangladesh that is reportedly inhabited by two different otter species. However, sightings of smooth-coated otters are less frequent. For example, the survey by **Aziz (2018)** for small-clawed otters did not yield any observations of smooth-coated otters.

Char Kukri Mukri Wildlife Sanctuary (21.931671 90.653701; 2019)

In 2019, at around 7:00 am, an individual was observed running along the bank of a mangrove creek (21.931671 90.653701) during low tide (Table 2; Figures 1D, 2B). The wildlife sanctuary is located on a coastal island, contains old planted mangroves of 0.4 km^2 on the mouth of the Meghna River and is a popular destination for campers. The observation was also made near a campsite.

The wildlife sanctuary is known to support the Asian small-clawed otter. Although it has long been suspected that the smooth-coated otter is also present, this observation comes as the first verifiable instance.

Shariatpur, Ganges River (23.424605 90.549215; 2 December 2021)

On 2 December 2021, on a small channel (23.424605 90.549215) of the Ganges River, an individual was incidentally photographed by members of a bird-watching group (Dany and Siddique**)** in the morning during low tide (Table 2; Figures 1D, 2C). It was crossing a reed-bed, later plunged into the river and disappeared. The site is near the confluence of the Meghna River and the Ganges River. Being near the capital, Dhaka, the channel is subjected to heavy human interference and serves as a freighter route; however, the banks and the small island patches within offer dense, tall grass patches and reed beds.

This is the first verifiable evidence of the smooth-coated otter in central Bangladesh in present times.

Patuakhali, Rangabali River (21.890235 90.417063; 18 December 2021)

An individual was spotted in the Rangabali River, Patuakhali district (23.941410 89.134495) (Table 2; Figures 1D, 2D). The otter was photographed and videoed by a group of tourists on a boat ride from close distance and it appeared to be indifferent to human presence. It was initially seen roaming along the shore but jumped into the water later and moved towards the mangrove patch on the far side of the shore. Similar to that of the Char Kukri Mukri Wildlife Sanctuary, the banks of the Rangabali River hold old mangrove plantations and a protected area named Kuakata National Park. The distance between the national park and the wildlife sanctuary is less than 100 km.

Kustia, Ganges River (23.941410 89.134495; 26 December 2021)

On 26 December 2021, at approximately 03:30 pm, on a waterbody (23.941410 89.134495) near the Ganges River, Kustia district, one otter individual was seen crossing a small water channel (Table 2; Figures 1D, 2E). It appeared for nearly 30 seconds before disappearing amidst grass patches – the sandy river bank was interspersed with grass patches. The observers (Iqbal, Mondal, Newaz and Nooshra) moved towards the east of the waterbody via boat where the water was deeper and wider with mostly *Phragmites sp.* on both sides. At 4:11 pm, two more otters were seen swimming parallel to the bank, one behind the other, less than 5m from the bank. The latter individuals were observed for about 1.5 minutes.

This location was about 2.4km from the junction of the Ganges and one of its distributaries, the Gorai River. It was winter and the water level was low compared to that of the monsoon season. The study site of **Shashoto and Yoxon (2020)** is about 100km upstream from this site. This observation, together with the one from Shariatpur, suggests the presence of the species along the whole stretch of the Ganges River in Bangladesh. The grassland-sandbar networks of the Brahmaputra River provide a similar habitat; however, there is no record of the species to date.

The waterbody is extensively used for fishing. There is a domesticated duck farm on one side which encourages human activity. The tall grasses on the bank are cut by the locals for household uses or commercial purposes. An adjacent shallow waterbody is seen to be recently modified into cultivated land, with an increased presence of people than in previous years. These can be perceived as possible threats to the species.

CONCLUSION

This study provides an overview of the distribution of the smooth-coated otter in Bangladesh. The recent incidental observations suggest several key points:

(1) The species is present in the coastal mangroves of Bangladesh including the Sundarbans. The region was missed out in **Khoo et al. (2021)**;

(2) The complete stretch of the Ganges River in the country holds a population of the species. The river was not included in the local assessment (**Feeroz, 2015)**;

(3) The Brahmaputra River, offering a habitat similar to that of the Ganges River but relatively more extensive and dense, is very likely to support another yet-to-be-reported population.

The study also poses several critical research questions.

(1) Although the species is regarded as Critically Endangered in Bangladesh, we are yet to understand the population size of the species and the driving ecological and anthropogenic factors that help or hamper these populations.

(2) Its threats have not been systematically assessed. This secretive and less-demanding species seems to be a silent victim of anthropogenic causes.

(3) Lastly, its absence in the northern parts as well as in three extensive camera-trapping efforts in eastern Bangladesh (where trap stations were installed on streams, low to the ground targeting terrestrial mammals) also demands urgent attention. Eastern Bangladesh, together with the adjacent Indian states (Meghalaya, Tripura, Mizoram, and southern Assam) belong to an ecologically uncharted territory and form the western limit of the Indo-Burma Biodiversity Hotspot (**Akash et al., 2022)**.

We, therefore, suggest an update on the distribution of the smooth-coated otter in Bangladesh, systematic studies involving camera-trapping and other contemporary techniques to overcome the severe dearth of information and initiate conservation mainstreaming of this long-neglected small carnivore in Bangladesh.

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No potential conflict of interest was reported by the authors.

Author Biographies

MUNTASIR AKASH is an assistant professor of zoology at the University of Dhaka, Bangladesh. He works on the conservation and ecology of lesser-known carnivores, to bring conservation attention to the otter, dhole, Asiatic golden cat, and other small carnivores of Bangladesh. “Northeast Bangladesh Carnivore Conservation Initiative” is one of his projects

to bring researchers and conservationists together for the carnivores of the country. He has been conducting camera-trapping surveys on terrestrial carnivores for the past three years and running a project to assess occupancy of small-clawed otters in northeast Bangladesh.

FARIHA IQBAL is an undergraduate student at the Department of Geography and Environmental Studies, University of Rajshahi, Bangladesh. She is an avid bird watcher, wildlife photographer and nature enthusiast.

SADANANDO MONDAL is a teacher of Kushtia Mission High School under the Church of Bangladesh. He is an experienced bird watcher involved in birdwatching in the Ganges river region around Kustia district, Bangladesh since 2011 and is an enthusiastic wildlife photographer.

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PRESENCE OF EVIDENCE AND FACTORS AFFECTING DISTRIBUTION OF EURASIAN OTTER (*Lutra lutra)* IN THE PELMA RIVER, RUKUM EAST, NEPAL

M.B. SHRESTHA*, G. SHRESTHA, S. REULE, S. OLI and T.B. GHARTIMAGAR

Wildlife Research & Education Network, Kathmandu, Nepal

*Corresponding author: shrmohan5@gmail.com

ABSTRACT

This study presents evidence of Eurasian otters (Lutra lutra) *and factors influencing distribution in the Pelma River. A survey for indirect signs (scat/spraint, latrine, tracks and holt/den) was carried out on one side of the river bank to understand otter presence/absence and distribution while camera traps were used for species images and identification. Mann-Whitney U test, Spearman's correlation coefficient and logistic regression model (backward stepwise regression) were applied to understand habitat factors (11 variables) affecting otter distribution. A total of 64 spraints were counted in the entire study (20km) and a dried otter skin was obtained but no camera images were obtained. Spraint density of 3.2 spraints/km^{-1} was obtained which is relatively higher than in adjacent rivers in the area. Fishing and killing of otters were identified as the prevailing threats to the otter in the study river. Mann-Whitney U test showed "elevation" has significant differences in sites with otter signs positive and negative. Elevation obtained a highly significant relation when otter signs are correlated against habitat variables. Logistic regression model noted "elevation" and "small stones" as significant independent variables to predict the probability of positive otter signs with 83.3% accuracy. The predicted variable would be applicable in rivers with similar geographic settings in Nepal with suggestions to critically evaluate the relevance of variables in relation to their local environment. The present study suggests further research on the otter population to assess the exact otter status in the area and need for conservation awareness to prevent killing of otters.*

Keywords: *Elevation; habitat variables; indirect signs; logistic regression model; Mann-Whitney U test; Spearman's correlation coefficient; spraint density; threats*

INTRODUCTION

The Eurasian otter (*Lutra lutra*) is believed to be widely distributed in wetlands such as rivers, marshes and lakes in Nepal (**Acharya, 1997**) with a population estimated at 1,000–4,000 (**Jnawali et al., 2011**). However, the rare sighting of this species for a

long time contradicts ideas of a wide distribution and prior estimates. The presence of evidence of this species in wetlands of Nepal was equivocal after 1991 until the recent records from the Roshi River in Kavrepalanchok district (skull of dead Eurasian otter), the Barekot River in Jajarkot district (camera trap images) and direct sighting and photographs from Tubang River in Rukum East district (**Shrestha et al., 2021b**). The nocturnal nature, secretive behavior and lower distribution density of Eurasian otters made it difficult to obtain direct sightings (**Ruiz-Olmo et al., 2001**), obligating indirect signs (scat/spraint, latrine, tracks and holt/den) as the evidence substantiating otter presence during a survey (**Mason and Macdonald, 1986**). However, the signs cannot confirm the otter species especially in areas with multiple otter species. Eurasian otter, smooth-coated otter (*Lutrogale perspicillata*) and Asian small-clawed otter (*Aonyx cinereus*) are otter species reported to be present in Nepal (**Hodgson, 1839**). Plenty of otter spraints were observed during a survey in October 2019 survey in the Sanibheri River and its upstream tributaries; the Uttar Ganga River and lower reach of the Pelma River (**Shrestha et al., 2021a**). However, otter species identification was not made during the 2019 survey. Thus, additional study was carried out to gather evidence of Eurasian otter presence, particularly in the upper reaches of the Pelma River, to examine the factors influencing otter distribution and to develop a predictive model to understand the factors affecting otter distribution in the study river.

STUDY AREA

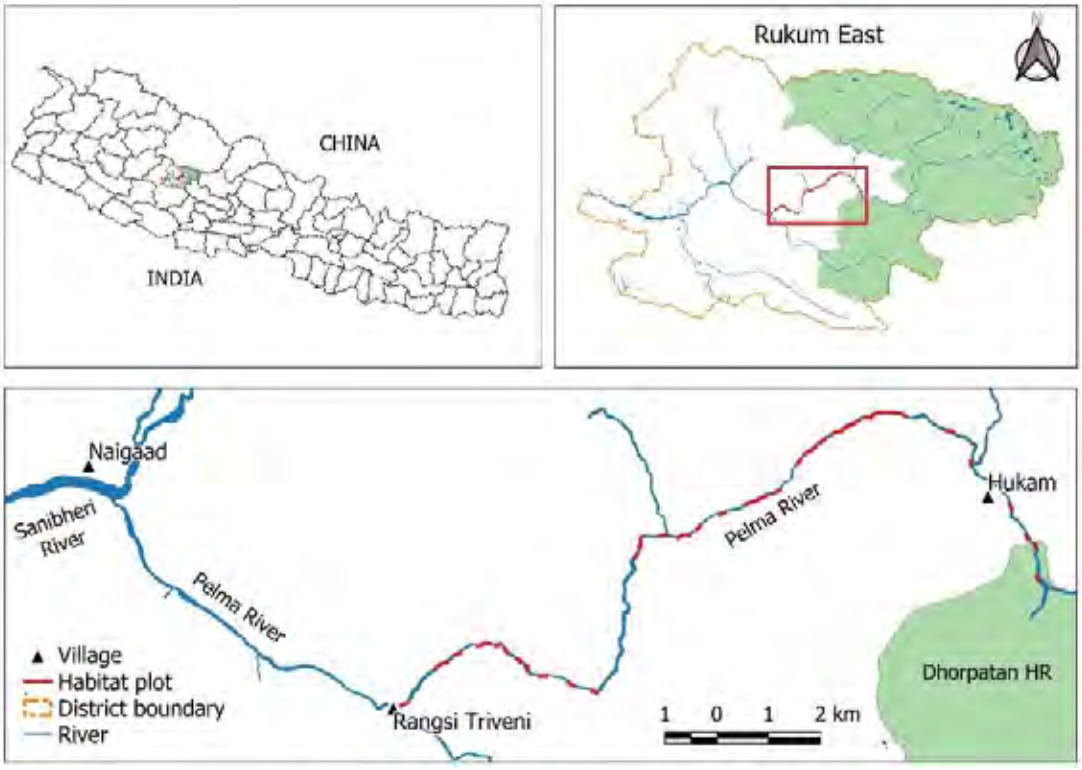

Figure 1. Otter survey study area.

This study was carried out along 20km of the Pelma River segment from Rangsi Triveni (48.633419°N 82.749056°E; 1430m a.s.l.) downstream to Hukam village (28.658241°N 82.876124°E; 1923m a.s.l.) and upstream to the edge of the Dhorpatan Hunting Reserve (Figure 1). The river here is mid-hills with rugged terrain and flows partly through a ravine. Nepalese alder, fern, pine, nettle and reed are the dominant river bank vegetation but in the deep gorge there are exposed bed rocks devoid of vegetation.

METHODS

The survey was carried out for 12 days in March 2021. A survey for otter signs on the river bank and camera traps were used for collecting information on otter presence and species identification.

The survey was carried out on one side of the river bank (**Andrews, 1989; Jamwal et al., 2016)** dividing the entire length (20km) into 1km transect (**Jamwal et al., 2016**). One plot of 100m (along the river bank) by 10m (away from the river bank) was placed at the start of each transect for a total of 20 plots. Observations of otter signs such as tracks, spraints, latrine, prey remains and holts/dens were used as evidence for otter presence (**Macdonald, 1990; Mason and Macdonald, 1991; Wilson and Delahay, 2001; Reuther et al., 2000; Sittenthaler et al., 2020**). In addition, otter parts obtained during the study period were used as further evidence. Spraints were identified by the fishy odour and fish bone remains (**Macdonald, 1990**). Photographs of spraints and otter body parts were confirmed by research specialists in the IUCN Otter Specialist Group. Otter spraints observed were recorded within the plots and whenever encountered outside the plots along the transect, unless prevented by inaccessible terrain (**Jamwal et al., 2016; Shrestha et al., 2021a**). Spraints were recorded separately when more than 5m apart (**Melquist and Hornocker, 1983; Newman and Griffin, 1994**). A site with more than five spraints within 5m was defined as a latrine site. Camera traps (two sets) were installed in the sites with fresh spraint or latrine sites or den sites for 24 hours to record otter images to help with species identification. From the cumulative spraints count in the entire study river length, spraint density per kilometre was calculated since fewer spraints were observed in the plot (**Shrestha et al., 2021a**).

Habitat variables were studied to understand the factors linked with otter distribution and these were recorded both in the plots within the transect and also at sites with spraints outside the transect. Separate plots (100m x 10m) were set when spraints were observed more than 100m apart in the transect. Two types of variables were used in this study: scalable and categorical variables. Scalable variables are elevation, river width, bank slope (left bank and right bank), river flow, river depth and bank substrate (sand and mud, pebbles and small stones,

large stones, rock boulders) while categorical variables are otter signs indicating presence and absence, and human disturbance (none, light, moderate and severe).

