NOTE FROM THE EDITOR

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Dear Friends, Colleagues and Otter Enthusiasts!

It has become a habit that we open the 2nd issue of the year sometime in April and this year is no exception, as we are opening issue 40/2 of this year. So now it is up to you to come back and see whether my promise that we have interesting manuscripts in the pipeline is true.

Those of you that are regular visitors to the site may have also observed that Lesley recently put updated versions of three literature compilations provided by Victor Camp online. I am very thankful for this very useful service and appreciate the work that Victor puts into these special issues.

I want to thank Gerard Schmidt and Claudio Chéhébar for their translations of the abstracts into French and Spanish. However, I want to mention that they often also spot inconsistencies and have helped to improve manuscripts in the last moments. Again we have several manuscripts with additional abstract translations and I want to encourage authors to provide me the abstract in your local language as I know this may be important for politicians but also for outreach to local communities.

I want to express my personal gratitude to Lesley who is correcting language issues, makes sure that references in the text and the list of references are complete. I know how much time Lesley puts into this service for our community. Lesley, thank you so much to make this journal an increasing success.

R E P O R T

INTERACTIONS BETWEEN FISHERMEN AND SMOOTH-COATED OTTERS (*Lutrogale perspicillata*) IN THE TAPTI RIVER OF SURAT DISTRICT: A CASE STUDY ON CONFLICT MITIGATION

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Abstract: The Smooth-coated otter (*Lutrogale perspicillata*) is a vulnerable mammal found in South Asia and Southeast Asia. The Tapti River, flowing within Gujarat, is home to many fishes, reptiles, birds, and thousands of other creatures. Smooth-coated Otters living in the Tapti River is threatened by a number of factors, including conflict with fishermen. As fishering communities depend on the Tapti River for their livelihood, this has led to trapping, poisoning, and hunting of otters as they have been causing economic loss by preying on fish catches and damaging the nets. To understand the nature and extent of this negative interaction, and the impact that it has on local fishermen, Nature Club Surat, Wildlife Trust of India and Gujarat Forest Department conducted interviews and surveys. As a part of the pilot project started by NCS and WTI to create a compensation policy, fishermen were reimbursed for their economical loss. Sensitization programs for otters among the fishering community, and compensating their losses caused by otter, is having a positive effecton the conservation of the species.
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Keywords: Fishermen-otter interaction, Smooth-coated otter, Compensation policy, India.

INTRODUCTION

Human-animal interactions and conflict is well documented across the world. A high conflict ratio can be observed if the humans and animals compete for the same resources (Freitas et al., 2007). In India, fisheries and aquaculture are important sectors of the food industry, and increasing growth in the sector is creating conflict with animals and birds thath are dependent on fish. Among three species of otters found in India (Menon, 2014), the Smooth-coated otter (*Lutrogale perspicillata*) is found in Gujarat (Suthar et al., 2017). Trivedi and Joshi (2018) reported conflict between fish

farmers and otters in Surat. Similar kinds of fishermen-otter conflict have been reported for African clawless otters (Ergete at al., 2018), Giant otters (Gómez and Jorgenson, 1999; Roopsind, 2002; Carrera, 2003; Rosas et al., 2003; Gómez, 2004; Zucco, 2004; Carrera-Ubidia, 2007; Recharte et al., 2008; Rosas-Ribeiro et al., 2011), Spotted-necked otters (Akpona et al., 2015) and Eurasian otters (Václavíková et al., 2011).

The present study reports the negative interaction between Smooth-coated otter (*Lutrogale perspicillata*) and fishermen in the Tapti river of Surat, and strategies used for mitigation. Riverine fishermen prefer gillnet fishing over many other techniques (Petrere, 1978; Batista et al., 1998; Crampton et al., 2004) as it provides them time to do other activities after setting gillnets in the water (Freitas and Rivas, 2006).

In Surat, fishermen leave the gillnets overnight in the Tapti river and check the nets every morning for the catch. In last few years, otters have been reported preying on the netted fish from gillnets. While preying on netted fishes, otters cause extensive damage to the nets (Fig. 1). The nets are torn apart and destroyed completely by otters in 4-8 weeks. Previously, Giant otter and African-clawless otter have been reported to feed on netted fishes and damage gillnets (Ergete et al., 2018; Rosas-Ribeiro et al., 2011). Due to the economic losses caused by damaged nets, fishermen are documented using various ways to eliminate otters from the fishing areas. During this study, we found poisoned fishes, a cage trap, and evidence of intentional habitat destruction done by fishermen to eliminate the otter population. In India, Smooth-coated otters are protected under schedule II of the Wild Life (Protection) Act, 1972. Any attempt to harm or kill is a punishable offense under Section 9(1) of WPA 1972. The species is listed in appendix I of CITES (CITES, 2019) and stated as vulnerable in the IUCN Red List (de Silva et al., 2015).

Figure 1. Fishing nets torn by otters.

METHODS AND MATERIALS

Data was collected between 2015 and 2019 from four locations in Surat city. Negative interactions with otters were investigated by interviewing and assisting fishermen in their daily fishing activities. Interviews with fishermen gave a summary of the current scenario. Fishermen explained all the measures taken to avoid otters damaging their nets. Some of the ways used to eliminate otters from their fishing ground

were harmful, such as trapping (Fig. 2) and poisoning (Fig. 3). All the interviews were oral and informal. A team of volunteers was formed alongside fishermen, and surveys were done on boats to cover otherwise unapproachable land around the river. A camera trapping exercise was conducted from November 2018 to February 2019 to confirm the presence of otters at the conflict sites (Fig. 4). Four infrared camera traps of Cuddeback X-change IR model were used for the study.

Figure 2. Cage trap on the small beyt (Small Island)

Figure 3. Poisoned fish left for otter on the beyt (Small Island)

Figure 4. Camera trapping at the fishermen-otter conflict sites

RESULTS

In the initial phase of the project, a preliminary survey was conducted in conflict-affected areas to understand the current scenario. The interactions/informal interviews (n=36) with the fishermen provided insightful information about otter distribution in the study area and the damage caused by them. Many fishermen (n=26) reported nets being damaged by otters during their everyday fishing activity. Some nets were partially torn while some were ripped to shreds and left unusable. As well as economic losses due to torn nets, fishermen also faced catch loss, where fish were preyed on by otters. Two otter bite cases were also reported during the survey from the Rander area of Surat. Similar otter bite cases are also reported in other parts of India. (Govind and Jayson, 2018; Thakor, 2015). Otter presence was confirmed on the basis of camera trap photos, direct sightings and indirect signs.

DISCUSSION

The present study provides insights of fishermen-otter interaction in Surat district. The study also provided baseline data for otter conflict, otter ecology, potential threats, and conservation status. At the beginning of the study, all the fishermen considered otters to be a potential threat to their livelihood. The fact that Smooth-coated otters' predatory behavior is quite conspicuous facilitates mental construction of a relationship between these animals and any problem related to fish depletion. Thus, the negative interactions between fishermen and otters were noteworthy and need to be addressed.

After surveying the human-otter conflict situation, the project focused on changing the perception of fishermen about otters and involving them in otter conservation. Sensitization programs were conducted with the fishing community to make them aware about the importance of otters. Later on, a few of them were trained to use camera traps for documenting otters. This newly formed group of fishermen was named "Team Otter Watch".

A workshop on Human-animal conflict was organized by Nature Club Surat, Wildlife Trust of India, and the forest department. A session on the importance of otters in Surat and their interactions with fishermen was presented during the workshop. On the occasion of World Wildlife Day 2019, fishing nets and appreciation certificates were distributed to the fishermen (Fig. 5) who were helping us in carrying out activities such as camera trapping, locating otters, boat surveys, interviews, short film documentation, and many other activities for the conservation of otters in Tapti River. The nets were distributed under *ex gratia* support from Nature Club Surat, Wildlife Trust of India, and the Gujarat Forest Department as compensation for nets damaged by otters. Some fishermen joined the seasonal job of removing water hyacinth from the Tapti River under Surat Municipal Corporation, which helps in keeping the riverine habitat healthy.

Figure 5. Distribution of nets and certificates to the fishermen

These initiatives acted as a mediator for all the stakeholders and everyone played a vital role in the species conservation. The forest department has taken the issue forward to the state government for starting/granting a compensation policy. Other identified threats such as habitat destruction, sand mining, poaching, etc are needed to be addressed as well. Negative interaction between fish farms or aquaculture farm owners and otters is a serious concern and a proper study needs to be done to assess the threat level. In European countries, compensation for economic loss, and use of electrical fencing around small lakes and ponds, is used most frequently for mitigating/avoiding predation of fishs (Leblanc, 2003; Jay et al., 2008). The activities done under this project will continue in the future and efforts shall be made to develop a proper conservation strategy to save this elusive and important animal species.

CONCLUSION

In a broader sense, the objective of this study was to establish an example for species conservation and to reduce human-animal conflict in a human-dominated habitat. It is critical that conservation education be linked to the livelihoods of local people in order to ensure local support for better management of human-wildlife conflict. A well-planned and long-term comprehensive communication strategy should be designed to obtain effective results. The duties of the administration, the media, the general public, and decision-makers should all be considered and tailored during the conflict situation.

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RÉSUMÉ

INTERACTIONS ENTRE LES PÊCHEURS ET LA LOUTRE A PELAGE LISSE (*Lutrogale perspicillata*) DANS LA RIVIERE TAPTI DU DISTRICT DE SURAT : UNE ETUDE DE CAS SUR LES MESURES D'ACCOMPAGNEMENT DES CONFLITS

La loutre à pelage lisse (*Lutrogale perspicillata*) est un mammifère vulnérable que l'on trouve en Asie du Sud et du Sud-Est. La rivière Tapti, qui coule dans le Gujarat, abrite de nombreux poissons, reptiles, oiseaux et des milliers d'autres espèces . La loutre à pelage lisse qui vit dans la rivière Tapti est menacée par un certain nombre de facteurs, dont les conflits avec les pêcheurs. Comme les communautés de pêcheurs dépendent de la rivière Tapti pour leur subsistance, cela a conduit à la capture, l'empoisonnement et la chasse des loutres qui sont à l'origine de pertes économiques par prédation des prises de poisson et dégradation des filets. Afin de comprendre la nature et l'étendue de cette interaction négative, et l'impact qu'elle a sur les pêcheurs locaux, le Club Nature de Surat (CNS), le « Wildlife Trust of India » (WTI) et le Département des Forêts du Gujarat ont mené des entretiens et des enquêtes. Dans le cadre d'un projet pilote lancé par le CNS et le WTI en vue de lancer une politique d'indemnisation, les pêcheurs ont

été remboursés de leur perte économique. Des programmes de sensibilisation de la communauté des pêcheurs aux loutres et la compensation des pertes causées par les loutres ont permis la préservation de l'espèce.

RESUMEN

INTERACCIONES ENTRE LOS PESCADORES Y LA NUTRIA LISA (*Lutrogale perspicillata*) EN EL RÍO TAPTI, DISTRITO DE SURAT: UN ESTUDIO DE CASO SOBRE LA MITIGACIÓN DE CONFLICTOS

La nutria lisa (*Lutrogale perspicillata*) es un mamífero vulnerable que se encuentra en el Sur y Sudeste de Asia. El Río Tapti, que discurre por Gujarat, es hogar para muchos peces, reptiles, aves, y miles de otras criaturas. Las Nutrias Lisas que viven en el Río Tapti están amenazadas por un número de factores, incluyendo el conflicto con los pescadores. Como las comunidades de pescadores dependen del Río Tapti para su subsistencia, eso condujo a captura, envenenammiento, y caza de las Nutrias ya que éstas han venido causando pérdidas económicas, al depredar los peces capturados y dañar las redes. Para entender la naturaleza y magnitud de ésta interacción negativa, y el impacto que tienen sobre los pescadores locales, Nature Club Surat (NCS), el Wildlife Trust de India (WTI) y el Departamento Forestal de Gujarat condujeron entrevistas y relevamientos. Como parte de un proyecto piloto comenzado por NCS y WTI para comenzar una política de compensación, los pescadores fueron reembolsados por sus pérdidas económicas. Los programas de sensibilización entre la comunidad de pescadores, y la compensación por sus pérdidas económicas causadas por las nutrias, ayudaron a la conservación de la especie.

R E P O R T

THE OTTER IN AN ARID ZONE - LAKE JORF TORBA, SOUTHWEST ALGERIA: ECOLOGY, DIET AND BEHAVIOR

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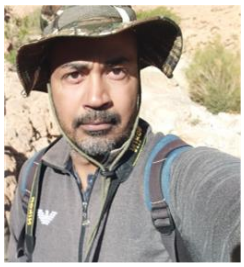

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Abstract: Global warming, anthropological activities, water pollution, integration of non-indigenous species, these factors profoundly influence the biodiversity of Lake Jorf Toba in southwestern Algeria. The environment is becoming more arid, with long heat waves and less precipitation. The conservation of endangered arid zone species is a big challenge, especially if we are talking about a semi-aquatic animal like the Eurasian otter (*Lutra lutra)*. The study aims to evaluate the situation of otters in arid environments such as Lake Jorf Torba. Our data showed the existence of *Lutra lutra* in the lake, which is an index of food and shelter availability. The major otter forage was *Barbus antinorii*, *Hypophthalmichthys molitrix*, *Cyprinus carpio*, and some arthropods. The otter preferred a rocky shelter to protect itself from the wind, cold and high temperatures. Our observation confirms that the *Lutra lutra* has always existed in the lake, but during our tracking, we noticed the mortality of two otters. Otters in lake Jorf Torba are a small population, which needs to be protected, and a serious conservation approach should be adopted.

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Keywords: Lac Jorf Torba, Otter, *Lutra lutra*, Conservation, Biodiversity, Arid zone

INTRODUCTION

The arid zones and the desert of Algeria are characterized by a hostile climate, very low precipitation, high temperature, and winds which can be strong; in these conditions, flora and fauna are restricted to number of species.

