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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 will 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
A limited number of copies of the Journal will be printed and these will be available for sale on the Ottershop (www.ottershop.co.uk). It will also be made available on the IOSF website (www.otter.org)

Back Issues
Issue 1 (Proceedings of the First Otter Toxicology Conference, Published 2002) is now 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) is available on a CD at the Ottershop (www.ottershop.co.uk).

Issue 3 (2017), Issue 4 (2018) available as a pdf or hard copy from the Ottershop (www.ottershop.co.uk).

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IOSF WORLD OTTER DAY 2018

An important day for otters and IOSF, **WORLD OTTER DAY** in 2018 took place on Wednesday 30 May. It has become a great opportunity for people around the world, who care about otters, to come together and raise awareness of this beautiful and vital animal. Better education results in better conservation which protects the otters and their habitats, and this benefits all of us and the education of our younger generation is building awareness in the guardians of the future.

A small selection of the events that took place on World Otter Day 2019

2018 was our fourth annual celebration of otters and people took part in over 26 countries, including Taiwan, India, Japan, Laos, Romania, China, Switzerland, Portugal, Mexico, Russia and United States. It was exciting to see a wide range of people and organisations involved, raising awareness and raising funds, which supports important work in otter conservation and this was done through public and educational events, to individuals utilising social media and displaying posters.

Resources were available on our website, including posters translated into 19 languages and our video into 10. Social media played a big part in extending the reach of the **WORLD OTTER DAY** event and yet again, together we managed to get #worldotterday trending on Twitter.

Again, we were very happy to offer three grants of £100 to help towards the cost of an event for IOSF's **WORLD OTTER DAY**. There was an enthusiastic response from applicants with a wide range of ideas for their celebration and our 2018 grants were awarded to:

Montenegro – Ninoslav Durovic, NVU Living Green: with the children's educational TV show, young reporters, TV Vijesti "Pčelice – Small Bees", discussed otters and IOSF's **WORLD OTTER DAY**, visited local otter habitat in Skadar Lake NP to search for otter signs and installed a camera trap to help with future research there. ***(Photo: © Ninoslav Durovic)***

Uganda – Godfrey Lubanga, Uganda Wildlife Authority at Murchison Falls National Park: Carrying out a survey for otters on a 10km stretch of the Nile River east of Karuma and involving the local fishing community.
(Photo: © Godfrey Lubanga)

UK, Wales – The Cardiff University Otter Project: Streamed an otter post mortem via their Facebook and Twitter pages, to provide an insight into the research carried out on otters in the UK.

(Photo: © Cardiff University Otter Project)

Thank you to all who supported IOSF **WORLD OTTER DAY**. It is your participation that brings success to this special day for otters.

IOSF **WORLD OTTER DAY** is on the last Wednesday in May each year.

So put a date in your diary:

Wednesday 27 May 2020 is IOSF's next WORLD OTTER DAY

IOSF OTTER OSCAR AWARDS 2018

The 2018 IOSF Otter Oscars received another high number of nominations from a variety of sources around the world, including children's projects, conservation work and research. The variety of work being done always makes this a difficult decision. It is always good to learn of young environmental enthusiasts working to improve what they believe in and raise awareness to build a better future and likewise, the projects of research and rehabilitation to protect and preserve our precious otters.

On 1 December 2018 we announced the seven successful nominees, as follows:

Special Award – Dr Donald Jefferies, UK

Over many years, Dr Jefferies has worked on the status and conservation of the otter in the UK. Don identified the problem that pollution by organochlorines was having a drastic effect on predators, including the otter. He also worked with the Otter Trust to bring otters back to large parts of England. Don is an unassuming man who has done so much for otters and we are delighted to recognise this with our Special Award.

(Dr Donald Jefferies photographed with grandsons Felix and Xander Dickinson)
Photo: © Sarah Jane Dickinson

Children's Award - Ruby Bedelph, Australia

Whenever able, Ruby raises awareness and educates people about otters. She loves assisting her mum at marine educational events.

Ruby with her well-earned award.
Photo: © Gretta Pecl

Young People's Award (12-18yrs) **- Ullapool Sea Savers (USS), Scotland**

Poppy Lewis-Ing is the Otter Champion of this enthusiastic group of young people committed to "look after our seas and marine life by reducing rubbish and waste, protecting the animals that live in our seas and raising awareness of the things that threaten those creatures."
www.ullapoolseasavers.com/
Poppy and friends receiving their Otter Oscar.
Photo: © Janis Patterson

Group/Organisation Award - OBC Chinchimen, Chile

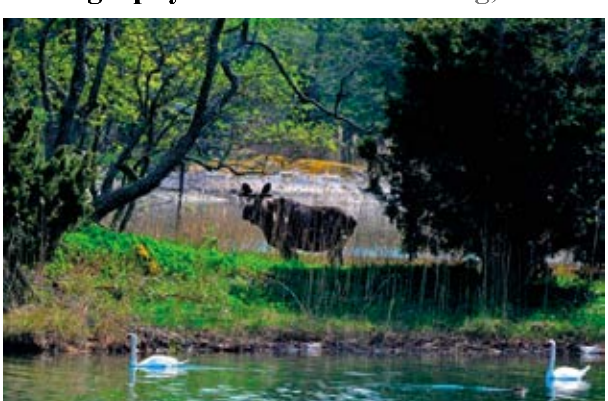
OBC Chinchimen has, for many years, been working hard in otter conservation and rehabilitation, alongside the biodiversity of the area. There is a strong educational ethos and community involvement.
http://www.chinchimen.org/
Photo © Rinaldo Verdi, Chinchimen

Community Achievement – Chaminda Jayasekara, Sri Lanka

By converting an abandoned paddy field into a small mammal conservation area (Vil Uyana), Chaminda Jayasekara has attracted rare and vulnerable species, including the otter *Lutra lutra*. He has also set up a community centre for educational and awareness activities, as well as a library and involves school children and members of the community.
Photo: © Chaminda Jayasekara

Research – Reckendorf, A; Siebert, Prof. Dr. U; Uni. of Vet Med. Hannover, Foundation; Habbe, Dr. B; Krueger, Dr. H-H; Aktion Fischotterschutz eV/Oberlercher, T; Fladung, E: Inst. of Inland Fisheries Potsdam-Sacrow; Goeckemeyer, S; Chamber of Agri. Lower Saxony; Hahn, A; Assoc. of Inland Fisheries and Pond Hosts, Schleswig-Holstein.
Otters are at risk of drowning in fish traps commonly used in Northern Germany. This project, involved collaboration with stakeholders to trial otter-friendly fyke nets, enabling otters to escape but fish to remain. Watch a short video here: www.youtube.com/watch?v=u9T4mcEY-8o
Anja and Britta with an otter-friendly fyke net. © Anja Reckendorf

Photography/Artwork – Hans Ring, Sweden



Hans' engaging photograph shows the otter in its natural habitat amongst other wildlife. An opportunity afforded from years of observation.
Photos: © Hans C Ring

ASIAN OTTER CONSERVATION NETWORK REPORT

PADMA DE SILVA

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

IOSF has again had a busy year in Asia and the Network now has an active Facebook page where people post photos and videos taken in Asia. We do not post exact location details of otter sightings of otters as this could lead to disturbance and possible hunting threats. However, we do encourage people to send otter records or incidents of possible illegal trade to IOSF at enquiries@otter.org. Obtaining such information is very important.

I have been personally working with Chaminda Jayasekara at Jetwing Vil Uyana, in Sri Lanka, who reported on sightings of otters in Volume 4 of *OTTER, the Journal of the IOSF*. He has a group of enthusiastic young conservationists who created a safe haven for various fauna and flora by converting an abandoned area of paddy fields at Rangirigama, near the historical city, Sigiriya. He has been using camera traps and obtained excellent photos and videos of otters, some of which have been posted on the AOCN Facebook page. Together we are going to be doing some education work for IOSF's WORLD OTTER DAY as part of his "Protect Eurasian Otters" project.

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

Padma de Silva, IOSF Asian co-ordinator; Chair - Asian Otter Conservation Network

1. SOUTHEAST ASIA: ADREAN, INDONESIA

Threats from the Pet Trade

Trade in otters as pets in Indonesia, Malaysia, and Thailand is increasing and many animals are sent to Japan and the US. The highest repeat route for trade is now from Thailand to Japan with numerous captures of illegally traded animals. Given the popularity of otters in Japan it can be assumed that many of these include otters. For example, in January two men were arrested in Japan for trying to smuggle in a baby Asian short-clawed otter which had come from Thailand. IOSF has been assisting with investigations being carried out into suspected illegal breeding of otters as pets.

Increased Legal Protection in Indonesia

The Ministry of the Environment and Forestry have signed a decree so smooth-coated otters are now fully protected in Indonesia. This is a major step forward, as now three of the four native species are protected. However, there is still no protection for Asian small-clawed otters, which is the species most involved in trade as pets. We will continue to work for such protection to be extended to these otters.

2. SOUTH ASIA: JYOTI BHANDARI, NEPAL

Nepal

1. With the financial support from the Rufford Small Grant Project, Jyoti Bhandari conducted a project entitled "Conservation status survey and awareness of smooth-coated otters in Babai River of Bardia National Park, Nepal." The fieldwork has been completed and data analysis is underway.

2. Pramila Thapa, is conducting an otter survey in Shuklaphanta Wildlife Reserve.

3. Aarati Basnet is also conducting research entitled "An ethnological study of otters to assess bygone and current evidence of otters in Budigandaki River, Nepal."

India

1. Sayanti Basak is currently pursuing a Master's degree in Wildlife Science from the Wildlife Institute of India. She is carrying out field work on "The resource use of smooth-coated otters in the Sub-Himalayan river systems of Uttarakhand, India."

2. Surther et al. published their research: **Surther, AR, Rathod, JY, Patel, IB, Gavali, DJ and Lakhmapurkar, J, 2017**. Historical and current distribution of smooth coated otter, *Lutrogale perspicillata* in Gujarat, India. *IUCN Otter Spec. Group Bull.* 34, 2, 95–103.

Bangladesh

Aziz published his research on Asian small-clawed otters in the Sundarbans mangrove forests. He reported that they are feed predominantly on mudskippers (*Periophthalmus* sp.) on exposed river mudflats, particularly during ebb tide. Chemical pollution in watercourses from several recent cargo incidents may well have adversely affected otters. Systematic surveys are needed to assess populations to guide conservation effort, and monitor the health of the ecosystem.
Aziz, MA, 2018. Notes on population status and feeding behaviour of Asian small-clawed otter (*Aonyx cinereus*) in the Sundarbans Mangrove Forest of Bangladesh. *IUCN Otter Spec. Group Bull*. 35, 1, 3–10.

Pakistan

Ahmad et al. looked at habitat suitability for Eurasian otters and found that areas of high habitat suitability were very limited (0.79% of the total area) whereas unsuitable habitat area accounted for 94.39%. This clearly explains the declining otter population in the area. They concluded that there is a need for immediate attention towards conservation and management of the Eurasian otter and its habitat to prevent a further decline in population.
Ahmad, Z, Chaudhry, H, Ali, H, Rehman ,A, Ahmad, S, Ashraf, U and Nisar, N, 2017. Suitable habitat evaluation of Eurasian otter (*Lutra lutra*) in Khyber Pukhtunkhwa, Pakistan. *Transylvanian Review.* 25(18)

3. EAST ASIA: LING-LING LEE, TAIWAN

China

(i) Live otter spotted in Shanxi province

As more people are paying attention to protected wildlife species in China, more evidence of the presence of otters is being revealed. According to a news report, in January 2019 a photography enthusiast Wang Jianho saw and took photos of a wild otter feedomh at night by the Jiaoxi River Valley in Foping County of Shanxi province. According to Wang, with the acceleration of forest regeneration, improvement in the environment, and stronger awareness of people on protecting wildlife in Foping County, more and more wildlife, including protected species such as otters, appear in the vicinity of the county. (http://hsb.hspress.net/system/2019/0127/148648.shtml).

(ii) Stable activity of otters in the Sanjiangyuan National Park

According to China News, monitoring over the past year has shown stable activity of Eurasian otters in the headwaters of the Lancang, Yangtze and Yellow Rivers in the Sanjiangyuan National Park. Project director Zhao Xiang of the Landscape Nature Conservation Centre explained that the Park has little human impact and the three major rivers and their tributaries provide an ample water supply to vast areas. They are also rich in freshwater fish, important as otter prey. Monitoring in the past year has shown that Eurasian otters not only appeared in less populous headwater areas, but also in urban waterways of nearby Yushu city, which has a population of about 80,000 (2001 figures). Nine of the 21 infrared camera sites along three tributaries of the Yangtze River in the city recorded otter activities of feeding, defecation, marking and other behaviour. There were also records of otter activities along the Lancang River. Zhao Xiang said they are currently trying to draw on the experience of habitat restoration in the UK and Taiwan to provide more shelters for the Eurasian otters in Yushu (http://www.chinanews.com/sh/2019/01-15/8729752.shtml).

Taiwan

Otter workshop

Multiple stakeholders met in Kinmen to discuss how to mitigate the impact of water-related Forward-Looking Infrastructure on otters. Representatives of Kinmen County Government, Water Resource Agency (WRA), Township leaders, environmental NGOs, and experts and academics visited Jinsha (or Chinsha) Stream, which is one of the largest streams in Kinmen. The stream, surrounding ponds and irrigation channels form a waterway network which is one of the most important habitats for Eurasian otters. However, the County Government recently received funding to implement a water-related infrastructure project from the Special Act for Forward-Looking Infrastructure of the central government. The purpose was to solve occasional flooding of the nearby township, which requires dredging the stream. Instead of using an eco-friendly approach, the construction unit severely disturbed the stream with large scale excavation, removal of most natural vegetation along both banks, and creating vertical cement sides, sparking strong criticism from local conservationists. A field visit and meeting was held to clarify the scope of the project, the social and ecological issues of concern, and ways to move forward. The WRA, the leading agency responsible for the projects, concluded by stating that they would conduct a review and make sure ecological considerations would be carefully integrated into the mitigation measures and project implementation in the future.

4. MIDDLE EAST: OMAR AL-SHEIKHLY

Iraq

On 20 December 2013 the UN General Assembly proclaimed 3 March as UN World Wildlife Day to celebrate and raise awareness of the world's wild animals and plants. In 2019 the theme was "Life below water: for people and planet", so clearly includes otters. This was the second time the Iraqi Green Climate Organisation (IGCO) participated, and they focused the event on Maxwell's otter (*Lutrogale perspicillata maxwelli*). This is a separate sub-species of the smooth-coated otter found in Iraq and it was named after Gavin Maxwell, the author. The event was held in the Baghdad Mall in cooperation with the Saviours team for Wildlife and Al-Chebaeish Ecotourism organisation, to raise awareness of wildlife conservation in Iraq.

Lebanon

A case study was carried out on attitudes of local people in Hima Anjar/Kfarzabad towards otters and how this can be improved by working with local fish restaurants. It is hoped this will help otter conservation after years of decline due to persecution, conflict over food resources, and deterioration of aquatic and riparian habitats.

A full report on this work can be found in this issue.

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AFRICAN OTTER NETWORK (AON) AND THE POWER OF ONE INITIATIVE

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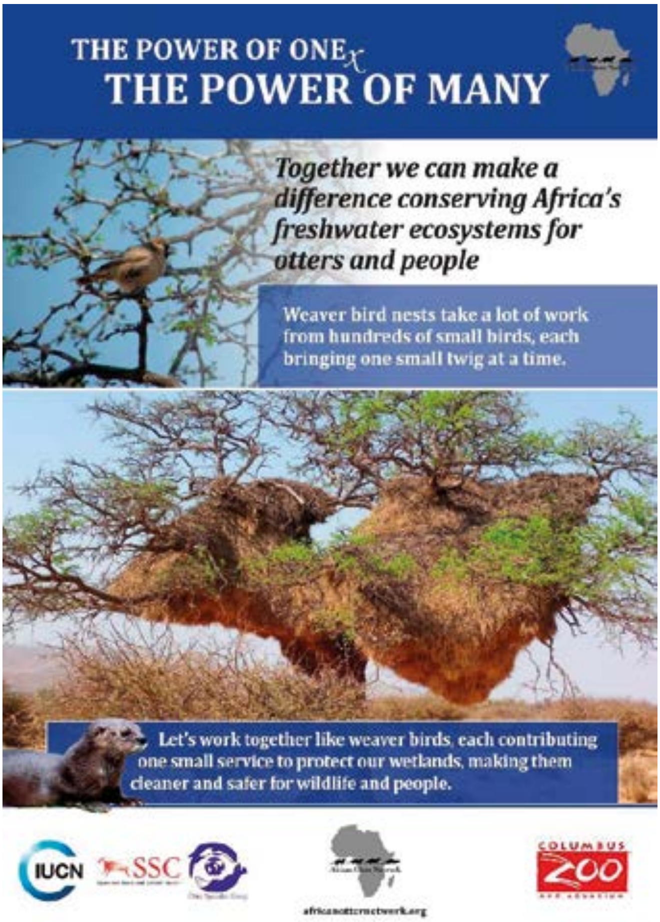
JAN REED-SMITH

Director, African Otter Network

The African Otter Network was originally founded by a loosely organised group of otter biologists, wetland experts, and conservationists. Its purpose is to advance our knowledge of Africa's otter species, promote awareness of Africa's otters, and foster the creation of a viable network of biologists and citizen conservation activists across the continent. As with all conservation efforts, funding for much-needed research has been an issue; however, this has not halted our Power Of One Initiative.



This effort is designed to identify, support, and encourage local citizens in their efforts to preserve freshwater ecosystems for the benefit of wildlife and people. The premise is that we all often feel overwhelmed as individuals by the prospect of making a difference in conserving our ecosystems. But, the power of one idea, one person, one initiative, one project, can have implications and outcomes beyond that one action. Here are the stories of two people working to conserve freshwater ecosystems and the otters that inhabit them in Tanzania.

James Leonard Mazelele, born in a small town on the shore of Lake Victoria, is employed as a Chimpanzee tracker on Rubondo Island National Park, located in the Southwest corner of Lake Victoria (Figure 1). This is a beautiful, little known island that is home to a wide range of wildlife species, including the spotted-necked and African clawless otters. In his spare time James is monitoring the spotted-necked otters (Figure 2). Because of his dedication over the last year we know that the population on the island's Eastern shoreline is holding its own and that several groups still utilise a core denning area documented originally over ten years ago. James' contributions to our understanding of the island's otters include over 90 sightings, photographs, videos, and the sharing of his otter knowledge with his colleagues and friends in other towns along the shore.

Figure 1. James Leonard Mazelele, on Rubundo Island

Figure 2. Spotted-necked otters on Rubundo Island

William Mgomo is a ranger in one of Tanzania's game reserves located in the Southern part of the country. He was introduced to otters at the IOSF 2015 African Otter Workshop and has been active as a partner of both IOSF and AON since that time. Thanks to the support of the Columbus Zoo for the past year William has been conducting a project designed to begin assessing the awareness of, and traditional uses of otter (spotted-necked and African clawless), as well as the degree of perceived conflict between people and otters in the Mbinga District of Southern Tanzania. Results of his study will be published soon but here are some of the interesting highlights:

- He has interacted with more than 1,000 people in the area since he started this study.

- Based on responses he has received to questions regarding conservation of freshwater systems we are encouraged that his outreach efforts are having an impact.
- We now have a better idea of how otters are perceived by people living in the area. Negative attitudes appear to be associated with specific occupations; traditional uses appear to be associated in some cases with tribal affiliation but in others with occupation.
- Conflict at small, single-owner fish ponds is of concern because the otters can impact fish numbers that are relied on by some people for an important source of protein (Figure 3).
- Mitigation efforts at these fish ponds is being tested in one location.
- Both otter species are present in the area.

Figure 3. William speaking with a fish pond owner

DISCLOSURE STATEMENT

No potential conflict of interest was reported by the authors.

AUTHOR BIOGRAPHY

Jan Reed-Smith did her Master's project on the habitat use and behavior of spotted-necked otters on Rubondo Island National Park, Tanzania. She is the Director of the African Otter Network and worked with IOSF to organise the first African otter training workshop in Tanzania in 2015.

FIRST PHOTOGRAPHIC DOCUMENTATION OF SMOOTH-COATED OTTER *Lutrogale perspicillata* IN MAHI RIVER, GUJARAT, INDIA

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Abstract

Three species of otter are found in India, but only the smooth-coated otter Lutrogale perspicillata *is reported in Gujarat. Smooth-coated otters have recently been reported from some scattered locations in Central and South Gujarat like Surat, Bharuch, Narmada and Vadodara District. There are some stray direct sightings of the species reported from Mahi River, but no photographic evidence was available. Thus this study is the first photographic documentation of the smooth-coated otter from Mahi River. During bird surveys we made an opportunistic observation of a raft of four otters basking. Sand mining, water pollution, garbage dumping, grazing, fishing and constructions of dams, bridges and other infrastructures were seen to be are major threats. There is a need for further extensive and intensive study on the status, distribution, habitat-use pattern, and to map out site-specific threats to the otters in Mahi River. Habitat conservation, minimising treats, creating mass awareness among the local community and involving them in otter conservation is required in order to secure the future of this species in Gujarat.*

Keywords: *Conservation; Gujarat; Mahi River; smooth-coated otter*

INTRODUCTION

Otters form a distinct group within the mammalian family, Mustelidae, and are grouped into the sub-family Lutrinae (**Sivasothi, 1995**). Among the carnivores, they are the only semi-aquatic group (**Nowak, 1991**). There are 7 genera and 13 species of otter worldwide, of which 5 are found in Asia. Three species – *Lutrogale perspicillata* (smooth-coated otter), *Lutra lutra* (Eurasian otter) and *Aonyx cinereus* (Asian small-clawed otter) – are found in India but only *Lutrogale perspicillata* (smooth-coated otter) is reported in Gujarat (**Suthar et al., 2017**).

The smooth-coated otter is one of the most commonly occurring otters in India. It inhabits lakes, large rivers, dams, irrigation canals, swamps, shallow rice fields and coastal mangroves and prefers sloping banks with vegetation (**Menon, 2003**). Ample bankside vegetation provides cover and escape, and deep soil is needed for digging holts. Their prey is mainly fish, supplemented by crabs, insects, frogs, birds and rats (**Yoxon and Yoxon, 2014; www.otterspecialistgroup.org**). Smooth-coated otters are indicators of the health of a wetland ecosystem because they are sensitive to environmental changes (**Nawab, 2009**). Therefore the presence of otters gives accurate and direct knowledge about the health of a wetland.

The smooth-coated otter is one of the least studied species (**Hussain and Chaudhry, 1997**). It has been assessed as '*Vulnerable*' in the IUCN Red Data Book of Threatened species (**https://www.iucnredlist.org**) and is listed in Appendix II of CITES (**Shenoy, 2005**). In India, the species is protected and listed in Schedule II under the Wildlife Protection Act 1972 (**Hussain and Chaudhry, 1997**).

