First record of *Cervus elaphus* in a coastal protected area of Central Italy

Short communication

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Abstract: The red deer (*Cervus elaphus* Linnaeus, 1758) has experienced a progressive expansion of its range in Italy during recent decades, mainly due to reintroduction programmes. Here, we report the first documented occurrence of the species within the WWF “Calanchi di Atri” Regional Nature Reserve (Teramo Province, Abruzzo, Central Italy), located approximately 9 km from the Adriatic coast. A young male individual, estimated to be about two years old, was recorded by a camera trap on 14 June 2023 at 00:57. Considering the estimated age and sex of the observed individual, the record is likely attributable to a dispersing male. This finding contributes to the understanding of the current distribution dynamics of *C. elaphus* in peninsular Italy and highlights the importance of long-term wildlife surveying in detecting new occurrences of large mammals in previously unoccupied areas.

Keywords: camera trapping; dispersal; range expansion; red deer; protected area; wildlife surveying; Abruzzo.

1. Introduction

The red deer (*Cervus elaphus* Linnaeus, 1758) is one of the largest wild ungulates in Europe and exhibits marked sexual dimorphism, with males characterised by the presence of antlers and a larger body size compared to females (Mattioli, 2003). Adult males typically weigh between 160 and 200 kg, whereas females range from 90 to 120 kg (Mattioli, 2003). The species generally inhabits deciduous and mixed forests interspersed with open areas and grasslands, although its ecological plasticity enables adaptation to a wide variety of environmental conditions (Perco, 1987).

In Italy, the distribution of red deer has undergone substantial changes over time. Between the eighteenth and nineteenth centuries, the species disappeared from most of the Italian Peninsula, with the only native remnant population surviving in the Bosco della Mesola (Ferrara Province) (Castelli, 1941; Ghigi, 1911). Since the early twentieth century, natural recolonisation processes from neighbouring countries and several reintroduction programmes have contributed to the progressive recovery and expansion of the species across the Alps and the Apennines. Between 1950 and 1998, 45 reintroductions of red deer were carried out in Italy, strongly contributing to the recolonisation of suitable habitats (Mattioli et al., 2001; Meneguz, 2019).

The current expansion of the species' range in Italy has increased the probability of detecting red deer in areas where its presence had not previously been documented. In this context, wildlife surveying programmes based on camera trapping can provide valuable information for identifying new occurrences and improving knowledge of species distribution dynamics. The use of camera traps is a well-established and widely validated method for wildlife surveying and monitoring, enabling reliable data to be obtained on the presence, distribution, activity and relative abundance of species, whilst having a minimal impact on the animals (Burton et al., 2015; Nichols et al., 2011; Rovero & Kays, 2021; Rovero & Zimmermann, 2016).

The red deer population in Abruzzo has experienced a massive increase in numbers and range over the last three decades. Having become extinct in the region between the 18th and 19th centuries, the red deer was reintroduced from the 1970s onwards, initially in the Abruzzo, Lazio and Molise National Park and subsequently in the Sirente-Velino Regional Nature Park, the Gran Sasso and Monti della Laga National Park and the Maiella National Park. The total population is currently estimated at around 16,000 individuals across the region. The highest density is found in the large, protected mountain ranges (the Central Apennines). In agricultural, forestry and pastoral areas not subject to strict conservation

measures, significant average densities are recorded (up to 4.6 animals per km²) (Latini et al., 2015; Regione Abruzzo, 2020). Having reached ecological saturation in the mountainous areas, the species is now colonising spontaneously along river courses and secondary ecological corridors, gradually moving towards the sub-coastal hilly areas and transition zones (ecotones) characterised by agricultural mosaics and Mediterranean scrub (Ferretti et al., 2015; Lovari et al., 2007). The deer population closest to the study area is found in the Castel Cerreto Regional Reserve, in the province of Teramo, on the border with the Gran Sasso and Monti della Laga National Park (Figure 1).
Here, we report the first documented presence of red deer within the WWF "Calanchi di Atri" Regional Nature Reserve (Teramo Province, Abruzzo, Central Italy) of a young male individual obtained during long-term wildlife surveying activities.