Of the habitat variables, elevation was recorded using Garmin GPSMAP 64s. River width (distance from bank to bank) was measured through Rangefinder, River bank slope was measured using a Clinometer (**Nawab and Hussain, 2012**). River flow (m/s) was measured using a floating ball method. River depth (m) was measured using a measuring scale (1m length) at the river bank closest to the recorded spraint site. River bank substrate was categorically differentiated based on diameter into (1) sand and mud (<5mm), (2) small stones (5–50cm), (3) large stones (50–100cm) and (4) boulders (>100cm). Mean substrate attributes were calculated by averaging each percent category thus the total percentage may not be equal to 100% because of the use of mid-points of values in calculations. Habitat disturbances were categorically differentiated as none, light, moderate and severe based on observation of abundance of dogs and cow tracks, trash and proximity to houses (**Jamwal et al., 2016**).

Mann-Whitney U test and Spearman's correlation coefficient were applied for statistical analysis because of non-normal distribution of habitat variables. Mann-Whitney U test was applied to identify the significant difference in habitat variables among sites with positive and negative sites (**Madsen and Prang, 2001).** Spearman's correlation coefficient was applied for assessing the relationship of otter signs with habitat variables and among habitat variables (**Hysaj et al., 2013**).

Logistic regression model (backward stepwise regression) was applied (**Miller et al., 2002; Medina-Vogel et al., 2007; Yoxon, 2013; Balestrieri et al., 2015; Jo et al., 2017**) to examine the influence of selected habitat variables on otter detection and non-detection with a vector of 1s (otter positive sites) and 0s (otter negative sites) as the binary dependent variables. This tool is used for species distribution models and has high accuracy due to both presence and absence data (**Brotons et al., 2004**). Variables that are not significant on a 0.05 level in a stepwise and backward selection were dropped subsequently from a model. A classification table was used to compare predictions to the observed outcomes to understand the accuracy of the model applied (**Yoxon, 2013**). Selected variables were used for model development in a linear form as: $\text{logit}(p) = I + \beta x$, where, "p" is probability of otters to be present, "I" is Intercept parameters and "β" is vector slope parameters (**Madsen and Prang, 2001**).

RESULTS AND DISCUSSION

Evidence of otter presence

In total, 64 spraints were counted throughout the length of the river studied (Figure 2) and a dried otter skin was obtained (Figure 3). Few tracks were observed but these could not be identified because the prints were unclear. Otters

are secretive and preferred natural caves and holes in rock piles (**Wood, 1978/79**) or a densely vegetated river bank (0.5m) with mature trees having a higher root network that precludes domestic stock penetration (**Andrews, 1989**) and areas with low human disturbance (**Green and Green, 1987)**. Settlements are closer to the study area (Figure 2) with grazing livestock at the river bank. Despite the presence of natural rock piles suitable for holts, the human disturbance (fishing, washing, visitors at natural hot water springs at the river bank) posed insecurity for otters in the river.

Nylon loops set for fish become a potentially lethal trap to the otter when they become entangled. The otter pelt collected during the study had a deep cut mark on the toes caused by trying to disentangle it. This otter had clearly visible claws, a tapering cone-shaped tail (**Kruuk, 2006**), dense dark-brown pelage throughout the body (**Larivière and Jennings, 2009**) with lighter coloured fur near the throat (**Sivasothi and Nor, 1994**). These features are identical to the Eurasian otter, substantiating the presence of this species in the study river (Figure 3). Eurasian otters are also known in the Tubang River (**Shrestha et al., 2021b**) downstream of the study river which also suggests the pelt is of this species. While the pelt does confirm the presence of Eurasian otters in the study river, on the other hand it also conveys otter–human competition for prey species (fish) resulting in killing of otters. This is the key threat to otters besides human disturbance and livestock penetration in the otter habitat. However, the effect of human disturbance is low due to the extremity of geographic terrain. Spraints are distributed evenly in major portions of the river length while occasional and limited at the upper stretch (Hukam area, Figure 2) where human activities of the river are observed relatively more.

Through the cumulative spraints count (64) in the entire study length (20km), spraint density of 3.2 spraints km^{-1} was obtained. This is a relatively higher spraint density compared with the lower reach of the Pelma River (2.38 spraints km^{-1}) and the Sanibheri River (1.14 spraints km^{-1}) downstream and the adjacent Uttar Ganga River (spraint density-2.67 spraints km^{-1}) (**Shrestha et al., 2021a**). Higher spraint density may be an indicator of good otter habitat and this would be best supported by a population study in the river. Furthermore, spraint abundance directly relates with fish biomass availability (**Hutchings and White, 2000; White et al., 2003; Almeida et al., 2012**). Therefore, population and prey species availability in the study river could benefit conservation of otters.

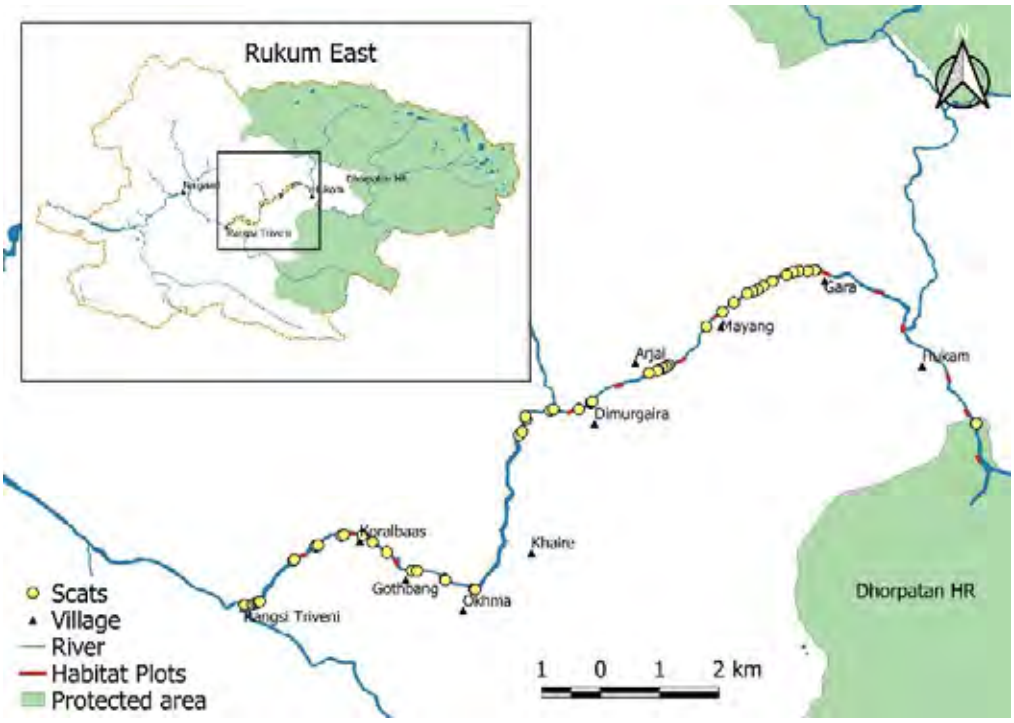

Figure 2. Otter spraint distribution along the study river length.

Figure 3. Front view of snout (A), lighter coloured fur at throat (B), dorsal view of feet with deep cut from entangled fishing loop (C) and whole otter skin specimen (D).

Factors affecting otter distribution

Habitat variables differ markedly within the study area. The higher variance in elevation, river width, bank slopes and bank substrate (primarily boulders and small stones) showed as the main determinants of otter presence and absence (Table 1). Mann-Whitney U test showed elevation is significantly different with regard to otter sign presence and absence (0.009, $p<0.05$) among 11 habitat variables tested (Figure 4). Unlike the factor obtained in this study, Mann-Whitney U test applied in the study of habitat factors in relation to presence and absence of Eurasian otters in Denmark found that river width, water depth, river substrate characteristics, water flow and bank vegetation have significant difference (**Madsen and Prang, 2001**).

Table 1. Descriptive statistics of habitat variables in the study area

Habitat variables	Mean	Standard Deviation	Sample Variance	Kurtosis	Skewness	Minimum	Maximum
Elevation (m)	1650	130	17089	–0.66	0.02	1431	1923
Sand and mud (%)	11.67	9.96	99.29	–0.88	0.59	0.00	30.00
Small stones (%)	25.21	14.25	203.15	–0.98	0.19	0.00	50.00
Large stones (%)	33.44	10.73	115.06	2.19	1.14	15.00	70.00
Boulders (%)	29.17	21.59	466.31	–1.16	0.14	0.00	70.00
River flow (m/s)	1.39	0.34	0.12	–1.55	–0.07	0.88	1.87
River width (m)	27.65	10.80	116.66	2.17	1.26	12.00	65.00
River depth (m)	0.55	0.19	0.04	2.07	1.41	0.20	1.05
Right bank slope	46.96	19.44	377.91	0.29	0.87	15.00	90.00
Left bank slope	38.79	13.76	189.23	0.93	0.74	10.00	80.00

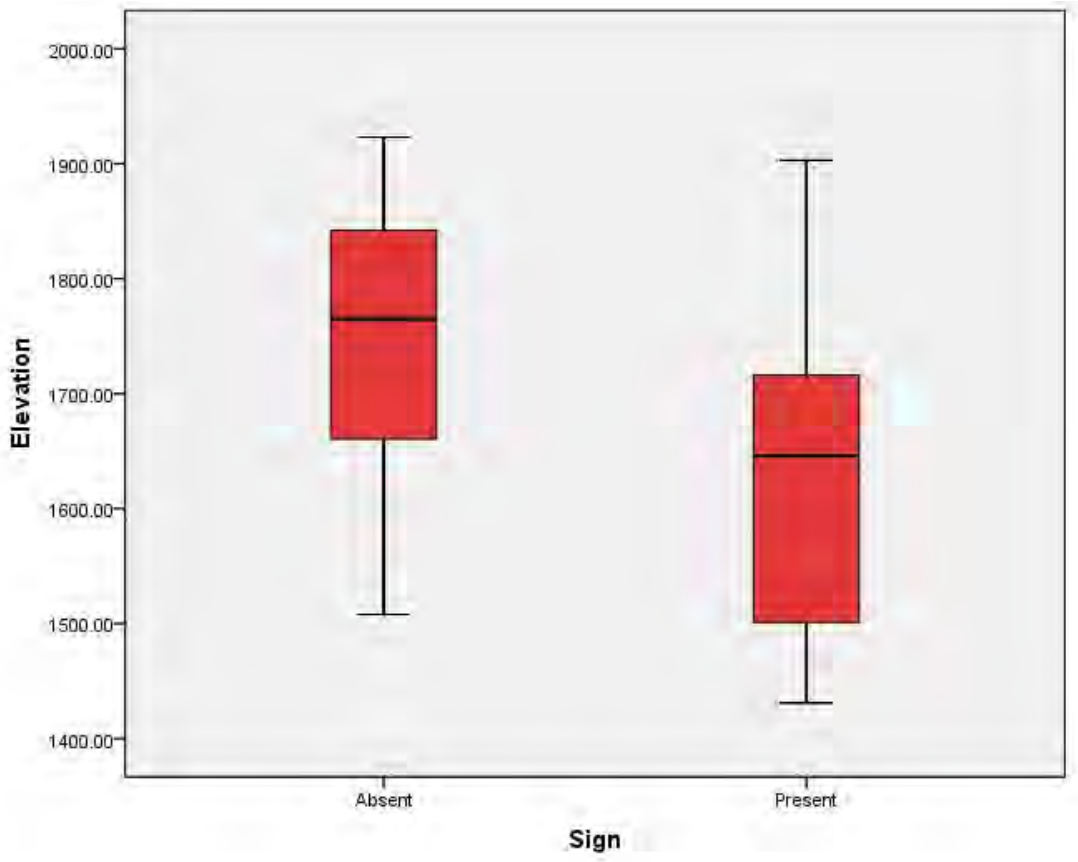

Figure 4. Box plot showing relation between otter signs and elevation (meter).

By correlating otter distribution through signs found against habitat variables, elevation showed a highly significant negative relation (–0.381, $p<0.01$). Whereas, insignificant relationships were obtained with other variables (Table 2). Insignificant correlation of spraint distribution with other variables besides elevation could be due to low variation in parameters. Other researchers have found spraints to be positively correlated with boulders (**Chettri and Savage, 2014, Shrestha et al., 2021a)** unlike in this study. Otter prefers river site riffles with boulder substrates for fishing (**Durbin, 1993**) and consuming prey whilst resting on boulders (**Jamwal et al., 2016**).

While correlating within the habitat variables, a highly significant positive correlation of elevation was obtained with boulders and river flow while a significant negative relationship was observed in sand and small stones. The smaller the amount of variability in independent and dependent variables, the lower the apparent correlation exists.

Table 2. Spearman's correlation coefficient matrix between otter sign and habitat variables and within the habitat variables

Habitat variables	Elevation	Sign	Sand and mud	Small stones	Large stones	Boulders	River flow	River width	River depth	Right bank slope	Left bank slope	Disturbance
Elevation	1											
Sign	–0.38**	1										
Sand and mud	–0.31*	–0.09	1									
Small stones	–0.44**	–0.16	0.70**	1								
Large stones	–0.14	–0.01	–0.26	–0.10	1							
Boulders	0.46**	0.11	–0.74**	–0.86**	–0.21	1						
River flow	0.31*	–0.21	–0.18	–0.35*	0.15	0.21	1					
River width	–0.44**	–0.03	0.37**	0.53**	0.19	–0.70**	–0.27	1				
River depth	0.03	0.14	–0.28	–0.27	–0.01	0.30*	0.05	–0.21	1			
Right bank slope	0.31*	–0.10	–0.26	–0.40**	0.03	0.40**	0.76**	–0.40**	–0.01	1		
Left bank slope	–0.48**	0.20	0.43**	0.49**	0.08	–0.54**	–0.28	0.37**	0.01	–.45**	1	
Disturbance	–0.23	0.07	0.50**	0.27	0.04	–0.36*	0.00	0.17	–0.41**	–0.05	0.37**	1
** Correlation is significant at the 0.01 level (2-tailed).												
* Correlation is significant at the 0.05 level (2-tailed).												

Among 11 independent habitat variables, a logistic regression (backward stepwise) model showed elevation and small stones are the main variables significantly ($p < 0.05$) associated with otter presence (Table 3) in the rivers studied. The estimated logit of the probability of otter presence was defined using parameter estimated as follows:

$$\text{logit}(p) = I + \beta x = 27.309 - 0.14 * \text{elevation} - 0.096 * \text{small stones}$$

Both variables, elevation and small stones, had negative effects on the probability of otter signs which is similarly explained by Spearman correlation coefficient.

Table 3. Results of backward stepwise regression model

	Estimate (B)	S.E.	Wald	df	Sig.	Exp (B)	95% C.I.for EXP(B)	
							Lower	Upper
Elevation	–.014	.005	9.187	1	.002	.986	.977	.995
Small stones	–.096	.043	5.046	1	.025	.908	.835	.988
Constant	27.309	8.631	10.012	1	.002	7.249E+11		

The classification table (Table 4) showed 83.3% accuracy which means this model will correctly predict 83.3% of cases.

Table 4. Classification accuracy of the logistic regression using cut-off value of 0.5

Observed		Predicted		
		Sign		
		.00	1.00	Percentage Correct
Sign	.00	5	6	45.5
	1.00	2	35	94.6
Overall Percentage				83.3

The governing factors may differ with the landscape type. Six habitat variables (location, pH, water depth, trees, river bottom substrate and organic pollution) were identified as predicting factors of Eurasian otter occurrence in Denmark (**Madsen and Prang, 2001**). The logistic regression model based on detection and non-detection data identified water quality and human disturbance as predicting variables in otter distribution in South Korea (**Jo et al., 2017)** whereas MaxEnt presence-only model in the same study predicted elevation among many contributing factors to predict habitat use. **Robitaille & Laurence (2002)** marked elevation as a poor indicator of otter occurrence in the European continent, contrasting with the predicted factor (elevation) in the present study. Thus, the potential user should critically evaluate the relevance of each variable in relation to their local environment (**Madsen and Prang, 2001**). Thus the predicted variable may be suitable for identifying otter habitats in similar habitats in Nepal.