These otters are under pressure due to habitat destruction, large hydroelectric projects, wetland reclamation, pollution from pesticides and agricultural run-off, over-fishing, conflict with fishermen (**www.otterspecialistgroup.org**), depletion of food sources, and hunting for the fur and pet trade (**IOSF, 2014**).

The smooth-coated otter is known as *Jalbiladi, Ud-bilado, Jalmanus*, *Undu* and *Jalmundia* in the local language of Gujarat (**Suthar et al., 2017**). **Singh (2013)** stated that the survival of the species was doubtful in the state, and if they are present, the numbers must be very low. Although recently smooth-coated otters have been reported from some scattered locations of Central and South Gujarat like Surat, Bharuch, Narmada and Vadodara District (**Suthar et al., 2017; Trivedi and Joshi, 2018**), there were no photographic records from the Mahi River. During a small mammal survey in central Gujarat in 2007 (**GES, 2009**), a group of five individual otters were seen in the Mahi River near Lachhanpur village. More recently, in June 2016, **Suthar et al. (2017)** directly sighted a group of seven smooth-coated otters in the Mahi River near Amrapur village. Thus, this is first photographic documentation of smooth-coated otters from the Mahi River in Gujarat.

DETAILS OF THE SIGHTING

Gujarat has varied climatic and geomorphological conditions (**Singh, 2001**). It is very rich in floral and faunal diversity due to the diverse habitat, including the longest coastline in the country; two of the three gulfs are located here, and in addition there are plains, mangroves, saline desert, vast grassland, thorny and dry deciduous forest, and coastal and inland wetlands. Five major rivers, the Mahi, Tapi, Narmada, Sabarmati, and Banas, flow through the state from North to South.

The river Mahi is third major west flowing interstate river of India, draining into the Gulf of Khambhat. It is one of the four major perennial rivers in Gujarat (**Directorate of Information, 1960**). Its total length is 583 km, traversing 167 km in Madhya Pradesh, 174 km in Rajasthan and the remaining 242 km from Gujarat. The present sighting occurred in the Mahi River near Kotna Village (Figure 1) of Vadodara district.

During a bird survey on 1 October 2018, at around 7:15 am, a group of four smooth-coated otters (Figure 2) was sighted on the riverside near Kotna village (22°21'42.08"N, 73°2'56.20"E). The otters were seen basking on the sandy riverside near a small sand dune at the water's edge and they were hidden in dense *Typha angustifolia*, locally known as *Gha Bajariyu.* The general habitat was a riparian zone with dominant hydrophytes such as *Typha angustifolia* (rooted emergent), *Eichhornia crassipes* (free-floating) and *Nymphaea Sp.* (rooted and floating). The otters were photographed using a Canon EOS 700D with 250 mm lens.

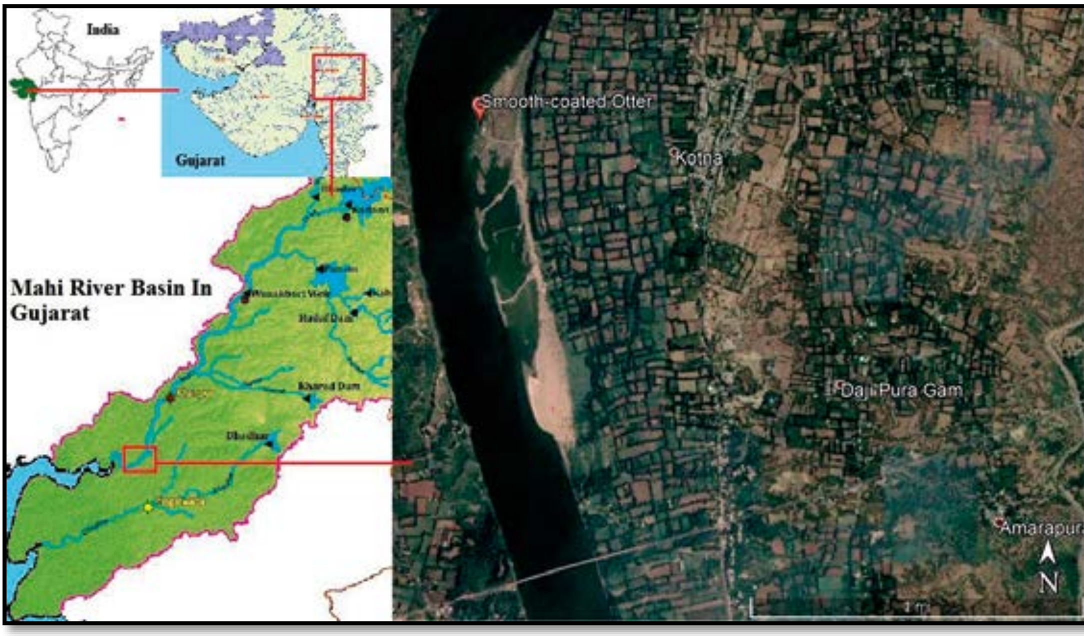

Figure 1. Map showing the location of the study area and the red dot marks the location of the otter sighting.

Figure 2. Smooth-coated otters basking at the Mahi River near Kotna Village. © Pratik Nagrecha

Subsequent visits were made from October 2018 to January 2019 to try to relocate the otters, but they were not directly seen again. An examination was made for indirect signs in the surrounding area near Kotna village during five subsequent visits looking for otter tracks, spraints, den sites, etc. A grooming site and spraints were found.

Some plastic and other garbage and grazing cattle were seen along both of the river banks during the visits. During the subsequent visits, fishing (Figure 3), illegal sand mining (Figure 4), washing of clothes, bathing (Figure 5), and bridge construction (Figure 6) were observed. Human habitation is less than 1 km away (Kotna Village).

Figure 3. Observed fishing activities and information-gathering at sighting location

Figure 4. Sand mining activity

Figure 5. Clothes washing and bathing

Figure 6. Bridge construction activity observed near sighting location

CONCLUSION

The present study confirms the presence of the smooth-coated otter in the Mahi River by this first photographic record. The presence of spraints and a grooming site indicates that the species regularly uses the area, and thus the Mahi River is a promising site for the survival of the species in Gujarat.

It also suggests that sand mining, water pollution, garbage dumping, grazing, fishing, and the construction of dams, bridges and other infrastructures are major threats faced by the otters here. There is a need for a further extensive and intensive study on the status, distribution and habitat-use pattern, and to map out site-specific threats to the otters in this stretch of the Mahi River in Gujarat.

Habitat conservation, minimising the threats, creating mass awareness among the local community and involving them in otter conservation is required to provide a secure future of the species in Gujarat.

ACKNOWLEDGEMENTS

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DISCLOSURE STATEMENT

No potential conflict of interest was reported by the authors.

AUTHOR BIOGRAPHIES

Pratik G.Nagrecha is a wildlife photographer and explorer by passion and chemical engineer by profession. Over the last 6 years he has been exploring new and less explored places in Gujarat in search of rare and endangered wildlife. His main area of interest is avifauna but over the past 2 years he has been involved in documentation of mammalian species. He has participated in many state level censuses for carnivores, herbivores and birds as an expert.

Akshit R.Suthar is a conservation biologist with 9 years of research experience in the fields of faunal study, biodiversity conservation, ecosystem management/restoration, socio-economic impact assessment, mitigation of human/animal conflict, wildlife conservation and research and environmental education.

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PRELIMINARY STUDY ON THE OCCURRENCE, DISTRIBUTION AND TRADITIONAL KNOWLEDGE OF OTTERS IN THE LAKE VICTORIA BASIN, KENYA

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Abstract

*The Lake Victoria basin has undergone many changes over recent decades, due to overharvesting of resources, environmental degradation and the introduction of invasive species. There are two species of otter in the area African clawless (*Aonyx capensis*) and spotted necked (*Hydrictis maculicollis*) but generally otters are an understudied part of the ecosystem. The aim of this study was to use a semi-structured questionnaire for elders, fishermen and other respondents to see how attitudes have changed towards otters.*

Keywords: *Otter, Lake Victoria, fishermen, human/otter conflict*

INTRODUCTION

The Kenyan part of Lake Victoria covers a surface area of 4,128 km^2 (approximately 6% of the whole Lake) of which 34% comprises the Nyanza Gulf. The Gulf lies south of the equator between 0º 6' S – 0º 32'S and 34º 13'E – 34º 52'E and is at an altitude of 1,134 m above sea level. It has a surface area of 1,400 km^2, with mean inshore and offshore depth ranging between 4 m and 12 m. The length of shoreline is 500 km, and the catchment area is 12,300 km^2. The main rivers flowing into the Lake do so through the Gulf and these include Nyando, Sondu-Miriu, Nzoia, Yala, Kibos and Awach.

The Lake Victoria basin has undergone changes in recent decades due to overharvesting of resources, environmental degradation and the introduction of invasive species. For appropriate conservation and management of resources, there is a need to carry out scientific investigations into the various biological components in the lake basin. A number of studies are currently being carried out in Lake Victoria on fish species and other biota. However, it is also necessary to extend such studies to other organisms, especially those that are threatened with extinction.

One of the least studied organisms in the region is the otter. They can be found in fresh, brackish, or salt water, provided the water is not silted or polluted and there is sufficient prey. Clearly the Lake Victoria habitat is freshwater. Otters are opportunists, eating a wide variety of food items, but mostly fish. The usual prey is 10–15cm slow moving fish species, such as carp, and freshwater cichlids. However, they can detect concentrations of fish in upstream ponds which drain into small, slow-moving creeks, and can travel large distances, even into urban areas. They also eat freshwater mussels, crabs, crayfish, amphibians, large aquatic beetles, birds (primarily injured or moulting ducks and geese), bird eggs, fish eggs, and small mammals. In riparian and lacustrine habitats adequate vegetation in the form of long grass, reeds, dense bushes, overhanging trees is essential to provide cover for its survival and large boulder piles can also provide holt sites. They will also use under boathouses, duck blinds, and other human structures up to 500m away from water mostly in wetland sites.

There are two species which occur in Lake Victoria: spotted-necked otter (*Hydrictis maculicollis*) and African clawless otter (*Aonyx capensis*). In this study there was no differentiation between these two different species. However, previous studies by **Agwanda** (**2018**, **pers comm**) reported the occurrence of both and stated that the African clawless are present in Homa Bay and the spotted-necked prefers to stay along rivers.

Both species of otter are classified as "Near Threatened" in the IUCN Red List, due to a decline in its distributional range. Thus, it is important to conserve otters where they still occur. Otters are now rarely seen in areas of Lake Victoria where they used to be routinely observed. This could be attributed to the impact of global climate change throughout Africa (**Magadza, 1994; Hendrix and Glaser, 2007**), which has decreased the availability of suitable habitat for otters and increased human/otter conflict for increasingly scarce resources such as water, land, and fish. Lake Victoria is faced with habitat loss, pollution and degradation of the ecosystem due to agricultural practices and urbanisation. There have also been problems with the introduction of exotic species such as water hyacinth and Nile perch (*Lates niloticus*). Crocodiles and pythons are the main predators of otters.

In this study, a rapid assessment of the status of otters was undertaken in order to ascertain the current status of the otters in the natural habitats mostly within the Lake Victoria Basin and other freshwater bodies including fish farming areas. Although seldom seen, otters are relatively common throughout freshwater bodies e.g. ponds, lakes, rivers, estuaries, and bays. Otters commonly avoid polluted waterways, but will seek out a concentrated food source upstream in urban areas.

METHODOLOGY

The study was carried out using a semi-structured questionnaire for elders, fishermen and other respondents. The former would give their views on otters in the early days (distribution, uses etc.) whilst the latter would present the present knowledge on the animal with respect to their occurrence and impact on fisheries. Youths from designated points in the five counties (Homa Bay, Kisumu, Migori, Busia, and Siaya) along the shores were trained in the use of the questionnaires and they then carried out the work at different sites for five days each. Research scientists in three research centres (Sagana, Lake Naivasha, and Kegati) were interviewed by phone. The questionnaires were then put into SPSS and Excel spreadsheet for analysis.

STUDY SITES

The main source of data was from interviews with fishermen in the Lake Victoria Basin (Figure 1). However, information was also sought from other areas especially fisheries research institutions.

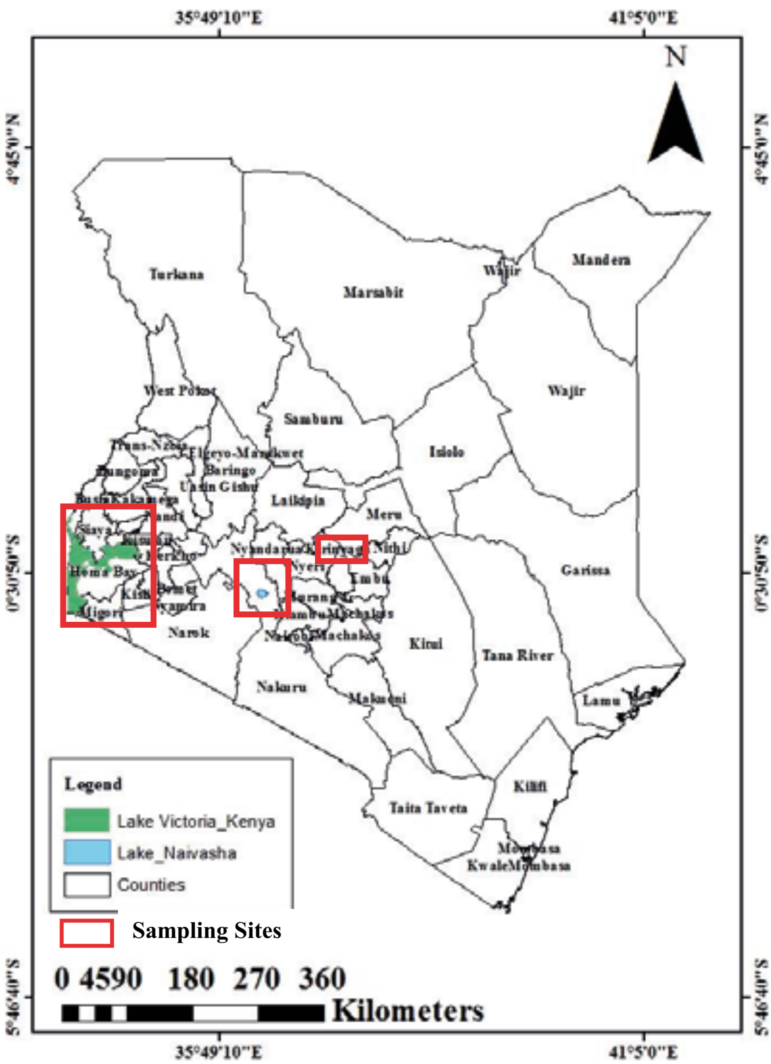

Figure 1. Map of Kenya showing study areas

RESULTS AND DISCUSSION

Different groups of people were asked whether they knew and had seen otters. These groups included fish traders, Beach Management Unit (BMU) officials, university students, fishermen, and research scientists at the three research institutions (Table 1).

Table 1. Occupations and knowledge of otters

Occupation of respondent	Knowledge of otters	
	No interviewed	%
Fishermen	15	100
Fish traders	5	100
BMU Officials	2	100
Papyrus harvester	1	100
Research scientists	3	66.7
University students	25	0

The results showed that most of the people directly associated with aquatic ecosystems are acquainted with otters, especially amongst those in the Lake Victoria Basin. Among the research scientists, only two had seen an otter, those from the Sagana and Sangoro Stations but not the scientist from Kegati Station. The latter is an aquaculture centre situated in Kisii County, approximately 120km away from Lake Victoria, and this probably explains why the scientist was not aware of otters. Sagana aquaculture centre is found in Kirinyaga County in central Kenya (Figure 1), and it gets its water from the River Ragati, where otters are frequently sighted (Figure 2). A number have also been seen within the farm where guards scare the animals away.

The students interviewed were from the Aquatic and Fishery Department of Kisii University. This university is also located in Kisii County, 10km from the Kegati Aquaculture Research Station. It is therefore possible that they were not aware of otters due to the distance from Lake Victoria and their presence only being in low order streams. The students' awareness of the animal did not improve even by showing them a picture of the animal.

Fishermen in the Lake Victoria Basin were further asked about the importance of the otter. In the region otters have traditional values in terms of medicine, food and other social interactive aspects. Skin bangles are used on children to prevent measles and it is believed that the meat boosts sexual libido in men. Commercial sex workers also use certain specific organs as natural attractants.

Asked whether otters were important and should be conserved, all fishermen below the age of 30 responded that the animal is not important, dangerous and should be hunted whenever spotted – hence the high percentage of people who regarded the otter as "dangerous" as shown in Figure 3. Among the older fishermen only 14% appreciated the animals.

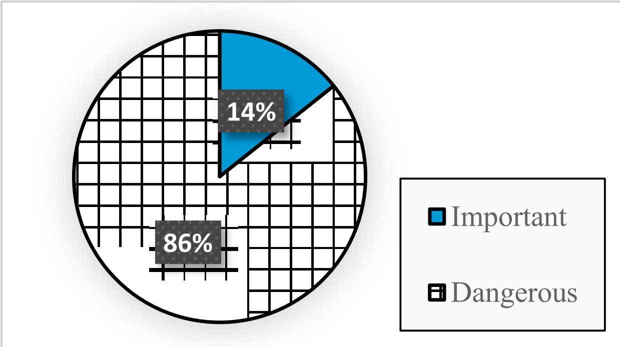

Figure 3: Perception of otters in the environment by respondents – fishermen over 30 years old

Fishermen reported that otters predate on gilled fish thus affecting their catches. The animals have also been reported to predate on fish in fish ponds. In both cases otters are usually hunted whenever spotted.

To determine the frequency of otter sightings, different groups of people were asked when they last saw the animal. Frequency was categorised into daily, previous week, previous month and year (Table 3).

Table 3. Percentage frequency of sighting of otters by occupation

Occupation of respondent	Daily	Last week	Last month	Last year
Fishermen	20	80		
Fish traders	0	20	40	40
BMU Officials		100		
Papyrus harvester			100	
Research scientists				100

The results showed that the animal is frequently sighted by those closely with frequent interaction with Lake Victoria viz. fishermen and BMU officials. These are individuals whose daily activities involve being at the beaches and hence there are more chances of seeing otters. At Dunga beach in Kisumu, BMU officials associate the animal with balsa wood trees (*Aeschynomene elaphroxylon*), which they are banned from cutting within the wetland.

CONCLUSION

It was evident from the study that the majority of people in the country do not know otters. Most of those who are familiar with them take them to be dangerous animals which should be hunted down. Traditional knowledge on the importance of the animal is known only to the elderly. The study revealed that although there is little conservation awareness, in some areas like Dunga beach, there is already some serious consideration regarding saving the otter. Education work is being carried out in primary and secondary schools by the Kisumu Science Teacher Otter Conservation Group (KISTOC)

RECOMMENDATIONS

There is an urgent need to create more awareness of otters and their importance in the environment among the young people, especially students, and fishermen. Just as with other aquatic biota, it is also important to study its biology and ecology and ways of its conservation in the region. This can best be done through creating awareness at all levels of education and through conservation groups.

ACKNOWLEDGEMENTS

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DISCLOSURE STATEMENT

No potential conflict of interest was reported by the authors.

AUTHOR BIOGRAPHIES

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Peter Nyamenya was Principal Curator at the National Museums of Kenya, Kisumu Branch, with a speciality in reptiles and fish. He also dealt with the conservation of rare species in Lake Victoria and coordinates schools projects on this subject, particularly through KISTOC.

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APPENDIX 1 - Questionnaire

Date _______________ **Name of interviewer** ________________________________

Name of the area ____________________ type of water body ____________________

GPS: ____

1. Name of respondent __________________________________

2. Occupation of respondent __________________________________ Age (Yrs) ________

3. Have otters been sighted in the area ________________ which color was this __________

4 When was this (Yr.) _____________________

5. Any local beliefs on the mammal ____

6. Are they seen frequently and in high numbers? Yes ☐ No ☐

7 How are the mammals treated in the wild? Important ☐ Dangerous ☐

8. How are otters treated when they intrude into fish farms?

Hunted ☐ Protected ☐

TOWARDS A COOPERATION BETWEEN THE EURASIAN OTTER *Lutra lutra* AND LOCAL PEOPLE OF HIMA ANJAR/KFARZABAD, LEBANON: A CASE STUDY

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Abstract

The authors present the status and conservation efforts for the Eurasian otter Lutra lutra *and a case of future cooperation between the otter and local people of Hima Anjar/KfarZabad, Lebanon. It is suggested that this relationship will help otter conservation after years of decline due to persecution, conflict over food resources, and deterioration of aquatic and riparian habitats.*

Keywords: Lutra lutra*; otter; conservation; mutualism; Hima; Anjar/Kfarzabad; IBA; Lebanon*

INTRODUCTION

The Eurasian otter was listed on the IUCN Red List as "Near Threatened" in 2004 and remains at this level until today (2019). This is mainly based on declines in parts of the range, the lack of information from many parts of its range, and the sensitivity of the species to sudden changes in threats (**Roos et al., 2015**). In Lebanon, the otter is "Endangered" at national level (**Loy et al., 2016**). To our knowledge, the species was first documented in a record that dates back to 1967 when **Lewis et al.** (1994; cited in **MacDonald and Mason, 1994**) stated that it was seen at Aammiq Swamp in the Beqaa Valley. **MacDonald & Mason (1994)** could not find more recent information on the otter from Lebanon.

CHRONOLOGY OF OTTERS IN LEBANON

Between 1970 and 1972 one of the authors (GR-J) was working with another ornithologist (Joel Neuschwander [JN]) ringing birds at Aammiq and Anjar (12km apart). During this time he observed an otter in spring 1971 and 1972 at Anjar and in spring 1970 and 1972 at Aammiq. The species could have been overlooked at Anjar in 1970 as the swamps and river were not dry, but not at Aammiq in summer 1971, when the swamps and river were totally dry, most probably as a result of drought and overexploitation of water in that year. JN asked his colleague from the University of Saint Jerome in Marseille about the disappearance of otters and assumed they travelled along tributaries of the Litani River and the main river itself to another more appropriate habitat. This explanation would also suggest that otters of Aammiq went to Anjar as both sites are interconnected with the Litani and its tributaries.

In 1985, a book was published on the mammals of Lebanon using a photo of the Eurasian otter on the cover (**Assad Serhal, 1985**).