The Saharan flora is adapted to hostile conditions, and there are a few hundred families of plants in the south-west of Algeria belonging mainly to chamaephytes and therophytes (Guenaia et al., 2019). Oases are the only places where the fauna can develop into a species-rich community, but it is often also a site of human gathering. Anthropogenic action has impacted the number of oases, which limits potential otter habitat. However, the construction of dams such as the Jorf-Torba dam, 40 km southwest of Bechar, provide water and offers a favorable environment for animals to settle, and a resting site for migratory birds.

The Jorf-Torba dam has become a unique artificial lake in the south-west region of Algeria. Its freshwater is supplied by Wadi Guir (from the Moroccan Atlas) and this allows colonization by water animals.

The Eurasian Otter *Lutra lutra* is categorised as Near Threatened, under the A2c criterion, on the IUCN Red List of Threatened Species (Roos et al, 2021). The first otter record from the arid lands in south-west Algeria was in Igli, south of Jorf-Torba, in 1966 (Dupuy, 1966), before the building of the Jorf-Torba dam. Another record comes from 2009 (Khetar et al., 2009).

This species has been documented in arid and semi-arid zones in Morocco and Tunisia (Macdonald and Mason, 1984), Syria (Jacques, 1998), Jordan (Karami et al., 2006), Iran (Mirzaei et al., 2010), and Iraq (Al-Sheikhly and Nader, 2013). Little information is available on the status of the otter and its environment in Algeria. Libois et al. (2015 *b*) studied the otters of Kala in the north of the country. The only study in the south is that of Khetar et al. (2010). The objective of the present study is to evaluate the status of the Eurasian Otter in Lake Jorf Torba, in the context of its environment in the lake.

STUDY AREA

Figure 1. Aerial image of Jorf Torba Lake

The study was centered on a sector of the Jorf Torba Dam (reservoir) in the northwest of Algeria, 40 km west of Bechar: 31°25’46’’N 2°40’11” W (Fig. 1). Jorf Torba dam is an artificial lake that supports wetland fauna and flora (Fig. 2, 3). The dam receives its water mainly from Oued (=River) Guir; starting from the

Moroccan Atlas, the Oued Guir runs for more than 600 km, passing through lake Jorf Toba, then joining the Oued Zouzfana north of Igli (south of province of Bechar around 250km from the Moroccan atlas), where together they form the Oued Saoura (Kabour et al., 2015). Lake Jorf Torba keeps ample water throughout the year. The Saharan zone is characterized by a high temperature which has a direct influence on the reservoir size. The heat period begins practically on the first of June, to extend until September (Coyne et Bellier, 1985). Temperatures are coolest between December and February. Annual rainfall at Jorf Torba was 9-49 mm (Mekkaoui, 2012), but it has decreased in the subsequent decade (Fig. 4).

Figure 2. Jorf Torba dam

Figure 3. Riparian vegetation in Jorf-Torba area

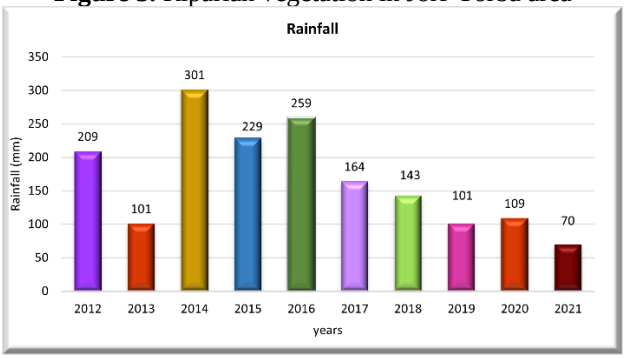

Figure 4. Frequency of rainfall in Bechar in the last decade (2012-2021)

The most abundant fish in Jorf Torba are *Barbus antinorii*, *Hypophthalmichthys molitrix* and *Cyprinus carpio*. Arthropods include the beetle *Blaps gigas*. These are eaten by the otter population of Lake Jorf Torba (Khetar et al., 2009, Nait-Larbi and Sellami 2011). The vegetation is mostly riparian, growths of *Ephedra alata, Tamarix* sp., *Launaea* sp., *Hammada* sp., and others (Table 1).

Table 1: Abundant plants species growing around the lake Jorf -Torba

Family	Species
Anacardiaceae	*Rhus tripartitae*
Rhamnaceae	*Ziziphus lotus*
Tamariacaceae	*Tamarix articula /Tamarix gallica*
Cistacae	*Helianthetum lipii*
Chenopodiacae	*Atriplex halimus*
Asteraceae	*Artemisia herba alba* *Launea arbroscens*
Brassicaceae	*Zilla mecroptera spinosa*
Amaranthaceae	*Anabasis aretioides* *Traganum nudatum* *Haloxylum scoparium* Anabasis aretioides
Ephtedraceae	*Ephedra alata*
Euphorbaceae	*Euphorbia Guyoniana* *Ricinus communis*
Globulariacae	*Globularia alypum*

Survey

The observation of otters was focused on otter spraints and/or footprints. The presence of otters was tracked from Afar in Lake Jorf Torba in January 2020 and August 2021. During this period, the temperature was 3 °C higher than expected (December to February), when it should have been colder and frosty.

RESULTS AND DISCUSSION

Combining records of footprints and observation of the animal, Lake Jorf Torba may hold about six otters (3 young otters were photographed, plus 1 male and 1 female and ± one more otter). Some otter activity is by night. All otters were close to the dam (Fig. 5), where the otter's shelters were detected in rocky spaces (Fig. 6, 7), a refuge from the wind, cold, and heat. This observation corroborates other studies such as Kruuk (2006), which mentioned otters can use cavities as shelter.

figure 5. Distribution of otters in Lake Jorf Torba (province Bechar): Blue points represent the occurrence of otters.

Figure 6. The Otter (*Lutra lutra*) in Lake Jorf Torba January 2021

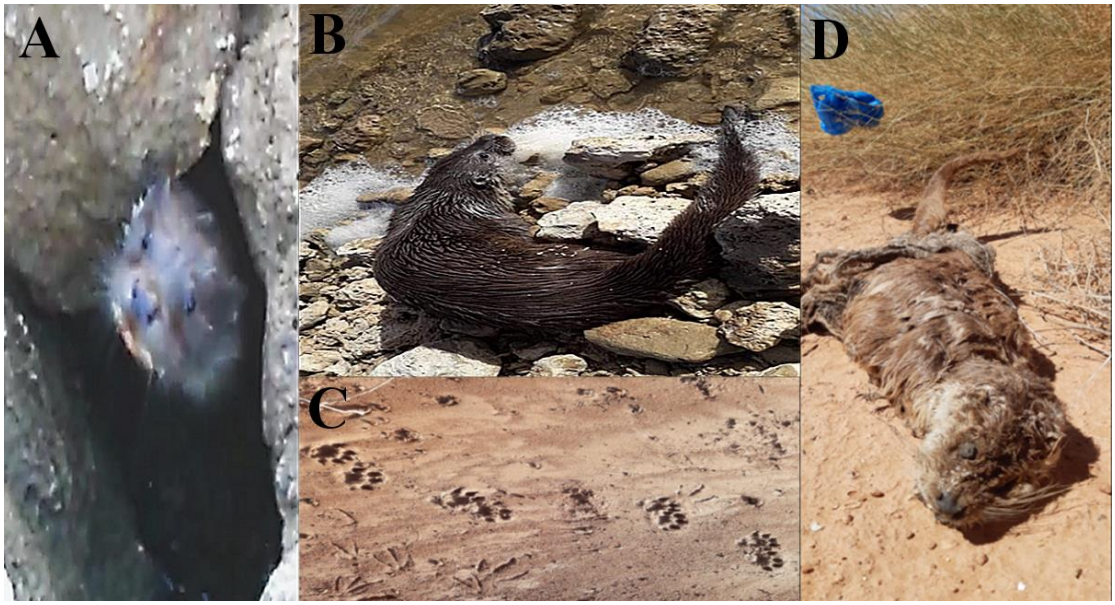

Figure 7. The otters in lake Jorf Torba; A) Otter in rock shelter (January 2021); B) Otter at lake shore 08 August 2021; C) Footprint of otters in Jorf Torba area; D) An otter found dead.

In addition to Lake Jorf Torba, the otter can be found in two other sites: The Abdala dam is 80 km and Igli (Oued zouzfana) is 150 km south of Bechar, where they have been reported by witnesses for years (pers. comm.). However, flooding is getting scarcer than usual. Droughts are becoming more frequent, and the level of the water in Lake Jorf Torba is seriously decreasing. On 15 July 2022, the authorities declared that

the dam is completely unusable (Fig. 8). Dams upstream on the Oued Guir and Oued Zouzfana, the source of Lake Jorf Torba, reduce water supply to Jorf Torba, and may threaten the existence of the Eurasian Otter and the lake's wetland ecosystem. Such dams include Kaddoussa dam, Douisse dam, Oued Zelmou dam and Kheng Alhalouf dam in Morocco.

Figure 8. Situation of drought in lake Jorf Torba (15th July 2022)

Human persecution is also an issue for this population of the Eurasian otter. Otters have been taken by traps in the southwest but people do not use the animal's fur.

Consideration has to be given to list Lake Jorf Torba as a wetland site of international importance under the Ramsar convention, to conserve the ecosystem existing in this area, in collaboration with Morrocan ecologists.

Conflict of Interest: The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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RESUMÉ

LA LOUTRE EN ZONE ARIDE, LAC JORF TORBA AU SUD-OUEST DE L'ALGÉRI: ÉCOLOGIE, ALIMENTATION ET COMPORTEMENT

Le réchauffement climatique, l'activités anthropologiques, pollution de l'eau, et l'intégration d'espèces non autochtone, Tout ces facteurs influencent profondément la biodiversité du lac Jorf Toba dans le Sud-Ouest de l'Algérie, l'environnement devient plus aride, de longues vagues de chaleur et moins de précipitations. La conservation des espèces menacées dans les zones arides est un grand défi, surtout s'il s'agit d'un animal semi-aquatique comme la loutre Loutre eurasienne *Lutra lutra* à Jorf Torba. L'étude vise à évaluer la situation des loutres dans un environnement aride tels que le lac Jorf Torba. Nos données ont montré l'existence de *Lutra lutra* dans le sud-ouest de l'Algérie dans le lac Jorf Torba, qui est un indice de disponibilité de nourriture et d'abris. Le principal fourrage de la loutre était *Barbus antinorii*, *Hypophthalmichthys molitrix, Cyprinus carpio* et certains arthropodes. La loutre préfère un abri rocheux pour se protéger du vent, du froid et des températures élevées. Notre observation confirme que *Lutra lutra* a toujours existé dans le lac, mais lors de notre repérage, nous avons

récupéré deux corps de loutres. La loutre dans le lac de Jorf Torba est une petite population qu'il faut la protégée et adopter une approche de conservation sérieuse.

RESUMEN

LA NUTRIA EN EL LAGO JORF TORBA, DE LA ZONA ÁRIDA DEL SUDOESTE DE ARGELIA: ECOLOGÍA, DIETA Y COMPORTAMIENTO

El calentamiento global, las actividades antrópicas, la contaminación del agua, la integración de especies no-nativas, todos éstos factores influyen profundamente sobre la biodiversidad del Lago Jorf Torba, en el sudoeste de Argelia; el ambiente se torna más árido, con largas oleadas de calor y menos precipitación. La conservación de especies amenazadas en las zonas áridas es un gran desafío, especialmente si estamos hablando de un animal semi-acuático como la nutria Eurasiática *Lutra lutra* en Jorf Torba. El estudio está dirigido a evaluar la situación de las nutrias en ambientes áridos como el Lago Jorf Torba. Nuestros datos mostraron la existencia de *Lutra lutra* en el sudoeste de Argelia, Lago Jorf Torba, lo que indica que hay disponibilidad de alimento y refugio. Los principales alimentos de la nutria fueron *Barbus antinorii*, *Hypophthalmichthys molitrix*, *Cyprinus carpio*, y algunos artrópodos. La nutria prefirió refugios rocosos para protegerse del viento, el frío y las altas temperaturas. Nuestra observación confirma que *Lutra lutra* siempre ha existido en el lago, pero durante nuestro seguimiento, notamos la mortalidad de dos nutrias. La nutria en el lago Jorf Torba tiene una población pequeña, que necesita ser protegida, y debería adoptarse un enfoque serio de conservación.

ملخص

الاحتباس الحراري، الأنشطة الإنسانية، تلوث المياه، تكامل في وجود أنواع حيوانية المهاجرة، تؤثر هذه العوامل بعمق على التنوع البيولوجي لبحيرة الجرف تربة في الجنوب غربي للجزائر، وأصبحت البيئة أكثر جفافاً، وموجات حر طويلة المُدة، وقلة هطول الأمطار. يعتبر الحفاظ على الأنواع المهددة من الانقراض في المنطقة الصحراوية تحديًا كبيرًا، خاصةً إذا كان حيوانًا شبه مائي مثل ثعالب الماء الأورأسي "*Lutra lutra*" في بحيرة جرف التربة. تهدف الدراسة إلى تقييم حالة ثعالب الماء في البيئة الجافة مثل بحيرة جرف التربة. أظهرت بياناتنا وجود *Lutra lutra* في الجنوب الغربي للجزائر في بحيرة الجرفة تربة، وهو مؤشر لتوفُر الغذاء والمأوى. و يتمثَل غذائها ف Barbus *antinorii* و *Hypophthalmichthys molitrix* و *Cyprinus carpio* وبعض المفصليات. يفضل ثعالب الماء المأوى الصخري للحماية من الرياح والبرد ودرجات الحرارة المرتفعة. تُؤكد ملاحظتنا أن *Lutra lutra* كانت موجودة دائمًا في البحيرة، ولكن أثناء الدراسة الذي أجريناها، لاحظنا وجود جثتين من ثعالب الماء. ثعالب الماء في بحيرة جُرف التُربة هي مجموعة صغيرة تحتاج إلى الحماية وهناك حاجة مُلحة إلى إستراتيجية ناجعة للحفاظ عليها.

R E V I E W

REPORTED WORLDWIDE OTTER ATTACKS ON HUMANS OVER THE LAST DECADE (2011-2021): DICTATED BY HUMAN ENCROACHMENT OR OTTER BEHAVIOR?

