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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 authors are asked to refer to the Guidelines for Contributors before submitting a paper. These Guidelines may be found at the back of each Journal or can be sent as a pdf upon request. Papers should be submitted through enquiries@otter.org.

Publication
The Journal will be available to download free on the Media and Resources page of the IOSF website (www.otter.org). A limited number of copies will be printed and these will be available for sale on the Ottershop (www.ottershop.co.uk).

Back Issues
These are all available to download free on the Media and Resources page of the IOSF website (www.otter.org). This includes the following special issues:

Issue 1: *Proceedings of the First Otter Toxicology Conference*, Published 2002 – OUT OF PRINT

Issue 2: *Proceedings of the European Otter Conference "Return of the Otter in Europe – Where and How?"*, held on the Isle of Skye in 2003, Published 2007 - available on a CD at the Ottershop (www.ottershop.co.uk).

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ASIAN OTTER CONSERVATION NETWORK REPORT 2020

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

IOSF has again been busy across Asia and the Facebook page is active. On this page there are photos and videos taken in Asia, although exact location details are confidential to prevent risks to the otters. However, people are encouraged to send otter records or incidents of possible illegal trade to IOSF at enquiries@otter.org. Obtaining such information is very important.

There are various educational resources available for workers in Asia on the IOSF website, including the IOSF video in Chinese, Japanese, Nepalese, Khmer, Sinhalese, Arabic and Lao.

Many Asian countries took part in World Otter Day in 2019 including Nepal, Sri Lanka, Iraq, UAE, Pakistan, India, Laos, Cambodia, Malaysia, Singapore, Hong Kong, Taiwan, and Japan. Information about some activities is given below. In 2020 many countries will again be involved but this year things will be very different, with restrictions due to the virus pandemic.

Interest in the IOSF education programme is increasing in Asia, and in addition to the Team Otter club in Bangladesh there are plans for clubs in Sri Lanka, Laos, Nepal, and Indonesia.

An important step forward in Asian otter conservation was the upgrading of Asian small-clawed (*Aonyx cinereus*) and smooth-coated otters (*Lutrogale perspicillata*) to Appendix I of CITES (the Convention on International Trade in Endangered Species of Wild Fauna and Flora). Until recently the only Asian otter species listed as Appendix I was the Eurasian otter (*Lutra lutra*). IOSF worked with various other organisations and together we continue to push for the upgrading of the hairy-nosed otter (*Lutra sumatrana*) which is still Appendix II. The upgrade of the two species restricts trade but of course is only as good as the law enforcement, and it does not affect illegal trade.

The pet trade in otters continues to be a problem and in recent months 15 otters were rescued by Save Vietnam's Wildlife and a further 17 by Wildlife Friends Foundation Thailand. Nearly all of these were Asian small-clawed although a Eurasian otter was rescued in Indonesia – see below. More have been rescued by Phnom Tamao Wildlife Rescue Centre in Cambodia, who currently have 24 otters including one hairy-nosed, one Asian small-clawed and 22 smooth-coated otters.

SUMECO (Sumatra Ecoproject) is an organisation which is tackling the illegal trade in Sumatra. They are very much hands-on and work with many species, rescuing them from traffickers. At the start of 2020 they rescued two otters – one Asian small-clawed and one Eurasian – the first report of the latter species on Sumatra in about 80 years.

SCORPION (also known as Scorpion Wildlife Trade Monitoring Group) are also working on the pet trade issue in Indonesia and in February 2019 IOSF was able to support them to carry out an investigation into an otter captive breeding facility in Malang, East Java Province. The company concerned is registered as a "domestic investment company" but has a Japanese director, so animals may well be going there. During the visit, 17 otters were found with information on their enclosures but there were several other cages with otters and civets with no information on the animals.

Clearly at the time of writing Covid 19 is an extreme worry all over the world and no-one knows the full implications or outcomes of this outbreak. Of course, everyone is very worried about the health effects on people. However, there appears to be one positive outcome and that is the ban on the sale of wildlife in markets in China and a similar ban could be introduced across Southeast Asia. At present the Chinese ban is just temporary but it is hoped that this will become permanent. This will have a considerable effect on trade in otters and other wildlife and will help conserve populations. Of course, there will be some who will trade illegally but this at least gives law enforcers more power to stamp down on such trade

Below is a summary of activities compiled by the four regional co-ordinators of AOCN.

SOUTHEAST ASIA: ADREAN, INDONESIA

Various countries in this region took part in IOSF World Otter Day:

Cambodia

Kouprey Express and Wildlife Alliance delivered an otter education and environmental programme to over 1000 school children from Oudong High School. On 3 June they brought 260 students and teachers from the same school to visit Phnom Tamao Rescue Centre, where they could see a number of otters rescued mostly from the pet trade. Kouprey Express will continue to work closely with IOSF.

Laos

The event in Laos was funded by a fourth World Otter Day grant, thanks to an anonymous donation. Kiengkai Khoonsrivong, who helped to organise the IOSF 2018 Lao otter conservation workshop, held meetings with representatives from the Wildlife Conservation Society and Provincial Agriculture and Forestry Office of the Province. The aim was to raise awareness and reduce illegal trade of otters in Bolikhamxay Province. A strategy for long-term conservation of otters within the country was also discussed.

Malaysia

Leona Wai, Otter Conservation Officer at Danau Girang Field Centre, was awarded an IOSF World Otter Day grant for a workshop at Batu Puteh, Kinabatangan, Sabah. This was focused on the village fishermen in order to enhance knowledge and awareness of otters, to look at solutions for human–otter conflict, and also to inspire them to participate in community-based conservation. More such otter conservation workshops will be organised in other riverine villages.

Recently a hairy-nosed otter was also recorded but this is still to be published.

Vietnam

Save Vietnam's Wildlife runs a rescue centre where confiscated animals, including otters, are cared for and their new rescue facility was opened on World Otter Day. They also created a short video to raise awareness of the biggest current threat to otters, namely the pet trade, and called for people not to support this trade by having an otter pet.

SOUTH ASIA: JYOTI BHANDARI, NEPAL

Bangladesh

Bisharga Das (Delip) has started a Team Otter Club in Pogose School, Bangladesh, with funds donated by IOSF. An event was initially organised for students to learn about otters and their status in Bangladesh and this concluded with a quiz. Based on their performance members were selected for the club. They have had a discussion about future plans and the first event is a visit to the zoo to see live otters.

Delip has continued to observe otters in the central coast of Bangladesh where he studies migratory birds. In the future he wants to concentrate on people's perceptions of otters and the human–otter conflict.

Zahid Amin Shashoto carried out a study to confirm the presence of smooth-coated otters in the Ganges-Padma River basin area of Rajshahi, in the central Northwestern region. A paper on this is included in this issue of the *Otter* journal.

India

Eurasian otters have recently been confirmed and a paper on this discovery in Chilika is included in this issue of the *Otter* journal.

For World Otter Day, Suthar Akshit ran an awareness programme on smooth-coated otters working with local fisherman, communities, families, and farmers who rely on the river. This was held at Kotna village near the banks of the Mahi River, in Gujarat. By involving local village leaders and decision-makers it will encourage long-term otter conservation and active involvement of local youth for sustainable conservation programmes.

Recent (Published) Otter Research in India

The following articles have been published. These are essentially either to do with sightseeing or video or camera trap recording of smooth-coated otters in areas where the species was not known to occur previously (e.g. Madya Pradesh, Arunachal Pradesh, Maharashtra, Puducherry, South India).

Rather, TA, Tajdar, S, Kumar, S and Khan, JA (2019). First photographic record of smooth-coated otter (*Lutrogale perspicillata*) in Bandhavgarh Tiger Reserve, Madhya Pradesh, India. *IUCN Otter Spec. Group Bull.* 36 (2): 93 – 97 https://www.iucnosgbull.org/Volume36/Rather_et_al_2019.pdf

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

Gupta, N, Tiwari, V, Everard, M, Savage, M, Hussain, SA, Chadwick, MA, Belwal, and VK (2020). Assessing the distribution pattern of otters in four rivers of the Indian Himalayan biodiversity hotspot. *Aquatic Conservation: Marine and Freshwater Ecosystems*, 30(3), 601-610.
https://uwe-repository.worktribe.com/output/4750929/assessing-the-distribution-pattern-of-otters-in-four-rivers-of-the-indian-himalayan-biodiversity-hotspot

Laxminarayan, S, Sonawane, P, Gujar, A, and Tadvi, R (2019). First record of smooth-coated otter *Lutrogale perspicillata* at Hatnur Dam back waters, Jalgaon district, Maharashtra, India. *Ela Journal of Forestry and Wildlife.* Vol.8 (1 & 2): 573-575. https://www.researchgate.net/profile/Rushikesh_Sankpal/publication/336701882_Sighting_of_Leucistic_House_Sparrow_Passer_domesticus_in_Kolvihire_Taluka_Purandar_District_Pune_Maharashtra/links/5dade6c2299bf111d4bf8884/Sighting-of-Leucistic-House-Sparrow-Passer-domesticus-in-Kolvihire-Taluka-Purandar-District-Pune-Maharashtra.pdf#page=40

Chackaravarthy, SD, Kamalakannan, B and Lakshminarayanan, N (2019). The necessity of monitoring and conservation of smooth-coated otters (*Lutrogale perspicillata*) in non-perennial rivers of South India. *IUCN Otter Spec. Group Bull.* 36 (2): 83 – 87
https://www.iucnosgbull.org/Volume36/Volume_36_Issue_2_Pages.pdf

Raman, K, Sivangnanaboopathidossvimal, Kishorekumar, S, Krishnakumar, BM and Selvan, KM (2019). Occurrence of smooth-coated otter *Lutrogale perspicillata* in Sankaraparani River, Puducherry, India. *IUCN Otter Spec. Group Bull.* 36 (1): 28 - 33 https://www.iucnosgbull.org/Volume36/Raman_et_al_2019.pdf

Two new papers on otters in India are published in this issue of the Otter journal. The first is "The potential role of social media in support of otter conservation in the Indian Himalayan biodiversity hotspot", by Gupta et al. The second by Adhyaa and Dey is on the "First record of Eurasian otter from Chilika Lagoon – a Ramsar site situated on the East coast of India".

Nepal

For World Otter Day Aarati Basnet conducted a workshop and art competition in Shree Kanak Muni Higher Secondary School, near Jadagispur Reservoir, Kapilvastu – an area known to have otters. The wetland faces several threats such as over-exploitation and improper harvesting of resources, encroachment, habitat destruction, and draining of the reservoir for irrigation and construction purposes. Illegal poaching has increased with a decline in wetland species, including otters. Otters are a flagship species to help long-term conservation of the entire wetland ecosystem. Students took part in an otter artwork competition with a prize for the top four drawings.

Pakistan

Pakistan Wildlife Foundation (PWF), in collaboration with Farozaan TV, celebrated World Otter Day in a local school in Islamabad with PWF's junior ambassador, Miss Minahil Safwan, giving a comprehensive presentation on the ecological role of otters.

Sri Lanka

Chaminda Jayasekara has continued his observations at Vil Uyana otter haven at Dambulla and has been able to collect very interesting data on behaviour of the Eurasian otter, especially feeding. He has also put up a sign-board at the entrance incorporating an otter photo taken there. He is now planning a Team Otter Club for local young enthusiasts and Padma de Silva is guiding this work.

EAST ASIA: LING-LING LEE, TAIWAN

The 2019 Chinese Otter Investigation and Protection Report stated that:

1. The Qinghai Sanjiangyuan National Nature Reserve and its surrounding areas may be the largest and most promising area for Eurasian otters in China.
2. The report takes the most widely distributed Eurasian otter as an example and points out that the area under investigation is less than 4% of its potential distribution area, and 80% of potential habitats are not yet within the protected area.
3. The habitat of Eurasian otters has gradually shrunk from the historically recorded Southeast coastal areas and the middle and lower reaches of the Yangtze River to relatively marginal areas such as the Qinghai-Tibet Plateau and the Northeast.

Japan

Japan has received much criticism about the increase in demand for pets especially following the rise in the number of otter cafés. On 3 November 2019 the Asian Otter Conservation Society of Japan (AOCSJ), held a symposium on pet otters at the University of Tokyo. The government is now taking some action to control commercial sales of both Asian short-clawed otters and smooth-coated otters. New regulations were brought in on 26 November 2019 to deter people from "collecting" otters and this covers renting, borrowing, giving, and receiving as well as buying and selling. Current owners will be able to register their pets and hopefully this should prevent, or at least reduce, smuggling into Japan.

South Korea

Sungwon Hong carried out a study of the public perception of otters in South Korea by looking at images from various videos on the Internet. A report is included in this issue of the Otter journal.

Taiwan

Taipei Zoo held a series of World Otter Day events to raise awareness for the species and their conservation. Due to the pandemic, many planned trips to China to collect information on otters there and their relationship with otters in Kinmen have been cancelled or placed on hold.

MIDDLE EAST: OMAR AL-SHEIKHLY

Iraq

The Jaljamos for Antiquities and Marshlands held an awareness campaign for the local fishing community in Hawr al-Hammar, a lake in the Southeast, including the threat from electric fishing to biodiversity, such as otters.

Surveys have been carried out to give a preliminary population estimate for the endemic sub-species of the smooth-coated otter (*Lutrogale perspicillata maxwelli*) in Southeastern Iraq and it has also been confirmed for the first time in Southwestern Iran. This is reported in this issue of the Otter journal.

UAE

Dubai Aquarium and Underwater Zoo partnered with the Dubai Mall and Emma Skinner Art for a week-long event for World Otter Day to raise awareness and support for otter conservation.

AFRICAN REPORT

Many local conservationists are still unaware of the existence and ecology of, and potential threats facing otters in Africa. Raising awareness and conservation education is the best way to build a staircase to fill this gap.

IOSF has supported various educational projects in Africa and since IOSF's training workshop in 2015 various small-scale education projects have sprung up.

IOSF's Team Otter education project is being introduced to Africa and there are plans for clubs in Uganda and more affiliated clubs in other countries.

THE GAMBIA

Karanta Camara visited Jimmansar village and the surrounding areas to carry out meetings with local fishermen. It was an interactive session which encouraged them to take a lead in preserving their otter populations and wetland habitats. A committee was tasked to continue the work and monitor and document the otters. Some local fishermen admitted that in the past otters were hunted for traditional Juju but this practice no longer takes place. The fishermen in this community are keen to embrace best practice otter conservation and understand the benefits of localised populations of the species. Karanta intends to return to the area for an otter survey whilst continuing to raise awareness of the species in the area.

TANZANIA

Many local conservationists are unaware of the existence and ecology of, and potential threats facing otters in Tanzania. William Mgomo was one of the attendees at IOSF's training workshop in Tanzania in 2015. Since then he has gone on to work closely with schools and fishing communities to raise awareness of the importance of otters and their conservation. He has just produced a documentary in Swahili entitled *MZIZI ALIOUMEZA FISIMAJI KUKAMATA SAMAKI WAMPONZA KWA WAVUVI ZIWA*

NYASA. This concerns the traditional notion that otters possess a root in their mouth which helps them to catch fish. Fishermen kill otters in order to get that root so that they can catch more fish, hence William's video aims to counter this belief and so reduce the killing. You can see the video at https://youtu.be/RxRz-P6SvK0.

William has been very active each year for World Otter Day and in 2019 he visited Ndela Secondary School, Mbinga, for his event, reaching out to 288 students and five teachers. He taught them all about otters and conservation in their area. At the end, the children took part in an art competition and the winners received books and pens.

Martin Bayo also celebrated World Otter Day with the Head of the Wildlife Management Department at Sokoine University of Agriculture. They organised a two-hour presentation on two important aspects: (1) introducing students and university staff to basic research techniques used to study otters, and (2) presenting the progress of his project in Mtera Dam, funded by a Rufford Conservation grant.

TUNISIA

On 16 February 2019 a team from the Association Tunisienne de la Vie Sauvage were travelling with a film director on the road to Nefza when they found a dead otter. This was the first digital proof of their existence in Tunisia. A documentary called *Operation otter* was subsequently produced about this. The Association has been searching for signs of otters for years and Zakher Bouragaoui has produced a paper that is published in this issue of *Otter*, the Journal of the International Otter Survival Fund.

RESCUE AND REHABILITATION

Various cubs have been taken in for care including in the **Democratic Republic of Congo, Cameroon, and South Africa.**

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. A recent study **(Alcock et al., 2020)** found that people who have access to nature act in a more sustainable and environmental way compared to those who do not. A lack of knowledge leads to a lack of interest.

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.

Below is an overview of some of the programmes that we have started already.

BANGLADESH

In Bangladesh, IOSF workshop attendee, Delip K. Das, has started a club consisting of 15 enthusiastic children. Delip spent a full day at Pogose School in Dhaka, the nation's capital, talking to hundreds of children before launching the club involving the children who have a clear passion to help.

GUYANA

In 2019, IOSF held its seventh international workshop and the first in South America. IOSF and our partners, Save The Giants, travelled to Yupukari village in the North Rupununi to work with the community on otter conservation, education, and outreach, and help develop the Yupukari Wildlife Club. During this time there was a big wildlife club day when over 75 children attended; the Yupukari Wildlife Club now meet twice a week to focus on raising their awareness of otters and the environment.

MONTENEGRO

Montenegro is now home to a number of 'ZaPazi Vidru' (Team Otter) clubs. Ninoslav Djurovic visited schools across the Balkan country and encouraged them to join the movement and use otters as a mascot to increase their environmental awareness. The clubs (based in Berane, Međurečja, Mojkovka, Plužina, Rožaja, and Virpazara) focus on meeting around big events such as IOSF World Otter Day and they held an event during the 2019 event.

UNITED KINGDOM

In Broadford, on the Isle of Skye, the Team Otter club meets once a week to discuss all things to do with wildlife. The group, led by IOSF's education officer, held their first meeting to decide what we are going to do. The children are passionate about their wildlife, learning more and understanding simple steps on what they can do to help. They are also doing a weekly Team Otter News post online.

The Ullapool Sea Savers (USS) has become affiliated with IOSF and the Team Otter programme. USS were instrumental in stopping the mechanical kelp dredging proposal that would have destroyed habitats of otters, among other species, across the entire west coast of Scotland. The kelp forests are vital to the entire ecosystem in the area and the proposal would have caused a catastrophic decrease in biodiversity in the area.

On Saturday 22 February, IOSF was delighted to welcome Scotland's new Otter Species Champion, MSP Kate Forbes, as she announced her new role. Otters had previously been unrepresented under the Scottish Government's Species Champion system and so Poppy Lewis-Ing, the USS otter ambassador, approached Ms Forbes to take this on. Following the meeting three members of USS and four members of IOSF's Team Otter Broadford did a clean up in a nearby lay-by to draw attention to the litter problem. In what was a relatively clean lay-by we managed to collect just under 12 kg of waste!

COMING SOON

As IOSF's Team Otter programme continues to grow we now have plans to create Team Otter clubs in other areas of the UK, and other countries. We have interest from Nepal, Sri Lanka, Mexico, Laos, Uganda and Indonesia, among others.

What it means to be involved in the Team Otter programme

Team Otter allows children to feel a sense of ownership towards otters and a sense of duty to help protect them in the long term. You will be part of the change; part of the change that will help the long-term survival of otters, other species, and the natural world.

When IOSF visited Yupukari, Ben Yoxon, the Education Officer, took letters to the children there from the local village school in Broadford where IOSF is based. He then brought back letters and posters from the Yupukari children which have been given to the Skye children and this link is to continue. This type of exchange is very useful in creating a connectedness across the world.

It also allows children to:

- Learn more about otters, wildlife and their environment, sparking a passion to help.
- Understand the role we play in helping to save our environment.
- Engage with other clubs/children from other parts of the world. Through IOSF's pen-pal programme you can connect with other clubs and showcase your area/culture/wildlife and much more.
- Be connected to one of the world's leading otter conservation organisations.

If you are interested in starting an IOSF Team Otter club then please contact Ben Yoxon, at ben@otter.org. He will be a contact source at all times and will help with organisation, materials, ideas, pen-palling, and much more.

REFERENCES

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WORLD OTTER DAY: 29 MAY 2019

IOSF World Otter Day was launched to raise awareness and support for otters and their conservation globally. Since 2014, the event has continued to grow and this year was again a massive success.

We had events in over 30 countries including Brazil, Cambodia, Chile, Costa Rica, Germany, India, Italy, Laos, Montenegro, Nepal, Pakistan, Poland, Sri Lanka, Tanzania, The Gambia, Uganda, Vietnam, the USA, and the UK. These ranged from school events, fundraisers, community awareness and much more – all aimed at helping in the conservation of otters across the globe.

As with many similar events, social media played a massive part in spreading awareness for the day and *#WorldOtterDay* was trending at **seventh in the world** at one stage!

We would like to say a massive **THANK YOU** to everyone who took part in whatever capacity in IOSF World Otter Day this year! Each and every one of you has helped us to achieve this.

As with every year, IOSF offered three World Otter Day grants and was fortunate enough to be able to offer a fourth, thanks to a kind donation from an anonymous donor. This year's grants were awarded for the following projects:

© Otters Up

Brazil

In Paumari, Ana Maria Montes Ferro, of NGO Otters Up, visited a local community and had an otter celebration with the whole community, raising awareness for the species and their benefits to the environment. The children had fun 'playing like otters' while the rest of the village learned about food webs and the role of people and otters in our ecosystem.


© Kiengkai Khoonsrivong

Laos

Kiengkai Khoonsrivong, who helped so much in our Lao training workshop in 2018, held another workshop aimed at raising awareness for otter conservation and to reduce the illegal trade in the country.


© Leona Wai

Malaysia

Leona Wai delivered a human–otter conflict workshop at Batu Puteh, Kinabatangan, Sabah, focussing on the local fishermen. The aim was to enhance knowledge and awareness of otters in Sabah, plan solutions for any human–otter conflict and also to inspire fishermen to participate in community-based conservation.


© Karanta Camara

The Gambia

Karanta Camara visited local fishermen to encourage them to preserve their local otter populations. Since then a group has been established to continue otter monitoring in the area.

The next IOSF World Otter Day will be Wednesday 27 May 2020.

IOSF OTTER OSCAR AWARDS 2019

2019 was our fourth IOSF Otter Oscars. We launched the awards in 2016 to ensure that people who were making a difference in helping otters that year, received the recognition they deserved.

Again, we were amazed at the number of submissions received and the spectrum of work people are involved in – from research to youngsters enthused by what they are learning at school. We hope that these awards will encourage more of you to take part and do more for otters, whatever your field.

On 4th December 2019 the seven successful nominees were announced as follows:

Special Award – Hans Kruuk, Scotland

Hans is a renowned otter scientist who has written many papers and books on otters and other carnivores. He did a lot of work in Shetland and was probably the first to really study coastal Eurasian otters. He was Paul's supervisor for his PhD and was a great help to him during his studies.

Photo © Hans Kruuk

Young People's Award (12–18yrs) – Grace MacLean, Scotland

Grace put her passion towards wildlife and otters by raising awareness and support for otter conservation through selling cakes and hot drinks at the home of Skye Camanachd shinty club.

Photo © Sarah Corrigall

Children's Award – Annie, Lula, Clara, and Sky, USA

As the four girls were finishing up for the term they were learning about loads of different animals when they fell in love with otters. They chose to do something for otter conservation and raise support through selling home-made bookmarks, posters, slime, otter balloons, and otter cupcakes and cookies.

Photo © Mary DePaolo

Group/Organisation Award – NGO Living Green, Montenegro

NGO Living Green and Ninoslav Djurovic have raised the profile of otters in Montenegro and around Lake Skadar, the largest lake in the Balkans, and home of the Eurasian otter. They have also been integral in the creation of seven Team Otter clubs across the country. http://www.greenhome.co.me

Photo © Ninoslav Djurovic

Research – Suthar Akshit, India

Suthar Akshit has worked on finding more information on the illegal trade in Gujarat, India, concentrating specifically on the smooth-coated otter. He has gathered information on the trade and helped encourage law enforcement within the area.

Photo © Suthar Akshit

Community Achievement – Heidy Davis and Otter Patschel Team, Germany

Heidy and the team have raised awareness across Germany with otter talks, education stands, and press releases. They also spend their time spreading the word of IOSF and helping to raise support for the work we are doing.

Photo © Heidy Davis

Photography/Artwork – Chaminda Jayasekara, Sri Lanka

Chaminda monitors Eurasian otter populations across the island country and often gets amazing pictures of his resident otters.

Photo ©Chaminda Jaya

CONSERVATION OF THREATENED OTTERS AND THEIR HABITATS IN GUYANA: WORKSHOP REPORT

1–14 November 2019

Caiman House, Yupukari, Guyana

INTRODUCTION

Otters are facing many problems today such as habitat loss, pollution, and climate change. There are also conflicts with fishermen over competition with fish and this can be a big problem, particularly in poorer areas. We are now more aware of otters being traded illegally in Asia but trade in giant otter cubs also exists in South America. In community work it is important to demonstrate that the presence of otters is a good sign for the environment. Because they need both clean water and land habitats, they are excellent ambassadors for a healthy environment and by monitoring otters it gives us insight into the bigger picture of what we are doing to our planet.

Guyana is known as the "Land of the Giants" with giant anteaters, anacondas, caiman, jaguar, harpy eagles, and of course the giant otter (*Pteronura brasiliensis*). It also has the lesser-known neotropical otter (*Lontra longicaudis*). Unlike giant otters, neotropical otters do not live in groups and individuals are harder to identify as they have no throat patches. In the Red List, giant otters are classified as "Endangered" and neotropical otters are "Near Threatened" and numbers of both species are still declining.

The giant otter (Figure 1) is not only the largest otter in the world but is also one of the largest carnivores of South America. They are found in the Amazon basin but are poorly studied throughout their range, including in Guyana. The neotropical otter (Figure 2) is fairly widespread in South America and lives in a variety of habitats. But little is known of its ecology, distribution, or population status and in some areas it is believed to be verging on extinction. Wild population numbers of both species are merely speculation, due to insufficient data, and active conservation plans have been implemented in only a few countries. It is therefore vital to develop more otter workers to deliver the data.

Figure 1. Giant otter © Save The Giants

Figure 2. Neotropical otter © Pablo Hernandez

Conservation planning is already under way in Guyana and the giant otter is seen as an important species needing protection. However, few Guyanese have ever seen these

animals and most of those who have are fishermen who often see them as competition for fish. Records of neotropical otters are very rare.

LOCATION

The workshop was held at Yupukari, a small Amerindian village in western Guyana with a population of about 3000 people. The village is spread out along the river Rupununi and the area has amazing biodiversity with black caiman, turtles, ocelot, jaguar, and many species of birds.

