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Mouflon *Ovis gmelinii* Blyth, 1841 distribution in the south of Spain: the role of hunting estates escapes

Distribución del muflón *Ovis gmelinii* Blyth, 1841 en el sur de España: el papel de los animales fugados de cotos de caza

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Abstract

This study presents an update on the distribution of the mouflon *Ovis gmelinii* Blyth, 1841 population in the province of Málaga, based on interviews with environmental rangers and subsequent field sampling conducted between 2023 and 2024. Mouflon presence in the province was previously reported in seven 10x10 km UTM grid squares, but has now expanded to occupy seventeen. Furthermore, we have verified that many of these mouflon populations are free-ranging, inhabiting open estates outside of hunting zones, or in protected areas. To test the hypothesis that these newly established populations originated from escapes from enclosed hunting reserves, we performed a nearest-hub distance analysis and compared the results with those obtained from randomly selected control points outside hunting areas that included mouflon in their hunting management plans. The results showed that free-ranging populations were, on average, 3.6 ± 0.5 km closer to hunting estates than randomly selected control points. This is consistent with the escape hypothesis, the dispersal range of the species, and the suggestions of local environmental rangers. The expansion of the species, especially in natural parks, including Sierra de las Nieves, suggests that control measures to prevent escapes from hunting estates and manage colonising individuals should be implemented urgently to limit the expansion of this exotic species in the province of Málaga.
Keywords: Andalucía, game management, hunting enclosures, introduced species, wild ungulate expansion.

Resumen

Se presenta una actualización de la distribución de las poblaciones de muflón *Ovis gmelinii* Blyth, 1841 en la provincia de Málaga basada en entrevistas con agentes de medio ambiente y una posterior verificación de las presencias mediante muestreos sistemáticos de campo entre 2023 y 2024. La especie aparecía citada en siete cuadrículas UTM de 10x10 km en la provincia. Sin embargo, los resultados de este estudio permiten asumir una expansión hasta diecisiete cuadrículas. La mayoría de estas nuevas poblaciones se localizan en fincas abiertas, fuera de cotos de caza o en espacios protegidos. Hemos puesto a prueba la hipótesis de que estas poblaciones podrían provenir de escapes de fincas cinegéticas mediante un análisis de distancia al centro de origen más cercano, considerando los cotos cuyos planes técnicos tienen muflón en su plan de caza y una serie de puntos de control al azar. Los resultados muestran que las poblaciones libres están más cerca de los cotos de caza (3,6 ± 0,5 km) que de los puntos generados al azar fuera de ellos. Este resultado es consistente con la hipótesis de los escapes, con la distancia de dispersión y área de campeo de la especie y con las impresiones de los agentes de medio ambiente, que en muchos casos tienen evidencias de escapes. La expansión de la especie en parques naturales y en especial en el Parque Nacional Sierra de las Nieves sugiere que deberían considerarse medidas de control que prevengan los escapes de los cotos de caza y gestionar de manera urgente las nuevas poblaciones para limitar la expansión de esta especie exótica en la provincia de Málaga.
Palabras clave: Andalucía, cercados cinegéticos, especies introducidas, expansión de ungulados silvestres, gestión cinegética.

Introduction

The mouflon *Ovis gmelinii* Blyth, 1841 is a species of wild sheep originating from Asia and the oriental Mediterranean basin, although its exact origin remains unclear (Hiendleder *et al.* 2002). European populations appear to come from Corsica and Sardinia (Michel & Ghoddouisi 2020, Garel *et al*. 2022). Mouflon are considered a domesticated species that later became feral (Garel *et al.* 2022). For these reasons, the species has occasionally been termed *Ovis aries* Linnaeus, 1758 or *Ovis orientalis* Gmelin, 1774 according to the code of zoological nomenclature (ICZN 2003; but see Michel *et al*. 2026); however, these names appear to refer to a hybrid, and are no longer used (Valdez 1982, Groves & Grubb 2011). In Spain, they were introduced for hunting purposes between the 1950s and 1960s (Rodríguez-Luengo *et al.* 2007), with the first known appearance in the Cazorla and Segura mountains (Rodríguez-Luengo *et al.* 2002). Later, they were introduced to the Cuenca mountain range and other locations, including the Teide National Park, where they expanded rapidly (Rodríguez-Luengo 1993). Currently, there are populations in Extremadura, the central plateau (Toledo and Ciudad Real), Andalusia, and the Valencian community (Cassinello 2017). However, introductions for hunting purposes may be much more widespread (Ayucar *et al*. 2022). In Andalusia, there are notable populations in the provinces of Almería, Cádiz, Córdoba, Jaén, Málaga, and Sevilla (Rodríguez-Luengo *et al*. 2007) although there have also been observations in Granada (Jesús Duarte per. obs.). Due to their high dispersal and invasive capacity (Rodríguez-Luengo & Fandos 1990), mouflon are catalogued as a global invasive alien species (GISD 2007), and included as an invasive species in the Spanish catalogue of the Ministerio de Agricultura, Alimentación y Medio Ambiente (2013).