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Abstract: Otter species populations are negatively impacted by human encroachment. This can result in habitat loss as well as close encounters with humans, which are often perceived by otters as a threat. Whether this results in otters attacking humans was confirmed in a historic review of worldwide reported incidences up to 2010. However, whether these incidences have escalated since then is unknown and lead to this current review (2011-2021). Otter attacks on humans were recorded geographically and chronologically in both wild and captive environments. The goal was to identify frequency and severity of these attacks and document human activities that may have triggered them. Over this 10-year period, this review identified 20 reports, 3 of which were in captive environments. Similar to the previous findings, the majority of attacks continue to be reported from North America, and more specifically the USA. Water related activities by humans were identified in 53% of such attacks, not surprising as this is the environment where otters primarily reside and hunt. Of the humans attacked, 59% were preventatively treated, of which, only two cases reported suspected rabid otters. Clearly there continues to be issues related to human encroachment on otter habitat that warrants continued monitoring and attention.
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Keywords: global, bite, scratch, temporal, activity, proximity

INTRODUCTION

In all animals, behaviors may be influenced by their niche, defined as the physical and environmental conditions they require to thrive, as well as interactions with other species. Therefore, it is important to understand otter's role in their ecosystem, which can help appreciate what could be at the root of any unexpected human-otter interactions. Some species of otters involved in human interactions include river otters in North America (*Lontra canadensis*) or Eurasia (*Lutra lutra*), Smooth-coated otter (*Lutrogale perspicillata*), and giant otter (*Pteronura brasiliensis)*, each present in

different regions of the world (Groenendijk et al. 2021; Khoo et al., 2021; Loy et al 2022; Serfass 2021). River otters live in Eurasia (Loy et al 2022), North and Central America (Serfass 2021), Smooth-coated otters live in Southern Asia (Khoo et al., 2021), and giant otters live in northern central South America (Groenendijk et al. 2021). Commonly otters inhabit terrestrial, freshwater, and marine environments (Groenendijk et al. 2021; Khoo et al., 2021; Loy et al 2022; Serfass 2021). All species prey on fish, while each species will additionally hunt snakes, amphibians, turtles, and crustaceans (Groenendijk et al. 2021; Khoo et al., 2021; Loy et al 2022; Serfass 2021). River otters have an exceptionally diverse diet, where they occasionally hunt mice, birds, squirrels, and dogs (Loy et al 2022; Serfass 2021). Diets may be indicative of the otter's location, where otters may enter forests, open waters, or residential locations to hunt for food, and increase their human contact. In the wild, both the river and smooth coated otter live up to approximately 10 years (Khoo et al., 2021; Loy et al 2022; Serfass 2021), while the giant otter up to 13 years (Groenendijk et al. 2021; Wikipedia[a] 2022). River otters breed December to April (Serfass 2021), while Smooth-coated otters breed year-round (Khoo et al., 2021), and giant otters July-September (Groenendijk et al. 2021). Each species gestation period is approximately 65 days. Invasive human activity into otter habitat may disrupt the otter's niche and initiate defensive behaviors in response to perceived threats, whether humans intend to harm otters or not.

With stressors such as climate change and the continued expansion of humans into wildlife habitat, the impact of these on both the humans and otters should be closely monitored and action taken to minimise such stressors. Specific threats that could impact otter populations include residential and commercial development, agriculture, aquaculture, biological resource use, natural system modifications, transportation, invasive species, disease, energy production, mining, climate change, and pollution (Groenendijk et al. 2021; Khoo et al., 2021; Loy et al 2022; Serfass 2021). All of such threats become increasingly severe with human population increase, due to associative increase in human dispersion, and demand for earth's resources. In the last decade, the world's population has risen by approximately 1 billion people (Wikipedia[d] 2022), which could significantly increase encroachment into otter habitats, as well as worsen the other pre-existing threats to otter populations. Linked to this, otter populations continue to decrease, such that over the last 30 years, the smooth coated otter population has faced a decrease of 30%, and is expected to continue 30% more in the next 30 years (Khoo et al., 2021). The giant otter population has decreased more than 50% in the last 25 years, and is expected to continue to decrease another 50% in the next 25 years (Groenendijk et al. 2021). So not only are otters populations on a decline, but whether all these stressors could also result in negative interactions between humans and otters was confirmed in a worldwide historic review of documented otter attacks on humans, which found that majority of attacks involved the North American river otter, and occurred more often in Florida (Belanger, 2011). Furthermore, the review found that the greatest number of attacks were reported in the more recent years, indicating an escalation over time. Of the attacks, the report suggested that in 24-66% of cases, rabies was either confirmed or considered (Belanger, 2011). Additionally, the encroachment of expanding human populations into the otter's habitat appeared to be the leading cause for such defensive behavior (Belanger, 2011). Now, a decade later, to understand progression of previous findings, this review collected all reported human-otter attack information since 2010, with focus on attack quantity, severity, and geographic location. In assessing severity per attack, bite and scratch quantity, as well as associated medical treatment are compared. Additionally, this review will discuss the conditions

that are most indicative of attacks, species involved, victim qualities, and rabies occurrence.

MATERIALS AND METHODS

Data mining was conducted using internet resources utilizing terms including "otter attack" and "otter bite". Any otter-human incidents were recorded from all scientific, academic, and public media platforms. Of the twenty reported attacks since 2011, 90% were sourced from public media. The scientific literature accounted for only 10% or a total of two reports. Each attack was reviewed for any duplication in reporting across sources. Any duplicated reports of the same attack were examined for additional information, and sourced accordingly. The geographic distribution of wild otter attack data can be seen in Table 1, while the chronological events are highlighted in Table 2. Table 3 contains the captive otter attack data. Captive attacks were recorded separately from those reported to have taken place in the wild, where 17 attacks occurred in the wild (Tables 1, 2), and 3 attacks occurred in captivity (Table 3).

RESULTS

Geographical distribution of the available wild otter attack reports included India, Canada, USA, Scotland, and Singapore (Table 1). India and Singapore were grouped as Asia for a geographical analysis. The USA had 9 times more reported wild attacks than Scotland, 3 times more than Canada, and 2.3 times more than Asia. Of the attacks reported in the USA, 44% occurred in Florida.

Species distribution of these attacks between river, Smooth-coated and giant otters found that river otters were present in the attacks in North America only, with none in England where many Eurasian otters reside. Unsurprisingly, smooth-coated otters were only found present in attacks in Asia, since this is where the species resides. Smooth coated otters are the only species reported to attack in groups of two or more otters, and as many as 20 otters present in one attack. There were no giant otter attacks reported in the wild, only in captivity (Tables 1, 3).

Table 1. Geograpical distribution of otter attacks in the wild

Date (ref)	**Habitat**	**Otter (#)**	**Species**	**Victim Age (F/M)**	**Bite / Scratch**	**Treatment**	**Location**	**Activity**
July 2012 (Kalia)	Island Lake	1	RO	31yr F	25/-	Rabies Antibiotics	Canada (Manitoba)	Swim
August 2013 (Puri)	Greeny Lake	1	RO	Adult F	9/-	-	Canada (British Columbia)	Swim
Summer 2016 (Cheng;Kirkey)	Lake	1	RO	52yr F	y*/y *8 Sites 23 Punctures	Rabies Antibiotics Tetanus	Canada (Quebec)	Swim
September 2021 (Davenport)	Anchorage Pond	1	RO	9yr M	y/-	Rabies Booster	USA (Alaska)	Filming at water edge
2013 (Puri)	-	1	RO	96yr M	-/-	-	USA (Florida - Venice)	-
March 2018 (Bever)	Braden River	1	RO	77yr F Adult M	y/-	Rabies (s)	USA (Florida)	Kayak
February 2020 (Berkowitz)	House	1	-	Teen F Dog	y/-	Rabies (s)	USA (Florida)	Dog Chase

2021 (Connolly)	Driveway	1	RO	Adult F	y/-	Rabies	USA (Florida)	Warming Otter
July 2013 (Moran)	Washington State River	1	-	13yr F 11yr -	-/y	--	USA (New York)	Swing Rope Swimming
July 2014 (Assoc Press)	Pilchuck River	1	-	8yr M Old adult F	y/-	y	USA (Washington)	Swim
July 2021 (Hoyt)	Black Dan Lake	1	-	12yr F	y/y	Rabies	USA (Wisconsin)	-
August 2021 (Adams)	Big Hole River	Group	-	12yr M	y/-	Rabies Stitches	USA (Montana)	Floating Tubes
May 2017 (Barden)	Road	1	-	24yr M	y/-	-	Scotland (Glasgow)	Forestry Work
June 2011 (Govind)	Thrissur Forest - pond	1+	SCO	9yr M	y/-	Rabies	India (Kerala)	Playing in shallow water
September 2011 (Govind)	Vazhachal Forest canal	1+	SCO	13yr M	y/-	Rabies	India (Kerala)	Crossing canal
May 2021 (O)	Kallang River	20	SCO	77yr M	y/-	y	Singapore	Exercising near river
November 2021 (Cost)	Botanic Gardens River	Fam	SCO	Adult M	26/-	Tetanus Antibiotics	Singapore	Walking near river

Shaded reference = scientific source.
RO = River otter
SCO = Smooth-coated otter
– information not specified.
Y refers to "yes" but no further information was given.
(S) = suspected rabid animal (not confirmed).
Victims are human.

Captive otter attacks were only reported in the USA (Texas) and Europe (Germany) (Table 3). There were three such cases, all involved a giant otter, one in a zoo in Germany and the other two occurred in aquariums in Texas. Although there are smooth coated otters held in captive environments in the UK, as well as river otters in a number of facilities worldwide, no attacks on humans were reported from these captive species.

In comparison to the previous report that ended in 2010, across the 10-year (2011-2021) span examined (Table 2), the greatest number of reported otter-human attacks occurred in 2021. Seasonal variances were noted. Specifically, from January to December, the quantity of attack occurrence gradually increased, with peak attacks occurring in July, and decreasing gradually until December and January where there were no occurrences. When examining the captive data (Table 3), the attack at the German facility occurred in June, the other two in the USA (Texas) were in September and October.

The demographics of attack victims demonstrated that 53% of wild attacks involved youth under 20 years of age (Table 1), in comparison to 66% in captive attacks (Table 3). The severity of otter attacks can be assessed by contrasting the incidences when attacks involved scratches vs bites. For this report 88% of wild attacks involved bites vs 66% in captive attacks, clearly indicating significant severity. This was reinforced by the fact that when multiple bites were reported, they varied from 8 to as high as 26. Two attacks involved a suspected rabid animal but were not confirmed,

while 59% of wild attack victims were treated preventatively against rabies, and 24% of wild attack victims were treated further with antibiotics, tetanus, and/or stitches. For the captive events, there was only one case where the victim was preventatively treated for rabies.

Table 2. Chronological distribution of otter attacks in the wild

Date (ref)	**Location**	**Habitat**	**Otter (#)**	**Species**	**Victim Age (F/M)**	**Bite/Scratch**	**Treatment**	**Activity**
2011 June (Govind)	India (Kerala)	Thrissur Forest-pond	1+	SCO	9yr M	y/-	Rabies	Playing - shallow water
2011 September (Govind)	India (Kerala)	Vazhachal Forest canal	1+	SCO	13yr M	y/-	Rabies	Crossing canal
2012 July (Kalia)	Canada (Manitoba)	Island Lake	1	RO	31yr F	25/-	Rabies Antibiotics	Swim
2013 July (Moran)	USA (New York)	Washington State River	1	-	13yr F 11yr -	-/y	-	Swing Rope Swimming
2013 August (Puri)	Canada (British Columbia)	Greeny Lake	1	RO	Adult F	9/-	-	Swim
2013 (Puri)	USA (Florida – Venice)	-	1	RO	96yr M	-/-	-	-
2014 July (Assoc. Press)	USA (Washington)	Pilchuck River	1	-	8yr M Old adult F	y/-	y	Swim
2016 Summer (Cheng; Kirkey)	Canada (Quebec)	Lake	1	RO	52yr F	y*/y *8 Sites 23 Punctures	Rabies Antibiotics Tetanus	Swim
2017 May (Barden)	Scotland (Glasgow)	Road	1	-	24yr M	y/-	-	Forestry work
2018 March (Bever)	USA (Florida)	Braden River	1	RO	77yr F Adult M	y/-	Rabies (S)	Kayak
2020 February (Berkowitz)	USA (Florida)	House	1	-	Teen F Dog	y/-	Rabies (S)	Dog chase
2021 May (O)	Singapore	Kallang River	20	SCO	77yr M	y/-	y	Exercising near river
2021 July (Hoyt)	USA (Wisconsin)	Black Dan Lake	1	-	12yr F	y/y	Rabies	-
2021 August (Adams)	USA (Montana)	Big Hole River	Group	-	12yr M	y/-	Rabies Stitches	Floating tubes
2021 September (Davenport)	USA (Alaska)	Anchorage Pond	1	RO	9yr M	y/-	Rabies Booster	Filming at water edge
2021 November (Cost)	Singapore	Botanic Gardens River	Family	SCO	Adult M	26/-	Tetanus Antibiotics	Walking near river
2021 (Connolly)	USA (Florida)	Driveway	1	RO	Adult F	y/-	Rabies	Warming Otter

Shaded reference = scientific source.
RO = River otter
SCO = Smooth-coated otter
– information not specified.
Y refers to "yes" but no further information was given.
(S) = suspected rabid animal (not confirmed).
Victims are human.

Table 3. Chronological distribution of captive otter attacks

Date [ref]	Location	Habitat	Otter (#)	Species	Victim age (F/M)	Bite/Scratch	Treatment	Activity
2012 June (W,JC)	Germany (Hamburg)	Zoo	1	GO	56yr (F)	y/-	y	Cleaning bench
2019 September (Marfin)	USA (Texas)	Aquarium	1	GO	2yr (F)	y/-	Rabies	Child on parent shoulder
2021 October (NBCDFW)	USA (Texas)	Aquarium	1	GO	18mo (M)	-/y	-	Lifted to Otter

–information not specified.
GO = Giant otter.
Y refers to "yes" but no further information was given.
F: female; M: male. Victims are human.