CONCLUSION

Eurasian otters are yet to be prioritised as focus species for study in Nepal. The wider distribution of Eurasian otters in Nepal is anecdotal and population estimates are equivocal. The species presence in wetland and rivers in Nepal was ambiguous due to lack of substantial evidence. Dry pelt and spraints provided evidence to support the occurrence of Eurasian otters in the Pelma River, East Rukum. Spraint was found throughout the entire study area except in areas with higher human activities. Fishing in the river is a common practice in the study river with occasional killing of otters identified as threats to otters in the area. The rugged terrain was found influential in setting the habitat variables and therefore to otter signs distribution. Elevation is a highly significant environmental factor governing the distribution of otter signs and/or otter presence and absence. A logistic regression model identified elevation and small stones among habitat factors predicting otter distribution in the study river. The relevance of predicting variables could be applicable in rivers with similar geographic settings in Nepal. However, the users should critically evaluate the relevance of variables in relation to their local environment. Through this study, it is evident that the Eurasian otter is present in the area but there are prevailing threats to otters. Further studies are necessary on the otter population to understand the exact status of this species in the area and there is a need for conservation awareness to prevent otters from being deliberately killed. The findings of this study will be useful in the formulation of conservation action to safeguard otter population.

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Disclosure statement

No potential conflict of interest was reported by the authors.

Author Biographies

MOHAN BIKRAM SHRESTHA is a wildlife researcher carrying out otter research in Nepal. He has been a member of the IUCN Otter Specialist Group since 2017. He is primarily involved in gathering evidence of the presence of the Eurasian otter and otter conservation awareness campaigns in Nepal.

GANGA SHRESTHA is an environmental science graduate and is enhancing her knowledge of otter ecology and distribution modelling through field studies.

SWABHIMAN REULE is a forestry student in Kathmandu Forestry College, Tribhuvan University. He has been actively involved in otter studies in Nepal.

SUNDAR OLI is a forestry student working for a Bachelor’s degree in forestry at the Institute of Forestry in Tribhuvan University. He has been actively involved in otter studies in Nepal.

TEK BAHADUR GHARTI MAGAR is a nature guide and wildlife researcher. He has been supporting otter studies in Nepal.

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THE CENTRAL ASIAN OTTER IN THE WESTERN PART OF THE HISSAR RANGE IN UZBEKISTAN

E. BYKOVA*[a], A. ESIPOV[a] and B. AROMOV[b]

[a]Institute of Zoology, Academy of Sciences, Uzbekistan; [b]Hissar State Nature Reserve

*Corresponding author: ebykova67@mail.ru

ABSTRACT

The Central Asian otter (Lutra lutra seistanica) *is an endangered species listed in the Red Data Book of Uzbekistan as 1(EN). In the past, it inhabited all major rivers of Uzbekistan, but as a result of a combination of anthropogenic factors (poaching, disturbance and decline of populations of its main prey – freshwater fish) its distribution area and numbers have decreased. Unlike the mountainous regions, the otter's habitats in the desert zone have increased in area, which is associated with the growing network of canals and reservoirs through increasing human activity. The purpose of this research work is to study the current otter status in the western portion of the Hissar Range, which is a habitat for one of the main subpopulations in and outside the protected area. The research is based on interviews and ground survey data and long-term monitoring data collected in the Hissar State Nature Reserve in 2009–2020 have been reviewed. The data suggest that otter numbers outside the Hissar Nature Reserve are decreasing primarily associated with decreasing populations of prey fish species and an increase in disturbance due to the growth of local human population and more economic activity. Within the Hissar Nature Reserve otter numbers have generally been increasing due to the protection regime. However, this positive situation is recorded in just two of the four sections of the reserve (Kyzyldarya and Tankhazdarya rivers), while in the other two (Aksu and Tamshush rivers) the otter population seemed to decrease.*

Keywords: *Central Asian otter;* Lutra lutra seistanica*; endangered species; Uzbekistan; western part of the Hissar Range*

INTRODUCTION

The Central Asian otter, *Lutra lutra seistanica*, is a subspecies listed as Near Threatened in the IUCN Red List (https://iucnredlist.org/) and 1(EN) in the Red Data Book of Uzbekistan (**Kashkarov, 2019**). In the past, it inhabited all major rivers of Uzbekistan, but under the influence of a combination of anthropogenic factors (poaching, disturbance and declining populations of its main prey – freshwater fish) its distribution area and numbers have decreased.

In the mountainous part of Uzbekistan, the Central Asian otter is widespread in western Hissar Alai – along the rivers Surkhandarya, Kashkadarya, Kyzyldarya, Aksu, Sherabaddarya, Machaidarya and Sangardakdarya. On the flatlands of the country, it is distributed along a network of irrigation canals and lakes in Surkhandarya province. It has also been found on the Zeravshan River and one of its branches – the Dargom canal in Samarkand province. The otter is also recorded along the Amu Darya river down to Lake Sarikamysh in southeastern Uzbekistan, on

the border with Turkmenistan. Through the Amu-Bukhara canal, it spreads into the lakes of the Jeyran Ecocenter and the Dengizkul reservoir in central Kyzylkum (**Ishunin, 1961, 1987; Aromov, 1982; Taryannikov, 1986; Volozheninov et al., 1985; Esipov et al., 2000; Aromov, 2016; Marmazinskaya and Mardonova, 2016; Kashkarov, 2019**). Until the 1970s, it lived in the valleys of the Syrdarya and Chatkal rivers. **Zarudny (1915)** assumed the presence of this species in the Western Tien Shan (**cited by Mitropolsky, 2005**). The only reliable record in the Pskem valley was made in October 1986, when our team found the lower jaw of an otter (**Volozheninov et al., 1990**), which is currently stored in the collection of the Institute of Zoology, Academy of Sciences of the Republic of Uzbekistan. In September 2021, fresh otter footprints were found on the Karazhengeldy reservoir fed by the main canal in southern Karakalpakstan, which begins in the Amu Darya River in the Turtkul oasis of Karakalpakstan (north-western Kyzylkum) (**Marmazinskaya et al., 2021**) (Figure 1).

Figure 1. Central Asian otter footprints first discovered in northwestern Kyzylkum desert in September 2021. Photo by Natalia Marmazinskaya.

Previously, the otter was never observed in this area. The discovery of an otter in the desert area (central and northwestern Kyzylkum) testifies to the flexibility of this hydrophilic species and broad opportunities to spread through an expanding network of canals and reservoirs, which are the result of human activity.

The otter's habitats include both rapid mountain streams and slow flatland rivers or stagnant bodies of water (lakes, reservoirs and canals), with low steep banks and shores and dense thickets of aquatic and semi-aquatic plants. In fast-flowing rivers, such as the Amu Darya, the otter lives in areas with quiet currents.

In Western Hissar Alai, the Central Asian otter is protected in the Hissar State Nature Reserve (zapovednik) with a total area of 80,986.1 hectares. Nowadays, the Hissar Nature Reserve is the largest mountain reserve in Uzbekistan with the status IUCN A1; it also has the status IBA Uz042. The otter is also protected in the Zeravshan National Park and Jeyran Ecocenter.

The total number of Central Asian otters in Uzbekistan is estimated at around 500 individuals (**Kashkarov, 2019**), but it is still open to question, because some part of the species' range is not covered by the research. We aimed to collect data from typical otter habitats in the western part of the Hissar Range, the location of one of the species' main subpopulations.

STUDY AREA

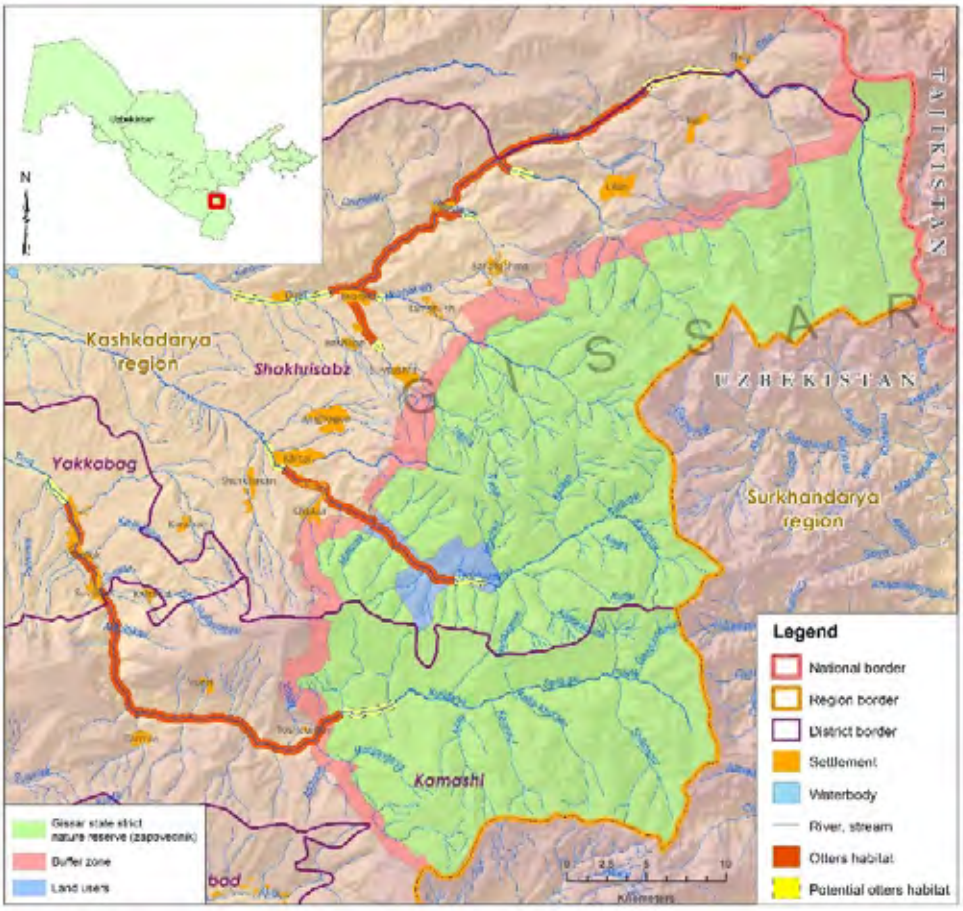

Figure 2. A map of existing and potential Central Asian otter distribution in the study area of Western Hissar Range in Uzbekistan.

The studies covered the western macroslope of the Hissar Range, which is a part of the Pamir-Alai mountain system. Administratively, it is located on the territory of Kashkadarya region of Uzbekistan. The terrain is characterised by large differences in altitude and steep rocky slopes. The study area included the main rivers within the Hissar Nature Reserve (Kyzyldarya, Tankhazdarya, Aksu and Tamshush) and basic otter habitats in the middle course of the Aksu River outside the protected area, on adjoining territories (Figures 2 and 3).

Figure 3. Suitable otter habitats in Aksu river with stony banks and single rocks within the river. Photo by Alexander Esipov.

The area is quite strongly developed. It is affected by waste material coming from the main road with a fairly intensive movement of trucks and cars and by the proximity of villages. Many bridges have been built across the river. The entire arable area is used for gardening (walnuts, pears, apples), growing timber, and as hayfields. Summer cottages used by local people during the warm season have been built everywhere. Steeper slopes are used for grazing, with excessive pressure on pastures recorded throughout, which leads to the degradation of vegetation and soil erosion.

The presence of the Central Asian otter on the western slopes of the Hissar Range was confirmed by **Ishunin** (**1961, 1987**), **Aromov** (**1982**) and **Taryannikov** (**1986**) in the past. The first two authors recorded otter presence in the middle course of the

Kyzyldaria river. Taryannikov discovered the species in the valley of the Kashkadarya river, near the village of Bashir. More recent data indicate the presence of the otter on the western slopes of the Hissar Range, which means its habitats are not restricted to the Kyzyldarya and Kashkadarya rivers, as was previously thought, but also cover the basin of the Aksu river with its left tributaries – the Yakkakhona, Tamshush, Sutushar and some smaller ones (**Esipov et al., 2000; Aromov, 2016**).

METHODS

Our survey methods included interviews with local people (12 records in total). The ground survey in September 2021 covered a 25km section of the project area in the middle course of the Aksu (up to 1,500m a.s.l.), from Miraki village to the confluence of the Aksu and Gilan rivers. We also interviewed local people and surveyed the upper course of the Aksu river up to 1,800m a.s.l. and a section of the Gilan river up to 2,000m a.s.l. – an altitude identified in past surveys as extreme for the otter. Otter distribution is limited by the availability of food resources. Otters prey on fish and this food resource is not available at higher altitudes in Uzbekistan (over 2,000m a.s.l) as the water temperature is too low for the fish to inhabit there. Therefore, otters are not found at these altitudes either in Uzbekistan. In total, 40km were covered. In addition, we used official reports with otter monitoring data from the Hissar State Nature Reserve obtained in 2009-2020.

RESULTS AND DISCUSSION

Otter monitoring data from the Hissar Nature Reserve

Within the Hissar Nature Reserve, the otter inhabits the Kyzyldarya, Tankhazdarya and Aksu rivers, as well as the Aksu's tributaries – the Tamshush, Suvtushar and Naushur. The total area of the reserve is 80,986.1 hectares, of which 173 hectares are occupied by the water surface of the streams.

The main habitats for the otter are the tributaries of the above rivers, where there are many rifts, pits, waterfalls and whirlpools. In winter, the water in these rivers does not freeze in some places, which allows otters to remain throughout the year. Long term monitoring data show that the number of otters in the Hissar Nature Reserve fluctuates depending on food supply, but there is a general trend towards population growth. In the period from 2009 to 2020, the number of otters in the reserve changed from 19 to 43 individuals, including adults and youngsters (Figure 4).

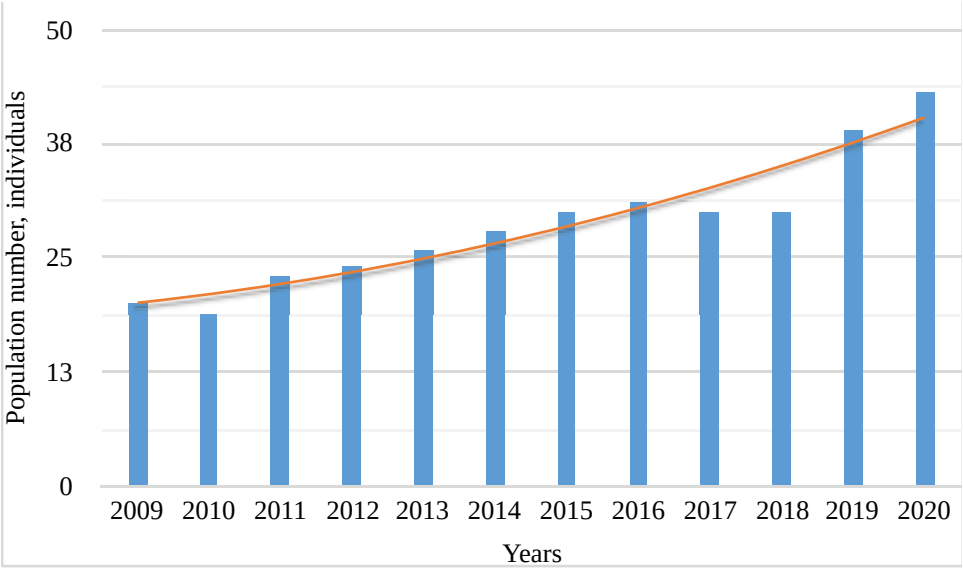

Figure 4. Population dynamics of the Central Asian otter in the Hissar Nature Reserve in 2009–2020.

