NOTE FROM THE EDITOR

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Dear Friends, Colleagues and Otter Enthusiasts!

I am just back from the well-organised 16th International Otter Conference in Lima, Peru and still full of all the impressions. There was a lot of science and conservation but also laughter and (re)-connecting. It was very well organized, and all went smoothly from transport to and from the venue to the catering with the explanations on local food and fruits. I think this impression is true for all of us that were there. May I say once again thank you to everybody involved in organizing this event.

Some of us saw the marine otter on Friday afternoon during the boat trip, and I heard that those that went to Tampobata all saw giant otters.

There will be Proceedings published as a special issue of the IUCN OSG Bulletin, and the participants will soon receive information on how to submit their manuscripts. Accepted submissions will go online as they come in and proofprints have been accepted.

We have already closed issue 42/1 and are opening issue 42/2. The good news is that we are almost at the end of our backlog which means future submissions will go online with only short delays.

All this is only possible by having Lesley working every week on the Bulletin. My sincere thank you Lesley for all your devotion to otters!

A R T I C L E

MONITORING OTTER ABUNDANCE IN UKHAHLAMBA DRAKENSBERG PARK, SOUTH AFRICA

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Abstract: uKhahlamba Drakensberg Park is one of the largest and most important inland freshwater protected areas in South Africa for both the African clawless otter *Aonyx capensis* and spotted-necked otter *Hydrictis maculicollis*. The relative abundance of both species was estimated by recording the number of spraint sites at four localities on three major rivers in the park for six consecutive years at the same time each year. Findings were compared with previous surveys done during the 1970s and 1990s at all four localities, and in 2010 at one of them, using the same methods. Otter spraint site abundance in this study differed significantly between species and study sites but not between years, with spotted-necked otter being more abundant than African clawless otter. There was a significant difference in otter spraint site abundance between study periods, and the relationship between species and study periods. The results indicated that the park's otter population had not declined significantly in the past 30 years. An observed difference was that more sign of spotted-necked otter was found in the current study, whereas in previous studies the sign of African clawless otter was more abundant. The park thus continues to contribute to otter conservation in the country, particularly that of the spotted-necked otter. Further studies are required to determine the drivers of the annual fluctuations in the number of sign, and the substantial increase in spotted-necked otter sign in the park in recent years.
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INTRODUCTION

African clawless *Aonyx capensis* and spotted-necked *Hydrictis maculicollis* otters coexist in the 242,813 ha uKhahlamba Drakensberg Park, the largest freshwater protected area in South Africa that conserves the headwater catchments of five major rivers in the country. This park was recognised by Rowe-Rowe et al. (1995) as an important otter sanctuary. The aim of this study was to investigate whether this is still the case.

Studies undertaken by Rowe-Rowe in the 1970s (Rowe-Rowe, 1975, 1992, 1995), and by Carugati 20 years later (Carugati, 1995; Carugati et al., 1995; Perrin and Carugati, 2006), revealed a regular abundance of otter sign. However, a more recent study confirmed that the amount of otter sign had declined by 75% at a section of previously surveyed river that was downstream of a human settlement and farmed area (Kubheka et al., 2013). Following these findings, it was decided that a programme of regular monitoring of that river and other rivers previously surveyed in the park by Carugati (1995) and d'Inzillo Carranza (1995), was required.

In 2013, a monitoring programme was initiated at four different locations in the park in an attempt to assess whether there had been any change in the abundance of the two resident otter species over four time periods: the 1970s, 1990s, 2010 and present. As otters are seldom seen, sign (spraint sites, tracks, dens) are used to establish presence and estimate abundance, with the number of spraint sites being the most reliable in estimating otter abundance (Jenkins and Borrows, 1980; Mason and Macdonald, 1987). First, I compared the otter spraint site data between annual surveys undertaken during the current study between 2018-2023. Then, I compared these abundance estimates with those of previous studies (Rowe-Rowe, 1992; Perrin and Carugati, 2006; Khubeka et al., 2013) summarised by Rowe-Rowe (2016).

The methods employed to determine otter abundance are similar to those used previously to ensure comparable results. The results will determine whether conservation action is required.

MATERIALS AND METHODS

Study Area

uKhahlamba Drakensberg Park is a crescent shaped protected area in the KwaZulu-Natal province of South Africa. It forms the South African component of the Maloti-Drakensberg Park World Heritage Site, a transfrontier park with Sehlabathebe National Park in the Kingdom of Lesotho (Fig. 1). The park is 242 813 ha in size and comprises 15 management units. The Maloti-Drakensberg Park is a World Heritage Site, proclaimed for both its cultural and natural values. uKhahlamba Drakensberg Park is a Ramsar Site, a wetland of International Importance, is recognised as one of BirdLife South Africa's Important Bird and Biodiversity Areas and also serves as the most important conservation area for montane habitats in southern Africa (Ezemvelo KZN Wildlife, 2020).

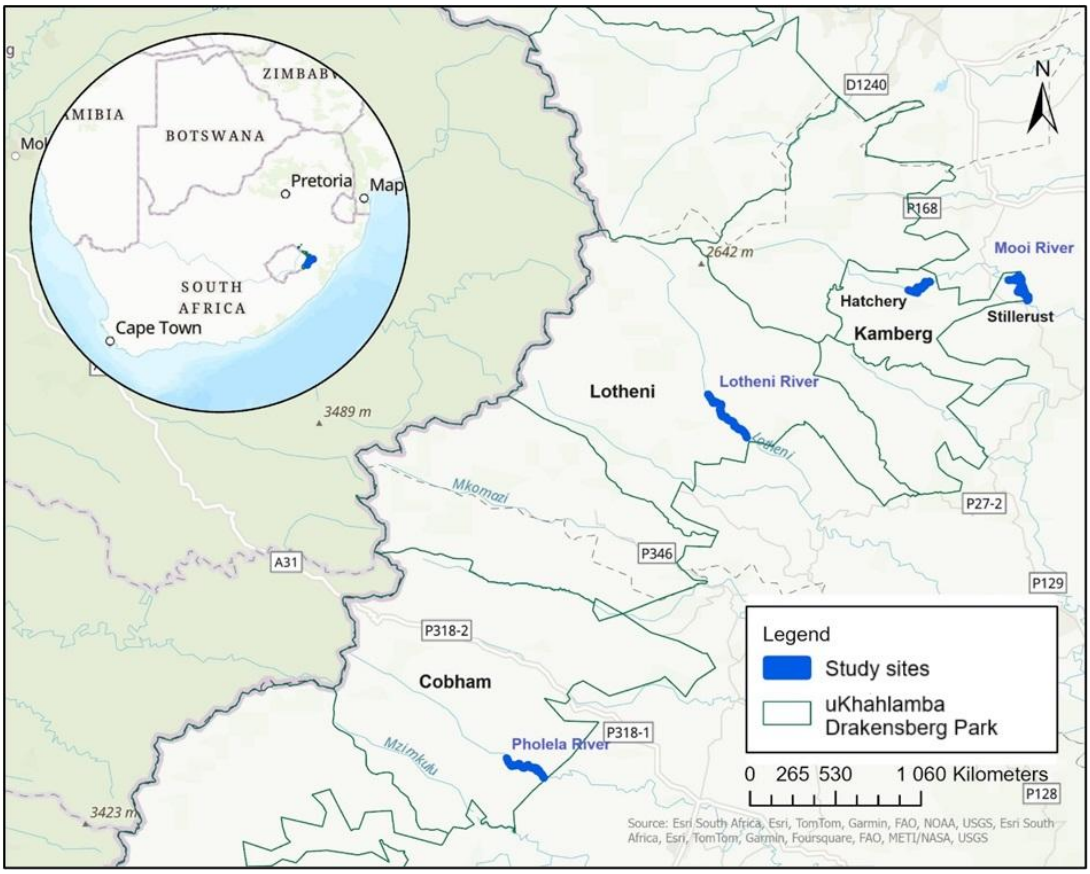

Figure 1. The location of the study sites in uKhahlamba Drakensberg Park, KwaZulu-Natal province, South Africa.

On the South African side, the Drakensberg catchment area is of major economic importance as it contributes significantly to the flow of the uThukela, uMkhomazi and uMzimkhulu Rivers, the three largest catchments in KwaZulu-Natal. The park plays a key role in the economy of KwaZulu-Natal and South Africa, through the production of high-quality water from its dense network of wetlands and rivers, the sustainable use of natural resources, and serving as a core destination for the tourism industry.

Ezemvelo KZN Wildlife is the management authority of the protected area and has monitored the population trends of riparian carnivores, the African clawless otter, spotted-necked otter and water mongoose *Atilax paludinosus,* through annual surveys since 2013.

Survey Methods

Annual surveys were conducted in late winter/early spring along 4-5 km stretches of three rivers in four management units of the park between 2013 and 2023 (Fig. 1). These surveys were undertaken by trained Ezemvelo KZN Wildlife staff.

The study sites were chosen to be the same as previous studies (Rowe-Rowe, 1975, 1992; Carugati, 1995; Perrin and Carugati, 2006; Khubeka et al., 2013). This included i) a 5 km section of the Pholela River in Cobham, ii) a 5 km section of the Lotheni River in Lotheni, iii) a 4.2 km section of the Mooi River in Kamberg (Stillerust), including an oxbow, and iv) a 5 km section of the Mooi River in Kamberg, including three trout fishing impoundments (dams). At Kamberg, the Mooi River starts in the protected area, then flows out of it for 8 km through a dense rural settlement and farmland, then re-enters the protected area. The upstream section of the Mooi River is

known as Kamberg (previously referred to as the Hatchery - historically the location of a trout hatchery), and the downstream section is known as Stillerust.

I used the method described by Rowe-Rowe (1975, 1992) to establish the presence and densities of otters. As otters are seldom seen, various authors have used sign to establish presence and estimate numbers, including faeces (known as scats or spraints), tracks, rolling places, runs, slides and dens (e.g. Mason and Macdonald, 1987; Rowe-Rowe, 1992).

Each bank of each section of river and the shoreline of dams were surveyed for sign of otters once per year between 07:00h-17:00h in the last week of August or the first week of September; because it is easy to identify sign in late winter/early spring, and the two otter species are most widely distributed during this time. The survey method involved slowly walking and visually scanning along both banks of the river and the shoreline of the dams including near the dam walls and inlets. Three observers were used; one walked in the river to identify sign in mud and sand between the rocks and along the water's edge, and entry and exit points of slides. The second observer walked along the bank to identify sign within 5-10 m of the water's edge, because signs are generally found within 10 m of the water (Rowe-Rowe, 1992). The third observer walked 10-20 m from the water's edge, looking for sign amongst the riparian vegetation. Where the riverbanks are very steep, at Kamberg and Stillerust, the observer in the river used a boat in 2019-2021 to improve the detection of sign. The type and location of all signs were recorded using a GPS and saved to a database for further analyses.

Analyses

The number of spraint sites has been found to be the most reliable method for estimating otter abundance (Jenkins and Borrows, 1980; Mason and Macdonald 1987). Similarly, as a result of differences in the riparian zone between study sites and years, it was felt that spraint sites were the most reliable sign of otter presence at the four study sites. I thus report only on spraint sites. Where spraint sites contained more than 10 spraints, indicating that they had been used numerous times, they were referred to as latrines or main sites. The number of spraint sites was used to estimate the relative abundance of each species.

First, I compared the otter spraint site data between annual surveys undertaken during 2018-2023 to establish whether there was variation in otter spraint abundance in recent years. To compare spraint abundance between species (African clawless and spotted-necked otter), sites (Cobham, Lotheni. Kamberg and Stillerust) and years (2018, 2019, 2020, 2021, 2022, 2023), I used a Generalised Linear Model (GLiM) with a Quasi-Poisson distribution for over-dispersed data and Wald chi-square tests. Spraint site abundance was used as the response variable, and species, site and year were fitted as fixed factors in the model. I then used a Generalised Linear Mixed Model (GLMM) to determine whether there was a significant difference in otter spraint site abundance between years when controlling for study site.

Second, I compared the mean total number of spraint sites recorded during this study (2018-2023), inclusive of the oxbow site at Stillerust, with those of previous studies. For this I used data from each study period recorded in the same season or month as my study, i.e. the dry season or the last week of August/first week of September. Rowe-Rowe's (1975) study was undertaken in Stillerust only, over a 24-month period between 1972-1974 (Rowe-Rowe, 1975; 1992). The average number of spraint sites, density per km and total number of spraint sites were reported on by season (Spring, Summer, Autumn and Winter). Carugati's (1995) study covered all of my

study sites, and the total number of spraint sites seen over a 12-month period (March 1993 - February 1994) were reported on by month and by season (wet and dry season) (Carugati, 1995; Perrin and Carugati, 2006). Khubeka et al. (2013) reported on the total number of spraint sites recorded over a four-month period in the dry season (July 2010 - September 2010) in two of my study sites, Stillerust and Kamberg.

To investigate differences in spraint site abundance between study periods, I used the ‘‘lme4’’ v.1.1-35.5 package within R (Bates et al., 2015) to perform a GLMM with Wald chi-square tests to explore the relationships between species and study period, while controlling for study site. All analyses were conducted in R v. 4.4.1 (R Core Team 2013).

RESULTS

Present Study

Surveys were undertaken annually from 2013, but only data from surveys undertaken between 2018-2023 (n=6), when the survey team received training, and the methods used (but see below) were consistent and reliable, were used in the analyses.

During the 2018-2023 surveys, an oxbow lake at Stillerust was excluded for the first two years (2018 and 2019). An average of 2.75 spraint sites of African clawless otter and 3.25 of spotted-necked otter were seen in the four years that the oxbow was surveyed (2020-2023). I tested whether the exclusion of the oxbow area in the first two years affected the results by removing all spraints identified at the oxbow at Stillerust. The exclusion affected the significance values; therefore, the data from the oxbow were excluded for comparisons between species, years and sites in my study, but the average values obtained for both species from four years (2020-2023) were included for between study comparisons. The use of the boat at Kamberg and Stillerust for three of the six years, during 2019-2021, was assumed not to affect the results since it improved the detection of sign such as tracks and slides rather than spraint sites.

The total numbers of spraints recorded from 2018-2023 are shown by species, study site and survey year (Table 1). There was a significant difference in spraint site abundance between species (χ^2=34.22, df=1, P<0.001) and sites (χ^2=12.16, df=3, P=<0.05), but not between years (χ^2=1.89, df=5, P=0.864). The average number of spotted-necked otter spraints accounted for this significant effect (P<0.001), with a higher average number of spraints than African clawless otter at every site apart from Kamberg where the average abundance of spotted-necked otter spraints (n=15) was slightly lower than the average abundance of African clawless otter spraints (n=16) (Table 1), accounting for the effect of this study site (P=<0.1), although this was not highly significant.

When controlling for study site, the difference in spraint abundance between years was not significant overall ($\chi^2_{(5)}$=8.16, P=0.148), although 2021 showed the most significant effect (P<0.01). The number of African clawless otter spraints was lowest in Lotheni in 2021 (n=10) and highest in Kamberg in 2021 (n=20) and 2022 (n=23) (Table 1). The number of spotted-necked otter spraints, on the other hand, was much lower in Kamberg (n=7) and higher in Lotheni (n=60) in 2021 than in other years (Table 1).

Table 1. The total number of otter spraint sites recorded at the four study sites in uKhahlamba Drakensberg Park between 2018-2023 (where the number of main sites or latrines are in parentheses and included in the total number of sites).