The reported activities by the humans at the time of the wild attacks varied (Table 2) but revealed that 53% were directly water related. Specifically, 29% of wild attacks occurred while the victim was swimming with the other 24% involving 'on water' activities such as kayaking or tubing. In addition, 18% were activities beside the waters edge such as exercising or photography. Interestingly, ~12% occurred in residential environment, one attack (5%) occurred in a forest, while another ~12% did not provide any details.

DISCUSSION

Geographical findings of the otter attacks mimicked those from the 2011 review (Belanger, 2011), where most were found in North America, many occurring in Florida. Similarly, like the previous review, not surprisingly, most of the attacks took place in environments nearest to water including rivers, lakes, and a pond. Forests and lakes are commonly explored by humans, who are exercising, adventuring, spending time at the cottage, residential, or occupational activities. Otters commonly also live in such areas, therefore setting up the situation for a potential attack to occur when the human enters the vicinity of the otter's homeland. Approaching the vicinity of the otter's territory may occur in either of residential expansion in association with human population growth and dispersion, as well as the aforementioned recreational activities, both of which lead to encroachment of people into otter's habitats. River otters, who account for almost half of all wild otter attacks in Canada and the USA, reside across large and small bodies of water including lakes. Smooth-coated otters found in Asia, reside in large and small wooded areas near rivers including forests and are the only species reported to have attacked in groups of 2 or more. Though all otter species are social, and prefer to live in groups, the smooth coated otter species requires a group specific formation to hunt (Ladds et al., 2017). This method of hunting is used in smooth coated otter groups of up to 11 otters (Wikipedia[c], 2022), and especially in a V shape formation when swimming up stream (World Wildlife Fund – India, n.d.). This may be why the Smooth-coated otter was the only species for which attacks in groups were reported.

As well, wetlands have dramatically declined worldwide in the last few decades and continue to do so (World Wildlife Fund, 2018). With the decline of otter habitats, otter populations are forced beyond their familiar environments, and into proximity of humans, leading to increased human encroachment, threats, and attacks. It was notable

that England was the only country where otters are found in abundance that had no attacks reported. They have enforced strict otter protection regulations for otter conservation perhaps explaining the lack of reported attacks, as human encroachment might be minimized by these regulations (Natural England, 2011).

Seasonal conditions are also likely associate with attack frequency, as observed by the lack of reported attacks in October to April. Possibly the mid year months of May-September, when summer weather is prevalent, increases the likelihood of humans coming in contact with otters more frequently. As well, based on December-April breeding season, the 67% of river otters attacks during the months of July-September are also when young pups would be under protection of parent otters and human presence viewed as an even greater threat (Serfass, 2021).

Over half of human victims were under the age of 20 and female. The youth unawareness of surroundings may contribute to more invasively unaware activity. As well, the fact that most victims were bitten more than once, suggests defense behavior rather than just a warning. Interestingly, in this current review, preventative measures were taken in over half of the cases. It is possible that, though there were no deaths, the overall severity of attacks has increased such that medical attention was required.

In captivity, it would have been anticipated that the otter handlers would be attack victims in transporting and caring for the animals, not the public. Surprisingly, of attacks reported involved victims in captive environments, none were otter handlers. In the aquarium/zoo captive environment, there were only a few reports of attacks, and those were all with giant otters. Facilities that hold this species can be found in England, Germany and the USA (Wright, 2010), yet only the latter 2 countries had any reports of attacks. River otters are kept in captive environments in the USA, and Canada, however no reports of any attacks were found for this species in captivity (Smithsonian Natural Zoo & Conservation Biology Institute, n.d.; Toronto Zoo, n.d.). Smooth coated otters are also kept in captivity in England but also no reports of captive attacks were found (Wingham Wildlife Park, n.d.). Additionally, one would have anticipated wildlife rescue groups would have been a higher risk of otter attacks during retrieval, however, none were found in this subgroup anywhere in the world. It is possible such events go unreported as it is expected as part of rescuing and handling the otters, or that the staff are properly trained for handling the otters with care.

Finally, reports were predominantly recorded in media rather than scientific literature. Of attacks reported across all platforms, there are likely cases which go unreported, whether due to insignificance of injury, or an unwillingness to publicize such an event and this unfortunately is one limitation of the findings reported herein.

CONCLUSION

Otters will defend themselves if they feel threatened, as observed in the reported attacks. Human encroachment into otter habitat will obviously increase especially in the face of an increase of 1 billion people since 2011. Evidence for this encroachment is the fact that in 53% of wild attack cases, the human victim was engaged in a water related activity. Geographic distribution of the reports of such wild attacks was heavily weighted (71%) to North America, with just over half in the USA, more specifically 44% of which were in Florida. Seasonal effects on the frequency of attacks was also noted, peaking in July. A small number (15%) of attacks were in captive environments, where unexpectedly the victims were not otter handlers but the public. It is obvious that the incidences of otter attacks has not diminished since the previous report and that that human encroachment is at the root of most attacks. Clearly as humans are increasingly

coming in contact with otters, the public needs to be aware of otter habitat conservation and behaviors to reduce threats to otters to reduce or hopefully prevent further attacks.

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RESUME

LES ATTAQUES DE LOUTRES SUR L'HOMME SIGNALÉES AU NIVEAU MONDIAL AU COURS DES DIX DERNIÈRES ANNEES (2011-2021) SONT-ELLES DICTÉES PAR L'EXPANSION DE L'HOMME OU LE COMPORTEMENT DE LA LOUTRE?

Les populations d'espèces de loutres subissent les effets négatifs de l'expansion humaine. Cela peut entraîner une perte d'habitat ainsi que des rencontres proches de l'homme, qui sont souvent perçues par les loutres comme une menace. Si ces observations de loutres attaquant l'homme ont été confirmées dans une étude historique des incidents signalés dans le monde entier jusqu'en 2010. Cependant, on ne sait pas si ces incidents se sont intensifiés depuis lors, ce qui a conduit à l'étude actuelle (2011-2021). Les attaques de loutres contre les humains ont été enregistrées géographiquement et chronologiquement dans des environnements sauvages et captifs. L'objectif était d'identifier la fréquence et la gravité de ces attaques et de documenter les activités humaines susceptibles de les avoir déclenchées. Au cours de cette période de 10 ans, cette étude a identifié 20 attaques, dont 3 en milieu captif. Conformément aux conclusions précédentes, la majorité des attaques continuent d'être signalées en Amérique du Nord, et plus particulièrement aux États-Unis. Des activités humaines liées à l'eau ont été identifiées dans 53% de ces attaques, ce qui n'est pas surprenant, dans la mesure où c'est un environnement où les loutres vivent et chassent principalement. Parmi les attaques sur l'homme, 59% ont été traitées de manière préventive, et parmi celles-ci, il y avait seulement deux cas de loutres suspectées d'être enragées. De toute évidence, il continue d'y avoir des problèmes liés à l'expansion de l'homme dans l'habitat de la loutre qui justifient une surveillance et une attention continues.

RESUMEN

ATAQUES DE NUTRIAS A HUMANOS INFORMADOS MUNDIALMENTE A LO LARGO DE LA ÚLTIMA DÉCADA (2011-2021): ¿DICTADOS POR LA OCUPACIÓN HUMANA Ó POR EL COMPORTAMIENTO DE LAS NUTRIAS?

Las poblaciones de especies de nutrias son impactadas negativamente por la ocupación humana. Ésto puede resultar en pérdida de hábitat, así como en encuentros cercanos con los humanos, que a menudo son percibidos por las nutrias como una amenaza. Que ésto resulta en que las nutrias ataquen a los humanos, fue confirmado en una revisión histórica de las incidencias reportadas mundialmente, hasta 2010. Sin embargo, no se sabe si éstas incidencias han escalado desde entonces, lo que motivó la presente revisión (2011-2021). Registramos geográfica y cronológicamente los ataques de nutrias a humanos, tanto en ambientes silvestres como en cautiverio. De manera similar a los hallazgos previos, la mayoría de los ataques continúan siendo informados en Norte América, y más específicamente los EEUU. En el 53% de esos ataques, fueron identificadas actividades de los humanos relacionadas con el agua, lo que no sorprende ya que éste es el ambiente en el cual las nutrias primariamente residen y cazan. De los humanos atacados, el 59% fue tratado preventivamente, y de éstos, en solamente dos casos se reportó sospecha de nutrias con rabia. Claramente, continúa habiendo incidentes relacionados con la ocupación humana de los hábitats de las nutrias, lo que requiere de monitoreo y atención continuada.

SIGHTING

A RARE SIGHTING OF SMOOTH-COATED OTTER (*Lutrogale perspicillata*) IN THE MAHANADI RIVER, ODISHA, INDIA

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Abstract: The smooth-coated otter (*Lutrogale perspicillata*) is an apex predator and indicator species in the aquatic ecosystem. Herein, we report a rare sighting of this species based on photographic evidence from the Mahanadi River in the central part of Odisha state. Our report of this highly threatened species from the central part of the state has ecological significance and will aid in their conservation and management planning. We urge further surveys to obtain detailed information on their population status in the human-dominated area of this river basin. Historical context, traditional ecological knowledge and the research gap have been discussed.

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Keywords: *Lutrogale perspicillata*, Indigenous knowledge, photographic evidence, threats

INTRODUCTION

The Smooth-coated otter *Lutrogale perspicillata* (Geoffroy, 1826) is an elusive amphibious mammal distributed throughout the Oriental region (Hussain, 1993). It is a social species and prefers the wetland ecosystem, such as large rivers, lakes, swampy areas, mangroves, coastal areas etc. In recent few decades, due to several human introduced threats such as habitat loss, degradation, poaching, illegal trading, pollution and eutrophication of the aquatic bodies, etc., there has been a decline of >30% of their population (Khoo et al., 2021). As a result, the species have been enlisted in the "Vulnerable" category in the IUCN Red List of Threatened species. There are three species of otters, i.e., Smooth-coated otter (*Lutrogale perspicillata*), Eurasian otter (*Lutra lutra*) and Asian small-clawed otter (*Aonyx cinereus*) which are found in India, have already been reported in Odisha state (Palei et al., 2022; Palei et al., 2020; Adhya and Dey, 2020; Mohapatra et al., 2014). However, earlier reports of smooth-coated otters are primarily from the coastal zones of the Odisha state and the distributaries of this Mahanadi River (Acharjyo, 1999; Mishra et al., 2018; Palei et al., 2020; Adhya,

2020). Hence, our report from the hinterland of the state carries significant importance from the conservation perspective of this highly threatened species.

OBSERVATIONS

On dated 28th March 2022, during a field survey of the upstream areas in the Mahanadi River, two otters were sighted and photographed by a digital camera Nikon Coolpix P900™ (Fig. 3,4) at Hatagaon, Boudh (20.74870°N, 84.38819°E) (Fig. 1,2). The animals were identified as smooth-coated otters considering the reference guide of Menon (2017). The individuals were observed resting over the sandbank on the shoreline in the early hours of the day and were seen grooming, playing, and swimming for the next few minutes. The locality of Hatagaon is 40 km radial ca. upstream from the protected area of Satkosia Gorge Wildlife Sanctuary and nearly 150 km from the Chilika lagoon, the nearest published locality for the species. The river width at the present sighting place is 1400m, out of which 350m of the meandering water channel is on the right bank of the river, and the rest is covered by a large sandbank and stone outcrops at the left bank. The water depth in the river course at the time of observation was around 3-4 meters. Many stone outcrops, vegetation, and sand bars are scattered inside the river channel, and the riverbanks have vegetation with large to small rocks, reiterating the apposite habitat characteristics of otters. The periphery of Hatagaon inhabits more than sixty families of fishermen community who used to catch fish from this river on daily basis. We interviewed the local fishermen community, which stated that the otter species, vernacularly (in Odia language) called *Paani-Sena* were abundant at the respective locality and often seen in large groups (n=15-20) during the earlier days (dating >50 years back) but now scarce to sight. A few aged fishermen also stated that these animals were killed in large numbers by their forefathers since it was a menace in capture fishing, and young/ orphan otters were often kept as a pet. Around 70% of the respondents who were interviewed and confirmed sightings of otters around Hatagaonarea were more than sixty years of age.

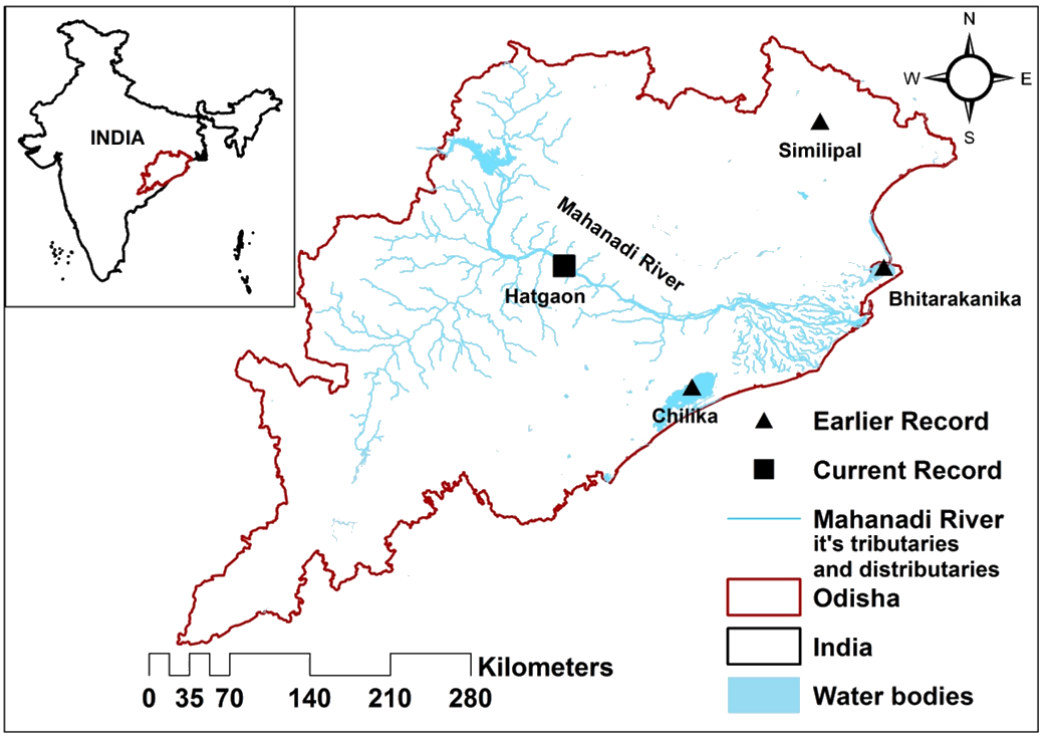

Figure 1. Distribution map of Smooth-coated otter in Odisha highlighting the current sighting in Mahanadi River.