In preparation for the declaration of Anjar/Kfarzabad as a Hima,[1] surveys were conducted in 2004 and 2005 by the Society for the Protection of Nature in Lebanon (SPNL), under the supervision of two of the authors (AS and BK), and this included interviews with local people from Anjar and Kfarzabad. In fact, as early as 2005 Vahie and his brother, Jean, of the Al-Jazeerah (island) fish restaurant, started showing SPNL films of the otter families, where adults were raiding their trout fish pools. The films received different reactions – SPNL staff regarded them as "hilarious" and "amusing", but they were seen as a "nightmare" for the fish restaurant that is located half way between the two villages (Anjar and Kfarzabad).

In 2007, the owner of another fish restaurant, Messak, showed the SPNL a video that was taken by a night camera at his restaurant to identify who was stealing fish from their breeding pools. The "thief" was an otter, which prompted SPNL to send Mr Berj Tumberian of the Homat Al-Hima ("enthusiastic heroes from the local communities") from Anjar on a specialised training course on otters to Italy, in coordination with the IUCN Species Survival Commission and university professors. After training, SPNL provided Mr Tumberian with night cameras and canoes to help him monitor the otter families along the wetlands and river system.

SURVEYS AND IMPLEMENTATION OF THE ACTION PLAN

The GTZ[2] project and MAVA Foundation support for the wetlands, in addition to the EU Commission in Lebanon, helped develop wise water management at spring sources and wetlands. Dr Sills, RSPB, spent his sabbatical with SPNL at Hima KfarZabad and helped to design a rehabilitation plan for the wetlands, pools, water level, educational trails, etc. This helped the Hima wetlands and its water system and wildlife to survive the toughest years of drought. At that time even the Aammiq wetlands were reduced to virtually no water, whereas water, fish and otters were still present at both Himas Kfarzabad and Anjar.

It is indeed a success story for the quality and quantity of water saved using the Hima approach, a model used to restore the Litani River habitat. Prior to 2008, A Rocha Lebanon* (undated) stated that *Lutra lutra seistanica* is known as breeding in the Beqaa Wetlands and in the Shouf Reserve. Our literature search for the Shouf Reserve, which was mainly a biodiversity assessment and monitoring study that was conducted by the Lebanese University in 2005, indicated that the otter is a potential mammal species that could be encountered in the reserve.

Recently, **Loy et al. (2016)** reported on an individual otter recorded by camera trap in 2013 in a fish pond at Hima Anjar/Kfarzabad. More recently, SPNL conducted a survey at Anjar/Kfarzabad and Aammiq during 2014–2015. It found no otter signs at Aammiq for the first time since at least 1968. A family of 6-7 individuals was recorded at Anjar in 2014 but only 5-6 in 2015. Although this study is not completed and has limited data, the apparent disappearance, possibly temporary, at Aammiq

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[1] Hima means protected area in Arabic; it is a community based approach used for the conservation of sites, species, habitats, and people in order to achieve the sustainable use of natural resources (https://www.spnl.org/hima/).

[2] Deutsche Gesellschaft für Technische Zusammenarbeit

could indicate a possible decline in otter numbers, especially as there have already been various degrees of declines in Syria (**Jacques, 1998**), Turkey (**Eroğlu, 1994**), Jordan (**Foster-Turley and Santiapillai, 1990**) and Israel/Palestine (**SPNI, 2014**). This prompted SPNL to take measures for otter conservation at Hima Anjar/ Kfarzabad and also to encourage the owners of Aammiq (private property) to take appropriate conservation steps. Water management is essential at Anjar for otters and also the "Vulnerable" Syrian Serin, a small regionally endemic bird. Hence SPNL commissioned the Anjar municipality and Homat Al Hima to be responsible for implementing the project "Restoring the function of Hima ecosystems through promoting a sustainable community-based water management system". This led to the development of a water policy for the Anjar Water Users Association (WUA), which ensures the "sustainable management of water resources and improved management of the Anjar spring".

Similarly, in collaboration with the communities of Anjar/Kfarzabad, SPNL developed an Action Plan for the Eurasian Otter **(Loy et al., 2016**) aiming to provide recommendations for acting at both local (Anjar/Kfarzabad municipalities) and large scale (Beqaa Valley and Lebanon) levels. This has three main objectives: (1) Increasing basic knowledge about distribution and ecology of the otter in the region; (2) Reducing the main limiting factors, conflicts, and potential causes of death; and (3) Promoting the expansion of otter population in the region. The Action Plan identified the following threats as highly significant: riparian habitat destruction, scarcity of feeding resources, and persecution and conflict over food resources.

Following the development of this Action Plan, SPNL immediately started its implementation and assigned to Homat Al Hima the protection of the riparian habitat including limiting access of visitors and tourists to one land trail and one water trail using canoes. As for persecution, conflict and food shortage, it was also necessary to take quick action in cooperation with fish restaurant owners. It was important to raise awareness of the local community about the importance of otters to stop the persecution and reduce conflict with aquaculturists. Workshops, seminars, articles, media, otter day and other events contributed to create a friendship between otters and the local community. To address conflict and food shortage, SPNL proposed to owners of fish restaurants to establish a good relationship with otters on an economic basis. The aquaculturists can attract clients to the restaurants where otters can be seen. This means sparing one fish pond at each restaurant, with easy and safe access for otters to feed. This will provide safe places for otters to encourage them to appear for clients of the fish restaurants. Subsequently, the restaurant owners will benefit by attracting more clients with a chance of seeing the otters at their pools. The proposal was readily accepted by the restaurant owners to help them grow their business and at the same time save this semi-aquatic endangered mammal in Lebanon. The owners of the restaurants implemented the proposal in 2017 and the otter started shyly to appear at night but as yet it has not been seen by visitors or restaurant clients. From the frequency of its appearance at Homat Al Hima, it is expected that the otter will lose a little of its shyness and hopefully will be seen in 2019.

ACKNOWLEDGEMENTS

This project has been made possible through generous funding from the MAVA Foundation to SPNL and with assistance from the GTZ[2] project and the EU Commission in Lebanon. There was also amazing support from both municipalities and local communities of Anjar, especially responsible hunters who have stopped shooting or harassing the otters.

DISCLOSURE STATEMENT

No potential conflict of interest was reported by the authors.

AUTHOR BIOGRAPHIES

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PRELIMINARY RESULTS OF FIRST-EVER OTTER SURVEY IN CHORNOBYL EXCLUSION ZONE, NORTHERN UKRAINE

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Abstract

*In 2018 the first survey of the Eurasian otter (*Lutra lutra*) within the Chornobyl exclusion zone was carried out using so-called "standard methods" (searches for spraints and other signs of otter presence). The Chornobyl exclusion zone is a 2600 km^2 territory in Kyiv region, Northern Ukraine, where since the Chornobyl nuclear disaster in 1986 the human impact on natural ecosystems has been dramatically reduced. Forest landscapes dominate the zone and the area is well drained by rivers of various sizes and drainage canals. The Eurasian otter has been known to inhabit rivers here long before the disaster and was consistently recorded thereafter but no species-focused survey was attempted. We undertook such a survey covering all major otter habitats e.g. rivers, lakes and drainage canals. The survey was done by inspecting both banks at predetermined sites. The proportion of positive sites was taken as a measure of habitat use. Signs of otter presence were found everywhere within the habitats studied. Otters used large (94% of 18 sites inspected) and medium-sized (81% of 27) rivers more than smaller ones (75% of 16) and more than flood-plain lakes (60% of 5). The least favourable habitats were drainage canals (44% of 52). The habitat distribution of otters in the Chornobyl exclusion zone corresponds well to the data for adjacent territories in Belarus and Ukraine obtained by tracking surveys in winter. This helps to produce a rough estimate of the number of Eurasian otters within the Chornobyl exclusion zone (72-153 individuals).*

Keywords: *Chornobyl exclusion zone; Eurasian otter* (Lutra lutra)*; habitat use; Northern Ukraine; standard otter survey*

Introduction

The disaster at the Chornobyl[1] nuclear power plant (thereafter ChNPP) on 26 April 1986 is usually categorised as the greatest technological catastrophe in human history which resulted in extremely high radioactive contamination of vast territories. The Government had to evacuate nearly 91,000 residents from 74 settlements in the Ukrainian part of the most affected zone (ca. 2600 km^2) and to ease traditional land use and economic activities there (**Baryakhtar, 1995; Baloga, 2006, 2011**).

[1] The Ukrainian spelling "Chornobyl" is used throughout the text, apart from citations where the Russian spelling "Chernobyl" has been used by the author referenced.

It caused the gradual transformation of agricultural and forestry lands into wilder habitats within this area. Finally it resulted in a remarkable growth in wildlife abundance and diversity (**Gashchak et al., 2006**).

Regular zoological field surveys within the Ukrainian part of the Chornobyl exclusion zone (thereafter ChEZ) had almost ceased by the mid-1990s (**Gashchak et al., 2006**), except for some studies (e.g. **Baker et al., 1996; Gashchak, 2000; Ryabov, 2004; Zharkikh & Yasinetskaya, 2008; Domashevsky et al., 2012; Deryabina et al., 2015; Gashchak et al., 2000, 2013, 2016, 2017; Shkvyria & Vishnevsky, 2012; Shkvyria et al., 2018**). In particular, there were virtually no surveys focused on semi-aquatic mammals e.g. Eurasian beaver (*Castor fiber*) and Eurasian otter (*Lutra lutra*) and therefore no factual information on their distribution and abundance. The only earlier assessment (**Gashchak et al., 2006**) was based exclusively on published data for the adjacent region of Belarus (**Pikulik & Sidorovych, 1991**) and the extent of suitable habitats in ChEZ. Therefore, the ChEZ is a unique area for animal population studies in an almost natural environment with negligible human impact due to strict access regulation.

This paper presents results of the first otter survey in the ChEZ and a pilot attempt at preliminary assessment of distribution and otter numbers. The survey was planned to analyse if otter distribution can be explained by hydrological parameters, riparian habitats, presence of other semi-aquatic mammals and other aspects. It was commissioned by, funded and done in cooperation with the Chornobyl Centre for Nuclear Safety, Radioactive Waste and Radioecology (Slavutych, Kyiv Region).

Study Area

The ChEZ covers 2600 km^2 on the North of Kyiv region. It is crossed by two large streams: Pripyat River on the East and its tributary Uzh River in the South (Figure 1). They both possess vast flood-plains of 3 to 7km width with numerous flood-plain lakes of varying size. The western and northwestern parts of the ChEZ are heavily forested with only a few small water bodies and therefore they are hardly suitable for otters. Much of the territory of the ChEZ is a morainic plain with a network of smaller rivers (Uzh River tributaries) and several small lakes of glacial origin. It borders the Kyiv reservoir of the Dnieper River in the southeastern part. A cooling pond of the Chornobyl nuclear power plant (22 km^2) is situated in the central part of the ChEZ but this was drained over the last few years and actually represented a system of small flood-plain lakes in 2018. In the past this region was rather swampy but due to the construction of a dense network of drainage canals the total area of wetlands has been reduced over the last 150 years to 4.2% of the ChEZ (**Development project, 2006**). Aquatic plant and animal life is quite diverse in the ChEZ because of the abundance of various water bodies (**Gashchak et al., 2006**).

Methods

Otter surveys within the ChEZ were done by means of so-called “standard methods” (**Mason and Macdonald, 1987; Breaux et al., 2002; Chanin, 2003**) which involve searching for spraints and other field signs of otter activities at certain intervals along waterways. Each site was scored as positive (presence of any sign e.g. one or several spraints, sprainting point, urine markings, tracks, prey remains) or negative (absence of such signs). This method is convenient for surveying vast areas and for launching a monitoring programme. The standard method is comparatively easy to learn by unskilled surveyors whose efforts may be necessary to undertake monitoring of large areas (**Kent, 2015**).

Several habitat types were selected for the survey e.g. large rivers (Pripyat River), medium-sized rivers (Uzh River), small rivers (tributaries of the Uzh River), drainage canals and flood-plain lakes and oxbows. The overall purpose of the survey was to cover as large an area as possible accounting simultaneously for the proportionality of habitat types. Signs of otter presence were searched for within predetermined survey sites which contain bridges, dams or other such landmarks, providing easy access to both banks of a waterway or at least a possibility to check one of the banks. Survey sites were distributed at 2–2.5-km intervals but no closer than 1km and no further apart than 10km. Adjacent survey sites were chosen more regularly at 2–2.5-km distance on larger rivers e.g. Pripyat and Uzh Rivers (where there are no bridges or dams).

Both waterway banks were surveyed within 300m upstream and downstream of a bridge/dam or other selected centre of a survey site. Whenever possible the overall length of the site was searched and the inspection continued to the end point unless otter signs were found. If some parts of a bank were inaccessible for some reason the total length of a surveyed site was enlarged to 1000m or reduced to 100m. The banks of the Pripyat and Uzh Rivers were inspected from an inflatable rubber boat. The locations of the survey sites as well as the location of every otter sign were recorded by handheld GPS Garmin-62S. Wherever the survey site was centred at a bridge both banks under it was searched to enhance accuracy of the method (**Elmeros and Bussenius, 2002**).

Chi-square tests were computed using R v. 3.5.1 (R Core Team 2018) to test for differences in the proportion of positive otter sites according to habitat type. Confidence intervals (95%) for the estimate of the total number of otters were calculated using formula:

$N \text{ upp.} = N * [1 + 1{,}64 * e(N)]$

$N \text{ low.} = N / [1 + 1{,}64 * e(N)]$

$e(N) = 1{,}2 * \sqrt{k}$, where k is a number of encounters (**Ravkin and Tchelintsev 1990**).

Results

A total of 118 sites were surveyed within the study area during three field visits and otter signs were found at 77 sites. The data allowed an assessment of the distribution of otters by habitat types within the Chornobyl exclusion zone (Table 1).

Pripyat River: This river is the biggest watercourse within ChEZ. It runs from the North to the Southeast and falls into the Kyiv reservoir at the border of ChEZ (**The State Water Cadastre 1967**). It is a lowland river and the banks are waterlogged for about 15%. The river course in the central part of ChEZ (up to 12km) was straightened during the construction of the ChNPP cooling pond in 1970s. The

Pripyat flood-plain is comparatively wide, up to 5–7km, with terraces above it. The length of the Pripyat River within ChEZ is about 60km, of which 43.5km were within the survey area. Evidence of otter presence was noted in 94% of the 18 sites surveyed in 2018 (Table 1; Figure 1). The most suitable habitats for otter were found in the lower reaches of the Pripyat River from the Southern dams of the former ChNPP cooling pond to the Kyiv reservoir. The same reaches experience a medium-level impact of people living in Chornobyl town and several villages (Paryshev, Otashev, Teremtsy).

Table 1. General results of the otter survey in Chornobyl exclusion zone in 2018

No	Watercourse or water body	Number of survey sites	Total positive survey sites	The number of survey sites where signs of otter marking activities were found					Visual observations
				Marking point	Spraints	Urine signs	Footprints	Prey remains	
1.	Pripyat River	18	17	11	13	4	7	2	–
2.	Uzh River	27	22	13	11	1	17	6	–
3.	Small rivers	16	12	4	9	1	4	–	1
4.	Flood-plain lakes and oxbows	5	2	–	2	–	–	–	1
5.	Drainage canals	52	23	7	17	5	4	2	–

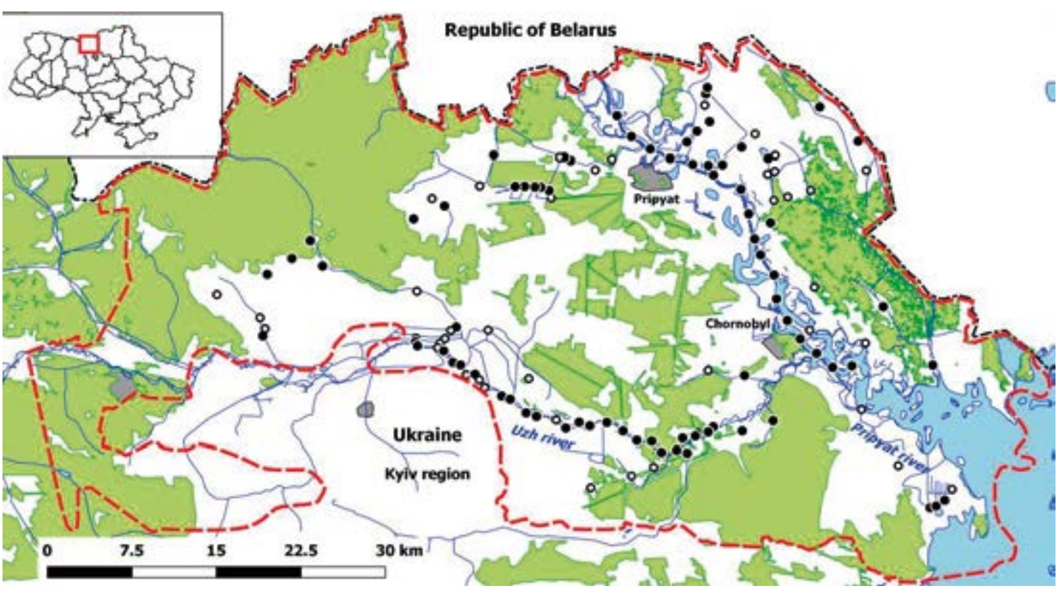

Figure 1. The distribution of survey sites in the Chornobyl exclusion zone in 2018

Key: Black circles – positive survey sites (signs of otter presence were found); white circles – negative survey sites (no signs of otter presence).

Uzh River: This is a tributary of the Pripyat River. Its length within ChEZ is about 115km and 54.5km were surveyed. Signs of otters were found at 81% of the 27 sites surveyed in 2018 (Table 1; Figure 1). Riparian habitats of the Uzh River are diverse with numerous river rifts and deep places, sand bars and stretches of sand, and also tree debris in the water. Sinuosity index amounts to 1.6 for the middle reaches of the river which indicates meandering. The flood-plain is wide, with a number of wetlands covered by shrubby willows. Oxbows (dried up at the time of the survey) and numerous small temporary pools with prey (fish and frogs) are readily available for otters and at higher water levels these will probably be flooded. Downstream 4–5km of the river channel becomes straighter (sinuosity index 1.2) and has only a few flood-plain lakes. There it passes Chornobyl town and therefore experience some level of human impact.

The survey of the Uzh River was carried out in late August when the water level was at its lowest point. At that time the water depth at most measured points was 0.7–1.0m and this fell to 0.2m or even less at river rifts, with exposed river bed. Depths of 1.5m or more were found exclusively at stream pools. These seasonal hydrological conditions will affect the distribution of fish and therefore otters.

Small rivers: These are tributaries of the Pripyat and Uzh Rivers and the overall length of these watercourses is 145km of which 85.9km was surveyed. Signs of otter presence were found at 75% of the 16 sites surveyed in 2018 (Table 1; Figure 1).

Flood-plain lakes and oxbows: The overall length of these water bodies is up to 100.4km (**The State Water Cadastre 1967**), 28.8km were inspected. The otter presence was noted in 60% of five surveyed sites (Table 1; Figure 1).

Drainage canals: These watercourses are widespread in different parts of ChEZ. Our on-site investigations in 2018 showed that a considerable part of the canal system was almost dry, overgrown with reeds, and not suitable habitat for otters. We identified the most full-flowing canals as indicative for these type of water bodies, and calculated their total length within ChEZ by space imagery. However it should be noted that the amount of water and length of the full-flowing canals is dependent on current weather conditions and fluctuate a lot season by season and year by year.

In our estimations, the total length of full-flowing canals in 2018 was ca. 250 km, and of this 39.7 km was surveyed. Presence of otter was noted in 44% of the 52 inspected sites (Table 1; Figure 1).

Discussion

The standard method used in this survey does not make it possible to obtain reliable estimates of the otter population as there is no correlation between otter spraint numbers and size of population (**Yoxon and Yoxon, 2014; Day et al., 2016**). Nevertheless it is suitable for estimating distribution and habitat preferences (**Mason & Macdonald, 1987; Beja, 1992; Lopez, 2004**). The results of our study show that within ChEZ otters more frequently occur on large and medium-sized rivers (94% sites on Pripyat River, 81% sites on Uzh River). Small rivers (75%) and flood-plain lakes (60%) appear to be less favourable. However, the latter may be under-estimated possibly due to the small sample size. We consider flood-plain lakes and oxbows as excellent habitats for otters and they significantly enrich the ecological capacity of the area for this species. However, the low accessibility to these water bodies and the large scale of the work for one season did not allow us to undertake a comprehensive survey. Our fragmentary observations of past years show that otters favour these habitats no less than the Pripyat River.

The lowest rate of otter signs was found on drainage canals (44%). Cessation of agricultural and forestry activity resulted in the abandonment of the drainage network and total overgrowth which made it unsuitable for otters. Only a few of the main canals and small local networks are still maintained in an operative state for reasons of radiation safety: e.g. catchment area of the small river Sakhan (Northern central part of ChEZ), polder system on the left bank of the Pripyat river, and catchment area of the small river Braginka on the east of ChEZ. Such canals could be potentially suitable for otters.

Chi-square tests revealed significant differences between various habitat types by the occurrence of the signs of otter activities ($\chi 2$=21.834, df=4, p=0.0002).

The distribution and habitat preferences of otters in ChEZ are in agreement with those known for adjacent territories e.g. in Belarusian Polissya in 1983–1990 (**Sidorovych, 1992**) and in Polissky nature reserve in Zhytomir region of Ukraine in 1996–2002 (**Panasevych, 2002**) (Figure 2).

Figure 2. Chornobyl exclusion zone in Ukraine and adjacent areas where otter surveys were done

Key: Red area – Chornobyl exclusion zone (2018); Blue area – Polissky nature reserve, Zhytomir region, Ukraine (1996–2002; Green area – surveyed regions in Republic of Belarus (1983–1990).

In Belarus the highest otter densities were found on large and medium-sized rivers with moderate flow and with low to medium-inundated flood-plains (up to 3.8 individuals per 10km of watercourse) and on small rivers with high flow (up to 4.0 individuals per 10km of watercourse) (**Sidorovych, 1992**). High values of otter densities in Belarussian Polissya arise from quite regular settling of otters on small watercourses which constitute the overwhelming background of the river network and have a very high total length. Otter densities were much lower on drainage canals in forests and on arable lands as well as on canalised small rivers (0.2 to 1.5 individuals per10 km of watercourse). Everywhere in Belarusian Polissya otter densities were higher within protected areas as compared to the areas where hunting is legal (**Sidorovych, 1992**).

In the Polissky nature reserve in Ukraine otter densities were also higher on small rivers as compared to drainage canals (1.1 to 2.1 individuals per 10km of watercourse on rivers, 0.9 individuals per 10km of watercourse on canals) (**Panasevych, 2002**).

As mentioned above the standard survey method is not suitable for precise estimation of the number of otters. Therefore we computed order-of-magnitude estimates using the data on otter densities on various waterways in adjacent Belarusian Polissya (**Sidorovych, 1992**) and the data on the length of water bodies in ChEZ obtained in our study. The results of the assessments are summarised in Table 2. On these estimations the number of otters in ChEZ ranges from 72 to 153 individuals.