Species	Study Site	Year						Average ± Standard Deviation
		2018	2019	2020	2021	2022	2023	
African clawless otter	Cobham	10 (5)	13 (8)	14 (6)	9 (3)	7 (1)	3 (3)	9 ± 4.03
	Lotheni	18 (7)	11 (2)	26 (8)	10 (5)	30 (14)	15 (12)	18 ± 8.12
	Kamberg	4 (3)	19 (6)	18 (4)	20 (9)	23 (17)	11 (9)	16 ± 7.02
	Stillerust	9 (8)	6 (2)	6 (3)	16 (6)	23 (13)	1 (1)	10 ± 7.98
Spotted-necked otter	Cobham	30 (4)	37 (6)	48 (6)	38 (8)	28 (6)	40 (16)	37 ± 7.22
	Lotheni	34 (5)	41 (4)	36 (4)	60 (10)	30 (2)	36 (11)	40 ± 10.65
	Kamberg	19 (5)	24 (5)	12 (2)	7 (1)	12 (4)	18 (2)	15 ± 6.28
	Stillerust	18 (10)	25 (4)	19 (1)	33 (7)	23 (11)	48 (21)	28 ± 11.31

Differences in the Abundance of Otter Spraints

There was a significant difference in otter spraint site abundance between study periods ($\chi^2_{(3)}$=17.24, P<0.001) and the relationship between species and study periods ($\chi^2_{(3)}$=31.99, P<0.001), when controlling for study site.

Pairwise comparisons showed that the number of African clawless otter spraint sites differed significantly between the 1993-1994 and the 2010 study (P<0.05), with numbers being much lower at Stillerust in 2010 (n=5) than in 1993-1994 (n=20) (Fig. 2).

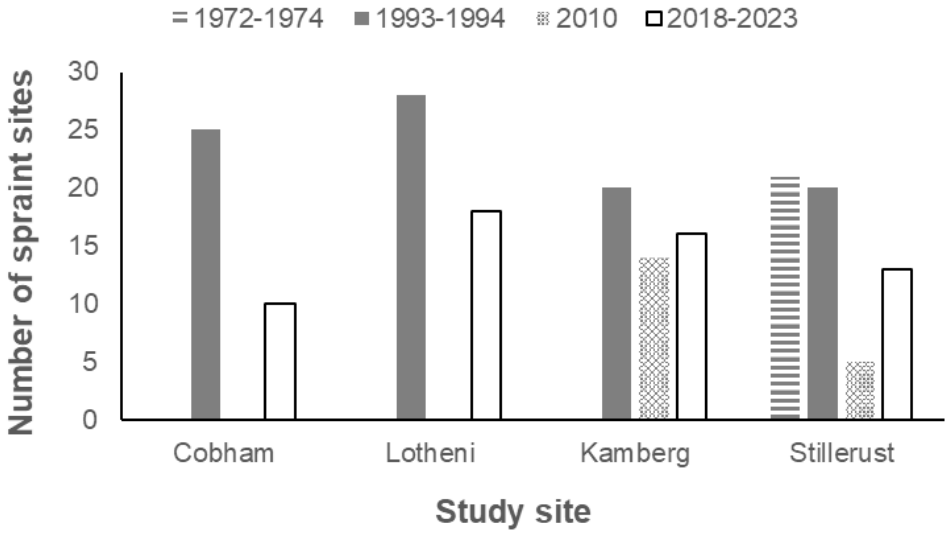

Figure 2. The average number of **African clawless otter** spraint sites at each of four study sites over four time periods in uKhahlamba Drakensberg Park: 1972-1974 (Rowe-Rowe, 1992); 1993-1994 (Perrin and Carugati, 2006); 2010 (Kubheka et al., 2013) and this study 2018-2023. N=6 for each study.

The difference in the number of spotted-necked otter spraint sites was highly significant between the 1993-1994 study and my study (P<0.001) with numbers being much higher at three of the four study sites in my study (Fig. 3). The difference in the number of spotted-necked otter spraint sites was also highly significant between 2010 and my study (P<0.001) with numbers being much higher in Stillerust in my study (n=31) than in the 2010 study (n=4).

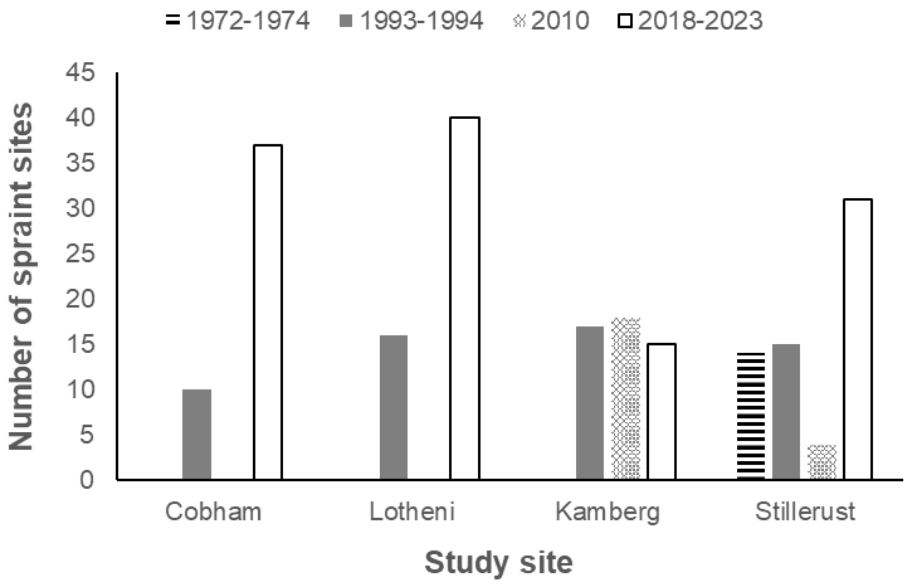

Figure 3. The average number of **spotted-necked otter** spraint sites at each of four study sites over four time periods in uKhahlamba Drakensberg Park: 1972-1974 (Rowe-Rowe, 1992); 1993-1994 (Perrin and Carugati, 2006); 2010 (Kubheka et al., 2013) and this study 2018-2023. N=6 for each study.

Overall, spotted-necked otter spraint abundance remained similar in Kamberg in the past 30 years, whereas numbers at the other study sites were higher in recent years (Fig. 3). On the other hand, African clawless otter spraint abundance was lower overall during the current study period than it was 30 years ago (Fig. 2).

DISCUSSION

This study has shown differences in spraint site abundance between otter species and study sites. Although I was not able to determine the density of the two otter species coexisting at the four study sites in uKhahlamba Drakensberg Park, the evidence of sign is useful to obtain a trend in the abundance of both species.

Although no significant differences in sign were found over the past six years, there were marked differences in that there was less evidence of African clawless otter recently than in the past, whereas there is currently more evidence of spotted-necked otter. When comparing my results with those of a previous study covering all study sites (1993-1994), the only notable difference was in the number of spotted-necked otter spraint sites, that were higher in my study. There were also notable differences in African clawless sign between 1993-1994 and 2010, and in spotted-necked otter spraint abundance between 2010 and the present.

Earlier studies revealed a regular abundance of African clawless otter sign (Rowe-Rowe, 1992; Perrin and Carugati, 2006), whereas a more recent study showed that numbers of both species had declined, particularly at Stillerust (Khubeka et al., 2013). The lack of otter sign at Stillerust in 2010 was attributed to the impacts of a densely populated subsistence farming settlement and intensive commercial dairy farming, leading to river health deterioration downstream (Khubeka et al., 2013). The substantial increase in otter sign in my study, about 20 years later, is unexpected. I predicted a further decrease in otter sign over time with the increased human population of the settlement and the intensification of farming leading to further degradation of the riverine habitat. Further investigation into the drivers of this increase is required. The Cobham, Kamberg and Lotheni study sites are within a protected area; therefore, little

change in otter spraint site abundance was expected between 1993-1994 and the present.

The greater amount of sign of spotted-necked otter than that of African clawless otter presents a conundrum. Based on all African studies, Rowe-Rowe and Somers (1998) concluded that the spotted-necked otter has evolved more as a piscivorous otter and is, therefore, dominant in the fish-rich lakes and large rivers. The African clawless otter, on the other hand, is well-adapted for the capture and consumption of crabs and is thus the dominant otter in waters which are poor in fish faunas but rich in crabs, as is the case in Drakensberg rivers and minor streams. The findings of this study, therefore, deserve further investigation, particularly in terms of prey availability.

I recommend an investigation into the drivers of the decline in African clawless otter spraint sites and the increase in spotted-necked otter spraint sites. Further studies can be undertaken to determine the factors that most influence the annual fluctuations in the numbers of spraint sites of both species. The spotted-necked otter is more aquatic than the African clawless otter (Lejeune and Frank, 1990; Rowe-Rowe and Somers, 1998); therefore, I would expect higher numbers with improved water quality and quantity. Prey availability and water flow levels can be used as surrogates for water quality and quantity, respectively. Prey availability can then be compared with that reported by Perrin and Carugati (2000), which may help clarify why more spotted-necked otter sign was noted in the current study. Both species require some degree of cover along the riverbank (Carugati, 1995; Lejeune and Frank, 1990; Rowe-Rowe, 1992); therefore, the fire management programme (whether the riverbank has burnt or not) will indicate the available vegetation cover. The location of the river (whether in the catchment area or further downstream) will provide a further indication of the value of the protected area in conserving these riparian carnivores.

I recommend regular monitoring of otter populations at the four study sites, as well as a baseline survey of additional suitable rivers in the central and northern sections of uKhahlamba Drakensberg Park. Otters as apex predators are indicators of freshwater ecosystem health (Rowe-Rowe, 1995). Surveys of water quality and prey availability will provide a good indication of river health. Regularly monitoring these aspects at all study sites and other major rivers in the protected area could indicate changes at an early stage, which can then be addressed before the situation worsens.

CONCLUSIONS

Jenkins and Borrows (1980) studied otter distribution using the location of spraints and concluded that change in the number of spraints only gives an approximation of the change in the number of otters. However, I suggest, based on the data presented here, that regular surveys are sufficient to monitor the presence of these species and that the use of sign, in particular the density of spraints sites, allows comparisons between years and studies.

The results of this study suggest that uKhahlamba Drakensberg Park continues to contribute significantly to otter conservation in the country, specifically spotted-necked otter. The healthy increase in the number of spraint sites of spotted-necked otter is encouraging, considering its vulnerable status. The decrease in the sign of African clawless otter from the original study is concerning and requires further investigation.

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RÉSUMÉ: SUIVI DE L'ABONDANCE DES LOUTRES DANS LE PARC DRAKENSBERG D'UKHAHLAMBA EN AFRIQUE DU SUD

Le parc Drakensberg d'Ukhahlamba est l'une des plus grandes et des plus importantes zones protégées d'eau douce intérieures d'Afrique du Sud pour la loutre à joues blanches *Aonyx capensis* et la loutre à cou tacheté *Hydrictis maculicollis*. L'abondance

relative des deux espèces a été estimée en enregistrant le nombre de sites d'épreintes dans quatre localités sur trois grands fleuves du parc pendant six années consécutives à la même période chaque année. Les résultats ont été comparés aux enquêtes précédentes effectuées dans les années 1970 et 1990 dans les quatre localités, et en 2010 dans l'une d'entre elles, en utilisant les mêmes méthodes. L'abondance des sites d'épreintes de loutres dans cette étude différait significativement entre les espèces et les sites d'étude, mais pas d'une année à l'autre, la loutre à cou tacheté étant plus abondante que la loutre à joues blanches. Il y avait une différence significative dans l'abondance des sites d'épreintes de loutres entre les périodes d'étude, et la relation entre les espèces et les périodes d'étude. Les résultats ont indiqué que la population de loutres du parc n'avait pas diminué de manière significative au cours des 30 dernières années. L'étude actuelle a permis de mettre en évidence qu'il y avait davantage d'indices de présence de loutre à cou tacheté, alors que dans les études précédentes, les indices de présence de loutre à joues blanches étaient plus abondants. Le parc continue donc de contribuer à la conservation des loutres dans le pays, en particulier, celle de la loutre à cou tacheté. D'autres études sont nécessaires pour déterminer les facteurs à l'origine des fluctuations annuelles du nombre de d'indices de présence et de l'augmentation substantielle des indices de présence de loutre à cou tacheté dans le parc ces dernières années.

RESUMEN: MONITOREO DE LA ABUNDANCIA DE NUTRIAS EN EL PARQUE UKHAHLAMBA, SUDÁFRICA

El Parque uKhahlamba Drakensberg es una de las áreas protegidas de aguas dulces continentales más grandes y más importantes en Sudáfrica, tanto para la nutria sin uñas Africana Aonyx capensis y la nutria de cuello manchado Hydrictis maculicollis. La abundancia relativa de ambas especies fue estimada registrando el número de sitios con fecas en cuatro localidades en tres ríos grandes en el parque, por seis años consecutivos, durante el mismo período cada año. Los hallazgos fueron comparados con relevamientos previos hechos durante los 1970s y los 1990s en las cuatro localidades, y en 2010 en una de ellas, utilizando los mismos métodos. La abundancia de sitios con fecas/marcas olorosas en este estudio difirieron significativamente entre especies y entre sitios de estudio pero no entre años, siendo más abundante la nutria de cuello manchado que la nutria sin uñas Africana. Hubo una diferencia significativa en la abundancia de sitios con fecas entre períodos de estudio, y en la relación entre especies y períodos de estudio. Los resultados indican que la población de nutrias del parque no ha declinado significativamente en los últimos 30 años. Una diferencia observada fue que en el presente estudio encontramos más signos de la nutria de cuello manchado, mientras que en los estudios previos fueron más abundantes los signos de nutria sin uñas Africana. El parque, por lo tanto, continúa contribuyendo a la conservación de nutrias en el país, particularmente la nutria de cuello manchado. Se requieren ulteriores estudios para identificar los determinantes de las fluctuaciones anuales en el número de signos, y del incremento sustancial de los signos de nutria de cuello manchado en el parque en años recientes.

R E P O R T

INTERGROUP CONFLICT AND MYIASIS-INDUCED MORTALITY IN A GIANT OTTER FROM THE BRAZILIAN PANTANAL: IMPLICATIONS FOR POPULATION CONSERVATION

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Abstract: Agonistic encounters, characterized by confrontations and conflicts, have been documented across various animal taxa. Intraspecific conflicts are more common in socially structured populations such as the giant otter (*Pteronura brasiliensis*), a gregarious and territorial species. Here, we present the evolution of injuries resulting from a territorial dispute between two giant otter groups during the dry season in a disturbed touristic area in the Brazilian Pantanal. The injuries of a dominant male showed an unfavorable progression of a myiasis leading to the individual's death and implications for the social dynamics of the group and for conservation of the population.

Keywords: zoonosis; sociobiology; wildlife tourism; *Pteronura brasiliensis*

INTRODUCTION

Agonistic encounters, characterized by confrontations and conflicts, have been documented across various animal taxa, including both aquatic and semi-aquatic mammals (Simpson, 2000; Ribas and Mourão, 2004; Jacobs et al., 2008). Intraspecific conflicts can arise from territorial, sexual and parental disputes, as well as instances of parental-child aggression, and are more common in socially structured populations (De Dreu and Triki, 2022). Intergroup conflicts are energetically costly and can involve severe injuries and even the death of individuals and disruption of social units (Ribas and Mourão, 2004).