Mouflon are small wild sheep common to mountainous areas (Shackleton 1997) that also inhabit forests, scrubland, and open areas, in which they can overlap and compete with livestock (Brivio *et al*. 2022). They show a special predilection for the ecotones between these habitats and stony or rocky areas where they find pasturelands (García-González & Cuartas 1989), but also exhibit browsing habits (Marchand *et al.* 2013). In fact, the species adapts to different types of habitats, in both high and low areas, and exhibits social habits, with segregation by sex in spring and summer (Cassinello 2017). Like most ungulates, males are polygynous, and females can have different oestrous cycles throughout their breeding season (Santiago *et al*. 2004), giving strong reproductive potential. No competition has been found with other ungulates, except the Iberian ibex *Capra pyrenaica* Schinz, 1838 (Sarasa *et al.* 2012); nevertheless, their diet may overlap with other wild species and livestock, especially during times of scarcity or seasons in ranges where they coexist (Martínez & Fandos 1989, Miranda *et al*. 2012). Although there is little data in Mediterranean environments, it is estimated that the herds have relatively small range areas (5 km radius) and are sedentary (Pfeffer 1967). Herds are usually large, stable, and philopatric, led by older females (Bon *et al.* 1990). Males are more solitary or form small groups. Herds may undertake seasonal migrations to seek better resources or for climatic reasons (Cassinello 2017). Mouflon in Spain, however, is a relatively unstudied species (Carvalho *et al.* 2025).

The species' reproductive potential, ability to form large herds, and adaptability to different habitats -alongside their high dispersal capacity- allow them to expand in new areas. The establishment of new populations is facilitated by the absence of top predators in most areas in which the species is present (however, see Duarte *et al*. 2016), as does an interest in hunting; this can lead to mouflon being introduced to new estates, or escapes from those in which they were already established.

Recent studies on distribution and population trends of mouflon in the Iberian context are scarce. Marco *et al*. (2011) and González *et al*. (2013) described how populations in Aragón have changed during the 2000s. Torres *et al*. (2014) reported densities in a Mediterranean forest environment (Muela de Cortes, Valencia). Ayucar *et al*. (2022) contributed data on distribution and population parameters of free-living populations in Navarra. Finally, Illanas *et al*. (2025) analysed and updated distributions for Spain at a 5x5 km grid resolution, using presence data based on hunting yields. To our knowledge, no recent studies have assessed the distribution of this species in Andalusia or in the province of Málaga (southern Spain). Here, we present an update on free-living mouflon populations in Málaga and test the hypothesis of whether these populations are associated with escapes from nearby hunting estates.

Material and methods

The study area was the province of Málaga, with a sampling period from January 2023 to December 2024. The sampling included two approaches. The first one consisted of a survey of environmental rangers in the province. Systematic surveying of environmental rangers has previously proven useful for updating wildlife distribution and population trends (González *et al.* 2013, Descalzo *et al.* 2021, Carpio *et al.* 2024, Delibes-Mateos *et al.* 2026). With the support of the coordinator of environmental rangers in Málaga (Consejería de Sostenibilidad y Medio Ambiente de la Junta de Andalucía), we distributed a questionnaire by email to collect information on mouflon records in the province. The questionnaire asked rangers to report the geographic coordinates, site names, and municipalities where they had observed mouflon. The researchers did not have access to the rangers' contact details or the exact number of respondents. However, approximately 77 environmental rangers are estimated to work throughout the province. From their answers, we created a database and located each reported presence. For each affirmative response, we contacted the rangers to precisely locate the sighting, confirm whether the mouflons were free or enclosed within a hunting estate, and, in the case of free-range mouflon, determine whether the rangers were aware of the origin of the animals.