Table 2. The number of Eurasian otters in the Chornobyl exclusion zone according to the assessments the of 2018 survey

Water body type	Total length of watercourses inhabited by otters, km	Otter density (ind./10 km; Sidorovych 1992)	Otter number ind.	Confidence interval, ind.
Drainage canals	250	0,7 ± 0,1	17	12–23
Flood-plain lakes and oxbows	100,4	–	4	2–7
Small rivers (Braginka, Veresnya, Vyalga, Ilya, Rudyavka, Sakhan, Turya)	145	1,2 ± 0,6	17	11–26
Medium-sized rivers (Uzh River)	115	3,8 ± 0,3	44	31–62
Large rivers (Pripyat River)	60	3,8 ± 0,3	23	16–34
TOTAL	670	–	105	72–153

The results of this survey should be considered as preliminary not least because it was planned as a pilot study to launch more comprehensive surveys both within ChEZ and on adjacent territories. The results, however, demonstrate that nowadays the Eurasian otter is a quite common species within the Chornobyl exclusion zone.

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A SURVEY OF THE EURASIAN OTTER (*Lutra lutra*) ON THE RIVER DON, ABERDEENSHIRE, SCOTLAND, 2017–2018

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Abstract

The River Don was surveyed for signs of otter activity from source to sea. Spraint sites were the most abundant field signs observed along the course of the River, with a total of 374 spraint sites found, the majority of which consisted of fresh and recent spraints (54.6%). The upper and lower reaches had more recent and fresh spraint deposits than old spraints; however, the middle reaches had far more old spraints. Conversely, the middle reaches of the Don had the most spraints found compared to its upper and lower regions. The nearest sign of otter activity to the source of the River Don was a spraint site 340m downstream from the Well of Don. A spraint was found at the Bridge of Don on the lower estuarine reaches of the River; however, no other field signs of otter activity were found downstream from here at Donmouth, or along the dune system on the east coast. The most abundant prey items found in the spraints were bones from the salmonids (63.6% occurrence). Other prey found in the spraints included amphibian, bird and mammal remains. Amphibians made up the majority of the non-fish prey items found in the spraints (20% occurrence). Remains of marine fish were found in a spraint some 67km upstream from the sea.

Keywords: *Otter;* Lutra lutra*; prey items, River Don; salmonids; sprains*

INTRODUCTION

The aim of this survey was simply to assess the current presence of activity of the Eurasian otter (*Lutra lutra*) along the banks of the River Don from source to sea, by means of spot-checks for spraint sites (deposits of otter faeces).

STUDY AREA

The River Don arises from a spring referred to as the Well of Don, located on Corrie Don, part of the Ladder Hills, in the Grampian Mountain range (Grid ref: NJ 195067; 680m elevation). It mainly flows parallel to and north of the River Dee, in an eastwardly direction and outflows into the North Sea at Donmouth Nature Reserve, Old Aberdeen (Figure 1). The River Don is approximately 135km long, making it the sixth longest river in Scotland.

The Don catchment has two distinct topographical areas; the mountainous peatlands of the upper reaches and headwaters, and the relatively flat floodplains and farmland along its middle and lower reaches. There is a tidal influence up to Seaton Park (*c*.2.4km upstream from Donmouth). At Donmouth, the associated coastline becomes part of an extensive sand dune system.

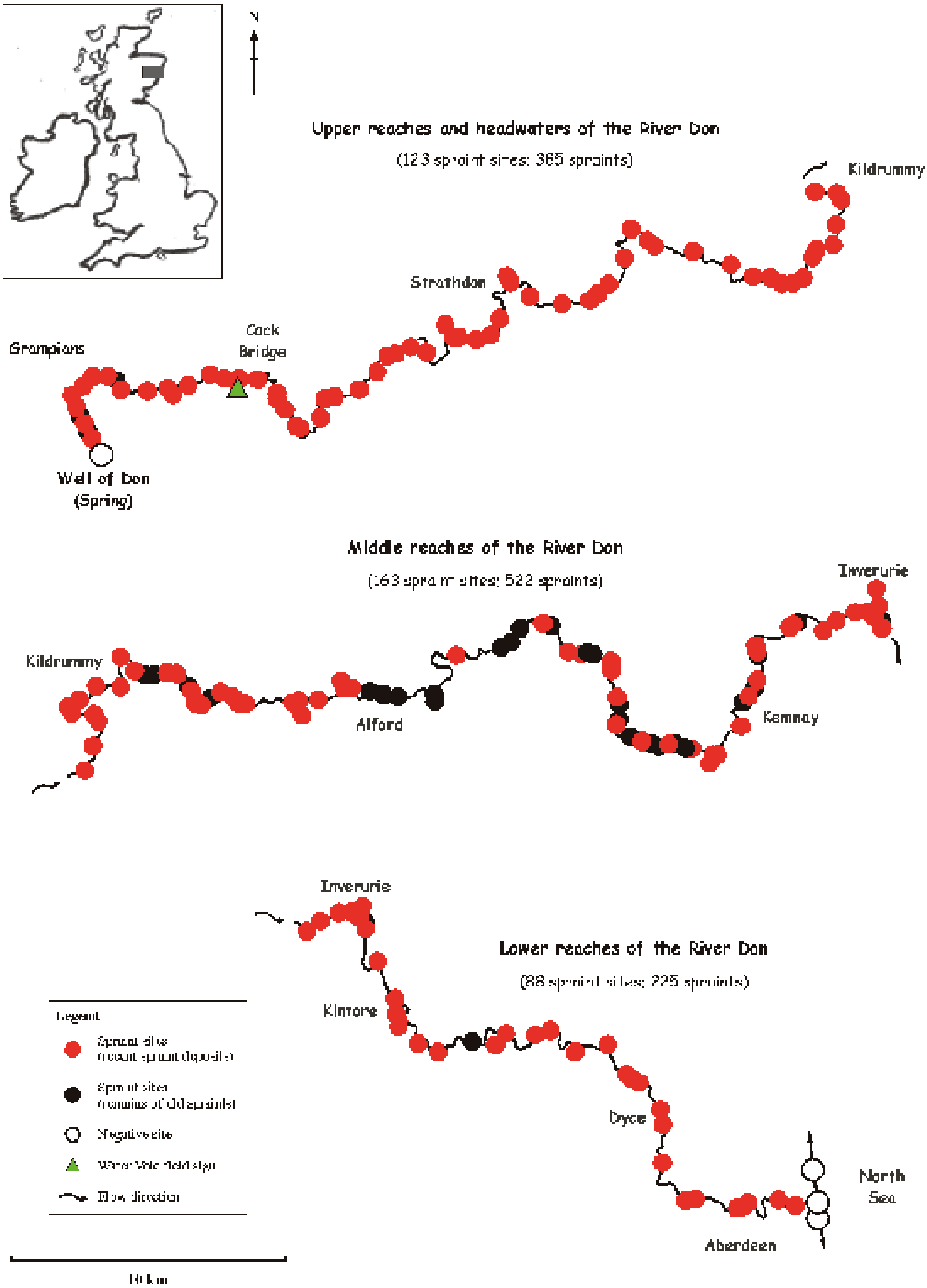

Figure 1. Survey location, spraint sites and water vole occurrence on the reaches of the River Don, Aberdeenshire, during spot-checks at random sites chosen every 2km, conducted during 2017–2018.

Like the River Dee, the River Don is a fast flowing oligotrophic river and supports larger fish species such as salmon (*Salmo salar*) and trout (*Salmo trutta*), which are important food resources for otters.

METHODS

A series of survey sites were chosen on either bank of the River Don roughly every 2km (based on ease of accessibility).

At each survey site, any field signs indicating otter activity were recorded:

- SPRAINTS – otter faeces;
- SPRAINT SITES – spraints are principally deposited at regularly visited areas within the otter's territory, and are usually located on prominent features such as grass tufts, rocks, and areas where there is cover, for example under bridges (**Chanin, 1985; Mason & Macdonald, 1986**);
- FOOTPRINTS – otters have five toes and webbed feet, although the smallest toe does not often make a mark resulting in the appearance of a "four-toed" print. Such prints tend to be lopsided and can be distinguished from the more symmetrical dog or fox prints;
- REST-SITES – areas utilised by otters for sleeping or resting. The structure of a rest-site can vary depending on the geographical resources present, whether it is an underground den or a temporary resting place above ground. They can range from substantial piles of branches/logs; dug burrows; dense scrub or amongst rocks and boulders. The den of an otter is commonly referred to as a holt and this is considered as the main resting site within an otter's territory. Otters may also use temporary and much smaller resting places, often referred to as a "lie up" "hover" or "couch". Such rest-sites can also be found in a variety of places, for example under dense scrub, small rocky outcrops and simply amongst grass or sedge tussocks.

If a survey site was perceived as negative, then up to 15 minutes was spent traversing the riverbanks to establish if there were any field signs evident beyond the initial focus point. Clearly the distance travelled within the 15 minutes 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.

A select few of the River Don's tributaries were also surveyed (Table 1), in order to ascertain any immediate otter activity away from the main river. The site choice for the tributaries was also based on opportune access whilst travelling to the next survey site along the main River Dee. As a result, the survey of the tributaries was largely based on a quick single spot-check around bridges.

Table 1. Tributaries of the River Don surveyed and number of spraints and spraint sites found principally from single spot-checks at bridges.

Tributary Name	Don Region	Date	Total Spraint Sites	Total Spraints
Unnamed Balgownie Links burn	*Coastal*	9-Nov-17	0	0
River Urie	Lower	10-Nov-17	4	10
Black Burn	Lower	6-Nov-18	1	2
Ton Burn	Mid	11-Nov-17	2	4
Drainage ditch (Bankhead)	Mid	8-Apr-18	1	6
Bents Burn	Mid	8-Apr-18	6	13
Birks Burn	Mid	8-Apr-18	1	1
Leochel Burn	Mid	9-Apr-18	3	15
Douls Burn	Mid	10-Apr-18	2	7
Boggerie Burn	Mid	10-Apr-18	2	4
Burn of Logie	Mid	10-Apr-18	1	4
Esset Burn	Mid	11-Apr-18	1	1
Mossat Burn	Mid	11-Apr-18	5	24
Drainage ditch (Kildrummy)	Mid	11-Apr-18	1	1
Unnamed Towie burn	Upper	7-Nov-18	1	2
Burn of Towie	Upper	7-Nov-18	4	40
Water of Buchat	Upper	7-Nov-18	1	2
Water of Carvie	Upper	7-Nov-18	0	0
Deskry Water	Upper	8-Nov-18	7	54
Conrie Water	Upper	8-Nov-18	1	16
Ernan Water	Upper	8-Nov-18	2	20
Unnamed Inverernan burn	Upper	8-Nov-18	1	1
Ernan Water	Upper	8-Nov-18	1	3
Water of Nochty	Upper	9-Nov-18	3	10
Garchory Burn	Upper	9-Nov-18	1	7
Little Burn	Upper	9-Nov-18	1	2
Cock Burn	Upper	10-Nov-18	1	4
Drainage ditch (Cock Bridge)	Headwaters	10-Nov-18	1	2
Allt Veannaich	Headwaters	11-Nov-18	3	7
Meoir Veannaich	Headwaters	11-Nov-18	1	3

An assessment of spraint contents was made in the field with a x10 magnification hand lens. Where spraint analysis could not be readily established 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 during favourable weather conditions in November 2017 (for five days), April 2018 (for four days) and November 2018 (for six days). The majority of the River Don was surveyed during 2018, whilst its lower reaches and part of the middle reaches were surveyed during 2017.

Field signs of otter activity were found at each survey site throughout all of the reaches and are summarised in Figure 1 and Table 1. Spraint sites were by far the most abundant sign (Figure 2). A total of 374 spraint sites were found, the majority of which comprised either fresh or recent spraints (*n* = 618; 54.6%); the remaining spraints sites had only old spraints or remains of old spraint fragments (*n* = 514; 45.4%).

Figure 2. Spraint site at a confluence of Deskry Water and Tomdubh Burn in the upper reaches of the River Don

Although the actual source at the Well of Don was found to be negative, the nearest positive site was only *c*.340m downstream, next to a spring arising on the peat bogs of Corrie Don, at an elevation of 575m (Figure 3). Here the spraint found was fresh and contained a combination of salmonid bones and bird feathers. Two other fresh spraints (both containing salmonid remains), together with one old spraint (containing amphibian bones), were also found along this stretch of the embryonic Don (called Alltan Mhicheil).

Mainly fresh and recent spraints were found on the upper reaches and headwaters, with a random scattering of spraint sites only containing old spraints. Within the upper reaches of the Don, was found one of the most numerous spraint deposits, with an estimated 40 spraints from a couple of spraint heaps, associated with the road bridge on the Burn of Towie and River Don confluence.

Figure 3. Spraint site located 340m downstream from the source of the River Don.

A fresh spraint with a helminth (parasitic worm) clearly visible, was found by the upper Don near Inverernan (Figure 4). Gastrointestinal helminths have been recorded in *Lutra lutra* by several authors (e.g. **Chanin, 1985; Jefferies et al., 1990; Weber, 1991**); and in other species of otter (**Harris, 1968; Fleming et al., 1977; Hoberg et al., 1997; Margolis, 1997**).

Figure 4. Fresh spraint with a parasitic worm (mid-left edge of spraint) found in upper reaches of the Don.

Markedly fewer spraint sites on the middle reaches of the Don had recent and fresh spraints, and far more old spraints, compared to its other reaches (Figure 1). A noticeable clustering of old spraints was found near Alford and Keig, and to a lesser extent, an area near Monymusk and Kirton. Conversely, the middle reaches of the Don had the most spraints compared to its upper and lower regions (Figure 1).

The spraint sites found along the lower reaches of the Don had mainly fresh or recent spraints and few old spraints. It was also at the lower reaches where a survey site was situated around the Diamond Bridge at Haydon (Figure 5), which had the highest number of spraints found on the River Don during this survey. A total of 51 spraints were associated with this newly constructed bridge (completed and opened in June 2016); whereby 41 spraints were located under the bridge on the north side, and 10 on the south side.

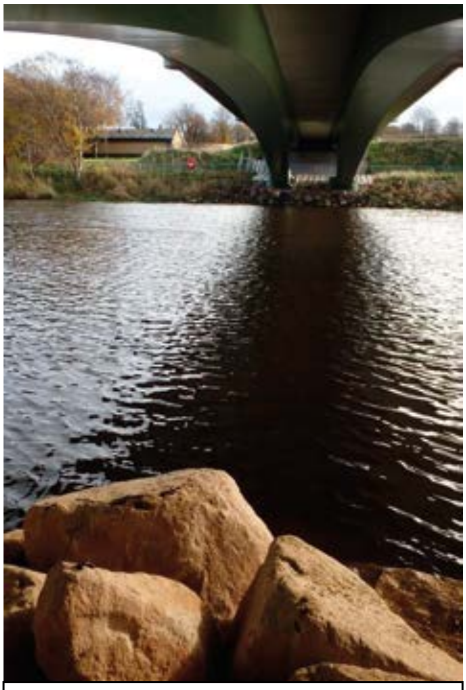

Figure 5. Multiple spraints under both sides of the newly built Diamond Bridge on the lower reaches of the River Don.

Figure 6. Series of spraint sites on bank slumps, approx. 320m from major new trunk-road construction, on lower reaches of the Don.

A series of spraint sites with many fresh and recent spraints, were located on bank slumps and on spoil heaps outside rabbit burrows in the banksides, approximately 320m away from the major new trunk-road construction, on the lower Don at Nether Kirkton (Figure 6).

Throughout the whole of the survey the only negative area was at Donmouth and the eastern coastal dunes. However, there was a fresh spraint under the Bridge of Don *c*.750m upstream from Donmouth. Just over 2km of coast from the north side of Donmouth was surveyed and a little over 1km of coast to the south. Apart from the River Don, there are very few freshwater sources on the eastern coast. A small burn, which runs through the Balgownie Links golf course and onto the dune system, within the northern 2km surveyed, was also negative for secondary signs of otter activity. Other small burns flow into the dunes much further north, but these were not investigated during this survey.

A spot-check of 29 tributaries of the River Don, including a select few minor streams and rivulets, were surveyed (Table 1). Spraint sites were found on 28 of these and only the Water of Carvie had no immediate evidence of otter activity. However, fresh spraints were found on the River Don within a kilometre from the Water of Carvie confluence. From the 59 spraint sites found associated with the tributaries, fresh or recent spraint deposits (n = 136; 51.3%), were found more than old spraints (n = 129; 48.7%). Deskry Water, a tributary of the upper Don, had the most spraints associated with it compared to the other tributaries surveyed (Table 1). However, this may have been biased due to the fact that three locations on Deskry Water were surveyed, whereas all the other tributaries were only examined at either one or two survey points.

Figure 7. Recent adult otter prints, together with sign heap (top-left) on sand bar at bridge footings on the Lower reaches of the River Don.

Among the other fields signs observed indicative of otter activity were several sign heaps, formed by otters scraping substrate or vegetation into a small mound on which to deposit a spraint (Figure 7). Sixteen of these were found on the main River Don and seven on the tributaries. Adult otter prints were found by the headwaters, upper, middle and lower reaches of the Don, and juvenile otter prints were found along the riverbank near Woodend, on the middle reaches of the Don.

Thirteen rest-sites were found; 12 associated with the River Don, under eroded bank overhangs, large tree overhangs, root stocks, and dense broom. A rest site on Allt Veannaich, a tributary in the headwaters of the Don, was found under an eroded bank overhang.

Spraint analysis

The majority of sprains found were examined *in situ*: 867 from the Don and 265 from tributaries. A further 41 spraint samples (36 from the Don and 5 from tributaries) were collected for more detailed laboratory analysis. The most abundant prey items found in all sprains combined were fish bones (68.7% occurrence). Other dietary components comprised amphibian, bird and mammal (Figure 8).

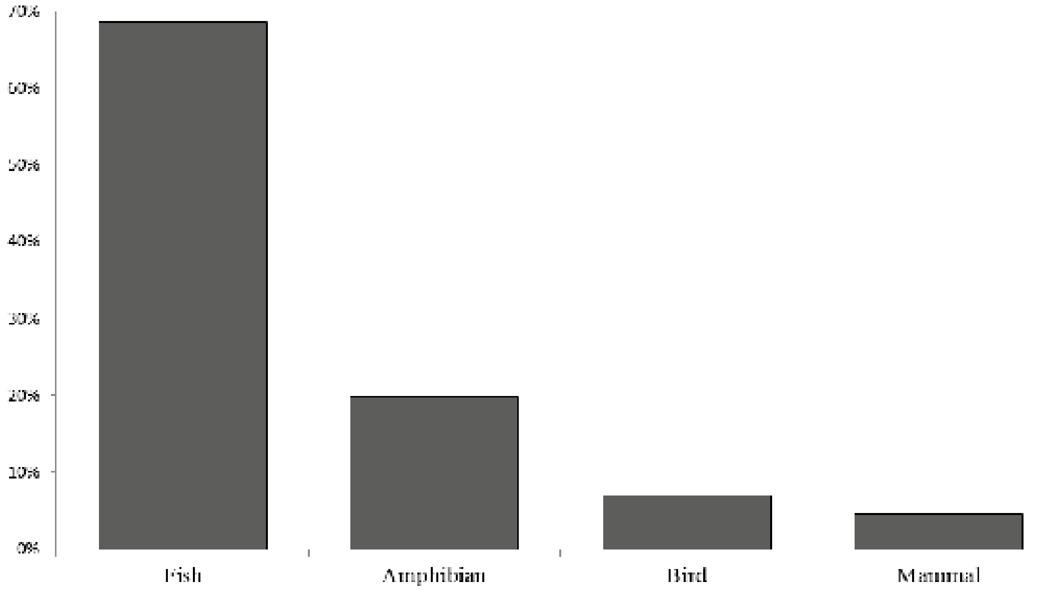

Figure 8. Combined percentage occurrence of prey items from sprains observed in situ (n=1132) and laboratory analysis (n=41), from the River Don and its tributaries.

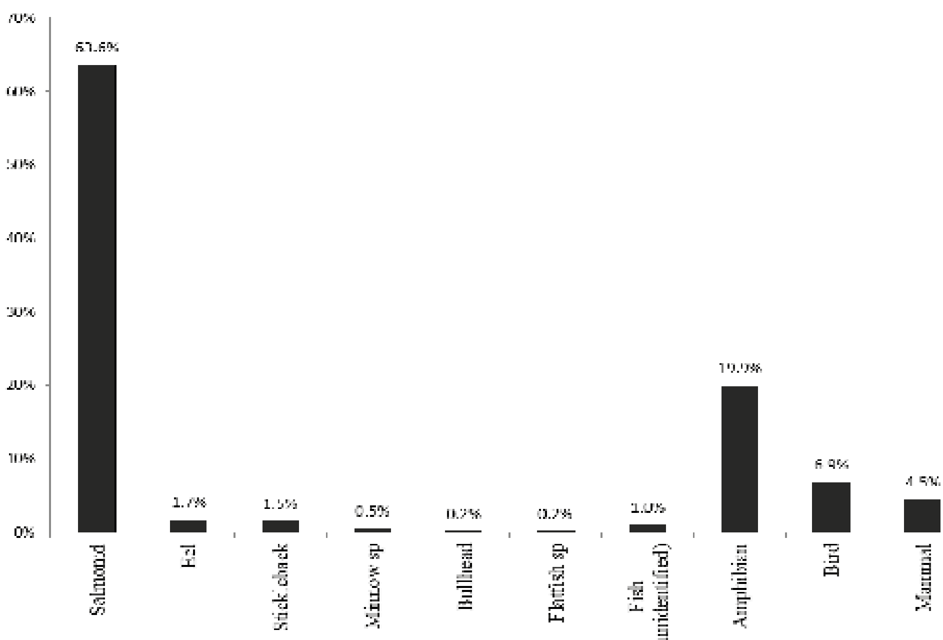

Figure 9. Percentage occurrence of prey items from 1132 sprains examined in the field, from the River Don and its tributaries.