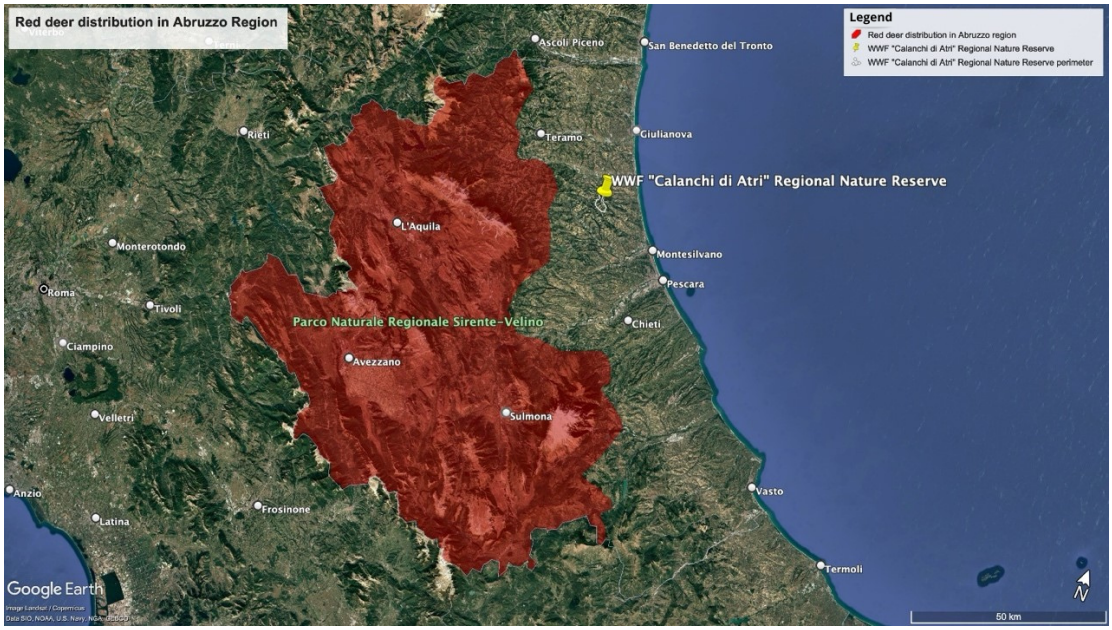


Figure 1. Red deer distribution in Abruzzo Region and location of WWF "Calanchi di Atri" Regional Nature Reserve. The known distribution of red deer in the Abruzzo region is shown in red. The yellow marker indicates the location of WWF "Calanchi di Atri" Regional Nature Reserve, whilst the white line indicates the Reserve's boundary

2. Materials and Methods

Wildlife surveying by camera trapping was conducted within the WWF "Calanchi di Atri" Regional Nature Reserve, located in the Province of Teramo (Abruzzo, Central Italy). The protected area covers approximately 380 ha and ranges from 106 m a.s.l. in the Piomba stream valley to 468 m a.s.l. at Colle della Giustizia. The reserve is characterised by a heterogeneous landscape composed of calanques wooded patches, cultivated areas, reforestations, small wetlands, and riparian habitats (Comune di Atri, n.d.).

Since 2018, wildlife surveying activities have been continuously conducted within the study area to investigate the occurrence and distribution of vertebrates. Surveying protocols included camera trapping, direct observations at dawn and dusk, and periodic inspections along itineraries to detect signs of wildlife presence, including footprints, faeces, feeding signs, and direct sightings. Surveying operations and the downloading of footage were scheduled at regular intervals of 7–10 days. This specific interval made it possible to balance two key requirements: monitoring battery charge levels to prevent deterioration or sudden shutdown, and ensuring a robust and consistent data flow over time. All multimedia data obtained from the footage was subsequently catalogued and entered into a structured database in an Excel spreadsheet for subsequent statistical analysis. A network of ten camera traps (Annew camera trap, model CW–200W01), positioned in an area regularly monitored for medium- and large-sized mammals were placed within the reserve as part of a long-term wildlife surveying programme. The specific locations of the camera traps and their associated routes were determined following a trial phase in which various positions and routes near the farms within the reserve were tested, in line with previous studies. This strategic decision was based on the detection of footprints and markings indicating the presence of wildlife. The sampling protocol stipulated that the devices should be activated exclusively between 18:30 and 08:00 CEST. To ensure synchronisation with seasonal light cycles, the time zone was set to UTC+1 during winter and spring, and to UTC+2 for summer and autumn, using the equinoxes and solstices as formal reference points. The decision to exclude daytime monitoring was dictated by the high level of human activity in the reserve area. The frequent passage of visitors, farmers, livestock, and domestic animals would have resulted in a high number of non-target recordings, unnecessarily increasing battery consumption and memory usage and thereby reducing the effective monitoring capacity of the camera traps. The camera traps were set up to record videos lasting one minute each.