Figure 3. Savannah vegetation © IOSF

Figure 4. Rainforest © IOSF

The area leading to the village is largely savannah (Figure 3) but it quickly changes to rainforest as you travel along the river, with a series of ponds and lakes (Figure 4). These areas are used by giant otters but neotropical otters prefer small creeks and streams off the main river. However, naturally there is some overlap and camera traps set for giant otters have detected neotropical.

THE WORKSHOP

This was IOSF's first training workshop in South America and it was held in partnership with Save The Giants, a community-driven conservation organisation, dedicated to preserving Guyana's wildlife via a multidisciplinary approach. IOSF's previous workshops had focused on training rangers, forestry workers, students, and government officials, but this time the focus was totally on community and there was a lot of curiosity from adults and children.

One of the aims of the workshop was to train local people to conduct regular surveys and then pay them for their work, thus providing a valuable income for the community. They will then be able to gather data to map otter distribution and populations, through their own observations and through citizen science. They will also feel a sense of ownership and responsibility for *their* otters. It was encouraging to find that many of the community are already aware of the presence of both otter species, and fishermen reported seeing them while they are working quietly.

Another aim was to raise awareness of otters, their conservation, and how a thriving otter population will benefit all co-existing species, including mankind. This would be implemented through a community outreach and educational programme, partnering with other local communities living within the range of otters. By showing how

sensitive and sustainable ecotourism can produce more income for the area it could bring about major benefits for otter populations and the ecosystem.

There was already a wildlife club in the village, but it was felt that it needed more input and more people to help run it. Save The Giants intern, Ben Driver, will be in Yupukari for one year and one of his roles is to work with existing volunteers to help the club to move forward.

IOSF's Education Officer, Ben Yoxon, Joe Sarvary from Para La Tierra and Voces de la Naturaleza in Paraguay and Save The Giants volunteers worked with community members to organise an afternoon of activities, including artwork and games, for 80 children from Yupukari and surrounding villages. (Figures 5a and 5b).

Figures 5a and 5b. Education sessions with Yupukari children © Save The Giants/IOSF

The adult part of the workshop (Figure 6) involved presentations and discussion in break-out groups about various topics, including:

- The work of IOSF and Save The Giants
- The role of otters in the ecosystem
- Global otter overview
- Giant and neotropical otter behavioural ecology and conservation
- Threats to otters including the pet trade, with a case study on trade of the Asian small-clawed otter
- The value of otters in responsible and respectful ecotourism operations. Two villagers gave a presentation on how they are involved in small-scale ecotourism and how it can be developed. They understand the wildlife, the needs of local people, etc and it is important to get the input of the people.
- Effective communication about otter conservation - with the general public and with tourists
- Implementing community environmental education programme - wildlife club involvement
- Case Study: IOSF Team Otter and an overview of the education work of Para La Tierra

Practical sessions included training in:

- Survey techniques including holt and latrine detection
- Use of camera traps (Figure 7)
- Identifying individuals - unique throat patches of giant otters
- Spraint (faecal) analysis
- Data collection, use of GPS, data entry

Figure 6. Break-out adult session © IOSF

Figure 7. Setting camera traps © IOSF

Figure 8. Giant otter holt and slide © IOSF

Figure 9. Spraint of neotropical otter on a log © IOSF

Six community members, including four women, expressed an interest in helping with regular monitoring. It is hoped that this will also encourage future young women to take part in science.

At present no crafts are being produced although there is a cotton-spinning building which is no longer in use. This could be brought back to make sustainable souvenirs as visitors prefer to buy from local sources. Caiman House already has a certain amount of

ecotourism based on birds and wilderness experiences, but it was suggested that there should be a "cap" on tourist numbers to prevent disturbance to the wildlife and habitat.

During the field training several giant otter holts were found (Figure 8) and a number of these animals were also seen – one group of four including a cub and another group of two in the river and one group of five in the lake. The more elusive neotropical otter evaded sight but a holt and sprainting site (Figure 9) were found at the entrance to a small stream flowing into the main river. It is proposed that this site be studied further using camera traps.

THE FUTURE

Save The Giants have been working in Yupukari for a number of years and the new intern will develop the project further. IOSF also has educational material which can be adapted for local use, and the IOSF video is being translated into the local language, Makushi.

The community decided that the best way forward is to form a committee to cover both survey work and education through the wildlife club. In this way, the workload can be shared which will ensure that the project does not rely on just a few individuals. They also want to extend the outreach to neighbouring villages and it will be useful to have the Makushi video for this. They also plan to have an otter and wildlife festival around World Otter Day in 2020.

It is proposed that a small stipend be paid to those who commit to working on the project either in terms of field monitoring or education/outreach. This will provide a very valuable extra income to the community.

Overall, the workshop was a big success and it lays a strong foundation for future work on otter conservation and indeed general wildlife and environmental conservation.

Thanks to everyone who took part:

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- Jennifer Bucolo, Ashley Calandro, Benjamin Driver, Sunna Khan, Ruth Steel Mock, Bridgette San Marco, Michael San Marco, Christina Ward ***(Save The Giants)***
- Joseph Sarvary ***(Para La Tierra and Voces de la Naturaleza)***
- Ben Yoxon, Grace Yoxon, Paul Yoxon ***(IOSF)***
- Niya Adolphus, Oswin Ambrose, Roselyne Ambrose, Caroline Barnabas, Marcilene Edwards, Eiotius Francis, Juliette Francis, Felix Holden, Shannon Holland, Cindy Lawrence, Helen Lawrence, Florence Laurindo, Luwara Laurindo, Maisy Li, Elean Roberts, Elianie Roberts, Russian *(Toshao, Head of the village)* Kelly Thomas, Lorrie Thomas, Tnesha Thomas, Michelle Thompson ***(Community)***
- Caiman House for their hospitality during our stay

And to the sponsors of the project without whose help this could not have taken place: Moody Gardens, Oklahoma City Zoo, The Rufford Foundation, Sequoia Park Zoo.

NEW SIGHTING OF THE NEAR THREATENED EURASIAN OTTER *Lutra lutra* IN TUNISIA

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Abstract

The Eurasian otter, Lutra lutra *(Linnaeus, 1758), is the most widely distributed of the otter species and is listed as Near Threatened in the IUCN Red List. However, in Tunisia, information about its distribution remains poorly known. A new sighting of this species was made during an expedition near the shores of El Barrak's dam where a dead body and footprints were found. This sighting is a new record, 36 years after the last one by Macdonald and Mason.*

Keywords: *Otter; new sighting; Near Threatened; Tunisia; Africa.*

INTRODUCTION

The Eurasian otter *Lutra lutra* is classified by the International Union for Conservation of Nature (IUCN) (**Roos et al., 2015**) as a Near Threatened species. The species has a wide distribution which covers Europe, most of Asia and North Africa. Although its populations are fairly well studied in Europe where they seem to be recovering (**Roos et al., 2015**), the North African populations are poorly investigated. In fact, over the last six decades only five scientific studies were carried out in three countries: Morocco, Algeria and Tunisia (**Macdonald and Mason 1983, 1984; Macdonald et al., 1985; Delibes et al. 2012; Badis et al. 2015**).

In Tunisia, **Macdonald & Mason (1983)** explained that the otter is common in the Northwest of the country and is quite abundant in the rivers of Oued Medjerda. Nevertheless, between 1983 and 2019, significant changes directly affected the streams in Northern Tunisia such as pollution (**Jdid et al., 1999; Abidi et al., 2015**) and dam construction (**Yadh et al. 2008**). No sighting of the species has been made since.

No national field survey has ever been undertaken in Tunisia and information on the status of the population of *Lutra lutra* is rare over the last 36 years, when the single study was made in the country (**Macdonald and Mason, 1982**). The aim of this study is to gather preliminary data about the remaining Tunisian population in order to comprehend its distribution.

MATERIALS AND METHODS

Based on the survey conducted by Macdonald & Mason in 1982, a team investigated 35 sites in which signs of otters were previously found (**Table 1**). The survey was conducted between 2017 and 2019. At each site a transect of 1.5 km was covered searching for spraints or footprints. Roads leading to these localities were carefully surveyed for possible dead otters as a result of a collision with vehicles whilst attempting to cross the road.

Table 1. List of visited sites in northern Tunisia from 2017 to 2019

Governorate	Station	Date
Jendouba	Eddir's dam	19-XII-2017
Jendouba	Oued Selloul	28-VI-2018
Jendouba	Barrage Jwewdeya's dam	28-VI-2018
Jendouba	Oued Bou Heurtma 1	11-XI-2018
Jendouba	Oued Bou Heurtma 2	11-XI-2018
Bizerte	Oued El Bagrat	26-XI-2017
Bizerte	Joumin	26-XI-2017
Bizerte	Sejnene	28-I-2018
Bizerte	Oued Ettin's dam	18-II-2018
Bizerte	Oued Sejnen	22-IV-2018
Béja	Sidi El Barrak's dam 1	18-II-2018
Béja	Chotte El Zweraa	21-IV-2018
Béja	Sidi El Barrak's dam 2	21-IV-2018
Béja	Thibar's dam	26-VII-2018
Béja	Hamem Essaiela	26-VII-2018
Nabeul	Oued Borj Cedreya	20-VIII-2018
Nabeul	Lebna's dam	29-VIII-2018
Nabeul	Oued Lebna	11-IX-2018
Nabeul	Oued Lahjar 1	29-VIII-2018
Nabeul	Oued Tafakhsit	29-VIII-2018
Nabeul	Oued Abid	03-IX-2018
Nabeul	Oued Lahjar 2	06-IX-2018
Nabeul	Oued Chiba	07-IX-2018
Béja	Ouechtata	01-VI-2018
Jendouba	Sidi Rouin	04-II-2018
Jendouba	Oued Zen	04-II-2018
Jendouba	Ain Baya	08-IV-2018
Jendouba	Deren's dam	08-IV-2018
Jendouba	Barbara's dam	08-IV-2018
Jendouba	Sidi Said	08-IV-2018
Jendouba	Beni Mtir's dam	25-VIII-2018
Jendouba	Oued Beni Mtir	25-VIII-2018
Jendouba	Beni Mtir	25-VIII-2018
Béja	Sidi El Barrak's dam 3	26-II-2019
Béja	Nefza	26-II-2019
Total	**35**	**3 years**

RESULTS

At these 35 visited sites, signs of the presence of otters were observed at only two sites **(Figure 1).**

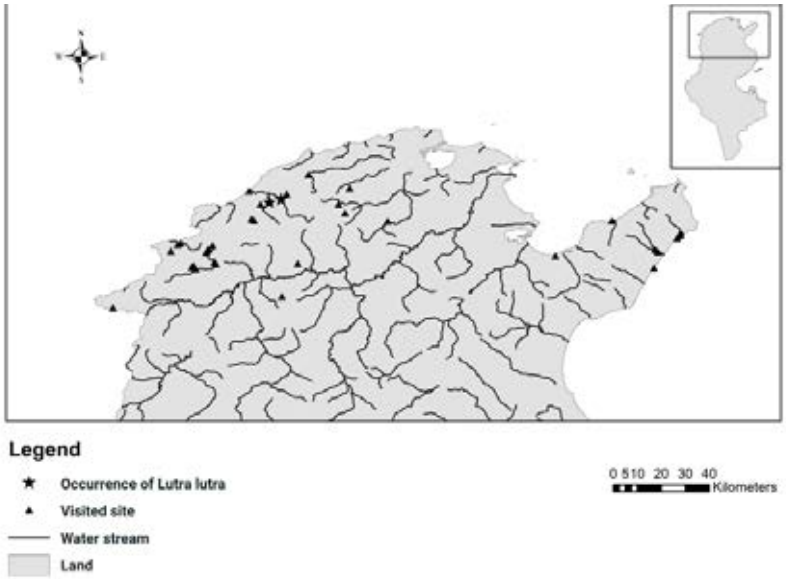

Figure 1. Map of sites visited and occurrence locations of the Eurasian otter in Northern Tunisia during the last three years

No direct sightings were made of otters but footprints were observed in two localities (El Barrak's dam and Nefza). The abundance of these footprints was extremely high at Nefza with over 100 footprints all along a river bed leading to El Barrak's dam. A dead otter was discovered on a road near the shores of El Barrak's dam (**Figure 2**).

Figure 2. Dead body of the Eurasian otter found near El Barrak's dam

Apparently, the otter was struck by a car while attempting to cross the roadway. Based on its body length, the specimen appears to be an adult. It was severely damaged and so it was not possible to determine the sex. The body was found at a distance of 5km from

the nearest footprint. These observations suggest the presence of an otter population surrounding the streams leading to El Barrak's dam and clearly roads in that area represent a threat for the species.

DISCUSSION

The fieldwork focused on the Northern side of the Madjerda river where water is permanent compared to the Southern side of the river where water is scarce and the land starts to turn dry as it approaches the steppes of Kairouan.

The otter occurred strictly in the Northwest part of Tunisia where water is still available and clean. Habitat fragmentation in the Cap Bon (Northeast) region was very accentuated and the absence of otter footprints suggest that the isolated population that existed back in 1983 may have disappeared. Oued Abid, the main river stream in Cap Bon, is heavily affected by the industrial activities surrounding the area.

The otter population of Tunisia is of high importance as it lives on the edge of its geographical distribution. More research needs to be carried out with more emphasis on ecological protocols in order to study the otter's distribution, habitat preferences and population dynamics in the region. This will also help to identify threats and enable the creation of an action plan to preserve the remaining population of this threatened species and its natural habitats in Tunisia. The fact that signs of the occurrence of the otter was only found in two localities out of all of the visited sites, and that there was also a dead body on the road, may indicate the threat of road networks on the remaining population of the Eurasian otter in Tunisia.

DISCLOSURE STATEMENT

No potential conflict of interest was reported by the authors.

AUTHOR BIOGRAPHIES

ZAKHER BOURAGAOUI is an evolutionary ecologist, mainly working on reptiles, specifically Lacertid lizards. He investigates their biology and ecology in Tunisia through various procedures from skeletochronology to species distribution modelling (SDM).

WAEL BEN ABA is an entomologist who has the largest private collection of Coleoptera in Tunisia. He has worked with international museums on sampling unstudied invertebrates in Tunisia and participated in a project as lead entomologist to study the biodiversity of the Madjerda river.

CHAWKI NAJJAR is a wildlife veterinarian and ecologist. He worked with Marwell Wildlife on the population dynamics and ecological preferences of reintroduced antelopes (Oryx, Addax, Gazelles) and ostriches in the Southern national parks and on the ecology of Tunisian tortoises. He also worked on the evaluation of the ecological diversity of the national parks ecosystems, organised translocations and reintroductions of wild animals and gives technical advice to both managers and workers of national parks in breeding and monitoring endangered species.

FAOUZ KILANI is curator of the scientific collection and an evolutionary ecologist. She is a passionate field student dedicated to the study of the natural world and conservation.

She has just graduated after investigating the behaviour of scimitar-horned oryx in two national parks as part of one of a Marwell's conservation project.

GHASSEN KMIRA is an evolutionary ecologist who is very passionate about zoology and botany. He is particularly interested in terrestrial arthropods, and is studying the taxonomy and ecology of spiders for his Master's degree. He is one of the very few scientific illustrators in Tunisia and aspires to use this skill to raise awareness about protecting global biodiversity and popularising science.

OLFA SEHLI is an ecologist and marine biologist who studied marine ecology and biodiversity for her Master's degree. Olfa is working as a marine life conservationist in TAW, trying to know more about the Tunisian biodiversity and promote this knowledge to raise awareness. She is also passionate about documentary filmmaking and underwater photography.

SAHAR CHEBAANE is a marine biologist, especially non-indigenous species. She achieved her Master's research degree in marine biodiversity from the faculty of sciences of Sfax and Master's degree in ecology and environment with the University of Le Mans, France. During her internship she set up a monitoring programme for non-indigenous species in Monastir Bay and in the Kuriat islands MCPA.

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MOHAMED SGHEIR BEN YOUSSEF is an amateur entomologist and wildlife photographer.

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MOHAMED AMINE HAMMOUDA is a documentary photographer and cinematographer with over five years of experience working with non-profit organisations in education, citizenship and human rights.

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A STUDY OF THE DIET AND DISTRIBUTION OF THE EURASIAN OTTER (*Lutra lutra*) IN THE WATER OF LEITH, EDINBURGH, SCOTLAND

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For the dissertation element of my MSc in Biodiversity, Wildlife and Ecosystem Health at the University of Edinburgh, I am undertaking a study into the diet and distribution of the Eurasian otter on a 12-mile urban stretch of the Water of Leith, Edinburgh, from Balerno to Leith. This is being done in conjunction with the Water of Leith Conservation Trust and the International Otter Survival Fund

Many studies have been undertaken on otters in coastal and riparian habitats (**Gallant, 2007**), but less is known of the movements of urban otters in the UK. As more reports

emerge of otters using our urban waterways, research is needed to ascertain the nature of this use and to what extent it is dependent on prey availability in the very different urban environment.

While it is acknowledged that population density and distribution cannot be accurately assessed by survey and spraint evidence alone (**Yoxon and Yoxon, 2013**), it is hoped that by mapping the results of surveys, spraint locations, sightings, and camera trapping, a picture will begin to emerge to illustrate how the otters are using the river. In addition, spraint analysis may demonstrate whether prey availability is a factor in distribution.

Results gathered so far from volunteer surveys, spraint collection, camera trapping, and recent sightings have highlighted a pattern of usage along the water course. Public sightings of otters in the area have increased from 11 in 2018 to 56 in 2019 and 8 in the early part of January 2020 alone. Twenty-one sightings since November 2019, when this study began, have confirmed otter presence in Dean Village, Stockbridge, Gorgie, Slateford, Leith, Murrayfield, Craiglockhart Dell, the Union Canal, and Figgart Pond.

Dietary analysis is not yet complete, but to date the main prey item is identified as Bullhead (*Cottus gobio*). Spraints have also been gathered from the vicinity of the Leith basin, but as yet they have not been analysed. These may show a presence of marine species in the otter diet, while spraints gathered on the banks of the Water of Leith where it is closest to the Union Canal have shown a variety of fish found in the canal but not the river.

Recent, well publicised sightings of several individual otters and more than one family group in the city centre have piqued public interest in this study which is due to be submitted to the University on 15 June 2020.

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USING ARTWORK AS A TOOL TO RAISE PUBLIC AWARENESS FOR THE CONSERVATION OF IRAQ'S SMOOTH-COATED OTTER *Lutrogale perspicillata maxwelli*

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The vulnerable endemic subspecies of the smooth-coated otter (*Lutrogale perspicillata*) is *L. p. maxwelli* and it is found in the extensive reed beds and marshy lakes of the Lower Mesopotamian marshes of Southern Iraq (**Al-Sheikhly et al., 2017**). Until recently it was believed to be confined to Iraq but it has now also been confirmed in Southwestern Iran (**Al-Sheikhly et al., 2020**).

Following its discovery by Gavin Maxwell in the 1950s, its population faced a dramatic decline mainly due to habitat destruction and severe illegal persecution. The drainage of the marshes in the 1990s put the species on the verge of extinction (**Al-Sheikhly and Nader, 2013**). The smooth-coated otter along with its sympatric Eurasian otters (*Lutra lutra*) are targeted by local Marsh Arabs wherever and whenever possible for their fur or to be raised as pets; therefore, hunting of adults and trapping of juveniles and cubs was identified as a major threat to both species (**Al-Sheikhly et al., 2014**).

The Iraqi Wildlife Center (IWC) is a recently founded body consisting of a group of scientists, conservationists, and environmental activists working together to advocate the endangered biota of Iraq. The IWC is conducting field surveys/tours, public events, and using social media to raise awareness about hunting and trapping of wild fauna by local hunters, an issue that has increased recently in certain Iraqi societies and warrants urgent action. The conservation of *L. p. maxwelli* is one of the IWC objectives, especially related to testing new approaches as tools to reduce the impact of illegal persecution.

The IWC in cooperation with the Al-Chebaeish Organization for Ecotourism (AOE) and the Iraqi Green Climate Organization (IGCO) has recently encouraged young Iraqi artists to express their thoughts regarding illegal persecution and the impact of climate change on the population of *L. p. maxwelli* in Iraq.

The aim is to use art as a tool to encourage the Iraqi public to feel more responsible for the conservation of their native natural heritage and encourage the Iraqi authorities to enforce wildlife protection legislation. Several artistic masterpieces were submitted by many Iraqi artists for consideration of the IWC, and among many creative contributions, two pieces of art were selected to transmit the message to the Iraqi public (Figure 1).

Figure 1. Selected artwork presented by a local Iraqi artist (F. Al-Iraqi) to the Iraqi Wildlife Center to be used as a conservation tool to raise awareness among the Iraqi public.

The effectiveness of such a tool was tested by evaluating the interaction of the Iraqi audience through many shares and comments of sympathy and annoyance posted on the IWC, AOE, and IGCO social media. This reflects the high responsibility of the Iraqi public towards such critical issues.

This suggests that this could be a useful tool in conservation in many other countries,

The Iraqi Wildlife Center Facebook post can be found at:

https://web.facebook.com/IraqiWildlifeCenter/?_rdc=1&_rdr

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DISTRIBUTION MODELLING OF THE EURASIAN OTTER (*Lutra lutra)* ON THE ISLE OF ANGLESEY, WALES

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Abstract

*The Eurasian otter (*Lutra lutra*) remains a high priority conservation species despite recent increases in UK populations. Specifically, a marked increase in surveyed site occupancy (50%) was observed on the Isle of Anglesey (North Wales) between 2002 and 2009. Understanding the drivers that act upon the distribution of* L. lutra *will allow for more targeted conservation efforts. In this study, species distribution modelling (MaxEnt) was applied to predict the potential distribution of* L. lutra *across Anglesey. Elevation and, distance to roads and water (m) were found to be the most influential factors in determining the distribution of individuals across all models. The generated models performed better than random and were capable of identifying areas where* L. lutra *could potentially occur across Anglesey (AUC = 0.818). Locations for concentrating future research efforts are suggested through analysis of spatial variation, human disturbance effects and population analysis across the study region. This study provides a baseline of* L. lutra *habitation possibility across Anglesey and exposes areas for future conservation in habitat management and research efforts.*

Keywords: *habitat suitability; conservation; management; human impact*

INTRODUCTION

Lutra lutra (Eurasian otter) is a key biological indicator species **(Delibes et al., 2009)** that has experienced a continued population decline during the 1900s **(Conroy and Chanin, 2000)**. Since the 1970s surveys have been conducted across the British Isles to monitor their presence **(Strachan, 2010)** and these have shown a continued expansion and consolidation of their range. However, there are still regions where *L. lutra* previously inhabited which continue to show no presence. In surveys on Anglesey, North Wales, that were conducted prior to 2002 no positive sites were reported. However, after 2002 the island recorded an increase in positive observations (17.9% to 67.5%) between 2002 and 2009 **(Strachan, 2010)**. Little or no formal research has been conducted to quantify the population status on Anglesey, most likely due to evidence from previous surveys suggesting there was possibly no population to monitor (**Strachan, 2010**). The cause of this marked population increase in recent years has yet to be ascertained.

Population and distribution monitoring efforts have been carried out for several decades throughout the UK, commonly through the analysis of spraint distribution **(Macdonald and Mason, 1983)**. Recently, Species Distribution Modelling (SDM) has been used to analyse their distribution **(Jo et al., 2017)**. Field observations of organism presence are coupled with environmental data to determine the niche of a species and this can be used to determine the likelihood of an organism occurring in unsurveyed areas (**Phillips et al., 2018**). One popular technique is known as MaxEnt, which has been found generally to outperform other SDM techniques **(Elith et al., 2006)**. MaxEnt shows robustness to irregular data samples and minor location errors and has been shown to predict accurate models from relatively small sample sizes (n = 25; **van Proosdij et al., 2016)**.

Several studies have assessed the factors that control *L. lutra* distribution **(Ross, 1985; Kruuk, 1995). Jo et al. (2017)** used MaxEnt to identify environmental variables affecting distribution across South Korea and aimed to determine potential distribution and identify regions for focused management and recovery projects. Elevation, land use and human disturbance were identified as key limiting factors. The results were different than those previously conducted within smaller regions of South Korea, suggesting that the results were spatially dependent. The influence of human disturbance on the distribution was also observed to be minimal, concluding that the two species can co-exist. This suggests that individual responses of *L. lutra* to human disturbance may vary **(Strachan, 2010; Jo et al., 2017)**.

Whilst the population of *L. lutra* has increased within the UK, this species remains a high conservation priority **(Roos et al., 2015)**. Specifically, on Anglesey, a population increase of 50% was observed between 2002 and 2009 **(Strachan, 2010)**. However, no specific studies have been conducted regarding the distribution of this species within the area. This study conducted species distribution modelling to help identify potentially suitable habitat on Anglesey. The relevance of findings are discussed by exploring the most important environmental drivers that influence distribution and identifying areas of high habitat suitability future studies and conservation efforts.

METHODS

Study Area

This study was conducted on the Isle of Anglesey in North Wales, which is isolated from the Welsh mainland by the Menai Strait (Figure 1a). The island is predominantly low-lying (<100 m) with its highest peak just 220m above sea level and additional hills/cliffs in the Northeast. Across the island, agricultural pastures account for 80% of total land use, with water bodies accounting for just 0.75% **(Rae, 2017)**. No rivers exceed 25km in length and they are generally narrow. Their gradient, low energy and bankside cover provide prime conditions for *L. lutra* habitation **(Strachan, 2010).**

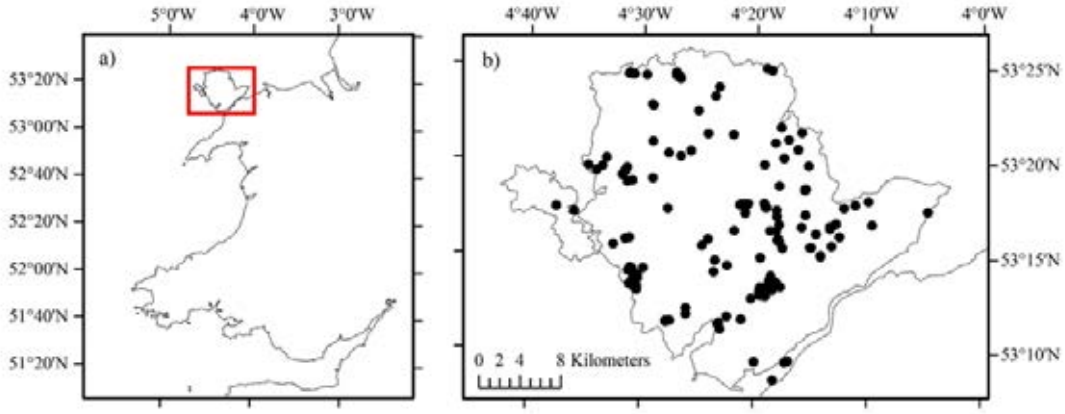

Figure 1. Distribution (2011 – 2016) of* Lutra lutra *across Anglesey from the Cofnod compiled database in WGS 1984 UTM 30°N for a) location of study site, b) sightings.