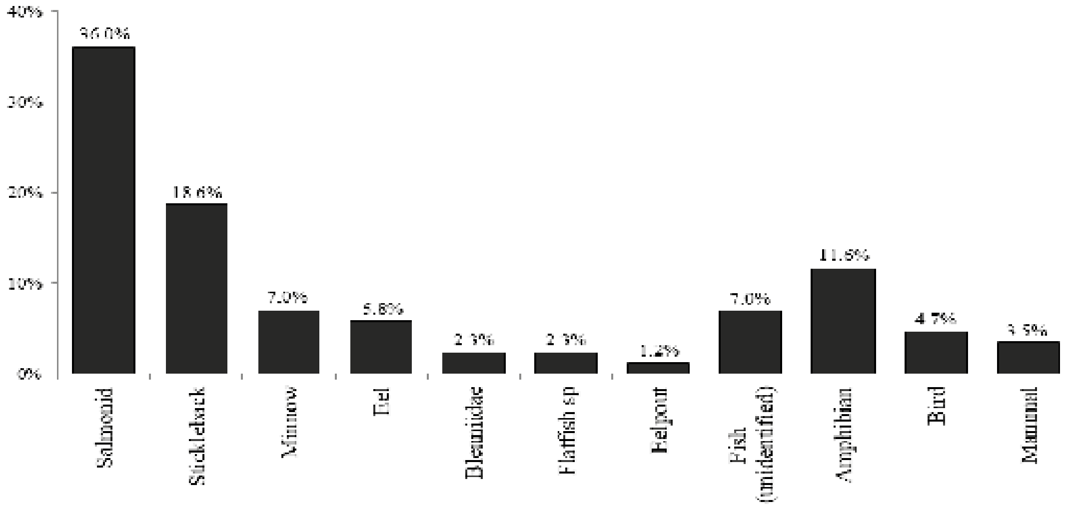

Figure 10. Percentage occurrence of prey items from 41 spraints collected for detailed analysis, from the River Don and its tributaries.

The dominant fish remains found in spraints examined in the field were bones from salmonids (salmon and trout species) at 63.6% occurrence. A small variety of other fish were also represented, but at very low frequencies (Figure 9). Similarly the 41 spraints analysed in the laboratory had a high percentage occurrence of fish bones (80.2%), which were predominately salmonids and secondly by stickleback species (Figure 10). Stickleback bones were mainly found in spraints from the lower and middle reaches, and only from one spraint on the upper reaches of the Don.

Although only a relatively low number of eel (*Anguilla anguilla*) bones occurred in the spraints analysed (20 spraints *in situ* and five spraints from collected samples), they were found in all reaches of the Don, with noticeably more from the lower region.

Bones of marine fish were found in spraints from the lower reaches, the furthest being *c*.5km upstream from the sea at Donmouth. Among these species were eelpout (*Zoarces viviparous*), Pleuronectidae (flatfish species) and Blenniidae (family of true blennies). Vertebrae from Blenniidae also occurred in a recent spraint on the middle reaches of the Don, near Alford which is *c*.67km from the sea at Donmouth.

Other fish species that occurred in the sprainst were minnow (*Phoxinus phoxinus*) from the lower and middle reaches, and bullhead (*Cottus gobio*) from the lower reaches of the Don.

Of all the non-fish items found in the spraints, amphibian bones were most common (Figure 8) and were mainly found in spraints from the middle reaches, with few from the headwaters, upper and lower reaches. From the spraints examined in the field during April (predominantly from the middle reaches), roughly equal amounts of fish and amphibian bones were found. In November amphibian occurrences were much reduced in the spraints (Figure 11).

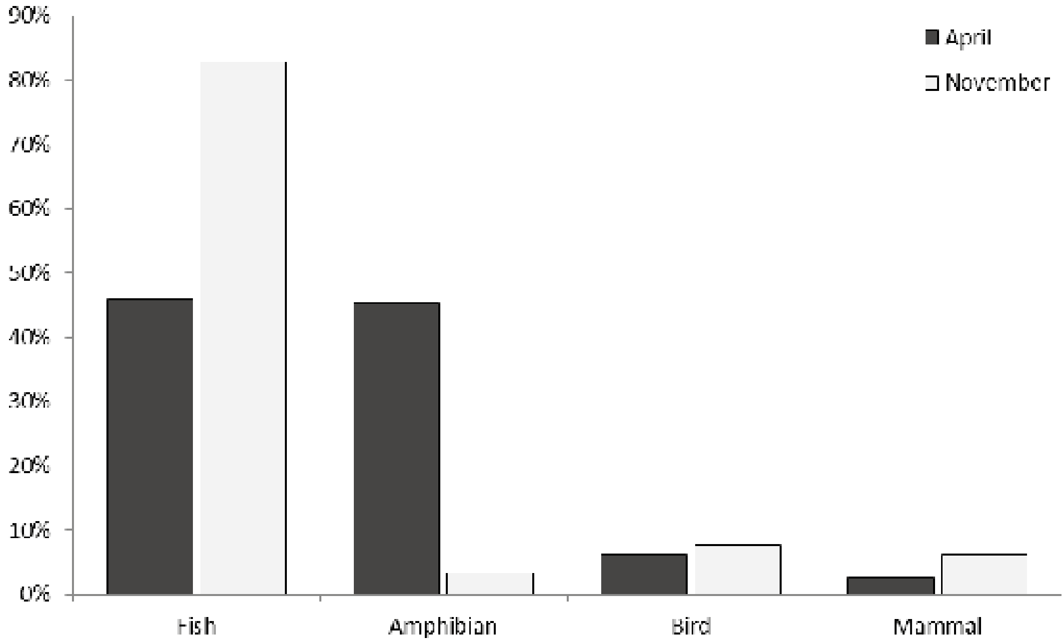

Figure 11. Percentage occurrence of prey items from 1132 spraints examined in the field, from the River Don and its tributaries, during November 2017, April 2018, and November 2018.

Bird and mammal remains were only found in spraints from the headwaters, upper and middle reaches of the Don. Bird remains were the principal non-fish prey item in spraints from the upper reaches, whereas in the headwaters mammal remains dominated.

Other mammal observations

Evidence of water vole (*Arvicola amphibius*) was found on a drainage system which flows directly into the Don along its upper reaches. A latrine and fresh droppings together with feeding remains were found outside of a burrow in the bankside at water level. It was also noted that two recent spraints (containing salmonid bones) on a spoil heap outside a rabbit burrow, were found along side the water vole burrow.

An adult mink (*Neovison vison*) was found in a mink trap along Fèith Bhàit (headwaters of the Don). This was the only evidence that mink were in the area, as no other field sign was found throughout the Don catchment during this survey. Conversely, mink prints were found at two locations on the upper reaches of the River Don during an opportune spot-check in November 2016 (**Rothwell, 2017**).

Other observations included five mountain hares (*Lepus timidus*) seen on the moorlands of Corrie Don; a grey seal (*Halichoerus grypus*) was spotted below the Bridge of Don at Donmouth; a pine marten (*Martes martes*) scat was found at a roadside near Keig; several badger (*Meles meles*) latrines and prints were found along the banks of the middle and lower reaches of the Don; and an extensive bank vole (*Myodes glareolus*) colony was found on the banks of the upper Don near Lonach, with many burrows, runs and latrine sites amongst the vegetation.

DISCUSSION

The overall results of this survey show that otter spraints were found throughout all of the reaches of the River Don. Old spraints were found more frequently on the middle reaches, which suggest that otters are more active on the lower and upper regions of the river.

Salmonids were the most dominant prey item found in the spraints and this was also observed in historical studies on the Don (**Jenkins and Harper, 1980; Kruuk, et al., 1993; Durbin, 1996, 1997**). Similarly, salmonids were also the dominant fish species found in spraints from the River Dee (**Rothwell, 2017**). Other notable fish species found were stickleback and minnow and combined these were at a similar level to eel occurrence in spraints examined in the field (Figure 9), where eel was significantly less than salmonids as a prey item. The sprints collected for detailed analysis showed relatively higher amounts of stickleback and minnow, with stickleback occurring more than amphibians (Figure 10). **Jenkins & Harper** (**1980**) found that minnow was recorded in spraints more than eel on the River Don, and they also illustrated that eel was significantly less frequent than salmonids in spraints on the Don.

Amphibians were the dominant non-fish prey (Figures 8 and 9) and these were found in relatively equal numbers to fish in spraints examined in the field during April. In November amphibian occurrences were much reduced (Figure 11) and so otters appear to be taking advantage of the seasonal glut of amphibians. This was also observed along the upper reaches and headwaters of the River Dee, where amphibian superseded salmonid occurrence in spraints found during May (**Rothwell, 2018**). Several authors have also demonstrated that amphibians are an important food source for otters (**Weber, 1990; Clavero et al., 2005; Kruuk, 2006; Lanszki et al., 2009; Pagacz and Witczuk, 2010**).

The fact that otters are seeking non-fish alternatives was also reflected in the bird and mammal remains found along the headwaters, upper and middle regions of the Don, but not the lower reaches. This implies that non-fish prey occurs far less in the lower reaches and that there might be a higher density of fish in this region. Therefore land-based prey is not being selected; as otters will take a variety of prey depending on their availability (**Jenkins and Burrows, 1980; Mason and Macdonald, 1986; Kruuk, 1995; Carss et al., 1998; Ruiz-Olmo, 1998**).

A lot of fresh spraints were found in the lower reaches, a few of which had remains of marine fish. Vertebrae from Blenniidae (marine fish) also occurred in a spraint on the middle reaches, some 67km upstream from the sea. This suggests that otters are travelling a considerable distance to forage at the lower reaches of the Don. Conversely, no spraints were found at Donmouth and the associated coastal sand dunes. Spraints can be hard to find on non-linear features, so this could result in a false negative for this area. Nevertheless, apart from the River Don, there were limited freshwater sources along the east coast dunes, which makes this type of habitat suboptimal for an otter. A similar observation was seen on the west coast dunes of South Uist, where significantly fewer spraints (only 4.5% of the survey total) were found on 18km of coastal dunes (**Rothwell, 2000**).

Several spraint sites were found on the embryonic Don at Corrie Don. Along the headwaters of the river, there is good connectivity between other major river systems; the Spey catchment via the River Avon and its tributaries, and the Dee catchment via the River Gairn and its tributaries together with the Loch Builg cluster. The shortest distance is *c*.110m between Meikle Caochan Odhar (tributary of the Don) and Corndavon Burn (tributary of the River Gairn), at Brown Cow Hill, and *c*.230m between Fèith Bhàit (headwaters of the Don) and Allt Roderick (tributary of the River Avon), at Lagganauld.

Although no field signs of mink were found, a mink was found in a trap along the headwaters. On several recent surveys of ≤2km on rivers in England, mink had been observed foraging along the banks; however, again no field signs were found on these rivers (*personal observation*). Are mink changing their habits? Otters may be displacing mink in the same territory, which could mean that mink are not depositing scats along a river system as often and so field signs (or lack of them) can produce false negatives. Or it may be that mink are scatting further inland, beyond the confines of a standard river survey?

It was interesting to note that the newly constructed bridge on the lower reaches of the Don had many spraints associated with it. Inanimate objects appearing in an animal's territory are often marked and otters will frequently place spraint sites under bridges (**Chanin, 1985; Mason and Macdonald, 1986**). The high number of spraints found under the Diamond Bridge suggests that an otter is taking advantage of the new cover for its spraints, as the nearest spraint site to this bridge was *c*.400m upstream on rocks along the southern banks. However, the number of spraints cannot be used to indicate population size (**Yoxon and Yoxon 2014**)

ERRATUM

From my previous survey report on the River Dee (**Rothwell, 2018**, 56, ***Spraint analysis***) the third sentence should have read 'The fish bones were predominately represented by the salmonids (22.%), together with a low percentage of unidentified fish fragments (4.4%).'

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I am most grateful to Grace and Paul Yoxon of the International Otter Survival Fund for support, encouragement and for their passion and enthusiasm for otters, which has led me to develop my own interests and love of this very special and endearing riparian mammal. In additional I must further thank Paul and Grace for much patience for this report to be produced. I would also like to thank the landowners and ghillies for allowing access to the river, as without this this study would not be possible.

DISCLOSURE STATEMENT

No potential conflict of interest was reported by the authors.

AUTHOR BIOGRAPHY

Andrew Rothwell is a self-employed zoological surveyor, specialising in otter and water vole surveys.

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EURASIAN OTTER (*Lutra lutra*): A REVIEW OF THE CURRENT WORLD STATUS

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Abstract

The Eurasian otter (Lutra lutra) *has the widest distribution of all 13 otter species but the actual worldwide status is very uncertain. It disappeared in many parts of Europe largely due to pollution but with considerable effort to improve environmental conditions they are starting to return in some areas. However, the rate of this return is largely exaggerated which creates problems with fisheries. In vast parts of its range in Asia and North Africa there is very little data and few modern records. It is therefore important to continue conservation efforts, increase public awareness and research to obtain up-to-date information on the true status.*

Keywords: *Eurasian otter;* Lutra lutra*; threats; fisheries; hunting; pollution; roads*

BACKGROUND

The Eurasian otter (*Lutra lutra*) has the widest distribution of all 13 otter species and ranges throughout Europe and Asia from Ireland in the west as far as Eastern Russia and China. They are also found in small numbers in North Africa (Morocco, Algeria and Tunisia) and the Middle East. However, population numbers and status in many areas, especially in Russia and most of Asia, are largely unknown.

The Eurasian otter is classified as “Near Threatened” in the IUCN Red List with a declining population. At a meeting of the IUCN Otter Specialist Group in Korea in 2007, proposals were put forward for the species to be downgraded to “Least Concern”. This was based on the fact that populations seemed to be recovering in Europe, although the scale and speed of this recovery has been largely exaggerated in the media. IOSF was represented at this meeting and was able to demonstrate that even if populations are recovering to some extent in Europe we have little or no reliable data from the vast extent of the range, i.e. North Africa and the whole of Asia. The category of the species was therefore left as ‘Near Threatened’

This paper aims to assess the worldwide status of the species as at 2019 to ascertain what recent data is available.

METHODOLOGY

Questionnaires were sent to otter scientists in all 77 range countries that have or have had populations of Eurasian otter. They were asked for data on distribution, estimated population, trends, threats, illegal trade and the sources of the information given. In addition a literature search was carried out for recent publications.

RESULTS

Table 1 shows the status of the otter based on information from questionnaires and literature searches.

Table 1. Status of Eurasian Otter

STATUS	NO OF RANGE COUNTRIES (T = 77)	% OF RANGE COUNTRIES
Unknown population*	46	60
Declining population	9	12
Stable population	8	11
Increasing population	8	11
Back from extinction (reintroduction or natural recolonisation)	3	4
Extinct population	1	1
Other**	1	1

***Includes those countries who gave no data on status of population**

****Japan - see below for more detail**

Let us have a look at this in more detail.

EUROPE

Data obtained for Europe is shown in Table 2:

Table 2. Summary of country data in Europe

Country	Source	Status & Estimated Population	Threats
Albania	**Balestrieri et al., 2015**	Widespread in most of country. Healthy populations in NW and S.	Pollution and industry
Andorra	**Ruiz-Olmo et al., 2002**	*Population: Extinct*	

Armenia	Buzzard et al., unpub. data 2019 in collaboration with Andranik Gyonjyan, Levon Aghasyan and Gor Kaloyan, Scientific Centre of Zoology & Hydroecology, National Academy of Sciences of Armenia	Present in Arpi Lake National Park in NW. Also around Lake Seval (central)	Hunting, conflict with fish farms.
Austria	Nick Huisman	Present in river systems throughout the country	Renewed hunting due to fishery pressure
Belarus	Vadim Sidorovich	Found throughout the country but declined since 2009	
Belgium	Michaël Torfs, Roland Libois, Gérard Schmidt. **Schmidt et al., 2012**	Back from extinction & breeding. Possibly moved in from The Netherlands and Germany. Believed to be extinct along Luxembourg border.	
Bosnia & Herzegovina	Endangered in Crvena lista faune federacije Bosne i Herzegovine (Bosnian Red List)	Present but now endangered	Habitat destruction, water pollution, harassment and poaching
Bulgaria	**Georgiev, 2007**	Widely distributed in plains. Scarce in high mountains & steppe regions in NE *Population: Relatively stable*	Poaching most common cause of death (52% of all mortalities recorded), then road kill (10%), drowning (8%).
Croatia	**Krka National Park; Jelic 2018**	Present throughout. Mediterranean region lower than rest of the country.	Habitat destruction, water pollution, disturbance &poaching.

Czech Republic	Lukáš Poledník	Widespread across country. Over last decade increased. Recently stabilised with perhaps some localised decline. *Population: 3,800*	Poaching, road kills, habitat degradation & pollution (due to drought). Increased pressure from anglers/ fishing community ***Illegal Trade:*** Yes: Every year records of illegal killing – poisoning-carbofuran, shooting, leg hold trapping (several individuals per year).
Denmark	**Elmeros et al., 2006**	*Population: Appears to be increasing but uncertain*	
Estonia	Meelis Leivits	Widespread across country & known to exist on larger islands. *Population: 1,500–2,500*	***Illegal Trade:*** No
Finland	Ulla-Maija Liukko	Present throughout, including Aland Islands & SW Archipelago. *Population: >4,000 (2015 figures)*	No serious known threats, Road kills main threat. 10-15 otters killed legally a year by fish farms ***Illegal Trade:*** *No*
France	Lionel Lafontaine, Franck Simonnet	Mainly widespread in W & S with some coastal. Reintroduced to Alsace. *Population: Approx 10,000*	Mainly pollution (especially POPs affecting food chain), road kills, trapping, (including legal), illegal practices. ***Illegal Trade:*** *No*
Georgia	George Gorgadze	2012 NACRES survey covered 631 sites – otters present at 245 (39%) Listed as "nearly extinct" in Georgian Red book but very old data. Not abundant but appears stable. *Population: >300*	Pollution main problem, loss of habitat, lack of prey, hunting. ***Illegal Trade:*** *No*

Germany	Hans-Heinrich Kruger	Stronger in E but spreading W. Few provinces have no known populations. *Population: Exact number unknown*	Road kills, trapped in nets but this should decrease after research. Mention of cull, like in Austria. ***Illegal Trade:*** *No*
Gibraltar	**Gomez 2019**	Presence first confirmed in Jan 2019 *Population: Unknown*	Unknown ***Illegal Trade:*** *Unknown*
Greece	**Macdonald & Mason, 1982**	Present but populations becoming fragmented.	
Hungary	József Lanszki	Widespread, covering approx. 77.5% of country. Less in mountains in NE & dry plain areas (central). Population considered stable or possibly increasing, although regional fluctuations and differences. *Population: 1,000–10,000 (likely top end)*	Road kills, illegal hunting, degradation ofwater bodies, especially small streams/canals. ***Illegal Trade:*** *No*
Ireland	Ferdia Marnell	Widespread across much of the country & neighbouring N Ireland.	
Italy	**Balestrieri, Remonti & Prigioni, 2016**	In last two decades recovered in central & S. In N present on River Ticino following reintroduction in 1997. Also in South Tyrol & Friuli Venezia Giulia region by natural expansion from Austria	
Latvia	Thomas Sjöåsen, **Ozoliņš et al 2018**	Found on most water courses but distribution sporadic. Dense populations W & E. Reports of decline in 2008 and 2009 *Population: 4,000*	Caught in beaver traps but exact numbers unknown.
Lithuania	Linas Balčiauskas, Balčiauskas, unpubl.	Across whole country. Last monitoring survey showed otters present in 70% (2007–2013) *Population: Estimated at 3,000*	Caught in beaver traps, road kills and poaching – none seriously threatening populations ***Illegal Trade:*** *No*

Luxembour g	Gerard Schmidt, Eva Rabold **Schmidt et al., 2012**	Only 40% of rivers suitable for otters *Population: Declining*	
Moldova	**Danube Parks**	Rare but small populations in Beleu Lake	
Montenegro	Ninoslav Djurovic, Jelena Koprivica	Found across the country. *Population: 40–80*	Eel traps, fishing nets, road kills, construction of small hydro power plants, urbanisation of habitat, tourism, litter, conflicts with fishermen. Some hunters prepare them as a trophy. ***Illegal Trade:*** *No*
Netherlands	Loek Kuiters, Hugh Jansman	Following reintroduction, across all country but more in N. *Population: approx. 275*	Road kills ***Illegal Trade:*** *No*
North Macedonia	**Poledník et al., 2008**	Present in most of the country, but in S & SE areas with low or no otters	
Norway	Jiska van Dijk	Across entire country. Density higher on coasts. S of Bergen to Oslo, numbers lower, as well as populations inland. *Population: <20,000*	Many drown in fishing nets, but exact numbers unknown. Conflicts because of otter predation on birds, wild salmon/sea trout & aquaculture, ***Illegal Trade:*** *No*
Poland	**Romanowski, 2006**	Widespread in most of country, especially common in lakelands in N, along W & E borders, & in Karpaty/ Carpathian Mts (SE)	No longer endangered in Poland
Portugal	**Pedroso et al., 2014**	Widespread across country but not near Lisbon.	

Romania	George Bouroș	Wide distribution from Black Sea level at 0 m altitude, to subalpine zone, (1,800–2,000 m altitude). Recent increase after worrying fall in last decades of 20th century. *Population: 7,500–10,200*	Habitat loss, pollution, road kills, poaching, conflict with fish farms, illegal trade for pets & skins
Russia	Aleksey Oleynikov, Sergey Makeev	Across much of the country. Higher populations in E and W	Local water pollution, habitat destruction, poaching, reduced prey, road kills, killed by stray dogs. ***Illegal Trade:*** *Yes. 10–20 easily found a year for skins & pets – increasing problem.*
San Marino		Present but no data	
Serbia	**Paunovic & Milenković, 1996**	*Populations: Encouraging & perhaps stable*	
Slovakia	Peter Urban	Most parts of the country except parts of W and SE lowlands. *Population: 400–600*	Road kills, habitat destruction/ fragmentation, poaching, water pollution ***Illegal Trade:*** *No*
Slovenia	Danila Golob	Throughout the country but common in NE. Detailed information on distribution is scarce	
Spain	Josep Maria López-Martin, Santiago Palazon, Rafael Romero Suances	Widely distributed in W but threatened in central and E.	Road casualties, water pollution, habitat loss/ fragmentation, overexploitation of water for agriculture
Sweden	**Sampson, 2015**	Declining population from 1950–1980 but reintroduction programmes in central. *Population: Increasing.*	
Switzerland	**Info Fauna**	Records now increasing especially in SW & E. Returning probably from neighbouring countries.	