The highest number with an increasing trend was recorded on the Kyzylsu (min = 4 inds. in 2014; max = 17 inds. in 2020) and Tankhazdarya (min = 1 ind. in 2010; max = 17 ind. in 2019) rivers. The lowest number with a negative trend was recorded on the Aksu river (min = 2 in 2009, 2016; max = 11 in 2012) and its tributary, the Tamshush (min = 1 in 2011; max = 5 in 2016) (Figure 5).

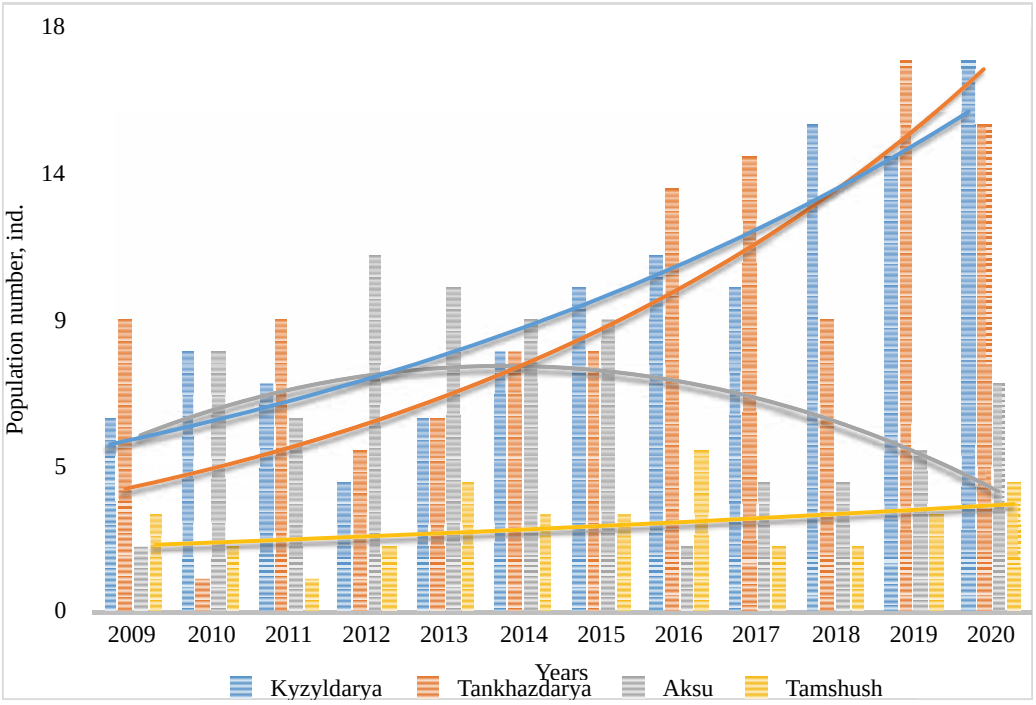

Figure 5. Population dynamic of the Central Asian otter in four sections of the Hissar Nature Reserve in 2009–2020.

The recorded youngsters numbered from 1 to 4, with the largest number of juveniles recorded in the Kyzyldarya (1–3 inds.) and Tankhazdarya valleys (1–4 inds.).

Thus, we can see that for 12 years the number of otters in the reserve has generally been increasing, which is associated with the protection regime, as well as with the sufficiency of food, which contributes to the stabilisation and restoration of the population of this ichthyophage. However, this positive situation is recorded only in two of the four sections of the reserve (Kyzyldarya and Tankhazdarya rivers), while in the other two (Aksu and Tamshush rivers) the otter's population appears to decrease.

Interviews

Our interviews were conducted in September 2021 and covered a part of the Aksu river valley outside the protected area. We surveyed local people from the Hisarak, Kul and Gilan villages located close to the otter habitats. Overall, 12 people took part in our survey. All the people were interviewed anonymously.

Nine out of 12 respondents reported about their observation of the otter at various times from the early 2000s to the present time. Only two participants indicated that they had recorded the otter in 2021. A resident of Hisarak village, who is involved in farming in the Aksu river valley, saw an otter 2–4km upstream of Hisarak village sitting on a large stone during the daytime in May that year. Another farmer from Hisarak reported that he saw a swimming otter near Gilan village in the evening time in July 2021. One more farmer said that he had heard from residents of Hisarak that in August 2021 an otter ate fish caught in fishermen's nets in the Aksu river valley near its confluence with the Gilansay river.

Most of the respondents reported that they had observed animals 3–4 years ago or earlier, in the Aksu river valley (near Hisarak village at the confluence of the Aksu and Gilansay and near the Hisarak reservoir). Most of the respondents were farmers and shepherds, some of whom regularly fish in the Aksu and Gilansay. Everyone noted that in the past they recorded the otter or its signs (footprints and droppings on stones, which they correctly described) more frequently. No one observed the otter's "burrows" or holts.

One of the main reasons for the decrease in otter numbers, according to the respondents, was human population growth and resultant increase in human disturbance. In the past, there were single recorded cases of otter poaching for their skin, but currently hunting is not popular due to the low number of otters. More often animals were killed in revenge for attacking poultry or eating fish from nets. So, according to local residents from Hisarak village, one otter was killed in 2018, when it entered a chicken coop at night and killed all the chickens.

It should be noted that in the Aksu and its tributaries fish is not abundant due to the naturally low water temperature. The otter's diet includes two fish species inhabiting the mountain rivers – the Sattar snowtrout (marinka) *Schizothorax intermedius* and the Amu Darya trout *Salmo truta oxianus*. This is confirmed by **Aromov** (**2016**), who studied the otter food resources within and outside the Hissar Nature Reserve. He made 18 records of otter faeces containing the bones of the Sattar snowtrout (marinka) and 12 records with trout bones on a 10km section of the Aksu river. It is important that, while the marinka is a native species for the Aksu river, the trout was brought from other rivers of Hissar Alai. In particular, the Amu-Darya trout was introduced into the Aksu in 1994 from the Tankhazdarya river. The trout numbers reached their peak in 2016 and the number of otters increased in the same period. After the introduction of the trout, the numbers of the marinka decreased due to the depredations of the Amu Darya trout (note: *Schizothorax intermedius* is a herbivorous species). The trout is popular with locals, who often use illegal fishing methods, such as using Chinese nets with a small mesh size. During our short visit to the project area, we met a fisherman with a net of this type and some fish. Judging from the behaviour of the fisherman, who quickly disappeared after our arrival, the catch was illegal.

Thus, the main habitats of the otter in the project area are located in the middle course of the Aksu river, from the Hisarak reservoir to the confluence of the Aksu and Gilan rivers, at altitudes from 1,300 to 1,500m a.s.l. Less often, the otter goes further up the river (up to a maximum of 1,600m a.s.l.). There is a fish pond in the Gilan valley, which apparently attracts the animals. During our visit, the pond was empty of fish, and a local guard reported that he had not seen otters in 2020–2021. The villages of Hisarak and Yakkakhona are located within the otter habitat in the Aksu river valley. The villages of Miraki downstream and Gilan and Kul upstream are also within the habitat. Residents of all the villages possess vegetable gardens (potato), orchards and hayfields in the Aksu valley; some of them are fond of fishing and can periodically observe the otter.

Thus, based on the collected data, we can conclude that the otter numbers outside the Hissar Nature Reserve are decreasing, which is primarily associated with a decrease in food supply. On the one hand, the introduced Amu Darya trout is displacing the marinka, whose numbers are declining; on the other hand, people catch both species, competing with the otter. Another threat is the instability and decrease in flow in the rivers, which have primarily been caused by a series of droughts in the last two years. This is evidenced by the state of the Hisarak water reservoir, which was mostly empty in 2021. The water level in this reservoir depends on atmospheric precipitation and an irrigation pattern used for cotton and other plantations. The water drops to a minimum by late summer, when the irrigation season is mostly over and the filling of the reservoir begins. Mudflows can also be a potential threat to otters in the Aksu river. Cases are unknown of the death of otters as a result of a

mudflow in the Aksu, although this phenomenon is usual for the studied area. There is information from an adjacent territory of the Hissar Range (Igrisu river) where an otter died in a mudflow in August 2015 (**Gritsyna et al., 2016**). There is also an obviously increasing threat of human disturbance associated with the growth of local population and economic activity.

Ground survey

During the two field trips to the project area (1–2 and 26–27 September) our team surveyed a large part of the floodplain of the Aksu river, from Miraki village located below the dam of the Hisarak reservoir, up to the confluence of the Gilan river, covering a 25km section of the river.

Except for some inaccessible places, most of the described area was covered with walking trails. The team purposefully searched for signs of the otter's presence, including its tracks and footprints on the damp banks, as well as its holts and faeces (spraints). Large stones and rocks in the riverbed, the river banks under bridges and similar places were examined, because otters tend to use such sites to defecate (**IOSF, 2021**) and leave its characteristic spraints containing fish scales and bones. Observations were carried out both with the naked eye and with the help of binoculars. As a result, the presence of the otter was not confirmed by the ground survey.

CONCLUSIONS

Thus, despite the fact that we were not able to visually observe the otter or find its signs, we can conclude that this species is present in the Aksu river basin. This is evidenced by the interviews with locals and the information from the staff of the Hissar Nature Reserve, who studied the otter both in the project area proper and in territories adjacent to the reserve. The surveys have shown that habitats most suitable for the otter can be found both in the project area and on nearby rivers at altitudes up to 1,500–1,600m a.s.l.

The general consensus is that the otter population has been declining over the past few years. This threatened animal is now observed extremely rarely, even by residents of local villages who spend a lot of time on their land plots adjacent to the river bank or fish in the same places where the animal was previously observed. The reason for this decline, in their opinion, is the reduction of the otter's prey, namely, the two main fish species (Amu Darya trout and marinka). In addition, all the respondents noted increasing human disturbance in the Aksu river basin. At the same time, the data of otter surveys carried out in the adjacent territory of the Hissar Reserve indicate a relatively stable status of this species in the rivers of the reserve, including the Aksu, which is associated with the protection regime.

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Disclosure Statement

No potential conflict of interest was reported by the authors.

Author Biographies

DR ELENA BYKOVA is a Head of Laboratory of the Endangered Species Census and Cadaster, Institute of Zoology, Uzbek Academy of Sciences, PhD. She practised as an Intern of the IUCN/SSC Red List Programme, Cambridge University, UK and fellow of the Interdisciplinary Centre for Conservation Science in the Department of Zoology at the University of Oxford, UK. Her research interests focus on mammalogy, biodiversity conservation, assessment and conservation of threatened species, urban ecology of mammals. She is the author of over 200 published scientific works and some popular articles on ecology and nature conservation, including the Red Data Book of Uzbekistan.

ALEXANDER ESIPOV is a Researcher of the Institute of Zoology, Uzbek Academy of Sciences and Senior Researcher of the Chatkal State Biosphere Nature Reserve. His research includes ecology of carnivores, rodents and ungulates; conservation of endangered species of mammals in Uzbekistan; hunting-game species. He is author of over 100 published scientific works and some popular articles on ecology and nature conservation, including the Red Data Book of Uzbekistan.

BAKHTYOR AROMOV is Director of Hissar State Nature Reserve. He has long-term experience in Mustelidae and Felidae research, including Central Asian otter, snow leopard and Turkestan lynx. He is the author of over 100 published scientific works and some popular articles on ecology and nature conservation.

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THE PERCEPTIONS OF FISHERMEN TOWARDS THE CONSERVATION OF SPOTTED-NECKED OTTERS (*Hydrictis maculicollis*) AND CONFLICTS IN THE RIVERINE AREA OF ONDO STATE, NIGERIA

O.M. SALAMI*[a], O.S. ODEWUMI[a] and P.C. HERNANDEZ-ROMERO[b]

[a]Department of Ecotourism and Wildlife Management, School of Agriculture and Agricultural Technology, Federal University of Technology, Akure, Ondo State, Nigeria;

[b]Facultad de Estudios Superiores Iztacala, Universidad Nacional Autónoma de México, Mexico City, Mexico

*Corresponding author: salamiolalekan92@gmail.com

ABSTRACT

*This study aims to assess the perceptions of fishermen towards spotted-necked otter conservation and conflicts in the riverine area of Ondo State. 51 focus group discussions were carried out among the fishermen across 17 communities in Ilaje, Irele, Ese-Odo and Okitipupa local government areas. Field observations were made and 100 structured questionnaires were given to respondents in the study area. A descriptive analysis was used to analyse the questionnaire responses using SPSS Data Editor while data collected on the focus group discussions were analysed qualitatively through thematic analysis. Spotted-necked otters (*Hydrictis maculicollis*) are widely distributed in several rivers systems in the communities. The empirical results indicate that most of the fishermen (86%) have seen otters in swamps, rivers, streams and marsh. 65% report sightings of otters mostly during the rainy season. In addition, all the fishermen (100%) identified the main cause of conflict in the area as stealing of fish caught in nets and destruction of fishing nets. The results indicate that direct hunting (4.74) and accidental capture (4.13) are the most prevalent threat factors toward otter populations in the area. 83% of the fishermen have negative perceptions toward otter conservation while 88% suggest compensation as the solution to prevent retaliatory killing of otters in the area.*

Keywords: *Conservation; fishermen-otter conflict; Ondo State; perceptions; riverine area; spotted-necked otter;* Hydrictis maculicollis

INTRODUCTION

Human socio-economic context plays a significant role in biodiversity conservation activities (**Dickman, 2010**). People's perceptions of species conservation are influenced by gender, age, education, profession, region, religious and cultural beliefs (**Campbell and Torres, 2011**). Data paucity on the ecology, lack of community awareness, and recurrent conflict with human neighbours are some of the factors limiting the conservation of small carnivores in Africa (**Reed-Smith et al., 2015**). As is the case for other carnivores, socio-economic characteristics of people affect their perceptions of otters ranging from positive when otters act as a source of

revenue generation through ecotourism to negative when they consume fish caught in nets and damage fishing nets (**Norris and Michalski, 2009**).

Otters are carnivores, capable of using strong molars and premolars for crushing the bones of prey (**Hussain et al., 2011**). Like other otter species, seasonal variation affects the diet of spotted-necked otters in their home range (**Perrin and Carugati, 2000**). There have been many cases of conflict between otters and people and fishermen expressed negative attitudes towards otter conservation due to depredation of netted fish and damage to fish nets (**Andarge et al., 2018**). Human-wildlife conflict is likely to become more prevalent as urbanisation increases and natural areas diminish in quantity and quality (**Luck and Smallbone 2010**). **Basnet et al. (2020)** reported that human–otter conflict is persistent in Asia as a result of over-exploitation of fish. In the Czech Republic, Poland and Portugal, Eurasian otters (*Lutra lutra*) are the main predator of fish and major cause of conflict with fishermen (**Santos-Reis et al., 2013**). Spotted-necked otters and African clawless otters (*Aonyx capensis*) were reported as the main cause of conflict with the fly-fishing tourism industry in South Africa (**de Vos, 2018**). In the Hlan River, Benin, conflict between spotted-necked otters and local people arose as a result of damage to fishing nets and consumption of the fish caught (**Akpona et al., 2015**). **Ergete et al. (2017)** also indicated that African clawless otters caused the loss of captured fish and damage of fishing equipment in Lake Tana, Ethiopia. So conflict between otters and people is not unique to Africa.