Presence Data

Cofnod, (North Wales Environmental Information Service) a Welsh organisation that compiles large data sets of species observation records to produce one centralised database, provided presence data for *L. lutra* across Anglesey (Figure 1b). Records between 2011 and 2016 were selected as the most current for distribution analysis. The record type (categories: live sighting, spraint and road casualties) were assessed to determine their suitability for distribution modelling. Road casualties were further omitted from analysis due to these not being a true representation of habitat utilisation. A total of 243 presence records were used for analysis.

Environmental Variables

A total of four environmental layers (distance to coastline, railway, roads and freshwater), elevation and a land cover map were compiled from three data sources and used in analysis (Table 1).

Table 1. Environmental data sources and original resolution used in this study.

Variable	Native Resolution (m)	Categories	Source
Distance to coastline (m)	200	1	*Open Street Map Contributors (2018)*
Distance to railway (m)	200	1	*Open Street Map Contributors (2018)*
Distance to roads (m)	200	1	*Open Street Map Contributors (2018)*
Distance to freshwater (m)	200	1	*Open Street Map Contributors (2018)*
Elevation	1000	1	*OS Terrain 5 (2018*)
Land cover	1000	10	*Jackson (2000)*

The 2015 land cover map of Anglesey (**Land Cover Map 2015, 2018**) provided information on the ten land use categories across the island in 1km squares. Elevation data was provided in 5km grid squares (**OS Terrain 5, 2018**) and these were stitched together in ArcGIS using the 'Mosaic to New Raster' tool providing a range of 0 – 220m. The environmental data layers were imported from Open Street Map in vector form **(Open Street Map Contributors, 2018)**. As the statistical model used in predictive distribution (MaxEnt) cannot read vector data these were converted to Raster form using 'Euclidean Distance' analysis in ArcGIS. The maximum distance (m) used in transformation was dependent on the feature being analysed (coastline = 11,000m, railway = 11,000m, road = 2,500m and water = 4,000m).

Statistical Data Analysis

Presence data of *L. lutra* was partitioned randomly generating 90% training and 10% test data (used to test produced models). These were then cross-validated using 100 random partitions comparison of fit to test presence data using AUC (Area Under Curve). Models with an AUC of 0.5 represent a no better than random prediction, whilst an AUC of 1.0 denotes a perfect fit (**Baldwin, 2009**). Raw output of MaxEnt is the importance of each layer and estimate of relative suitability of one location compared to another **(Ward et al., 2016)**.

RESULTS

The distribution model produced performed well across validation metrics with a mean AUC value of 0.818 (Table 2) and was significantly different from that of a random prediction (AUC = 0.5; Wilcoxon rank-sum test, $p < 0.01$). The omission rate observed (12%) indicates that only few presences were misclassified and that the predictions were more probable than that of a random background pixel (Table 2).

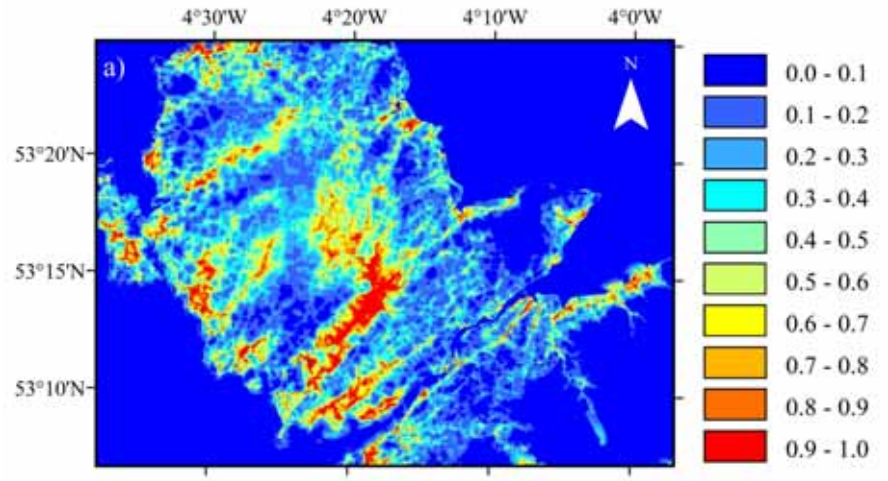

Figure 2. Pointwise mean* Lutra lutra *potential distribution (habitat suitability) across Anglesey from 100 cross validation runs of MaxEnt, based on six environmental factors (elevation, land use and distance to coastline, railway, road and water (AUC = 0.818) in a WGS 1984 UTM 30N map scale. Map cropped to the extent of the data.

The MaxEnt models identified suitable habitat for *L. lutra* across Anglesey (Figure 2) and the majority was around Malltraeth Marsh, Rhosneigr and, Afon Cefni, Braint and Alaw. The land South of Red Wharf Bay had predictable low probability of *L. lutra* habitation (Figure 2).

Table 2. Analysis of statistics and jack-knife variable contributions to the models produced by MaxEnt.

Variable	
Validation Statistics	
Test AUC	0.818
Test gain	0.822
10th percentile training presence	0.472
Omission rate (threshold 10)	12%
Jack-knife of variable importance	
Distance to coastline (m)	0.017
Elevation (m)	0.503
Land use	0.065
Distance to railway (m)	0.054
Distance to roads (m)	0.246
Distance to water (m)	0.222
Test AUC for a single variable	
Distance to coastline (m)	0.554
Elevation	0.761
Land use	0.587
Distance to railway (m)	0.586
Distance to roads (m)	0.678
Distance to water (m)	0.681

MaxEnt identified the variables most likely to influence the probability of species presence (Table 2). Jack-knife analysis of variable contribution and test AUC scores for single variable models showed that the highest contributions to habitat suitability were elevation, and distance to roads and water (Table 2).

DISCUSSION

Habitat Suitability

This study found elevation to be the most influential environmental variable affecting *L. lutra* distribution on Anglesey. The combination of two aspects creates the limiting effect of elevation: the availability of food and air/water temperatures. Elevation has been observed to influence the distribution of *L. lutra* in previous studies **(Macdonald and Mason, 1983; Kruuk, 1995; Jo et al., 2017)** with only one record of the species in a highly elevated region (Tibet, 4120 m; **Macdonald and Mason, 1983**). The effect of increased elevation on the physiological requirements of individuals is threefold: drop in atmospheric pressure, drop in temperature and reduction of oxygen concentration. The key limiting factor most influential in semi-aquatic mammals is that they do not possess thick layers of fat or blubber to protect themselves as the temperature decreases with increased elevation **(Crait et al., 2012)**. **Kruuk (1995)** observed that with decreasing temperature, foraging time increased as a result of significant heat loss. The increase in thermoregulatory energy requirements means an increased need for food, thus increasing foraging time. The limitation of prey availability with increased elevation **(Ruiz-Olmo, 2007)** is an additional factor imposing increased foraging times upon individuals. The regions observed in this model with a suitability of <20% were all locations above 75m and this demonstrates a clear avoidance of highly elevated regions by *L. lutra* on the island. The region South of Red Wharf Bay for example, showed the greatest area with low suitability (elevation height of 175m).

Distance to water (m) was also found to influence *L. lutra* distribution across Anglesey. However, this was for freshwater with distance to coastline (m) and therefore saltwater was found to have little influence on the distribution. This infers that at present the population may not be exploiting the coastal marine habitat and are purely freshwater, although this could be confirmed by more detailed study. The generally narrow and short rivers across Anglesey lead to a high fish carrying capacity **(Rae, 2017),** thus increasing prey capture success rates, with brown trout and eels widespread in the island's waterways **(Hunt and Jones, 1972)**. In this study, all *L. lutra* reports were found within 400m of freshwater. The closeness to water, along with improved waterways and availability of fish in rivers could explain the increase in positive survey sites throughout the UK as a correlation has been noted between breeding success and prey availability **(Kruuk and Moorhouse, 1991)**.

Whilst *L. lutra* are known to be highly affected by human disturbance, recent research has shown the scale of tolerance to be dependent upon individual variation **(Strachan, 2010)**. This was echoed in our study, with the distance to roads (m) found to be a limiting factor in the habitat suitability models. Therefore, tolerance to disturbance is higher than previously thought with individuals, on average, being found closer to roads than waterways (100m and 400m, respectively). The

construction of new roads in particular has the greatest impact as they use traditional paths, which often cross such developments **(Macdonald and Mason, 1983)**. Whilst land use, particularly agricultural pastures has been found to impact habitation, in this study it was found not to be a limiting factor.

The increase in *L. lutra* populations between 2002 and 2009 does suggest that individuals on the island may be consolidating their territories and breeding **(Strachan, 2010)**. However, such increases need to be treated with caution, as they do not necessarily infer a population increase. This study identified three key rivers that had the highest habitat suitability and are therefore most likely to be exploited by *L. lutra* across the island: Afon Alaw, Braint and Cefni. The areas of Malltraeth Marsh and Rhosneigr are wetland regions on the island that also had high habitat suitability. These regions are most valuable for future protection. In general, almost all waterways on the island show high habitat suitability for otters with only regions more than 75m above sea level found to have the lowest suitability.

STUDY LIMITATIONS

Whilst this study has produced some significant findings there are still some factors that should be considered when interpreting the results. Firstly, the variety of sampling methods **(Cofnod, 2018)** used in this compiled data set, allows for the possibility of sampling bias and therefore, all results should be taken with care and as indicative. The output and weakness of the MaxEnt algorithm has the possibility for significant over-prediction of habitat suitability, and this has been mostly noted in small presence data sets which were not analysed in this study **(Papes and Gaubert, 2007)**. The data analysis was conducted based on the presence of spraint and this has been shown not to be an extensive representation of habitat use by *L, lutra* as spraint deposits are subject to seasonal changes. It has also been found that spraints are left in some vegetation types, banks or areas, but not in all habitats **(Conroy and French, 1987)**. Several variables that may influence distribution (e.g. water quality and human disturbance; **Jo et al., 2017**) could not be included in the analysis either due to insufficient resolution available or such data not being available. The use of the term habitat preference should also be taken with care as it does not always infer habitat usage **(Kruuk et al., 1998)**.

CONCLUSIONS

This study provides a baseline for future research efforts of *Lutra lutra* on Anglesey with results being indicative and not conclusive. Whilst the output models do not pinpoint specific areas of habitation it is useful for directing future research efforts and indicates highly probable regions of suitability. This study found elevation to be a key limiting factor on presence and this greatly influences food availability and air/water temperatures. An analysis of Anglesey fish populations and resultant availability, along with specific *L. lutra* population analysis is further required to infer the potential causal factor of the increase in positive survey sites observed

between 2002 and 2009. This study has been key in providing a baseline of *L. lutra* habitation probability across Anglesey and denoting areas for future conservation and research efforts. Areas of research concentration pointed out by this study include, spatial variation, effects of human disturbance, and specific population analysis.

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Disclosure Statement

No potential conflict of interest was reported by the authors.

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THE POTENTIAL ROLE OF SOCIAL MEDIA IN SUPPORT OF OTTER CONSERVATION IN THE INDIAN HIMALAYAN BIODIVERSITY HOTSPOT

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Abstract

Anthropogenic stressors in the Indian Himalayan biodiversity hotspot over recent decades have taken a toll on otter populations. Low public awareness and a lack of routine monitoring data hamper conservation strategies. Social media has the potential to generate both positive and negative perceptions about otter species among target stakeholder groups. This approach can serve as a tool to generate vital conservation information and promote public knowledge and interest. This paper examines the role of social media as a tool to reinforce contemporary conservation initiatives, advocating its stronger utilisation for the potential protection of otter species in the Indian Himalayan biodiversity hotspot. The proposed approach is also maintained through a case study from the region.

Keywords*: Freshwater; Lutrinae; Mustelidae; Uttarakhand; wetlands*

BACKGROUND

Potential threats to otter species in the Indian Himalayan biodiversity hotspot include destruction or degradation of essential habitat and illegal poaching activities **(Gupta et al., 2016, 2020)**. Compounded pressures arise from a projected increase in mean temperature across the region of 1–2°C by 2050 compared to a 1960s baseline, a likely extended and less predictable monsoon, precipitation varying by 5% on average, and a likely increase in intensity of extreme rainfall events **(Alfthan et al.,**

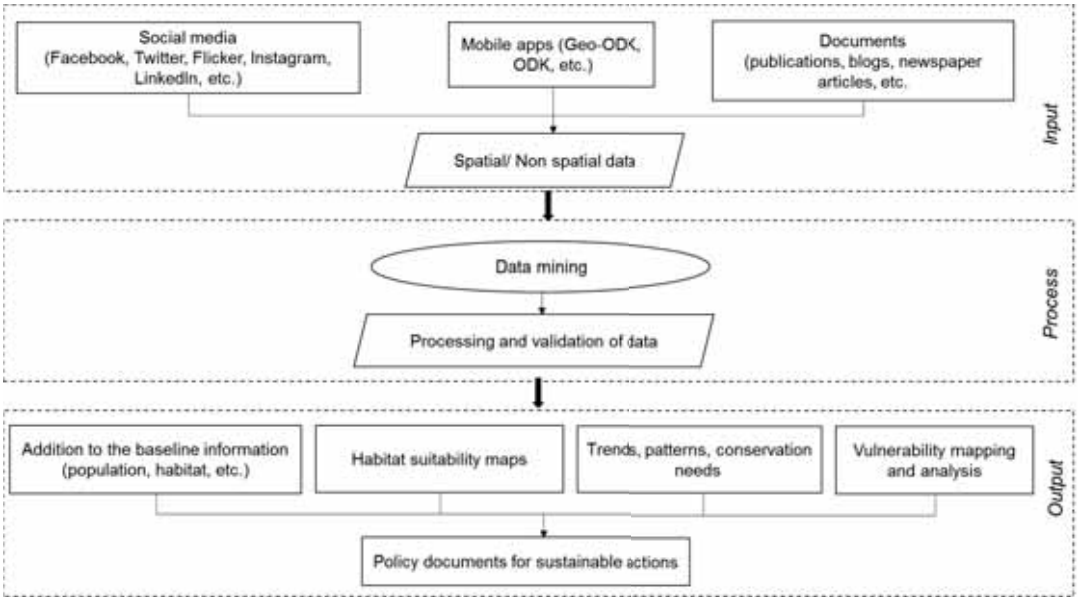
2018). All of these pressures potentially affect the habitat of otter species, including the viability of prey populations.

Social media, defined as a collection of online information sources **(Barker et al., 2012)**, has played an increasingly influential role in advancing communication **(Mangold and Faulds, 2009)** due to its broad outreach and availability, enabling a speedy and increasingly broad circulation of content. Social media can therefore potentially play an important role in otter species monitoring and conservation initiatives. Existing examples include internet sites such as iNaturalist **(www.inaturalist.org)** which provides platforms to post photographs of species and obtain information from the wider scientific community. Inputs to biodiversity databases can also provide species observations with specific dates and locations, with potentially thousands of users contributing to databases available to conservationists and ecologists. As one large-scale example, the Global Biodiversity Information Facility (GBIF) **(www.gbif.org)** is a free and open access portal to biodiversity data **(GBIF, 2013)**. Such databases can serve as valuable tools to evaluate, for example, the arrival/departure time of summer and winter resident populations in an area.

Mobile apps such as Pakshi **(https://pakshiapp.appspot.com/)** and Frog Find 1.0 **(https://gubbilabs.in/Launch-Frog-Find-1.0)** provide an opportunity to share faunal data on social networking platforms, and analyse/monitor 'big data' using crowd-sensing technology **(Herlekar and Prakash, 2014)**. Nonetheless, accessibility issues persist, especially among communities in high mountain areas due to geographical, social, and economic isolation. In the majority of these regions, access to the internet has developed rapidly, but research interest in the role of social media in otter conservation is still embryonic.

THE ROLE OF SOCIAL MEDIA FOR OTTER CONSERVATION: A POTENTIAL FRAMEWORK

Social media can play a crucial role in data mining (a process through which raw data are converted into useful and usable information) for otter species. Posts, comments, tweets, images, locations, etc. shared on platforms such as Facebook, Instagram, Flicker, Twitter, etc. have been used in business analytics, market research, prediction, and wildlife conservation previously. Regrettably, there is also evidence of poachers using information on social media **(Springer, 2016)**, though conversely social media has also been used as a weapon to track down poachers **("Social media used as weapon", 2018)**. These considerations sound a note of caution about widespread communication of locations of threatened and tradable species such as otters.



Social media datasets can be characterised into two types: spatial and non-spatial data. Spatial data refers to information which can be represented by numerical values in a geographic coordinate system (i.e. latitude, longitude of a location, geo-tagged photographs and posts). Non-spatial data doesn't have any geographical information (e.g. posts on Twitter, Facebook, blogs, texts, etc.).

Figure 1 shows a proposed framework for data mining to assist with otter conservation in the Indian Himalayan biodiversity hotspot in three possible steps.

Figure 1. Proposed framework for data mining

Step 1 [Input]: The species-related data from multiple sources (both spatial and non-spatial) can be harnessed to extract the relevant data. Here, the assistance from local stakeholders will be crucial for on the ground information throughout the various seasons.

The input steps involve the use of social media platforms. The data obtained here will be through photographs and latitude/longitude information and we will obtain the highest number of posts of otters. This has the potential to assist with otter species determination and promotion. Further, it will help to generate habitat suitability maps, and identify potentially vulnerable sites, i.e. where human intervention is the most. Android applications such as Geo-ODK will provide field-based information. This will help with topographic analysis based on remote sensing datasets after data processing. This will provide information for land cover analysis to understand habitat locations/types of otters. It also has the potential to obtain social survey data to understand community support for otters, greatly providing inputs for planning and implementation of targeted conservation strategies. Published/non-published documents can provide research data for understanding

baseline information and research gaps and needs. More importantly, location specific information, and an inventory of scientific research in a particular area and on a particular otter species, can also be obtained.

Step 2 [Processing]: The data acquired requires processing and validation to extract valuable information. This could be conducted by field trips to the observation sites, and will require financial assistance from donor and government agencies. Data assimilation on a common platform is the key here, and will potentially avoid redundancy of data. Data cleaning can be conducted with validation based on expert knowledge at this stage. Open source data will ensure its authenticity. Further, data cleaning can be achieved by organising annual workshops for scientists and non-scientists working on otters.

Step 3 [Output]: Data can then be used to develop different useful strategies to assist with the protection of otters.

Importantly, the knowledge products generated through this process have the potential to assist in the development of policy documents, advisories, and recommendations for sustainable actions for the protection of otters. Some of the advantages of the proposed framework for otter conservation include the creation of a centralised data system which is easily accessible by all as an open source. This will avoid data redundancy and repetition of otter-related work. The data can be used for further research work, saving both time and money. It is important to note that coordination at various levels will be required through a multi-stakeholder approach involving all otter scientists on a national and international scale. Initial stage capacity building will be needed for field researchers and non-scientists/scientists to bridge the knowledge gap on otters.

CASE STUDY: OTTERS OF UTTARAKHAND

Background

Three species of otter have previously been reported from the Indian state of Uttarakhand, one of three Indian Himalayan biodiversity hotspots **(Hussain, 1999; Nawab, 2007; Khan et al., 2014)**. They are the Eurasian otter (*Lutra lutra*), smooth-coated otter (*Lutrogale perspicillata*), and Asian small-clawed otter (*Aonyx cinereus*). The local threats faced by these three species of otter are similar at the local level, in comparison to the global assessments **(Gupta et al., 2020)**. These otter species play critical roles as top carnivores in the balance and processes of riverine ecosystems, significantly influencing the overall spatiotemporal dynamics of river systems and thus the beneficial ecosystem services that they provide **(Gupta et al., 2016, 2020)**.

Study area

The study was focused in the state of Uttarakhand (30.0668° N, 79.0193° E), located in the Western region of the Indian Himalayas. Uttarakhand has rich aquatic habitat diversity including numerous rivers, reservoirs, freshwater lakes and wetlands, which in turn support rich biodiversity **(Gupta et al., 2016)**. This work focused on four significant catchments in the region (see Figure 2). The Kosi River originates from Budha Peenath village in the Kausani area of Almora District of Uttarakhand, and has a total length of about 240 km and a catchment area of 3,420 km^2; the Western Ramganga River is an important tributary of the Ganges River, and originates from the Shivalik Himalayas at Dudhatoli in the District of Chamoli in Uttarakhand; the Khoh River is a tributary of the Western Ramganga, originating from Langur in Dwarikhal and has a catchment basin of over 250 km^2; and the Song River is a tributary of the Suswa River, which in turn is a tributary of the Ganges and originates as spring-fed stream in the southern slopes of the Mussoorie ridge of the Himalayan range **(Gupta et al., 2016)**.

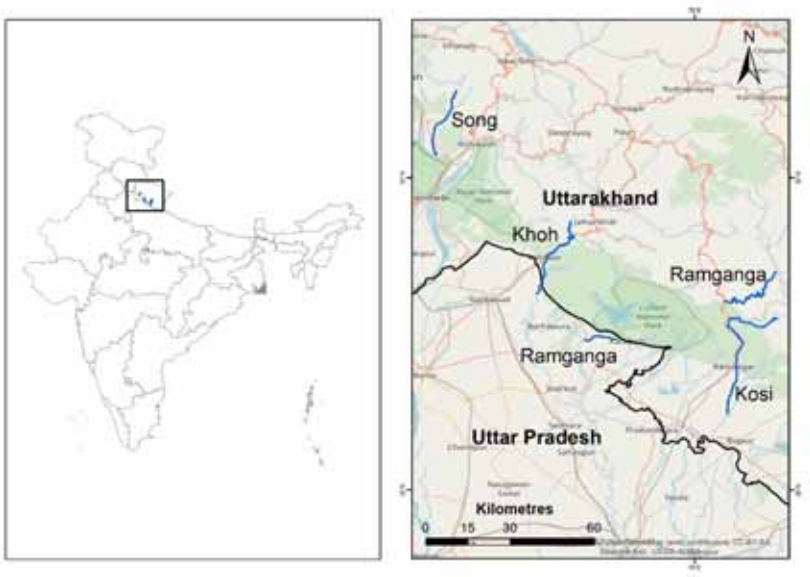


Figure 2. River catchments in study area

Methods

Despite the numerous perennial rivers in the region, the above-mentioned rivers were judged representative by the authors. This is because a previous field study conducted by the corresponding author in the region during 2018–2019 reported otters (direct and indirect sightings) from these rivers **(Gupta et al., 2020)**. These rivers also have villages along their reaches with whom the research team has strong

links. The rivers and the villages were also accessible by road. In addition, some research team members could converse in the local dialect and were sensitive to local customs.

The social science surveys were conducted between 2018 and 2019 with the aid of semi-structured interviews to document the perspective of local community members on the effectiveness of social media for otter conservation under the following sections: (a) the respondents' gender and age in years; (b) tools and strategies used by local people currently indulged in leisure activities to attract tourists; (c) the likelihood of the application of social media working for otter conservation in the region; and (d) any additional comments or suggestions.

The respondents were from the communities located along the rivers. As many households as possible were approached for the survey (both men and women) to ensure that a significant number of individual responses were obtained for the analysis. The community selection was based on the voluntary willingness and the availability of members in the study area during the field survey. Consent was requested and obtained from all the participants to make notes of the conversations. All responses were kept anonymous so that respondents felt free to express their views (following **Everard et al., 2019**). Written notes were transferred into spreadsheet format.

Discussions took place primarily in Hindi. Gender sensitivity was considered, including questioning of women by a female member of the research team, though no inhibition was encountered in wider discussions with female or other informants. Conversation flowed freely with no evidence of it being dominated by any individuals. Researchers fluent in Hindi translated the responses, taking written notes in English and collating them following the meeting. Additional input was derived from literature searches (as seen in the citations used in this paper).

Results

A total of 279 semi-structured interviews were conducted during the survey period. Participants included local community members, aged between 18 and 70 years old, with 204 men and 75 women being interviewed. An attempt was made to understand the perspective of local community members on the effectiveness of social media for otter conservation, and if such an approach could act as a conservation strategy in the region.

Almost all the respondents were aware of the increasing opportunities for local communities to participate in the existing and upcoming ecotourism opportunities. The community members currently indulged in tourism activities (e.g. birding, wildlife safaris, catch-and-release angling, and trekking) and paid attention to social

media platforms such as Facebook to attract incoming tourists. This was sometimes their main channel to market, locate, and communicate with their tourists, and for the tourists to schedule their visits well in time. Sixty-eight percent of the respondents pointed out that they could not comment on the application of social media for otter conservation as not enough information was provided to them to take advantage of such an opportunity. The remaining 32% stressed that such an approach could be beneficial for otters. Seventy-two percent of the respondents also mentioned that appropriate and timely support from concerned officials, and guidelines for maintaining a healthy ecosystem could go hand-in-hand for the long-term success of such initiatives in the region. The rest (28%) mentioned that information gathered through social media could inform the concerned officials, who would then be more likely to be more favourable towards otter protection in the region.

Discussion and way forward

The authors acknowledge the significant limitations and uncertainties imposed in this study by focusing efforts on just the villages located along four of the rivers in the region, particularly given the high socio-ecological diversity across the region. To a substantial degree, this was enforced by resource limitations, field visits and interviews in particular taking substantial patience and time. However, other features noted in the study area section [reported otters (direct and indirect sightings) from these rivers; villages along the river reaches with whom the research team has strong links; the rivers and villages being accessible by road; some research team members being able to converse in the local dialect and sensitive to local customs] mean that it was a suitable study site, with all of these features not readily available elsewhere. Although the findings of this study are therefore subject to some unquantifiable uncertainty, the findings are nonetheless significant.

DISCUSSION

This paper suggests how the involvement of a data mining approach can potentially act as a supplementary tool for protecting otters and their habitats. This is supported by testing this proposal through the case study in Uttarakhand. Social media has been used to report illegal hunting and trade, and local stakeholders in the region can play a critical role in this. Social media not only has the potential to provide basic information on otters, but also to play a role in promoting public awareness of their conservation needs.

Data mining through social media is an emerging technique in wildlife conservation, and for understanding the patterns and process of ecological systems **(Hochachka et al., 2007)**. For example, **Gallant et al. (2016)** used data mining techniques for

studying the trends, population, and identifying hotspots of the wolverine (*Gulo gulo*) in Canadian Maritime provinces. Further, **Perumal et al. (2015)** demonstrated its use for the analysis of traffic and tourist monitoring, and biodiversity conservation.