Once the locations were determined, the second stage was a field test. Field visits to each of the locations were conducted to verify the presence of mouflon and confirm free-ranging populations (animals outside the limits of closed hunting estates). The sampling consisted of census surveys in areas where rangers had reported mouflon presence. The aim was only to confirm presence, not to estimate abundance or density. The field survey consisted of three visits to each site reported by the environmental rangers. During these visits (on different weeks, not consecutive days), a random transect was conducted to detect the animals. The sampling route was at least 10 km in each area (normally 10-20 km), either by vehicle on tracks or on foot, if the area did not allow vehicle use, and always by two observers. Only direct mouflon observations, not signs -i.e. excrements or other traces- were considered. If the ungulates were detected on the first or second transect, their presence was recorded and subsequent visits were aborted. If no animals were detected after three visits to the area indicated by the rangers, that location was ruled out as an area of positive mouflon presence. Mouflon were typically observed during the first field visit.

Additionally, we also considered previous records included in the atlas of terrestrial mammals of the SECEM, using 10x10 km UTM grids as the sampling unit. Any new presence confirmed during fieldwork was then used to update this database. We also used the database of hunting estates in Andalucía (Junta de Andalucía 2025), limited to Málaga province, to obtain geographical information on hunting estate limits, ID numbers, and categories (big or small game) in the province (updated to 2023-2024; public information available at REDIAM, Red de Información Ambiental de Andalucía). Based on this information, we selected big game estates with mouflon in their technical hunting plan and small game estates with authorised mouflon damage control. A shapefile was created with these areas identified as hunting mouflon, and their geographic centroid was calculated. The intention was to use them as possible origin sites of free-ranging mouflon populations. We also considered zoological centres and closed recreational estates from which there were well-founded suspicions of mouflon escapes as further possible centres of origin. Shapefile containing confirmed records of free-ranging mouflon, together with a set of randomly generated points three times the number of presence sites (Barbet-Massin *et al.* 2012, Hanberry *et al.* 2012), was used to define presence and control points, respectively. These random points were stipulated to exclude mouflon hunting areas and a 5-km radius of their centroid (the range area of the species; Pfeffer 1967), to avoid them coinciding with areas where mouflon were likely present while still matching suitable environments (i.e., not urban areas or farmlands).

To test the hypothesis that free-ranging mouflon populations originate from escapes from hunting estates, we calculated the distance to the nearest possible point of origin and compared it with the distance to randomly selected control points using ANOVA (Fowler & Cohen, 1992). We used the QGis (QGis.org, 2025) distance-to-nearest-hub tool to estimate distances between the different shapefiles (presence of free-range mouflon populations to centroids of possible centre of origin and to random control points). Statistical analyses were carried out using R (R Core Team 2025) and JASP software (JASP Team 2025). All means are given with their standard errors.

Results

We received 14 questionnaires from environmental rangers reporting 60 sites of mouflon presence in the province of Málaga (Fig. 1). The response rate from rangers was poor (18.2% of the estimated environmental rangers) but covered the main natural areas of the province (the Antequera range, Axarquía and Sierra Tejeda, Costa del Sol, Guadalhorce Valley, Guadalteba, the Ronda mountain range, and Sierra de las Nieves), except for the district of Málaga city and the northeastern region of Málaga (the Archidona and Camarolos mountains). A potential source of bias should also be acknowledged, as environmental rangers with confirmed mouflon observations may have been more likely to respond than those working in areas where the species was absent. We also assume that one ranger from each biogeographical unit (homogeneous territorial demarcations in which the rangers are grouped) responded to the survey, probably to avoid duplication of data. The environmental rangers reported geographical information that facilitated the subsequent field visit for verification.

The field sampling allowed us to confirm all reported sites, detecting the presence of free-living mouflon in each open area. Presence was not in doubt in any of the locations. The verification of rangers' data involved a sampling effort of 88 field visits and 1,372.8 km of transects.

Previously, seven grid squares in the Atlas of the Terrestrial Mammals of Spain (Rodríguez-Luengo *et al.* 2002) had a reported mouflon presence (6.7% of the total area). The new areas detected include seventeen new grid squares (16.3%), representing an increase in the provincial distribution area of the species (Fig. 2) in terms of 10x10 UTM grids.

The average distance from points with free-range mouflon to possible centres of origin was 3.6 ± 0.5 km (n= 60); this was significantly smaller than the average distance to random control points (9.3 ± 0.2 km; n= 180; ANOVA; F= 122.178; $p < 0.001$; Fig. 3). Table 1 summarises the populations found as well as their possible origins and areas of expansion.