Turkey	**Erogulu et al., 2009**	Found throughout country in variety of aquatic environments.	
Ukraine	Ievgen Skorobogatov; **Volokh & Rozhenko, 2009**	All over Ukraine except Crimean peninsula & some steppe territories along Black & Azov seas, where low density of rivers. *Population: >10,000 in mid 2000s but based on poor official game statistics data*	Poaching, drowning in fishing nets, road kills, habitat loss, lack of prey, predation by wolves/feral dogs. ***Illegal Trade:*** *No.* Poaching seems low because of low demand for otter fur. Have been several cases in Kharkiv region & elsewhere.
UK	Yoxon	Found in most parts of UK *Population: Estimated at about 10,000 but reports of rapid increase are exaggerated*	Habitat loss/ fragmentation, conflict with fisheries, road kills, pollution, litter

The Eurasian otter disappeared in many parts of Europe largely due to pollution. With considerable effort to improve environmental conditions they are now starting to return in some areas. Europe is showing the best recovery throughout their world range, although this has not been as rapid or extensive as often quoted in the media. In **The Netherlands** the last record of a Dutch otter was in 1989 and there was a reintroduction programme from 2002–2008 with the release of a total of 30 animals (**Koelewijn et al., 2010**). Although to some extent controversial at the time, this seems to have been successful and there is now a breeding population. In some countries where they were once extinct they appear to be returning naturally. For example, in **Belgium** there is now a small breeding population, which is thought to have arrived after the Dutch reintroduction programme. In **Switzerland** there was an attempted reintroduction programme but this appeared to fail. However, records are now increasing mainly in the Southwest and East of the country. These seem to have come in from neighbouring countries, although a small number in Canton Bern may be descended from animals which escaped from the Bern Zoo in 2005. In **Gibraltar**, an otter was photographed by camera trap in January 2019 and this clearly must have come from Spain (***Gibraltar Chronicle*, 2019**). In the **UK**, otters disappeared from most of England and Wales but kept a stronghold mainly in Scotland, East Anglia and the Southwest of England. There was no true reintroduction programme but animals were translocated to areas on the edge of their range to expand the population. They are now present throughout most of England, Scotland, Wales and Northern Ireland but numbers are still believed to be below 10,000.

ASIA

Data for Asia is shown in Table 3:

Table 3. Summary of country data in Asia

Country	Source	Status & Estimated Population	Threats
Afghanistan	**Ostrowski, 2016**	Present but little new information	
Azerbaijan	Elshad Askerov	Found across country but rare. Present in lowland & mountain rivers & lakes & estuaries close to Caspian sea. *Population: 1,000–1,500*	
Bangladesh	**Feeroz, 2007**	Critically endangered & not confirmed since 1995. Sporadic small populations were in Chittagong, Chittagong hill tracts and wetlands of Mymensingh and Greater Sylhet.	Habitat loss, urbanisation, pollution, logging, poaching/hunting, disturbance, traditional medicine, lack of law enforcement.
Bhutan	Tshering Tobgay	Most seen in Punatshangchhu Basin (central) as far as Sunkosh. *Population; 20–30*	Hydroelectric dams, illegal fishing, development, sand extraction. One killed by domestic dogs in Phobjekha valley in 2012. ***Illegal Trade:*** *No*
Cambodia	Heng Sokrith	No information *Population: Unknown*	
China	Yoxon	Otter populations greatly reduced & seldom seen. Still present in Hong Kong and Tibet.	Conflicts with fishermen, road kills. ***Illegal Trade:*** *Yes*
India	**Mudappa et al., 2018; Jena et al., 2016**	Found in foothills of W Himalayas & states of Kerala, Tamil Nadu, Karnataka & Goa, & in S. Lake Kribco believed to be only site in S Gujarat. Recently, dead animal found on roadside in Western Ghats	Habitat destruction, sand extraction, pollution, urbanisation, conflicts with fishermen. ***Illegal Trade:*** *Yes*

Indonesia	Aad Aadrean	No information *Population: Unknown*	
Iran	Saeid Naderi	N & W – less in S *Population: Unknown but declined*	Drought & critical condition of water resources, pollution, habitat loss, poaching ***Illegal Trade:*** *Yes. For fur but believed to have declined*
Iraq	Omar Al-Sheikhly, Mudhafar A Salim; **Al-Sheikhly et al., 2017**	Present around Tigris & Euphrates rivers. Became very rare after Iraqi marshlands inundation in 2003. Photo taken in 2014 first confirmed record in about 50 years.	Hunting, trapping, (fur & pets) conflicts with fishermen, habitat destruction
Israel	**Reuther & Dolev, 2000**	Dramatic decline since 1960s *Population: <100*	Illegal hunting, water pollution, depletion of water sources, habitat loss. ***Illegal Trade:*** *Yes*
Japan	***Japan Times*, 13.10.2018.**	"Japanese otter" declared extinct in 2012. 1 Eurasian otter caught on camera trap in 2017 *Population: Unknown*	
Jordan	Zuhair S Amr	Still found in River Jordan *Population: Unknown*	Floods, poaching by fishermen ***Illegal Trade:*** *No*
Kazakhstan	**Oleynikov & Saveljev, 2015**	Population increased slightly recently *Population: 100*	
North Korea		Otters protected in 3 reserves: Sinyang, Daehung and Popdong. Also inhabit upper reaches of all major rivers. *Population: Unknown*	
South Korea	Sung-yong Han	Across much of country. Conservation increased. *Population: Unknown*	Habitat fragmentation & destruction, human conflict ***Illegal Trade:*** *No*

Kyrgyzstan	Dmitry Milko, Kubanychbek Zhumabai; Zairbek Kubanychbekov	Found in Chon-Alay valley and upper tributaries of Kizil-Suu river. Believed to be extinct elsewhere. *Population: 20–30 max*	Poaching, disturbance, habitat loss, lack of prey, dogs ***Illegal Trade:*** *No*
Laos	**Yoxon, 2018**	Found in Nakai District during IOSF training workshop in 2018. May also be present in Nam Et Phou Louey NP. *Population: Unknown*	
Lebanon	Ghassan Ramadan-Jaradi, Assad Serhal, Bassima Khatib	In Hima Anjar only. Believed not to exist elsewhere *Population: Very low*	Pollution, habitat loss ***Illegal Trade:*** *No*
Malaysia	**Sivasothi & Burhanuddin, 1994; Abdul-Patah et al., 2014**	No recent evidence.	
Mongolia	**Shar et al., 2018**	Very rarely reported.	
Myanmar	**Shepherd & Nijman, 2014**	Reported present but no further data *Population: Unknown*	***Illegal Trade:*** *Yes*
Nepal	Jyoti Bhandari, Purna Man Shrestha	Literature reports largely over 30 years old. No recent sightings documented. *Population: Unknown*	
Pakistan	**Khan & Bhagat, 2010**	Occurs in N mountainous region *Population: Unknown*	
Palestine	**Palestine Wildlife Society**	Present but declining. Dead Sea & Jordan River area. No mention of status or populations. *Population: Unknown*	
Sri Lanka	de Silva; **de Silva & Nugegoda, 2017**	Present but rare. New regular sightings in central area first reported in *Population: Unknown*	

Syria	**Jacques, 1998**	No evidence although locals recognise pictures and say present	
Taiwan	Ling Ling Lee	Present on Kinmen island *Population: 400*	Habitat fragmentation, road kills, water extraction
Tajikistan	Alexey Yu. Oleynikov, Khalil Karimov	Throughout country in low numbers. Present in floodplains of Vakhsh, Pyanj & Murghab rivers. *Population: Unknown*	Habitat loss, conflicts with fishermen.
Thailand	Budsabong Kanchanasaka	Thought to be distributed in the northern and western part of Thailand.	Habitat loss, pollution.
Turkmenistan	**Fet & Atamuradov, 1994; Oleynikov & Saveljev, 2015**	Present but little information. *Population: Believed to be <200*	
Uzbekistan	**Oleynikov & Saveljev, 2015**	Present but no more information *Population: Unknown*	
Vietnam	Daniel Willcox	No information. No records since 1990s, & these can't be verified. All other records from early to mid 20th century genuine. *Population: Unknown*	Habitat loss, pollution, conflicts with fishermen

Eurasian otters have a wide distribution right across Asia. However, there have been no recorded sightings of this species since the early 1990s in many countries including **Bangladesh**, **Indonesia**, **Cambodia and Vietnam**. The status in other parts of Asia is largely unknown.

There had been very few recent records in **Sri Lanka** until 2018. A very enthusiastic group of young conservationists working for the Jetwing Vil Uyana carried out habitat restoration work in abandoned paddy fields in the centre of the island. After this Chaminda Jayasekara was successful in camera trapping an otter there (**de Silva & Nugegoda, 2018**).

There is also very little or no information in countries such as **Myanmar**, **Cambodia** and **Indonesia**, while it is not known if the psecies has ever been present in **Malaysia**. However, evidence was found for the first time in **Lao PDR** in April 2018 during the IOSF training workshop there (**Yoxon, 2018**).

The otter in **Japan** was officially declared extinct in 2012 but in February 2017 a single animal was caught in a camera trap on Tsushima island, in Nagasaki prefecture. This was the first record of an otter in 38 years. Four spraints were found and DNA analysis showed that three were from a male and the fourth could not be identified, so there could be more than one. The actual origin of this otter has not yet been confirmed but it is believed to be a Eurasian otter, possibly from South Korea, rather than the extinct Japanese otter (*Lutra nippon*) (***Japan Times*, 13.10.2018)**.

In the Middle East Eurasian otters have been recorded in **Israel**, **Jordan**, **Lebanon**, **Iraq** and **Iran** but numbers are low, largely down to lack of watercourses. In **Iraq** the first photographic evidence of a Eurasian otter since the 1950s was reported by **Al-Sheikhly et al.,** in 2017. In **Lebanon,** a project has been working to increase public awareness and reduce human/otter conflict (**Ramadan-Jaradi et al., 2019**).

NORTH AFRICA

Data for North Africa is shown in Table 4:

Table 4. Summary of country data in North Africa

Country	**Source**	**Status & Estimated Population**	**Threats**
Algeria	Redouane Thari	Bashar, Jijel and Alkala *Population: 20*	Human conflicts, dams, fishing nets, stray dogs ***Illegal Trade:** Yes. Pets/ poaching*
Morocco	**Delibes et al., 2012**	Healthy populations remain in foothills of Middle & High Atlas but trend of populations disappearing from relatively flat Atlantic slope increased.	Decline caused by differences in implementation of environmental policies, especially regarding water pollution. ***Illegal Trade:** Small number of furs used for decoration*
Tunisia	**Macdonald & Mason, 2008**	Common & widespread in N. Oued Medjerda is S limit. Distribution largely coincident with dense bankside cover, largely absent further S	

There is little information from North Africa, although in **Tunisia**, the population is believed to be increasing.

THREATS TO THE EURASIAN OTTER

There are still a number of threats to the survival of Eurasian otters. These are mainly habitat loss/fragmentation largely due to urbanisation, pollution, hydrological changes such as dam construction, road kills, conflicts with fishermen and poaching/illegal killing. Poaching is interpreted as being for fur, whilst illegal killing includes so-called "pest control". Otters can also drown in fish and beaver traps, suffer predation and attacks by wolves, dogs, etc., and body parts may be used in traditional medicine.

Road deaths and habitat destruction are the biggest threats but still in 37% of the countries the Eurasian otter is poached in spite of legal protection. In **Bulgaria** 52% of otter mortalities were from poaching.

In **Croatia** and **Georgia** the species is mostly threatened by habitat destruction and water pollution. It is interesting to note that in the Chornobyl exclusion zone, in **Ukraine**, the otters seem to be surviving in spite of radiation caused by the nuclear disaster in 1986. (**Skorobogatov et al., 2019**)

In **Lithuania** many otters die in beaver traps and this almost certainly occurs in other countries where beaver trapping is legal. Hydroelectric dams are also causing a problem in countries like **Bhutan** and **Algeria**.

In addition there is an increase in conflicts with fisheries, and this is exacerbated by the exaggerated reports in the media such as the headline on 2 March 2019 which read "Fishermen fight back against otter plague" (https://salzburg.orf.at/news/stories/2967594/). Such sensationalism really does not help otter conservation – or the fishermen either, for that matter.

Problems at fish farms occur in **Romania** and **Norway**. In **Austria** a cull was started in 2018 and permission was given to kill 40 animals, even though it was declared illegal by the justice court in Lower Austria. In the end 20 otters were killed and then it was suspended. However, permission was also given to kill 43 otters in Carinthia and 23 were hunted with a further 16 being killed in accidents. Fishermen in other parts of Austria are now also calling for "otter management" i.e. a cull. There are similar calls for "control" in other countries. In addition, from responses to our questionnaire, it appears that in Finland 10–15 otters per year are killed legally at fish farms and in France there is also an element of legal trapping, although this does not appear to be quantified. There are also calls for a cull in Germany and there have been similar reports in the UK media e.g. ***The Telegraph*, 2009**; ***Wiltshire & Gloucestershire Standard*, 2014**.

DISCUSSION

From the data in Table 1 it can be seen that throughout its range positive trends are found in 26% of countries (11% stable, 11% increasing and 4% back from extinction whether by reintroduction or natural recolonisation). In contrast, negative trends can be found in 73% of countries (12% declining, 60% unknown and 1% extinct).

The "Unknown" category includes countries where there is no indication as to the status. It is argued that otters are increasing more or less "everywhere" throughout Europe, but without the scientific data this cannot be claimed.

Population figures are generally based on surveys based on secondary signs mainly spraint. The standard methodology involves visiting selected sites and checking for a distance of up to 600m. If spraint is found then that 10km grid square is marked as positive. There are clearly limitations with this methodology:

- The presence of spraint gives no indication as to whether the otter is resident or transient – it could merely have been passing through trying to establish a home range and yet there will be a positive record.
- Otters have vast home ranges and in freshwater systems a male can have a home range of about 40km. So it may actually spraint in four 10km grid squares giving four positive records, suggesting four otters rather than one.
- There is no relationship between the number of spraints or sprainting sites and the number of otters present **(Yoxon & Yoxon, 2014)**.

Using DNA analysis to identify individuals is the only reliable method currently available which can give exact numbers, but to date only a few studies have used this, for example **White et al., (2013)**, and **Hájková et al., (2011)**. This method is not only expensive but spraint samples must be collected within 12 hours after deposition and before 10am and the samples have to be stored at –20°C in a solution to stop DNA breakdown (**Jansman et al., 2001**).

Field identification can also be a problem. Mink are often misidentified as otters giving rise to false positive records. Clearly all records should be verified by a qualified researcher but this is not always done. Furthermore, in Asia there are five species of otter, namely the Eurasian, Asian small-clawed (*Aonyx cinereus*), smooth-coated (*Lutrogale perspicillata*), hairy-nosed (*Lutra sumatrana*) and the sea otter (*Enhydra lutris*). The last is restricted to the coastline of eastern Asia and is easy to identify. However, many records of otters in Asia simply list them as "otter" and are not species-specific. This is particularly true in cases of illegal trade in fur. Thus the scale of the threat of the fur trade is largely unknown in terms of species.

Geographical status can be difficult to ascertain. Data may be available from detailed studies in certain areas but these cannot be extrapolated throughout the whole country. For example, information has been provided for Russia, but it is such a large country crossing two continents, that the status may be more negative than it appears. In addition populations may be healthy in some parts of a country but not in others. Thus, any indications of population status are at best an estimate.

CONCLUSIONS

The Eurasian otter is regarded by many as in a healthy state, based on records from Europe. However, without detailed data from all range states in Asia and North Africa this cannot be stated. Even with detailed population figures, unless there is regular monitoring it is impossible to give a reliable population trend. Thus until further data is obtained and the real population trend becomes more evident it is vital that conservation of the Eurasian otter is continued. It is also necessary for range states which currently intend to cull otters to appease fishery concerns accept that this cannot be justified unless and until sufficient data is obtained.

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AUTHOR BIOGRAPHIES

Paul Yoxon is the co-founder of IOSF and did his PhD into coastal otters around the Isle of Skye, where he continues regular monitoring work. He has organised many otter training workshops particularly in Asia and Africa.

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THE FREQUENCY AND SIZE OF MAIN PREY ITEMS TAKEN BY THE EURASIAN OTTER (*Lutra lutra*) ON THE ISLE OF HARRIS, NORTHWEST SCOTLAND

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Abstract

*Otters are unique diving mammals as they rely on their fur for insulation, instead of blubber. This form of insulation and their relatively small size results in an increased energy cost for thermoregulation and therefore increases the food requirements when foraging in cold seawater. Studying otter diet can provide a useful insight into how otters select suitable prey to meet these energy demands. We investigated the relative frequency and size of prey in the Eurasian otter (*Lutra lutra*) diet on the Isle of Harris by spraint analysis. This study was conducted over a five-week period in summer 2018, and spraints were collected from coastal and freshwater habitats. Fish vertebrae contained in the samples were identified to species, and full measurements were taken. In coastal spraints, butterfish and Crustacea were the most frequent prey species found, even though they may not be the best quality prey choices. Otters were found to take 20 species as prey and butterfish were found to be larger than several other prey items. Crustacea especially are not energy efficient prey upon as otters will only consume meat within the carapace and there is a longer handling time to achieve this. Therefore, the otter may be taking a greater quantity and diversity of prey to meet their energy demands instead of relying solely on one prey item.*

Keywords: *Diet; Eurasian otter;* Lutra lutra*; Isle of Harris; Scottish Islands*

INTRODUCTION

Otters are unique diving marine mammals as they do not possess a layer of sub–cutaneous fat, or blubber, for thermoregulation (**Nolet and Kruuk, 1989**). In fact, otters have almost no fat and instead rely on fur to insulate their bodies during diving and foraging. The extent of this fur varies across different species of otter, as they all forage in differing habitats and spend varying amounts of time in water.

Regardless of the extent of aquatic living, all otter species need to deal with the high cooling properties of water. A study by **Liwanag et al.** (**2012**) examined the thermal properties of mammalian insulation and found that an increased reliance on the marine environment correlated with increased fur density, especially in mustelids. Due to the high conductivity of water relative to air (**Kuhn and Meyer, 2009**), successful water-living relies on the insulation of the body to maintain the body temperature during prolonged submergence (**Liwanag et al., 2012**).

The insulating properties of otter fur come from the geometric layout of the hairs. The fur consists of two hair types: primary guard hairs, and secondary inner hairs (**Kuhn**

and Meyer, 2009). The secondary hairs lock a layer of air next to the skin, while the primary guard hairs protect the inner layer from water by lying parallel to the body which creates a barrier between the water and the inner fur. The otters' extensive washing and grooming routine puts air into the coat to provide this insulation (**Nolet and Kruuk, 1989**). For the otter, this results in a reliance on freshwater sources to wash the salt out of their fur to reduce heat loss.

The protected inner layer is warmed by body heat which is at about 28^{o}C while the external water temperature can be 13^{o}C (**Kuhn and Meyer, 2009**). The presence of water vapour in the under layer compromises the insulating ability of the inner hairs. Moreover, the protective barrier is fragile, with any disturbance resulting in rapid heat loss (up to 3 x) at the point of disruption (**Kuhn and Meyer, 2009**).

An otter's relatively small size, in addition to a fragile insulating mechanism, leads to greater heat loss while diving. This then leads to a greater resting metabolic rate and higher energy requirement for survival (**Pfeiffer and Culik, 1998**). Their study measured oxygen consumption of *L. lutra* while diving. Due to the greater thermo-conduction of water, the otter loses heat 23 x faster during a dive compared to when it is on land. As a consequence more energy is spent on thermoregulation than on energy expenditure while swimming (**Pfeiffer and Culik, 1998**).

To match their energy expenditure, otters need to consume large amounts of food; between 0.8 and 1.8 kg a day (**Kruuk, 2010**). Therefore, an otter needs to hunt for around six hours a day, catching about 200 g of fish per hour. Time spent foraging can be offset by the size of prey caught as larger prey providea a greater energy source. However, this means that a 50% decrease in preferred fish populations could cause a serious problem for otter populations (**Kruuk, 2010**). Moreover, the longer an otter spends diving, the more the insulating air layer will be compressed so warm air escapes, and this limits the duration it can spend foraging (**Nolet, Wansink and Kruuk, 1993**). Optimal foraging by maximising net energy gain while minimising handling, or dive time, is thus vitally important to the otter.

Studying diet has been used by many researchers to establish whether otters are feeding successfully and this is often done by spraint analysis. Undigested prey remains, such as fish vertebrae, can be identified due to the otters' rapid digestive system (**Conroy et al., 2005**). Thus it is possible to identify prey species and estimate whether their food sources match their energy expenditure (**Conroy et al., 2005**). In addition to fish and amphibian vertebrae, exoskeleton remains from Crustacea, bird feathers and mammal hairs can also be observed in spraints.

Studies suggest that otters are highly opportunistic in their foraging (**Britton et al., 2006**), but certain prey items are preferred due to their high energy content. European eel (*Anguilla anguilla*) is a common prey of the otter in freshwater due to its high fat to weight ratio which makes them very energetically valuable (**Britton et al., 2006; Conroy et al., 2005; Parry et al., 2011**). Eels are also relatively easy to catch due to their large size (between 150 and 270 mm). Other common prey species include sticklebacks (*Gasterosteidae*), gobies (*Gobiidae*) and blennies (*Blennioidei*) (**Parry et al., 2011**).

There have been a number of studies on otter diet in Scotland (**Kruuk et al., 1989; Kruuk, Nolet and French, 1988; Watt, 1995; Yoxon, 2008**) but there appears to be a lack of data on otter diet and distribution on the Isle of Harris in the Outer Hebrides. Otters in Shetland and the Outer Hebrides hunt mostly in coastal habitats instead of riparian (**Kruuk et al., 1989**). One reason for the otter decline in past decades was riparian habitat loss (**Roos et al., 2015**). The pristine habitat of the Outer Hebrides and the coastal foraging of the otter suggests that this area should be highly suitable. Moreover, it has been suggested that the major future threat to the otter is limited resources due to a collapse in fish populations (**Kruuk, 2010**). Therefore, monitoring prey communities can provide an insight into this threat.

The first aim of this study was to investigate the otter diet on the Isle of Harris by collecting spraint samples and identifying prey remains. We also aimed to determine any differences between coastal and freshwater diet. We hypothesise that there will be a greater frequency of prey species found in spraints which provide a higher energy content to the otter compared to less profitable prey. Additionally, we predict that coastal locations will provide better food sources than freshwater based on the higher frequency and diversity of high energy content prey. We also aimed to quantify the diversity of the prey community by determining a diet diversity index. Finally, we wanted to investigate the average length of prey remains by measuring the length of the vertebrae. We hypothesise that there will be a preferred length of prey across a range of prey species, as this will provide a preferred size for handling and consumption, in addition to providing a favourable energy content.

STUDY AREA

The study was carried out over five weeks from June to July in 2018 on the Isle of Harris in the Outer Hebrides of Scotland. A pilot study was performed within the first week to identify areas with spraint mounds in the Southern part of the island. The search area was constrained to the South due to travel limitations. The coastline was searched for otter signs which included fresh spraints, feeding remains, and tracks. Locations included Leverburgh, Finsbay, Quidinish, Ardslave, Geocrab, Plocropol, Lingerbay, Northton, Rodel and Seilibost and as shown in Figure 1.

Coastal locations had to be within 1 km of the coast, and each sample site was at least 1 km away from another (**Chanin, 2003**). The otter home range typically lies within 1 km of the shore, although they may stray further. Restricting the coastal sites to 1 km reduced the possibility of otters that use freshwater habitats invading search areas of the coastal habitat. A GPS location was recorded at each site.

Freshwater sites were at least 1 km from the coastline and freshwater spraints were found in Loch Langabhat and Loch na Moracha (Figure 1).