Nonetheless, it is important to note that social media may have negative implications for otter populations. For example, social media is popularising the keeping of otters as pets and the illegal trade in otters across Asia **(Siriwat and Nijman, 2018)**. As noted above, there is also possible abuse of locational information by poachers, so this information has to be carefully monitored and controlled. Active intervention in social media messaging may be needed to maintain a positive perception of otters and support for their conservation, using the medium as a public education platform.

Another challenge for the use of social media for species awareness is that otters in the area could be elusive and shy, and even villagers who are on the site most days still see them rarely **(Gupta et al., 2020)**. Therefore, posting photos of and information about otters would be challenging. Here, building the capacity of interested stakeholders through targeted outreach will be needed for social media to be valuable in the region. This was also pointed out by the respondents (see the results section of the case study above). Given the local awareness and the potential of social media to make a positive impact on otters, an approach as mentioned above could be trialled further to assess its sustainable applicability to protect otters **(Cianfrani et al., 2011)**, with due caution about detailed locational information that may be abused. Further research needs to include a deeper understanding of sustainable ecosystem–community relationships by additional assessments of community relationships with their supporting environments in more villages in Uttarakhand.

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FIRST RECORD OF EURASIAN OTTER (*Lutra lutra*) FROM CHILIKA LAGOON: A RAMSAR SITE SITUATED ON THE EAST COAST OF INDIA

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Abstract

*Little is known of the distribution and abundance of the Eurasian otter (*Lutra lutra*) in India, although it was historically recorded from Northern and Southern India. We recorded the Eurasian otter along with the smooth-coated otter during a fishing cat specific camera trap study undertaken in 1070km^2 area around Chilika lagoon, one of India's oldest Ramsar Sites. Our findings along with recent unpublished records of Eurasian otter presence in Satpura and Kanha landscapes in peninsular India as well as in Bhitarkanika and Coringa mangroves) in India's East coast suggest that 'missing link' populations do persist between Eurasian otter populations in the Himalayas and South India. This provides renewed thrust to detect these populations in order to bring them under the radar of research and conservation.*

Keywords: *camera trap; Chilika; Eurasian otter; fishing cat; Ramsar; smooth-coated otter*

INTRODUCTION

The Eurasian otter (*Lutra lutra*) is the most widely distributed among the 13 otter species and ranges throughout Europe and Asia as well as in parts of North Africa and the Middle East. It is classified as 'Near Threatened' in the IUCN Red List of Threatened Species with 55 out of 77 countries having unknown/declining status of populations (**Conroy et al., 1998, Yoxon and Yoxon, 2019**). Even though it has been extensively studied in Europe, where conservation efforts have resulted in a certain degree of recovery of the species, its distribution, abundance and current conservation status in North Africa, Russia and the whole of Asia remains largely unknown (**Yoxon and Yoxon, 2019**).

Researchers demonstrated the alarmingly limited availability of highly suitable otter habitat in Pakistan (**Ahmad et al., 2017**) while the Eurasian otter population in Bangladesh is critically endangered and its presence has not been confirmed since 1995 (**Feeroz, 2007**). The species has not been sighted for the last 30 years in Nepal whereas they are present but rare in Sri Lanka with new regular sightings from the central area (**Yoxon and Yoxon, 2019**).

In India, historical records of the Eurasian otter exist from Kashmir, the Himalayas and

Assam in the North, and from states of South India (**Prater, 1965**). The same pattern of a disjunct Northern and Southern population is also portrayed in the current IUCN distribution map found online (**Roos et al., 2015**). This raises questions: if there are no connecting populations in between, how could the Eurasian otter come to occur in South India?

In this context, recent reports of Eurasian otter from various places in the middle such as Satpura and Kanha landscapes, as well as unpublished records from the Eastern coast of India such as from Bhitarkanika and Coringa mangroves (**Joshi et al., 2016**; **Conroy et al., 1998; Jain, 2016**), suggest the persistence of 'missing links' in between the Northern and Southern populations in India. They also provide impetus for more Eurasian otter targeted surveys.

All otter species found in India are protected under the Indian Wildlife (Protection) Act, 1972, which lists the Eurasian otter as a Schedule II species. Thus hunting or attempting to even injure otters are punishable offences by law.

STUDY SITE

We conducted our study at Chilika, an estuarine lagoon situated on the Indian East coast during 2017–2019 (Figure 1). It is one of the oldest Ramsar sites of India and is influenced by three hydrological systems – the tributaries of the Mahanadi river system, rivers flowing into the lagoon from the Western catchment, and the saline waters flowing in from the Bay of Bengal. It is also a major wintering ground for migratory waterfowl in the Indian subcontinent and considered to be a biodiversity hotspot (**Ghosh et al., 2006**).

The North and Northeastern sections of Chilika are seasonally flooded by delta distributaries of the Mahanadi and rivulets of the Western catchment (**Chilika Development Authority, 2001**). This area receives the maximum freshwater inflow (75%) and also the maximum annual sediment load (74%, average annual sediment load of 1 million MT) of the lake. The heavy sediment load has contributed to the shallow character of the lake in this section. Here, *Phragmites*-dominated emergent vegetation proliferated since 1990 possibly due to heavy siltation and episodes of the closure and reopening of the entrance to the sea (**Chilika Development Authority, 2001**).

The soil in the upland habitat and hill tracts is predominantly lateritic with hill streams creating deep gullies and ravines interspersed with fertile depressions filled with alluvium. Upland land cover types consist of crop fields and are interspersed with terrestrial vegetation (trees, bamboo groves, shrubs and mono-plantation), human habitation and road networks. Hill tracts are covered with mixed deciduous forests with settlements and roads.

In the Southeast, the main lagoon is connected with the Bay of Bengal through an artificial mouth opening which is about 12km away from the main lagoon and at the Southwest, a 14m long channel (called the Palur canal) connects to the sea through the Rushikulya river mouth.

Figure 1: Location of the study site, Chilika

Chilika basin has a tropical climate, with average maximum and minimum annual temperatures of 39°C and 14°C respectively and average annual rainfall of about 1240 mm, 75% of which is received during June to September. The winter season starting from November marks the onset of the dry season whereas July to October is the monsoon season.

METHODS

We analysed camera trap data from a study conducted to estimate fishing cat occupancy around Chilika during 2017–2019. Camera trap images/footage of other species were also identified and all otter images/footage was segregated. After this, a film was made on our findings from Chilika and uploaded to YouTube. The link was shared on our social media platforms and members of the IUCN Otter Specialist Group contacted us and informed us that they could identify two otters from the images/footage provided in our film. Following this, we sent out nine pieces of video footage of otters (otter_28_02_2017.AVI, otter_run.AVI, IMG_0456.AVI, IMAG_0453.AVI, IMAG_0767.AVI, IMAG0768.AVI, IMAG0771.AVI, IMAG0776.AVI, IMAG3075.AVI) obtained from camera traps at different locations in Chilika to four independent experts of the group and requested them to identify the otters. The members were Nisarg Prakash, Daniel Willcox, Will Duckworth and Dr Syed Ainul Hussain from the Wildlife Institute of India, Dehradun.

RESULTS

Table 1 shows the results of the expert opinion survey.

VIDEO ID	NISARG PRAKASH		DANIEL WILCOX		WILL DUCKWORTH		DR SA HUSSAIN	
	ID	Comments	ID	Comments	ID	Comments	ID	Comments
VIDEO 1 (otter_28_02_2017.AVI)	X		X	*Unsure*	X		Eurasian	*1) Elongated muzzle*
VIDEO 2 (otter_run)	X		X		X		Eurasian	*2) Long and thick vibrissae*
VIDEO 3 (IMAG_0453.AVI)	Possibly smooth-coat		Smooth-coat	*Smooth-coat. (Tail looks very large and appearing flattened on the final 2/3rds, which is diagnostic)*	Possibly smooth-coat		Smooth-coat	*1) Short muzzle* *2) Flattened tail*
VIDEO 4 (IMAG_0456.AVI)	Possibly smooth-coat		X	*Unsure, though based on face shape and snout length I would be leaning towards smooth-coat.*	X		Smooth-coat	*3) Less vibrissae*
VIDEO 5 (IMAG_0767.AVI)	Eurasian		Eurasian	*Long, broad snout, and where visible, tail is rounded in cross-section.*	Eurasian		Eurasian	*1) Elongated muzzle*
VIDEO 6 (IMAG_0768.AVI)	Eurasian		Eurasian		Eurasian		Eurasian	*2) Long and thick vibrissae*
VIDEO 7 (IMAG_0771.AVI)	Eurasian		Eurasian		Eurasian		Eurasian	*3) Rounded tail*
VIDEO 8 (IMAG_0776.AVI)	Eurasian		Eurasian		Eurasian		X	
VIDEO 9 (IMAG_3075.AVI)	Eurasian		Eurasian		Eurasian		X	

Table 1: Table depicting decisions and comments from experts from IUCN Otter Specialist Group and Wildlife Institute of India.

DISCUSSION

The discovery of the Eurasian otter from Chilika happened by chance when we were analysing data from fishing cat specific studies conducted in the area from 2017 to 2019. During the same time, around 1000 interviews were conducted to collect information on the fishing cat and its sympatric species. We showed interviewees, most of whom were fishermen, photographs of otters and asked if they had seen these animals in their area. Most locals reported seeing otters from a large proportion of the 1070km^2 study area. They referred to these as 'Uddho' – a generic term for otters – and reported seeing them in groups. None of them reported the presence of two different otter species. This makes the findings of this study a discovery indeed, and underlines the importance of conducting intensive camera trap surveys designed to detect wetland mammals.

Moreover, most of the reports of otter sightings come from within protected areas which are more regularly surveyed by researchers than the vast amount of landscape existing outside the protected areas. Camera trapping in human-dominated landscapes is a challenge in itself. Even though a lot of reports of otters also exist from outside protected areas within human modified landscapes like from Cauvery, Goa and Tamil Nadu to name a few (**Yoxon and Yoxon, 2019**), small mammal surveys outside protected areas have only just begun to receive attention. Therefore, there is a possibility that otter populations have remained undetected, especially because targeted surveys on semi-aquatic mammals are even lesser in number.

However, under no circumstances should we undermine the possibility that such populations could be the remnants of much wider occupancies. It is common knowledge that much of otter habitat in India has been intensively modified or has contaminated waterbodies (**Bhattacharya et al., 2019**). We would like to highlight that our camera trap surveys on the fishing cat from Howrah district in South Bengal returned zero records of the otters whereas older locals reported seeing otters very commonly even 30 years back. If the Eurasian otter is present in Sundarbans (**Sanyal, 1999)** and Bhitarkanika mangrove forest (**Conroy et al., 1998**), it is highly likely that they were present in Howrah district of South Bengal but have probably become locally extinct there.

Eurasian otter populations might be persisting outside protected areas yet remain outside the purview of any protection and scientific vigilance. In the absence of previous distribution and abundance estimates, there is no way to understand population decline that has probably happened in the recent past. However, populations that still persist must be mapped and their conservation threats assessed in order to create baseline data. For example, Chilika is a Ramsar site situated outside protected areas and has two other globally threatened wetland carnivores in addition to the Eurasian otter. The presence of these wetland carnivore trio calls for the creation of a broad platform with species-centric groups like otter working groups and fishing cat working groups as well as wetland community and ecosystem-centric groups/organisations/institutions like Chilika Development Authority (CDA) to collaborate for science and conservation.

In addition, otters are often perceived as a threat to fishing gear such as fish baskets made of thinly cut bamboo sticks. These baskets are set in shallow channels by indige-

nous fishing communities, and otters reportedly break open the baskets to take the fish. This situation is conducive to the development of negative interactions between humans and otters. This, in some cases, even leads to retaliatory persecution of otters although we did not detect large-scale killing of these species anywhere around Chilika. Otters that sometimes become entangled in fishing nets are reportedly killed and their meat eaten, according to local fishermen.

Some of the prominent threats to otters worldwide come from the international demand for its fur, as well as from the pet trade. Online information like scientific publications, news articles and social media posts might be inadvertently helping these illegal and immoral networks to thrive. Therefore, we should be careful while disseminating sensitive information about otters, and location details should only be available to researchers and not be in the public domain. However, our study also shows that social media has enabled us to network like never before to the benefit of science.

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PARTICIPATORY MONITORING COMMITTEES: AN OPPORTUNITY FOR NEOTROPICAL OTTER CONSERVATION IN MEXICO

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Abstract

The neotropical otter, Lontra longicaudis*, is listed as an endangered species in Mexico and it is important to implement programmes for the monitoring of its populations and its conservation. The inclusion of civil society in conservation programmes has become necessary to increase their success in the medium and long term. In the present study the experiences obtained by including local communities in several monitoring and conservation programmes for the neotropical otter in seven Natural Protected Areas of Mexico are presented. Participatory Monitoring Committees were created and trained, composed entirely of men and women from the local communities, most of whom were involved in fishing, aquaculture, and agriculture. Several workshops on environmental education were also held at the study sites, aimed at the entire population of the communities, on the relevance of otter conservation and how they can contribute to its preservation. There was an average abundance of 0.25 otters/km, equivalent to other studies conducted by researchers with experience in otter monitoring. The lack of awareness of the importance of the species as a top predator and the negative perceptions of the species changed positively, which is essential for the conservation of the species. In Mexico, the integration of local communities is essential for the conservation of the neotropical otter, which can be replicated in other areas of its distribution or for other otter species.*

Keywords: *Neotropial otter; participative monitoring; conservation; Natural Protected Areas*

INTRODUCTION

The neotropical otter in Mexico

Freshwater ecosystems are environments that cover less than 15% of the world's terrestrial ecosystems, yet account for more than 10% of all global biodiversity. These environments are considered fragile when it comes to environmental disturbances and deterioration, which is why it is a priority to improve actions to preserve these environments and the species inhabiting them. An emblematic species

with a significant role in freshwater ecosystems are semi-aquatic otters that live around the globe.

In Mexico there are 3 of the 13 species of otter that exist in the world: the sea otter (*Enhydra lutris*), the North American river otter (*Lontra canadensis*), and the neotropical otter (*Lontra longicaudis*). However, the neotropical otter is the one that presents a wide distribution throughout the country **(Díaz-Gallardo et al., 2007; Gallo-Reynoso and Meiners, 2018)** and it is considered the top predator species of the riverside environments in Mexico **(Soler, 2002)**. This species is highly dependent on its aquatic habitat dynamics such as water availability, riparian vegetation, and abundance of prey **(Gallo-Reynoso, 1997; Briones-Salas et al., 2013; Hernández-Romero, 2011; Hernández-Romero et al., 2018)**. This makes the species an indirect biomonitor of the conservation status and disturbance of aquatic ecosystems **(Ramos-Rosas et al., 2012, Duque-Dávila et al., 2013, Latorre-Cárdenas 2013)**.

The neotropical otter in trouble

Unfortunately, several factors, such as the disruption and degradation of aquatic habitats, hunting, and conflicts between fishermen and the otter, have led to the reduction and loss of otter populations in some areas **(Gallo-Reynoso, 1997, Briones-Salas et al., 2013, Hernández-Romero, 2011, Hernández-Romero et al., 2018)**. The aforementioned has caused the otter to be catalogued as a "Threatened Species" in the NOM-059-SEMARNAT-2010 **(SEMARNAT, 2010)**, and as Near Threatened by the IUCN **(Rheingantz and Trinca, 2015)**. Despite its conservation status, few studies have estimated the species' population dimensions and habitat status (**Macías-Sánchez, 2003; Díaz-Gallardo 2007; Briones-Salas et al., 2008; Casariego-Madorell et al., 2008; Rangel-Aguilar, 2008; Hernández-Romero, 2011; Arellano et al., 2012; González-Chisten et al., 2013)**, which is why it is important for the species to be monitored throughout its distribution in Mexico, in order to generate future conservation actions.

Local populations and conservation programmes

A monitoring and conservation programme is limited in effectiveness if local populations are not included in these programmes, since the people who live in these communities are the ones who use the resources and make the decision whether to conserve their resources or not **(Botello et al., 2011)**. The goal of Participative Monitoring Committees (PMCs) is to integrate local communities into the collection of data for monitoring and conservation programmes of species **(Villaseñor et al., 2016)**. Furthermore, they allow local people to build local skills and raise awareness about the care of their species. Thus, it is vitally important to take advantage of the wealth of empirical knowledge of local populations and training of PMCs in species conservation programmes, which represent an instrument to strengthen pride, sense of belonging, and social participation with respect to the conservation of these species and their habitat **(Villaseñor et al., 2016)**.

For this reason, it is necessary to carry out standard monitoring programmes that include the participation of civil societies in the development of conservation programmes for the neotropical otter in Mexico. This paper is a compilation of the experiences achieved in the incorporation of local communities into neotropical otter monitoring and conservation efforts in Mexico.

METHODOLOGY

The neotropical otter monitoring and conservation programmes were implemented in seven Natural Protected Areas (NPAs) located in Southeast Mexico (Figure 1) during the period 2015 to 2018. These programmes consisted in training PMCs and the implementation of environmental education workshops aimed at the local communities near the areas of study.

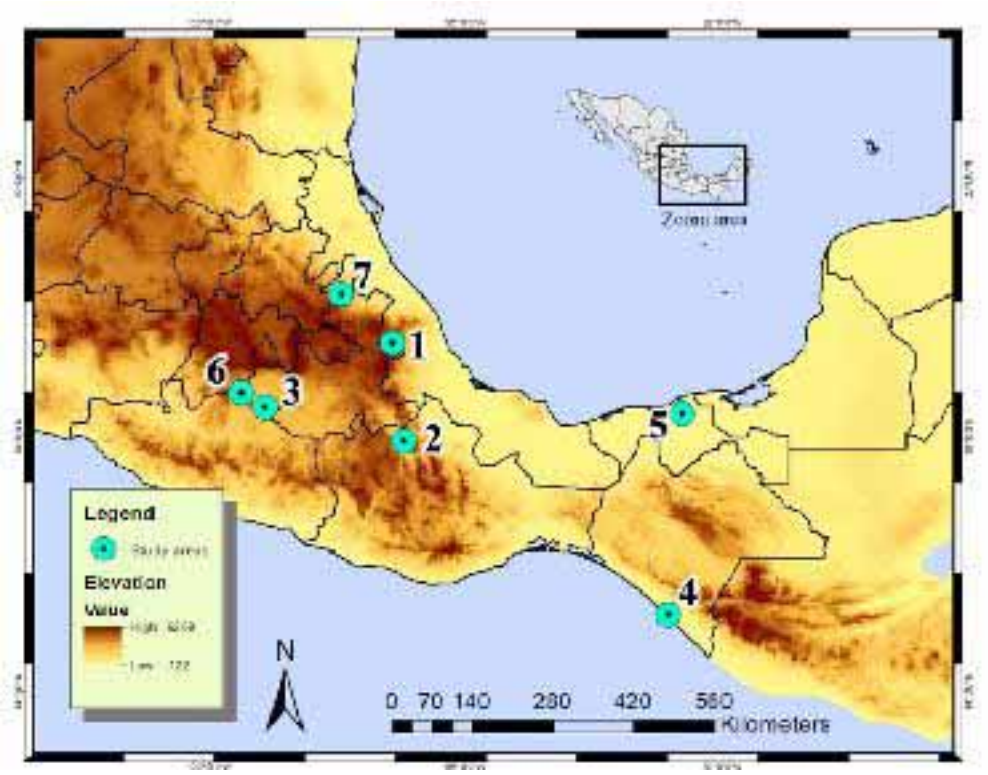

Figure 1. Location of the seven Natural Protected Areas (NPAs) in Mexico where the monitoring and conservation programmes of the neotropical otter,* Lontra longicaudis*, were carried out. The numbers on the map correspond to the names of the NPAs (see Table 1).

Participative Monitoring Committees (PMCs)

In order to integrate local communities into neotropical otter monitoring and conservation programmes in Mexico, seven PMCs have been formed, with 57 people from seven PNAs (Table 1). People who were part of the PMCs were those who live there in local communities and are involved in agriculture, fishing, or aquaculture activities.

Table 1. Participative Monitoring Committees established for the monitoring and conservation of the neotropical otter in Mexico

Id	Protected Natural Area (PNA)	Location	Number of people forming the PMC
1	Cofré de Perote National Park	Veracruz	8
2	Tehuacán-Cuicatlán Biosphere Reserve	Oaxaca	7
3	Sierra de Huautla Biosphere Reserve	Morelos	6
4	La Encrucijada Biosphere Reserve	Chiapas	6
5	Pantanos de Centla Biosphere Reserve	Tabasco	19
6	Grutas de Cacahuamilpa National Park	Guerrero	7
7	Natural Resources Protection Area Necaxa Basin	Puebla	4

For the formation of each PMC, there were theoretical and practical workshops where people were shown, through presentations, the main characteristics of the neotropical otter, its conservation status, and ways to preserve it. During the workshops, the members were trained to recognise the traces of the species in the wild and to systematically collect data in the field. Also, they were taught how to use GPS, trail cameras, and fill out field forms and take pictures.

Environmental education workshops

Workshops were held in the seven study areas, where locals were invited to participate. The workshops were targeted at two main sectors from the local populations: the first was considered the most influential one for the otter and was composed of people dedicated to fishing and aquaculture; a second sector was aimed at the population in general, divided into workshops for adults and another for younger people and children.

For the first sector, workshops emphasised the ecological importance of the neotropical otter in aquatic systems of their communities, the main threats they face for their conservation – stressing overfishing and the conflicts between fishing activity and the otter as a predator – and about the environmental legislation that protects this species. For the second sector of the population, workshops were aimed at emphasising the importance of the conservation of the otter, about its biology, the importance of the otter as a bio-indicator for the quality of its habitat, and about actions that local people can do to protect them.

RESULTS AND DISCUSSION

Participatory Monitoring Committees (PMCs)

Figure 2. Sampling and data collection of the neotropical otter,* Lontra longicaudis*, carried out by the Participatory Monitoring Committees in the seven Natural Protected Areas.

Surveys were made by the PMCs along the rivers from the above-mentioned seven Natural Protected Areas, in which there was a total of 709 neotropical otter records (Figure 2). These records consisted of otter sightings, excreta (spraints), footprints, and burrows. However, only fresh spraints were used to estimate the population abundance of the species (Table 2). As a result, the abundance values show some fluctuation between each area of study, but the reason is the particular conditions of

each location. There was an average abundance of 0.27 otters/km of river, which is a very similar value reported for other areas in Mexico.

Table 2. Results of abundance and records of neotropical otters by the Participatory Monitoring Committees.

Id	Área Natural Protegida (ANP)	No of otter records	Abundance No of otters/km
1	Cofré de Perote National Park	58	0.24
2	Tehuacán-Cuicatlán Biosphere Reserve	240	0.252
3	Sierra de Huautla Biosphere Reserve	61	0.32
4	La Encrucijada Biosphere Reserve	78	0.70
5	Pantanos de Centla Biosphere Reserve	97	0.14
6	Grutas de Cacahuamilpa National Park	9	0.033
7	Natural Resources Protection Area Necaxa Basin	166	0.22
	Total	**709**	**0.27**

The results of neotropical otter abundance obtained by the PMCs are similar to those obtained by other studies in Mexico. This shows that the incorporation and training of the local population can give reliable results for the implementation of medium- and long-term monitoring programmes. On the other hand, the inclusion of local communities allows the formation of local capacities, which generates a greater impact on conservation projects, since local communities can in the future implement their own monitoring and conservation programmes for otters and other wildlife species. With the inclusion of fishermen and fish farmers in the PMCs, there has been a change in people's perceptions about the otter, since it was initially perceived in a negative way as a harmful and predatory species for fisheries resources. By understanding its importance, population dynamics, and that the otter is a threatened species, the perception changed to favourable, which made other people dedicated to the fishing sector join the work of monitoring and conservation efforts of the species in their regions.

Conservation threats for otters at the study areas

During the development of the projects and the work done by the PMCs, the main threats to otter conservation in the study areas were identified. These threats were taken into consideration by direct observation, interviewing local people, and activities implemented in the study areas (Table 3).

Table 3. List of the principal threats for the conservation of the neotropical otter identified in the study areas. Threat level: High, medium, low. Threat Site refers to the Natural Protected Area where the threat was identified, the numbers represent the code of each site, see Table 1.

Type of threat	Threat level:	Threat Site
Pollution of bodies of water	High	2, 3, 5, 6, 7
Ignorance of the species	High	1, 2, 3, 4, 5, 6, 7
Overfishing	High	1, 2, 4, 5, 6, 7
Mining	Low	2, 3
Hunting	Low	1, 4, 5
Taking otters as pets	Medium	3, 4, 5
Deforestation	Medium	1, 2, 4, 7

Environmental educational workshops

Over 80 environmental educational workshops were given to more than 1200 inhabitants in the seven Natural Protected Areas where the neotropical otter conservation projects were carried out (Figure 3).

The results of these workshops showed that there was a considerable lack of awareness about the neotropical otter and its biological requirements. This implied a threat to the conservation of this species, as this meant that local populations were indifferent to conservation projects.

The little knowledge that the local communities had about the species was mostly wrong, believing that they were a harmful species for fishing activities, an aggressive species and responsible for the decrease of fish and shrimp in the river. Thanks to the workshops and outreach materials such as leaflets and posters at the end of the projects, an important change in the people's attitude towards the conservation and importance of the neotropical otter in their communities was observed. Some of them adopted it as a flagship species for the conservation of their communities' rivers.

Figure 3. Awareness workshops conducted in local communities in the areas of study on biology and the importance of conserving the neotropical otter.

LIMITATIONS

In this study otter abundance was evaluated using the number of spraints as has been done in many other studies of otter populations. **Yoxon & Yoxon (2014)** showed that there is no correlation between numbers of spraints or sprainting sites and actual otter numbers. However, studies of population sizes inferred through molecular and excreta data show that values obtained from fresh excreta counts can give approximations of population size **(Sittenthaler et al., 2020)**.

CONCLUSION

The inclusion of local communities in otter monitoring and conservation projects provides a great opportunity for a higher degree of success in such projects. The lack of knowledge about aspects of the biology of the neotropical otter and its ecological

importance in freshwater environments is a potential barrier to the success of a conservation programme for the species.

Participatory Monitoring Committees proved to be a viable alternative for carrying out monitoring and conservation programmes for the neotropical otter in both the medium and long term, and which would be applicable to other otter species around the world.

In addition, the implementation of the PMCs encourages the development of local skills among the residents and allows them to get involved and carry out conservation projects in their communities.

Thanks to the PMCs, the information obtained is comparable with other studies of neotropical otter population sizes in other parts of Mexico, which allows for a better regional evaluation of the species' populations and thus allow better decision-making for its conservation.