Discussion

This research highlights some noteworthy findings based on a questionnaire survey. This type of sampling, alongside studies based on citizen science data, is a powerful tool for collecting information on wildlife distribution (Linares *et al.* 2020, Díaz-Ruiz *et al.* 2024, Alba-Patiño *et al.* 2026), allowing

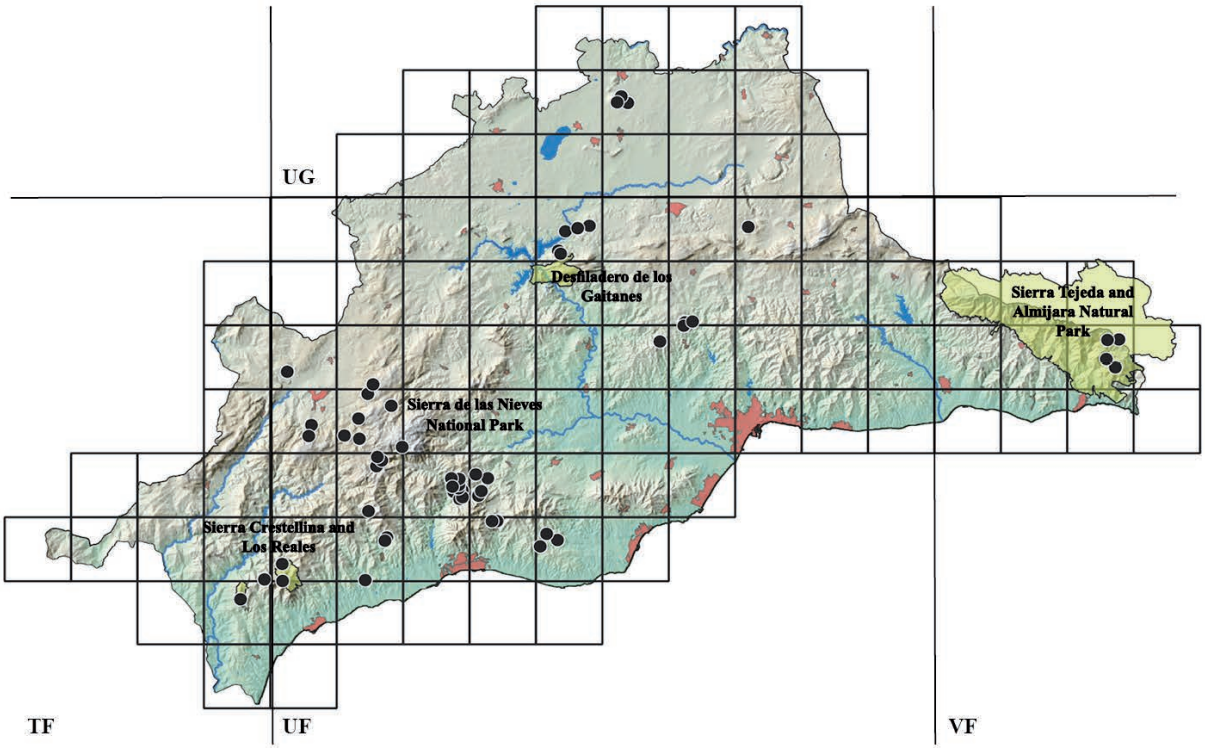

Figure 1. Presence of free-range mouflon populations in the province of Málaga (marked with black circles). Data reported by environmental rangers and confirmed through field sampling.

information to be obtained about certain species from professionals with extensive knowledge of the territory. This type of information allows sampling efforts to be more focused and adds value when subsequently verified using systematic sampling methods, as in the present study. A systematic sampling of the entire province would have entailed a much greater -possibly unmanageable- sampling effort. However, it is evident that the questionnaire does not guarantee full coverage of the territory, given that the response rate was not 100%; consequently, there are likely additional areas where the species is present that have not been detected in this study.