Figure 2. Microhabitat of Mahanadi River where Smooth-coated otters were observed.

Figure 3. A smooth-coated otter grooming at the sand bank of the Mahanadi River while a male gharial is swimming in the river channel.

Figure 4. A smooth-coated otter running at the water edge of the left bank of Mahanadi River.

The Gharials (*Gavialis gangeticus*) and Gangetic softshell turtles (*Nilssonia gangetica)* have also been sighted in this area, indicating the potential of microhabitat, supporting such highly threatened species. However, illegal activities such as the blasting of dynamites and stone and sand quarries question the long-term survival of these highly threatened species in this region. Being an indicator species to their ecosystem and considering their vulnerability, this species should be provided with legal protection in their habitats. Smooth-coated otters *(Lutrogale perspicillata)* have an ethnozoological value among the locals around Mahanadi but were never reported scientifically.

CONCLUSION

Despite the fact that Acharjyo (1999) roughly pointed out the presence of otters in the downstream distributaries of Mahanadi in the earlier era, no specific locality or range of distribution for the species was marked. Therefore, the present study serves the first evident record from the main river channel of the Mahanadi and the fourth from the Odisha state. It is also a subsequent range extension of *L. perspicillata* from Bhitarkanika National Park, Chilika Lagoons and Similipal Tiger Reserve, located around 250km, 150 km and 200 km, respectively: the only other three known localities in Odisha state. Further surveys have been suggested to obtain detailed information on the population status of otters in the Mahanadi River. We also recommend that the authorityprotect this species in this area by taking measures to gain control over the threat of blasting and illegal sand quarrying. In addition, frequent awareness camps should be organized to promote the ecological importance of threatened species, viz. turtles, otters and gharials, among the local people, which we believe must be effective to ensure their smooth existence in their respective habitats.

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RESUME

UNE OBSERVATION RARE DE LA LOUTRE À PELAGE LISSE (*Lutrogale perspicillata*) LE LONG DE LA RIVIÈRE MAHANADI, DANS L'ETAT D'ODISHA, EN INDE

La loutre à pelage lisse (*Lutrogale perspicillata*) est un prédateur au sommet de la pyramide alimentaire et une espèce indicatrice de l'écosystème aquatique. Nous mentionnons dans cette étude une observation rare de cette espèce basée sur des preuves photographiques de la rivière Mahānadī dans la partie centrale de l'état d'Odisha. Notre rapport consacré à cette espèce hautement menacée de la partie centrale de l'État a une importance écologique et contribuera à sa conservation et à la planification de sa gestion. Nous demandons instamment d'autres suivis afin d'obtenir des informations détaillées sur le statut de la population de ce bassin fluvial situé dans une zone fortement occupée par l'homme.

RESUMEN

UN RARO AVISTAMIENTO DE NUTRIA LISA (*Lutrogale perspicillata*) EN EL RÍO MAHANADI, ODISHA, INDIA

La nutria lisa (*Lutrogale perspicillata*) es un predador tope y especie indicadora en los ecosistemas acuáticos. Aquí, informamos de un raro avistamiento de ésta especie, en base a evidencia fotográfica del río Mahanadi, en la parte central del estado de Odisha. Nuestro registro de ésta especie altamente amenazada en la parte central del estado tiene significación ecológica, y va a ayudar en su conservación y la planificación de su manejo. Exhortamos a que se realicen más relevamientos para obtener información detallada sobre su status poblacional en el área dominada por humanos de ésta cuenca fluvial.

ARTICLE

AN ECOLOGICAL STUDY OF THE PREY OF THE OTTER IN AN ASYNCHRONOUS PADDY FIELD LANDSCAPE

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Abstract: Otters are the top predators in wetlands. Otters have an essential ecological role in preserving the species richness of their food web. The availability of prey species in the habitat influences otter prey selection. Because of the cultivation stage, paddy fields in the tropical area have a distinct temporal seasonality. Consequently, information on the prey species of otter temporarily availability in Paddy field settings is essential for developing wildlife-friendly agricultural techniques. From January to April 2020, researchers studied the ecology of otters' prey in rice fields in West Sumatra. We examined the ecological indexes of otters' prey and whether cultivation stages influence the availability of otters' prey. Fish, snails, frogs, and water insects were the prey species studied in four cultivation stages. Ecological indices such as diversity index (H'), evenness index (E), and species richness index (R) are used to compare the findings of each type of otter prey. The ecological index values of the prey animals obtained by otters varied quite a lot depending on the type of prey and the growing season. The abundance of snails, the number of snails, the abundance of fish and the abundance of *Oreochromis nilloticus* were significantly different across cultivation stages ($P<0.05$) according to the results of the ANOVA test. The asynchronous paddy field system is suitable for providing otters with abundant prey all year round. Therefore it will be used to create an otter-friendly rice field landscape.
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Keywords: diversity; abundance; latrine site; top predator

INTRODUCTION

Paddy fields are artificial wetland ecosystem very useful for human life as food producers. Paddy fields are also stagnant water ecosystems that support the life of various aquatic animals and plants. The paddy field ecosystem has a high diversity of fauna. Various types of fauna are native inhabitants of paddy field habitats, and humans intentionally introduce some for cultivation purposes (Puspita et al., 2005). Paddy field cultivation activities can regulate the abundance and diversity of aquatic insect organisms (Asghar, 2010; Che Salmah and Abu Hassan, 2002; Hayasaka et al., 2012; Mogi, 2007). Paddy field cultivation is divided into multiple stages during the cultivation process (Fernando, 1993), resulting in variations in the composition of

aquatic insects in different phases (Che Salmah et al., 1998). Other organisms in the paddy fields outside aquatic insects include wild plants, plankton, several types of bacteria, rodents, and water snakes (Lu et al., 2002). The interaction of these organisms produces a balanced ecosystem, providing paddy fields with an ideal environment for various species (Deb, 2009). It has otters, the primary predators of the rice field landscape.

The otter is one of the species that are dependent on the existence of wetlands (Asmoro et al., 1994). They are the top predators in their habitat. Otters are essential in maintaining the balance of animal abundance in their ecosystems (Foster-Turley & Santiapillai, 1990). Otters primarily consume fish, although each species has varied dietary preferences (Anoop and Hussain, 2005; Kasper et al., 2008). Indonesia has four otter species out of the world's thirteen. These are *Aonyx cinereus* (Illiger, 1815), *Lutra sumatrana* (Gray, 1865), *Lutrogale perspicillata* (Geofroy Saint-Hilaire, 1826) and *Lutra lutra* (Linnaeus, 1758). (Corbet and Hill, 1992). Only *A. cinereus* is not protected by the Regulation of the Minister of Environment and Forestry of the Republic of Indonesia.

Small-clawed otters *(A. cinereus*) are widespread throughout South and Southeast Asia. The International Union for Conservation of Nature (IUCN) Red List has categorized them as vulnerable species (Wright et al., 2015). Rivers, peat swamps, mangroves, paddy fields, ditches, and fish ponds are among the natural and artificial habitats used by small-clawed otters (Hussain et al., 2011). Small-clawed otters forage in paddy fields and use those as latrines in several Southeast Asian contries, including Malaysia, Thailand, the Philippines, and Indonesia (Foster-Turley, 1992; Aadrean et al., 2010; Gonzalez, 2010; Kanchanasaka and Duplaix, 2011). In the Malaysian Peninsula, otter latrine sites were discovered in paddy fields near mangrove muck (Foster-Turley, 1992). While conducting a preliminary study on the occurrence of small-clawed otters (Aadrean et al., 2010) and their feeding characteristics (Aadrean et al., 2011), it was discovered that they utilize a paddy field near the settlement for foraging and as a latrine site.

The diet of small-clawed otters has been previously studied with the composition of the diet having aquatic animals such as crabs, fish, frogs, arthropods, mammals, and snails in natural wetlands dominated by crabs (Kruuk et al., 1994; Hon et al., 2010) While in artificial wetlands such as paddy fields, fish dominate (Andeska et al., 2021). The difference is influenced by prey availability in their habitat (De Silva, 1991). In the present study the researchers wanted to reveal the effect of different stages of paddy-field cultivation on the prey abundance of small-clawed otters. Previous studies, several related to the ecology of otters, have been carried out to examine the influence of spatial and temporal characteristics on visits to latrine sites (Aadrean and Usio, 2017; 2020) and temporal environmental factors on the diet of otters in paddy fields (Andeska et al., 2021). The results of this study can complement previous research to develop the basis for creating a paddy field cultivation system suitable for the survival of otters.

STUDY SITE AND METHODS

Study site

This research was carried out from January - April 2020. The research location was selected in the rice fields of Lubuk Alung sub-district, Padang Pariaman district, West Sumatra (longitude 0°38'00"S - 0°40'40"S, latitude 100°17'10"E - 100° 20'20"E), with an altitude of 25 - 50 m above sea level. The paddy field cultivation system is carried out individually by the owner of the paddy fields and the owner can determine

the timing of his rice cultivation, thus creating heterogeneous rice fields (Aadrean and Usio, 2017).

The tools and materials used in this research are digital cameras, G.P.S., plastic bags, collection bottles, sticky labels, compound microscopes, ropes, petri dishes, dip nets, filters, electro-fishing instruments, fishing nets, flash lights, data sheets, 70% alcohol, and 4% and 10% formalin.

The Abundance of Otter Prey

This study uses quantitative methods and purposive sampling to determine the location of the selected planting season. The selected location should be close to the latrine site surveyed (Aadrean and Usio, 2017). We divided the cultivation stage into four categories: preparatory, vegetative, generative, and postharvest. The preparation stage is the period that starts from the time the fields are ploughed until the farmers plant rice seeds. The vegetative stage is when farmers start planting rice until the emergence of rice flowers. The generative stage starts from flowering until the farmer harvests the rice. Postharvest is the period after harvesting until the land is ploughed again (Andeska et al., 2021).

At every cultivation stage, we collected prey animals of small-clawed otter such as insects, molluscs, fish, and frogs. The limitation of the animals collected is based on the research of Andeska et al. (2021). He used the category of prey animals that have an occurrence frequency above 10% in the diet of small-clawed otters in rice fields. The density of prey animals was calculated at each different rice growing season. Sampling was carried out in the rice field plots, and the dich closest to the rice field. Methods and efforts for taking samples were adjusted to taxa groups and rice growing season. Sampling at every cultivation stage was done at five different locations.

Table 1. Prey animal survey methods and identification guidebooks used.

No	Category	Method	Effort	Identification guide
1	Insect	*Dip Net*	20 cm x 500 cm	Merrit and Cummin, 1984
2	Mollusc	*Dip Net* and *Hand Sorting*	20 cm x 500 cm	Pennak,1978, Djajasasmita, 1999
3	Fishes	Electrofishing	200 m transect distance x 40 cm net width	Kottelat, *et al.*,1993
4	Frog	*Visual encounter survey*	200 m transect with 5 m left and right visibility	Inger and Stuebing, 2005

Data Analysis

We calculated the abundance of prey for the small-clawed otter at each cultivation stage. The number of species and density of otter prey categories in each cultivation stage was also calculated. Using this data ecological indices, such as the Shannon-Wiener diversity index (H'), evenness index (E), and Margalef species richness index (R), were calculated to compare community patterns in each cultivation stage. In addition, the one-way ANOVA test and Tukey's test were conducted to see the effect of different cultivation stages on the prey abundance of the Small-clawed otter.

RESULTS

A wide variety of prey items were identified (Table 2, Table 3).

Table 2. Number of individual otter prey in each cultivation season

Category	No	Taxa/species	Cultivation Stage			
			Preparation	Vegetative	Generative	Postharvest
Insect	1	Bezzia	1	-	1	-
	2	Cullicoides	-	1	14	-
	3	Disticidae	2	2	-	-
	4	Glossiphonidae	-	3	-	-
	5	O*rthemis* sp.	-	3	1	-
	6	*Pantala* sp.	-	1	-	-
	7	*Plathemis* sp.	-	6	5	-
	8	Pseudocloeon	1	-	-	2
	9	Tipulidae	-	3	2	-
	10	*sp* 1	5	3	-	-
	11	*sp* 2	-	-	3	-
Mollusc	1	*Acroloxus lacustris*	56	-	-	-
	2	*Gyraulus* sp.	3	5	-	-
	3	*Corbicula* sp.	-	3	2	-
	4	*Lymnaea rubiginosa*	326	131	61	-
	5	*Melanoides granifera*	70	57	62	-
	6	*Melanoides tuberculata*	223	242	210	-
	7	*Pomacea canaliculata*	225	131	169	16
	8	*Thiara* sp.	117	177	144	-
Pisces	1	*Pterygoplichthys* sp.	1	1	1	-
	2	*Oreochromis niloticus*	-	4	16	-
	3	*Anabas testudineus*	9	10	9	-
	4	*Channa striata*	-	-	4	-
	5	*Aplocheilus panchax*	3	2	4	-
	6	*Gambusia affinis*	4	-	8	8
	7	*Puntius brevis*	-	-	1	-
	8	*Rasbora* sp.	-	10	2	-
	9	*Hemibagrus hoevenii*	-	-	-	-
	10	*Barbonymus gonionotus*	1	-	-	-
Amphibia	1	*Fejervarya cancrivora*	72	29	21	11
	2	*Fejervarya limnocharis*	6	5	1	1
	3	*Hylarana nicobariensis*	-	-	1	-
	4	*Hylarana erythraea*	1	1	2	-
	5	*Mycrohylidae*	3	-	-	-

Table 3. Number of species and individuals in each growing season

No	Prey Category	Preparation		Vegetative		Generative		Postharvest	
		S	N	S	N	S	N	S	N
1	Insect	4	9	8	22	6	26	1	2
2	Mollusc	7	1020	7	746	6	648	1	16
3	Fish	5	18	6	27	8	45	1	8
4	Frog	4	82	3	35	4	25	2	12

S = Total Species/taxa; N = Total Individuals

Based on the observations of otter prey in the paddy fields, it was found that the most common prey category was Molluscs during the preparation stage (N: 1020; Table 3), which was dominated by the species *L. rubiginosa*. While for the category of Fishes most commonly found during the generative stage, namely 45 individuals with a total of 8 species (Table 3), the most common species found was *O. niloticus* (16; Table 2). Furthermore, for the amphibian category, the highest number of individuals was found in the preparation stage, and insects in the vegetative stage (Table 3), dominated by the species *F. cancrivora* for frog prey and Cullicoides for insect prey (Table 2). The prey density of otters observed shows that the number of individuals changes according to the cultivation stage. The number of individuals appears to be high if the environmental factors of the cultivation stage support the presence of otter prey.