SPRAINT ANALYSIS

All spraints were left out to dry for at least 24 hours and then frozen for later analysis to preserve the contents of the spraint. They were then soaked for three hours using the biological detergent Biotex to break down impurities. The contents were washed through a 1 mm sieve using warm water, and then washed again using a 250 µm sieve. The remains were transferred to petri dishes with paper roll and left to air dry for at least 24 hours before being transferred to plastic tubes.

Vertebrae found were examined using a dissecting microscope and identified to species using a key (**Conroy et al., 2005**). The number of vertebrae found was noted for each species and the length of the centrum was measured. For those samples that contained more than 10 vertebrae for a species, a sub-sample of 10 was measured and recorded. The length of the centrum can be used to calculate the total length of the fish using previously described equations (**Conroy et al., 2005; Watt, Pierce and Boyle, 1997**).

Statistical analysis

The data collected was analysed using R in Rstudio v1.1.419 to determine the frequency of occurrence of fish species found in marine and freshwater locations. A barplot was produced to display frequency of occurrence for each environment, and a chi-square test was used to determine any significant differences in these frequencies. Frequency of occurrence (FO) can be calculated using the following formula described by **Watson (1978)**:

$$FO\ \% = \frac{Number\ of\ occurences\ of\ prey\ category}{Sum\ of\ occurences\ of\ all\ spraints}\ X\ 100$$

A diversity index was calculated for preferred prey capture to identify the richness and evenness of the prey community. A Shannon entropy index was calculated to quantify the uncertainty of identifying a species chosen at random from the dataset. The Shannon entropy index (H') was calculated using the following equation:

$$H' = -\sum_{i-1}^{S} p_i ln p_i$$

Additionally, the richness (S) and a Simpson dominance index was used to further quantify the diversity of the prey community. The Simpson dominance index (λ) can be calculated using the following equation:

$$\lambda = \sum_{i-1}^{S} p_i^2$$

A histogram was displayed the frequency of fish lengths and a barplot showed the median lengths for each species. Due to the skewed distribution of lengths found from the histogram, a Kruskal-Wallis test was performed to test for differences in median fish lengths. A pairwise Wilcox test was calculated to show which median fish lengths were significantly different.

RESULTS

Fifty-two spraints were collected in total; 44 from coastal and 8 from freshwater locations. Figure 1 displays the distribution of the locations. Many coastal collection sites were found on the East coast which has mainly rocky shores (Figure 1). Out of 52 samples, 9 contained no fish vertebrae (6 coastal and 3 freshwater samples).

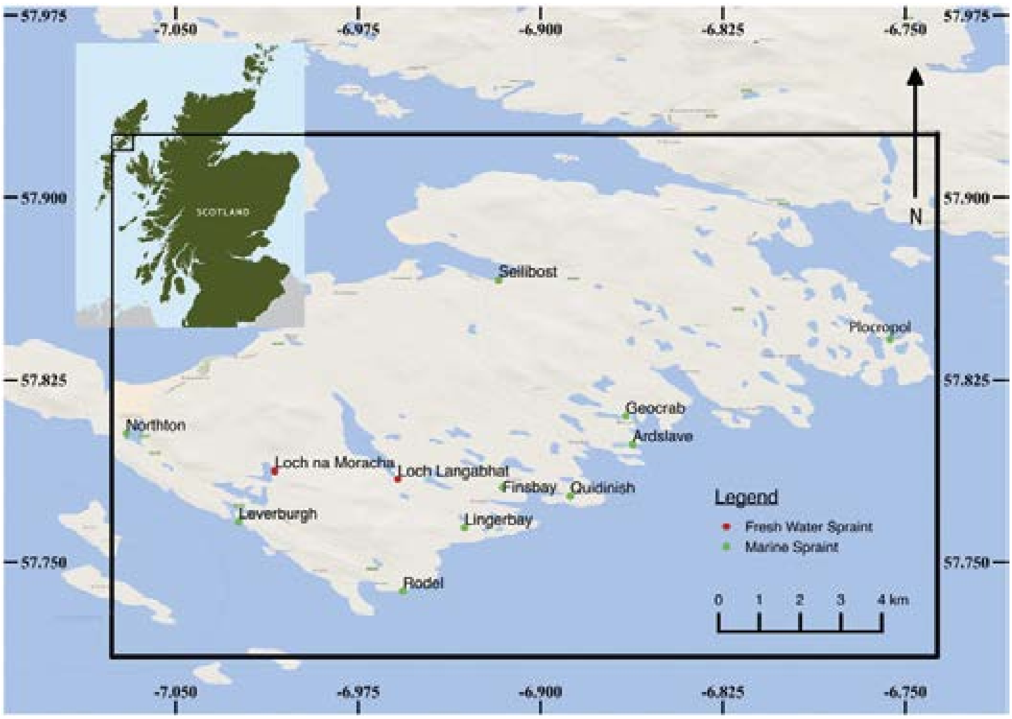

Figure 1. The distribution of otter spraint sites found around the Southern part of the Isle of Harris in relation to mainland Scotland. Locations marked green indicate the area where coastal spraints were found; locations marked red indicate freshwater spraints.

Coastal and freshwater spraints varied in frequencies of prey items found (Table 1).

In coastal spraints 86% contained fish remains, and over 50% contained Crustacea remains. In the 44 coastal spraint samples, there were 7 main prey items identified by their high frequency: Crustacea, butterfish (*Pholis gunnellus*), rockling (*Gaidropsarus sp*.), eel, bullrout (*Myoxocephalus scorpius*), sole (*Soleidae*), stickleback (*Gasterosteidae*) (Figure 2). Spraints which contained no fish vertebrae were recorded as ‘no remains’. Prey species that were recorded fewer than five times were grouped together as ‘Other’, and this included bullhead (*Cottus gobio*), clingfish (*Lepadogaster*), dab (*Limanda limanda*), goby (*Gobiidae*), lumpsucker (*Cyclopteridae lumpus*), pipefish (*Syngnathinae*), saithe (*Pollachius virens*), salmonid (*Salmonidae*), sea snail (*Liparidae*), wrasse (*Labridae*) and Yarrell’s blenny (*Chirolophis ascanii*). Rockling (3-bearded [*Gaidropsarus*], 4-bearded [*Enchelyopus cimbrius*], and 5-bearded [*Ciliata*]) and stickleback (3-spined [*Gasterosteus aculeatus*], and 15-spined [*Spinachia spinachia*]) species were grouped together (Figure 2). Butterfish was the most frequent overall fish species (43.2%) found in coastal spraints, along with rockling species (25.0%) and eel (20.4%). Crustacea were also prominent and were found in 52.3% of the coastal spraint samples. A chi-square test found the frequencies of butterfish and Crustacea to be greater than the other prey in the coastal samples (X^2=34.62, f=8, p<0.0001).

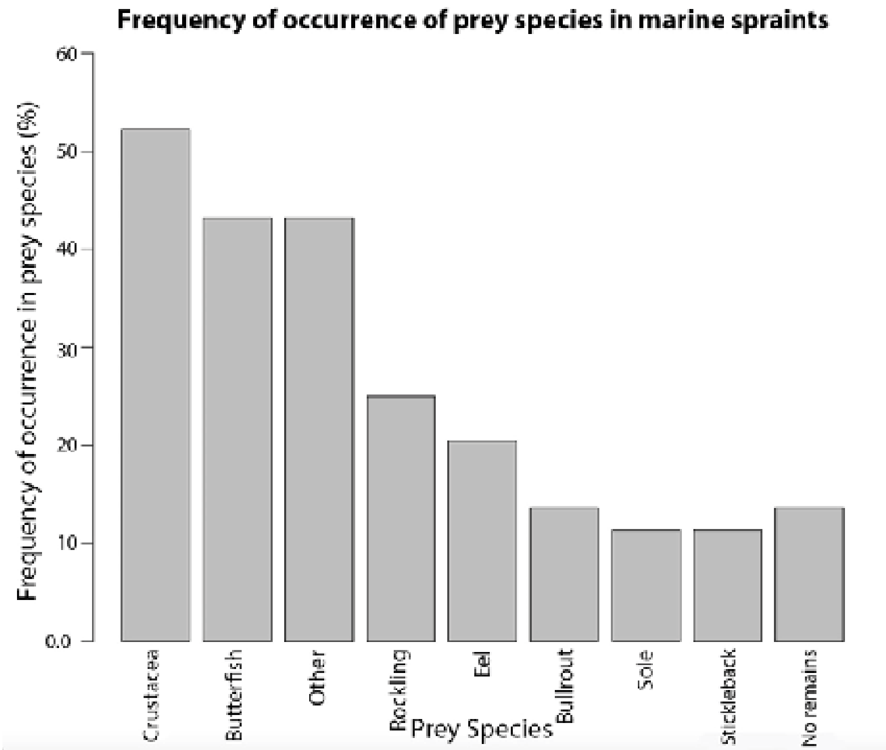

Figure 2. Frequency of occurrence (%) of prey remains found within coastal spraints (n=44). 'Other' includes prey remains that were recorded fewer than five times within coastal spraints.

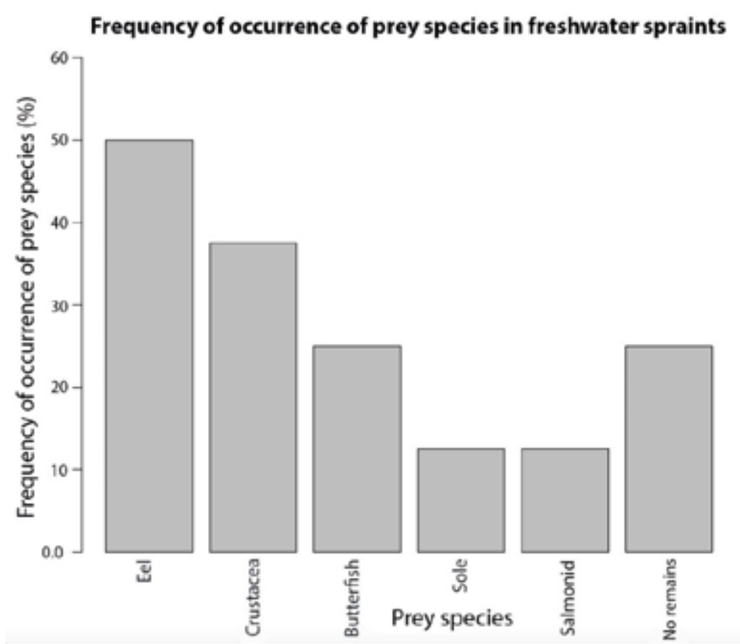

Figure 3. Frequency of occurrence (%) of prey remains found in freshwater spraint samples (n=8)

Only eight spraints were found within freshwater habitats and these contained five prey species (Figure 3). Due to the limited sample size, statistical tests could not be used to examine the differences in frequencies of prey species in freshwater habitats. However, we can see that eel featured more prominently (50%), in addition to crustacean remains (37.5%).

Table 1. Relative frequency of occurrence (%) of prey species (n) found in otter spraints from p marine and freshwater (FW) locations. Main fish species found displayed in bold.

		frequency	*Frequency*	*frequency*	*Frequency*
n=		*44*		*8*	
Fish		38	86.3	5	62.5
Crustacea		23	52.3	3	37.5
15–spined Stickleback	*Spinachia spinachia*	2	4.5	0	0
3–spined Stickleback	*Gasterosteus aculeatus*	3	6.8	0	0
Stickleback	***Gasterosteidae***	5	11.4	0	0
3–bearded Rockling	*Gaidropsarus vulgaris*	3	6.8	0	0
4–bearded Rockling	*Enchelyopus cimbrius*	2	4.5	0	0
5–bearded Rockling	*Ciliata mustela*	6	13.6	0	0
Rockling	***Gadiformes***	11	24.9	0	0
Bullhead	*Cottus gobio*	1	2.3	0	0
Bullrout	***Myoxocephalus scorpius***	5	11.4	0	0
Butterfish	***Pholis gunnellus***	19	43.2	2	25.0
Clingfish	*Lepadogaster*	1	2.3	0	0
Dab	*Limanda limanda*	2	4.5	0	0
Eel	***Anguilla anguilla***	9	20.4	4	50
Goby	*Gobiidae*	3	6.8	0	0
Lumpsucker	*Cyclopteridae lumpus*	2	4.5	0	0
Pipefish	*Syngnathinae*	1	2.3	0	0
Saithe	*Pollachius virens*	3	6.8	0	0

Salmonid	*Salmonidae*	1	2.3	1	12.5
Sea snail	*Liparidae*	1	2.3	0	0
Sole	***Soleidae***	5	11.4	1	12.5
Wrasse	*Labridae*	2	4.5	0	0
Yarrell's Blenny	*Chirolophis ascanii*	2	4.5	0	0

The Shannon entropy index was calculated at 2.6, with a total of 20 species in the coastal prey community (S=20). Additionally, the Simpson dominance index was calculated at 0.1. Together, these values imply that this prey community is diverse and that the probability of two prey individuals being the same is low.

The highest frequency of fish length was found to be between 160 and 180 mm (Figure 4). One of the largest was butterfish which ranged from 133 to 222 mm with a median of 181.1 mm, but the largest median length was salmonids at 208 mm (Table 2). Some species did not have an equation to relate centrum length to fish length and these were all included in the 'other' category described for Figure 2. They included 15-spined stickleback, clingfish, pipefish, sea snail and Yarrell's blenny. A Kruskal-Wallis test found significant differences in the median lengths of the fish species (X^2=53.29, df=14, p<0.0001).

A pairwise Wilcox test found significant differences between several species lengths. Eel were smaller than 5-bearded rockling (p=0.031), and bullrout (p=0.031). Butterfish were larger than eel (p=0.003), sole (p=0.021) and bullrout (p=0.021). Figure 5 shows median lengths for each species including significant relationships.

Table 2. Median lengths of prey species calculated using vertebrae length. Note that not all prey species found have an equation for fish length, thus they are not included in this Table.

Species	*Median (mm)*	*Minimum (mm)*	*Maximum (mm)*
3-Spinned Stickleback	15.9	14.1	16.4
Eel	46.4	36.5	65.3
Lumpsucker	80.9	73.5	88.2
Sole	82.8	44.0	119.9
Saithe	97.3	80.6	230.9
Bullhead	114.3	114.3	114.3
Bullrout	114.3	106.4	142.9
Dab	115.9	115.9	115.9
Goby	125.0	125.0	131.2
5-bearded rockling	126.2	77.8	156.3

Wrasse	151.6	140.0	163.3
3-bearded rockling	155.8	89.1	190.1
4-bearded rockling	156.5	135.6	177.4
Butterfish	181.1	133.3	222.2
Salmonid	208.6	208.6	208.6

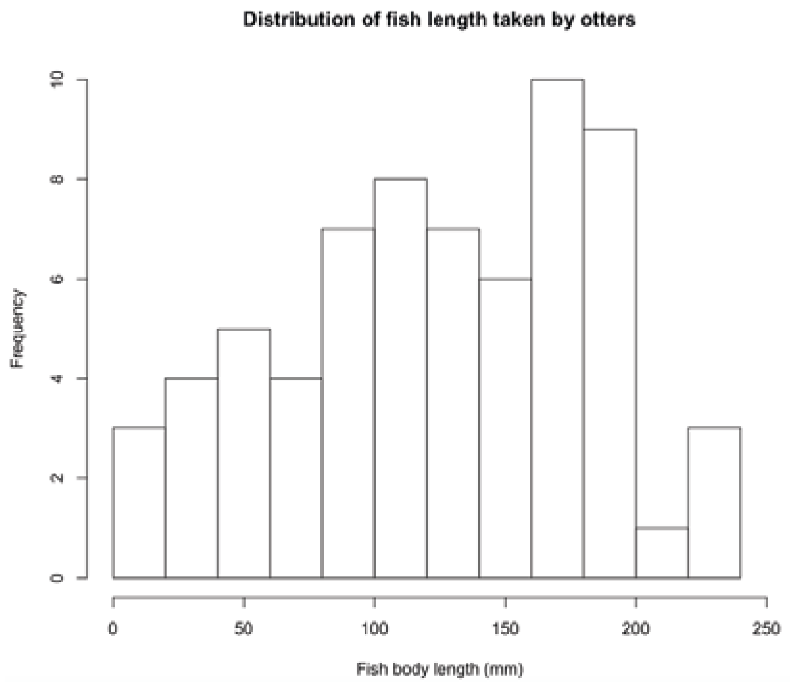

Figure 4. Distribution of fish size taken by otters. There is a peak fish length between 160–180 mm with 10 recordings.

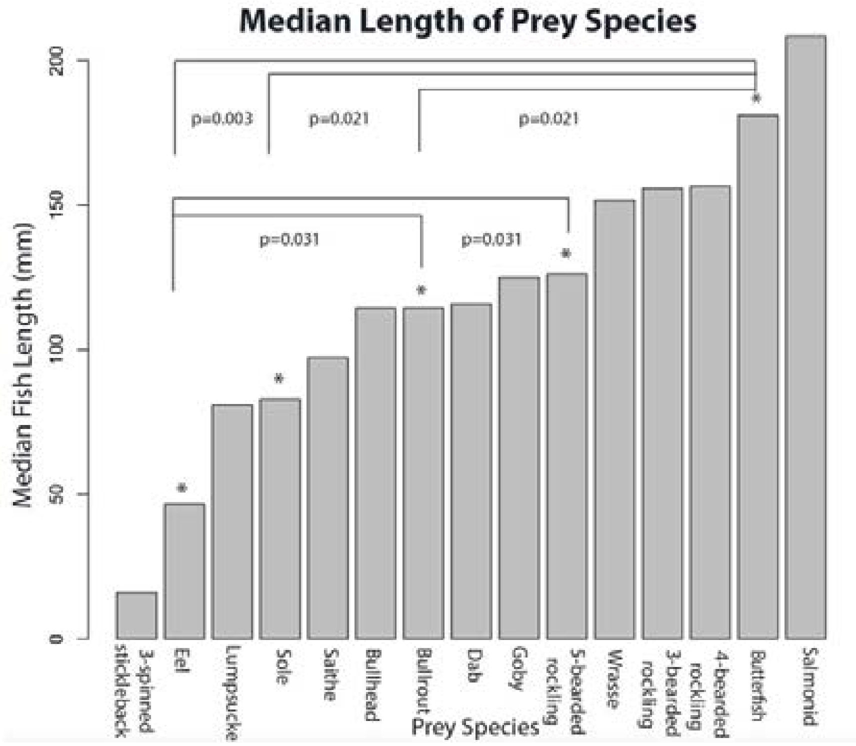

Figure 5. Barplot illustrating the median lengths of prey species found within spraints. The significant values are denoted with * and the p–values are represented for each relationship.

DISCUSSION

We aimed to investigate the prey choice taken by otters on the Isle of Harris and found that there was a higher frequency of certain prey in the coastal environment (Figure 2). Fish were present in 86.3% of coastal spraint samples, and butterfish and Crustacea were the highest frequency of prey item ($p<0.0001$), so seem to be the preferred prey choice. Butterfish were the most abundant fish species (43.2% of samples) and Crustacea were found in over 50% of samples. Our hypothesis stated that otters would have a preferred food choice related to favourable energy content so one interpretation is that butterfish and Crustacea have a greater energy factor..

The abundance of butterfish in spraints has been found in similar studies on other North West Scottish islands. A study on the Isle of Mull found butterfish to be the most common prey species being found on average in 25.8% of spraints (**Watt, 1995**). Other studies found blennies, rockling and eel to be most common, but butterfish still feature prominently in spraints (**Yoxon, 2008; Britton et al., 2006**).

Conversely, Crustacea offer little energy for the effort needed to eat this prey (**Watt, 1995**). Previous studies found that otters will only consume the meat within the crustacean carapace leaving the legs and appendages untouched (**Kruuk, 2010**). Some observational studies report that Crustacea are often taken by young otters and by older individuals (**Kruuk, 2010**). This implies that Crustacea are taken when inexperienced or old and are thus, an easier choice of prey than fish.

By investigating the frequency of occurrence in prey capture we aimed to determine if there was a preferred environment in which otters choose to forage (coastal or freshwater), and if there was a similar preferred prey choice for each environment. Due to the limited number of spraint samples from freshwater sites (n=8) we were unable to perform any test to find which prey species was dominant in the diet. Moreover, the low sample size for freshwater and the larger sample size for coastal environments (n=44) implies that the latter is better for foraging. However, this could also be explained by seasonal changes in fish populations and abundances.

The diversity of fish species found within spraints further explains the differences between coastal and freshwater foraging. A total of 20 fish species was found in coastal spraints as well as Crustacea, whereas freshwater spraints contained four fish species and Crustacea. This greater diversity of prey items further suggests that the coastal environment provides better foraging for otters.

The restriction of otter territory to coastal and freshwater habitats could influence these results. Some sources report otter territory to range up to 1 km (**Chanin, 2003**), but a study by **Gentle** (**2000**) on the Isle of Skye found that otters would move 2–3 km from freshwater lochs to the coast to feed. Furthermore, some fish species found in freshwater spraints were marine such as butterfish, while others such as eel and salmonids occur in both coastal and freshwater environments.

A study by **Yoxon** (**2004**) examined many freshwater pools in Southern Harris and found a number of spraint sites. These spraints contained marine organisms, indicating that otters on Harris hunt in the coastal habitat but travel inland. Freshwater spraints found within the current study contained marine organisms such as butterfish, as well as others such as eel and salmonids which occur in both coastal and freshwater environments. It is therefore hard to conclude whether the freshwater spraints obtained were in fact from otters foraging in freshwater habitats.

In addition to investigating preferred prey choice, we also aimed to quantify the diversity of the prey community. In this study this appears to be diverse with a Shannon entropy of 2.6, richness (S) of 20 and Simpson dominance index of 0.1. The Shannon entropy index value typically lies within 1.5–3.5, with larger values suggesting greater diversity. The Simpson dominance index ranges from 0–1 with 0 being a community infinitely diverse. Therefore, our values suggest that the prey community in this study was relatively diverse.

Diversity indices have not been used widely in research into otter diet in coastal habitats, but this is a useful way to quantify how well the otter is feeding and if it is relying on a certain food item. Studies have quantified diet diversity in riparian habitats, but appear to be more diverse with a Shannon diversity index of 3.8 (**Mikheyev, 2017**). Additionally, the number of species, or richness, found in coastal spraints was 20, demonstrating a relatively rich prey community. This is reported in other studies with an average 20.2 prey species in spraints (**Parry et al., 2011**).

Although we found Crustacean and butterfish were dominant prey species the diversity index indicates there is indeed a wider range of species taken by otters.