Species identification and sex determination were based on visible morphological characteristics, including body size, body conformation, and antler development.

3.
Results

The first documented detection of red deer within the WWF “Calanchi di Atri” Regional Nature Reserve was obtained on 14 June 2023 at 00:57, when a young male individual was recorded by a camera trap through video footage (Figures 2 and 3). Based on visible morphological characteristics, including antler development and body proportions, the animal was identified as a young male, estimated to be approximately two years old.
Following the initial record, the same individual was observed on two further occasions through direct observation, confirming the species’ continued presence in the study area throughout the survey period. The second sighting took place on 28 June 2023 at 07:04, whilst the third took place on 24 September 2026 at 10:02. Following these observations, the deer was no longer sighted within the Reserve. The camera trap detected the animal in a meadow used as livestock pasture, which is situated next to a calanques with scrub vegetation, whilst direct observations spotted it in a field used for growing barley, adjacent to the pasture mentioned above. It has been suggested that the animal was the same one, as the size of the antlers was consistent across the various surveys and because the sighting locations are very close to one another.



Figure 2. The young male recorded by the camera trap



Figure 3. Location of the first detection within the Reserve. The yellow marker shows the position of the camera trap that captured the first image of the red deer, whilst the white line indicates the boundaries of the Reserve

4. Discussion

The repeated detection of a red deer within the WWF “Calanchi di Atri” Regional Nature Reserve represents the first documented and confirmed occurrence of the species in this protected area. This finding is consistent with the ongoing expansion of red deer distribution observed in Italy over recent decades, driven by both natural recolonisation processes and reintroduction programmes (Giovannelli et al., 2022; Mattioli et al., 2001; Meneguz, 2019). The observed individual was identified as a young male, approximately two years old, a demographic class commonly associated with dispersal movements in cervids. Dispersal in red deer is typically male-biased,

particularly among subadult individuals leaving their natal areas in search of new territories and social groups (Haanes et al., 2011). Although repeated detections confirmed the presence of the species within the reserve, this record should not be interpreted as evidence of a resident population. Rather, it most likely reflects the occasional presence of a dispersing individual, consistent with the species' dispersal ecology. Nevertheless, in the context of the ongoing demographic expansion and range increase of red deer populations throughout the central Apennines, this observation may represent an early indication of future natural colonisation, although further evidence is required to assess this possibility.

The ecological context of this record highlights the potential role of small protected areas in facilitating wildlife movements across human-dominated landscapes (Linnell et al., 2020). Located approximately 9 km from the Adriatic coast, the reserve comprises a heterogeneous mosaic of badland formations, woodland patches, reforestation areas, riparian vegetation, shrublands, pastures, and cultivated fields. Although red deer are generally associated with forested and mountainous environments, their ecological plasticity allows them to exploit a variety of habitats, particularly during dispersal (Apollonio et al., 2010; Fontana et al., 2022; Perco, 1987). The surrounding landscape is characterised by olive groves, vineyards, arable fields, scattered rural settlements, roads, and other anthropogenic infrastructures, which may constrain wildlife movements. Within this fragmented matrix, the reserve may provide temporary shelter and foraging opportunities, potentially functioning as a stepping stone that contributes to landscape permeability and ecological connectivity between inland Apennine populations and the Adriatic hilly sector. Although this function remains hypothetical in the absence of additional movement or occurrence data, the record underscores the potential conservation value of small protected areas within fragmented Mediterranean landscapes (Apollonio et al., 2017; van Beeck Calkoen et al., 2020).

This finding also emphasises the importance of long-term, standardised wildlife monitoring for documenting changes in species distribution (Steenweg et al., 2017). The standardised camera-trapping approach adopted within the reserve provides a systematic framework for detecting wildlife occurrences and following potential distributional changes over time. Continued monitoring will be essential to determine whether the present record remains an isolated occurrence or is followed by further detections indicative of natural colonisation. Such data will improve understanding of red deer range dynamics in the Adriatic hilly sector and support evidence-based conservation planning.

5. Conclusions

Although the presence currently appears limited to a single individual, continued surveying will be essential to determine whether the reserve represents a temporary passage area or a site of more stable occurrence for the species. Long-term camera trapping and direct observations may therefore provide valuable information for assessing future distribution patterns of large mammals in coastal protected areas of Central Italy.

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