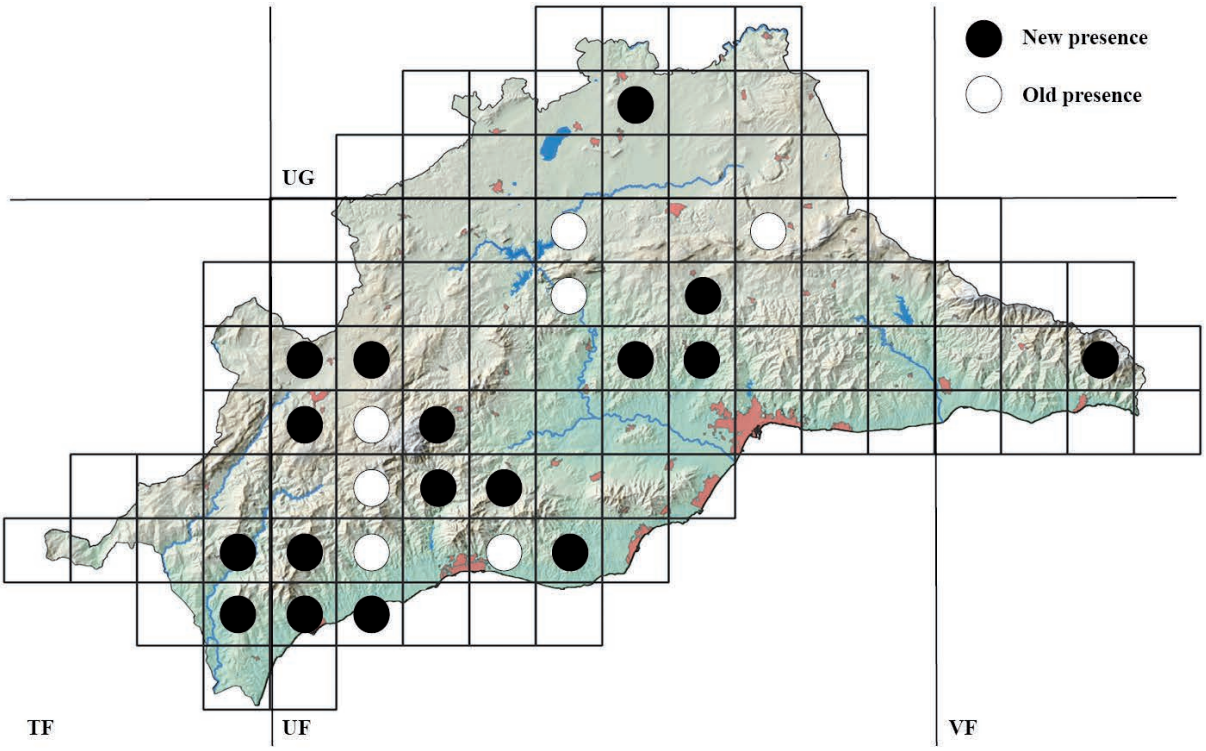

Figure 2. Distribution of mouflon populations in the province of Málaga (10x10 km UTM grids). Old presence: Atlas of Mammals of Spain (Rodríguez-Luengo *et al*. 2002). New presence: present field survey.

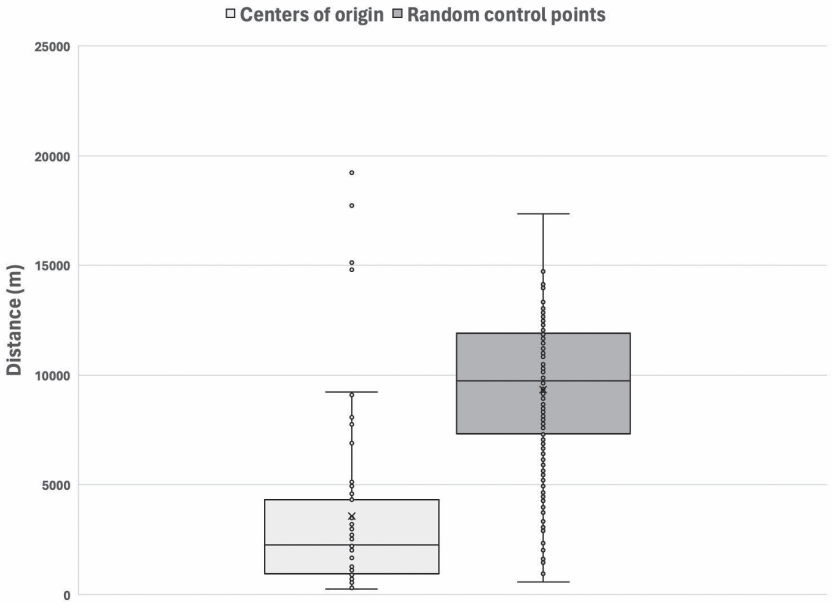

Figure 3. Distance of the locations of free-range mouflon populations to possible centre of origin (hunting estates with mouflon in their hunting planning) and to random control points

Table 1. Free-living mouflon populations in the province of Málaga (Andalucía, SE Spain) verified during the study period (2023-2024).

