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A Eurasian otter *Lutra lutra* (Linnaeus 1758) (Carnivora: Mustelidae) in the Tiber basin near Rome: relict or range expansion?

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Abstract - The Eurasian otter *Lutra lutra* faced significant decline in Italy during the 20th century, leading to local extinctions. After fifty years of otter disappearance from the Tiber basin, this study documents a sighting near Rome, obtained during a long-term trail camera monitoring. The study area, Rio Moscio, offers a habitat rich in hygrophilous vegetation and diverse fauna, including other protected species such as the Italian wolf, the European wildcat, and the European polecat. The observed otter could either mark a potential range expansion or could challenge the presumed extinctions in this region, since it could be in dispersal from the closer known populations or an individual from a Tiber basin relict population. The study emphasises the need for continued monitoring and prompt future genetic analyses to obtain necessary insights for conserving otters in Central Italy.
Key words: camera trapping, conservation, Latium, Rio Moscio, Tiber.

Riassunto - Una lontra eurasiatica *Lutra lutra* (Linnaeus 1758) (Carnivora: Mustelidae) nel bacino del Tevere presso Roma: relitto o espansione dell'areale?
La lontra eurasiatica *Lutra lutra* ha subìto un significativo declino in Italia durante il XX secolo, arrivando ad estinguersi localmente. Dopo cinquant'anni dalla scomparsa della lontra nel bacino del Tevere, questo studio documenta un suo avvistamento vicino a Roma, ottenuto attraverso un assiduo monitoraggio con fototrappole. L'area di studio, Rio Moscio, offre un habitat ricco di vegetazione igrofila e fauna diversificata, includendo anche altre specie protette come il lupo appenninico, il gatto selvatico europeo e la puzzola. L'osservazione della lontra in quest'area potrebbe indicare una potenziale espansione dell'areale oppure mettere in discussione le presunte estinzioni in questa regione, poiché potrebbe trattarsi di un individuo in dispersione dalle popolazioni conosciute più vicine o di un individuo di una popolazione relitta del bacino del Tevere. Lo studio sottolinea la necessità di un monitoraggio continuo e di future e tempestive analisi genetiche per ottenere informazioni necessarie per la conservazione della lontra in Italia Centrale.
Parole chiave: conservazione, fototrappolaggio, Lazio, Rio Moscio, Tevere.

INTRODUCTION

The Eurasian otter *Lutra lutra* (Linnaeus 1758) (Carnivora: Mustelidae) is widespread in Europe, Middle East, Central Asia (from Siberia to Japan), India, South-Eastern Asia, and Northern Africa (Loy *et al*., 2022). In Europe it became rarefied over the last century, especially in the 1960s and 1970s, when there was a general collapse of its populations (Panzacchi *et al*., 2011). At that time the species became extinct in Luxembourg, Netherlands, Liechtenstein and Switzerland, and its range underwent fragmentation in the United Kingdom, Belgium, France, Spain, Germany, and Italy (Randi *et al*., 2003).

The species was present throughout the Italian peninsula, but it began to be rarer starting from the second half of the 20th century (Cagnolaro *et al*., 1975). Until the 1980s it was still present in Liguria, Emilia-Romagna, Tuscany and Northern Latium (Prigioni *et al*., 2007). The otter is currently present in Northern Italy in the Ticino Valley, between Piedmont and Lombardy, where it was reintroduced (Balestrieri *et al*., 2022), and in Friuli Venezia Giulia and Trentino Alto Adige following the expansion from Slovenia and Austria (Loy *et al*., 2015). Recently, the species returned to Veneto (Dartora *et al*., 2023), and a new nucleus on the western part of the Alps was detected in 2020 on the Roya basin (Liguria) across the French border (Giovacchini *et al*., 2021). Moreover, in 2024 press news reported its presence in Tuscany (Greenreport.it, 2024a) and Marche (Greenreport.it, 2024b). The largest viable population is present in Central-Southern Italy (Fig. 1a). In the past, this population was divided into two nuclei: the southern nucleus, larger in size, in Campania, Apulia, Basilicata and Calabria, and the so called "Molise nucleus" in Molise, Abruzzo and Campania (upper course of the River Volturno) (Panzacchi *et al*., 2011). Currently, these two subpopulations have merged their ranges (Giovacchini *et al*., 2018).