Previous research has suggested that otters choose prey based on ease of capture in addition to energy content (**Britton et al., 2006**). Eel, for instance, is a dominant species commonly found in otter diet studies due to their ease of capture by otters in addition to having a high energy content (**Britton et al., 2006**). However, otters have been shown to be highly opportunistic with prey capture, in addition to being active hunters (**Britton et al., 2006; Copp and Roche, 2003; Almeida et al., 2012**). This could explain why they have such a diverse diet: there may be a particular prey species that is easier to capture and high in energy, but there are other suitable, or more abundant species present in the community. Their high energy requirements for probably reduces their ability to rely solely on one food source.

The final aim of this study was to investigate any preferred length of prey species and this was proven to be positive (Figures 4 and 5). The distribution in fish length was not normal (Figure 4), with the most frequent length being skewed towards 160–180 mm, but the distribution of lengths was found to be significantly different ($p<0.0001$). Butterfish were found to be larger than several species including bullrout ($p<0.05$), sole ($p<0.05$), and eel ($p<0.05$) (Figure 5).

We hypothesised that otters will take a certain length of prey as this would correlate with size and thus energy content and handling efficiency. We did find a significant difference in the median lengths for each prey species and a high frequency of prey within 160–180 mm. Moreover, butterfish covered the range of most frequent fish length (160–180 mm) (Table 2). Considering butterfish were the most frequent fish species caught and one of the longest species with a median length of 181.1 mm, it can be suggested that their bigger size provides a greater energy content in addition to efficient handling.

Similar lengths of butterfish were found in other diet studies (**Watt, 1995**); however, these studies recorded other species being longer, such as eel, gadids and rocklings. Eels and rocklings were found in the current study but were much smaller than those recorded in previous studies. Eel can range between 150–270 mm (**Parry et al., 2011**), whereas this study found eel in the range of 36–65 mm. Optimal foraging theory predicts that an animal should be maximising their net energy gain while minimising handling time. Therefore, the lower energy content of smaller prey and greater handling time associated with the smaller size contradicts such theory.

Butterfish have been found to be in greater abundance during summer months. **Kruuk et al.** (**1988**) measured prey species over a two-year period in Shetland. Although not the most frequent species found, butterfish displayed a regular seasonal fluctuation in population as they would breed in spring and become most abundant in August (**Kruuk et al., 1988; Watt, 1995**). This study also recorded butterfish as being 50% heavier during summer months (**Kruuk et al., 1988**). While butterfish are more abundant during summer months, several studies suggest that they do not provide the best source of energy (**Kruuk et al., 1988**). Even the biggest individuals are smaller than other available prey such as eel, gadids and rocklings (**Watt, 1995**).

Additionally, it has been documented that Crustacea are found in greater abundance in spraints when there has been a great reduction in fish stocks (**Kruuk, 2010**). While butterfish and Crustacea were the most frequent prey species found in this study, the contradiction in energy content and greater diversity in prey community suggests there could be a reduction in available fish populations (**Kruuk, 2010**).

As mentioned before, otters are highly opportunistic in their feeding, and usually prey upon the most abundant species in the environment **(Almeida et al., 2012; Copp and Roche, 2003**). A study by **Almeida et al.** (**2012**) examined otter diets in the river Glaven in England to investigate prey capture and available fish species. It was found, that when compared to previous data, otters were taking less preferred prey species, and they had no preference on food choice. This would suggest that butterfish are not a specifically preferred food choice, but the most abundant prey species around the Isle of Harris. Furthermore, it would imply that otters do not make a choice to prey upon butterfish but live up to their highly opportunistic feeding behaviour. Additionally, this could further suggest a reduction in fish populations in the area as some 'preferred' fish species such as eel, gobies or blennies described in other studies, were not common.

As this study did not record any data on fish populations, we cannot conclude whether there has been any reduction. Therefore, it would be useful for future research to include a fish trapping study to gauge available prey and identify seasonal fluctuations similar to previous studies (**Kruuk et al., 1988**). Thus it would have to be conducted over the course of a year which would reveal if there is any seasonal preference in prey choice.

Several studies suggest that monitoring fish populations and dominant prey species could be a good indicator to aid otter conservation in the future (**Almeida et al., 2012**). The eel was once the preferred prey choice for otters in freshwater habitats, but since its rapid decline in the 1970s this species has featured less in spraints (**Almeida et al., 2012**). If a high energy prey source like the eel is not available then otters may resort to foraging on lower energy prey sources or simply choose to prey upon the most abundant food source regardless of energy content.

The energy constraints associated with fur insulation could also explain the preferred prey choice and size found in this study. The foraging and diving of otters is restricted due to morphological and physiological constraints of the insulating properties of the fur (**Nolet et al., 1993**). Through observational studies, it has been found that otters in Shetland prefer to forage in shallow waters as this provides a warmer temperature than deep water and thus reduces heat loss. Additionally, shallow waters allow for shorter travel times to find prey (**Nolet et al., 1993**).

Shallow diving and foraging may help with energy constraints associated with feeding in water, but deep diving usually allows capture of larger prey, although this involves greater dive times. The longer an otter spends during deep dives, the more air will be compressed and escape fromo the dense inner fur resulting in greater heat loss. This does not mean the otter will spend less time diving on a daily basis when in deep water, but suggests that there may be an extra cost involved which could outweigh the benefit of larger prey items (**Nolet et al., 1993**).

Based on the collection sites used in this study, it can be suggested that otters prefer to forage in rocky shores around the Isle of Harris, which usually have greater depths. Out of the 10 coastal collection sites, 7 were located on the east coast, which is characterised by rocky shores. However, if this were true, it did not seem to provide otters with larger prey items.

Therefore, a further insight into this study would be to complete observational studies on foraging behaviour. If some otters are foraging on sandy shores, then we would expect the prey to be smaller compared with rocky shores and expect shorter dive times. Furthermore, the reliance on foraging there could explain the abundance of Crustacea in this study as they would be found in greater abundance in this area.

CONCLUSIONS

The high frequencies of butterfish and Crustacea found in spraints suggests that otters on the Isle of Harris prefer these prey items as they provide a greater quality of energy intake. However, the literature demonstrates that Crustacea are not a high-energy food source. Additionally, the longer prey size taken suggests a preferred energy content in larger fish. However, even the largest butterfish do not offer a substantial food source when compared to other species such as eel.

The insulation from the fur creates a paradox for otters: they require more energy in the form of high energy prey caught per day, but the longer they spend foraging in water, the more heat is lost and therefore metabolic costs are greater. Thus it would be beneficial to take larger, high energy prey instead of Crustacea and butterfish.

Otters are highly opportunistic carnivores and will mostly feed on the most abundant prey species in the community, which suggests that butterfish and Crustacea are the most abundant prey species found around the Isle of Harris. Moreover, the literature suggests that a high frequency of Crustacea in spraints correlates with a reduction in fish populations.

Perhaps the abundance of low energy prey items demonstrates that otters around the Isle of Harris are choosing a greater quantity and diversity of prey to meet their energy demands. The diversity of prey items found may illustrate how otters cannot rely on one food source, in an environment that has an ever-changing abundance of fish populations.

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DISCLOSURE STATEMENT

No potential conflict of interest was reported by the author.

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Kirsty Hunter a 4th year zoology student at the University of Glasgow. In 2018, she completed an expedition with the University to the Isle of Harris where she completed her honours project on the dietary choice of the Eurasian otter.

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RECENT RECORDS OF THE EURASIAN OTTER (*Lutra lutra*) IN THE MERCURE-LAO RIVER VALLEY, SOUTH ITALY

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Abstract

*Here we report recent evidence of the presence of Eurasian otter (*Lutra lutra*) in the Mercure-Lao River valley, an area of great ecological interest situated in South Italy for which the last otter reports referred to sprаints collected in 2002. This work contains information and a selection of photographs of otter footprints and spraints found from October 2005 to January 2019, and photographs of both a cub and an adult otter from the Mercure-Lao River area.*

Keywords*: Eurasian otter;* Lutra lutra*; Italian population; Mercure-Lao River*

INTRODUCTION

The population of the Eurasian otter (*Lutra lutra*) in Italy is less than 300 adult individuals (**Prigioni et al., 2006**) occurring in the Southern part, mainly Basilicata, Calabria, Campania and Puglia regions. Here a larger population exists, while a smaller number is found in the Abruzzo and Molise regions (**Balestrieri et al., 2016**). Recent records of otters in Northern Italy (**Balestrieri et al., 2016**) were attributed to individuals probably originating from Austria and Slovenia. This is of great interest from the point of view of a possibile otter recolonisation there. Based on previous data, the otter is currently listed in the Red List of Endangered Species in Italy, although there seems to be some signs of recovery. This is probably due to improved river water quality and fluvial habitat restoration. Earlier environmental degradation caused the population decline and, in some cases, disappearance in vast areas of the country (**Prigioni et al., 2007**). Pollution, mainly associated with bioaccumulable contaminants affected otter reproduction and/or food availability. As the otter is a top aquatic predator it accumulates polychlorinated biphenyls (PCBs), which are also toxic to humans, through the food chain, even in environments with relatively low contamination (**Leonards et al., 1997**). This makes the species very vulnerable to pollution and so it is often used as a bioindicator species (**Ruiz-Olmo et al., 1998**). It is not surprising therefore that the Italian otter survived apparently undisturbed within inner areas of southern Italy, which are characterised by vast wild natural areas, very low urbanisation and a progressive human population decline, still underway today. It is generally accepted that the Calabria region represents the Southern limit of otter distribution in Italy. The last records in Sicily date to the nineteenth century and, to the best of our knowledge, there are no more recent reports on the island (**Gariano & Balestrieri, 2018; Cavazza, 1911**).

In Calabria, the otter is mainly present in the province of Cosenza and in the North (**Prigioni et al., 2005**). A population in the Sila Massif is also well documented (**Gariano & Balestrieri, 2018**). The most recent Southern report in Calabria was of a road-killed otter from the Angitola river mouth, in Vibo Valentia province, more than 100km South of the Mercure-Lao valley (**Balestrieri et al.. 2016**).

STUDY AREA

The Lao river takes its name from the Greek word Λαος (meaning "people") and is the name of an ancient Greek settlement on the coast surrounding the Lao river mouth. The river originates in the Basilicata region, where it is called the Mercure, hence the use of "Mercure-Lao" for the water course from its origin to the mouth.

Figure 1. Mercure-Lao River

The source is on the Serra del Prete in the Pollino massif, at an altitude of more than 2000m above sea level, and it runs Southwestwards toward the Tyrrhenian sea in a mountainous area with scarce urbanisation (Figure 1). It flows through the Mercure-Lao valley in the territories of several towns such as Viggianello (where it is called Mercure), Laino Borgo and Laino Castello (where the Jannello and Battendiero tributaries join the river which is now called Lao), Papasidero (where the tributary waters of the Saint Nocaio river flow into the main river), Santa Domenica Talao, Orsomarso (at the confluence with the Argentino tributary), Santa Maria Del Cedro and Scalea (at the river mouth).

It is 61km long but with its tributaries the total length is 143km and it has a drainage basin of about 600km^2. It has an average discharge of 12m^3/s and maintains its water flow during the dry season with a discharge generally never below 4m^3/s. The main tributaries are the Iannello, Battendiero and Argentino. The river bed consists mainly of stones and rocks with occasional little sandy shores

A river nature preserve (Riserva Naturale Orientata Valle del fiume Lao) was created to protect both the flora and fauna of the river, whose valley is part of the Pollino National Park. This is the largest Italian national park, covering nearly 200,000ha.

Riparian vegetation along the river banks comprises willow trees (*Salix* sp.), alders (*Alnus glutinosa*) and poplars (*Populus alba, P. nigra*). Roach (*Rutilus rubilio*), brown trout (*Salmo trutta*) and European eels (*Anguilla anguilla*) live in the river, and the latter two are favourite prey of the otters. This was ascertained by Prigioni group **Remonti et al., (2008)**, who estimated the number of otters at 26–29 in the study area, i.e. ~0.2 otter/km abundance, based on data collected more than 10 years ago (**Prigioni et al., 2006**).

For local villagers the presence of otter is not a novelty nor a surprise and many report otter sightings, including recent records. These are mainly from fishermen but farmers alo quote old stories of otters trying to steal fish from fishermen, or eating carcasses of dead livestock thrown by villagers from bridges into the river below.

The river flows mainly in canyons or in remote areas far from roads and this is why, to the best of our knowledge, there are no reports of road-killed otters in the area to date. However, proposed projects for fast roads, including close to the Lao River mouth, were recently presented (**Mollica, 2015**) These should be carefully evaluated before being given approval to ensure the otter population does not suffer as a result of changes to the water flow or to the riparian habitat.

Human pressure on the territory has been significantly reduced compared to the recent past. The population in the core research area almost halved from 1971-2011 (Table 1) and inhabitant density for 2011 was about 26 inhabitants/km^2, and even less (15 inhabitants/km^2) for Papasidero, which is part of the reserve. The resident human population is still decreasing, but the lack of inhabitants does not mean that the river and its valley are exempt from any human activity. In fact, a biomass thermal plant (ENEL Mercure thermal plant, recently acquired by F2i SGR [**https://it.wikipedia.org/wiki/Centrale_del_Mercure**] that uses biomass from forests of the National Park) has been authorised to use Mercure-Lao river waters (**http://regione.calabria.it/sviluppo/allegati/autorizzazioni_387/biomassa/centrale_mercure/aia/relazione_tecnica_152_mercure_modificata_mag_2008_rev_3.pdf**). Furthermore, part of the Mercure-Lao spring waters were bottled in 2014 by the San Benedetto company, and in recent months they have been authorised to bottle more water from a new point of the same springs (**Aurilio, 2018**). We hope that these authorisations followed accurate studies on the impact of these activities on the otters. However, eco-friendly tourist rafting companies have complained about significantly reduced river water levels in the last few years. We hope the river waters are being monitored for flow and quality and that these decreases in water flow, if real, were not caused by the above activities.

Table 1. Decline of human population in the core of the research area (numeric data from ISTAT statistics. Statistiche I.Stat – ISTAT; 28-12-2012)

	number of inhabitants in			
Town	**1971**	**2001**	**2011**	**Territory (km^2)**
Laino Borgo	2,951	2,275	2,027	57.08
Laino Castello	1,439	901	879	37.33
Papasidero	1,641	1,019	808	55.22
Santa Domenica Talao	1,451	1,314	1,272	36.12
Orsomarso	2,230	1,498	1,338	90.41
Total	**11,683**	**7007**	**6324**	**240.04**

The last published scientific records of otters in the Lao river were dated December 2002 (**Prigioni et al., 2006**), and we aim with our recent evidence to show how the otter is still present and trying to survive in this area. Our evidence is based on footprints, spraint and also photographs of two otter individuals found in the river valley. We do not have numeric data that can give indications of the current status of the otter population but we can testify that there is a healthy population of otters in this area. This area still needs to be studied by wildlife specialists, and protected in order to ensure the conservation of local high value flora and fauna.

METHODS

Monitoring was conducted from October 2005 to January 2019. Otter footprints are very distinct with their peculiar five-toed shape, and they were used to indicate only otter presence and not abundance. A 200m length of river was selected and searched at least twice a year for evidence of otter footprints. Spraints and photographs of otters were used on a stretch from the mouth to 25km upstream of the Mercure-Lao river. Measurements of footprints and spraints were performed using free software ImageJ (Wayne Rasband, National Institute of Health, USA) using metric references (coins, keys, etc.) shown for scale in the photo. Footprint widths were measured and ascribed to sex and age classes as follows: cub/juvenile <5cm; adult female 5–6cm; adult male 6.5–7cm (**Devon Biodiversity Records Centre**). The photo of a swimming otter was taken by Antonio Galiano using an action camera attached to his helmet during a river rafting trip in July 2015. The cub photographs (November 2018) were kindly provided by A. Colucci and G. Cirelli (WWF Policoro Herakleia).

RESULTS

A

We examined several five-toed footprints found in the study area. By comparison with metric references we could estimate track sizes. We could then tentatively assign them to adult (males or females) or cubs by considering that footprints >7cm were adult males, those with a width of ~5–6cm were females, whereas cubs and juveniles were <5cm.

B

C

Figure 2. Otter footprints photographed on 31 October 2005 (A). These were prints of different adult individuals (at least one adult male – B left; and one or more females – B right, C)

In October 2005 we found for the first time numerous otter tracks which were in the wet sand of the river beach (Figure 2). These all clearly showed the five toes and some also showed webbing and claws. Interestingly, their different sizes suggested that at least two otters visited the site and one of the two, with tracks wider than 7cm, was probably an adult male. To the best of our knowledge, this was the first report of otter footprints in the river Mercure-Lao, where otter presence had been previously identified by other indirect signs, mainly spraints. Since 2005, at least 60–70% of the subsequent surveys of the same river tract were positive, testifying that otters continued to use the area regularly. Below are some examples of this evidence:

A

B

Figure 3. Otter tracks (A) found in August 2006 (50 Euro cent coin for scale). Footprints (January 2006) showing a mother and cub walking together (B), details of cub tracks in right part of Figure 3B

In August 2006 we found 6.5–7cm wide five-toed footprints (Figure 3) well impressed in the wet sand that could have been left by an adult male otter. Very interestingly, five months later a double footprint path formed by five-toed tracks was found in the same site. This showed a much smaller otter (track size <5cm) walking next to an adult one. Thus, we supposed these two parallel tracks were left by a female and her cub.

Figure 4. Holes in the river sand near otter tracks observed in December 2007 (left) and October 2018 (right)

In December 2007 we also found 6.5–7cm sized tracks that we attributed to an adult individual, probably male. Nearby, we noticed a hole in the sand which was approximately 25cm wide (Figure 4 left). We believed that it was either a resting site or, more probably, the result of a search for crabs or toads which are found hidden under the sand in this zone. Another similar hole dug in the sand very close to the otter footprints was noticed by us also in October 2018 (Figure 4 right).

Other tracks were found in subsequent years at the same site:

- May 2008 – width 7cm so probably male
- April 2013 – width 5.5cm – female or subadult male

- December 2015 – width <6.5cm – female or subadult male
- July 2016 – width ~6cm – female or subadult male
- August 2017 – width ≤6.5cm – female or subadult male
- December 2017 (underwater footprints) –width ~6cm – female or subadult male
- November 2018 – width ~6cm – female or subadult male
- 8 and 29 December 2018 – width 5.8–6cm – female or subadult male

Finally, on 1 January 2019 we were very surprised to find same-sized otter footprints inside one of our own shoe prints left in the sand during the previous visit of 31 December 2018 (Figure 5).

Figure 5. Otter footprints inside human footprint left in the night between 31 December 2018 and 1 January 2019 (10 Euro cent coin for scale)

This meant that the same otter (possibly female), visited our study area during December 2018 and also during the night between 31 December 2018 and 1 January 2019.

Other evidence of otter presence in the Mercure-Lao came from spraints found frequently on a rock in the river, where our surveys had more than 70% positive results. This was situated some hundreds of metres North of the beach with many footprints mentioned above. By visual inspection of some of these spraints it was confirmed that the otters mainly feed on fish, but amphibians, crabs and birds are also taken (Figure 6). This has also been described and carefully analysed in the scientific literature, such as **Natchev et al. (2015)**.

A

B

Figure 6. Otter spraints found at an otter latrine site in the Mercure-Lao River in August 2015 (A), August 2017 (B left) and July 2018 (B right)

Figure 7. Eurasian otter (probably adult or subadult) photographed by A. Galiano in 2015 during a river rafting trip

Despite the typical crepuscular habits of otters in freshwater habitats, an otter (probably an adult or subadult individual) was seen and photographed in daylight by Mr Antonio Galiano during a river rafting trip in July 2015 (Figure 7). To the best of our knowledge, this is the first report in a scientific paper of a photographed otter in the Mercure-Lao River.

Even more recently, in November 2018, an otter cub (Figure 8) was found near the Lao mouth, not far from an urban zone.

Figure 8. Eurasian otter cub (three-month-old female) found in November 2018 near the mouth of the Mercure-Lao River

Note: These photos are a kind gift of WWF Policoro Herakleia Centre headed by A. Colucci and G. Cirelli.

This cub, a three-month-old female, had probably lost her mother after local flooding in the river which followed intense rain in preceding days. After initial care provided by the staff of WWF Policoro Herakleia at their wildlife care centre (in the Basilicata region), the cub was transferred to the specialised otter centre in Caramanico (Centro Lontra, Abruzzo) where she is currently growing under appropriate conditions to prepare this young otter for her future release into the wild.

DISCUSSION

Taken all together, even though mainly limited to a restricted area, the above evidence testifies that a population of otters survives in the Mercure-Lao area. We have examined mainly footprints of otters found in a short but central tract of the river since 2005, where the presence of the mustelid was ascertained in 60–70% of our surveys. By comparing track sizes we could conclude that the study area is populated by different otter individuals, mainly those having 6cm-wide tracks (probably females and/or subadult males), but also larger otters (probably males), as well as mothers with their cubs.

The river habitat is of great importance for the conservation of otters, and human activities using waters from the initial river tract (Mercure) should be given due attention in order to ensure that the habitat is not affected. In addition to the obligatory studies and authorisations necessary for such activities, more work should be carried out by otter specialists to obtain more quantitative data on the population and compare this with the data collected by the team of Prof. Prigioni up until 2002. Until this is done, the above-mentioned activities should not be authorised.

Encouraging signs come from the interest of local people in the protection of the otter. Recently there have been articles published in local newspapers, and following otter sightings in the Argentino river (one of the most important tributaries of Mercure-Lao River), there have been appeals to the Italian Ministry for Environment and Pollino National Park President asking for more concrete actions for habitat protection in the area in the interest of the otters (**Ansa 2018**).

LIMITATIONS

The data obtained by measuring the widths of the footprints cannot be used to give a precise sex. If the print is more than 7cm it is probably male but between 6 and 7cm it could be a female or subadult male. However, where there are prints with a clear difference in size it can be assumed that there is more than one individual. Where the track was of two individuals, one larger and one small, it can be assumed it is mother and cub.

Population figures quoted have been largely obtained from spraint survey but it has been demonstrated that the number of spraints or sprainting points is not related to population size (**Yoxon & Yoxon, 2014**). However, this method has been used in many studies and is often used as a baseline figure.

Otter footprints can sometimes be confused with mink but as there are no mink in this area, this is not a limitation.

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DISCLOSURE STATEMENT

No potential conflict of interest was reported by the authors.

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ERRATUM. We apologise that in the OTTER, Journal of the International Otter Survival Fund Volume 3, an author's name was not spelled correctly. The name should have read Jyoti Bhandari not Bandhari, "Developing the Nepal Otter Network". Apologies to Jyoti.

COVER PHOTO CREDITS:
Top - Smooth coated otter *(Lutrogale perspicillata)*, Photo: Prof MM Feeroz
Centre - Eurasian otter *(Lutra lutra)*, Photo: Chaminda Jayasekara
Bottom - Spotted-necked otter *(Hydrictis maculicollis)*, Photo: Derek Keats

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