The giant otter (*Pteronura brasiliensis*) is an endangered member of the Mustelidae Family, endemic to South America. It is an apex predator in aquatic systems, known for being a gregarious and territorial species. Giant otter groups typically consist of a reproductive couple and non-reproductive helpers, and it can range

in size from two to 20 individuals. They engage in complex social interactions (Leuchtenberger and Mourão, 2008) and although the alpha males play a predominant role in group defense, usually every individual within the group participates in agonistic encounters with rivals. Therefore, both the group size and the health of the alpha males serve as proxies for the group's defense capacity. This capacity is essential for the survival of giant otter groups, enabling them to secure larger and better territories and positively impacts the reproductive success of the alpha couple (Leuchtenberger et al., 2015).

Agonistic encounters between giant otter groups seem to occur more frequently during the dry season in the Pantanal (Leuchtenberger et al., 2015), when resources are limited to the water bodies' channels, and it coincides with the breeding time. A strategy used by giant otters to mitigate such encounters is scent-marking the banks along the water bodies within their territorial boundaries (Leuchtenberger and Mourão, 2009) and/or using vocalizations (calls) to advertise their presence to the neighboring group (Leuchtenberger et al., 2015; Potts et al. 2019). Nevertheless, it's noteworthy that this behavior does not prevent territorial overlap (Leuchtenberger et al., 2015). These agonistic interactions are aggressive, noisy, and risky (Ribas and Mourão 2004; Schweizer, 1992), as the species is equipped with sharp canines and claws that can cause lethal injuries (Rosas and Mattos, 2003). However, the evolutionary path of injuries leading to death remains unexplored.

Here, we present for the first time the evolution of myiasis resulting from a lesion caused by a territorial dispute in a giant otter, ultimately leading to the individual's death. This report highlights the implications for both individual health and social dynamics within the population, with significant implications for conservation efforts.

METHODS

The study area is located in the Northern Pantanal, Brazil, within the 'Encontro das Águas State Park' (56°W 39' 54", 17°S 14' 58"). The park is known as a prime location for jaguar safaris, attracting numerous tourist boats daily and providing ample opportunities to observe wildlife behaviors. The climate of the Pantanal is humid and tropical, characterized by hot, rainy summers and dry, sunny winters.

Between 2019 and 2023 a group of giant otters (hereafter referred to as G4) established their territory in this area. They were systematically observed during our population monitoring, as well as by tourist guides and professional photographers. The animals were identified using their individual throat pattern. The date and GPS coordinates of each observation were recorded to analyze their spatial movements and photographs were taken to document the group's behavior. Research activities were conducted with federal and state permits (SISBIO 85851-1, SEMA-MT-2017/2022).

RESULTS

During the five years of monitoring, the male named "Pai" and female named "Petri" endured as the reproductive couple of G4. The group size varied from three to seven individuals during this time (Supplementary Figure 1). In mid-2023, it finally split into two groups: one composed only by "Pai", "Petri" plus one adult male (named "A"); and another, composed by two otters, originated from G4 (the male "Nick", and the female "Starfish"). This second group established its territory nearby.

On July 11th, 2023, during the dry season, "Pai", "Petri" and "A" were observed fighting against an unknown giant otter group of four adults (Fig. 1A). Following the aggressive interaction, on the same day, "Pai" was observed with wounds and irregular lacerations on the right side of the face below the eye, extending to the mouth (Fig. 2A).

Flies could be observed landing close to injuries (Fig. 1B). Days later, we could also observe that Pai's scrotal sac exhibited a lacerating injury with the testicle exposed (Fig. 2B). The dominant female "Petri" had a small wound on its right front limb (Fig. 2C), while the subordinate male "A" had injuries on the front left paw with a marked difficulty in putting weight on it (Fig. 2D).

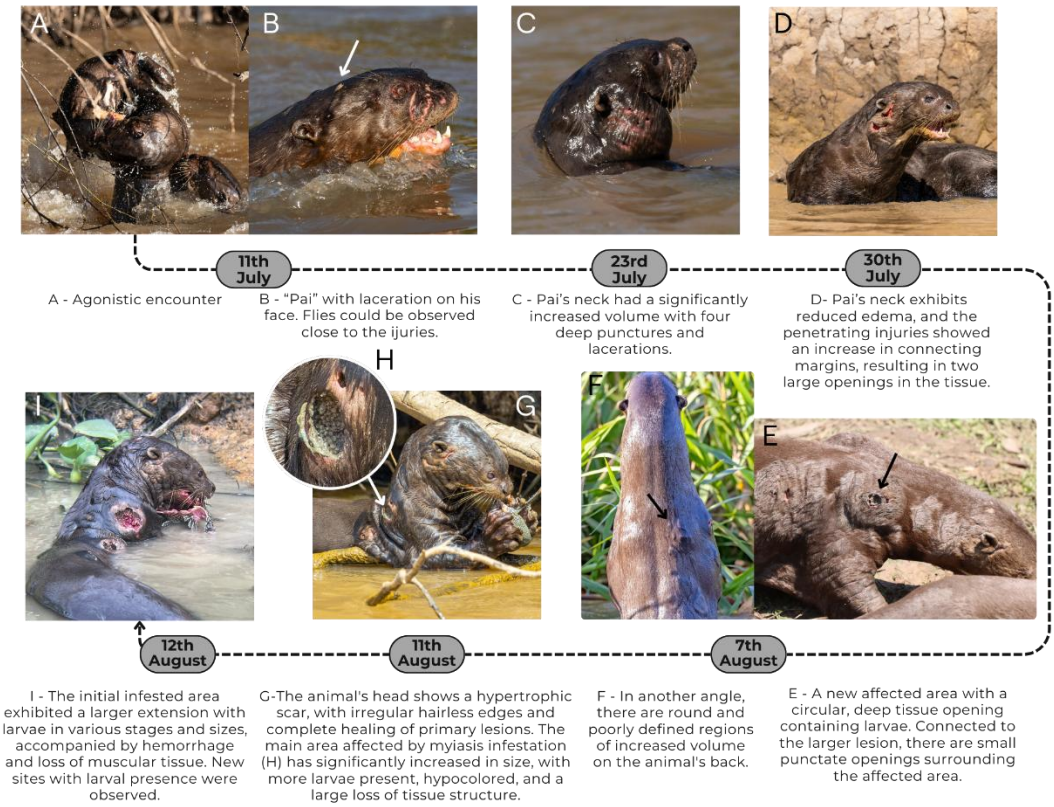

Figure 1. Timeline presenting the progress of the myiasis of a dominant giant otter male, after an agonistic encounter that occurred on July 11th 2023, in the Brazilian Northern Pantanal. (photo credits: A, B, C: Gustavo Gapari; D: Fabio Arruda/Barong House; E, F: Mark Thomas; G: Daniel De Granville; I: Cesar Moraga).

During subsequent monitoring, the injuries of "Pai" showed an unfavorable progression. On July 23th, his neck and head, which had previously been covered by fur, demonstrated a significant increase in swelling extending from the left ear to the ventral region, with four deep punctures and lacerations present (Fig. 1C).

In a new sighting, on July 30th, the animal was seen resting outside of the water, uncovering previously unnoticed lesions and a reduction in body condition score (Fig. 2B). Furthermore, abrasions were noticed on the cutaneous tissue on the left side of the neck (Fig. 2B). On the right side of the neck there was a reduction in edema, and the penetrating injuries showed an expansion in the connecting margins, resulting in two large openings in the tissue (Fig. 1D).

On August 7th, Pai's monitored injury on the neck showed almost complete reduction (Fig. 1E); there was no presence of edema, and the fur covered the site. A new affected area was seen on the animal's back, with a circular, deep opening containing larvae inside. Connected to the larger lesion, there are small punctate openings surrounding the affected area. Further down, new circular openings with larval infestation were present. From another angle, round and poorly defined regions of increased volume were found on the animal's back (Fig. 1F). The pattern and origin of the injury suggested new areas with the presence of myiasis, still covered by fur.

On August 11th, hypertrophic scar tissue, with irregular hairless edges was seen on the animal's head, along with complete healing of primary lesions. The same scar pattern could be seen on the paws while holding a fish (Fig. 1G). Nevertheless, the main area affected by myiasis infestation on the back showed a rapid increase in size, with more larvae, hypopigmentation, and significant loss of tissue structure (Fig 1H).

Figure 2. Injuries reported for a group of giant otters after an agonistic encounter on July 11th 2023, in the Brazilian Northern Pantanal. A: The dominant male "Pai" presents wounds with irregular lacerations on the right side of the face below the eye, extending to the mouth (photo: Gustavo Gaspari). B: The scrotal sac of "Pai" exhibited a lacerating injury, exposing the testicle (photo: Fabio Arruda/Barong House). C: The dominant female "Petri" had a wound on her right limb (photo: Fabio Arruda/Barong House); and D: The subordinate male "A" had injuries on his left front paw (photo: Fabio Arruda/Barong House).

In the last encounter, on August 12th, "Pai" was observed alone and outside the territory border of its original group. The initial infested area exhibited a larger extension, with larvae in numerous stages and sizes, accompanied by hemorrhage and loss of adipose and muscular tissue. New sites with larval presence were observed, with lesions continuously growing and becoming purulent through the parasites' feeding (Fig. 1I). This was the last observation of the individual.

On August 8th, the subordinate male "A" was observed scent-marking the territory more frequently than usual. By August 14th, the male "Nick" left his partner and joined "Petri" and "A", taking over the dominant position from that point forward.

On August 9th, two cubs were seen coming out of the den, estimated to be around 3 weeks old. Unfortunately, by mid-September, the cubs were last seen, indicating the loss of the offspring from the original G4 couple.

DISCUSSION

Our results showed that injuries resulting from conflicts among animals in their natural environment have the potential for unfavorable consequences, including

infections, tissue function loss, parasitic infestations and the death of individuals.

The affected otter in our study displayed a range of distressing clinical findings that persisted for nearly a month until its disappearance. These findings included loss of body condition, continuous bleeding in areas infested by larvae, the increase of lesions, and tissue loss due to larval feeding. The prolonged duration of these afflictions highlights the severe impact on the otter's health. These injuries not only led to potential secondary infections but also could have induced significant pain. Our study further contributes to the understanding of myiasis evolution and potentially lethal consequences of giant otter territorial disputes.

The main dipteran responsible for causing myiasis in wild and domestic animals in Brazil is *Cochliomyia hominivorax*, known as the New World screwworm (Costa-Júnior et al., 2019). This parasitic infestation also plays an important role in public health as a zoonotic disease in South America. The parasite lays its eggs in open wounds, which then develop into larvae and progress through instars. During this process, the larvae feed on living tissue and liquid body-substances causing lesions that are susceptible to new infestations (Batista-da-Silva et al., 2011; Costa-Júnior et al., 2019). This behavior was observed in our study on the male giant otter. Myiasis infestation caused by *C. hominivorax* was previously identified as the probable cause of death in a giant otter in the Brazilian Pantanal (Foerster et al., 2022).

The cumulative impact of these conditions on the animal's well-being extends beyond individual suffering, reducing its ability to fish and protect its habitat, and compromising its overall defensive capabilities. As expected for the social species, the disruption of social hierarchy, caused by the weakening of the dominant male in this case, can have negative effects on the group. This includes stress responses and longevity, decreased reproductive success, and loss of offspring (Tibbetts et al., 2022). In our study, the inflicted injuries disrupted the alpha male's hierarchical position within the group, further complicating the survivorship of the offspring and social dynamics. Since scent-marking plays an important role in giant otter communication, and, more specifically, in dominance hierarchy (Leuchtenberger and Mourão 2009), the decrease in scent-marking effort by the injured dominant male created new opportunities for the subordinate male to try to take the alpha's position. However, due to unspecified factors, this individual failed to secure this dominant position, allowing an earlier member ("Nick") to return to the group and assume the role of dominance.

Under certain circumstances it is expected that giant otter groups would be forced to suffer fission, disperse or die (Potts et al. 2019). In addition, G4 has established its territory in an area known for its high density of jaguars (Devlin et al., 2023), and routine conflicts with this predator are common (Leuchtenberger and Martin, 2020). Furthermore, the group faces disturbance from numerous tourist boats that visit the area daily during the dry season for jaguar safaris. The synergy of these factors, coupled with the advanced age of the dominant pair, may have influenced the reduction in the group's size in the last year and the consequent loss of defense capacity. These findings highlight the necessity for comprehensive conservation strategies that go beyond individual well-being and encompass broader ecological and social dynamics within natural habitats. Recognizing the intricate interplay between individual health, social structures, and ecological disturbances is crucial for the development and implementation of effective conservation measures for endangered species.

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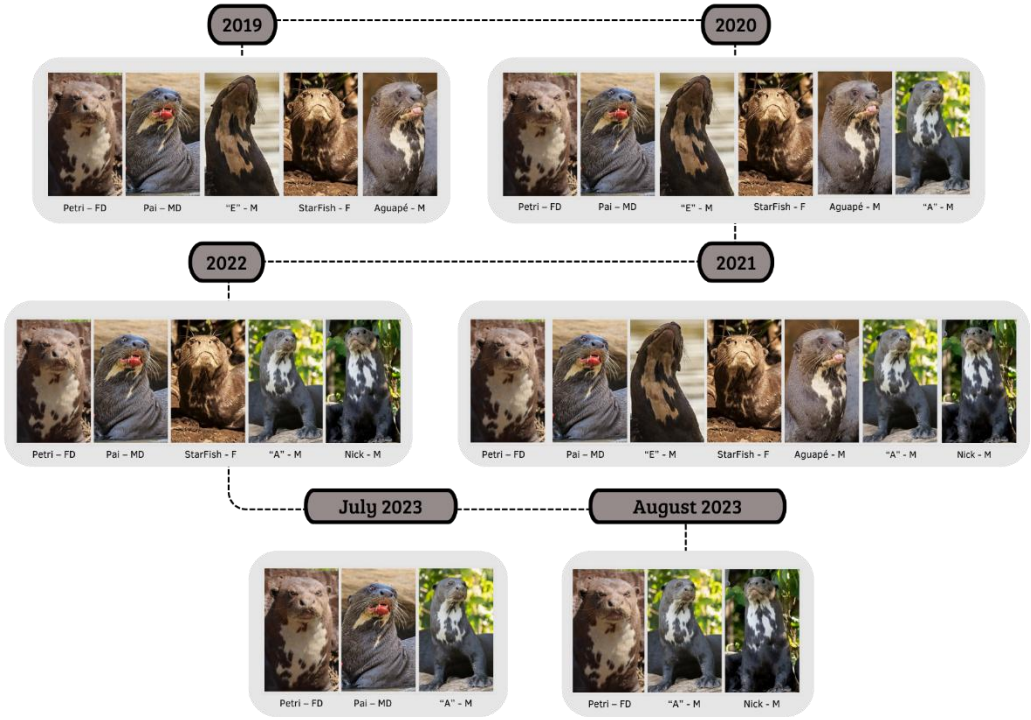
SUPPLEMENTARY MATERIAL



Supplementary Figure 1 - Composition of the giant otter group G4, resident at the river Três Irmãos, at the Encontro das Águas State Park, in the Northern Pantanal, Brazil, between 2019 and 2023. The name of each individual is written below the individual's picture of the throat pattern, besides the sex (F - female, M - male) and dominance position (D - dominant) of the individual within the group.