In Ondo State, on 24 August 2001 the body of a spotted-necked otter (*Hydrictis maculicollis*) which had been shot by a hunter was seen along the banks of a stream in a gallery forest habitat. (**Angelici et al., 2005**). Through effective conservation education, human perceptions can be improved to provide more positive attitudes towards species conservation (**Dickman, 2010**).

The aim of this study was to assess the perceptions and attitudes of fishermen towards spotted-necked otters and identify the main causes of conflict in the riverine area of Ondo State. By obtaining reliable information it can attract research and conservation attention towards effective management of otters and their natural habitat.

STUDY AREA

The study was carried out in the riverine areas of Ondo State located in southwest Nigeria, between Latitude 50 50’ N – 60 09’ N and Longitude 40 45’ E – 50 05’ E. It comprises four local government areas: Okitipupa is the most populated in this study area with a population of 234,138 Ikales speaking people and a land mass of 803 km^2. Ilaje has an area of 1,318km^2 and is the largest local government area in Ondo State in terms of its landmass with a population of 277,034 who belong to the Ilaje ethnic group. Ese-Odo local government area has a population of 154,978

comprising the Apoi and Ijaw ethnic groups, and a land mass of 762km^2. The Irele local government is the least populated with 145,166 people, also Ikale speaking people, and a land mass of 963km^2 (**National Population Commission, 2006**) (Figure 1). Fishing and agriculture are the main activities of local residents and commercial activities are carried out in speedboats, and canoes are used for transportation of goods and people (**Kabir et al., 2020**).

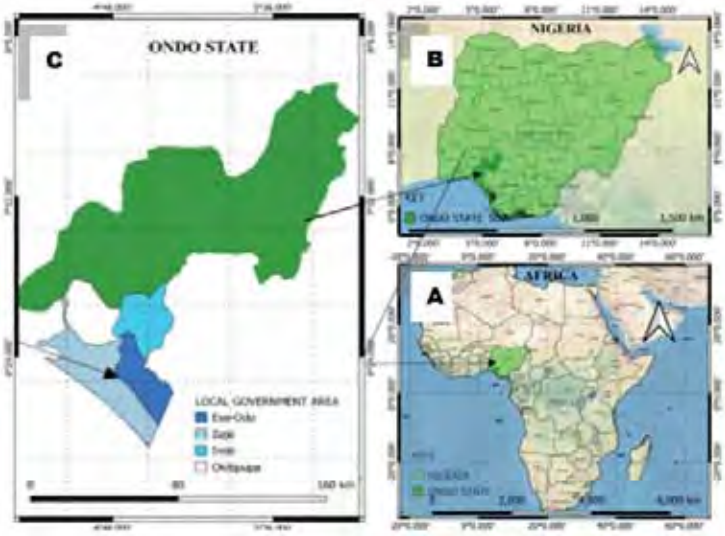

Figure 1A. The location of Nigeria in Africa, B: The location of Ondo State in Nigeria, C: Map of the study area, showing the local government areas in the riverine area of Ondo State, Nigeria.

The riverine area is a delta with most rivers flowing into the Atlantic Ocean. Ondo State coastline is about 180km and the area experiences a tropical climate consisting of both wet (April to October) and dry seasons (November to March). During the wet season, the average rainfall index is about 3000mm while the mean temperature is 28^{o}C. The average rainfall index for the dry season is 800mm with a mean temperature of 32^{o}C (**Agunbiade et al., 2010**). The area is drained by many perennial streams and rivers, that traverse several settlements of the coast, and empty into the open ocean (**Agunbiade et al., 2010**). The red mangrove *Rhizophora mangle* and the white mangrove *Avicennia marina* are the most dominant plant species. A striking feature of vegetation in this area is the desiccation induced by marine water incursion into about 10,000 hectares of freshwater swamp forest (**Olorunlana, 2013**).

METHODS

In February 2020, a reconnaissance survey was conducted among fishermen in the communities who regularly use the coastline and potentially encounter the spotted-necked otter. This method is appropriate in assessing the relative abundance of some rare species and has been used to assess other wild mammals hunting in the terrestrial ecosystem (**van der Hoeven et al., 2004**).

Field observations

Field observations were made by walking transects along the banks of the rivers from 5.00am to 6.00pm each day and using a speedboat/canoe on the water bodies. The aim was to observe otter activities as well as possible causes of conflict with humans. The survey was carried out both during the day (to look for otters and signs of their presence) and at night using headlamp and torch (to look for active individuals).

Focus group discussion

A total of 51 focus group discussions were conducted among fishermen across 17 communities in the four local government areas. Respondents with more than 10 years of fishing experience were selected. Subjects related to whether a respondent has ever seen an otter before in the area, main activities they are engaged in, types of fishing gear, any problems with otters in their daily activities, how they generally perceived the otter and what they do to mitigate otter-associated problems. Pictures of the otter were shown to respondents for easy identification and a local interpreter was employed to translate the questions into Ijaw language during discussions among the Ijaw communities (Figure 2A).

Figure 2A. Interview with fishermen at Aboto community; Figure 2B. Questionnaire used at Araromi.

Questionnaire

To understand the perceptions and attitudes of fishermen towards otters in the study area, a questionnaire survey with 100 respondents from 17 communities was conducted. The survey communities and respondents were selected based on proximity, access and occupation in the target community (**Etikan, 2016**). The questionnaire had several questions about the demographic profile of respondents, distribution and pattern of occurrence of otter, types of conflict with humans and

proposed solutions towards otter conservation in the area (Figure 2B). The information collected was analysed and information from focus group discussions was presented thematically. The GPS coordinates taken were processed using GIS tools.

RESULTS

A distribution map of otters in the study area was produced from the GPS coordinates taken (Figure 3).

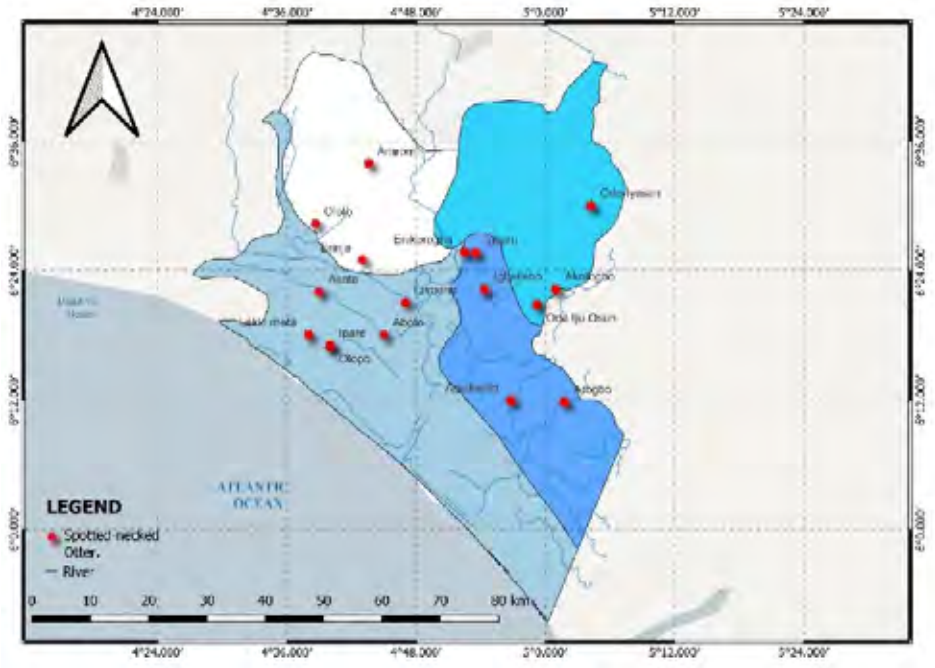

Figure 3. Spatial distribution of spotted-necked otter in the study area.

Awareness of otters by fishermen in the riverine area

The following responses were received from the fishermen:

- 86% stated that they normally see spotted-necked otters in their area
- 49% stated they see otters about once every week
- 38% stated that they see otters about once every month
- 7% stated they have not seen an otter for more than five years

Questions about activity behaviour:

- 51% see otters almost any time
- 22% see otters mostly at night

- 15% see otters in the afternoon
- 12% usually see otters in the morning

In addition

- 65% stated that they usually see otters most during the rainy season
- 30% see the species in both seasons
- 5% usually see them in the dry season

Respondents described different habitat types where spotted-necked otters are seen most (Figure 4).

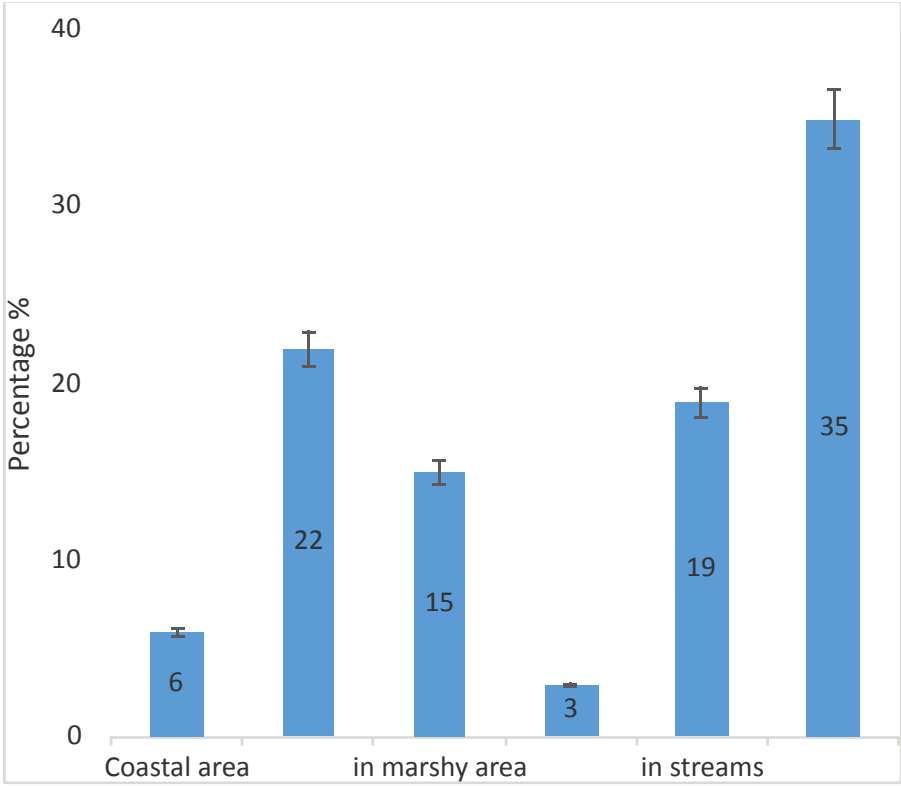

Figure 4. Habitat type of spotted-necked otter in the coastal area of Ondo State.

Fishermen–otter conflict in the riverine area of Ondo State

The result of the interviews in all the riverine communities revealed that spotted-necked otters do catch/steal fish in nets and damage fishing net/equipment while foraging (Table 1).

Table 1. Fishermen/spotted-necked otter conflict

Conflicts	Means of identification	Subjective response	Objective response
Catching/stealing from fishing nets	Field observation and focus group discussion.	100% of the interviewees agreed that otters do steal fish caught in nets.	Not encountered during survey.
Destruction of fishing equipment/ nets	Field observation and focus group discussion	100% of the interviewees agreed that spotted-necked otters damage fishing nets.	More than 500 damaged fishing nets/equipment was confirmed during the walking transect along the river banks and during interviews with fishermen.

Ilaje local government area: In Okoha Igbokoda, all the interviewees confirmed that otters often destroy fishing nets. In Akata, most of the interviewees perceived otters as a major threat to their economic activity. In Olopo, all the interviewees confirmed that otters destroyed their nets and one interviewee quantified the level of destruction caused by otters to his nets at being worth ₦500,000 ($1,205). In Ipare, all the interviewees said otters frequently destroy fishing nets set along the water course while taking fish caught in it (Figure 5A).

Figure 5. Damage to fishing nets caused by otter in Irele (5A - left) and in Ilaje (5B - right).

Ese-Odo local government area: The results of the focus group discussions held in the five selected communities revealed that otters do steal fish and destroy fishing nets. In Arogbo, Igbekobo, and Enikorogha the destruction was prevalent especially

during the rainy seasons. In Igbotu, otters were reported to have caused more damage to fishing nets and also steal fish caught in nets. This act had led many people in the area to have negative attitude towards otters.

Okitipupa local government area: In Araromi, otters had been confirmed as damaging fishing nets set in the river Oluwa and there were similar reports during group discussions in Erinje, Igbinsin-Oloto and Erin Orere Ara.

Irele local government area: The result of the focus group discussions held in Ode-Iyansan, Ode-Iju Osun and Akotogbo revealed that otters had destroyed more fishing nets while stealing fish caught in the nets. One interviewee said that over 300 of his fishing nets were destroyed by otters in one week (Figure 5B)

Threat factors associated with spotted-necked otters in the riverine area of Ondo State

This research identified the major threats to otters (Table 2). “Direct hunting capture” had the highest mean (4.74), followed by “accidental capture” (4.13), “inadequate law enforcement” (3.93), “pollution” (3.90), “sand mining” (2.69), “habitat degradation” (2.66), “illegal trade” (2.38) and “construction” (2.38).

Table 2. Threat factors associated with spotted-necked otter in the coastal areas of Ondo State

Factors	*Strongly agree*	*Agree*	*Undecided*	*Disagree*	*Strongly disagree*	*Mean*	*Standard deviation*	*Rank*
Direct hunting	74	26	0	0	0	4.74	0.44	1
Accidental capture	45	42	0	7	6	4.13	1.13	2
Inadequate law enforcement	43	32	6	13	6	3.93	1.25	3
Pollution	36	41	0	23	0	3.90	1.13	4
Sand mining	7	31	0	48	14	2.69	1.25	5
Habitat degradation	12	21	0	55	12	2.66	1.27	6
Illegal trade	12	11	18	21	38	2.38	1.40	7
Construction	14	14	6	28	38	2.38	1.40	8

Looking at the status of the otter population in the study area the perception is that they are increasing (Figure 6).

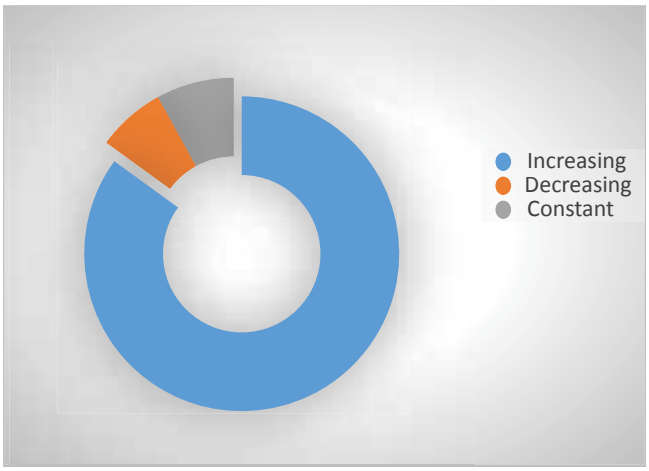

Figure 6. Trends in spotted-necked otter populations in the coastal region of Ondo State.