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Disclosure Statement

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BRIDGING THE GAP: PRELIMINARY OTTER (*Lutra lutra*) SURVEY ON THE LINKS BETWEEN THE RIVERS DEE, DON, AND SPEY CATCHMENTS, SCOTLAND, 2019

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Abstract

During May 2019 a select few waterbodies were surveyed in order to ascertain the potential links for an otter between the Rivers Dee and Don at their sources. This survey also included parts of the neighbouring River Spey catchment. Otter activity in two study areas was based on finding spraining sites along the waterbodies surveyed. Although most spraints found were old, recent spraints were found in both study areas. The River Gairn was deemed the most active of the surveyed waterbodies, and can be considered an important bridge between the Rivers Dee, Don, and Spey catchments. However, the most active connection immediately linking the two catchment areas found was between the headwaters of the River Don and the River Avon (Spey catchment), via Allt Roderick. Nevertheless, the shortest distance separating neighbouring waterbodies occurred between the Rivers Dee and Spey catchments, in which mainly old spraints were found, possibly indicating a less active area. There are many viable connections for an otter between several river catchments in the Cairngorm region and it would initially seem that some of them are utilised more than others.

Keywords: *Catchment links; Eurasian otter;* Lutra lutra*; rivers Dee, Don, and Spey; spraints.*

INTRODUCTION

Continuing on from the previous surveys conducted on the River Dee and River Don **(Rothwell, 2017, 2018, 2019)**, the question arose "if an otter had followed a main river to its upper most reaches, where would it be likely to go from there?" The aim of this preliminary survey was to establish the routes which might be utilised by otters that link these two major river catchments.

Geographically, the shortest distance between the River Dee and the River Don is amongst their associating headwater tributaries arising from the peat bogs on Brown Cow Hill, along the Grampian mountain range. Furthermore, there is also good connectivity between the headwaters of both the River Dee and the Don, with the neighbouring River Spey catchment, to the west. Due to time constraints, only a select few survey sites were chosen during this study.

STUDY AREA

For ease of reference, two distinct survey areas were established in relation to the uppermost headwaters of the River Dee and the River Don, which also incorporated parts of the River Spey catchment. Area 1 was located in the National Grid hectads of NJ10 and NJ20 and comprised waterbodies from all three catchments; Area 2 was located in hectads NH90 and NN99, of which only the Spey catchment waterbodies were surveyed (Figure 1).

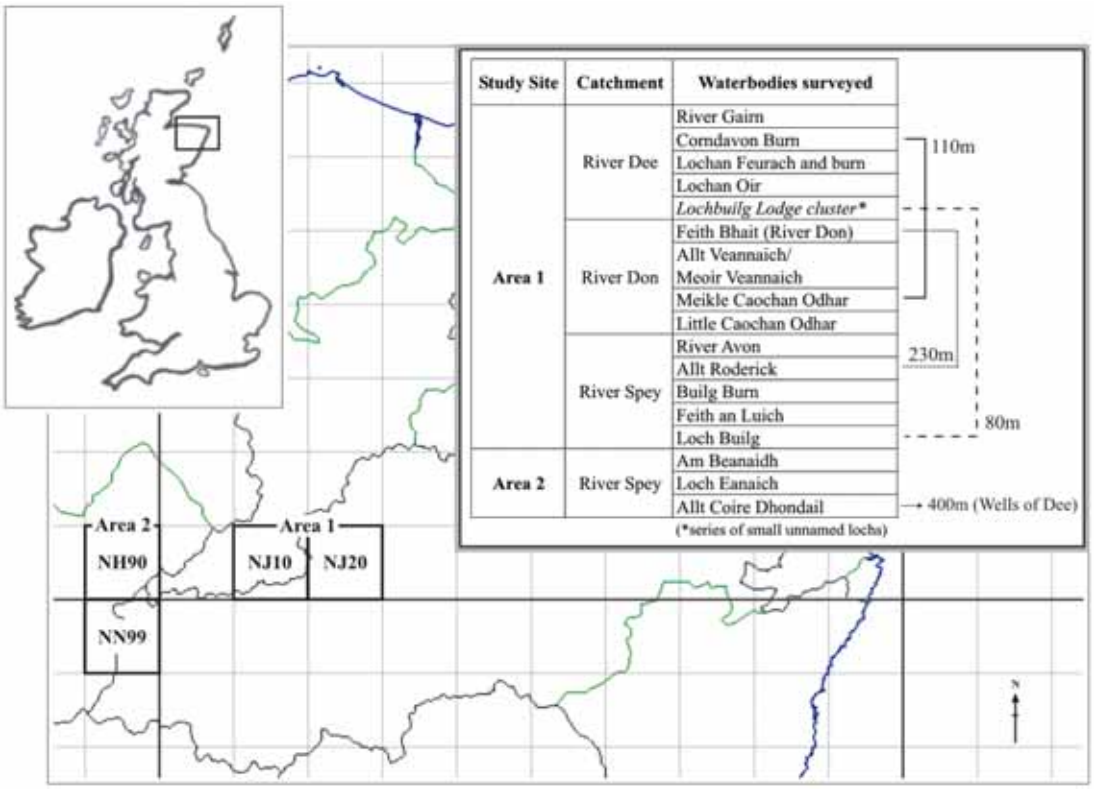

Figure 1. Study location and listing of waterbodies surveyed in each area; with the relative distance between the nearest waterbodies from different catchments also shown. Note: The Wells of Dee were not surveyed.

METHODS

A series of survey sites were chosen on either side of the riverbanks, based on ease of accessibility. The distance between the sites was dependent on the size of the river. Along the larger Rivers Gairn (Area 1) and Am Beanaidh (Area 2), spot-checks were made every 2km. For all the other waterbodies surveyed, the spot-check intervals were reduced to every 100m. The difference in method selection was due to a combination of the relative linear length of the waterbodies targeted in each study area, physical terrain, and time constraints.

At each survey site, any field signs indicating otter activity found were recorded. This included spraints (otter droppings), footprints, and rest-sites (areas utilised by

otters for sleeping or resting). If a survey site was found to be negative, up to 15 minutes was spent traversing the riverbanks to establish if there were any field signs evident beyond the initial focus point. It was acknowledged that the distance travelled within the 15 minutes of search time would vary depending on the limitations of the terrain and operative fatigue. Any incidental field sign of otter activity found during travel to the next survey site was also recorded.

An assessment of spraint contents was made in the field with a x10 magnification hand lens. Where this spraint analysis could not be done in the field, samples were taken for subsequent examination in a more controlled environment. In the laboratory, each spraint collected was put separately into a jam jar with hot water and a denture-cleansing tablet. The samples were soaked in solution for 24 hours and then rinsed through a 0.5mm sieve. The spraint contents were allowed to dry at room temperature on filter paper. The dry spraint contents were then examined under a binocular microscope and identified using a personal reference collection and published keys from **Webb (1977)**, **Watson (1978)**, and **Conroy et al. (1993)**.

RESULTS

This survey was conducted for six days during favourable weather conditions in May 2019. Spraint sites were found on all of the waterbodies surveyed in Area 1, and on two of the waterbodies in Area 2 (Table 1).

Table 1. Number of spraint sites and number of recent or old spraints found during spot-checks on the waterbodies surveyed.

Study Site	Catchment	Waterbody	Survey Distance	Spraint Sites	Recent Spraints	Old Spraints
Area 1	River Dee	River Gairn	14km	44	80	75
		Corndavon Burn	**2.4km**	3	2	7
		Lochan Feurach and burn	780m	10	6	19
		Lochan Oir	350m	4	0	9
		*Lochbuilg Lodge cluster**	500m	3	0	9
	River Don	Feith Bhait (River Don)	500m	2	2	2
		Allt Veannaich/	5km	5	5	2
		Meoir Veannaich **		4	1	7
		Meikle Caochan Odhar	**2.2km**	5	2	7
		Little Caochan Odhar	200m	1	0	2
	River Spey	River Avon	1.5km	7	10	5
		Allt Roderick	1.3km	14	15	10
		Builg Burn	700m	7	13	6
		Feith an Luich	**440m**	4	0	6
		Loch Builg	2km	16	0	63
Area 2	River Spey	Am Beanaidh	13km	12	2	36
		Loch Eanaich	1km	4	0	7
		Allt Coire Dhondail	1.8km	0	0	0

(*series of small unnamed lochs; results combined)

(**No distinct separation on ground or maps)

Figures in **bold** indicate full linear length of waterbody surveyed

Allt Coire Dhondail, a mountain stream leading to Loch Eanaich in the Spey catchment (Figure 2), was the only waterbody with no evidence of otter activity. However, the survey on this stream ceased once the snowline was reached (*c*.980 m.a.s.l.). The upper reaches of this small stream is the closest to the Wells of Dee and this part of the Dee catchment was not surveyed at this time.

Figure 2. Allt Coire Dhondail (foreground), a waterbody with no evidence of otter activity, which leads on to Loch Eanaich and Am Beanaidh (background) in the Spey catchment.

Recent spraint deposits were found in each catchment in both areas surveyed previously; however, the majority of spraints found in this study were old remains.

A small number of spraints were found on the minor tributaries and headwaters of the River Don, of which Meikle Caochan Odhar, a montane meltwater, arises from the peat bogs on Brown Cow Hill at a height of *c*.814m. The Corndavon Burn also has its origins here and flows south into the River Gairn (major tributary of the River Dee). However, there were no signs of otter activity found at the peat bogs or along the meltwaters above *c*.570m. Snow was still prevalent on the ground above *c*.750m which may have impeded the survey and there were no otter tracks found in the snow. However, plenty of mountain hare (*Lepus timidus*) tracks and runs were found.

Several recent spraints were found along Allt Roderick (tributary of the River Avon at Glen Avon, which runs East to West), and a fresh spraint was located on Fèith Bhàit (embryonic River Don) *c*.260m from Allt Roderick (Figure 3). The Builg Burn also joins the River Avon at Glen Avon and runs South to North. At the Northern section surveyed (480m), there were 13 recent spraints at 6 spraint sites. Conversely, at its Southern end (where it is linked to Loch Builg via a small burn called Feith an Luich) only old spraints were found. The Feith an Luich itself also only had old spraints on the few sprainting sites found. It should be noted however that the

majority of the Builg Burn in between these two sites was not surveyed (*c*.3.2km). A relatively high number of old spraints were found along Loch Builg.

Figure 3. Allt Roderick, a small tributary linking the Don and Spey catchments, had many spraints recently deposited along its banks.

The series of small lochans to the South of Loch Builg marked the separation of the Rivers Dee and Spey catchments. The shortest distance between any of the catchments studied in this survey was located at *c*.80m (Figure 1). All of the small lochans in this area, including most of Lochan Feurach's outflow, had old spraints located along their banks. Six recent spraints were however found on the Lochan Feurach outflow in the area where it joins the River Gairn.

The River Gairn was the largest river examined in this survey (Figure 4) and consequently most of the spraint sites and the highest number of spraints were located on this river.

Figure 4. River Gairn had the most recent spraints found of all the surveyed waterbodies, and can be considered an important bridge between the Rivers Dee, Don, and Spey catchments.

The second largest river surveyed was Am Beanaidh on the Spey catchment and all but two of the spraints found on this river were old deposits. Both of the recent spraints were located near Coire na Leacainn, along Gleann Eanaich, Rothiemurchus. Only a small number of spraints sites were found on Loch Eanaich.

Spraint Analysis

The majority of the spraints found were examined in the field (365 from Area 1, and 45 from Area 2), and the results are summarised in Figures 5 and 6. Only eight spraints were taken for further examination.

When combining the results from the catchments from each study area, non-fish prey items were mostly found in spraints from Area 1, particularly amphibian and mammal (50 and 30.6% occurrence respectively) (Figure 5). A low percentage of bird remains were only found in spraints from Area 1. Fish remains only occurred in 15.2% of the samples from Area 1, of which the main composition were salmonids (salmon and trout species) at 63% occurrence (n=34) (Figure 6). Eel occurred in nine spraints (all from the River Gairn), stickleback remains were found in two spraints from Allt Veannaich at the reservoir; and a minnow *sp*. was found in three spraints from the banks of Loch Builg.

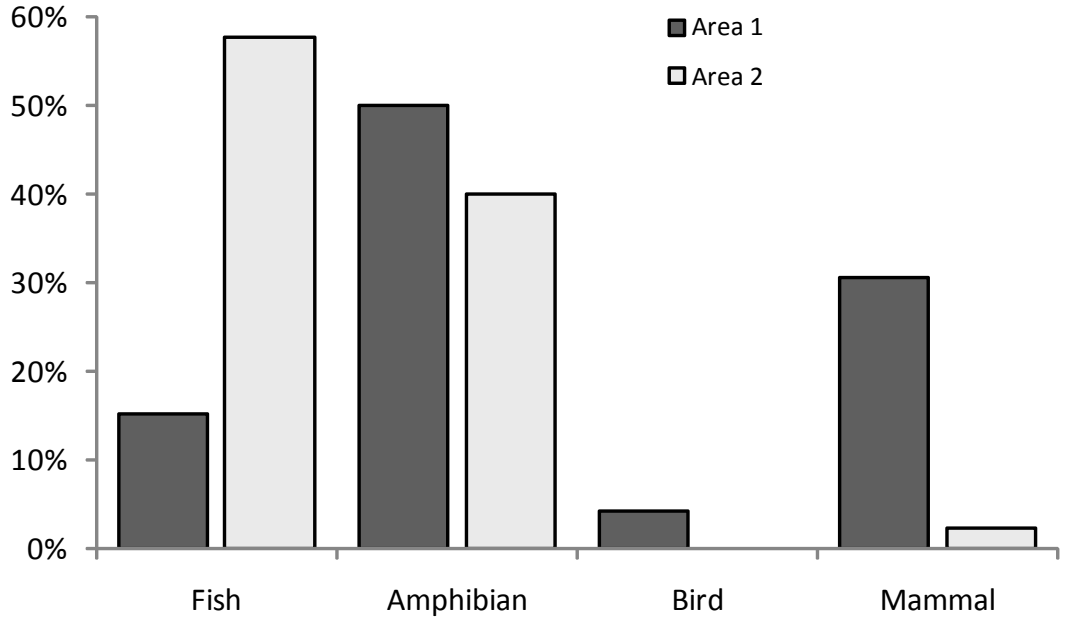

Figure 5. Combined percentage occurrence of prey items from spraints observed in situ (n=410) and laboratory analysis (n=8), from waterbodies in two study areas.

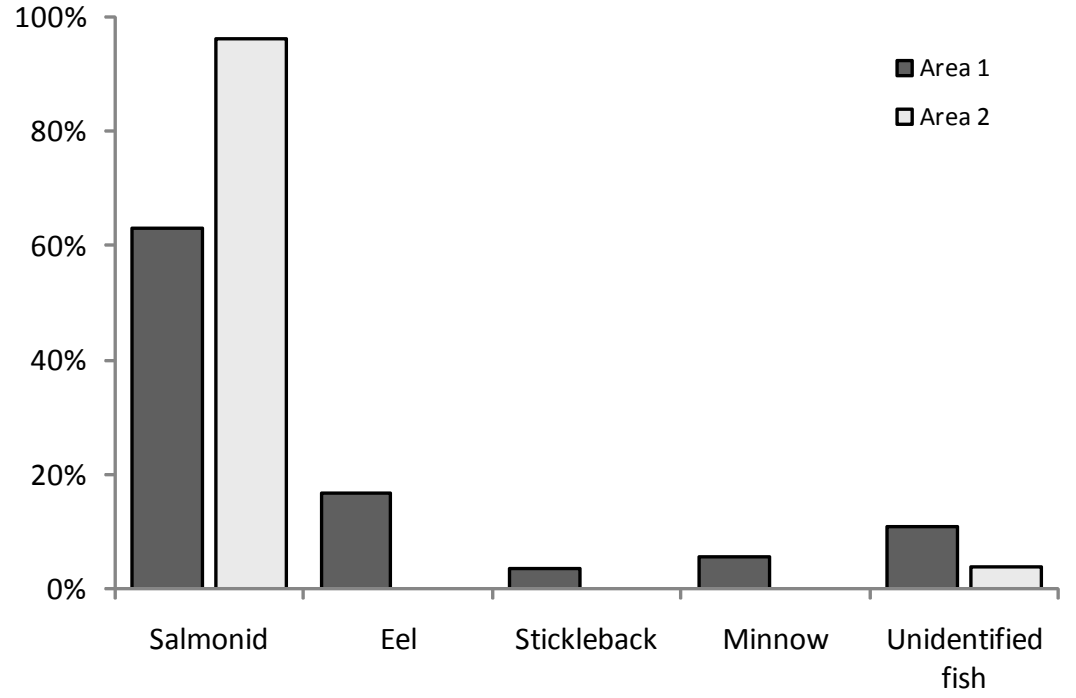

Figure 6. Percentage occurrence of the fish prey items in spraints examined from the waterbodies in two study areas.

The most abundant prey items found in spraints from Area 2 were fish bones at 57.8% occurrence. The fish remains were dominated by salmonids (96.2% occurrence; *n*=26), and these were only found at Am Beanaidh. Amphibian remains

were the most non-fish item found in spraints from Area 2 (40% occurrence; *n*=18). One spraint from Am Beanaidh contained mammal remains and none of the spraints found in Area 2 contained bird remains.

DISCUSSION

Recent otter activity (identified by recent spraint deposits) were found in each catchment in both areas surveyed, although the majority of spraints found in this study were old. Determining the relative age of spraints can be very subjective. Some that have been deposited recently can sometimes at first glance "*look*" old, especially when there is prolonged exposure to the elements (personal observation). From an historical study conducted on the River Dee, **Jenkins & Burrows (1980)** showed that 83 to 94% of spraints disappeared after seven weeks. With this in mind, it could be considered that the most active waterbody surveyed from Area 1 was the River Gairn, but this is not surprising as it is a major tributary river in itself. It can be postulated that the River Gairn could therefore be part of the main foraging territory of an otter, and from here an otter would have links to the neighbouring Rivers Don and Spey catchments.

A secondary concentration of recent activity was observed on Allt Roderick, and the Northern end of the Builg Burn together with its association with the River Avon. Only *c*.230m separates the River Don and Allt Roderick, and as recent spraints were also found on the River Don, it could be assumed that an otter is readily moving between the Don and Spey catchments via Allt Roderick. This would also seem to be the most active connection between all the catchments examined in this survey.

The route between the catchments of the rivers Don and Dee would seem to be more well-defined as indicated by the number of recent spraints found. It follows the embryonic Don down to the River Avon and then back upstream along the Builg Burn, and joins onto the River Gairn (via the "*Lochbuilg Lodge cluster*"). This can be compared to the alternative mountainous link between two associating meltwaters on Brown Cow Hill (Meikle Caochan Odhar and the Corndavon Burn). On these two small streams spraints sites were only found on their lower reaches, and it was presumed that an otter only ventured part way up the hill on each side. It is of course plausible that an otter could easily climb the hill and cross over into the neighbouring catchment, but with the lack of field evidence found this could not be confirmed. Furthermore, there were a relatively high number of spraints found along the banks of Loch Builg. Although these were all old, it is still indicative of more otter activity in this area than that on the Brown Cow Hill route.

Within Area 2 only three waterbodies were surveyed, essentially marking out one of the possible links between the Spey and Dee catchments. Spot-checks along 13km of Am Beanaidh resulted in several old spraints and only two recent spraints being found. Furthermore, no signs of otter activity were found on Allt Coire Dhondail.

This suggests that it is an area of much less activity and the link between Allt Coire Dhondail and the Wells of Dee may be utilised even less. Other links to the Dee catchment can be found further South via the River Eidart and the Geusachan Burn, or the River Feshie and the Geldie Burn. The distances between each of these links are much shorter than the mountainous route to the Wells of Dee.

There are many viable connections for an otter between the Rivers Dee, Don, and Spey catchments in the Cairngorm region. It would initially seem that some are utilised more than others. The most substantial link found during this brief survey was between the headwaters of the River Don and the River Avon (Spey catchment). However, this was not the shortest link (Figure 1). Instead it was probably *chosen* as it does represent a relatively short distance from the headwaters of one river system to a quite substantial river in a neighbouring catchment. Therefore an otter may have more resources immediately available to it. It is well documented **(**e.g. **Jenkins and Burrows, 1980; Kruuk, Conroy and Moorhouse, 1991; Yoxon, 1999)** that the distribution of otters is affected by the availability of resources, such as food and shelter. The seasonality of amphibians and fish migrations, particularly in the upper reaches and headwaters of river catchments, is also likely to influence the choice of foraging locations by an otter. Amphibian and mammal bones superseded fish remains in spraints from Area 1 (Figure 5). Amphibian bones were also the most common non-fish prey items found in spraints from Area 2. The high proportion of non-fish prey, particularly in Area 1, could imply a choice of foraging location coinciding with the seasonal glut of amphibians together with low fish productivity in the waterbodies at that time of year?

It has to be said that the concluding remarks in this discussion cannot justify which routes are likely to be taken by an otter, after all this survey was based on finding spraint sites with spot-checks along a small number of waterbodies. Otters on freshwater systems do tend to have vast home ranges **(Green, Green and Jefferies, 1984; Kruuk et al., 1993; Durbin, 1998)**, and their subsequent spraint distribution may reflect that. This study was conducted on a few days, which only represents a snap-shot of the spraint distribution pattern. An otter may be utilising different areas in its territory on sites not surveyed, hence why some areas seemed to have more activity on them. It may be a case of a single otter travelling across large distances leading to the high proportion of old spraints found. Localised activity immediately next to sites with a few old spraints may also indicate possible territory boundaries with other otters? However, the number of spraints and their distribution does not indicate the number of otters **(Yoxon and Yoxon, 2014)**.

The Cairngorm region by its very nature could provide many links with a multitude of rivers, tributaries, and montane meltwaters, for a foraging otter. Further surveys would be needed to ascertain a better idea of the movements of otters in the Cairngorms, and it is hoped to follow up with a more in-depth examination of the

catchment links in the Cairngorm region. However, on first account, this study has shown that some links would seem to be *selected* by otters.

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Disclosure Statement

No potential conflict of interest was reported by the author.

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A PRELIMINARY POPULATION ESTIMATE OF THE VULNERABLE SMOOTH-COATED OTTER *Lutrogale perspicillata maxwelli* (HAYMAN 1956) IN THE HAWIZEH MARSH IN SOUTHEASTERN IRAQ WITH CONFIRMED OCCURRENCE IN THE HOOR OL-AZIM WETLAND IN SOUTHWESTERN IRAN

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Abstract

The smooth-coated otter Lutrogale perspicillata *(endemic subspecies* L. p. maxwelli*) is a flagship and endemic subspecies in Iraq and is confined to the extensive marshlands in the South. It was described for the first time from the Al-Hawizeh Marsh in 1950s. The population size was enigmatic and it was believed to have faced global extinction due to disturbance during the Iraq-Iran war in 1980s and subsequent drainage of the Lower Mesopotamian wetlands in 1990s. In addition, there have since been no attempts to investigate the population which is vital to design further conservation actions. Five field surveys were conducted in March and July 2017 in the Hawizeh Marsh (1377km^2), a transboundary wetland of international importance (UNESCO and RAMSAR site) in Southern Iraq. Line-transects covering three study plots were performed and five individuals were recorded. The estimated species density was (0.6753 individuals/km^2) and the estimated population size in the Hawizeh Marsh was ca. 930 individuals. This is the first preliminary estimation for the* L. p. maxwelli *population in Iraq and further surveys may reveal better estimations. The current estimation suggests that the species has an Extent of Occurrence (EOO) less than 5000km^2 and an Area of Occupancy (AOO) less than 500km^2 with severely fragmented locations (≤5); therefore, a comprehensive review of its conservation status is recommended. Furthermore, the species has recently been observed in the Hoor ol-Azim Wetland in the Iranian territory adjunct to the international border with Southeastern Iraq. This is the first confirmed occurrence for this species in Iran. The otters are probably using the monotonic marshy habitats to move from Southeastern Iraq into Southwestern Iran where transboundary populations may be present, a subject which*

requires further investigation, international collaboration, and a comprehensive review of the conservation status of the study species.

Keywords: biodiversity; conservation; mammals of Iraq; Mesopotamian wetlands; protected area; range extension

INTRODUCTION

The smooth-coated otter (*Lutrogale perspicillata,* Mustelidae) is one of the 13 otter species distributed worldwide with the largest populations in Asia (**Yoxon and Yoxon, 2014**). The subspecies *L. p. maxwelli* is endemic to the extensive reed beds of the Lower Mesopotamian marshes of Southern Iraq (**Al-Sheikhly and Nader, 2013; Al-Sheikhly et al., 2017**). It was described for first time in 1956 from the village of Abusakhair (Faraijat tribe, *c.* 56km Southeast of Amara, along the Tigris River) and from a tumulus island village called Daub, *c.* 19km Northwest of Al-Azair (west of the Tigris River) in Southern Iraq (**Hayman, 1956; Maxwell, 1957, 1960; Young, 1977**). Later surveys recorded it from Rass Al-Beisha in Fao, Abu Al-Khasib and Umm Al Rassas Island, Abu Ajaj in Western Al-Hammar Marsh, Umm Al-Na'aj Lake in Hawizeh Marsh (**Al-Sheikhly and Nader, 2013; Al-Sheikhly et al., 2014; 2015**). Furthermore, an isolated population of *L. p. maxwelli* was found in TaqTaq in Northern Iraq (Kurdistan region) and this represents a significant extension to the known zoogeographical extent of the species so far (**Omer et al., 2012; Al-Sheikhly and Nader, 2013**). However, the occurrence of the species in Northern Iraq was not verified by **Moretti et al.** (**2017**). There was a marked decline of the endemic population due to excessive hunting, trapping and habitat destruction and fragmentation and therefore it was listed as Vulnerable by the International Union for Conservation of Nature (IUCN) Red List (**de Silva et al., 2015**).

During the period of 1991 to 2003, the Southern Iraqi marshes were ditched and drained by the previous Iraqi regime for political reasons and this negatively impacted on the wildlife of Southern Iraq (**Richardson and Hussain, 2006; IMOE, 2019**). It was believed that the drainage of the Lower Mesopotamia wetlands would almost certainly result in the global extinction of *L. p. maxwelli* (**Scott and Carp, 1982; Scott and Evans, 1993**) and after 1980s it was believed to be extinct. However, during field surveys carried out in 2007 to 2017 its continued occurrence in the Southern Iraqi marshes was confirmed (**Al-Sheikhly and Nader, 2013; Al-Sheikhly et al., 2017; IMOE, 2019**).