RÉSUMÉ: CONFLIT INTERGROUPE ET MORTALITÉ INDUITE PAR LA MYIASE CHEZ UNE LOUTRE GÉANTE DU PANTANAL BRÉSILIEN: IMPLICATIONS POUR LA CONSERVATION DE LA POPULATION

Les rencontres agonistes, caractérisées par des confrontations et des conflits, ont été documentées chez divers taxons animaliers. Les conflits intraspécifiques sont plus fréquents dans les populations socialement structurées comme la loutre géante (*Pteronura brasiliensis*), une espèce grégaire et territoriale. Nous présentons ici l'évolution des blessures résultant d'un conflit territorial entre deux groupes de loutres géantes pendant la saison sèche dans une zone touristique perturbée du Pantanal brésilien. Les blessures d'un mâle dominant ont montré une progression défavorable d'une myiase conduisant à la mort de l'individu et des implications pour les dynamiques sociales du groupe et pour la conservation de la population.

RESUMEN: CONFLICTO ENTRE GRUPOS Y MORTALIDAD CAUSADA POR MIASIS EN UNA NUTRIA GIGANTE DEL PANTANAL BRASILEÑO: IMPLICANCIAS PARA LA CONSERVACIÓN DE LA POBLACIÓN

Los encuentros agonísticos, caracterizados por confrontaciones y conflictos, han sido documentados en diversas especies animales. Los conflictos intraespecíficos son más comunes en poblaciones estructuradas socialmente, como en la nutria gigante (*Pteronura brasiliensis*), una especie gregaria y territorial. En este estudio, presentamos la evolución de lesiones resultantes de una disputa territorial entre dos grupos de nutrias gigantes durante la estación seca en una zona turística alterada del Pantanal brasileño. Las lesiones de un macho dominante mostraron una progresión desfavorable de miasis que culminó en la muerte del individuo, con implicaciones para la dinámica social del grupo y la conservación de la población.

RESUMO: CONFLITO ENTRE GRUPOS E MORTALIDADE CAUSADA POR MIÍASE EM UMA ARIRANHA DO PANTANAL BRASILEIRO: IMPLICAÇÕES PARA A CONSERVAÇÃO POPULACIONAL

Encontros agonísticos, caracterizados por confrontos e conflitos, têm sido documentados em diversos taxa animais. Conflitos intraespecíficos são mais comuns em populações socialmente estruturadas, como no caso da ariranha (*Pteronura brasiliensis*), uma espécie gregária e territorial. Neste estudo, apresentamos a evolução das lesões resultantes de uma disputa territorial entre dois grupos de ariranhas durante a estação seca em uma área impactada pelo turismo no Pantanal brasileiro. As lesões de um macho dominante apresentaram miíase com progressão desfavorável, levando à morte do indivíduo, trazendo implicações para a dinâmica social do grupo e para a conservação da população.

R E P O R T

NORTH AMERICAN RIVER OTTER (*Lontra canadensis*) PREDATION ON BROWN PELICANS (*PELECANUS OCCIDENTALIS*) AT ABBOTTS LAGOON, POINT REYES NATIONAL SEASHORE, CALIFORNIA, USA

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Abstract: North American river otters (*Lontra canadensis*) are opportunistic predators whose diet preferences may have ecosystem effects. In Northern California, USA, river otters are a recovering species, and their diet commonly includes waterbirds. Beginning in 2018, we observed and documented river otter predation on Brown pelicans (*Pelecanus occidentalis*), a novel prey choice for river otters, at a coastal lagoon. To investigate this emerging predator-prey relationship, in 2023 we conducted repeated surveys from June through November to identify and document the carcasses of Brown pelicans that had been predated by river otters. In 19 surveys, we found 73 carcasses. Carcass counts on individual surveys ranged from 0 to 11, with a mean of 3.84 carcasses per survey. Comparing carcass counts to weekly average pelican abundance, as reported by eBird, we found a moderate correlation between the two. Based on the location of the largest grouping of pelicans we observed on each survey, we found no evidence that, in the aggregate, pelicans altered their pattern of use of the lagoon in response to predation. Spatial analysis of carcass distribution revealed no significant clustering, suggesting that predation occurred across different areas of the lagoon. This study sheds light on the dietary choices of river otters, and also highlights important ecological questions. Persistence of this predator-prey relationship may influence nutrient cycles, as pelican carcasses are a nutrient subsidy for local scavengers. Our findings underscore the need for further study into the long-term effects of river otter predation on pelican populations, and on broader ecosystem dynamics in coastal environments.

Citation: Carroll, T. and Isadore, M. (2025). North American River Otter (*Lontra canadensis*) Predation on Brown Pelicans (*Pelecanus occidentalis*) at Abbotts Lagoon, Point Reyes National Seashore, California, USA. *IUCN Otter Spec. Group Bull.* **42** (2): 71 - 84

Keywords: predator-prey relationships; novel prey choice; nutrient subsidy; recovering species; coastal ecosystem dynamics

INTRODUCTION

North American river otters (*Lontra canadensis*) are opportunistic predators whose diet varies seasonally according to availability of prey species (Melquist et al., 2003), and whose diet choices can have ecosystem effects (Crait and Ben-David, 2006, 2007; Garwood, 2013). In parts of Northern California, USA, river otters are a recovering species (Schempf and White, 1977; Bouley et al., 2015), and their diet commonly includes various species of waterbirds (Penland and Black, 2009; Oates et al., 2019; Cosby and Szykman Gunther, 2021). Brown pelicans (*Pelecanus occidentalis*), marine-foraging seabirds that typically weigh approximately 3 to 4 kg and have a wingspan of over 2m (Schreiber et al., 1989), are also a recovering species,

having been removed from Endangered Species Act protection in 2009 (USFWS, 2009; Jacques et al., 2016). Brown pelicans are present at Abbotts Lagoon (38°06'54.0"N 122°57'10.8"W), in Point Reyes National Seashore, California during the nonbreeding season, May to December, using the lower lagoon as a resting site.

Beginning in the fall of 2018, and continuing to the present time, River Otter Ecology Project (ROEP) has observed and documented evidence of river otter predation on Brown pelicans at Abbotts Lagoon. We have received observer reports both through our community-science "Otter Spotter" web portal (https://riverotterecology.org/otter-spotter-community-based-science/), and by emails directly from observers. Figure 1 shows examples of photographic evidence provided by observers. In addition, we personally observed a river otter attacking and drowning a Brown pelican at Abbotts Lagoon in October 2021. In September 2022, we personally observed a group of river otters feeding on a freshly-predated pelican carcass they had dragged to the shoreline of the lagoon.

Figure 1. Photographs of river otters and predated Brown pelicans at Abbotts Lagoon. (a) River otter dragging a Brown pelican carcass by the neck, October 2020. Submitted by Wendy Sparks and Jeff Torquemada. (b) River otters with a freshly-predated Brown pelican carcass, September 2023. Submitted by Everett Clark. (c) River otters feeding on a freshly-predated carcass of a Brown pelican, July 2024. Still frame from a video submitted by David Ford.

Brown pelicans are a novel prey choice for river otters. So far as is known, this predator-prey relationship only exists in California, and had only previously been observed and documented in 2006 at Rodeo Lagoon (37°49'51.4"N 122°31'55.9"W**),** 48 km southeast of Abbotts Lagoon, in the Golden Gate National Recreation Area, California (Salman, 2007), and in a single predation event in 1998 at Lake Tolowa

(41°50'06.1"N 124°12'58.5"W), 429 km north of Abbotts Lagoon, in Del Norte County, California (D. Jaques, personal communication, November 30, 2023). Moreover, while conflict with California Sea Lions at commercial fishing docks, causing adult pelican injury or mortality, has been reported (Duerr et al., 2023), and there have been anecdotal accounts of sharks or eagles attacking them (D. Jaques, personal communication, November 30, 2023), adult Brown pelicans in California have no other known predators (Nevins et al., 2011; Stinson, 2014; Duerr et al., 2023).

At Abbotts Lagoon, river otters consume both fish and water birds year-round (Oates et al., 2019), and their predation of pelicans is likely an extension of an existing pattern of prey choice, rather than a response to changes in abundance of prey species, as hypothesized by Salman (2007) at Rodeo Lagoon. River otters are opportunistic predators, but their prey selection is heavily influenced by the energetic costs of foraging in aquatic environments, including thermoregulation costs (Kruuk, 2006). As a result, they tend to favor larger, less-agile prey species, and employ repetitive use of successful foraging routes (Blundell et al., 2001; Kruuk, 2006; Thompson and Stelle, 2014; Day et al., 2015.). In addition, river otters can gain a thermoregulatory advantage from catching larger prey that can be consumed on the shoreline (Kruuk, 2006), including pelicans.

At Rodeo Lagoon, Salman (2007) hypothesized that eutrophication had reduced fish stocks there, and that river otters began consuming pelicans as a supplemental or replacement food source. The same eutrophication condition does not exist presently at Abbotts Lagoon, and river otter predation on pelicans here likely represents a different relationship between predator and prey, and consequently may have different ecological and management implications. For example, river otters are providing a nutrient subsidy to local coyotes (*Canis latrans*) and other scavengers in the form of pelican carcasses (Gerraty et al., 2024). If pelicans are a consistent diet preference, rather than an episodic replacement food source, the ecosystem effects of these nutrient subsidies are likely to be magnified and longer-lasting.

Another important question, in terms of ecosystem recovery and function, is whether the pressure from river otter predation at Abbotts Lagoon is having a substantial localized negative impact on pelicans. The local persistence of this predator-prey relationship over a number of years suggests not. However, prior to our investigation, no baseline studies had been carried out to quantify the extent or impacts of this predation. We hypothesized that river otter predation of pelicans at Abbotts Lagoon occurs at a low level with little relation to the local abundance of pelicans. We further hypothesized that, in the aggregate, the pelicans have been tolerant of the predation, and do not respond to it by altering their pattern of use of the area, either spatially or over time.

STUDY AREA AND METHODS

Study Area

Abbotts Lagoon (38°06'54.0"N 122°57'10.8"W) is a complex of 3 connected lagoons on the coastal portion of the Point Reyes peninsula (Fig. 2). The lower lagoon is the largest and deepest of the 3, and is used by Brown pelicans as a resting place. The middle lagoon is separated from the lower lagoon by a rock outcropping, and is connected to it by a narrow channel spanned by a footbridge. The upper lagoon, the smallest of the 3, is fed by several small freshwater streams, and is separated from the middle lagoon by an earthen berm. For this study, we collected data at the lower lagoon, and along portions of the middle lagoon shoreline immediately adjacent to the footbridge.

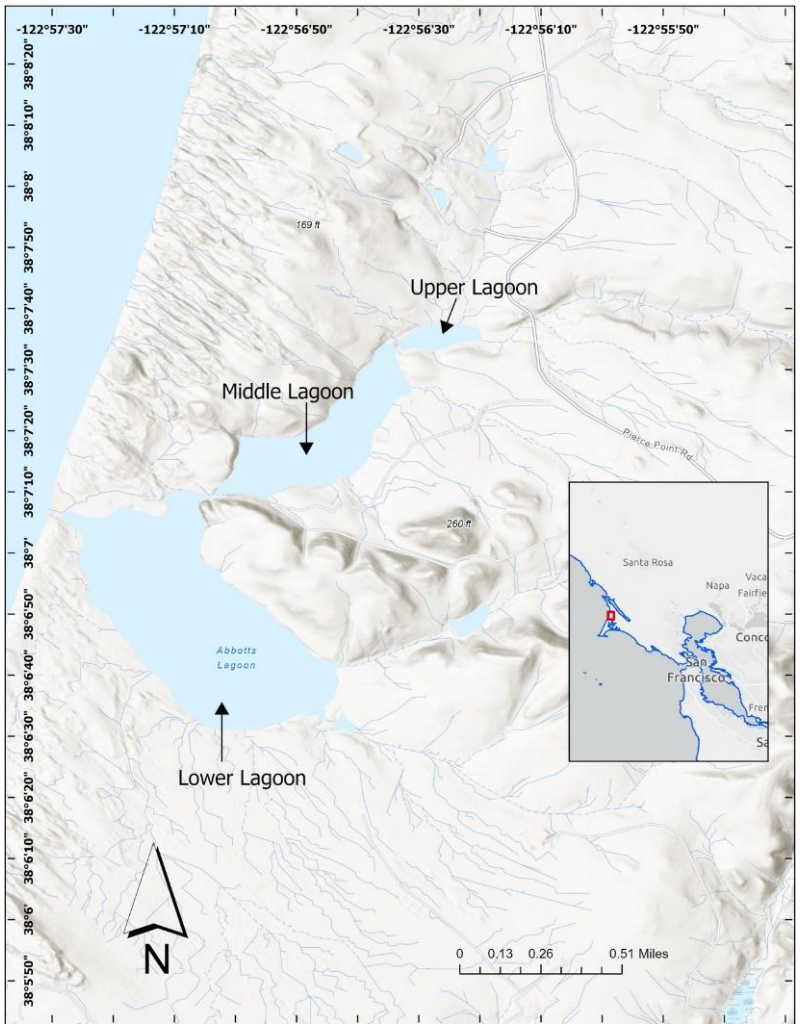

Figure 2. Map of the study area at Abbotts Lagoon, showing the lower lagoon in relation to the middle and upper lagoons, and the surrounding area.

Identification of Predated Pelican Carcasses

Based on observational data, we found that in the course of feeding on predated pelican carcasses, river otters severed the head and neck from the body, likely to facilitate access to the flesh in the pelican's breast area (see Fig. 3 for an example). With this understanding, we were able to identify pelican carcasses that likely had been predated by river otters (see Fig. 4 for examples).

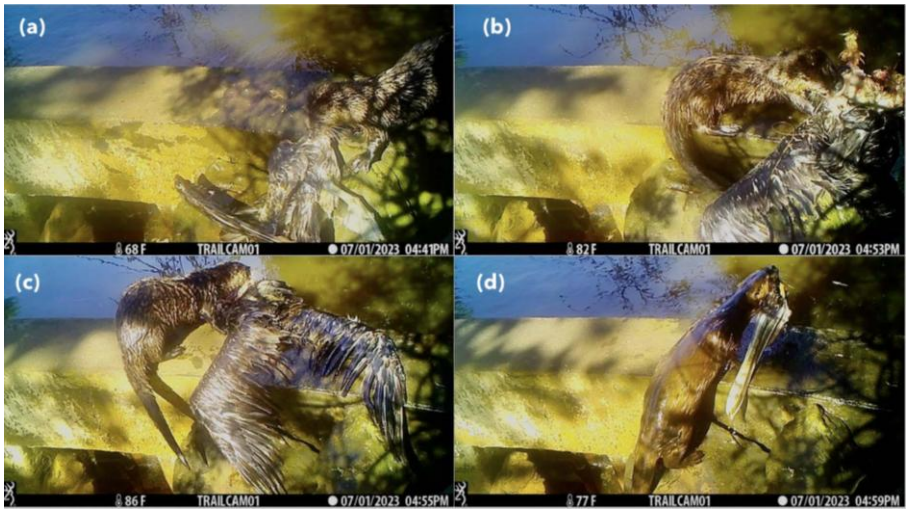

Figure 3. Still frames from a video sequence captured by a ROEP research camera at Rodeo Lagoon in July 2023 showing river otters with a freshly-predated Brown pelican carcass. (a) River otter drags the carcass on to a small concrete dam. (b) River otter feeds on exposed flesh in the breast area of the pelican. (c) River otter drags the carcass over the dam. (d) A second river otter carries the carcass's severed neck and head over the dam.