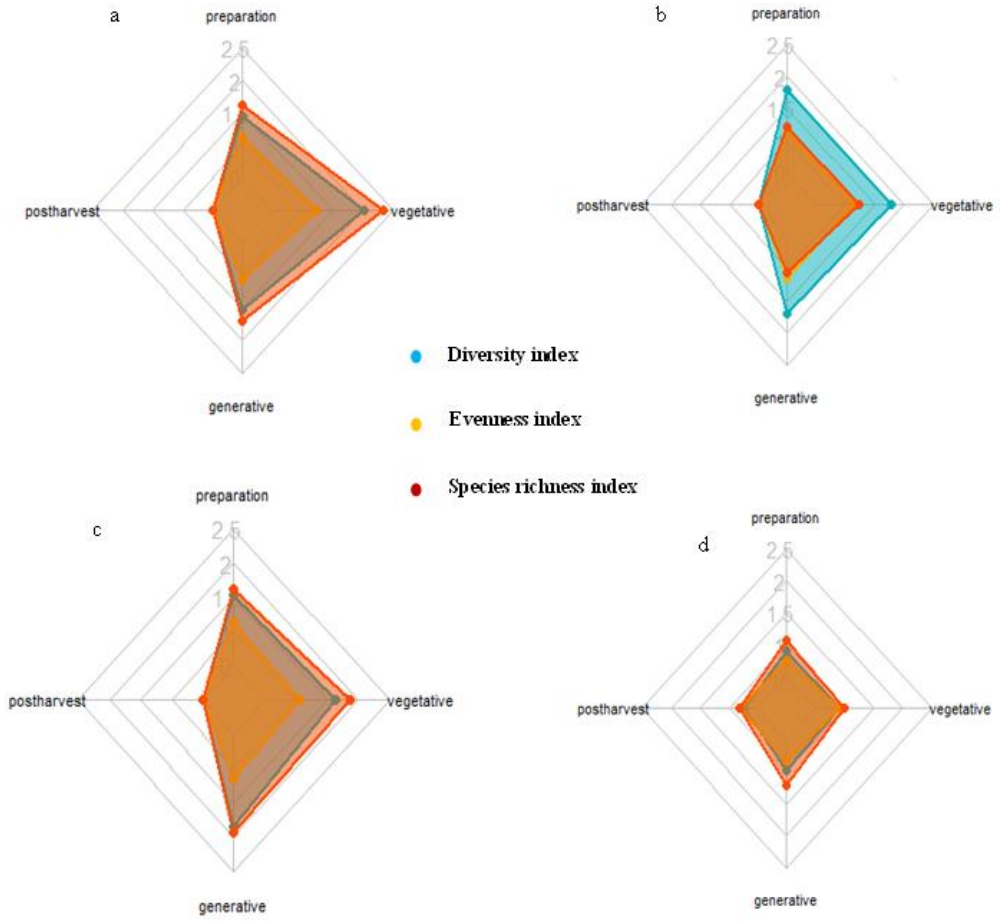

Figure 1. Chart diagram ecological index otter prey a. insect b. snail c. fish d. frog

Based on Figure 1, the ecological index values calculated varied depending on the cultivation stage and the type of prey category. The highest biodiversity index of insects, evenness index, and species richness index were in the vegetative stage (H': 1.94, E: 0.93, R: 2.64), while for the snails, the highest biodiversity index was in the preparation stage (H':1.64), the highest evenness index was during the generative stage (E: 0.85), and the species richness index was during the vegetative stage (R: 0.91). The highest ecological index for the Fishes category is the generative stage (H': 1.73, E: 0.83, R: 1.84), whereas for the frog, the highest biodiversity index was in the generative stage (H': 0.6), the evenness index (E: 0.49), and the species richness index in the generative stage (R: 0.93). Frogs have the smallest ecological index value for the prey

category compared to other prey categories, while insects have the highest ecological index.

Table 4. The effect of seasonal differences on prey categories, number of prey species, and every single species of prey for small-clawed otters

Category of prey	*P*-Value (95%)		Taxa/Species	*P*-value (95%)
	Abundance	Total of species		
Insect	0.10	0.05	Bezzia	0.55
			Coleoptera	0.42
			Culicoides	0.29
			Disticidae	0.55
			Glossiphonidae	0.12
			Orthemis sp.	0.52
			Pantala sp.	0.42
			Plathemis sp.	0.20
			Pseudocloeon	0.55
			sp1	0.32
			sp2	0.42
			Tipulidae	0.22
Molluscs	**0.02***	**0.01***	*Acroloxus lacustris*	0.42
			Gyraulus sp.	0.56
			Corbicula sp.	0.57
			lymnaea rubiginosa	0.33
			Melanoides granifera	0.65
			Melanoides tuberculate	0.65
			Pomacea canaliculata	0.27
			Thiara sp.	0.50
Fishes	**0.04***	0.11	*Anabas testudineus*	0.72
			Aplocheilus panchax	0.66
			Barbonymus gonionotus	0.58
			Channa striata	0.42
			Gambusia affinis	0.66
			Hemibagrus hoevenii	0.42
			Oreochromis niloticus	**0.01***
			Pterygoplichthys sp.	0.80
			Puntius brevis	0.42
			Rasbora sp.	0.20
Amphibians	0.49	0.24	*Fejervarya cancrivora*	0.40
			Fejervarya limnocaris	0.86
			Hylarana erytrhea	0.25
			Hylarana nicobariensis	0.42
			Mycrohyla gadjahmadai	0.42

Statistically significant variables are indicated in bold font ($P < 0.05$)

We split the dependent variable into three levels in the ANOVA test: the abundance of otter diet categories, the number of species from each prey category, and the abundance of each prey species collected. Of the four abundance categories of prey, only two were impacted by the cultivation stage in the ANOVA test of the effect of molluscs and fish ($P<0.05$; Table 4). For the number of species of prey, only mollusc was affected by the cultivation stage ($P<0.05$; Table 4). Meanwhile, only *O. niloticus* was shown to be influenced by the cultivation stage in terms of otter prey quantity ($P<0.05$; Table 4).

DISCUSSION

The diversity index categorizes the features of insects, snails, and fish as moderate. The highest insect diversity index occurs during the vegetative stage because it may provide shaded conditions that aquatic insects prefer (Norela et al., 2013). Paddies are essential for insects that reproduce in shallow water. Flooded paddy fields are frequently rich in algae, plankton, and other aquatic insect food (Roger et al., 1991). During growth from the tiller stage to the adult stage of paddy or when the paddy plant is actively producing rice grains, the abundance of Disticidae and Odonata is more abundant (Che Salmah and Abu Hassan, 2002; Mogi and Miyagi, 1990). The ANOVA test results show that the difference in the cultivation stage does not affect the number of insects. This research discusses other characteristics that have a distinct impact on insects. Climate, geographical conditions, altitude, food type, insect spreadability, habitat selection, and food availability are all environmental elements that may impact bug prevalence (Tofani, 2008).

In the snail prey category, the highest diversity index was in the preparation stage (Figure 2), and the difference in the cultivation stage impacted the abundance and number of snail species (P<0.05; Table 4). If related to paddy growth, the number of molluscs increased in the initial processing phase, then stayed steady until 2-3 weeks before harvesting. According to Aadrean and Usio's (2020), snails are most commonly found in rice fields that have been flooded, such as during the processing and vegetative periods. Figure 2 demonstrates that the cultivation stage that had the most significant impact on snail abundance was the preparation stage, while in Figure 3, the number of species of snails was found at the most in the generative stage. It was because when the paddy phase actively produces grains, it creates a suitable microhabitat for aquatic organisms to find food. The highest number of species and individuals of snail was generally found in paddy fields that are still waterlogged and soil is still slightly moist during one to two weeks of age of rice plants. In paddy fields with these conditions, sunlight penetration is still sufficient to reach the substrate because paddy plants have not blocked it.

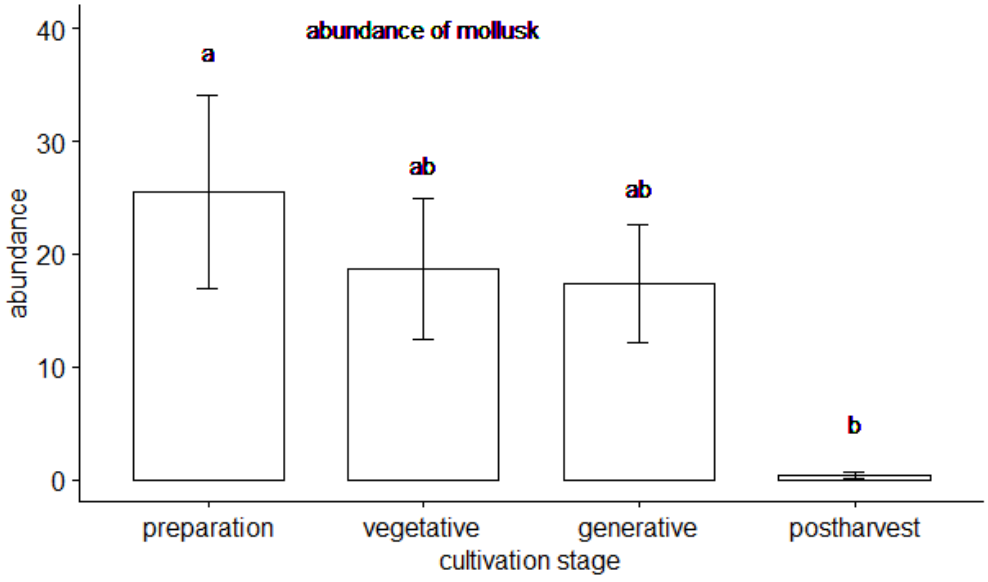

Figure 2. Boxplot diagram of the relationship between mollusc abundance and growing season in asynchronous rice fields

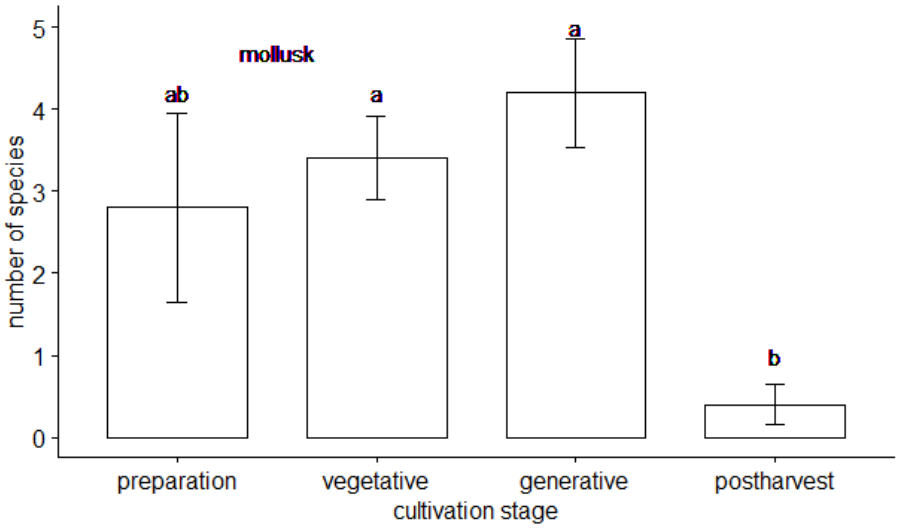

Figure 3. Box plot diagram of the relationship of cultivation stage on total species of snail in asynchronous paddy fields

On the other hand, fish abundance is influenced by the cultivation stage (Table 4; *P*=0.04*). Figure 4 shows the difference in the generative stage. Furthermore, among the ten taxa/species found, just *O.niloticus* abundance was affected by changes in the cultivation stage (Table 4; *P*=0.01*). Figure 5 illustrates the generative stage of *O. niloticus* with the greatest average abundance caused by water availability throughout the growing season, which is a determining factor for the survival of fish in rice fields. The number and diversity of fish will be high when fish can easily travel from the river/upstream to the rice fields since the paddy fields in this region use an irrigation system.

Furthermore, the water level will decrease in the last half of the generative stage. The water level is only raised at the margins of the paddy fields to create space for fish to be restricted or trapped, making it simpler to sample fish. The generative stage is highly beneficial to aquatic creatures foraging, especially fish. In a report by Andeska et al. (2021), the choice of fish in otters' diet was not influenced by an ecological factor. Existence of fish is always available during the cultivation stage.