Population	Origin	Range expansion
Sierra de las Nieves (south-eastern)	Escapes from hunting estate	Bornoque cork oak forest Rio Verde valley
Sierra de las Nieves (north-eastern)	Escapes from hunting estate	Cerro Avanto, Cerro Alcojona, El Sabinal, La Alcazaba and Manaderos estates
Sierra Blanca	Escapes from Ojén Ecoreserve	Sierra Parda
Elviria cork oak forest	Escapes from zoological centre	La Mairena estate, sierra Alpujata (Mijas)
Ronda mountains	Escapes from hunting estate	Linarejos, La Sanguijuela, La Hierbabuena estates
La Resinera and Benahavís mountains	Escapes from La Zagaleta estate	Sierra Bermeja and Palmitera mountains
Sierra Crestellina and Los Reales	Escapes from hunting estate	Localised population, possible expansion to Genal valley
Almogía and Campanillas river valley	Escapes from hunting estate	Localised population, possible expansion to the north (Torcal area)
Desfiladero de Los Gaitanes	Escapes from hunting estate	El Chorro reservoirs and Bobadilla area
Sierra Tejeda y Almijara	Escapes from zoological centre	South face of the natural park and Los Bermejales reservoir (Granada; north side)
Sierra de La Camorra	Introduced population	Nearby reservoirs of Córdoba
Las Pedrizas	Introduced population	Localised population, possible expansion to the Camarolos mountains area

In any case, the results show significant expansion of the mouflon species in the province of Málaga, including free-living populations, even within protected areas. From a hunting perspective, mouflon harvests have steadily increased in recent years, particularly in enclosed hunting estates, which are common in Andalucía (Garrido *et al.* 2019). According to these same authors, the hunting yield in the province of Málaga is double the national average. This suggests that the species is becoming increasingly common and abundant in big-game hunting estates, consistent with the possibility of escapes and expansion into adjacent areas. This is in contrast with data from other regions, where the species is stable or only shows signs of slight expansion (Marco *et al.* 2011, González *et al.* 2013, Ayucar *et al.* 2022). Nevertheless, it should be considered that there are many zones of unknown presence at regional levels (Illanas *et al.* 2025). The lack of recent, specific census data in many regions -combined with high hunting yields in other areas (Garrido *et al.* 2019)- suggests that there may be more free-living populations than currently known, as is the case in Málaga.

The results also support the hypothesis that various populations in Málaga may be related to escapes from hunting areas. While the available data do not allow us to establish a direct relationship between the populations sampled and the hunting estates that keep mouflon, two factors point to the plausibility of this hypothesis. First, for most free-range populations, environmental rangers have consistent indications of escapes and can identify possible origin sites. Second, our analysis shows that the average distance of these free populations to possible centres of origin is consistent with the dispersal distance of the species reported in the literature: normally between 2 and 3 km, with a maximum of 5 km (Pfeffer 1967); dispersion speed is reported between 0.7 and 2.8 km per year (Rodríguez-Luengo & Fandos 1990). These latter authors point out that the speed of dispersal of the mouflon slows over time, probably after successful colonisation and establishment in favourable habitats where hunting pressure is reduced. This argument is also supported by the sedentary nature of the herds (Bon *et al.* 1990). This is likely the case in areas where the herds are currently established, on estates where they are not hunted or are within protected areas, such as in the Sierra de las Nieves National Park, where the population has already reached a considerable size (Jesús Duarte per. obs.).

The same has been observed around the reservoirs of the protected area of Desfiladero de los Gaitanes (El Chorro).

The likely possibility of more free-living populations in addition to those described in this study, and further possible expansions in the coming years, raise a conservation issue and a debate regarding the species. This is especially pertinent given the difficulty of controlling mouflon, and emerging scenarios that facilitate the expansion of ungulates in general (Acevedo *et al.* 2011) and specifically mouflon in favourable habitats (Puddu & Mairano 2016). There is little data on the impact of the species on natural ecosystems -although problems have been reported in Teide and Sierras de Cazorla, Segura y las Villas Natural Park (Rodríguez-Luengo *et al.* 2002)- but there are indications that they can act as vectors of disease and parasites (Ruiz-Fons *et al.* 2008, Torres *et al.* 2014) and can compete with other ungulates and livestock (Martínez & Fandos 1989, Brivio *et al.* 2022), potentially leading to conservation and human–wildlife conflicts. Therefore, the management of mouflon populations in Málaga should be urgently considered.