Figure 4. Examples of carcasses of predated Brown pelicans found at Abbotts Lagoon during ROEP surveys. (a) Carcass found in July 2023. (b) Severed head of the same carcass found <1m away. (c) Carcass found in October 2023. (d) Severed head and neck of the same carcass found <1m away. (e) Carcass with severed head and neck found in August 2023.

Carcass Data Collection

We established 4 survey areas along the perimeter of the lower lagoon and small portions of the middle lagoon near the footbridge (Fig. 5). From June through November 2023, we surveyed the perimeter of the lagoon approximately every 7 to 10 days. On each survey, we documented each predated pelican carcass we found, photographing it and mapping its location using Survey123 (ESRI, Redlands CA). To avoid double-counting, we used a fluorescent non-toxic permanent marking pen to mark the beak and larger bones of each documented carcass.

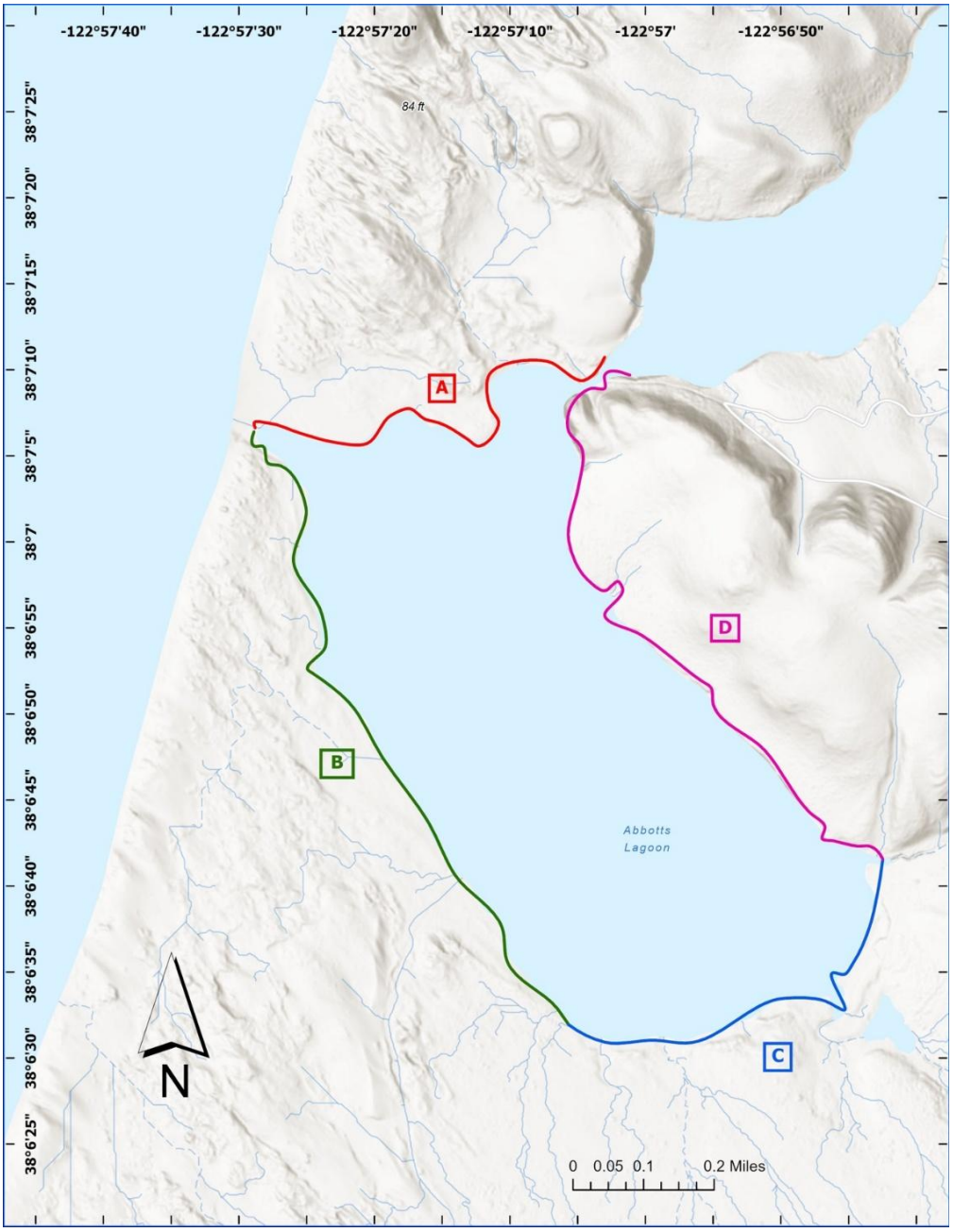

Figure 5. Locations and extents of the four survey areas at Abbotts Lagoon used during data collection for the study.

We assumed that carcasses found on the first survey were from pelicans predated prior to the study period, and did not include them in the data used for this study. In

addition, from June through August, survey area B on the southwestern side of the lagoon was inaccessible due to a seasonal closure to protect nesting Western snowy plovers (*Charadrius nivosus nivosus).* Survey area C, at the southern end, was also inaccessible due to inundation of the area, and the need to reach it by crossing a stream that we determined was too wide and deep to safely ford. During June through August, therefore, on each survey we used binoculars or a spotting scope to scan areas B and C, and used Survey123 to record the locations of any suspected carcasses. During our first survey of areas B and C in September we verified or discounted the presence and location of those carcasses.

Pelican Presence and Abundance Data

On each survey, we used Survey123 to record our count of the number of resting pelicans present at the lagoon, and the approximate location of the largest grouping. As a proxy for pelican abundance, we used data from eBird [eBird, 2023]. Specifically, we used eBird's Average Count data point for the week immediately preceding each survey date. Average Count represents the weekly average of the number of pelicans reported by observers who included Brown pelicans on a checklist of birds seen that they submitted for Abbotts Lagoon.

Data Analysis

For carcass data collected in survey areas B and C on our first survey in September, we matched carcasses found to the survey dates on which our visual scans first identified those suspected carcasses. For other carcasses found on in areas B and C on that survey, we used the condition of the carcass to estimate how long ago the pelican had been predated, and we accordingly assigned those carcasses to a survey date in July or August.

To assess the relationship, if any, between pelican abundance and predation by river otters, we used R version 4.3.3 (The R Foundation for Statistical Computing) to calculate the Spearman's Rank Correlation between the eBird Average Count and our count of carcasses for each survey period. We considered a P-value <.05 to be significant.

To assess whether pelicans, in the aggregate, altered the spatial pattern of their use of the lagoon in response to predation, we mapped our observations of the largest groupings in ArcGIS Pro 3.1 (ESRI, Redlands CA). We then used ArcGIS Pro's Mean Center function to determine the central point of those groupings for each month of the study period.

To assess whether the predation of pelicans was concentrated in particular areas of the lagoon, we used the ArcGIS Pro Optimized Hot Spot Analysis tool on the mapped locations of the carcasses. The tool performs a series of tests and operations on the spatial data to aggregate the points within the cells of a fishnet grid, and then produces a Getis-Ord Gi* statistic for each cell. The resulting z-scores and p-values describe the extent of the data's spatial clustering. We considered a z-score greater than 1.96 and a P-value less than .05 to be significant.

RESULTS

Carcass Data Collection

During the study period we completed a total of 19 surveys. The first 10 surveys covered only Survey Areas A and D, with visual scanning of the opposite shoreline using binoculars or a spotting scope. The remaining 9 surveys covered the entire perimeter of the lower lagoon. Over the course of the surveys, we counted a total of 78

pelican carcasses, 73 of which we identified as having been predated by river otters during the study period. The other 5 were either too old or too fragmentary to allow for a conclusion that mortality occurred during the study period. Predated carcass counts on individual surveys ranged from a low of 0 to a high of 11 ($\overline{x}$=3.84, *SD*= 3.24) (Table 1). The locations of the carcasses are shown in Figure 6.

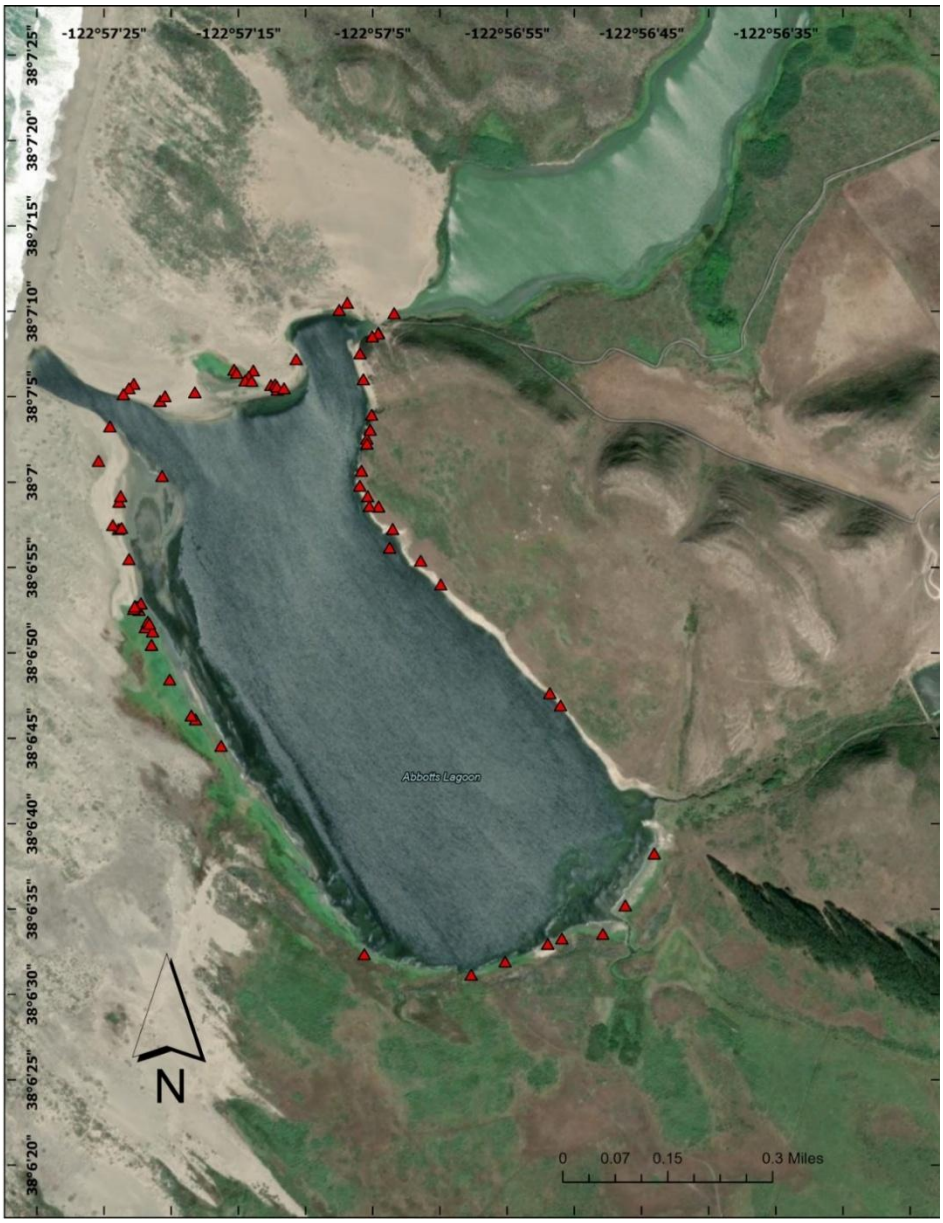

Figure 6. Locations of the 73 predated Brown pelican carcasses documented during June through November 2023 at Abbotts Lagoon.

Pelican Presence and Abundance Data

Our counts of pelicans present on the lower lagoon ranged from a low of 0 to a high of 300 ($\overline{x}$ = 35.47, *SD* = 67.46). Weekly Average Counts from eBird ranged from a low of 5.20 to a high of 73.48 ($\overline{x}$ = 36.55, *SD* = 17.77) (Table 1).

Table 1. Dates of Abbotts Lagoon surveys, with the number of new pelican carcasses identified, the eBird-reported average Brown pelican count for the prior week, and the number of resting pelicans counted during the survey, with means and standard deviations (SD).

Survey Date	Count of New Carcasses	eBird Weekly Average Pelican Count	ROEP Survey Pelican Count
6/6/2023	1	5.20	10
6/15/2023	0	14.75	19
6/25/2023	1	12.91	10
7/7/2023	3	56.57	40
7/14/2023	3	41.77	15
7/22/2023	4	73.48	15
7/29/2023	4	33.09	0
8/8/2023	11	35.85	6
8/15/2023	4	67.83	7
8/26/2023	4	44.37	72
9/5/2023	0	30.13	33
9/15/2023	7	51.90	22
9/26/2023	6	42.37	65
10/8/2023	10	44.58	300
10/15/2023	8	28.50	10
10/21/2023	2	30.18	0
11/1/2023	1	32.29	0
11/12/2023	1	28.10	5
11/26/2023	3	20.56	45
Mean	3.84	36.55	35.47
SD	3.24	17.77	67.46

Data Analysis

The Spearman's Rank Correlation between eBird Average Count and our count of carcasses for each survey period showed a moderate positive correlation between the two, with $r(17) = .60$, $P=0.006$. The spatial pattern of pelican use of the lagoon showed no apparent response to predation over time, with the monthly mean centers of pelican grouping all remaining in the northern half of the lagoon throughout the study period (Fig. 7).

The ArcGIS Pro Optimized Hot Spot Analysis Tool aggregated the carcass location points into 44 grid cells. From the calculation of the *Getis-Ord Gi** for each cell, no *z*-scores exceeded 1.96, and all *P*-values were >0.05, indicating that the carcass locations were not significantly clustered in any part of the lagoon shoreline.