Its presence in Latium was proven by Lepri (1911), who described its abundance in the Agro Pontino marshes and in almost all the watercourses of the plain (Tiber, Aniene, Mignone, Arrone, etc.). Bonaparte (1832-1841) reported 'among us, it is found in the Ostiense marshes, on the banks of the Aniene, and along the Tiber, sometimes within the walls of Rome'. The last data on its presence in the Tiber (the stretch from Nazzano to Monterotondo) was reported by Cagnolaro *et al*. (1975) in the period 1968-1972. In particular, the latest datum dates to winter 1972 when a male was captured at Nazzano, near the confluence with the River Farfa (Reggiani *et al*., 1986). Subsequently, the monitoring carried out by Cammerini (1986) in the period 1984-1985 in the Province of Rieti yielded no positive results, not even in the River Farfa. The decline of the otter in the region began in the 1960s and grew to catastrophic proportions in 1975 (Battisti *et al*., 2011). Land reclamation in the Paludi Pontine and Tiber areas in the period 1910-1930 dramatically affected the original population, fragmenting it into small disjointed nuclei (Battisti *et al*., 2012). The fragmentation of the range, with the isolation of subpopulations, then caused the rapid onset of local extinctions. Local extinctions were more likely to result from stochastic factors, encompassing demographic, environmental, and genetic elements, rather than from deterministic threats of anthropogenic origin such as direct persecution, pollution, and habitat destruction and transformation (Battisti *et al*., 2012). Three phases of extinction have therefore been hypothesised (Battisti *et al*., 2011), affecting in order the lowland range of the original population (Tiber basin, Agro Pontino), then Southern Latium (Simbruini, Prenestini, Ernici, Lepini, Ausoni and Aurunci Mountains) and finally Northern

Latium (Fiora and Mignone). In fact, the last sites populated by the otter in Latium were the Fiora (Arcà, 1986), Mignone (last sighting: 1999) and Tafone rivers (last sighting: 2006, unconfirmed datum) (Battisti *et al*., 2012). The species was considered extinct in Latium in 2008 (Boitani, 2008). A new nucleus was recently discovered in the Province of Frosinone, in the River Garigliano and tributaries (WWF Italia, 2022).
The Eurasian otter in Italy has been protected since 1977 (L. 27/12/1977, n. 968). The species is listed as Vulnerable in the national IUCN Red List (Rondinini *et al*., 2022) and is included in the "Bern Convention" (App. II), in Habitats Directive 92/43/EEC (Annex II-IV) and in CITES regulations (App. I).
In the present note we report a bycatch observation of an otter in the Tiber basin, fifty years after its disappearance. The observation was possible thanks to the efforts carried out by the Associazione Naturalistica Valle dell'Aniene (ANVA) during research aimed at the study of vertebrate presence north-east of Rome.

MATERIALS AND METHODS

The study area lies about 20 km north of the G.R.A. (Grande Raccordo Anulare ring road) and within Sub-basin nr. 7 "Tevere a monte dell'Aniene" - TEV-395. Rio Moscio, a left tributary of the Tiber (Fig. 1b), flows through this area. The stretch of the stream examined in our research spans approximately 7.6 km and is situated in the Municipality of Montelibretti (RM), within the Sabina region. Rio Moscio is fed by numerous tributaries and is intersected by the Via Salaria and by a railway line near its mouth.
The landscape surrounding Rio Moscio is characterized by gentle undulations and limited urban development. It is widely cultivated, with a mix of tree crops (olive groves and orchards), as well as herbaceous crops, primarily wheat.
In some places the vegetation can be ascribed to the Habitat 91E0*: Alluvial forests with *Alnus glutinosa* (L.) Gaertn. and *Fraxinus excelsior* L. (*Alno-Padion*, *Alnion incanae*, *Salicion albae*) (Fig. 1c, d). From a syntaxonomic point of view, we refer here to the alliance Ligustro vulgaris–Alnion glutinosae Poldini, Sburlino et Venanzoni in Biondi *et al*. 2015 (order Populetalia albae Br.-Bl. ex Tchou 1949), which, in the class Alno glutinosae-Populetea albae P. Fukarek et Fabijanic 1968, encompasses the riparian forests of the submediterranean regions of the Northern and Central Apennine Peninsula (Mucina *et al*., 2016). Monitoring activities in the study area started in May 2022 and involved surveys and the deployment of trail cameras aimed at detecting the presence of the Italian wolf *Canis lupus italicus* Altobello 1921, the European wildcat *Felis silvestris* Schreber 1777 and of smaller mustelids. Up to five cameras (three on average) have been operational along the watercourse since then, and altogether were working for more than 1600 days. The cameras were positioned to monitor the trails adjacent to the river, except for one providing a comprehensive view of a section of the stream.