The main resident isolated population of the smooth-coated otter in Iraq is found in the Hawizeh Marsh, one of the major Mesopotamian wetlands which had not been completely drained during 1990s (**Al-Sheikhly et al., 2017; Nature Iraq, 2017**). The Hawizeh Marsh is a vast complex of permanent and seasonal freshwater wetlands covering a total area of 1377km^2 and extending along the geographical zone (31°00' N–31°45' N, 27°25' E–47°50'E) between Myssan (Missan) and Basra

(Basrah) provinces (**RSIS, 2019**). It is a transboundary wetland situated to the East of the Tigris River, straddling the Iraq-Iran Southern borders with ca. 75%-80% located in Iraq and the rest in Iran where it is known as the Hoor ol-Azim (Hawr Al Azim) Wetland (**Evans, 1994; Nature Iraq, 2017**). The occurrence of *L. p. maxwelli* was used as a vulnerability criterion to evaluate the biodiversity status of the Hawizeh Marsh which has been designated as one of the major Key Biodiversity Areas (KBA#73), Nature Reserve, Ramsar and UNESCO's World Heritage sites in Iraq (**UNESCO-40 COM, 2016; Nature Iraq, 2017; RSIS, 2019; UNEP-WCMC, 2020**).

The current status of the smooth-coated otter in Iran is still enigmatic. According to **Harrington** (**1977**) and **Tajbakhsh** (**1995**) this species had not been recorded in Iran but it was suggested that it could possibly be found in the Southern rivers of the country (e.g. **Gutleb et al., 1996**). Evidence of its occurrence in Iran based on skin specimens were obtained from the Hoor ol-Azim Wetland, at the border to Iraq in 1972 (two skins) and in 1974 (one skin) (**Ziaie, 1996; Ziaie and Gutleb, 1997**). Moreover, the species was listed as being part of the Iranian fauna and it had been recorded from the marshes adjacent to the Iraq borders in Khuzestan Province (presumably Hoor ol-Azim) (**Eetemad, 1984; Firouz, 2000; Ziaie, 2008**). However, the occurrence was not confirmed in Iran during field expeditions conducted in 2007 and 2008 (**Mirzaei et al., 2010**).

To our knowledge, there were no previous estimations of *L. p. maxwelli* populations in Iraq; therefore, the main objectives of our field surveys was (i) to obtain a preliminary population estimate in the Hawizeh Marsh and (ii) to investigate whether the species had used the monotonic habitats of the Hawizeh Marsh/Hoor ol-Azim Wetland to establish new isolated and/or transboundary populations between Southeastern Iraq and Southwestern Iran which will aid its conservation strategies.

MATERIALS AND METHODS

Study Area

Hawizeh Marsh, Iraq

The study area is situated within the Hawizeh Marsh geographical zone (Figure 1). The site is a vast complex of freshwater open lakes lined with extensive reed beds mainly in its Northern and Central parts, while the Southern parts are mostly dominated by shallow seasonal wetlands. The study area encompasses an area of ca. 49km^2 in Iraqi territory and occupies the Tigris-Euphrates Alluvial Salt Marsh (PA0906) Ecoregion with altitudes of less than 6m. The Northeastern edge of the study area is bordered by Al-Edheam Marsh (Birkatt Al-Udheim) (31°42'N, 47°44'E), the middle part is mainly represented by Umm An-Ni'aaj Lake (Birkatt Umm An-Ni'aaj) (31°37'N 47°36'E), Lissan E'jeardah (47°34'E 47°34'E) on the

Southwestern edge, and the plain of Majnoon (Majnoon Oil fields, 31° 6'N 47°36'E) comprises the Southeastern edge. The Northwestern part of the study area is semidesert, arid lands, scrublands, and cultivated fields extending from Al-Sheeb plain Southward to Al-Musharah, Al-Kahla'a, Qal'at Salih, Al-Uzair (Ozair) and Al-Qurnah districts in the Southwestern extremity. Numerous dykes constructed mainly during the Iraq-Iran war in 1980s topped by paved military roads bisect the site including the strip of the Lissan E'jeardah, Lissan Howaidi, and Lissan Zirdani causeways running from West to East. The study area is fed with water from Al-Musharah and Al-Kahla'a distributaries of the Tigris River on the Iraqi side, while primarily from the Karkhe'h River in Iranian territory. The vegetation ranges from submerged and emerged marshland vegetation mainly common reed *Phragmites australis* and *Typha* sp. to riparian and steppe vegetation of *Salix* spp. and *Tamarix* sp.

Hoor ol-Azim Wetland, Iran

The site is a monotonic habitat of a single hydrological system comprising the Northeastern extremity of the Hawizeh Marsh fed with water primarily from Karkhe'h River and bisected by the Iraq-Iran international boundaries. It is situated in the North of the Azadegan Plain, ca. 80km to the Southwest of Ahvaz city in Khuzestan Province in the Southwestern of Iran. The general habitat resembles that of the Hawizeh Marsh with dense common reed and *Typha* sp. vegetation. The adjacent semidesert and arid plains have sparse steppe vegetation.

Field techniques

Three study plots were selected within the Hawizeh Marsh, and a line-transect survey with a distance sampling field method was performed (e.g. **Sutherland, 2006; Krebs, 2009**) (Table 1; Figure1).

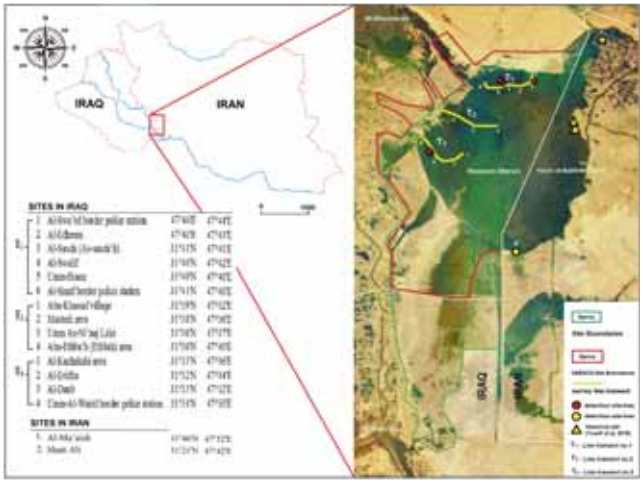

Figure 1. Study area of the smooth-coated otter* (Lutrogale perspicillata maxwelli) *in the Hawizeh Marsh (Iraq) and Hoor ol-Azim Wetland (Iran) marked with survey transects and detection sites in Iraq and Iran

Table 1. Survey areas and transects with numbers of smooth-coated otter* (Lutrogale perspicillata maxwelli) *detected in the Hawizeh Marsh with their sighting distances (r_i) in meter (m) and sighting angles (ɵ) º.

Surveying area-transect			Waypoint gazetteer	coordinates		Date	No. of Animals detected	Sighting Distance (r_i)(m)	Sighting Angle (ɵ)º	Study plot-approx. area size (km²)
Al-Edheam Marsh	T_1	1	Al-Swa'ed border police station	47°44' E	47°44 'E	29–30/3/2017	0	0	0	13.43
		2	Al-Edheam Lake (Birkatt Al-Udheim)	47°43' E	47°43 'E		1	83	22	
		3	Al-Sauda (As-sauda'h)	31°41' N	47°41 'E		0	0	0	
		4	Al-Swalif	31°40' N	47°42 'E		2	500-450	37-42	
		5	Umm-Hoam	31°40' N	47°40 'E		0	0	0	
		6	Al-Sinaf border police station	31°41' N	47°40 'E		0	0	0	
Umm An-Ni'aaj Marsh	T_2	1	Abu-Khassaf village	31°39' N	47°32 'E	17–18/7/2017	0	0		20.76
		2	Mastrah area	31°38' N	47°36 'E		0	0	0	
		3	Umm An-Ni'aaj Lake	31°36' N	47°37 'E		0	0	0	
		4	Abu-Ethba'h (Ethbah) area	31°36' N	47°40 'E		0	0	0	
Al-Daub Marsh	T_3	1	Al-Kachakchi area	31°33' N	47°36 'E	20/7/2017	0	0	0	14.35
		2	Al-Eridha	31°32' N	47°34 'E		0	0	0	
		3	Al-Daub	31°33' N	47°32 'E		2	80-85	62-60	
		4	Umm-Al-Warid border police station	31°34' N	47°30 'E		0	0	0	
							5			48.54

Three longitudinal water transects (length 10km each) covering three study plots of (ca 48.5km²) were randomly identified based on accessibility and security conditions and followed by a motor canoe. Transect (T_1) covered the area of Al-Edheam Marsh on the Northeastern extremity of the Hawizeh Marsh, and started from the Al-Swa'ed border police station through [Al-Edheam: Al-Sauda (As-sauda'h): Al-Swalif: Umm-Hoam] waypoint and ended in Al-Sinaf border police station (Figure 2a). Transect (T_2) covered the Umm An-Ni'aaj Marsh in the middle parts of Hawizeh Marsh, started from Abu-Khassaf village through [Al-Mastrah area: Umm An-Ni'aaj Lake] waypoint and ended in Abu-Ethba'h (Abu-Ethbah) area (Figure 2b). Transect

(T_3) covered the area of the Al-Daub Marsh on the Southwestern extremity of the Hawizeh Marsh, and started from Al-Kachakchi area through [Al-Eridha: Al-Daub] waypoint and ended near Umm-Al-Warid border police station (Figure 2c).

Figure 2. a: Al-Edheam Marsh (Transect T_1 area); b: Umm An-Ni'aaj Marsh (Transect T_2 area); c: Al-Daub Marsh (Transect T_3 area) – photos ©Mukhtar K. Haba 2017; d: An adult smooth-coated otter* (Lutrogale perspicillata maxwelli) *in Al-Edheam Marsh of the Hawizeh Marsh (Iraq) showing cryptic behaviour - photo ©Omar Al-Sheikhly 2017; e: An adult smooth-coated otter in Al-Ma'aish area in Hoor ol-Azim Wetland (Iran) - photo ©Sayed B. Mousavi 2017.

In order to increase detection probability, identification accuracy (misidentification with the sympatric Eurasian otter (*Lutra lutra*), and reduce the possibility of double counting, transects were carefully surveyed at a slow-moving rate (20–30 km/hour) and randomly followed. Stopping points were applied at fixed intervals (15–20 minutes), and a 30–40 minute time period was spent at each stop to count any smooth-coated otters within a fixed observation/detection distance (ca. 500m). Counting of otters stopped at the end of each survey transect and observations on the way back were ignored. Five field surveys were conducted in the Hawizeh Marsh in March and July 2017 and the start time of these field surveys varied. One or two days were spent at each study plot, and six to eight hours per day were spent moving along each transect. Field observations using 8×42 mm Swarovski binoculars were made using a 'double observer' approach (e.g. **Sutherland, 2006**) with two field observers (Al-Sheikhly OF as a primary observer and Haba MK as a recorder). Photographic documentation was made using a Canon EOS/DSLR-7D camera body attached to 500mm Canon image stabilizer telephoto lens (within Iraq territory) and Nikon DSLR-D500 camera body attached to 200×500mm Nikon image stabilizer zoom lens (within Iranian territory). A Garmin GPS device was used to position the three transect waypoints on the map digitally. The approximate area size of each

study plot was calculated using Google Maps Area Calculator Tool (www.daftlogic.com/projects-google-maps-area-calculator-tool.htm).

In order to obtain additional information on the occupancy and differential distribution of both otter species in the study area, interviews with Marsh Arabs (indigenous inhabitants of the Mesopotamian marshes) and local border policemen were performed whenever possible. The species field identification remarks followed **Harrison and Bates** (**1991**) and **Al-Sheikhly and Haba** (**2014**).

Data analysis

Due to the species cryptic behavior and vast monotonic habitat of the study area, line-transect sampling was used with Hayne estimator of density (e. g. **Sutherland, 2006; Krebs, 2009**) to estimate the species density (number of individuals detected in one kilometer of the study plot). The species density ($\hat{D}_H$) was calculated using the formula:

$$\hat{D}_H = \frac{n}{2\mathrm{L}}\left(\frac{1}{n}\sum\frac{1}{r_i}\right)$$

where $\hat{D}_H$ = Hayne estimator of density, n = total number of otters detected, L = length of transect, and r_i= sighting distance of each ith animal.

The variance of the species estimated density Var ($\hat{D}_H$) was tested using the formula:

$$Var\left(\hat{D}_H\right) = D_{\mathrm{H}}^2\left[\frac{\mathrm{var}\,(n)}{n^2} + \frac{\sum\left(\frac{1}{r_i - R}\right)^2}{R^2\, n\,(n-1)}\right]$$

where var(n) = variance of $n \cong n$, R = mean of the reciprocals of sighting distances i.

The Standard Error [S.E. $\left(\hat{D}_H\right)$] of the mean density is estimated by the square root of this variance. We calculated the 95% confidence interval of the species density in the usual manner: with 11 *d. f.* the *t*-value is 2.20 using the formula:

$$\hat{D}_H \pm t_{.025}\left[\mathrm{S.E.}\left(\hat{D}_H\right)\right]$$

Furthermore, we tested the critical assumption of using Hayne estimator of density of which the average angle of detection is 32.7º by using the standard normal deviate (χ) in the formula:

$$\chi = \frac{\sqrt{n}\,(\bar{\theta} - 32.7)}{21.56}$$

where $\bar{\theta}$ = observed mean sighting angle; our null hypothesis suggests that the sighting angle is 32.7° for our dataset (H_o = sighting angle is 32.7°) and the z acceptance range is greater than 1.96 or less than -1.96 for α = .05. The sighting distance (r_i) was estimated using the mean of two observers' estimations (e.g. **Sutherland, 2006**) and the sighting angle $\bar{\theta}$ was measured using a measuring protractor. The species population size was estimated by extrapolating the species density to the total area size of the Hawizeh Marsh (1,377km^2) (**Fazaa et al., 2015; Al-Sheikhly and Al-Azawi, 2019**).

RESULTS

Population size

A total of five smooth-coated otters of the subspecies *L. p. maxwelli* were detected in two of the three transects (T_1 and T_3) in the Hawizeh Marsh during the 2017 surveys (Table 1, Figure 1).

On 29-30 March 2017 two field surveys were conducted at Al-Edheam Marsh. On 30 March an adult smooth-coated otter was carefully observed and photographed at a 83m sighting distance (r_i) with 22° sighting angle in Al-Edheam Lake (T_1 site 2). Also on 30 March two adult otters were observed after being surprised by the canoe and forced to abandon their playing/grooming site. They then swam at 500-450m sighting distances with 37°-42° sighting angles respectively in Al-Swalif (T_1 site 4).

On 20 July 2017 two adult otters were observed swimming at 80-85m sighting distances with 62°-60° sighting angles respectively after being intercepted by our survey canoe when they were crossing a narrow waterway in the Al-Daub Marsh (T_3 site 3).

Despite the extensive field surveying efforts that were carried out in the Umm An-Ni'aaj Marsh (T_2) area on 17 and 18 July 2017, no smooth-coated otters were detected.

The estimated density of the smooth-coated otter in the study plot was 0.6753 individuals/km^2 and thus the estimated population size in the Hawizeh Marsh is 929.88 (~930) individuals. Our results also showed a wide confidence interval 0.6753 ± 0.6642 Kob/km^2. In addition, the standard normal deviate (z) was 1.23<1.96 and so our null hypothesis that the sighting angle is 32.7° is tentatively accepted for our dataset.

Recent observations of the smooth-coated otter in Hoor ol-Azim Wetland, Iran

The first sighting of smooth-coated otters in Iran was made on 11 November 2017, when two animals (an adult and juvenile) were observed and photographed at Al-Ma'aish area (31°46'40.34"N 47°52'39.74"E) to the Northwest of Bostan (Bseatin)

city, Khuzestan Province. Al-Ma'aish area is ca.1.4km away from the Iraq-Iran border at the Northern extremity of the Hoor ol-Azim Wetland (near Al-Edheam Marsh in the Iraqi Hawizeh) (yellow circle 1 in Figure 1 and Figure 2e).

Later on, in April 2019, a group of four (two adults and two juveniles) smooth-coated otters was sighted at Shatt Ali area (31°21'24.44"N 47°42'41.06"E) to the Southwest of Ahvaz city in Khuzestan Province, ca. 2.5km away from the Iraq-Iran border in the South of the Hoor ol-Azim Wetland (near Lissan E'jeardah Marsh in the Iraqi Hawizeh) (yellow circle 2 in Figure1).

DISCUSSION

Over the past 30 years, a decline of more than 30% of the smooth-coated otter global population has been suspected due to large-scale hydroelectric projects, reclamation of wetlands for settlements and agriculture, reduction in prey biomass, poaching and contamination by pesticides (**de Silva et al., 2015; Duplaix and Savage, 2018**). The endemic subspecies of the smooth-coated otter, *L. p. maxwelli*, in Iraq has been evaluated as one of the rare semi-aquatic carnivores confined to the marshlands in the South of the country (**Al-Sheikhly and Nader, 2013; Al-Sheikhly et al., 2015**).

Determining the population size for a species at risk of going extinct due to demographic changes or to predict ecological changes is extremely important for conservation priorities (**Harmon and Braude, 2010; Al-Sheikhly and Al-Azawi, 2019**). Over the decades, otters were persecuted by the Marsh Arabs for their skin or trapped to be raised as domesticated pets (**Thesiger, 1954; Hayman, 1956; Maxwell, 1957; Al-Sheikhly et al., 2014**). Moreover, it was believed that the bulk of the population of smooth-coated otters in the Southeastern Iraqi marshlands had declined during the Iraq-Iran war in 1980s and 1990s, when large areas of its habitat had become war zones or drained (**Scott and Evans, 1993; Evans, 1994; Mirzaei et al., 2010; Al-Sheikhly and Nader, 2013**). Since then, apart from a few scattered field observations (e. g. **Al-Sheikhly et al., 2014, 2017**) attempts to estimate the effective population size of this flagship and endemic subspecies in Iraq were non-existent. Despite just a few survey efforts in a site with critical security conditions, this study represents an initial attempt to quantify the smooth-coated otter *L. p. maxwelli* population size in the Hawizeh Marsh, a wetland of international importance in Southern Iraq.

When estimating this, we reduced bias probabilities through standardised field methodologies and arithmetical estimations; yet, a number of caveats should be taken into consideration. The scarcity of available data related to habitat classification in the Hawizeh Marsh made the identification of survey sites and suitable methodologies rather difficult. We assumed the species occupancy extends over the whole geographical landscape of the Hawizeh Marsh, and also that the habitat classification within the study area was homogenous; of course, this is a

simplification. The small sampling size (n=5) is attributed to: (i) the vastness of the study area in addition to short and sporadic field efforts and (ii) the species cryptic and often nocturnal behaviour, which probably resulted to some extent from successive years of anthropogenic influence and intrusion making otters rather difficult to detect. Swimming smooth-coated otters were carefully identified to reduce any confusion with the sympatric Eurasian otter and our results could therefore be biased to the latter. When swimming, otters only show their heads and part of their back; therefore, we distinguished smooth-coated otters by the anterior position of their eyes, short muzzles, and other cranial and pelage characteristics (e.g. **Harrison and Bates, 1991**). In addition, using secondary signs of otters such as spraints, tracks, grooming/playing sites to determine the species density (e.g. **Shenoy et al., 2006; Khan et al., 2014**) was not done as it may interfere with the Eurasian otters' phenology. Detection distances were estimated rather than being measured using digital rangefinders; such devices along with alternative abundance measuring devices (e.g. camera traps) are prohibited due to the critical security privacy of the Hawizeh Marsh. Current results suggest that the preliminary population of the smooth-coated otter in the Hawizeh Marsh is estimated to be 930 individuals [S.E. $\left(\hat{D}_H\right)$= 0.3019]. Our results also showed a wide confidence interval (0.6753 ± 0.6642 Kob/km^2) which is attributed to the small sample size; therefore, cumulative results from further field surveys during subsequent years may suggest further estimations.

There is a scarcity of information concerning the occupancy extent and home range of the smooth-coated otter in the Hawizeh Marsh (**Al-Sheikhly and Nader, 2013; Al-Sheikhly et al., 2017; Moretti et al., 2017**). The deficiency of baseline data on the ecology of the species is a major impediment for its conservation (**Khan et al., 2014**). The homogenous habitat of the Southern Iraqi marshes had never been explored to determine effective population dynamics and other ecological measures for the smooth- coated otter.

In our recent surveys, smooth-coated otters were detected in Al-Edheam Marsh (T_1) and in Al-Daub Marsh (T_3, terr. typ. of *L. p. maxwelli*) in the Northern and Southwestern parts of the Hawizeh Marsh, respectively (Figure 1). It is known that smooth-coated otters show a preference for sandy stretches often interspersed with marsh habitat that provide dens and grooming sites (e.g. **Hussain, 2013**) and to muddy shores as being inaccessible to humans (e.g. **Khan et al., 2014**). Furthermore, the occurrence of the species is associated with shallow and calm regions (with low water velocity) which increase the rate of prey capture per effort; ease in prey capture was attributed to be the most important factor in habitat selection by the species (**Nawab, 2007; Acharya and Lamsal, 2010; Khan et al., 2014**). The maximum detection of otters in T_1 and T_3 areas is probably the result of the dominance of shallow water habitat with broad muddy banks and dense reed bed vegetation in all seasons which provides playing/grooming sites and shelters (reed

hides, see Figure 2d) for the otters. In addition, T_1 and T_3 areas probably provide prey abundance as the Marsh Arabs fishing activities were less frequent compared to other parts of the Hawizeh Marsh. The distance between the T_1 and T_3 areas is ca. 25km which suggests small and sparse sub-populations may exist; however, this requires further investigation. The majority of recent otter observations were concentrated in the Al-Edheam Marsh and in Al-Daub Marsh which therefore merit special conservation management and protection for these areas.

Despite conducting extensive field surveys in the Umm An-Ni'aaj Marsh (T_2), no otters were detected. Our field observations and interviews indicated that the main fishing (mainly electro-fishing), bird hunting, and water-transportation activities of the Marsh Arabs are concentrated in the T_2 area. The absence of smooth-coated otters from the T_2 area may be attributed to the high level of anthropogenic disturbance with increased conflict with local fishermen and hunters, an issue which has been highlighted as a major threat to the species in Iraq (**Al-Sheikhly et al., 2014; 2017**). Furthermore, the landscape of the Umm An-Ni'aaj Marsh is predominantly represented by deep (4-6m) open lakes with scattered reed beds, a habitat avoided by otters as they could be exposed to poachers and fishermen and/or it makes their predation efforts more difficult (Figure 2b).

According to the IUCN Red List geographic distribution criteria, when the species/ taxon Extent of Occurrence (EOO) is <5000km^2, the Area of Occupancy (AOO) is <500km^2, and it is severely fragmented or the number of locations is ≤5, it is evaluated as Endangered (**IUCN, 2014**). In previous studies (**Al-Sheikhly and Nader, 2013; Al-Sheikhly et al., 2017; Moretti et al., 2017**) and as shown in our recent results, *L. p. maxwelli* is endemic to Hawizeh Marsh where the EOO is 1377km^2 (<5000km^2), the AOO is ca.49km^2 (<500km^2), and populations are severely fragmented in four recent locations in Iraq and Iran (≤5). In addition, the species seems to have declined due to anthropogenic threats. However, the reduction and decline of the population, number of mature individuals, and probability of extinction are still unknown. Therefore, a comprehensive review of the IUCN conservation status of this taxon is recommended and determined by rigorous scientific research and further international collaboration and monitoring in the transboundary region of Iraq and Iran.

In Iran, the occurrence of the smooth-coated otter was based on skin specimens collected in 1970s (**Ziaie 1996; Ziaie and Gutleb, 1997**). Field surveys carried out in winter 2007 and summer 2008 in the North Azadegan Plain including Hoor ol-Azim Wetland failed to find any sign of otters. In contrast, local fishermen and border policemen claimed that otters are sometimes observed in the inner or upper parts of Hoor ol-Azim Wetland (**Mirzaei et al., 2010**). Furthermore, the isolated population of the smooth-coated otter in Iran is assigned to the Iraqi endemic subspecies *L. p. maxwelli* (**Mirzaei et al., 2010; Yusefi et al., 2019**). Based on the above, the occurrence of the smooth-coated otter in Iran was expected and our recent

observations represent the first confirmed occurrence of this species in Iran. The otters are probably using the transboundary homogenous habitat to move freely from the Hawizeh Marsh in Southeastern Iraq into the Hoor ol-Azim Wetland in Southwestern Iran. It is also possible that a few individuals originally from the Iraqi population had already established small isolated sub-populations in the Hoor ol-Azim Wetland in Iran. Generally, smooth-coated otters avoid areas with high levels of anthropogenic disturbance (e.g. **Shenoy et al., 2006**). Furthermore, Indian smooth-coated otters were reported to damage fishing nets and steal fish from the fishermen's catch and so they are seen as competitors and fishermen kill them (e.g. **Khan et al., 2014**). Besides hunting and trapping, our recent interviews indicated that otters are targeted by Marsh Arabs for the same reason. The persecution of smooth-coated otters seems to be frequently and contentiously practiced in the Hawizeh Marsh (**Al-Sheikhly, 2012**; **Al-Sheikhly et al., 2014; 2017**), while it seems less intensive in the Iranian side (e.g. **Montazer Hojat and Mansouri, 2016**). Otters are possibly escaping from hunting pressure and temporarily abandoning the Hawizeh Marsh into less disturbed places in the Hoor ol-Azim Wetland. The increased over-exploitation and disturbance pressures (e.g. **Theng and Sivasothi, 2016)** in the Hawizeh Marsh will possibly push away much of the Iraqi smooth-coated otter population toward Iran, but this again requires further monitoring.

Besides its occurrence in the Iranian territory being confirmed by our study, our current estimation will aid the smooth-coated otter national conservation strategies especially after the designation of the Hawizeh Marsh as a UNESCO World Heritage site (**UNEP-WCMC, 2020**). Intensive awareness and education programmes should be launched and focus on indigenous communities known to be involved in otter persecution for their skin and offspring. It is worth mentioning that the Iranian population deserves proper monitoring as it would be in the best interest of the species survival across two neighbouring countries. A comprehensive genetic investigation is required to know if the two populations are genetically divergent, the extent of the gene flow and overall genetic diversity. In addition, detailed research on the species population and ecology is required to implement further management practices to conserve the species in Iraq and Iran.

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Disclosure Statement

No potential conflict of interest was reported by the author.