0

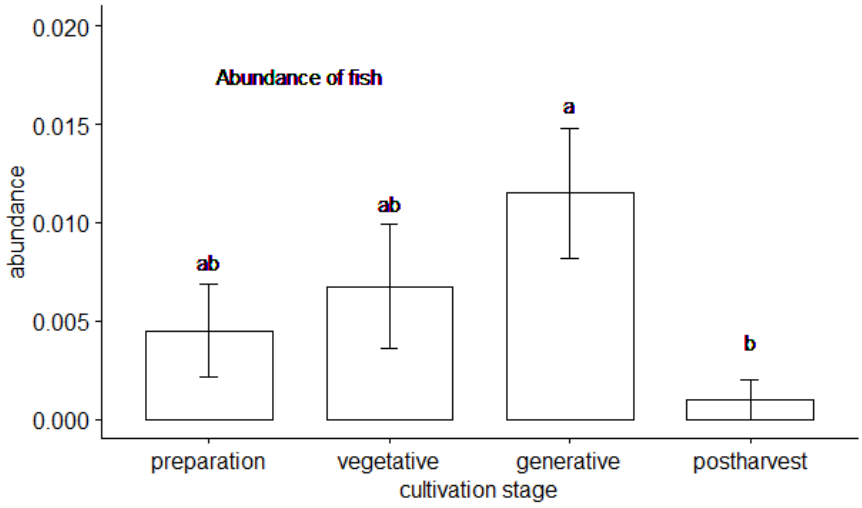

Figure 4. Box plot diagram of the relationship of cultivation stage on fish abundance in asynchronous paddy fields.

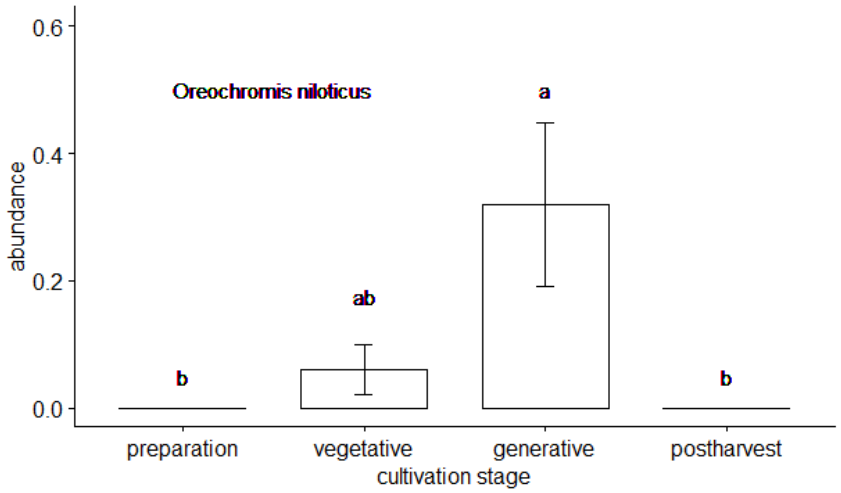

Figure 5.
Box plot diagram of the relationship of cultivation stage on *O. niloticus* abundance in asynchronous paddy fields.

The diversity index of frogs in Lubuk Alung paddy fields generally includes low diversity (H'<1). It can be seen from the low evenness index of amphibians, which means that the distribution of species in each cultivation stage was uneven. Of all cultivation stages, the preparation stage has the highest diversity value. Naturally, frogs will be highly abundant when the rice is still young because there is still a lot of water available, and it inundates all land surfaces of the paddy fields. Their abundance will decrease as water supply decreases and the age of paddy plants. Differences in the cultivation stage also did not affect the abundance and number of frog species in the study area. It was because other independent factors, such as surface water temperature, can affect the abundance of frogs. Kurniati (2017) stated that environmental factors in the form of surface water temperature affects the individual density of frogs and pre-adults of frogs (*F. cancrivora*).

In the natural habitat of paddy fields, small-clawed otters prey on fish, snails, insects, frogs, reptiles, crustaceans, birds, and mammals. Fish and molluscs were the most dominant prey hunted by small-clawed otters (Andeska et al., 2021). That was interesting because the cultivation stage influenced the abundance of small-clawed otter prey according to this study. In the research of Andeska et al. (2021), the selection of snails as prey was influenced by the water level in the paddy fields, and any environmental factors did not influence the selection of fish as prey. The results of this study can support the conclusion of Aadrean and Usio (2020), which states that small-clawed otters prefer the vegetative stage as a foraging area.

CONCLUSION

The existence of an asynchronous paddy field system throughout the year can maintain the availability of prey for small-clawed otters. If the paddy fields use a simultaneous planting system, it will result in otters experiencing food shortages (Aadrean and Usio, 2020). Therefore, applying the paddy cultivation system and paying attention to aspects of food security also needs to consider conservation aspects so that the existence of the small-clawed otter is not increasingly threatened. Therefore, it is necessary to have a sustainable rice cultivation that can increase the environment's carrying capacity to support the lives of present and future generations.

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RESUME

ETUDE ÉCOLOGIQUE DES PROIES DES LOUTRES DANS UN PAYSAGE ASYNCHRONE DE RIZIÈRES A l'OUEST DE SUMATRA

Les loutres sont les principaux prédateurs des zones humides. Les loutres ont un rôle écologique essentiel dans la préservation de la richesse spécifique de leur réseau trophique. La disponibilité des espèces de proies dans l'habitat influence la sélection des proies des loutres. En fonction du stade de culture, les rizières de la zone tropicale ont une saisonnalité temporelle distincte. Par conséquent, les informations sur les espèces de proies de loutre temporairement disponibles dans les rizières sont essentielles pour développer des techniques agricoles respectueuses de la faune. De

janvier à avril 2020, des chercheurs ont étudié l'écologie des proies des loutres dans les rizières de l'ouest de Sumatra. Nous avons examiné les indices écologiques des proies des loutres afin de voir si les stades de culture influencent la disponibilité en proies des loutres. Nous avons étudié les espèces de proies suivantes : les poissons, les escargots, les grenouilles et les insectes aquatiques, à quatre stades différents de culture. Des indices écologiques tels que l'indice de diversité (H), l'indice d'uniformité (E) et l'indice de richesse spécifique (R) sont utilisés pour comparer les résultats de chaque type de proie de loutre. Les valeurs de l'indice écologique des proies obtenues pour les loutres variaient fortement selon le type de proie et la saison de culture. Selon les résultats du test ANOVA, l'abondance d'escargots, le nombre d'escargots, l'abondance de poissons et de tilapia du Nil (*Oreochromis nilo*ticus) étaient significativement différents suivant le stade de culture ($P<0,05$). Le système de rizière asynchrone est donc adapté pour fournir aux loutres des proies abondantes tout au long de l'année. En conséquence, il sera utilisé pour créer un paysage de rizières respectueux des loutres.

RESUMEN

ESTUDIO ECOLÓGICO DE LAS PRESAS DE LA NUTRIA EN UN PAISAJE ASINCRÓNICO DE ARROZAL

Las nutrias son los predadores tope en los humedales. Las nutrias tienen un rol ecológico esencial en la preservación de la riqueza de especies de su red alimenticia. La disponibilidad de especies-presa en el hábitat influencia la selección de presas por la nutria. A causa del estadío del cultivo, los arrozales en el área tropical tienen una clara estacionalidad temporal. Consecuentemente, la información sobre la disponibilidad temporal de las especies-presa de la nutria en contextos de Arrozal es esencial para desarrollar técnicas agrícolas compatibles con la fauna. Entre Enero y Abril de 2020, estudiamos la ecología de las presas de la nutria en arrozales en Sumatra Occidental. Examinamos los índices ecológicos de las presas de la nutria, y si los estadíos del cultivo influencian la disponibilidad de presas. Las especies-presa estudiadas en cuatro estadíos de cultivo, fueron peces, caracoles, ranas, e insectos acuáticos. Usamos índices ecológicos como el índice de diversidad (H′), índice de equitatividad (E), e índice de riqueza de especies (R), para comparar los hallazgos de cada tipo de presa. Los valores de los índices ecológicos de las presas animales obtenidas por las nutrias, variaron considerablemente, dependiendo del tipo de presa y la estación de crecimiento. La abundancia de caracoles, el número de caracoles, la abundancia de peces y la abundancia de *Oreochromis niloticus* fueron significativamente diferentes en el estadío de cultivo ($P<0.05$), de acuerdo a los resultados del test ANOVA. El sistema de arrozal asincrónico es adecuado para proveer a las nutrias con presas abundantes a lo largo de todo el año. Por lo tanto, será utilizado para crear un paisaje de arrozales compatible con las nutrias.

RINGKASAN

KAJIAN EKOLOGIS MANGSA BERANG-BERANG DI LANDSKAP SAWAH ASINKRON

Berang-berang adalah predator teratas di lahan basah. Berang-berang memiliki peran ekologis yang penting dalam melestarikan kekayaan jenis rantai makanannya. Ketersediaan spesies mangsa di habitat mempengaruhi pemilihan mangsa berang-berang. Karena tahapan waktu budidaya, sawah di daerah tropis memiliki musim tahap yang berbeda. Konsekuensinya, informasi tentang spesies mangsa berang-berang yang tersedia sementara di sawah sangat penting untuk mengembangkan teknik pertanian ramah satwa liar. Dari Januari hingga April 2020, peneliti mempelajari ekologi mangsa

berang-berang di persawahan di Sumatera Barat. Kami memeriksa indeks ekologi mangsa berang-berang dan apakah tahap budidaya mempengaruhi ketersediaan mangsa berang-berang. Ikan, siput, katak, dan serangga air merupakan spesies mangsa yang dipelajari dalam empat tahap budidaya. Indeks ekologi seperti indeks keanekaragaman (H'), indeks kemerataan (E), dan indeks kekayaan spesies (R) digunakan untuk membandingkan temuan setiap jenis mangsa berang-berang. Nilai indeks ekologi hewan mangsa yang diperoleh berang-berang cukup bervariasi tergantung jenis mangsa dan musim tanam. Kelimpahan keong, jumlah keong, kelimpahan ikan dan kelimpahan *Oreochromis niloticus* berbeda nyata pada tahap budidaya ($P<0,05$) menurut hasil uji ANOVA. Sistem sawah asinkron cocok untuk memberi berang-berang mangsa yang melimpah sepanjang tahun. Oleh karena itu akan digunakan untuk membuat lanskap sawah ramah berang-berang.

ARTICLE

ANATOMICAL STUDY OF THE *CONUS MEDULLARIS* IN NEOTROPICAL RIVER OTTER (*Lontra longicaudis*)

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Abstract: The morphology and physiology of the *Lontra longicaudis* is not well understood, making it sometimes difficult to understand its anatomy or behavior. A descriptive anatomical study of the spinal cord of neotropical river otters is presented. It was conducted at the Wild Animal Research Laboratory at the Federal University of Santa Catarina, Brazil. Three female otters were used, two cubs and one adult, from the Instituto Ekko Brasil (IEB) — Otter Project. To analyze the spinal cord and its components, measurements of body length and epiaxial musculature and vertebral arches were registered from the cervicothoracic transition to the base of the tail. The conus medullaris reached the fourth lumbar vertebra. In one animal, it reached the fifth lumbar vertebra. At the level of the sixth lumbar vertebra, no spinal cord segments were observed. In neotropical river otters, the space between the sacrum and the first caudal (sacrococcygeal) vertebra can be used for epidural anesthesia injection. Practitioners should consider this description when considering injection sides for epidural anesthesia.
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Keywords: physiology; morphology; carnivorous; Mustelidae

INTRODUCTION

The neotropical otter, *Lontra longicaudis*, one of the four species of otters present in South America, occupies a wide region that goes from Mexico to Uruguay. It is a carnivorous animal with aquatic habits, which belongs to the Mustelidae family (Wilson and Reeder, 2005). In addition, this otter species is known to being dangerously

threatened in the Atlantic Forest biome (Rodrigues et al., 2013; Carvalho Junior et al., 2021). Little is known about the physiology of the species. It is present throughout the Brazilian national territory, but is rarely seen in nature due to twilight habits and solitary behavior (Carvalho Junior et al., 2010).

The morphology and physiology of the neotropical river otter are not well understood, making it sometimes difficult to understand its anatomy or behavior. A study on the vascularization of the aortic arch of the species, for example, observes that the origin of these vessels is similar to that described for domestic and wild carnivores (Barbosa et al., 2021). These results demonstrate that the aortic artery is the main vessel that distributes arterial blood to all systems, bringing oxygen and nutrients to different areas of the body, and collecting the carbon dioxide that results from cellular metabolites.

To our knowledge, there are no anatomical studies of the end part of the spinal cord, the *conus medullaris*, for neotropical river otters. Therefore, this descriptive anatomical study was conducted. This description might be helpful for practitioners when thinking about injection sides for epidural anesthesia.

MATERIAL AND METHODS

The study was conducted at the Wild Animal Research Laboratory at the Federal University of Santa Catarina (UFSC), Brazil. Three female otters were used, two cubs and one adult, from the Instituto Ekko Brasil (IEB) — Otter Project. The animals had been deep-frozen. After thawing, the animals were subsequently fixed by perfusion through the common carotid artery with a 10% aqueous formaldehyde solution. After fixation, the specimens were dissected.

The measurements of body length and the epiaxial musculature and vertebral arches were removed, from the cervico-thoracic transition to the base of the tail, in order to access the spinal cord and its components. Medullary conus in the spinal cord were recorded using a tape measure and a digital caliper. The study was based on the nomenclature adopted by the International Committee on Veterinary Gross Anatomical Nomenclature (2022).

RESULTS

The body measurement of the adult individual A was 44 cm, and of the cubs B and C, 37 cm and 32.5 cm, respectively. The lumbar vertebrae showed no variation among the animals studied. In all cases, six lumbar vertebrae were found (L1 to L6) (Fig. 1).