Fishermen's perception and attitudes towards spotted-necked otter conservation

The majority of the respondents (77%) are not willing to support otter conservation while 23% of the respondents disagree. Eighty-eight percent (88%) of the respondents stated that the current laws for otter conservation are not respected. In addition, all the respondents (100%) revealed they have not participated in sensitisation talks, events or campaign on otter conservation.

Proposed solutions towards spotted-necked otter conservation

Eighty-eight percent (88%) of the interviewees suggested that compensation should be given to fishermen in coastal communities in order to reduce conflict between otters and humans while a few of the interviewees suggested the use of chemicals on fishing nets, provision of iron/wire nets, alternative livelihoods and an otter sanctuary (Table 3).

Table 3. Proposed solutions towards spotted-necked otter conservation in the study area

VARIABLE	**INTERVIEWEES RESPONSES**	
	Agreed	**Undecided**
Compensation	88%	12%
Use of chemicals on fishing nets	18%	82%
Provision of iron/wire nets	29%	81%
Alternative livelihoods	29%	81%
Otter sanctuary	12%	88%

DISCUSSION

This study revealed the presence of spotted-necked otters in the riverine areas of Ondo State. This agrees with the work of **Angelici et al. (2005)** who reported that otters were seen at Ifetedo (7°27.1), Ondo State, at dusk on 3 December 2001. They inhabit freshwater ecosystems and are found mostly in swamps, streams, marshland, and major rivers. This is consistent with the findings of **Nawab & Hussain (2012)** who reported that otters inhabit permanent freshwater bodies which support abundant prey resources. Otters are seen at any time with a high encounter rate during the rainy season. This is a result of an increase in freshwater fish and reduction in water salinity flowing from the Atlantic Ocean into the region.

From the research, the majority of the respondents stated that otters steal fish caught in nets and also destroyed fishing net/equipment. This agrees with the findings of **Ergete at al. (2017)** in Lake Tana in Ethiopia. The majority of fishermen in the study area depend on aquatic resources for sustainability and competition for resources over the years has increased fishermen–otter conflict. **Govind & Jayson (2018)** reported that human–otter conflict is persistent throughout Asia and in Ecuador, **Carrera (2003)** reported an overlap of 70% between the diet of humans and giant otters (*Pteronura brasiliensis*).

Direct hunting and accidental capture are the main threat factors affecting spotted-necked otter populations in the area and this is consistent with the findings of **Gomez et al. (2016)** in India. They reported that hunting is a threat to otters in order to meet the high demand of the Chinese market and **Harrington et al. (2017)** reported that most otters are accidentally captured in fishing nets.

Figure 7. Spotted-necked otter killed at Ipare.

Most of the fishermen in the study area had negative perceptions toward otters which has led to retaliatory killing as result of the loss of fish and damage to fishing nets (Figure 7). All the respondents reported that they had not participated in any form of sensitisation event on otter conservation. This is largely due to a high illiteracy level, erratic electricity supply, and high poverty rate that is prevalent in the area. Compensation was suggested as a means of reducing fisher–otter conflict by the fishermen.

CONCLUSIONS

The present study confirms the presence of spotted-necked otters in the riverine area of Ondo State. It also identified the depredation of fish caught in nets and damage of fishing equipment/nets by otters as the main cause of fishermen–otter conflict which has led to retaliatory killings. The majority of interviewees showed very little support for conservation efforts from the government or any individual, and most of the respondents disagree with conservation efforts for the otter. The majority are also not aware of any law protecting otters. The few that agree to conservation efforts suggest that the government should provide compensation to affected individuals. Therefore, developing effective mitigation strategies for fishermen–otter conflicts is necessary to prevent local communities from adopting harmful control in retaliation for perceived and/or real losses.

RECOMMENDATIONS

At key sites, conservation education, particularly those focusing on otter conservation and research should continue. Habitat rehabilitation plans to stabilise the condition and improve access to food, shelter and space should be implemented. Funds should be made available to undertake further assessments and for an update throughout Nigeria to improve knowledge on distribution and status of the species.

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Disclosure Statement

No potential conflict of interest was reported by the authors.

Author Biographies

SALAMI OLALEKAN MICHAEL is a teaching assistant in the Department of Ecotourism and Wildlife Management, Federal University of Technology, Akure and the Education Research Officer of Netlink Environmental Conservation. He has over 4 years' experiences in the field of wildlife ecology, environmental and social impact assessment, biodiversity conservation, mitigation of human/wildlife conflict, GIS application and One-Health approach for natural resources management.

ODEWUMI OLUYINKA SUNDAY PhD is a lecturer in the Department of Ecotourism and Wildlife Management, Federal University of Technology, Akure. He is an astute scholar as attested to by the quality of his publications in local and international conferences and reputable journals. His fields of study include wetland management, ornithology and wildlife ecology.

PABLO CÉSAR HERNÁNDEZ-ROMERO PhD and member of the IUCN Otter Specialist Group since 2015, has 13 years' experience in neotropical otter research and conservation projects. His studies centre on aspects of evolution, morphology, ecology and conservation of *Lontra longicaudis* in Mexico and throughout its distribution.

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IT'S OTTERLY CONFUSING – DISTINGUISHING BETWEEN FOOTPRINTS OF THREE OF THE FOUR SYMPATRIC ASIAN OTTER SPECIES USING MORPHOMETRICS AND MACHINE LEARNING

F. KISTNER*[a,b], L. SLANEY[b], Z. JEWELL[b,c], A. BEN-DAVID[b,d] and S. ALIBHAI[b,c]

[a] Institute of Photogrammetry and Remote Sensing (IPF), Institute for Technology Karlsruhe (KIT), Germany

[b]WildTrack Specialist Group

[c]Nicholas School of the Environment, Duke University, NC, USA

[d]School of Zoology, the George S. Wise Faculty of Life Sciences, Tel Aviv University, Tel Aviv, Israel

*frederick.kistner@kit.edu

ABSTRACT

*Southeast Asia is home to four sympatric otter species: Eurasian otter (*Lutra lutra*), Asian small-clawed otter (*Aonyx cinereus*), smooth-coated otter (*Lutrogale perspicillata*) and hairy-nosed otter (*Lutra sumatrana*). All species are on the IUCN's Red List of Endangered Species. In many regions, there is an overlap in the distributions of at least two species. To establish population size and range of these elusive animals, a variety of non-invasive data collection methods is available. Footprints often tend to be overlooked as valuable scientific data, which potentially leads to a wealth of information being lost.*

The Footprint Identification Technology (FIT), developed by WildTrack, analyses morphometric data extracted from digital images of footprints and uses state-of-the-art Machine Learning models for classification tasks. In this study, we aimed to develop algorithms to distinguish between three of the four otter species of southeast Asia (Lutra lutra, Aonyx cinereus *and* Lutrogale perspicillata), *using footprints.*

For the three species, a digital footprint image database of known otters was developed with the help of several zoos. Using specific features, landmark points were placed on each footprint image and morphometric measurements in the form of distances, angles and areas were extracted and analysed in JMP software. The average classification accuracy for discriminating between the three species, using multiple analytical methods, was 97%. It is planned to develop this technology further adding the fourth species (Lutra sumatrana) *and aim for sex and individual classification, for which more footprint data are necessary. The authors welcome contributions of footprint images from known animals.*

Keywords: *Eurasian otter,* Lutra lutra*, Asian small-clawed otter,* Aonyx cinereus*, smooth-coated otter,* Lutrogale perspicillata*, hairy-nosed otter,* Lutra sumatrana*, Footprint Identification Technology, Footprint, Track, XGBoost*

INTRODUCTION

The development of effective conservation strategies requires reliable information on species distribution, population sizes and composition **(Conde et al., 2019)**. These data, however, are often hard to get, especially for elusive and predominantly aquatic animals like otters.

There are four otter species with an overlapping distribution range in Asia: the Eurasian otter (*Lutra lutra*), the Asian small-clawed otter (*Aonyx cinereus*), the smooth-coated otter (*Lutrogale perspicillata*) and the hairy-nosed otter (*Lutra sumatrana*). Each species has an IUCN protection status, with the hairy-nosed otter being the most endangered species of the four **(Duplaix and Savage, 2018)**.

There are several regions in southeast Asia where at least two of the four species are sympatric **(Yoxon and Yoxon, 2017)**. It can be difficult to distinguish between the species visually and it is therefore critical to have reliable monitoring tools available. Wherever possible, non-invasive methods should be deployed to minimise disturbance and potential harm to the animals whilst ensuring the reliability and quality of data collected **(Jewell, 2013)**.

Traditional tracking of animals can be seen as a non-invasive approach. Animal tracks can be collected without any disturbance to otter populations and used to inform on numbers and distribution. Data based on animal tracks is also reliable and cost-effective if the tracker has the required skills **(Evans et al., 2009)**.

Liebenberg (2021) called tracking 'the origin of science' and with the vast development in scientific data collection and computer-assisted analysis **(Petso et al., 2022)**, morphometric footprint analysis opens up new possibilities in wildlife monitoring. Another great advantage in using tracks as a data source for wildlife monitoring, is that indigenous communities with traditional ecological knowledge (TEK) can be involved in wildlife conservation research. Such collaborations can be of benefit to everyone involved and add valuable data for wildlife monitoring **(Vieira et al., 2015; Ramos et al., 2016)**. In order to use tracks as a reliable data source, a strict protocol in data collection and analysis is crucial.

The Footprint Identification Technology (FIT) developed by WildTrack (www.wildtrack.org), combines traditional tracking with modern Machine Learning classification algorithms **(Li et al., 2018)**. Following a strict protocol, it allows researchers, who might not be expert trackers, to draw dependable and unbiased information. FIT has been successfully developed for a wide range of endangered species and can classify species **(Alibhai et al., 2008)**, sex **(Alibhai et al., 2017)**, age

class **(Li et al., 2018)** and individual ID **(Alibhai et al., 2008; Jewell et al., 2016; Alibhai et al., 2017; Li et al., 2018)** once species-specific algorithms have been developed.

FIT classification accuracies are typically over 90% **(Petso et al., 2022)**. In order to build such models, a reference database comprising images of known individuals, sex and/or species of a sufficient size and quality is required. Such databases are often created with the help of ex-situ organisations.

In this pilot study, we investigated the use of FIT to predict three Asian otter species based on morphometric features of their footprints. We deployed two different prediction models, Stepwise Linear Discriminant Analysis (LDA) and XGBoost.

LDA has often been the method of choice in comparable footprint studies of other species **(Sharma et al., 2005; Alibhai et al., 2008; Alibhai et al., 2017; Li et al., 2018)**.

XGBoost is a supervised Machine Learning technique library that uses scalable, gradient boosting decision trees. It is often referred to as the best algorithm for classification and regression tasks of tabular data and has been the most successful method for the Machine Learning competition site “Kaggle” **(Chen and Guestrin, 2016)**.

To the best of our knowledge, this is the first study that implements Machine Learning algorithms to classify otter species using biometric measurements from footprints as input data. In this report, we want to highlight the possibility of developing unbiased models with high accuracy. In addition, we investigate which features are the most important for these models in order to share insights of important areas of a footprint when species classification in situ is desired.

We would also like to encourage researchers to implement this monitoring tool in the field and help improve the classification capability and robustness of this method by contributing otter tracks to our otter footprint database.

METHODS

Technical drawings

Figure 1 shows technical drawings of otter tracks of the three species investigated in this study. The drawings are based on footprint images received for this research as well as photos of the underside of the three species' feet. Track drawings give the tracker as much detail as possible to interpret a track found in the field, but it is rare to find a track with all the components shown in the drawings. Tracks can vary in size, shape and detail depending on substrate and gait of the animal **(Elbroch, 2019)**. As a result, certain parts of the otter’s feet often do not register well in the track and the drawings reflect this by showing these parts in light grey.

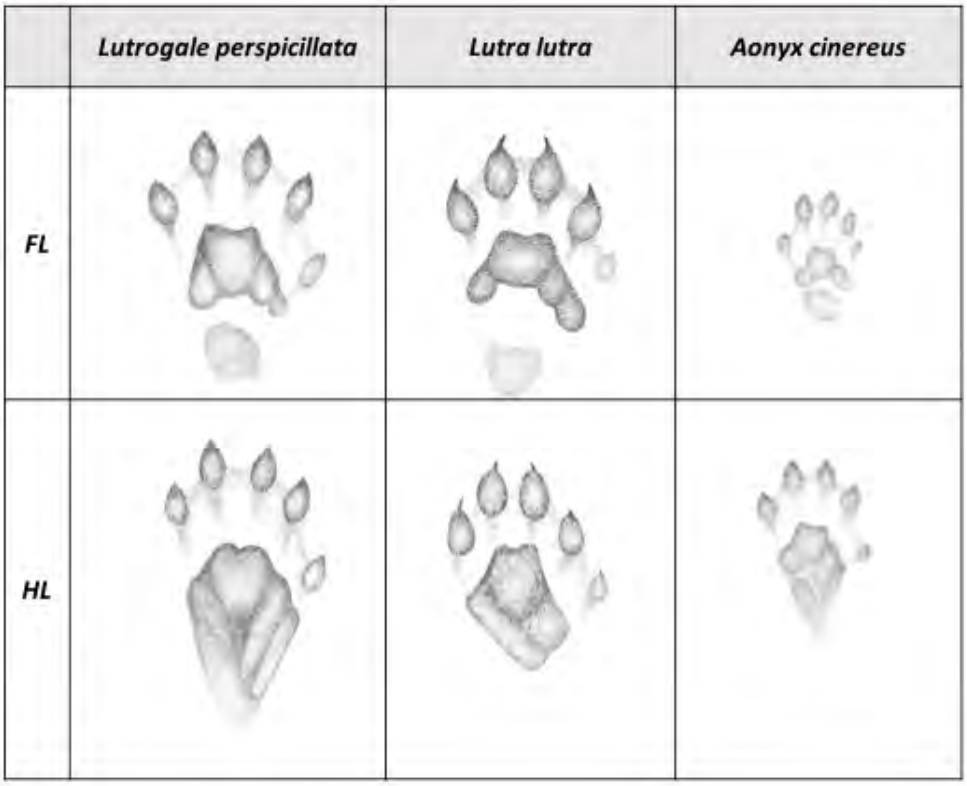

Figure 1. Technical drawings of tracks of three otter species. FL = Front Left; HL = Hind Left; Illustrations and copyright by Asaf Ben-David.

Description of the tracks by species are as follows:

- Smooth-coated otter (*Lutrogale perspicillata*): - The general impression is of a large, elongated otter track. The claws are short and blunt in comparison to the Eurasian otter. The toes are oval, and the bones between the toes and metacarpal or metatarsal pads are long and register clearly. Toe 1 (thumb) is almost straight below toe 2. The negative space between the toes and the metacarpal or metatarsal pad is 1.5 - 2 times the toe pad size. The metacarpal pad is wide and has a clear saddle in the centre top of the pad. The metatarsal pad is almost twice the size of the metacarpal pad.
- Eurasian otter (*Lutra lutra*) - The front track is less asymmetrical than the hind track and not as elongated as for smooth-coated and Asian small-clawed otters. The claw marks are small, sharp, and clear. The toe marks are large with a clear teardrop shape. The front foot's carpal pad is rounded and out of the three species it shows the most negative space to the metacarpal pad.
- Asian small-clawed otter (*Aonyx cinereus*) – This is the smallest track of the three species. The claws are very short and therefore mostly absent from the track. The toes are oval. The front foot is elongated and the carpal pad has a distinct angle towards toe 5.