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References

Acevedo P., Farfán A., Márquez A.L., Delibes-Mateos M. Real R. & Vargas J.M. 2011. Past, present and future of wild ungulates in relation to changes in land use. Landscape *Ecology,* 26: 19-31. DOI: 10.1007/s10980-010-9538-2

Alba-Patino D., Martínez-Jauregui M., Vaquerizas P.H., Morales-Reyes Z., Glikman J.A., Villafuerte R. … & Delibes-Mateos M. 2026. Leverage ranger's knowledge to assess wild boar contribution to people in Spain. *Ecosystems and People,* 22: 2624443. DOI: 10.1080/26395916.2026.2624443

Ayucar M., García-Serrano A. & Herrero J. 2022. Presencia del muflón mediterráneo *Ovis aries* en Navarra. *Naturalia Cantabricae,* 10: 21-28.

Barbet-Massin M., Jiguet F., Albert C.H. & Thuiler W. 2012. Selecting pseudo-absences for species distribution models: how, where and how many? *Methods in Ecology and Evolution,* 3: 327-338. DOI: 10.1111/j.2041-210X.2011.00172.x

Bon R., González G., Im S. & Badia J. 1990. Seasonal grouping in female moufflons in relation to food availability. *Ethology,* 86: 224-236. DOI: 10.1111/j.1439-0310.1990.tb00431.x

Brivio F., Ciuti S., Pipia A., Grignolio S. & Apolonio M. 2022. Livestock displace European mouflon from optimal foraging sites. *European Journal of Wildlife Research,* 68: 30. DOI: 10.1007/s10344-022-01581-y

Carpio A.J., Acevedo P., Villafuerte-Jordán R., Serrano-Rodríguez R., Pascual-Rico R. & Martínez-Jauregui M. 2024. Knowledge, perception, and awareness of society regarding (over)abundance of wild ungulate populations. *Ecology and Society,* 29: 24. DOI: 10.5751/ES-14828-290124

Carvalho J., Carpio A., Figueiredo A.M., Fonseca C., Ferreira E., Serrano E. … & Torres, R.T. 2025. Three Decades of Research on Iberian Wild Ungulates: Key Insights and Promising Research Avenues. *Mammal Review*, 55 (4): e12384. DOI: 10.1111/mam.12384

Cassinello J. 2017. Muflón - *Ovis orientalis*. En: Enciclopedia Virtual de los Vertebrados Españoles. A. Salvador & I. Barja I. (eds.). Museo Nacional de Ciencias Naturales, Madrid. http://www.vertebradosibericos.org/

Delibes-Mateos M., Villafuerte R., Arroyo B., Durá-Alemán C.J., Garrido F.E., Glikman J.A. … & Martínez-Jauregui M. 2026. Nationwide ranger-based survey reveals the widespread decline of the Iberian rabbit (*Oryctolagus cuniculus algirus*) in Spain. *Global Ecology and Conservation,* 67: e04143. DOI: 10.1016/j.gecco.2026.e04143

Descalzo E., Díaz-Ruiz F., Delibes-Mateos M., Salgado I., Martínez-Jauregui M., Soliño M. … & Ferreras P. 2021. Update of the Egyptian mongoose (*Herpestes ichneumon*) distribution in Spain. *Galemys, Spanish Journal of Mammalogy,* 33: 29-38. DOI: 10.7325/Galemys.2021.A4

Díaz-Ruiz F., Descalzo E., Martínez-Jauregui M., Soliño M., Márquez A.L., Farfán M.A. … & Delibes-Mateos M. 2024. Combining ranger records and biogeographical models to identify the current and potential distribution of an expanding mesocarnivore in southern Europe. *Science of the Total Environment,* 946: 174216. DOI: 10.1016/j.scitotenv.2024.174216

Duarte J., García F.J. & Fa J.E. 2016. Depredatory impact of free-roaming domestic dogs on Mediterranean deer in southern Spain: implications for human-wolf conflict. *Folia Zoologica,* 65: 135-141. DOI: 10.25225/fozo.v65.i2.a8.2016

Fowler J. & Cohen L. 1992. *Practical statistics for field biology*. John Wiley & Sons, Chichester, UK.