RESULTS

More than 12,000 videos were recorded by the trail cameras deployed in the study area. A single Eurasian otter was filmed on 20 November 2023 (08:39 PM), while walking on a fallen

tree crossing the stream (Fig. 2). The trail camera that recorded the otter has been operating for over 500 days, producing more than 3460 videos.
Other mammals protected by the Habitats Directive and detected in the study area are the crested porcupine *Hystrix cristata* Linnaeus 1758 (Annex IV), the Italian wolf *Canis lupus italicus* (Annex II-IV), the European wildcat *Felis silvestris silvestris* (Annex IV), the European polecat *Mustela putorius* Linnaeus 1758 (Annex V), and the European pine marten *Martes martes* (Linnaeus 1758) (Annex V).

After the first record, additional trail cameras have been deployed with the aim of locating this species, with no success. Furthermore, efforts were made up until December 2023 to locate tracks and spraints, yielding no results.

DISCUSSION

The filmed otter is likely on dispersal, considering that the species typically covers an average daily distance of 5 km but can travel distances of 10-16 km per day (Prigioni *et al*., 2003). However, the single individual recorded over 500 days leads one to question the appropriateness of the methodology employed. Our concern relates to the positioning of the cameras, which were not strategically placed for this species whose presence was not even suspected when the study was planned. Furthermore, even high-quality trail cameras frequently encounter operational issues in various components of the apparatus, such as power supply, PIR sensor, camera, IR light, and SD storage board. Similar challenges were encountered with the camera directed towards the stream. During 4% of the observation period, it exhibited suboptimal performance, and in 5%, it failed to function altogether. Notably, the footage featuring the otter was filmed when the animal was already positioned on the log, ready to cross it. Considering the Fresnel lens type on the PIR sensor of the camera, one would have expected a prompter triggering, akin to the instances of coypu passages where the subjects were recorded while still in the water (many hundreds of videos recorded). This could be because the coypu generally swims with its body less immersed in the water than the otter, which on the other hand sometimes swims completely underwater (Prigioni *et al*., 2003). For these reasons, the species can be less perceptible to the PIR sensor. Moreover, we should consider that the otter can move faster than the coypu. Lerone *et al*. (2015) hypothesized that the inferior detectability of the otter compared to the coypu could also be due to its thermoregulation and to its hair structure. However, in the last decade trail camera technology has greatly improved also for the detection system. This appears to be confirmed by the ease with which the coypu was detected in our study compared to Lerone *et al*. (2015). Whatever the case, the trail camera may have likely missed recording the potential passage of otters.
Only genetic analyses can determine whether this individual originates from the closer known populations, such as the population from the Garigliano basin or the populations from Abruzzo Region (see Fig. 1a), thereby supporting the hypothesis of range expansion from South or East (for genetic methods see Balestrieri *et al*., 2022). Alternatively, it could reveal whether the species belongs to a relict population from Central Italy, originating from the Tiber (including its Upper Valley) or its main tributaries (e.g., Nera, Treja), which has gone unnoticed over the years, also due to poor research effort of certain areas. According to Marcelli *et al*. (2023), the

northward expansion of otters in Abruzzo (80 km over more than 10 years) was driven by higher occupancy at its distribution limit, subsequently leading to long-distance dispersal. In our case, it is plausible that a similar pattern occurred with potential expansions from eastern or southern populations, situated approximately 70 km and 120 km away, respectively.
The future research objectives should prioritise an aimed standardized survey for the detection of the otter in the middle course of the Tiber and its tributaries (see Panzacchi *et al*., 2011). Once the current distribution in the area is defined, further investigations, including environmental DNA, DNA analysis from spraints, and the placement of trail cameras, will be necessary to characterize the potential population.
The possible main critical threats affecting the site seem to be hunting and poaching, this last especially with snares. Considering the naturalistic importance of Rio Moscio, demonstrated by the presence of otters and other species listed in the Habitats Directive (including uncommon and endemic species), as well as the presence of Habitat 91E0*, we believe it is worth designating the site as a Special Area of Conservation (SAC).