Generally, the difference between these three otter species is more apparent in the front tracks than in the hind.

It was important to learn as much as possible about the footprint anatomy of these three otter species to decide on the landmark point placement for feature extraction. It was further important to compare these perfect anatomical diagrams with real footprint images to decide which footprint images were of sufficient quality for the study.

Otters leave typical mustelid tracks, which show five toes, a segmented metacarpal (palm on the front foot) and metatarsal (palm on the hind foot) pad. The front feet also have a separate carpal (heel) pad while the hind feet are clearly elongated, but do not show the same separation of metatarsal and tarsal (heel) pads. The otter species in this study all have claws, although as its name suggests the claws on the Asian small-clawed otter are small and often do not show in a print. They all have webbing between the toes and a wide gap (negative space) between toes and meta pads. The heel pad as well as webbing and toe 1 (thumb) often do not register well in the track and are difficult to see for the untrained eye, which is one of the reasons why otter tracks can be mistaken for canine tracks **(Rhyder, 2021; Grolms, 2021)**. Figure 2 shows the numbering of toes in otter tracks as well as clearly labelled metacarpal, carpal and metatarsal pads.

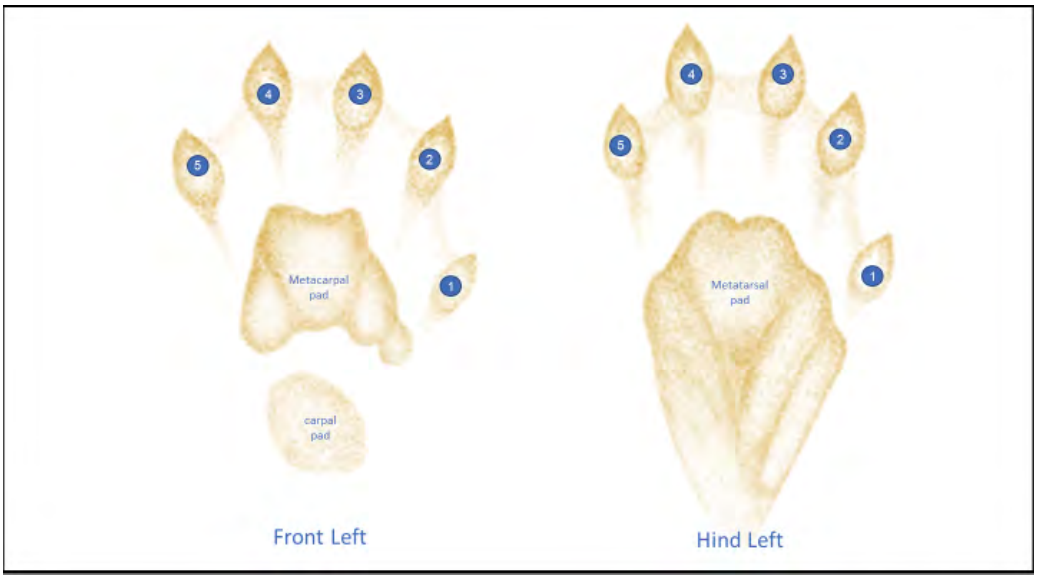

Figure 2: Illustration of otter left front and hind footprints with the appropriate labels for toes 1 to 5, metacarpal, carpal and metatarsal pads.

This shows how complex tracks and tracking are and to evaluate photographs of footprints can even be more challenging. In the field, well-trained trackers have a lot more information available than can be found in a photograph and they are able to take gait and behavioural signs, such as movement through habitat and sprainting

behaviour, into consideration for species classification. For most wildlife conservationists who lack such training this is not an option, but we show here that images of footprints can be analysed and are a very valuable data source, which provide a non-invasive tool for otter surveys and monitoring.

Data collection

Footprint images were collected following WildTrack's standardised footprint collection protocol for FIT (see Appendix) at eight zoos (six U.K., two Germany) by either the zoo staff or the researchers themselves. Several zoos have groups of otters in their enclosures, where keepers find it difficult to identify individuals. However, for the present study we focussed on classification at species level only, so individual identification of otters was not necessary.

To improve footprint quality, where possible, sand patches were created in the enclosures. However, prints found in muddy substrate were also included in the study. Each footprint was then photographed with a metric ruler for scale. Figure 3 shows footprint image examples of the three otter species, which show a variety of substrates and footprint qualities included in this study.

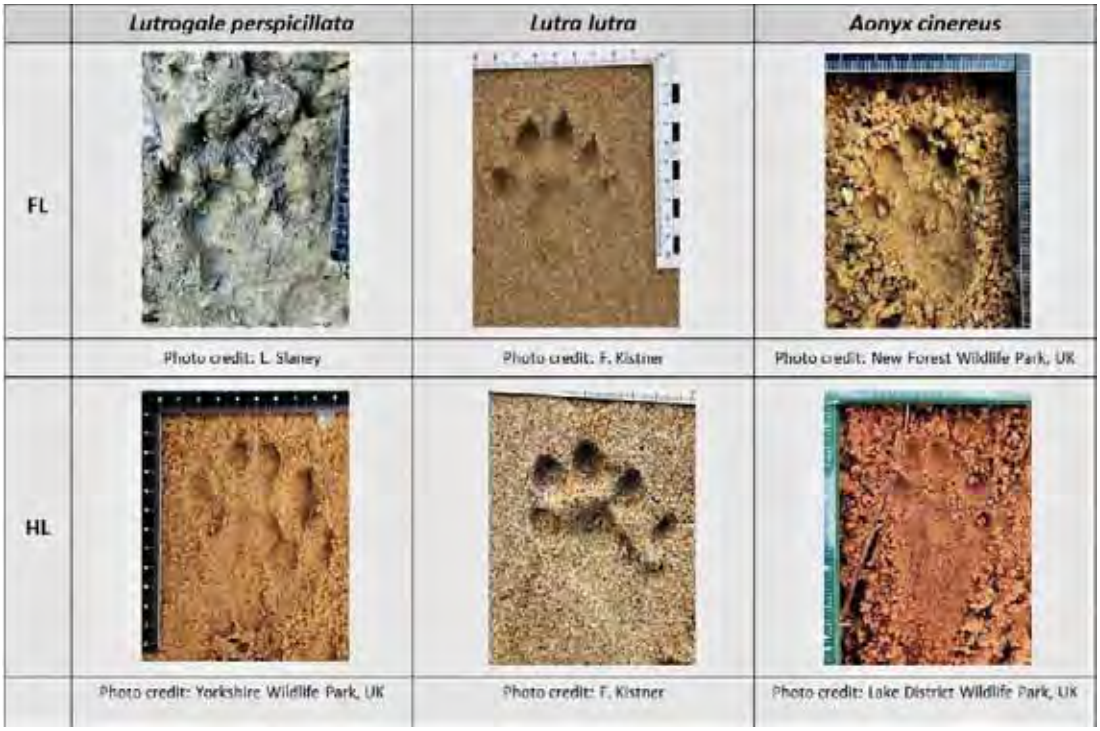

Figure 3. Examples of otter footprints of different quality and in a variety of substrates, which were used for the study. Note: FL = Front Left; HL = Hind Left;

The analysis is based on 100 footprint images for each species. Because of the large group size at some of the otter enclosures, we were only able to estimate a range of the number of individual otters which contributed data to the study (Table 1).

Table 1: Range of individuals per species contributing data

Species	Range of individuals in study
Eurasian otter (*Lutra lutra*)	**10-18**
Asian small-clawed otter (*Aonyx cinereus*)	**8-13**
smooth-coated otter (*Lutrogale perspicillata*)	**6-16**

Image processing

All subsequent image processing and statistical analyses were carried out in JMP 16.2 Pro version. The add-in, XGBoost, created for JMP software **(Wolfinger, 2020)** was additionally installed.

Following a standardised protocol, 300 footprints (100 per species) were analysed. This process comprises alignment and orientation of the image, calibration of scale and the manual placement of 11 specific anatomic landmark points (Figure 4). We used hind and front feet and aimed to define points that are consistently found in front and hind feet among all three species. The setting of the landmark points followed the standardised protocol for left feet. Therefore, images of the right feet were flipped horizontally prior to processing to increase the amount of processable footprints. Measurements here are taken at the centre of the toes and the heel pad, as this has proven to be more robust to variation in substrate.

A scripted routine adds a further six derived landmark points and subsequently automatically extracts a morphometric profile. This profile comprises 208 measurements per footprint, consisting of distances, angles, and areas, which is illustrated in Figure 4.

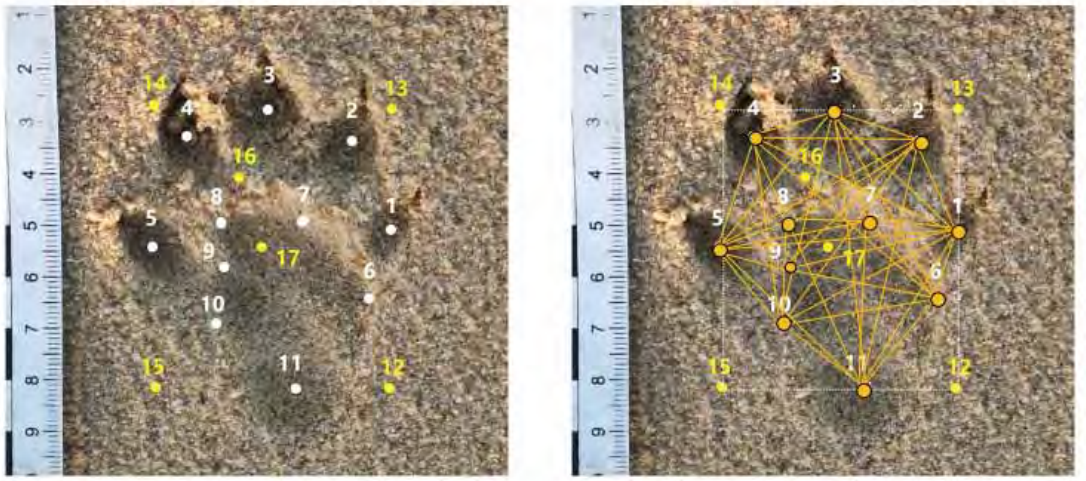

***Figure 4. Image of a left front track from a Eurasian otter* Lutra lutra.**

Left image: Footprints are first aligned at two rotation points at the base of the second and 4th toe and two points on a metric ruler are used for scaling of the image. Afterwards, 11 landmarks (white) are manually placed by a human operator and an additional six points are automatically derived (yellow).

Right image: Geometric profile of a footprint. A total of 208 measurements comprising distances, angles and areas form the morphometric profile of each footprint.

Statistical analysis

Species classification

In a first step, the dataset of the biometric measurements was randomly split into a training set (75% of data) for the model development and a test set (25%) to evaluate the classification capability of the model. The test set was excluded from the model development.

Stepwise forward LDA and XGBoost Classifier were chosen as classification models (classifier) and trained on the training set.

To avoid overfitting of the model, an additional internal k-fold (n=5) cross-validation step was applied during training. Hyperparameters were automatically tuned within the JMP Model screening platform.

The classifiers assign probabilities between 0 and 1 to a class (here 'otter species'). The class with the highest probability is assigned the predicted species.

In a second step, the models with the highest overall classification accuracy (correct number of predictions divided by total number of footprints) in the training process were selected and applied to the test set, which can be seen as new data.

Significance of footprint features ('Feature Importance')

An advantage of using tree-based methods, such as XGBoost, is that the importance of features for the prediction of the model can be evaluated. Often this is done by the calculation of gain scores, with "gain" being defined as the improvement in accuracy brought by a feature to the branches it is on **(Abu-Rmileh, 2019)**. For LDA, Feature Importance can be identified by calculating F-Ratios of the variables **(Gu et al., 2014)**.

We analysed the most important features chosen by the best overall model and investigated how much of the variance of the whole data could be explained when focusing only on the most influential measurements. In order to achieve this, we built a decision tree model with only two splits as a general field assessment recommendation.

RESULTS

Species classification

For the whole dataset, 291 of the 300 images (training and test set) were correctly assigned to its respective species by our final XGBoost model, leading to an overall classification accuracy of 97%. The Linear Discriminant Analysis (LDA) classified 271 prints correctly and therefore had an overall accuracy on the same data of 90%.

XGBoost predicted the Asian small-clawed otter correctly at a rate of 99%, the Eurasian otter at 97% and the smooth-coated otter at 95%. This and the predictions of the LDA are shown in Table 2, which is the confusion matrix of the entire dataset.

The confusion matrix compares the model prediction with the true class (species) of each data point (footprint). A perfect model would only have non-zero values on the main diagonal of the matrix.

Table 2. Confusion matrix of the whole dataset. Each species had one hundred footprints. The confusion matrix compares the true species of a footprint with the prediction of the XGBoost and the LDA classifier

	Prediction XGBoost			**Prediction LDA**		
Species	***Aonyx cinereus***	***Lutra lutra***	***Lutrogale perspicillata***	***Aonyx cinereus***	***Lutra lutra***	***Lutrogale perspicillata***
Aonyx cinereus	**99**	**0**	**1**	**96**	**3**	**1**
Lutra lutra	**1**	**97**	**2**	**1**	**92**	**7**
Lutrogale perspicillata	**1**	**4**	**95**	**3**	**14**	**83**

When looking solely at new data of the test set, the overall accuracy for XGBoost was 91% and 85% for the LDA model. ASCs were predicted with 96% accuracy, Eurasian otters with 92% and smooth-coated with 84% by XGboost and 92% of Asian small-clawed otters, 84% of Eurasian and 80% for the smooth-coated applying the best LDA model (Table 3).

Table 3. Confusion matrix of the test set. The test set comprised of 25 footprints per species. XGBoost had an overall accuracy of 91% correct predictions, LDA of 85%.

	Prediction XGBoost			**Prediction LDA**		
Species	***Aonyx cinereus***	***Lutra lutra***	***Lutrogale perspicillata***	***Aonyx cinereus***	***Lutra lutra***	***Lutrogale perspicillata***
Aonyx cinereus	**24**	**0**	**1**	**23**	**2**	**0**
Lutra lutra	**1**	**23**	**1**	**1**	**21**	**3**
Lutrogale perspicillata	**1**	**3**	**21**	**1**	**4**	**20**

Feature importance of the XGBoost and field recommendations

As XGBoost outperformed the LDA approach, we therefore only report the most important features of the better model. For our data, the final XGBoost classifier used 103 variables, with a gain score higher than 0. To take that number of measurements in the field is beyond practicality. Therefore, here we only want to focus on the six most important features, which are illustrated in Figure 5. It is noticeable that these six most essential measurements cover five distances and one triangle, distributed among the whole footprint.