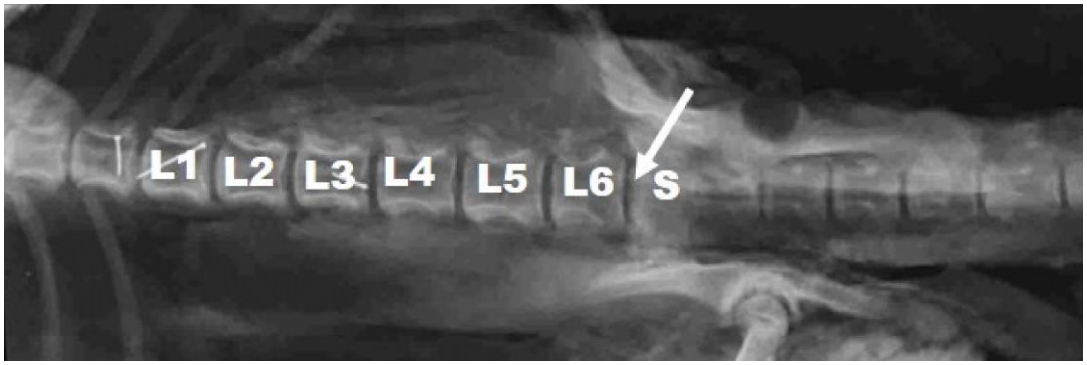

Figure 1. Ventrodorsal photograph of the lumbar vertebrae (L1 to L6) of the neotropical otter. The arrow indicates the intervertebral space between the last lumbar vertebra (L6) and the sacrum (S).

The spinal canal includes the spinal cord, meninges, cerebrospinal fluid, and epidural space. The dura mater follows the tail line to form the dural sac, enveloping the cauda equina and the terminal filament. In individuals A and B, the conus medullaris of the spinal cord ended at the fourth lumbar vertebra (L4), and in otter C at the fifth lumbar vertebra (L5), followed by the terminal filament.

Although in one individual the spinal cord extended to L5, in all analyzed individuals, the lumbar intumescence started from the last three thoracic vertebrae, extending to the first lumbar. In the lumbosacral space, between the sixth lumbar vertebra (L6) and the sacrum, only terminal filament and extensions of the spinal nerves that went towards the regions of the pelvic limbs and tail were seen (Fig. 2).

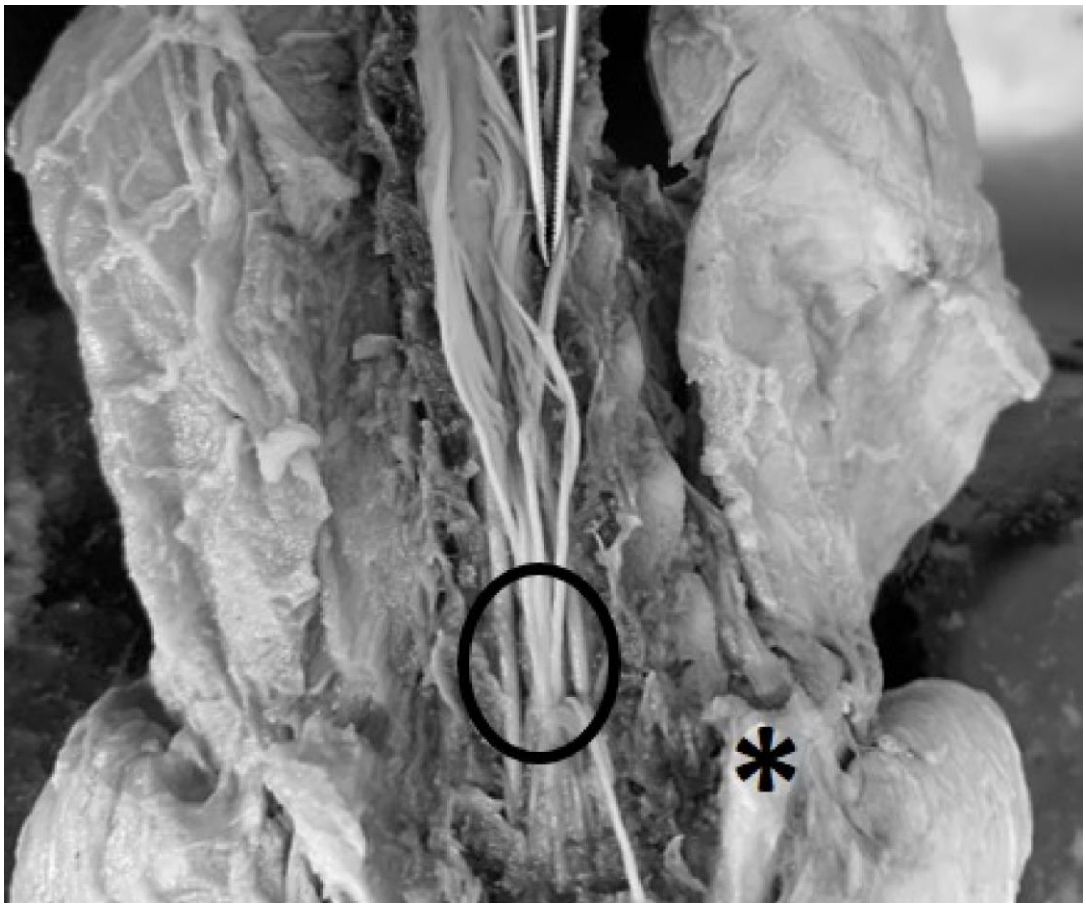

Figure 2. Dorsal photograph with emphasis on the lumbosacral region (circle), spinal nerve extensions and terminal filament, and ilium bone (*).

DISCUSSION

The spinal canal of the neotropical river otter is formed by the epidural space, the meninges, the cerebrospinal fluid, and the spinal cord (Ramsey, 1959). By definition, the epidural space is located between the dura mater and the spine. This space is also called intradural space (Groen and Ponssen, 1991). Epidural applications in small animals are commonly performed in the lumbosacral intervertebral space, as the L-S intervertebral space provides better access to the epidural environment, and closer approximation to the spinal cord (Valverde and Skelding, 2019).

Among species, there are variations in the number of lumbar vertebrae. In domestic carnivores, the number of lumbar vertebrae has an average of seven vertebrae (Sisson et al.,

1975). In wild carnivores, seven vertebrae exist for example in the lion (*Pantera leo*) (Santos et al., 2006), in the giant otter (*Pteronura brasiliensis*) (Machado et al., 2009), and in South American fur seal (*Arctocephalus australis*) (Machado et al., 2003). These data differ from our findings of only six lumbar vertebrae in three neotropical river otters (*Lontra longicaudis*).

However, it is like what has been described for the tayra (*Eira barbara*) (Branco et al., 2013; Adami et al., 2015), the maned wolf (*Chrysocyon brachyurus*) (Machado et al., 2002), jaguarundi (*Herpailurus yagouaroundi*) (Carvalho et al., 2003) and the South American ring-tailed coati (*Nasua nasua*) (Gregores et al., 2010). In all these carnivore species, only six lumbar vertebrae have been described.

Also, regarding the *conus medullaris*, different descriptions in different animal species can be found. For example, the medullary conus in the spinal cord of the tayra ends at the level of the fifth and sixth lumbar vertebrae, in the giant otter this occurs at the level of the fourth lumbar vertebra (Machado et al., 2009; Branco et al., 2013).

The results for the giant otter were similar to what was verified during this study in the neotropical river otter. In two animals (A and B) the conus medullaris ended at the level of the fourth lumbar vertebra. However, in one animal (C) it ended at the fifth lumbar vertebra. At the level of the sixth lumbar vertebra the spinal cord segments were not observed as mentioned for the tayra (Branco et al., 2013; Adami et al., 2015). Here, only extensions of spinal nerves could be seen.

In domestic carnivores like dogs and cats, variations are also known. In dogs, the medullary conus can reach up to the level of L7, and in cats the spinal cord reaches the sacral vertebrae (Evans and Lahunta, 2012; Dyce et al., 2019). In domestic animals, a huge amount of literature exists about spinal cord morphology and anatomy. This is especially helpful regarding anesthetic procedures and surgery procedures.

Regarding anesthesia, epidural anesthesia in veterinary practice is mostly used in large animals like cows, horses and sheep. However, it is also described in dogs. For example, more than half a century ago it was described in dogs by Bone and Peck (Bone; Peck, 1956). And according to Martin-Flores (2019), the epidural space at the lumbosacral level is the target location for an epidural injection. The space between the sacrum and the first caudal (sacrococcygeal) vertebra can also be used (Massone, 2019). The results of our anatomical study show, that the same locations theoretically could be used in the neotropical river otter.

Considering the results like those found by Machado et al. (2009) for giant otters, the lumbosacral level can also be used for epidural anesthesia in this species. However, for the tayra, the authors suggested the sacrococcygeal region as the choice for the use of this anesthesia (Branco et al., 2013), although in cats, which present a medullary cone arrangement beyond the last lumbar vertebra, the lumbosacral level is also indicated for epidural anesthesia in this species (Martin-Flores, 2019; Massone, 2019).

Epidural anesthesia represents a popular technique of local anesthesia in veterinary medicine (Valverde, 2008). For a safe anesthetic procedure, it is necessary that the painful sensation be controlled and allow the performance of surgical interventions without suffering to the patient (Silva, 2003). Epidural anesthesia is considered a safe technique when compared to general anesthesia, as it reduces intraoperative stress and minimizes the risks of anesthetic intervention, being widely used in critically ill and elderly patients (Martin-Flores, 2019). According to Massone (2019), epidural anesthesia causes a blockage in the sensory and motor roots of the spinal nerves due to the deposition of local anesthetic around the Dura mater, which diffuses into the epidural space.

The decision which kind of anesthetic method is the best for a patient depends, of course, on several different points which involve, for example, the patient, the surgery procedure, and the abilities of the veterinarian. Therefore, it has to keep in mind that this is an anatomical descriptive study and not a practical trial on living animals regarding epidural anesthesia. Especially in wild animals like otters, whose movements are very fast and flexible, and restrain procedures are difficult and very stressful, epidural anesthesia might be only an additional tool and definitely not the standard anesthetic method. Anesthetic methods of choice in otters are still injectable and/or inhalation anesthesia (personal communication, Weber 2022).

CONCLUSIONS

In two animals (A and B) of neotropical river otter (*Lontra longicaudis*), the *conus medullaris* ended at the level of the fourth lumbar vertebra. However, in one animal (C) it ended at the fifth lumbar vertebra. At the level of the sixth lumbar vertebra, the spinal cord segments were not observed. Here, only extensions of spinal nerves could be seen. Similar to other animals, the space between the sacrum and the first caudal (sacrococcygeal) vertebra can theoretical be used in neotropical river otters for epidural anesthesia injection.

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RÉSUMÉ

ÉTUDE ANATOMIQUE DU *CONUS MEDULLARIS* CHEZ LA LOUTRE À LONGUE QUEUE (*Lontra longicaudis*)

La morphologie et la physiologie de *Lontra longicaudis* ne sont pas bien connues, ce qui rend parfois difficile la compréhension de son anatomie ou de son comportement. Une étude anatomique descriptive de la moelle épinière des loutres à longue queue est présentée ici. Elle a été menée au Laboratoire de Recherche de la Faune sauvage de l'Université Fédérale de Santa Catarina au Brésil. L'Institut Ekko au Brésil (IEB) – Projet Loutre a utilisé trois loutres femelles, deux loutrons et un adulte. Pour étudier la moelle épinière et ses composants, des mesures de la longueur du corps, de la musculature épiaxiale et des arcs vertébraux ont été réalisées entre la transition cervico-thoracique et la base de la queue. Le cône médullaire atteint la quatrième vertèbre lombaire. Chez un individu, il a atteint la cinquième vertèbre lombaire. Au niveau de la sixième vertèbre lombaire, aucun segment de moelle épinière n'a été observé. Chez les loutres à longue queue, l'espace entre le sacrum et la première vertèbre caudale (sacrococcygienne) peut être utilisé pour l'injection d'une anesthésie péridurale. Les praticiens doivent prendre en compte cette description lors de l'examen des zones d'injection pour une anesthésie péridurale.

RESUMEN

ESTUDIO ANATÓMICO DEL *CONUS MEDULLARIS* EN LA NUTRIA NEOTROPICAL (*Lontra longicaudis*)

La morfología y fisiología de *Lontra longicaudis* no son bien comprendidas, lo que en ocasiones hace difícil entender su anatomía ó comportamiento. Presentamos un estudio anatómico descriptivo de la médula espinal de la nutria neotropical. Fue conducido en el Laboratorio de Investigación en Animales Silvestres de la Universidad Federal de Santa Catarina, Brasil. Se utilizaron tres nutrias hembra (dos crías y un adulto), oriundos del Instituto Ekko Brasil (IEB) - Proyecto Nutria. Para analizar la médula espinal y sus componentes, registramos las mediciones de largo corporal y de la musculatura epiaxial y los arcos vertebrales, desde la transición cérvico-torácia hasta la base de la cola. El conus medullaris alcanzó hasta la cuarta vértebra lumbar. En un

animal, alcanzó hasta la quinta vértebra lumbar. Al nivel de la sexta vértebra lumbar, no fueron observados segmentos de médula espinal. En las nutrias neotropicales, el espacio entre el sacrum y la primera vértebra caudal (sacrococcígea) puede ser usado para inyección de anestesia epidural. Los que deben intervenir animales deberían considerar ésta descripción al considerar los puntos de inyección para anestesia epidural.

RESUMO

ESTUDO ANATÔMICO DO CONUS MEDULAR EM LONTRA NEOTROPICAL (*Lontra longicaudis*)

A morfologia e fisiologia do *Lontra longicaudis* não são bem compreendidas, o que, às vezes, dificulta compreender a sua anatomia ou comportamento. Um estudo anatômico descritivo da medula espinhal de lontras neotropicais é apresentado. A pesquisa foi conduzida no Laboratório de Pesquisa em Animais Selvagens da Universidade Federal de Santa Catarina, Brasil. Foram usadas várias fêmeas adultas e dois filhotes de lontras, oriundos do Instituto Ekko Brasil (IEB) — Projeto Lontra. Para analisar a medula espinhal e seus componentes, foram coletadas as medidas do comprimento corporal e da musculatura epiaxial e arcos vertebrais desde a transição cervicotorácica até a base da cauda. O cone medular atingiu a quarta vértebra lombar. Em um animal, atingiu a quinta vértebra lombar. Ao nível da sexta vértebra lombar não foram observados segmentos da medula espinhal. Em lontras de rio neotropicais, o espaço entre o sacro e a primeira vértebra caudal (sacrococcígea) pode ser usado para injeção de anestesia peridural.