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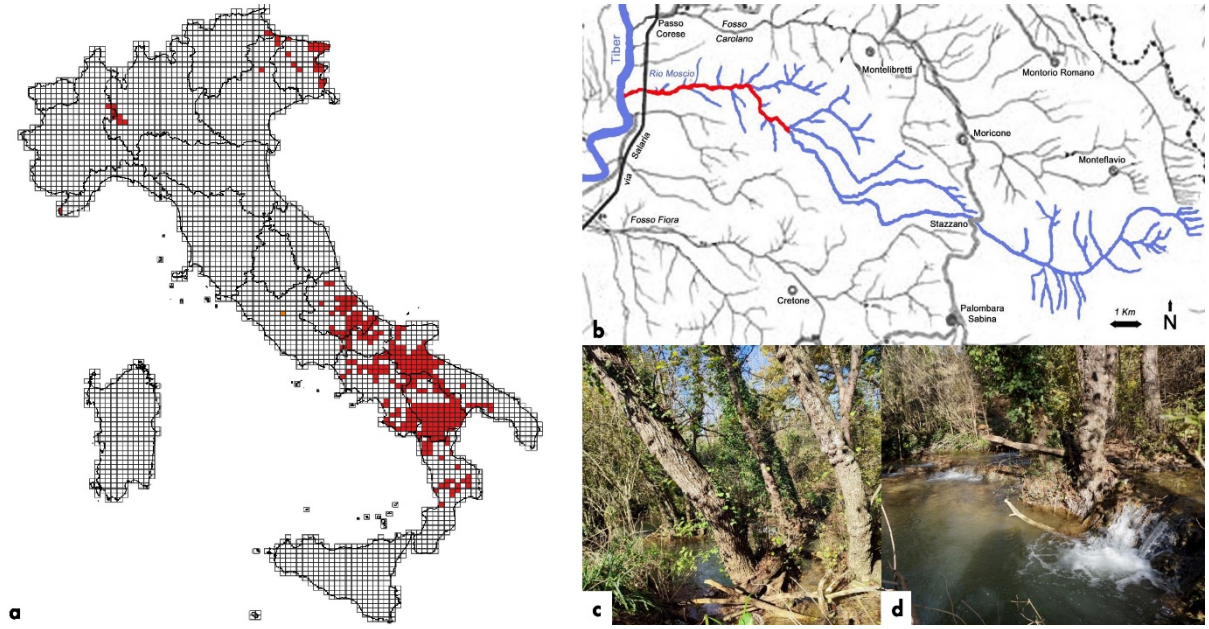

Fig. 1 – a) Current *Lutra lutra* distribution in Italy based on Balestrieri *et al*. 2016, Giovacchini *et al*. 2021, Dartora *et al*. 2023, Marcelli *et al*. 2023 (in red) and our sighting (in yellow). The map was created with QGIS 3.28 Firenze, using 10x10 km grid cells Series 25V WGS84. No cells were filled for the nuclei recently discovered in the Garigliano basin (WWF Italia, 2022), in the River Magra and in the Tronto basin (Greenreport.it, 2024a, b) because precise locations are not disclosed. b) Detail of the Rio Moscio, in red: study area (modified from Foglio 144 Palombara Sabina - Carta Idrografica 1:100.000). c), d) Habitat 91E0*: Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (*Alno-Padion*, *Alnion incanae*, *Salicion albae*); photos by Marco Giardini (c) and Simone D'Urbano (d). / a) Distribuzione attuale di *Lutra lutra* in Italia basata su Balestrieri *et al*. 2016, Giovacchini *et al*. 2021, Dartora *et al*. 2023, Marcelli *et al*. 2023 (in rosso) con la nostra osservazione (in giallo). La mappa è stata creata con QGIS 3.28 Firenze, utilizzando i quadranti 10x10 km Serie 25V WGS84. Nessun quadrante che rappresenti i nuclei recentemente scoperti nel bacino del Garigliano (WWF Italia, 2022), nel fiume Magra e nel bacino del Tronto (Greenreport.it, 2024a, b) è stato aggiunto nella mappa poiché non è stata pubblicata una localizzazione puntuale. b) Dettaglio di Rio Moscio, in rosso: area di studio (modificata da Foglio 144 Palombara Sabina - Carta Idrografica 1:100.000). c), d) Habitat 91E0*: Foreste alluvionali di *Alnus glutinosa* e *Fraxinus excelsior* (*Alno-Padion*, *Alnion incanae*, *Salicion albae*); foto di Marco Giardini (c) e Simone D'Urbano (d).