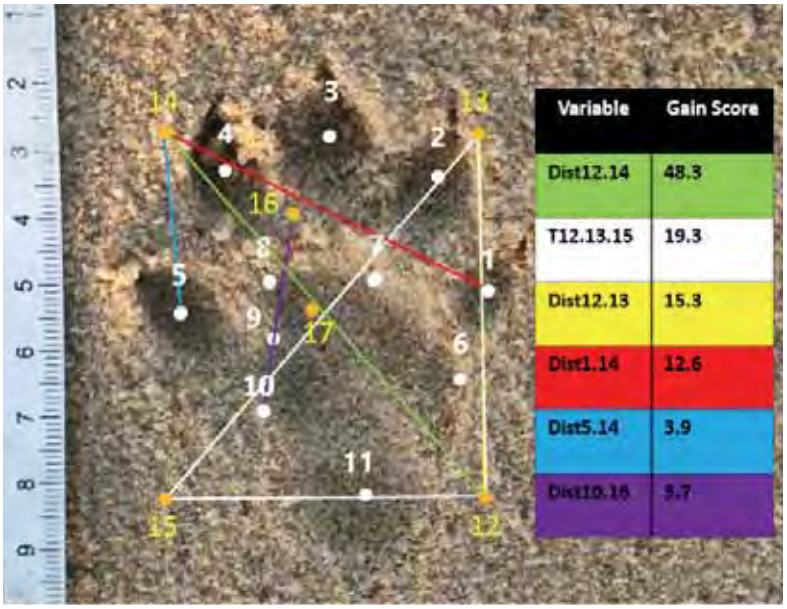

Figure 5. Colour-coded illustration of the six most notable features of the final XGBoost model. The implemented table reports the gain score of the respective variable. The most important feature is distance 12.14, highlighted in green.

Decision tree and potential field identification key

The most influential feature of the model is the distance between point 12 and 14 with a gain score of 48.3. This measurement is equal to the square root of the sum of the squared length and the squared width of the footprint and can be measured in the field.

A further simplified model, a two split regression tree using only this measurement, misclassified 37 of the total 300 footprints, leading to an overall classification accuracy of 88% (Table 4).

Table 4. Confusion matrix of the true species vs. the prediction of a simplified decision tree model with only the variable dist.12.14 and two splits.

	Prediction decision tree model		
Species	***Aonyx cinereus***	***Lutra lutra***	***Lutrogale perspicillata***
Aonyx cinereus	**98**	**2**	**0**
Lutra lutra	**3**	**89**	**8**
Lutrogale perspicillata	**4**	**20**	**76**

Within our dataset, 93% of measurements smaller than 6cm belonged to Asian small-clawed otters. Measurements greater than 8.3 cm belonged to smooth-coated otters in about 90% of the cases. Measurements between 6–8.3cm had the highest probability (~80%) of belonging to Eurasian otters, however, the two other species also had measurements of footprints within this interval (18% smooth-coated otters, 2% Asian small-clawed otters). The full classification tree model with additional information is displayed in Figure 6.

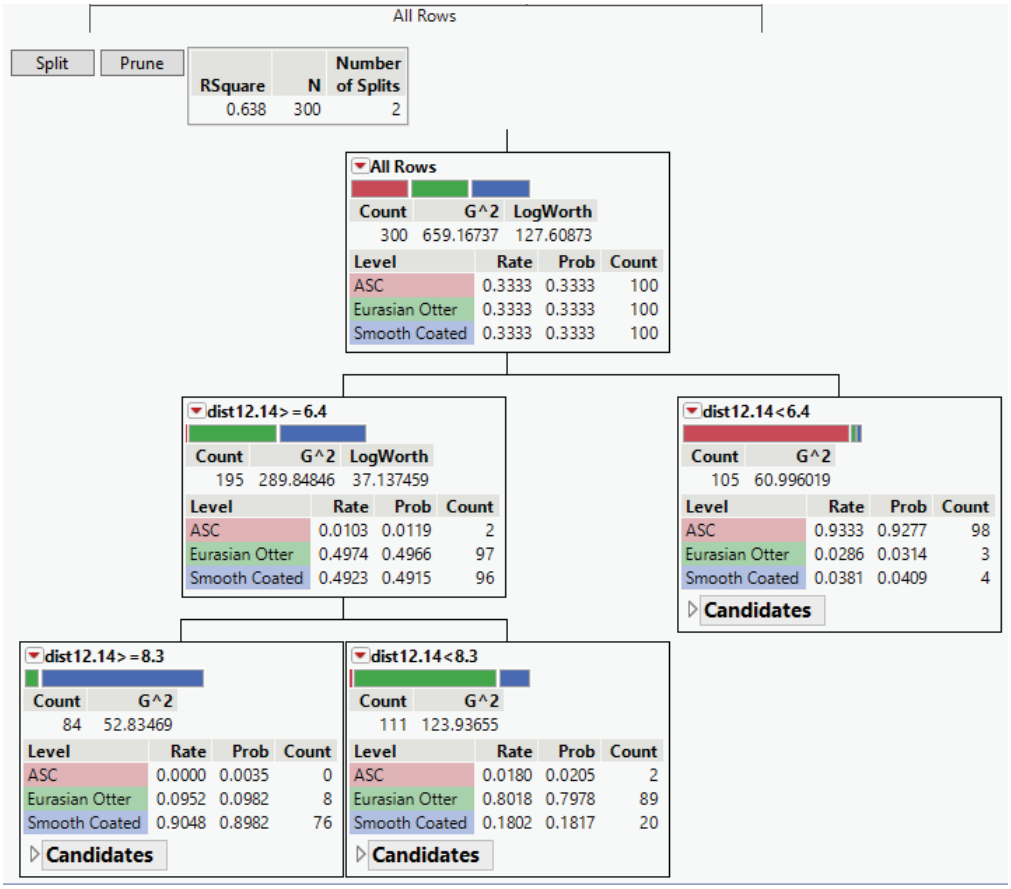

Figure 6. Output of decision tree model on the whole dataset. Target variable was species, explaining variable dist12.14. Only two splits were allowed. The model had an R^2 of 0.638. 88% of the data were classified correctly.

DISCUSSION

This research shows that FIT-models can predict otter species with an excellent accuracy when Machine Learning models trained on a high number of automatically derived morphometrics from otter footprints are applied.

We also show that XGBoost outperformed Linear Discriminant Analysis and therefore recommend the use of XGBoost if a minimal misclassification rate is desired. By investigating the most important features of the best XGBoost model, it was possible to identify a single measurement that can be taken in the field and still enables a good classification accuracy on sight.

These encouraging results confirm that footprints can be a reliable source of species classification for otters. This could be a valuable, cost-effective, non-invasive, and accurate tool for field biologists, conservation policy makers and stakeholders to learn more about otter species distribution on the Asian continent. FIT could

therefore be a useful tool for otter surveys by providing data on species distribution and population size in addition to data from camera trapping and spraint analysis.

The lack of accurate data on otter species distribution and the need for otter surveys throughout southeast Asia became evident at the recent Malaysia Otter Workshop 2022, which was held jointly by the Malaysia Otter Network (MON), the Malaysia Nature Society (MNS) and the International Otter Survival Fund (IOSF) in Kuala Selangor Nature Park, Malaysia. The general consensus was that due to habitat loss, pollution and the illegal pet and fur trade, which are both on the rise in southeast Asia, otter numbers are declining **(IOSF Workshop Report, 2022)**. Without accurate data, it is not known how serious the situation for each otter species is, which makes official and accurate surveys all the more important.

To survey more effectively, we need to engage a wider body of data collectors. The engagement of local communities, particularly those still holding Traditional Ecological Knowledge (TEK) could be transformational. Not only would this engage those communities as key stakeholders in the conservation process, but it would greatly augment the quality and volume of data available **(Jewell et al., 2020)**. FIT was inspired by traditional tracking techniques and the data collection protocol is widely accessible. After a short training period, data collection for FIT is straight-forward and only requires a (mobile phone) camera and a metric ruler as equipment.

Even though the results are already encouraging, they could be further improved with several adjustments:

- Increase the size and complexity of the dataset: The results are currently based on a small data set. The aim is to increase this to improve accuracy and test the robustness of the tool.
- In addition to improving the data set size and variation, continued re-training of classification models with clearly identifiable images from local (sub-) populations may be useful. This would likely improve accuracy and enable FIT models to address specific variations in those populations, which will most likely lead to better predictions.
- We would further like to develop models that can also predict sex and individual ID. This has been developed successfully for several other species, such as giant panda (*Ailuropoda melanoleuca*) **(Li et al., 2018),** mountain lion (*Puma concolor*) **(Alibhai et al., 2017)** and Amur tiger (*Panthera tigris altaica*) **(Gu et al., 2014)**. To do so, we require many footprints clearly identifiable to the target class. This is ideally done by collecting footprint images of single, known individuals.
- To have a model that can classify all four Asian otter species, we would like to add footprint images of known hairy-nosed otters (*Lutra sumatrana*) to the database. This has proven challenging so far, as we are aware of only one

captive individual. However, for species classification, we could use good quality field data to develop the necessary algorithm as long as we can be sure that the footprints undoubtedly belong to the species. Long trails from the field, undoubtedly belonging to the same animal, could also be used to train the model for individual ID.

Zoos and field conservationists are therefore invited to contribute footprint images of known Asian otter species and, if possible, known individuals for sex and individual ID. Machine Learning models perform better with more data and otter conservationists are encouraged to further upload any images of known otter species/ individuals following the link and barcode below.

All footprint images will, (given permission) also contribute to WildTrack's AI project (https://www.wildtrack.ml). This project aims to build computer vision models that enable classifications of footprints without the manual setting of landmarks. Once successfully developed, it will enable us to scale up this method significantly. Ultimately, we encourage field researchers to reach out and try this method and cross-validate it with other non-invasive monitoring approaches.

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Disclosure Statement

No potential conflict of interest was reported by the authors.

Author Biographies

FREDERICK KISTNER has a degree in Environmental Science and a strong interest in applied conservation biology and the usage of Machine Learning for ecological problems. He has been tracking and studying the tracks and signs of coastal otters in Portugal for many years, is a member of the IUCN Otter Specialist Group and a founding member of the WildTrack Specialist Group. He is currently doing his PhD at the Karlsruhe Institute of Technology where he is working on the development of new monitoring tools for elusive species.

LARISSA SLANEY is a founding member of the WildTrack Specialist Group, who specialise in the use of non-invasive methods for wildlife monitoring. She has a BSc (Honours) in Life Sciences, a 1st State Exam in German Law and is currently doing her PhD in cheetah footprint analysis at Heriot-Watt University in Scotland, U.K. She also develops science workshops and has worked internationally as a science communicator. Her interests are in non-invasive wildlife monitoring, education and traditional tracking.

ZOE JEWELL is the co-founder and Executive Director of WildTrack. She has a BSc in Zoology/Physiology, an MSc in Medical Parasitology from the London School of Tropical Medicine and Hygiene (London University) and a degree in Veterinary Medicine from the University of Cambridge, U.K. Jewell is responsible for WildTrack's field operations, research and development. She publishes on wild animal monitoring using non-invasive approaches and has a particular interest in animal monitoring ethics. She is an adjunct associate professor at the Nicholas School of the Environment at Duke University, NC, and an associate academic at the Centre for Compassionate Conservation at the University of Technology in Sydney.

ASAF BEN-DAVID is a qualified Level 3 tracker with the Cybertracker system. He teaches a Wildlife Tracking Course at Tel-Chai College in Israel, and is the author of the "Israeli Tracks Field Guide". He specialises in technical drawings of track images. He is also currently a PhD student at Tel Aviv University at the School of Zoology, specialising in citizen science with tracking data.

SKY ALIBHAI is the co-founder and Director of WildTrack. He has a BSc in Zoology from Makerere University, Uganda, and a DPhil in small mammal population dynamics from the University of Oxford, U.K. He is a fellow of the Zoological Society of London. Alibhai leads WildTrack's analytical platform and publishes on wild animal monitoring using non-invasive approaches. He is currently an adjunct associate professor at the Nicholas School of the Environment at Duke University, NC, and an associate academic at the Centre for Compassionate Conservation at the University of Technology in Sydney.

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Appendix

FIT Zoo Protocol for Otter

You need:

- sand, rake, trowel or similar
- metric(!) ruler (an L-shaped ruler/tri-square is ideal)
- label
- smartphone camera/digital camera
- watering can if necessary

Sand patches should be strategically placed at frequently used areas, e.g. the entrance of nest boxes, near feeding places, at water entry points or at the otters' patrol routes along fence lines.

1. **Prepare** the ~1cm deep sand patch by raking and levelling with trowel, add some water with watering can first if sand too dry. The sand should be level but not too compressed in the end.	
2. Let **one individual walk across** the sand patch so that you know for sure which otter left the footprints.	
3. - Take **overhead image of the trail*** (several tracks) - Locate complete **left front (LF) footprints** (see image on right) for FIT and circle them. - Any other good quality footprints of the **other feet** (RF, LH, RH) can be used for WildTrack's AI project.	
4. Place a **metric(!) L-shaped ruler** approximately **2cm above the footprint**, framing the track as shown in the image on the right (and making sure not to touch the edges of the footprint).	
5. Add a **label** stating the date and place of where the footprint was taken. Also note the number or name of the animal and the name of the photographer. When following a trail*, number it and mark the tracks* with letters 'A', 'B', 'C' etc. Also give foot ID as LF (left front) (or RF, LH, RH if you are also collecting for AI project)	**DATE:** 04 April 2019 **ANIMAL ID:** AIU05/name **LOCATION:** name of zoo_____ **FOOTPRINT #:** 1 A, B, C_____ **FOOT ID:** LH (left hind)_____ **PHOTOGRAPHER:** LS_____
6. Take a **close-up photo** of the footprint, incl. the label and enough of the ruler to clearly see a measurement of at least 5cm. It is important that the camera is absolutely parallel to the footprint (ensure right angle of ruler compliments right angle of camera screen). Photos of completely shaded footprints normally give the clearest image. Use an umbrella or similar to create shade if necessary.	

***track** = a footprint; **trail** = unbroken line of tracks belonging to one individual

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INSTRUCTIONS FOR CONTRIBUTORS

Before submitting an article for peer review for OTTER please read carefully and follow these Instructions for Contributors. The journal has a particular interest in material with the potential to improve otter conservation.

By submitting a paper, the author(s) confirm that it has not been published or submitted for publication elsewhere.

Papers should be 2,000 to 7,000 words. Note that word counts are all inclusive except for Tables and Figure and Plate captions. Suitable topics include research, education case studies, literature reviews, reports on illegal trade, etc.

Short reports and communications may also be submitted.

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Papers should include the following:

- ***Title:*** A short description of the work (≤ 20 words).
- ***Abstract:*** The aims, methods, major findings and conclusions; should be informative without reference to the text and should not contain any references or undefined abbreviations. (≤ 250 words)
- ***Keywords:*** Up to eight relevant words or phrases, in alphabetical order.
- ***Structure:*** Papers should then go on to include the following as appropriate: Introduction, Study Area, Methods, Results and Discussion. Please minimize use of other subheadings.
- ***Text:*** Times New Roman, justified, line spacing 1.5, paragraphs not indented but 0pt before 6pt after.
- ***Author's biographies:*** Brief outline of relevant work.
- ***References:*** Should be laid out as shown below:

Kruuk, H., Moorhouse, A., Conroy, J.W.H. and Durbin, L. (1989). An estimate of numbers and habitat preferences of otters *(Lutra lutra)* in Shetland. *Biological Conservation, 49, 241–254.*
Mason, C.F. & Macdonald, S.M. (1986). Otters: ecology and conservation. *Cambridge University Press, London..*

Review: All manuscripts are subject to peer review

Copyright: Once a paper has been accepted, the copyright will be transferred to the International Otter Survival Fund.

The deadline for submission is 1 February each year

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COVER PHOTO CREDITS:

Top – Eurasian otter (*Lutra lutra*). Photo: Martin Benson

Centre left: Footprint of *Lutra lutra*. Photo: Frederick Kistner;

Centre right: Footprint of *Lutrogale perspicillata*. Photo: Nobuyuki Yamaguchi

Bottom – Smooth-coated otter (*Lutrogale perspicillata*). Photo: Malaysia Nature Society/Woo Chee Young

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