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EXISTENCE OF SMOOTH-COATED OTTERS (*Lutrogale perspicillata*) IN THE GANGES–PADMA RIVER BASIN AREA OF RAJSHAHI, BANGLADESH

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Abstract

*In this age of Anthropocene, 12 of the 13 otter species show a declining trend across the globe. Bangladesh has three otter species: smooth-coated (*Lutrogale perspicillata*), Eurasian (*Lutra lutra*) and Asian small-clawed (*Aonyx cinereus*). The first two are listed as Critically Endangered and the latter as Endangered. This study was motivated by a photograph of two smooth-coated otters in a local newspaper in 2016 in Rajshahi, in the central Northwestern region, where there were no such formal records, according to the IUCN Red List. There has been insufficient detailed study on status, distribution and threat to otters in Bangladesh and this makes the available information highly unreliable. This study, the first of its kind, aims to confirm the existence of smooth-coated otters in Rajshahi district, and identify its current status and distribution. It is based on the Traditional Ecological Method (TEK) coupled with the collaborative effort of local para-biologists. Community surveys of fishermen and local people and identification of secondary signs of otters (spraint, footprint, damaged fishing nets, half eaten fish, slides or holts/resting places) confirm the existence of otters in Rajshahi. The population is estimated at 50–60 individuals in 90km^2, but human–otter conflict is a significant threat. This baseline data will help to create an effective conservation programme. It is recommended that immediate steps should be taken to designate Alipur Ghat and Mazardia Char areas of Rajshahi as an otter sanctuary, as these two areas have the highest density of otters and habitats seem ideal to sustain the otter population.*

Keywords: Lutrogale perspicillata*; smooth-coated otter; traditional ecological knowledge (TEK); focal study sites (FSS); Char land; transect line; Bangladesh*

INTRODUCTION

Bangladesh is home to huge areas of various wetlands, rivers, estuaries etc. It is known as the land of rivers, a country where 80% of the total land mass is flood plains (**Craig et al., 2004**). These wetland bodies support great floral and faunal biodiversity and provide some of the world's most ecologically critical habitats for wildlife.

One of the most common and abundant species in these areas was the otter and they were also considered as keystone species (**Prosic, 2008; Kroeger, 2005; Mills et al., 1993)**. There are three otter species that once dominated the wetland bodies of Bangladesh (**IUCN, 2015**), viz. (1) smooth-coated otter (*Lutrogale perspicillata*), (2) Eurasian otter (*Lutra lutra*) and (3) Asian small-clawed otter (*Aonyx cinereus*). Of these, the smooth-coated and Eurasian otters are listed in the IUCN (**2015**) Red List for Bangladesh as Critically Endangered, and the Asian small-clawed otter is Endangered.

Understanding about the wild otters of Bangladesh has not reached a confident level. Even their current distribution remains in doubt, and only very recently there was the first photo documentation of smooth-coated otters in the Char land of the Padma river, Rajshahi, which was published in a newspaper article in 2016 (Figure 1).

Figure 1. First photo documentation of smooth-coated otter from Rajshahi (Rahman, 2016)

This did not fall into otter habitats identified by IUCN in Bangladesh. Around the same time, a birder, Shahad A Raju, also photographed smooth-coated otters in that same area. This led to strong doubts about the species' current distribution based on data from IUCN, as there were no such formal records of otters in the central North-western part of Bangladesh. There has been little targeted research on wild otters in Bangladesh and even though they are listed as Critically Endangered there have been few conservation efforts until now. There has been some research conducted on the captive smooth-coated otters used for fishing in the district of Narail, Khulna and Gopalganj, but a systematic scientific approach is still needed. In 2014 the International Otter Survival Fund (IOSF) held a workshop to train more researchers to carry out more otter research and carry out more public awareness. Some public awareness is being carried out and an IOSF Team Otter children's education club has been formed. However, more detailed research is still needed.

Otters play a vital role in the ecosystem and they are known as keystone species for freshwater ecosystems and also coastal areas. Otters indicate the health of water bodies **(Mills et al., 1993; Prosic, 2008.**) and they can help to improve overall fish stocks in open water bodies by maintaining the ecosystem (**Kroeger, 2005**). They use a wide range of habitats, including rivers, sea, streams, lakes, marshes, paddy fields, wetlands, and mangroves (**Hussain et al., 2011**). The role of otters in maintaining habitats and their use as a keystone species is illustrated by sea otters (*Enhydra lutris*), which maintain the kelp forests by controlling sea urchins and preventing them from over-exploiting the ecosystem. (**Mills et al., 1993**). This underlines the need for conserving otters for a flood-plain country like Bangladesh, as they are monitors of the ecosystem and can benefit the environment and human population who are largely dependent on natural resources.

STUDY AREA

Bordering the Indo-Burma hotspot, this country is ecologically heterogeneous and requires extensive research and documentation in the broader spectrum of biodiversity conservation. The study area is located in Rajshahi District in the central Northwestern region of Bangladesh.

The sites included water bodies, Char land (sediments deposited in the middle of the river), and adjacent river banks. The river banks are located in the Bangladesh–India border's "No Man's Land" with no human settlement. This riparian area is sandy, with only grass and bush cover, although scattered acacia trees were seen in a few areas. Frequent tourist and fishing boats moved in the river but the Char lands are sandy with no vegetation cover. It is important to mention that the most of the Char lands do not exist during monsoon.

METHODS

The study area was selected based on the photographs of smooth-coated otters taken in Rajshahi district. A total of 421 local people were involved in semi-directive interviews, followed by a questionnaire survey to help to identify focal study sites. These covered 90km^2 of the Ganges–Padma River and its catchment area in the district and included fishing communities settled in the area. The questionnaire surveys were also designed to help these communities understand the threats to otters, and to investigate the status and behaviour in order to gather physical scientific evidence of the existence of smooth-coated otters. Furthermore, three fishermen who had extensive knowledge of the local ecosystem and wildlife were trained to be para-biologists. Through their Traditional Ecological Knowledge ten focal study sites were selected and surveyed.

Focal study sites (FSS) are areas that have been directly surveyed for physical evidence of various otter signs, either through direct observation or secondary signs. The FSS were selected based on observations of the community and sightings by the para-biologists. Other determinants of the FSS are: (1) human density, (2) fishing nets along river banks, (3) bush or forest cover and (4) Char land. FSS were explored using the TEK and through collaboration with para-biologists to understand the otters' status, distribution and threats in each identified area. Line transects were used during the field surveys, though due to both water bodies and Char lands the lines were sometimes diverted and recovered as soon as possible (**Sutherland, 2006**). Below is a list of all the focal study sites in Rajshahi:

(1) T-badh (Char)

(2) Shaet Bighar Char

(3) Bablar Char

(4) Khidirpur

(5) Mazardia

(6) I-badh Char areas (Char Rampur, Char Shampur)

(7) Khanpur Char

(8) 10 no Char or Alipurghat

(9) Mukterpur

(10) Charghat

The transect lines were 5m from the water's edge on river banks and Char lands, with a 300–500m visibility. The transect lines were drawn using the TEK method with the help of para-biologists (**Halpin Robbins Ecology and Environmental Service, 2016).**

Each survey period lasted five days and each transect was surveyed three times during the research period: once during monsoon, summer and winter. This was done to identify if there was any seasonal variation in status and distribution. The FSS was surveyed for four hours during the day and two hours during the night.

Figures 2 and 3 represent the transect lines surveyed in the FSS of Rajshahi. In total these covered about 28.5km^2. The map underlines the area where otter signs were found and these numbered 62 otter signs. The size of each transect is shown in Table 1.

Figure 2. FSS Transect lines, Rajshahi district (Google Earth)

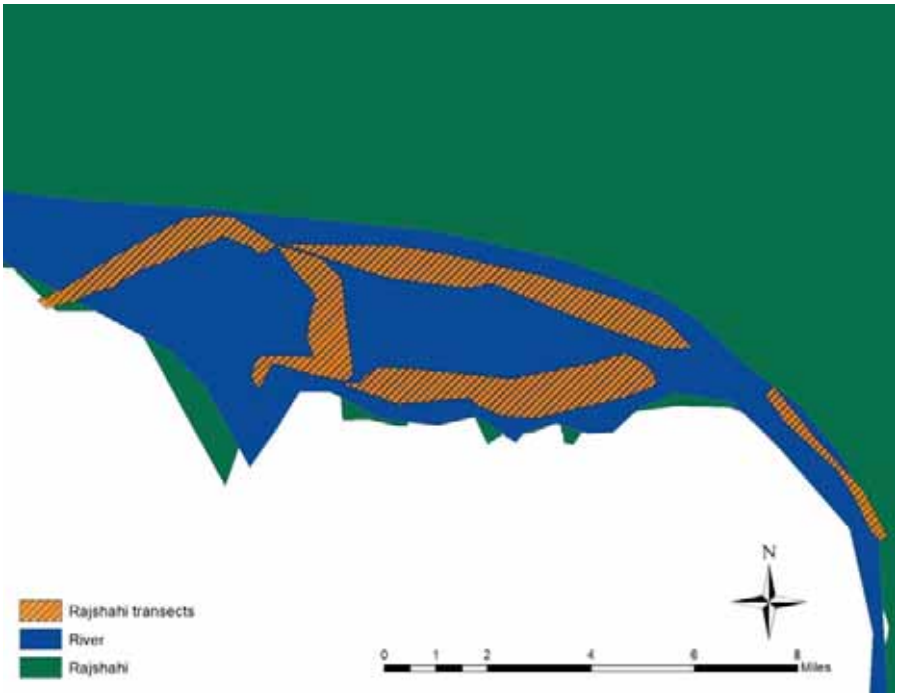

Figure 3. FSS Transect Line, Rajshahi district (Arc Gis)

Table 1. Transect Rajshahi

FSS	Transect length (km)	Area (km²)
Raj-Tran 1	6.46	5.13
Raj-Tran 2	5.11	4.50
Raj-Tran 3	10.46	8.96
Raj-Tran 4	10.75	8.22
Raj-Tran 5	5.94	1.65

Otter signs that were taken into account:

(1) Spraint (faeces)

(2) Footprint

(3) Damaged fishing nets

(4) Half eaten fish

(5) Otter slides

(6) Holts or resting areas

(**Survey Methodology: Otter Survey, 2016**)

RESULTS AND DISCUSSION

The existence of smooth-coated otters was confirmed through the otter signs, visual observations and photographs (Figures 4, 5, 6, 7, 8 and 9). It was further confirmed by going through the taxonomic guidelines (**Hwang and Larivière, 2005**), and field experts, biologists and zoologists were also consulted to confirm the species identification.

Figure 4. Fresh footprint trail of otters

Figure 5. Otter footprints (a few days old)

Figure 6. Otter spraint

Figure 7. Otter resting place

Figure 8. Smooth-coated otters in Padma Char, Rajshahi (Shahad A Raju, 2016)

Figure 9. Smooth-coated otters in Padma Char, Rajshahi (Ahamaduzzaman Shovon, 2017)

The existence of otters in Rajshahi was known to the local people, particularly among those whose livelihood is associated with the river. It is a common scenario for the villagers that if they set fish traps, otters might come to steal the fish and destroy the trap/fishing nets in the process. But even so, the existence of these otters was never documented by any researchers in Bangladesh and thus it was never incorporated as an otter habitat by IUCN. Through an interview with four birders in Rajshahi, it was revealed that until 2010 wildlife around the Padma Char was largely unexplored. Conservationists were also unaware of the thriving wildlife in the area and they explained that it has only been explored widely for the last five years. It has to be mentioned that the Bird Club in Rajshahi has been exploring around the Padma Char on a weekly basis, along with photographers, conservationists and birders from all over Bangladesh. This is the reason why the existence of smooth-coated otters was never confirmed before now. The first published sighting and photograph of otters was in a newspaper article in 2016 (Figure 1), but it did not talk about its habitat or any other relevant details on otters (**Rahman, 2016**).

This research focused on collecting primary data i.e. selecting focal study sites, drawing up transects with the help of TEK, and recording otter signs along the river

bank and Char lands of the River Padma, Rajshahi. Initially the existence of otters was confirmed when the local people started to show us fishing traps which were torn apart by otters. The size of the tear on the fishing trap indicated the size of the animal that had got in and taken the fish. This scenario was very common in the area. To confirm the research further, local birders were asked to provide photographs of the otters. This gave the research a new dimension, as it provided photographs of otters from the past three years. Along with this, the research also incorporated information from local fishermen about the locations of encounters with otters.

Status of smooth-coated otters in Rajshahi

The research confirmed the existence of smooth-coated otters in Rajshahi but found no evidence of Eurasian otters, and so it seems almost certain that this species does not exist here. Otters in focal study sites are commonly observed by fishermen, farmers, and other people regularly using the river. Based on the primary data, 99% people in our intensive study area had encountered otters at least once. The average encounter rate is 4.5 individual otters over a time span of three months. Additionally, through collaborative field work with para-biologists incorporating TEK, direct observation and otter signs were recorded on the five transects. A total of 62 footprints of different sizes were found. However, because some of the footprints had a difference of only a few millimeters but in different areas, a range of 50–62 has been given for the number of individuals. This covered an area of about 28.5km^2 of the 90km^2 of their habitat. As the population estimation was based on the size of each footprint, the accuracy of this figure remains under question.

This study confirms the presence of about 50–62 individual otters in an area of 28.5km^2, based on primary data and taking into account the water body represents an area of 90km^2. This figure was achieved by marking the size of all the footprints collected during the field survey. Using GIS analysis, it was calculated that a total of 223km^2 across Rajshahi Sadar Upazila, Charghat and a few patches of India were identified as otter habitat which includes grassland, river bank and Char lands. Information on the size of several home ranges of smooth-coated otters was gathered. According to IUCN the home range of a family of otters is 7–12km^2 (referencing **Wayre 1974**). **Hussain and Choudhury** (**1997**) in their study on the smooth-coated otter in the Chambal River in India documented that the average home range size for an adult male and a female with juvenile is 17km^2 and 5.5km^2 respectively, and that the home ranges overlap. Based on this territory size and assuming four otters in each home range of 10km^2, we can estimate that approximately 90–100 individual otters (with an estimated 22.3 territories) are now inhabiting across the catchment area of Padma River in Rajshashi region in Bangladesh and India. The approach of this population interpretation is consistent with the findings of **Barlow (2009)** who attempted to measure the density and

population size of tigers in the Sundarbans. The synthesis of the information from the survey during the present study is also in agreement with this interpretation as the local people confirmed that the otter population over the last 20 years has not decreased. This assumption will serve as a baseline for further study. However, the inclusion of more transects in the study area and application of advanced technology-oriented identification methods can provide a more accurate picture.

Distribution of smooth-coated otter in Rajshahi

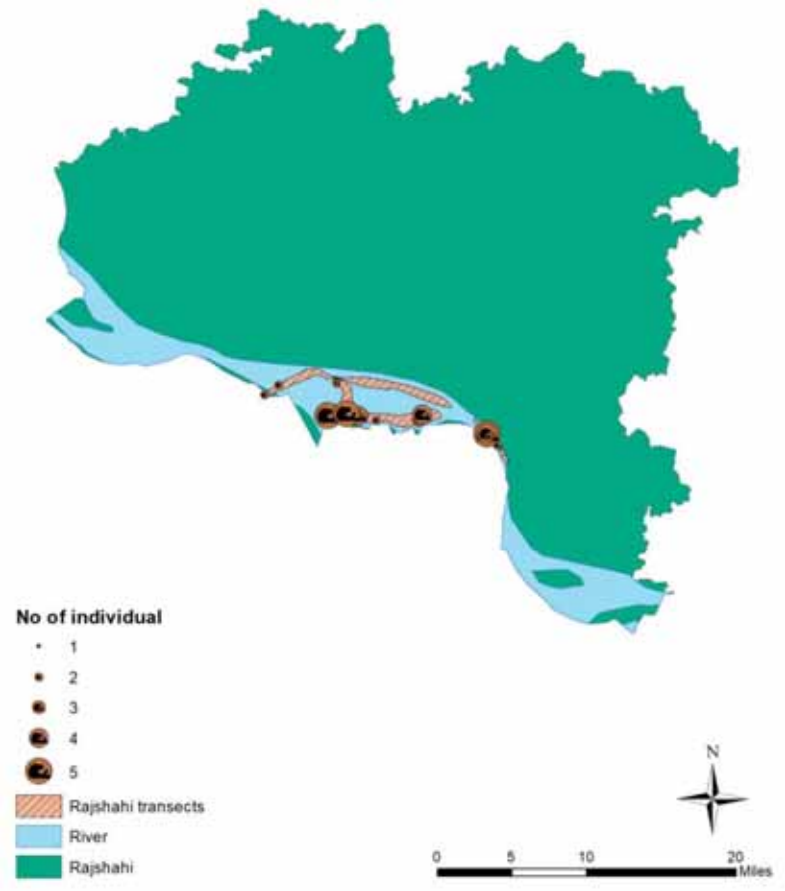

Figure 10. Otter signs recorded from Rajshahi, Padma Char 2017–2018

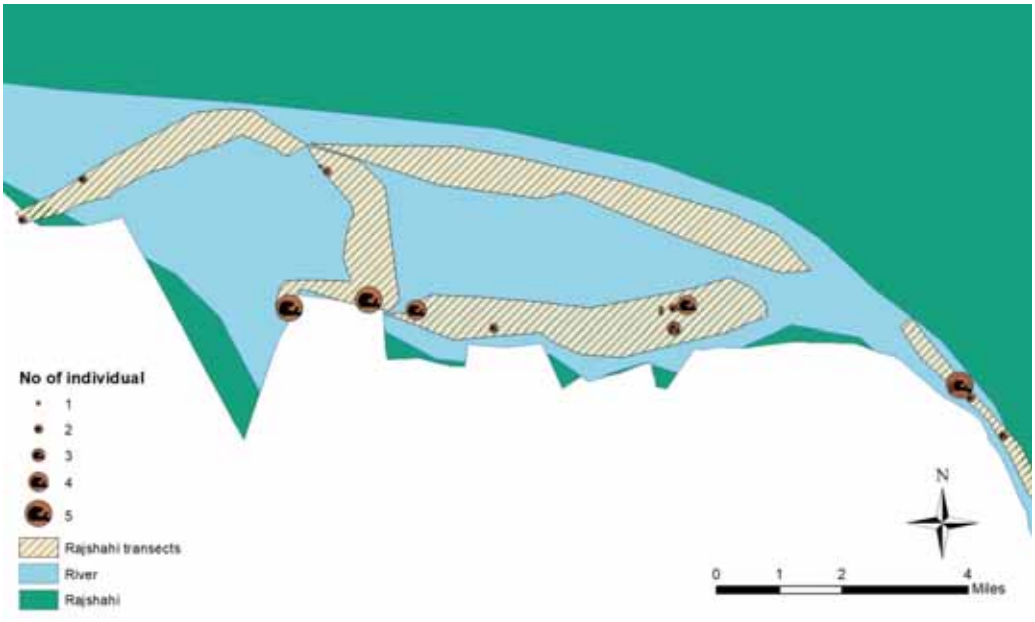

Figure 11. Otter signs recorded from Rajshahi, Padma Char 2017–2018

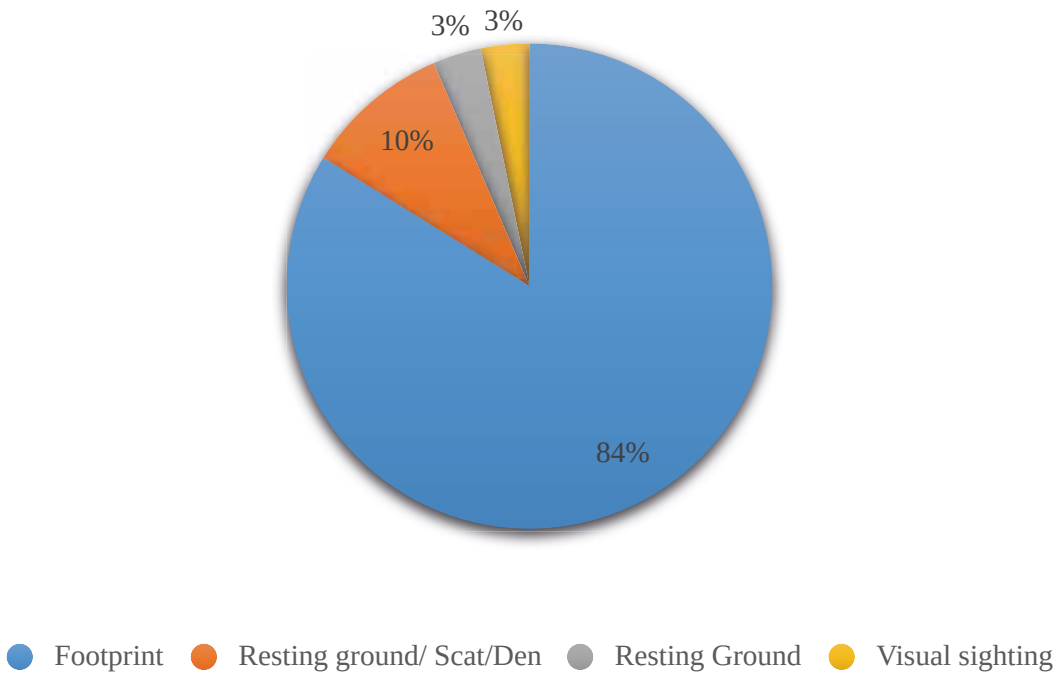

Figure 12. Resting place/holt/spraint/direct observation

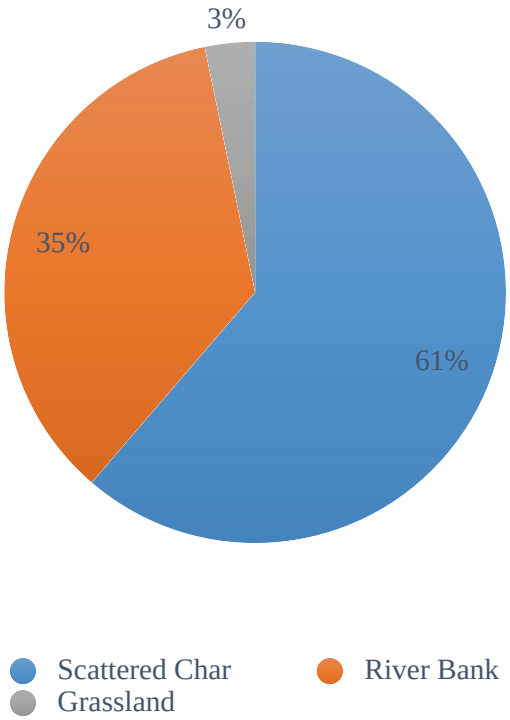

Figure 13. Types of habitat signs were collected from the transects

Maps in Figures 10 and 11 shows the distribution of smooth-coated otters in Rajshahi, mostly in Sadar upazila and Charghat upazila and where otter signs were found on the transects (Table 2). In total, 50–62 individual otters were identified from the signs collected in the focal study sites. Most of the signs were collected along the river bank and Char lands that are closely associated with the river banks. Figure 12 indicates the types of signs that were collected from the field survey and Figure 13 percentage of types of habitat where the signs were found.

Table 2. Otter signs collected in each transect

Transect	**No of signs**	**No of individuals**
Transect 1	2	4
Transect 2	6	14
Transect 3	18	30
Transect 4	0	0
Transect 5	3	14
Total	**29**	**62**

The distribution of otters is mainly along the river banks and Char lands of Rajshahi. Interestingly, though the otters use the river and Char lands for hunting and resting, the holts are mostly in grassland by the riverside. These are mostly inaccessible for us, as it is beyond India's geopolitical border. The transect lines were mostly drawn from Rajshahi Sadar upazila and Charghat upazila. The river area in the Charghat upazila was very narrow due to the close proximity of the Indian border, but the Sadar upazila occupied a larger area and had both side of the river banks inside Bangladesh. The transects lines that are within Bangladesh are: T-badh Char areas, Mazardia and Char areas, Bablar Char, Khidirpur and Char areas, Alipurghat or 10 no and Char areas, Khanpur and Char areas, Mukterpur, Charghat and lastly I-badh Char areas (Char Rampur, Char Shampuretc). Otter signs were found and collected from all of the areas inside the transects, except for I-badh Char areas.

If we disregard the borders between Bangladesh and India, the Padma catchment areas along Rajshahi can be assumed to be an ideal habitat for otters. First, the river is less polluted here than further downstream and the presence of both otter and Ganges River dolphin indicates a healthy ecosystem and good water quality. Second, a large area is comprised of "No Man's Land" between the borders of India and Bangladesh and this area is mostly grassland with no human settlement. Third, there are vacant sandy Char lands in the middle of the river, though these areas are temporary and there is seasonal agriculture. As otters are of a shy nature, these areas can be ideal habitat for them to thrive.

Threats to otter identified from the intensive study area

Fishermen and otter conflicts

Of the 421 respondents, 64% claimed that they have experienced otters stealing fish from their fish nets/traps. This results in annoyance among the fishermen and poses a particular threat to the otters as it causes a direct conflict with human interests, as fishermen encounter otters very frequently. By observing the damaged fishing nets/ traps and by analysing the size of the scratch and bite marks, it was confirmed that otters are responsible for the damage to the fishing nets and traps. Though the people in Rajshahi tend to have a higher knowledge about the ecosystem services of otters than other districts, the conflict does pose a serious threat to otters.

Declining habitat

Habitats of otters have been severely fragmented and changed through rapid human settlement and urbanization. Illegal reduction of wetland bodies due to loss of river navigability, means that suitable otter habitat is seriously decreasing. In addition, there is severe exploitation of natural resources especially fish and crab which leads to a decline in food supply.

CONCLUSIONS AND RECOMMENDATIONS

The research used Traditional Ecological Knowledge to fill in the absence of scientific study. It should be stated that in the field of conservation, wildlife survey without the help of the local community and their traditional or indigenous ecological knowledge is simply deficient. Therefore, in the field, with the help of TEK an estimated population of 50–62 otters has been presented based on signs collected from transect lines of 28.5km^2 representing river and Char lands of 90km^2. This is the first time in Bangladesh that an estimated population of otters in a particular area has been produced through a proper scientific approach.

The findings of this research recommend that the following areas should be designated as an otter sanctuary: 10 no Char/Alipurghat under Transect 3, Mazardia/ Bablar Char under Transect 2 and Transect 3 in Rajshahi. This is the only possible thriving population of the critically endangered smooth-coated otter *Lutrogale perspicillata* outside of the Sundarbans. Second, conservation efforts must be taken immediately in order to protect the species all over Bangladesh as its value to the ecosystem is critically important for a floodplain country like Bangladesh.

Acknowledgements

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Disclosure Statement

No potential conflict of interest was reported by the author.