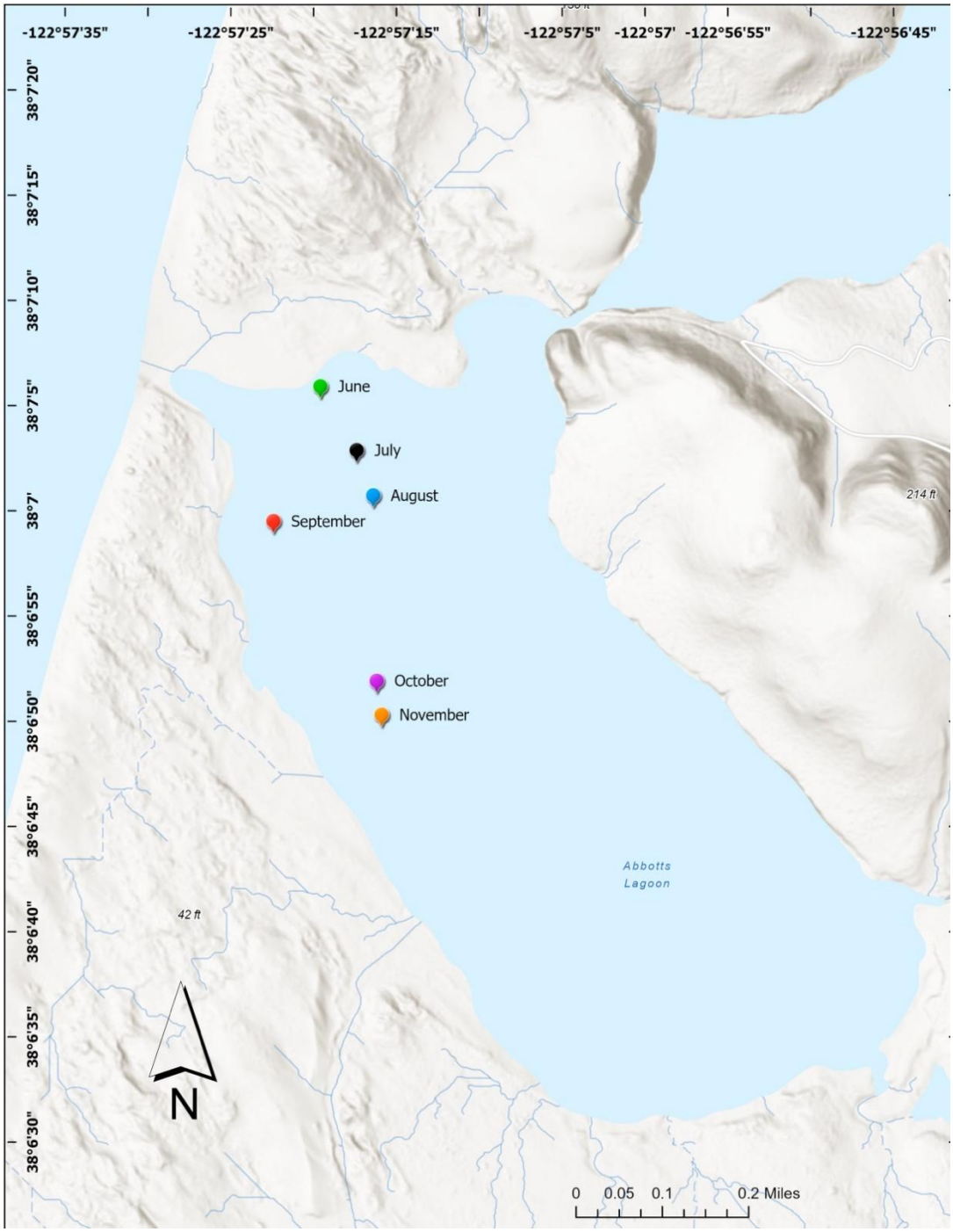

Figure 7. Monthly mean center locations of Brown pelican groups resting at Abbotts Lagoon.

DISCUSSION

The weight of the evidence from our study strongly suggests that at Abbotts Lagoon, river otters are the sole predator of Brown pelicans, and our results indicate that this predation occurred on a consistent basis throughout the study period. On 17 of our 19 surveys, we found carcasses of pelicans that had been predated since the prior survey. In addition, the 73 carcasses we identified likely represent a conservative estimate of the true extent of predation levels. Given the inaccessibility of survey areas B and C until September, as well as the likelihood of scavengers carrying off carcasses between surveys, we assume that a number of carcasses went uncounted.

Contrary to our first hypothesis, we found a moderate correlation between pelican abundance at the lagoon and the level of predation by river otters. It may be that larger groupings of pelicans resting on the lagoon include more isolated individuals around the periphery of the group, facilitating predation by river otters. The apparent correlation may also be an artifact of our use of weekly abundance counts, rather than the actual number of pelicans present during a predation event. Alternatively, it could be particular to circumstances at the lagoon during the study period, including the number of river otters present. During our surveys, we observed and documented a total of 9 river otters, including 3 adult females and 6 pups. Further study over multiple years would be required to assess whether the apparent correlation persists, given variability in local river otter and Brown pelican abundance from year to year.

Consistent with our second hypothesis, we found no evidence that, in the aggregate, pelicans responded to predation by river otters by altering their pattern of use of the lagoon during the study period. As shown in Figure 7, the monthly mean center of pelican groupings moved generally southward over the course of the study period, but never moved south of latitude 38°06'54.0"N, roughly the middle latitude of the lower lagoon. No pelicans were observed south of that point at any time during our surveys. During the summer months, the surface area of the lower lagoon recedes due to evaporation, seepage, and diminished inflows (Kratzer et al., 2006). The southward movement of pelican groupings over time is consistent with movement to the deeper area of the lagoon. The persistence of the groupings in northern half of the lagoon suggests that, in the aggregate, pelicans are not moving to avoid predation.

Our analysis of the spatial distribution of pelican carcasses around the lower lagoon did not show significant clustering in any area. Any given location where we found the carcasses may not be indicative of predation occurring in close proximity. From observational reports and photographic evidence, we have documented that river otters sometimes tow or drag carcasses for some distance before consuming them. The presence of carcasses along the southern shoreline of the lower lagoon, where pelicans are unlikely to be present, also illustrates this dynamic.

Persistent predation of Brown pelicans by river otters is a novel phenomenon, and no similar studies exist to which to compare our results. Salman (2007) focused on frequency of occurrence of pelican remains in otter scat, and also incidentally reported finding 30 pelican carcasses at Rodeo Lagoon, but he collected data mainly in the months of October and the following March. Our research camera at Rodeo Lagoon (Carroll et al., 2020) captured video of rivers otters with a predated pelican in July 2023, but opportunistic surveys of the area did not reveal evidence of persistent widespread predation. The concurrent episodic predation there, and concurrent persistent predation at Abbotts Lagoon, presents a valuable research opportunity for studying this phenomenon in greater depth. Future research should include a study to determine the relative frequency of Brown pelicans as a prey item in river otter diet. A comparative study at the two lagoons could yield insight into the importance of Brown pelicans as a prey species for river otters, the local ecosystem effects of the predation, and the effects of predation on local Brown pelican populations.

Further study could also offer insight into Brown pelican behavior in the presence of a novel predator. Our results suggest that Brown pelicans have yet to develop behaviors to adapt to, or counteract, predation by river otters. However, on several subsequent opportunistic surveys during the late summer of 2024 we identified only 3 pelican carcasses along survey area A (Fig. 5), where there had been approximately 20 the at the same time in the prior year. These recent surveys suggest that the level of predation may have decreased. Further, during those surveys we observed a group of

resting pelicans flush when a river otter approached. An observer at Rodeo Lagoon reported a similar interaction in August 2024. These observations are the first known reports of avoidance behavior on the part of Brown pelicans in the presence of river otters.

This study serves as a baseline from which to increase and enrich our understanding of an emerging predator-prey relationship between two recovering species in North-central California. Investigation of links among pelican habitat use, river otter predation behavior, and any consequent trophic subsidies may be a useful avenue for future research.

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RÉSUMÉ: PRÉDATION DE PÉLICANS BRUNS (*Pelecanus occidentalis*) PAR LA LOUTRE DE RIVIÈRE D'AMÉRIQUE DU NORD (*Lontra canadensis*) AU LAGON D'ABBOTTS, POINT REYES NATIONAL SEASHORE, CALIFORNIE, ÉTATS-UNIS

Les loutres de rivière d'Amérique du Nord (*Lontra canadensis*) sont des prédateurs opportunistes dont les préférences alimentaires peuvent avoir des effets sur l'écosystème. Aux États-Unis dans le nord de la Californie, les loutres de rivière sont une espèce en voie de rétablissement et leur régime alimentaire comprend généralement des oiseaux aquatiques. À partir de 2018, nous avons observé et documenté la prédation des loutres de rivière sur les pélicans bruns (*Pelecanus occidentalis*), une nouvelle sélection de proie pour les loutres de rivière, dans une lagune côtière. Pour étudier cette relation proie-prédateur émergente, nous avons mené en 2023 des enquêtes répétées

entre juin et novembre afin d'identifier et documenter les carcasses de pélicans bruns qui avaient été prédatées par les loutres de rivière. Lors de 19 enquêtes, nous avons trouvé 73 carcasses. Le nombre de carcasses lors des enquêtes individuelles variait entre 0 et 11, avec une moyenne de 3,84 carcasses par enquête. En comparant le nombre de carcasses à l'abondance moyenne hebdomadaire des pélicans, telle que rapportée par eBird, nous avons trouvé une corrélation modérée entre les deux. En nous basant sur la localisation du plus grand groupe de pélicans que nous avons observé lors de chaque étude, nous n'avons, dans l'ensemble, trouvé aucune preuve que les pélicans aient modifié leur mode d'utilisation du lagon en réponse à la prédation. L'analyse spatiale de la distribution des carcasses n'a révélé aucun regroupement significatif, ce qui suggère que la prédation s'est produite dans différentes zones du lagon. Cette étude met en lumière les choix alimentaires des loutres de rivière et met également en évidence d'importantes questions écologiques. La persistance de cette relation proie-prédateur peut influencer les cycles nutritifs, car les carcasses de pélicans constituent un apport complémentaire en nutriments pour les charognards locaux. Nos résultats soulignent la nécessité d'étudier plus en détail les effets à long terme de la prédation des loutres de rivière sur les populations de pélicans et sur la dynamique plus large des écosystèmes dans les environnements côtiers.

RESUMEN: PREDACIÓN SOBRE PELÍCANOS MARRONES (*Pelecanus occidentalis*) POR PARTE DE NUTRIAS DE RÍO NORTEAMERICANAS (*Lontra canadensis*) EN LA LAGUNA ABBOTTS, COSTA NACIONAL POINT REYES, CALIFORNIA, EEUU

Las Nutrias de río Norteamericanas (Lontra canadensis) son predadores oportunistas, cuyas preferencias dietarias pueden tener efectos ecosistémicos. En el Norte de California, EEUU, las nutrias son una especie en recuperación, y su dieta comúnmente incluye aves acuáticas. Comenzando en 2018, observamos y documentamos predación por parte de nutrias sobre Pelícanos Marrones (Pelecanus occidentalis), una elección de presas novedosa para las nutrias, en una laguna costera. Para investigar ésta relación predador-presa emergente, en 2023 condujimos relevamientos repetidos desde Junio hasta Noviembre para identificar y documentar las carcasas de pelícanos Marrones que habían sido predados por nutrias. En 19 relevamientos, encontramos 73 carcasas. Los conteos de carcasas en relevamientos individuales estuvieron entre 0 y 11, con una media de 3.84 carcasas por relevamiento. Comparando los conteos de carcasas con la abundancia semanal de pelícanos informada por eBird, encontramos una correlación moderada entre ambas variables. En base a la ubicación de los mayores agrupamientos de pelícanos que observamos en cada relevamiento, no encontramos evidencia de que, considerado en conjunto, los pelícanos alteraran sus patrones de uso de la laguna en respuesta a la predación. Este estudio arroja luz sobre las elecciones dietarias de las nutrias, y también destaca importantes preguntas ecológicas. La persistencia de ésta relación predador-presa puede influir en los ciclos de nutrientes, ya que las carcasas de pelícano son un subsidio nutricional para los carroñeros locales. Nuestros hallazgos subrayan la necesidad de realizar más estudios sobre los efectos a largo plazo de la predación de las nutrias sobre las poblaciones de pelícano, y sobre la dinámica ecosistémica más amplia en los ambientes costeros.

O B S E R V A T I O N

FIRST PHOTOGRAPHIC RECORD OF SMOOTH-COATED OTTER *Lutrogale perspicillata* IN GOMTI RIVER, UTTAR PRADESH, INDIA

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Abstract: The Smooth-coated otter (*Lutrogale perspicillata*) plays a crucial role as an indicator species and an apex predator in the aquatic ecosystem. This report marks the first sighting of this species in the Gomti River of Uttar Pradesh, supported by photographic evidence. Such records are vital for understanding India's biodiversity and the distribution patterns of species. They contribute significantly to scientific knowledge and inform conservation efforts in the region, emphasizing the importance of monitoring and protecting these essential components of aquatic ecosystems.
Citation: Maurya, V., Nautiyal, S., Badola, R., And Hussain, S.A. (2025). First Photographic Record of Smooth-Coated Otter *Lutrogale perspicillata* in Gomti River, Uttar Pradesh, India. *IUCN Otter Spec. Group Bull.* **42** (2): 85 - 90
Keywords: *Lutrogale perspicillata*, new record, photographic evidence, Gomti River

INTRODUCTION

Freshwater ecosystems, despite representing a small fraction of the Earth's surface, harbor about one-third of all vertebrate species, making them exceptionally rich in biodiversity (Dudgeon et al., 2006). However, these ecosystems are increasingly threatened by human-induced changes, such as dam construction, pollution, over-extraction of water, and habitat fragmentation. These changes significantly affect aquatic biodiversity, making freshwater habitats some of the most endangered ecosystems worldwide (Dudgeon et al., 2006; Vörösmarty et al., 2010). Conservation efforts are crucial to mitigate these impacts and protect the unique biodiversity found in freshwater environments. Otters, elusive mammals of the order Carnivora and family Mustelidae (Acharya and Rajbhandari, 2011), are top predators in wetland ecosystems. They thrive in habitats that include intact forests and scrub areas, where they have access to fresh water essential for their feeding needs (Yonzon, 1998; Acharya et al., 2010). Their presence indicates a healthy aquatic ecosystem, as they rely on abundant prey populations and suitable environmental conditions, highlighting their importance in wetland conservation and biodiversity monitoring efforts. Although Smooth-coated otters (*Lutrogale perspicillata*) are widely distributed (Hussain and Choudhury, 1997), there has been no documented evidence of their presence in the main stem of the Gomti River. This knowledge gap likely results from a lack of comprehensive ecological assessments along the entire length of the Gomti River, from its source to its confluence with the Ganga at Ghazipur. The recent photographic documentation marks the first confirmed sightings of smooth-coated otters in the Gomti, highlighting the need for further ecological studies and conservation efforts in this understudied river system.

OBSERVATION

An ecological assessment funded by the National Mission for Clean Ganga (NMCG), Ministry of Jal Shakti, Government of India, was conducted by the Wildlife Institute of India (WII) in 2023 under the project titled "Planning and Management for Aquatic Species Conservation and Maintenance of Ecosystem Services in the Ganga River Basin for a Clean Ganga." During this assessment, a single direct sighting of a smooth-coated otter (*Lutrogale perspicillata*) was recorded in the 929-km-long Gomti River at a location near the Lucknow-Sitapur border of Uttar Pradesh (Fig. 1,3).

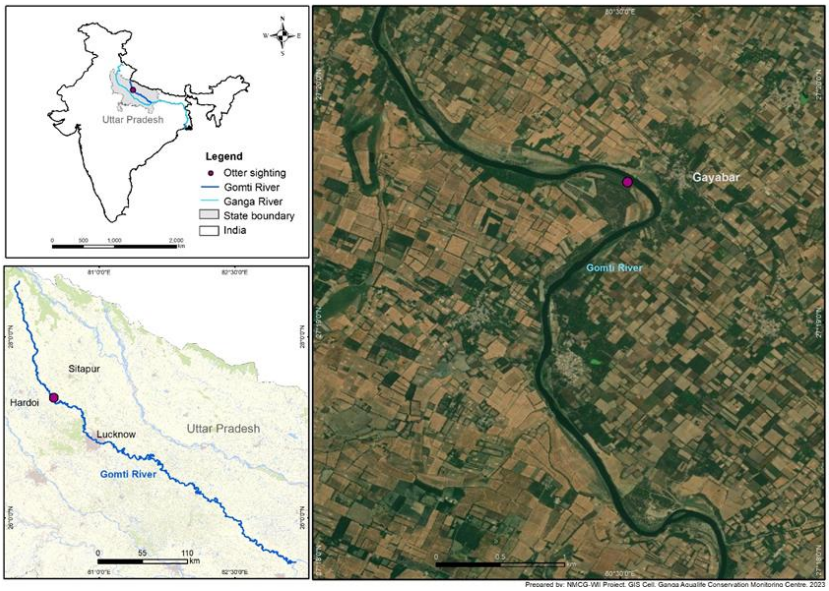

Figure 1. Map of Uttar Pradesh, showing the Gomti River and the current sighting location.