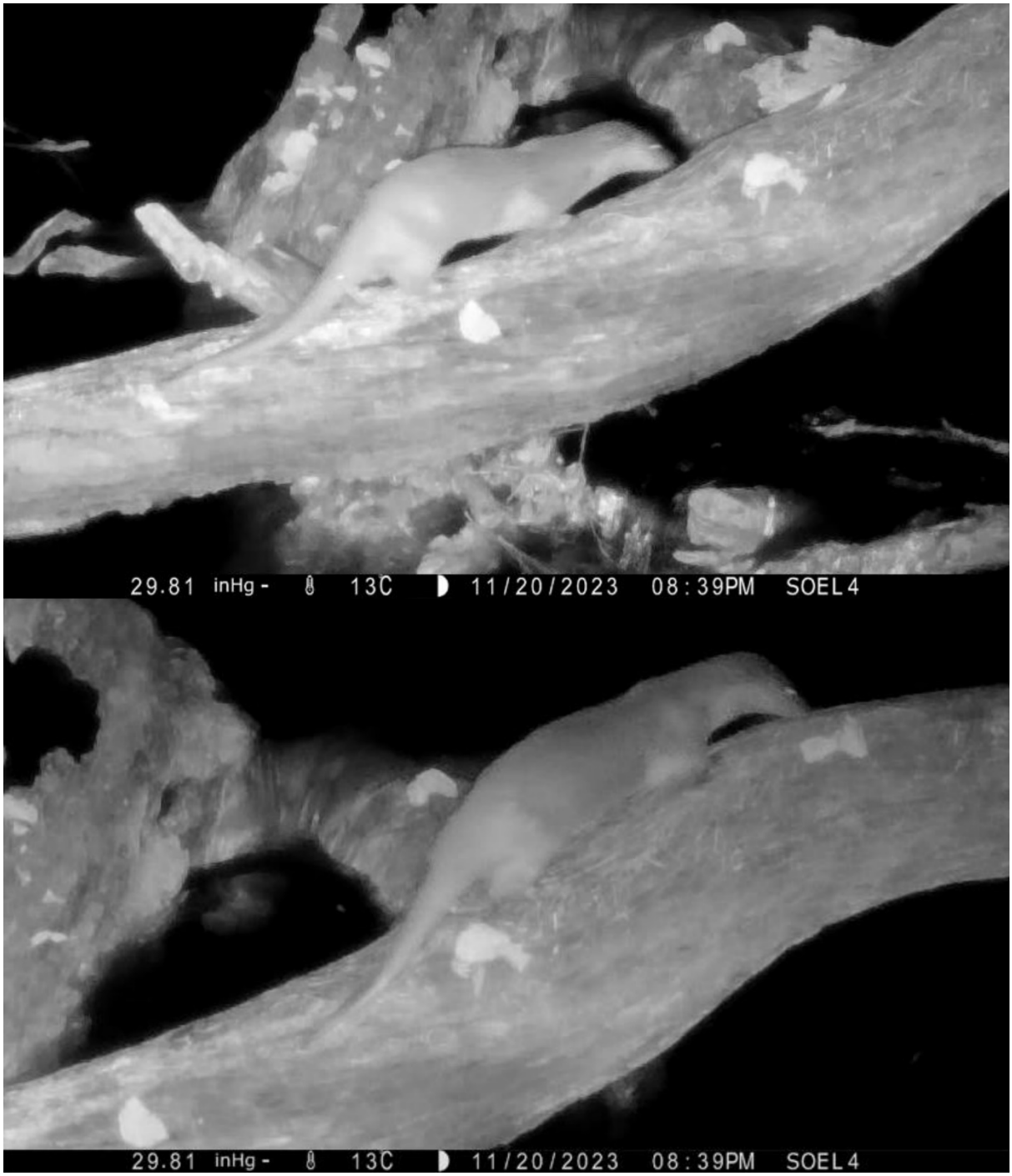

Fig. 2 - Images taken from the footage of the recorded individual of Eurasian otter. / Immagini tratte dal filmato dell'individuo di lontra osservato.