Author Biographies

ZAHID AMIN SHASHOTO has been working with otters for the past four years in Bangladesh. He is currently working in a non-profit development organisation in Bangladesh called Uttaran and is also leading a volunteer organisation, "Otter Research Project, Bangladesh". Currently, the organisation is working to generate awareness among fishing communities in the Northwest part of the country, and also developing community conservationists in the area.

GRACE M YOXON is the Director and co-founder of the International Otter Survival Fund, which was established in 1993. She has carried out many otter surveys and co-organised training workshops in Asia, Africa and South America. She is also responsible for the day to day running of the specialist otter hospital.

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PUBLIC PERCEPTION OF OTTERS IN SOUTH KOREA

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ABSTRACT

When the distribution of endangered species lies outside protection areas, one of the most crucial points for conservation is how the public responds to the animals. In South Korea, endangered Eurasian otter (Lutra lutra) *populations have recovered to some extent throughout the country due to improved habitat qualities and public awareness. However, most populations still live in remote countryside to avoid human disturbance, and thus it is necessary to seek a means of coexistence for humans and otters in more urban areas. In this study, I aimed to find (i) any evidence of caring for wild otters and promoting conservation on a regional scale, and (ii) what the public wants to know regarding the ecology of wild otters as evidenced from* YouTube *videos. The results found seven cases of otter conservation signs, restoration activities, and statues near streams in remote areas and city centres. Of the 173 Korean videos, 51 videos recorded wild otters in South Korea. The most popular views about wild otters were about feeding and inter-species interactive behaviour, while the views about captive otters were about interaction with people and the charm of the otters. Although there are several conservation efforts for wild otters in South Korea, most activities still have weak approaches on otter ecology and activities such as reducing risks of roadkill. In addition, the broadcasts have not yet reflected public interest to increase conservation awareness. Hence, analysing interactions between wild otters and public responses should be used to strengthen conservation programmes.*

Keywords*: Conservation; human dimension in wildlife; recovery;* YouTube*; urbanisation*

INTRODUCTION

An increased human population needs more spaces for urban and agricultural areas, and consequently results in the degradation of natural forests **(Green et al., 2005; Anand et al., 2010)**. Although defining protected areas secures biodiversity, the size of the areas is not sufficient **(Di Minin et al., 2016)**. Thus, it is necessary to identify a mechanism whereby humans and wildlife can coexist outside protected areas and encourage people to want to conserve wildlife **(Athreya et al., 2013; Hong et al., 2017)**.

South Korea is a rapidly growing industrialised country, in which the Eurasian otter

(*Lutra lutra*) has successfully recovered to some extent in human modified landscapes, and the increase of the population has led to an expansion of their distribution into urban areas (Figure 1; **Hong, 2018)**. Habitat quality improvements, such as water quality improvement and forest development, have had a positive impact on otter recovery. Meanwhile, improved public conservation awareness has also assisted the recovery **(Hong et al., 2017)**. However, most populations are still found in remote countryside, and thus monitoring and implementing restoration strategy are necessary for the population to establish in urban areas **(Lee et al., 2019; Hong et al., 2020)**.

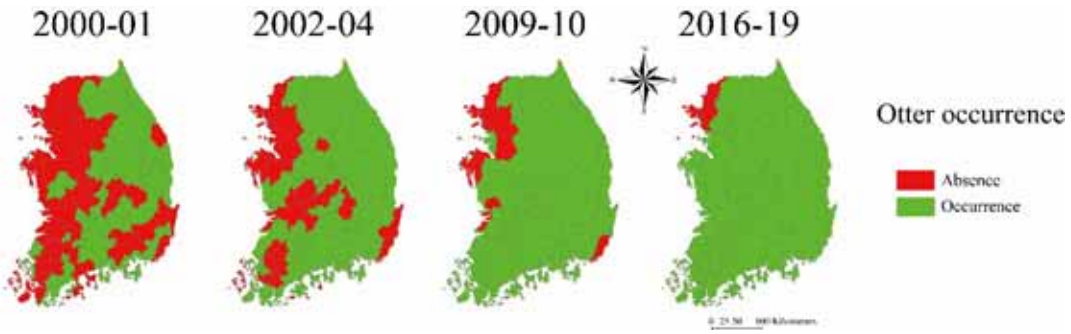

Figure 1 Distribution changes of Eurasian otter (*Lutra lutra*) in South Korea. Four different national surveys conducted during 2000–2001 (first), 2002–2004 (second), 2009–2010 (third), and 2016–2020 (fourth). Each polygon represents river sub-basins.

In order to define human activities and response to wild otter conservation, there are two possible approaches (direct and indirect methods). The direct method is to find any artificial monuments, restoration activities, signs for protection, and any other regional studies and policies **(Theng and Sivasothi, 2016)**. The indirect method is to trace any evidence of human responses for wildlife management from newspapers, social media such as YouTube, search engines, etc **(Hong et al., 2017; Harrington et al., 2019)**. Specifically, social media, especially *YouTube*, could provide new insights into human responses to the animals' behaviour, so that is helpful in understanding what people want to see and think about wildlife **(Burn, 2014)**.

Thus, in this study, I aimed to (*i*) find any direct evidence for regional conservation activities, and (*ii*) indirect evidence for human interests in wild otter behaviour searched for on *YouTube*. Then, I will discuss the future challenges for wild otter conservation in urban areas.

MATERIALS AND METHODS

Study area

The landmass of South Korea covers 100,210 km^2, and lies between 33–38°N and 124–131°E (Figure 2a). Approximately 64% of the landmass is covered by forests, particularly in the middle and Eastern parts of the country, which are primarily

higher altitude regions (Figure 2b). The Western part of the country is dominated by agriculture (Figure 2b). In 2016, the human population reached 51 million people, with more than 90% (approx. 47 million people: **Statistics Korea**, http://kostat.go.kr) residing in urban areas (red polygons on Figure 2b). The climate is temperate: the temperature ranges from below zero in winter to >30°C in summer **(Jung et al., 2002)**. The East Asian monsoon brings a short and heavy rainy season in summer **(Chang and Kwon, 2007)**.

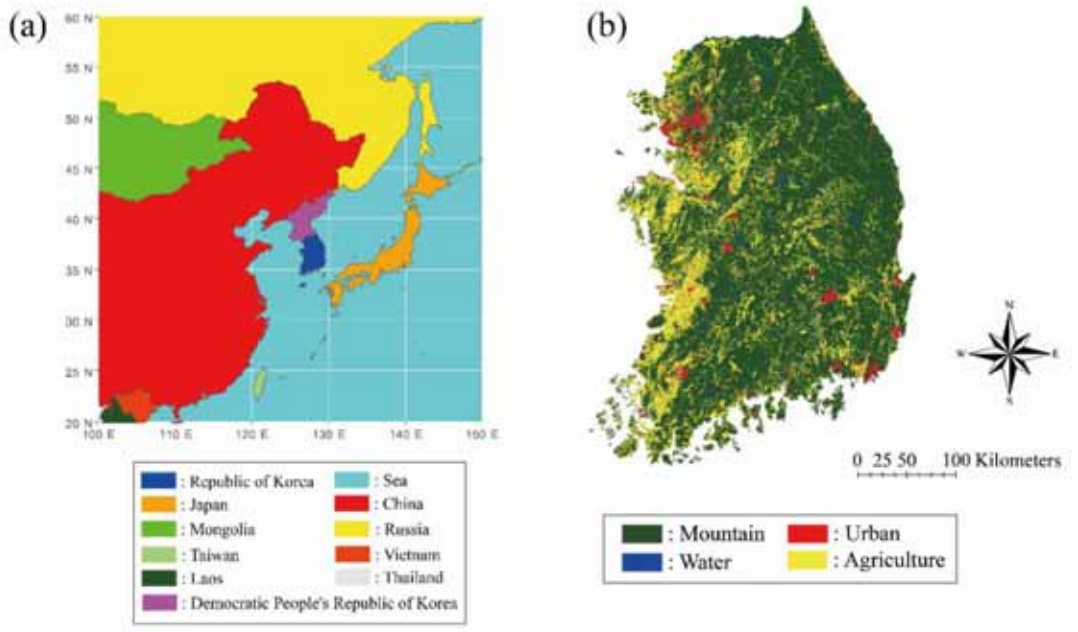

Figure 2. (a) Location of South Korea (blue) and nearby countries. (b) Land-cover map of South Korea (green: mountain, yellow: agriculture, blue: water, & red: urban areas)

Identification of direct evidence of otter conservation on a regional scale

Direct evidence of otter conservation signs and efforts at regional scales were recorded during field surveys, business trips, and using TV, newspapers, and social media, and documented as photos (Figure 3). Conservation efforts were classified as roadkill reduction signs, restoration activities, symbolic use to promote conservation awareness, and other purposes. In addition, location information was divided according to whether the sites were located in an urban area or remote countryside buffering 2.5km radius (an adult male otter's home range: **Min, 2007**) from the points using buffer tool of ArcGIS 10.5; ESRI, USA. The clip tool of ArcGIS 10.5 was used to get this information.

In order to address the spatial coherence (randomness) of sites, the average nearest neighbour analysis was performed using ArcGIS 10.5 **(Hong et al., 2018)**. The average nearest neighbour tool measures the distance between each feature centroid and its nearest neighbour's centroid location, and then averages all these nearest

neighbour distances. If the index (average nearest neighbour ratio which is calculated as the observed average distance divided by the expected average distance) is less than 1, the pattern exhibits clustering. If the index is greater than 1, the trend is toward dispersion.

Identification of human response to otter behaviour evidenced from YouTube *videos*

174 videos were found on *YouTube* after searching for the Korean word "Soodall (= otter)" for six days (specifically 2, 3, 4, 5, 10, and 11) January 2020. Information was recorded on the videos such as the date, contents, captive or wild, species, number of subscribers, and views. The views were recorded as interests (I), but the views are highly related to dates after uploading. Therefore, the views (V) were divided by days after upload (D), and then compared with interests among videos.

$$I = V / D$$

Although some videos can deliver distorting information on otter ecology to attract people (e.g. most videos delivered cuteness not wildness), the popularity of wild and captive otter videos including all contents were compared in order to identify the most interesting themes about otters. This analysis could make sense in that YouTubers are more likely to make videos that viewers want to see. Thus, based on the contents of popular videos of captive otters, it is possible to discriminate what people want to see about these animals. By comparing the contents of videos of captive and wild otters, and differences in popularity, it is possible to suggest strategies for making videos to increase public interest in the wild otter population in urban areas.

RESULTS

Direct evidence of otter conservation activities on a regional scale

Seven pieces of evidence of regional conservation efforts were identified but the locations of two sites were very close (Figure 3). The types of efforts were classified into restoration, awareness encouragement, and promotion of healthy areas due to the presence of otters. Restoration activities included building artificial holts, and shelters (Figure 3c, 3f, 3g). Building awareness and promoting healthy areas were not divided into different criteria, and activities were standing otter statues (Figure 3a, 3e) and signs (Figure 3b) or painting otters on buildings near streams (Figure 3d). Four cases were observed in urban areas, and three were observed in remote areas of the islands (Table 1). The sites were not clustered, but dispersed ($Z = 3.85$, $p < 0.001$; Figure 4).

Table 1. Geographical information (%, percentile) of sites showing the seven regional otter conservation efforts. The information was extracted by the buffers (2.5km radius, adult male's home range: Min, 2007).

Sites	a	b	c	d	e	f	g
Urban	51.06	2.10	13.58	92.55	0.18	0.65	43.52
Agriculture	28.74	18.31	43.08	0.05	9.15	6.91	18.49
Mountain	9.43	75.62	31.80	3.39	88.71	89.00	12.59
Grassland	5.34	2.30	5.28	0.65	0.96	0.99	10.93
Wetland	0	0.03	2.50	0	0.03	0	0
Bare-land	2.64	1.09	3.72	3.03	0.37	0.23	10.86
Water	2.78	0.55	0.03	0.33	0.60	2.23	3.62

Figure 3. The seven cases of otter regional conservation efforts. Pictures (a) mascot of Gwangju metropolitan city – the statues were erected to represent the healthy streams in the city, (b) description of otter ecology due to frequent occurrence in Namhae Island (*Choi, 2017*), (c) artificial holts in Ansan reed marshy park (*Kang, 2019*), (d) paintings of otter in the wall of an apartment in Daegu metropolitan city (*Lee et al., 2019*), (e) otter statue to encourage the endangered species conservation in Geoje Island, (f) restoration areas due to dam construction (dotted circle indicates the entrance of an artificial otter holt), and (g) restoration of shelter (lower picture) created by buying factory areas (upper picture) in Jeonju city (Kim, 2018).

Human response to otter behaviour evidenced from YouTube *videos*

Out of 174 videos, 51 videos (29.3 %) reported wild otters, while 121 videos (69.5 %) reported captive otters. Other videos delivered one rescued otter (0.6 %), and wild and captive otters, simultaneously (0.6 %). Whereas the popular contents of the captive otters showed interaction with people and feeding otters, those of the wild otters delivered broad subjects and showed no patterns. The large proportion of

contents of wild otters were campaigning for protection, observation, and against otter hunting and inter-species interaction activities (Figure 5).

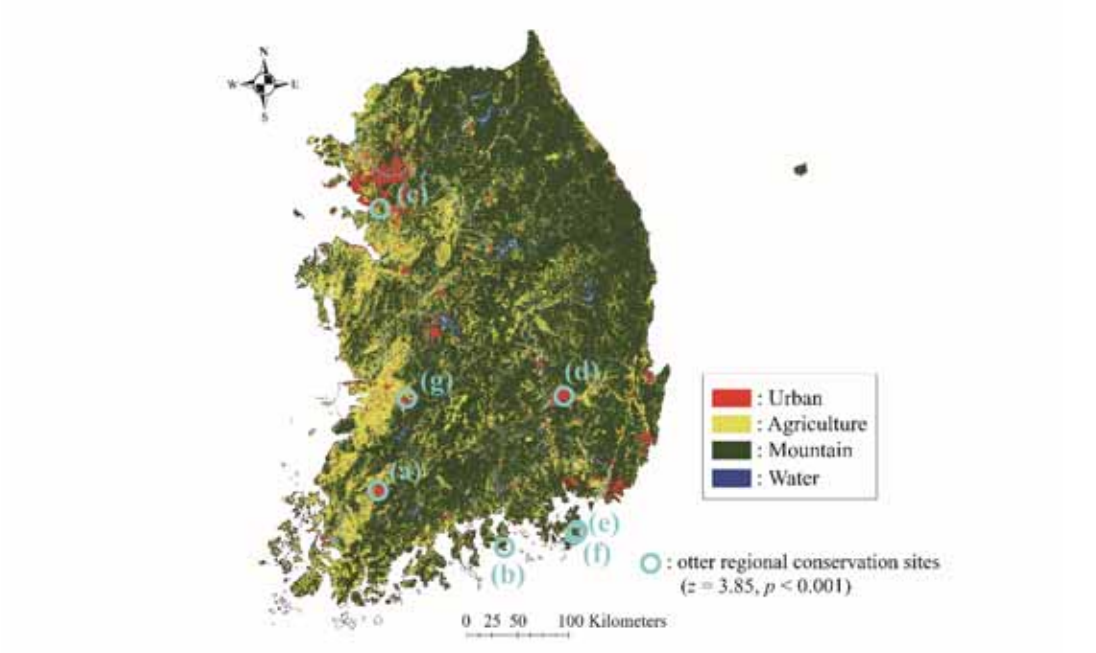

Figure 4. The location of the regional conservation sites corresponding the alphabet letters. Land cover map indicates that most sites were located in urban areas (red colours)

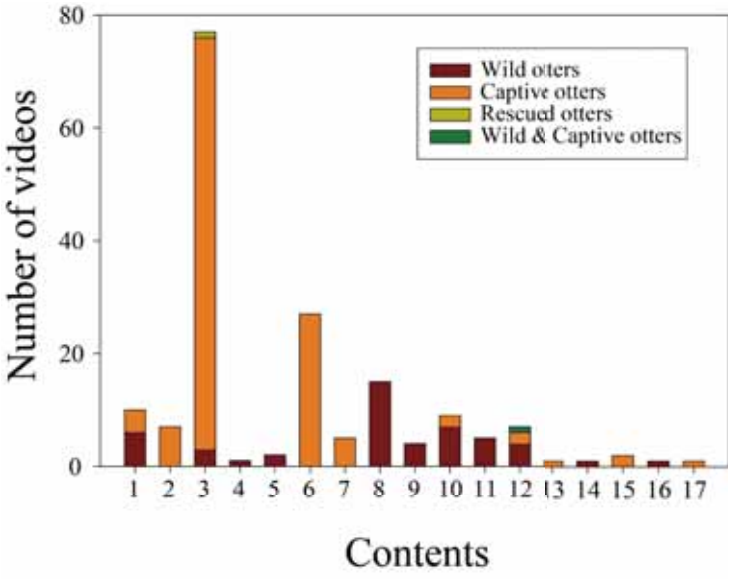

Figure 5. Number of videos of wild, captive, rescued otters, and simultaneously wild and captive otters classified by contents: (1) Investigation, (2) Advertisement, (3) Interaction with people, (4) Rescue, (5) Conflict with people, (6) Feeding, (7) Culture, (8) Observation, (9) Release into wild, (10) Hunting prey, (11) Inter-species interaction, (12) Ecology, (13) Territoriality (intra-species interaction), (14) Results of surveys, (15) Giving birth, (16) Death, and (17) sale of otters, particularly young cubs.

Most of the popular videos were broadcast on captive otters. The top views reported that an otter interacted with people visiting an aquarium (Table 2). The contents of the 10 most popular videos on captive otters were generally associated with the charm of otters.

Table 2. The 10 most popular videos about captive otters. The blanks in species spaces are where a species name was not provided.

Rank	Species	Channel	Interest index	Contents
1	*Aonyx cinereus*	Animalba	637883.400	Otter interacts with people visiting an aquarium.
2		Aty	292411.636	Owner washed otter.
3		Kotsumet	174681.070	Owner groomed otter.
4		Kotsumet	28547.304	Owner fed sushi to otter.
5	*Aonyx cinereus*	Otter family	17173.613	Otter slept near the owner.
6	*Aonyx cinereus*	Otter family	17053.758	Owner fed live shrimps to otter.
7	*Aonyx cinereus*	Otter family	14072.724	Otter followed owner.
8	*Aonyx cinereus*	Animalba	8911.335	Zookeeper played with otters and it implied otters enjoy it.
9	*Aonyx cinereus*	Dahuk	8663.047	Youtuber fed sushi of flatfish (*Paralichthys olivaceus*) to otters.
10	*Aonyx cinereus*	Otter family	6110.190	Otters played in bedrooms.

As the focus was on only wild otter videos, the most popular videos showed them hunting and intra-species interaction behaviour. In addition, some otter occurrences in unexpected areas such as Tsushima Island, Japan, and Han River in Seoul seemed to interest people. Four videos (40%) contained non-native otters in South Korea (Table 3).

Table 3. The 10 most watched* YouTube *videos about wild otters

Rank	Species	Channel	Interest index	Contents
1	*Pteronura brasiliensis*	National Geographic	899.933	Jaguar (*Panthera onca*) tried to hunt giant otters but failed.
2	*Aonyx cinereus*	National Geographic	722.220	Otter hunted northern snake head (*Channa argus*).
3	*Lutra lutra*	Sanai Jisik (Korean)	548.657	Otter foraged American bull frog (*Rana catesbeiana*).
4	*Lontra canadensis*	National Geographic	467.136	Coyote (*Canis latrans*) tried to hunt otters on the ground during winter.
5	*Lutra lutra*	Channel A	328.066	Korean otter dispersed in Tsushima Island, Japan.
6	*Pteronura brasiliensis*	Hada	291.832	Otter hunted one of the crocodile species.
7	*Lutra lutra*	YTN Science	187.619	Otter occurred in Seoul capital city of Han River.
8	*Enhydra lutris*	MBN News	159.742	Mother groomed her babies.
9	*Lutra lutra*	YTN News	73.636	Otter foraged in urban stream.
10	*Lutra lutra*	MBC	68.569	Animals in the Jiri National Park (the largest park in South Korea) during winter.

DISCUSSION

Worldwide, available land for wildlife has decreased remarkably due to extensive needs for agriculture and urbanisation as a result of population increases **(Green et al., 2005)**. Thus, it is necessary to have more developed animal conservation strategies regarding how wild animals can coexist with people outside of protected areas **(Anand et al., 2010)**. Conservation awareness, custom, activity, and socioeconomic cultures are important for establishing these strategies **(Athreva et al., 2013)**. Nowadays, Eurasian otters have recovered to some extent in Europe and South Korea, and so in this study I focused on these activities to reveal any evidence

and future directions for otter conservation **(Yoxon and Yoxon, 2019)**.

South Korea is a good example of improved conservation awareness for otters, and this awareness has positively affected their recovery. Previous research introduced the subject of improved public otter conservation awareness by reviewing newspapers since 1962, and I also provided some cases of highly developed regional conservation activities in this study **(Hong et al., 2017)**. Although these activities have provided better environments for the otters, it is necessary to assess the current situation objectively in terms of socioeconomic determinants, and then suggest better conservation strategies.

Although the activities found in this current study could be helpful for establishing otter conservation awareness in urban areas due to familiarity with wild otters, they are not effective in reducing risks of fatality. The priority for otter conservation could be to reduce such fatalities, but current activities are more focused on socioeconomic and political profit for people. In the Jeonju Stream, the regional government paid for factory areas to be restored as otter habitats (Figure 3g) as this reflected the desire of the people to conserve otters. However, it also contributed to an increase in land prices especially in urban areas **(Wolch et al., 2014)**. Building otter statues or using painted images as mascots in the cities of Daegu (Figure 3d) and Gwangju Metropolitan (Figure 3a) does not involve direct restoration activities for the otter population, but it does impact strongly on creating an impression of the cities as more salubrious environments because otters represent the health of the water **(Hong et al., 2018)**. Politically, this does seem to work in demonstrating that these cities have tried to do their best to improve life for their citizens and not for otters, although otters do occasionally live in urban areas without such habitat improvement **(Kabisch et al., 2016)**.

In urban areas, being killed on roads is one of most important threats to otters. Building shelters and holts can be helpful for urban otters, but these are not crucial for reducing otter fatalities. So far, there is a lack of consideration to mitigate and manage risk factors for road deaths. In one case roadkill warning signs have been put near roads in Deagu, but this action did not deal with fundamental factors. Nowadays, there are several scientific projects in urban areas such as Daegu (Figure 3d) and Jeonju (Figure 3g), but the results did not suggest fundamental action plans based on their results concerning the ecological characteristics of the species. Thus, it is urgent to conduct thorough scientific research regarding the fundamental questions on habitat availability and uses. Defining the most vulnerable areas could suggest where we should take action to release roadkill risks **(Fabrizio et al., 2019)**. If local citizens will participate in such projects, surveys will increase public awareness and provide scientific clues about habitat uses.

Social media such as *YouTube* can identify the trends in people's interests **(Burn, 2014)**. Although the videos of captive otters can have negative impacts on viewers

who perceive the species as pets, the popular videos suggested what people want to see **(Harrington et al., 2019; Measey et al., 2019)**. The most popular video contents of captive otters mainly involved feeding them, their charm, and their interaction with people (Table 2). Hence, it could be concluded that people want to see the foraging and charming behaviours of otters. However, it is very difficult to see videos reporting wild otters related to these subjects, especially charming behaviour (Table 3). In Daegu and Busan city, some otters foraged and played near people providing evidence that wild otters can also charm people. If some documentaries deliver these points, people can also rethink their opinion of urban otters and provide a motivation to conserve.

Wild otters represented in the most popular videos are not the native species in South Korea, which means that there are possibilities for attracting the public to see the native otters. In order to encourage their coexistence with people, some documentaries are needed to deliver the vulnerability and difficulties of surviving for urban native otters. The mass media has a great power to change public awareness **(Hong et al., 2017)**. Hence, reporting urban otters can be helpful for developing better public awareness.

In this study, several pieces of evidence of coexistence between human and otter species in urban areas have been presented. The evidence reflects the public desire to conserve otters, which indicates that if some thorough conservation plans dealing with both the public and science are established, the otters could live in urban areas in South Korea **(Chazdon et al., 2009)**. Using social evidence could provide powerful clues for determining a better strategy for conservation. Hence, broad surveys using public media, such as blogs and other social network services (SNS), with a scientific basis on ecology of wildlife can provide new insight into conservation strategies in urban areas.

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Disclosure Statement

No potential conflict of interest was reported by the author

Author Biography

Dr SUNGWON HONG received his PhD in the Department of Biological Sciences of Pusan National University at South Korea in 2018 and works as a postdoc in the same university. His main questions are how otter populations disperse and coexist with the public.

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OBITUARY: MOTOKAZU ANDO

Dr Ando was born in 1950 and passed away from pancreatic cancer on 24 March 2020 at the age of 69. After graduating from the International Christian University, he engaged in making wildlife movies in Africa, and then entered Kyushu University Graduate School of Agriculture to study wildlife. In 1982, while he was a graduate student, he worked as a lecturer at the Department of Biology at Kyongnam University in South Korea. During this time he carried out research on otters in Korea, which until then had hardly been studied. After obtaining his PhD. on the giant flying squirrel (*Petaurista leucogenys*) and their gliding adaptation, he worked as a staff member of the International Lake Environment Committee Secretariat, working on the conservation of wetlands around the world.

In 1994, he re-started the otter survey in South Korea with me conducting research on Japanese otters. In 1989 I had been asked by the government to start an otter survey in Kochi Prefecture. At that time, Dr Ando was the only researcher who had investigated otters in Japan. We went to South Korea and he taught me the methods to study otters. Since then, we established the Otter Research Group Japan and started otter research, dissemination and awareness activities in Asia and also contributed to the IUCN Otter Specialist Group. From 1995 to 2002, various symposiums and workshops were held by us in Japan, South Korea, Thailand, Taiwan, India and Vietnam. In South Korea, as the research progressed, awareness of otter conservation increased, and in 2013 Dr Sung-Yong Han, who was also doing research with us, founded the Korean Otter Research Center.

Dr Ando started work at the Tokyo University of Agriculture in 2001, and he was able to promote the ecological research of many mammals including otters together with his students. He was also instrumental in developing the younger generation. His major achievement concerning otters was the publication of “The Japanese Otter - Lessons from Its Extinction”. For wetland conservation, he took the leadership as Chairperson of the Ramsar Center Japan, Vice President of the Japan Wetland Society, and also for wildlife conservation he contributed as chairperson of the Japan Wildlife Conservation Society.

He was very energetic and continued to spend time on otter conservation up to the month when he passed away. The achievements of being able to carry out such a wide range of activities and nurturing young researchers are extremely significant, and Dr Ando is a real loss. I would like to express my deepest condolences.

Hiroshi SASAKI

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