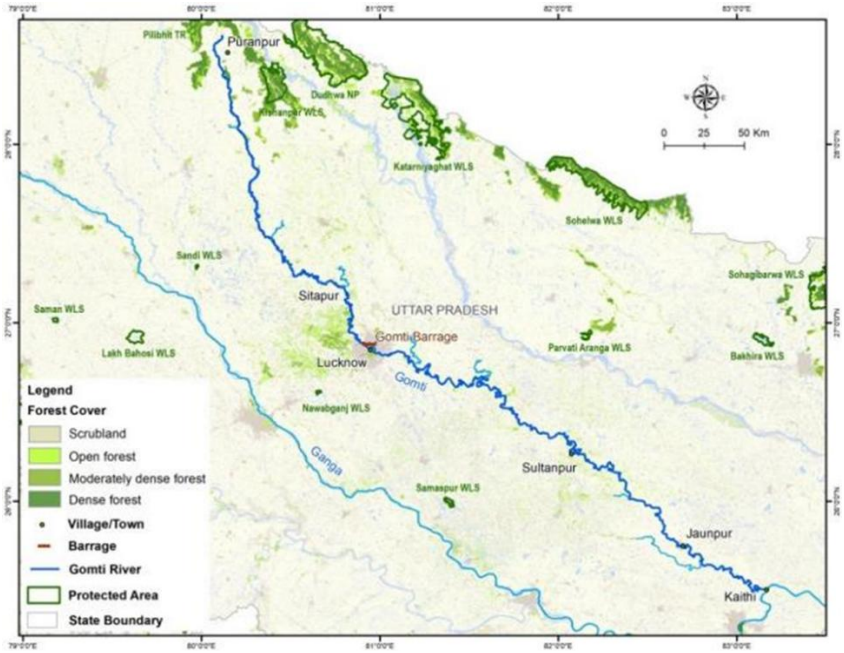

Figure 2. Forest cover in the Gomti Basin.

Figure 3. Survey for the aquatic biodiversity in the Gomti River.

The observation was made on March 5, 2023, near the Gomti River (27°19′35.57″N, 80°30′1.87″E). The otter's appearance, consistent with the description by Gray (1865), featured a dark brown coloration on the upper side and lighter-colored undersides (Fig. 4). This sighting is significant as it represents the first documented evidence of smooth-coated otters in this region, underscoring the importance of continued ecological monitoring and conservation efforts in the Gomti River basin. The Gomti River redistributes the weathered sediments derived from the Himalayas as it flows through the great alluvial fan of the Gangetic plain biogeographic zone (Upper Gangetic Plain – 7A), which is of Pleistocene-Holocene origin (Kumar and Singh, 1978). The upper section of the river is a part of the larger Terai-Arc Landscape and is included in the province of Upper Gangetic Plain 7A (Fig. 2). There is little documented information on the aquatic faunal assemblage of the Gomti River. The area is classified as a Tropical Dry Deciduous Forest according to Champion and Seth (1968). Singh and Chaturvedi (2017) provide a more detailed description, identifying several predominant forest types in this region. These include the northern tropical dry deciduous forest, characterized by species such as *Shorea robusta*, and the northern dry mixed deciduous forest, dominated by *Acacia catechu*. Other types include the general edaphic types of dry deciduous forests, featuring species like *Butea monosperma* and *Acacia arabica*, and the dry tropical riverine forest, which is home to *Terminalia arjuna*, *Acacia catechu*, and *Dalbergia sissoo*. Additionally, the area contains northern tropical thorn forests, which are composed of species such as *Acacia leucophloea*, *Acacia arabica*, *Prosopis cineraria*, and *Zizyphus* spp. This diverse mosaic of dry deciduous and thorn forests provides a range of habitats that support various flora and fauna, including species of conservation concern like the smooth-coated otter.

Figure 4. Sighting of smooth-coated otter in the Gomti River.

DISCUSSION

Otters, particularly the Smooth-coated otter, face significant threats from habitat destruction due to human activities, such as agricultural expansion that has led to the degradation of vital habitats like wetlands, grasslands, and forests (Ottino and Giller, 2004). In India, there have been limited sightings of otters, with only sporadic reports documenting their presence across various regions (Hinton and Fry, 1923; Pocock, 1940; Chitampalli, 1979). However, a recent sighting brings renewed hope for the survival of this declining population. Given that the smooth-coated otter is considered a threatened species, this new sighting, especially outside of protected areas, presents an opportunity for detailed population studies. Such research could inform and develop effective conservation strategies tailored to the species' needs in the region (Gupta et al., 2015).

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RÉSUMÉ: PREMIÈRE PHOTOGRAPHIE DE LA LOUTRE À PELAGE LISSE *LUTROGALE PERSPICILLATA* DANS LA RIVIÈRE GOMTI, UTTAR PRADESH, EN INDE

La loutre à pelage lisse (*Lutrogale perspicillata*) joue un rôle crucial en tant qu'espèce indicatrice et prédateur au sommet de l'écosystème aquatique. Ce rapport constitue la première observation de cette espèce dans la rivière Gomti de l'Uttar Pradesh, corroborée par des preuves photographiques. De tels enregistrements sont essentiels pour comprendre la biodiversité de l'Inde et les schémas de répartition des espèces. Ils contribuent de manière significative aux connaissances scientifiques et éclairent les efforts de conservation dans la région, soulignant l'importance de la surveillance et de la protection de ces constituants essentiels des écosystèmes aquatiques.

RESUMEN: PRIMER REGISTRO FOTOGRÁFICO DE NUTRIA LISA *Lutrogale perspicillata* EN EL RÍO GOMTI, UTTAR PRADESH, INDIA

La nutria Lisa (*Lutrogale perspicillata*) juega un rol crucial como especie indicadora y predador tope en el ecosistema acuático. Este reporte informa del primer avistaje de esta especie en el Río Gomti, Uttar Pradesh, con evidencia fotográfica. Este tipo de registros son vitales para entender la biodiversidad de India y los patrones distribucionales de las especies. Contribuyen significativamente al conocimiento

científico y dan base informativa a los esfuerzos de conservación en la región, enfatizando la importancia de monitorear y proteger a estos componentes esenciales de los ecosistemas acuáticos.

R E P O R T

ARTISANAL FISHING BYCATCH CONFIRMS THE NORTHERNMOST DISTRIBUTION OF EURASIAN OTTERS (*Lutra lutra*) IN NEPAL

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Abstract: In Nepal, there is limited information on the distribution and population status of Eurasian otters, hindering effective conservation planning. We organized focus group workshops in eight major settlements in the Sarkegad Rural Municipality of Humla District during April 2023, to document the presence and distribution of mammalian species in the region. In one of the workshops conducted in Dulli village, a participant shared information about an otter trapped in a fishing net in the Dulli Kuna section of Karnali River. This marked the first confirmed record of the Eurasian otter in Humla district, representing the northernmost distribution range for this species in Nepal. The fishing bycatch of the otter highlights the need for community-level conservation education and awareness-raising, as well as the regulation of fishing practices, which remained a major threat to the species in the region.
Citation: Thapa, V. and Lama, R.P. (2025). Artisanal Fishing Bycatch Confirms the Northernmost Distribution of Eurasian Otters (*Lutra lutra*) In Nepal. *IUCN Otter Spec. Group Bull.* **42** (2): 91 - 97
Keywords: Eurasian Otter, Freshwater Ecosystem, Humla, Karnali, Local Knowledge

INTRODUCTION

Otters, part of the family Mustelidae, are mammals adapted to aquatic, semi-aquatic, or marine environments. They serve as primary predators, playing a crucial role in regulating the populations of their prey, which encompass various species such as fish, crustaceans, invertebrates (Kruuk and Moorhouse, 1990), amphibians (Pagacz and Witczuk, 2010), reptiles, insects, birds, and small mammals (Lanszki and Sallai, 2006; Remonti et al., 2008). Otters hold a significant role in the conservation of aquatic habitats and are sensitive to pollution, making them particularly vulnerable to environmental contamination (Kafle, 2009; Yoxon and Yoxon, 2019; Jha et al., 2020). The Eurasian otter boasts one of the widest distributions among Palearctic mammals, spanning from Western Europe to Eastern Asia and from the Arctic to Southeast Asia (Loy et al., 2022). Despite its historical range, anthropogenic pressures resulted in local extinctions across Europe during the 20th century, but there have been ongoing recovery efforts (Foster-Turley and Santiapillai, 1990; Prigioni et al., 2007; Loy et al., 2022). In contrast, in China and numerous Southeast Asian countries, dwindling populations and absences prevail (Zhang et al., 2016; Li and Chan, 2018; Yoxon and Yoxon, 2019).

In Nepal, the existence of Eurasian otters is threatened by several major issues such as overfishing, the use of poison and electric fishing to increase fish catches, habitat loss and contamination, declining prey populations, and human activities along riverbanks, such as mining sand and stones (Kafle, 2009; Basnet et al., 2020; Shrestha

et al., 2023). Furthermore, as demonstrated by the confiscation of 755 otter skins between 1989 and 2017, the illegal otter pelt trade is a significant challenge (Savage and Shrestha, 2018). Compared to other large mammalian species, there is not as much research conducted in Nepal on otters thus information on otter status, distribution and extent of threats are still lacking. In Nepal, three out of the 13 otter species are found, namely the Smooth-coated otter (*Lutrogale perspicillata)*, Asian small-clawed otter (*Aonyx cinereus)*, and Eurasian otter (*Lutra lutra)* (Kafle, 2009; Jnawali et al., 2011; Jha et al., 2020). These otters inhabit various freshwater ecosystems, including rivers, lakes, and wetlands. The Eurasian otter is categorized as "Near Threatened" in the IUCN Red List of Threatened Species and is protected under CITES Appendix I (Loy et al., 2022).

STUDY AREA

The present study was conducted in Sarkegad Rural Municipality of Humla district, Karnali province, Nepal (Fig. 1). Karnali Province is the largest province in Nepal, which is home to approximately 2.3% of mammals, 2.1% of birds, 43% of amphibians, 22% of butterflies, and more than one-third of fish species in Nepal (Acharya and Paudel, 2020). The Karnali River, the longest river in Nepal, originates in west Tibet and flows through the Humla district. Sarkegad Rural Municipality, located in the middle section of Karnali River in Humla district has an average elevation of 1993 meters and is one of the most densely populated rural municipalities in Humla district, with a total population of 10,688 residents (NPHC, 2021). Sarkegad RM is divided into eight wards (the Ward is the smallest administrative unit in Nepal) of 15 settlements. The primary occupations in the region are subsistence agriculture, animal husbandry, and traditional trades in medicinal and aromatic plants (MAPs).

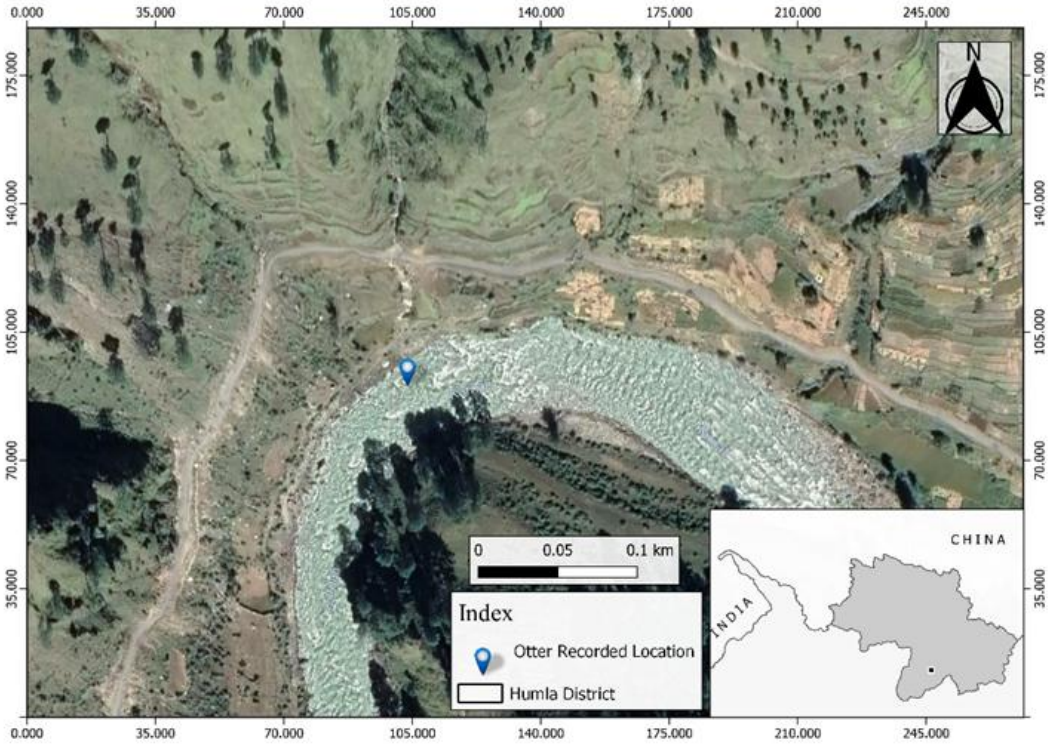

Figure 1. Eurasian otter capture location in Sarkegad Rural Municipality, Humla, Nepal

Sarkegad Rural Municipality is home to diverse wildlife, including the globally endangered Kashmir musk deer (*Moschus cupreus*), Himalayan black bear (*Ursus*

thibetanus), leopard (*Panthera pardus*), golden jackal (*Canis aureus*), blue sheep (*Pseudois nayaur*), Himalayan thar (*Hemitragus jemlahicus*), and birds such as Himalayan griffon vulture (*Gyps himalayensis*), Himalayan monal (*Lophophorus impejanus*), and Kalij pheasant (*Lophura leucomelanos*), among others (R. Lama and V. Thapa, *Observation*).

OBSERVATION

We organized eight ward-level workshops with representatives from all the settlements within Sarkegad Rural Municipality. We focused on wildlife species identification and distribution mapping using local knowledge, assessing the prevalence of human-wildlife conflicts, and identifying conservation threats. In remote areas with limited wildlife assessment studies, Local Ecological Knowledge (LEK) can prove to be a valuable resource for ecological information and has the potential to complement scientific data in the context of wildlife distribution mapping (Gandiwa, 2012).

A total of 87 participants from 12 villages participated in the workshops, including farmers (53%), herders (28%), and others (Community Forest Users Groups and ward members: 19%). In one of our workshops held on April 14, 2023, in Sarkegad, a participant from Dulli village mentioned an unusual animal caught as a bycatch in a fishing net (Fig. 1). Upon reviewing the pictures, we thought it resembled an otter, which was later confirmed by direct observation of the carcass, and locals' confirmation that it was an otter (Fig. 2). This was later verified by otter experts in Nepal as Eurasian otter (Shrestha, P., *pers. comm.).*

Figure 2. Carcass of a Eurasian otter, which was caught in a fishing net in Karnali River near Dulli Kuna, Humla. (Photo: Vidyaman Thapa)

The otter was captured in a fishing net on the banks of the Karnali River at Dulli Kuna (Fig. 1). Locals from Dulli village were unaware of such a mammal occurring in

the region; however, respondents from other villages in the Sarkegad Rural Municipality did hear about occurrence of otters in the Karnali river and its tributaries in Humla district: Gothi Khola, Ghatte Khola, and Ripgadh Khola. Occasional sightings of otters were also reported further north of the current confirmed location, along the bank of Karnali River at the Narla section (R. P. Lama, *pers comm.,* 2023).

Our workshop results indicate that more than 80% of respondents acknowledge the widespread occurrence of fishing in this region (Fig. 3). We observed local lodges and restaurants as the major participants in these fishing activities, primarily driven by economic incentives. Additionally, people living near the rivers and streams also engaged in subsistence fishing. We identified two distinct fishing practices that locals are adopting in the region. The first method is a traditional approach where villagers would visit streams, and manipulate the water flow by blocking it on one side and diverting it to the other, essentially creating a temporary dry path, and then catching fish in the exposed areas. The second method involves nylon netting, which is widely adopted in the Karnali river. The impact of net fishing practices is problematic as they leave overnight and, in many cases, for an extended period, increasing the chances of catching other species such as otters.

Figure 3. Fish caught in a traditional nylon fishing net by local fishermen in Sarkegad Rural Municipality, Humla. (Photo: Vidyaman Thapa)

In our conversations with 20 local fishermen from Sarkegad Rural Municipality, they reported that fishing success had decreased by 50% compared to the past five years. Traditionally, fishing in the Sarkegad region primarily occurs between February and May. However, in recent times, lodge and restaurant owners are involved in fishing activities throughout the year. This increased dependency on fish for both subsistence and income, could potentially disrupt the aquatic ecosystem and pose a significant threat to both fish and otter populations in this unique freshwater habitat.

CONCLUSIONS

The confirmed presence of Eurasian otters in the Karnali River in the Humla district is a significant addition to their current distribution range in Nepal. This rare confirmation presents an opportunity to formulate local conservation strategies in collaboration with Rural Municipalities for otters, fishes and their delicate habitats. To ensure the long-term persistence of otters in the Humla district, it is crucial to improve local knowledge about otter conservation and promote responsible fishing practices, including fishing gear regulations. To further enhance conservation efforts, it is important to identify and address research gaps related to local otter population status, distribution and human activities directly threatening otter conservation.

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RÉSUMÉ: LES CAPTURES ACCIDENTELLES DE LA PÊCHE ARTISANALE CONFIRMENT LA RÉPARTITION LA PLUS NORDIQUE DES LOUTRES EURASIENNES (*LUTRA LUTRA*) AU NÉPAL

Au Népal, les informations sur la répartition et l'état de la population des loutres Eurasiennes sont limitées, ce qui entrave la planification efficace de la conservation. Nous avons organisé des ateliers de groupes de discussion dans huit grandes agglomérations de la municipalité rurale de Sarkegad, dans le district de Humla, en avril 2023, afin de documenter la présence et la répartition des espèces de mammifères dans la région. Dans l'un des ateliers organisés au village de Dulli, un participant a partagé des informations concernant une loutre piégée par un filet de pêche dans la section de Dulli Kuna de la rivière Karnali. Il s'agissait de la première donnée confirmée d'une loutre Eurasienne dans le district de Humla qui couvre une aire de répartition la plus septentrionale de l'espèce au Népal. Les captures accidentelles de loutre lors de la pêche soulignent la nécessité d'une éducation, d'une sensibilisation à la conservation au niveau communautaire et d'une réglementation des pratiques de pêche, qui restent une menace majeure pour l'espèce dans la région.

RESUMEN: LA CAPTURA INCIDENTAL POR PARTE DE LA PESCA ARTESANAL CONFIRMA LA DISTRIBUCIÓN MÁS SEPTENTRIONAL DE LA NUTRIA EURASIÁTICA (*Lutra lutra*) EN NEPAL

En Nepal hay información limitada sobre la distribución y estatus poblacional de las nutrias Eurasiáticas, lo que dificulta la planificación efectiva de su conservación. Organizamos talleres con "focus groups" en ocho asentamientos importantes en la Municipalidad Rural de Sarkegad, Distrito de Humla, durante Abril de 2023, para documentar la presencia y distribución de especies de mamíferos en la región. En uno de los talleres conducido en el poblado de Dulli, un participante compartió información

sobre una nutria atrapada en una red de pesca en la sección Dulli Kuna del Río Karnali. Esto marcó el primer registro confirmado de nutria Eurasiática en el distrito de Humla, representando la distribución más septentrional de esta especie en Nepal. La captura incidental de nutria en redes de pesca destaca la necesidad de educación y concientización en conservación a nivel de la comunidad, así como de regulación de las prácticas de pesca, que sigue siendo una amenaza de importancia para la especie en la región.

S H O R T N O T E

BEYOND THE RIVER: NEW OBSERVATIONS OF EURASIAN OTTERS (*Lutra lutra*) BY THE CASPIAN SEA

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Abstract: The Eurasian otter (*Lutra lutra*), is one of the most widespread mammals in Iran, occurring in 13 provinces. They are aquatic and semi-aquatic mammals. We report here two new records of the species by the Caspian Sea, beyond their usual distribution.
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INTRODUCTION

The Eurasian otter (*Lutra lutra*) inhabits a variety of aquatic and semi-aquatic environments across Europe, Asia, and North Africa (Mousavi et al., 2023). It favors shallow, narrow sections of streams that are bordered by mature trees and rocky formations (Mousavi et al., 2023). Otters are also commonly found in rivers, streams, aqueducts, wetlands, lakes, and fish-farming ponds that support suitable vegetation (Mousavi et al., 2023). The selection of their habitat is influenced by multiple factors that vary across different geographical areas. In central Poland, field surveys conducted in 1998 and 2007 indicated a population increase, which has been positively correlated with river width and negatively impacted by the presence of human civilization (Romanowski et al., 2013). In South Korea, otters tend to inhabit areas with minimal human interference, favoring natural features such as streams with reeds, shrubs, and large boulders (Park et al., 2002). A recent study in Spain has shown that in river basins with considerable human activity, otters face a trade-off between accessing productive areas and finding well-structured, safe habitats (Tolrà et al., 2024). The suitability of habitats for otters is determined by the surrounding vegetation, the degree of human disturbance, and land use within 100 meters of riverbanks (Martin-Collado et al., 2020). Notably, research indicates that otters do not exclusively rely on natural aquatic habitats; even renovated gravel pits can provide adequate living conditions within

human-modified landscapes (Martin-Collado et al., 2020). However, the requirements for breeding sites are more stringent than those for general habitat use, particularly concerning human disturbance (Tolrà et al., 2024).

In Iran, otters have been recorded across 13 provinces (Yusefi et al., 2019), covering a diverse range of biogeographical regions, including the Irano-Turanian, Euro-Siberian, and Saharo-Sindian regions (Djamali et al., 2011). This variety of biogeographical areas gives rise to an array of aquatic and terrestrial habitats, each contributing uniquely to the country's ecological landscape. As a result, Iran boasts a multitude of wetlands and rivers, each characterized by its own distinct biogeographical features (Zehzad et al., 2002). The Euro-Siberian region, situated in the northern part of the country, encompasses records from Guilan, Mazandaran, and Golestan. The Irano-Turanian region, which spans much of central and western Iran, includes sightings from Tehran, Alboz, Kordestan, Kermanshah, Kohgiluyeh and Boyer Ahmad, Esfahan, Chaharmahal and Bakhtiari, Fars, and Azarbaijan W. The overlap of the Irano-Turanian and Saharo-Sindian regions is reflected in records from Khozestan (Yusefi et al., 2019). Additionally, there are also some other records from Azarbaijan E, Hamadan, Kordestan, Lorestan, Markazi, and Zanjan (Yusefi et al., 2019).

Habitat quality assessment on the Jajrood River revealed that downstream stretches are more suitable for otters (Mirzaei et al., 2009*b*). Habitat selection studies conducted on the Jajrood River revealed significant correlations between otter signs, altitude, and the presence of pools (Mirzaei et al., 2009*a*). In the Anzali wetland, otters favor quiet, less polluted areas with ample food availability (Naderi et al., 2017). Otters may have a more extensive distribution in Iran than previously believed, potentially inhabiting most rivers and lakes across the country (Gutleb et al., 1996). However, the species is threatened by environmental degradation, pollution, and conflicts with fisheries (Naderi et al., 2017). Otters are near threatened on the IUCN red list over the globe. However, they are regionally vulnerable (Yusefi et al., 2019). The presence of otters on the coasts of the sea is not a novel observation. MacDonald and Mason (1980) examined marking behavior in the coastal population of otters on a sea loch in northwest Scotland. Wales is also another country in which otter coastal activities have been recorded (Parry et al., 2011). In Iran, camera traps have captured otters in the Anzali wetland (Naderi et al., 2017). The Miankaleh Wetland is a rich wildlife refuge with special characteristics and suitable habitat for aquatic and terrestrial plants and animals (Ejtehadi et al., 2003). It is home to otters in the eastern parts of the Iranian Caspian Sea coast (Mousavi et al., 2023). However, there is no record of such in some lesser-studied areas due to insufficient funding and human resources. There are also some other reports of the species' occurrence in various habitats of the country. In 2014, two dead individuals were found in a fish farm pond in Taleqan, and in 2015 an adult was observed in a river located in Taleqan (Mohtasebi and Tabatabaei, 2018). Taleqan is a mountain area in Alborz province with rivers and a cold climate (Mohtasebi and Tabatabaei, 2018). In Guilan, besides the observation of otters in the Anzali Wetland mentioned in the text, otters have also been studied in Amirkelayeh Wildlife Refuge, revealing that the species signs can be found throughout the year, occurring more within the areas where food is more accessible (Hadipour et al., 2011). Amirkelayeh wetland is an international wetland with 15 fish species, located south of the Caspian Sea (Khara and Sattari, 2016).

OBSERVATION

We present here two new records of otters in the Caspian Sea (Fig. 1). The Caspian Sea is the largest inland body of water in the world, home to unique wildlife

(Nasrollahzadeh, 2010). The first observation was in the Miankaleh wetland in Golestan province from Behrad Farkhondeh (36°53’49’’N / 54°2’12’’E) in February 2015 at midday (Fig. 2). As it is clear in one of the photos, the otter was eating a fish. The second one is an observation by Mr. S. Kamali (36°35’58’’N / 51°40’9’’E) in Mazandaran province. He captured a video of an otter on the shoreline of the Caspian Sea in December 2020 in the daytime (Fig. 3). The locality is close to a river, from where we think the otter reached the Caspian shore. There is limited information and informal reports of the otter’s presence within the Caspian Sea from local fishermen, and the Caspian Sea hosts fish, frogs, and snakes that might attract otters. No record of otter breeding or nursing in the Caspian Sea is documented so the hypothesis of otter settlement in the Caspian Sea requires further evidence. We are not sure if the otter has been settled there or was just looking for some opportunities in its backyard.

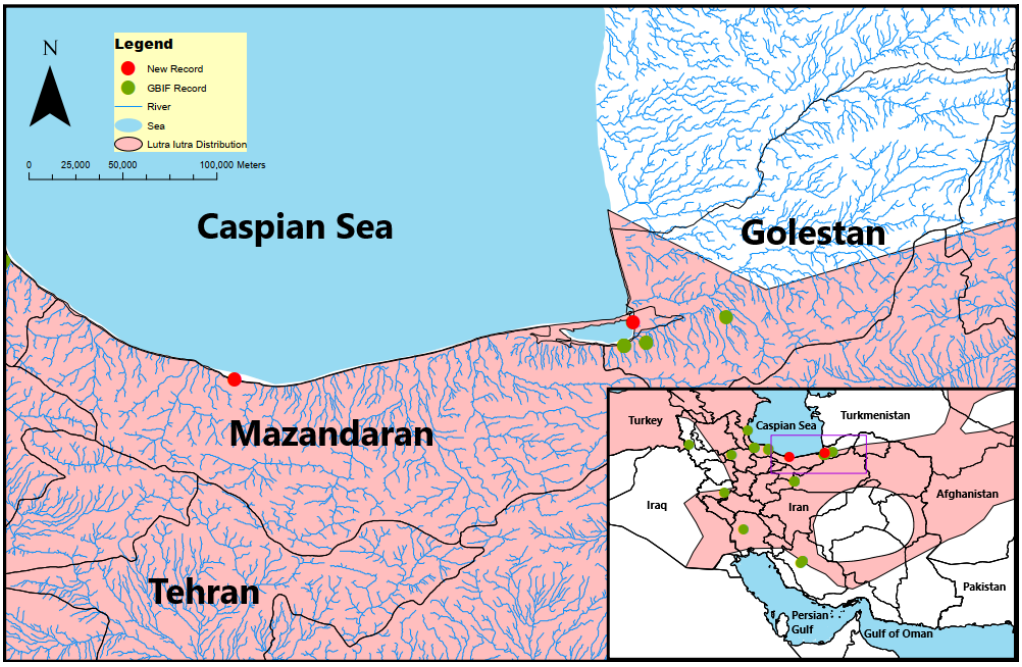

Figure 1. The distribution of Eurasian otters (*Lutra lutra*) in Iran, with new observation points near the Caspian Sea.

Figure 2. Picture of an Eurasian otter (*Lutra lutra*) in Miankaleh wetland, northern Iran.

Figure 3. Screenshots of the Eurasian otter (*Lutra lutra*) observed in the Caspian Sea.

These two observatations clearly show otter occurrence and foraging behavior by the Caspian Sea. We expect more sightings of the species in estuaries of the Caspian Sea where there is suitable vegetation and appropriate fish, frogs, and snakes around to feed on. While more studies are needed to understand how much of the otter population depends on the Caspian Sea, long-term changes in the Caspian Sea level due to anthropogenic influence and global warming by the end of the century could potentially deteriorate otter habitats (Lahijani et al., 2023). The Miankaleh wetland faces pollution, and scientists believe more attention to the wetland is needed (Mehrdadi et al., 2024). In 2020, in a mass mortality, about 38,000 waterbirds died over 50 days at Miankaleh because of *Clostridium botulinum* (Maken Ali et al., 2020). These changes in the habitat show an uncertain future for the rich biodiversity of the Miankaleh such as otters. We suggest more research on otters in such regions to understand how to safeguard their future, and to use them as indicators to predict the future of the habitats of Caspian Sea coasts.

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RÉSUMÉ: AU-DELÀ DE LA RIVIÈRE : NOUVELLES OBSERVATIONS DE LOUTRES EURASIENNES (*LUTRA LUTRA*) AU BORD DE LA MER CASPIENNE

La loutre eurasienne (*Lutra lutra*) est l'un des mammifères les plus répandus en Iran où elle est présente dans 13 provinces. Ce sont des mammifères aquatiques et semi-aquatiques. Nous rapportons ici deux nouvelles observations de l'espèce au-delà de son habitat habituel près de la mer Caspienne.

RESUMEN: MÁS ALLÁ DEL RÍO: NUEVAS OBSERVACIONES DE NUTRIA EURASIÁTICA (*LUTRA LUTRA*) SOBRE EL MAR CASPIO

La Nutria Eurasiática (*Lutra lutra*) es uno de los mamíferos más ampliamente distribuidos en Irán, ocurriendo en 13 provincias. Son mamíferos acuáticos y semi-acuáticos. Reportamos aquí dos nuevos registros de la especie sobre el Mar Caspio, fuera de su hábitat más común.