García-González R. & Cuartas P. 1989. A comparison of the diets of the wild goat (*Capra pyrenaica*), domestic goat (*Capra hircus*), mouflon (*Ovis musimon*) and domestic sheep (*Ovis aries*) in the Cazorla Mountain range. *Acta Biologica Montana,* 9: 123-132.

Garel M., Marchand P., Bourgoin G., Santiago-Moreno J.E., Portanier E., Piegert E. … & Cugnasse J.M. 2022. Mouflon, *Ovis gmelini*, Blyth 1841. In: K. Hackländer & F.E. Zachos (eds.). *Handbook of the Mammals of Europe*. Springer Nature Switzerland.

Garrido J.L., Gortázar C. & Ferreres J. 2019. *Las especies cinegéticas españolas en el siglo XXI.* IREC and Federación Española de Caza, 116 pp.

GISD, The Global Invasive Species Database. 2007. *Ovis musimon*. Invasive Species Specialist Group (ISSG) of the Species Survival Commission of the IUCN-World Conservation Union. <https://www.iucngisd.org/gisd/> Downloaded on 5 January 2026.

González J., Herrero J., Prada C. & Marco J. 2013. Changes in wild ungulate populations in Aragon, Spain between 2001 and 2010. *Galemys, Spanish Journal of Mammalogy,* 25: 51-57. DOI: 10.7325/Galemys.2013.A5

Groves C. & Grubb P. 2011. *Ungulate taxonomy*. The Johns Hopkins University Press, Baltimore.

Hanberry B.B., He H.S. & Palik B.J. 2012. Pseudoabsence generation strategies for species distribution models. *PlosOne*, 78: e44486. DOI: 10.1371/journal.pone.0044486

Hiendleder S., Kaupe B., Wassmuth R. & Janke A. 2002. Molecular analysis of wild and domestic sheep questions current nomenclature and provides evidence for domestication from two different subspecies. *Proceedings of the Royal Society B: Biological Sciences,* 269: 893-904. DOI: 10.1098/rspb.2002.1975

Illanas S., Fernández-López J., Vicente J., Ruiz-Rodríguez C., López-Padilla S., Sebastián-Pardo M. … & Blanco-Aguiar J.A. 2025. Presence-only data for wild ungulates and red fox in Spain based on hunting yields over 10-year period. *Scientific Data,* 12: 236. DOI: 10.1038/s41597-025-04574-z

JASP Team. 2025. JASP (Version 0.95.4). https://jasp-stats.org/

Junta de Andalucía. 2025. Catálogo de datos y servicios ambientales de Andalucía. Consejería de Sostenibilidad y Medio Ambiente. https://www.juntadeandalucia.es/medioambiente/portal/acceso-rediam/catalogo. Downloaded on 9th september 2025.

Linares O., Carranza J., Saliño M., Delibes-Mateos M., Ferreras P., Descalzo E. & Martínez-Jauregui M. 2020. Citizen science to monitor the distribution of the Egyptian mongoose in southern Spain: who provide the most reliable information? *European Journal of Wildlife Research,* 66: 65. DOI: 10.1007/s10344-020-01408-8

Marchand P., Redjadj C., Garel M., Cugnasse J.M., Maillard D. & Loison A. 2013. Are mouflon *Ovis gmelini musimon* really grazers? A review of variation in diet composition. *Mammal Review,* 43: 275-291. DOI: 10.1111/mam.12000

Marco J., Herrero J., Escudero M.A., Fernández-Arberas O., Ferreres J., García-Serrano A. … & Prada C. 2011. Veinte años de seguimiento poblacional de ungulados silvestres en Aragón. *Pirineos, Revista de Ecología de Montaña,* 166: 135-153.

Martínez T. & Fandos P. 1989. Solapamiento entre la dieta de la cabra montés (*Capra pyrenaica*) y la del muflón (*Ovis musimon*). *Doñana, Acta Vertebrata* 16: 315-318.

Michel S. & Ghoddousi A. 2020. *Ovis gmelini*. The IUCN Red List of Threatened Species 2020. DOI: https://www.iucnredlist.org/species/54940218/22147055

Michel S., Lovari S., Ghoddousi A. & Herrero J. 2026. The taxonomic status of the European mouflon in Spain. *Galemys, Iberian Journal of Mammalogy,* 38 (in press). DOI: 10.7325/Galemys.2026.F1

Ministerio de Agricultura, Alimentación y Medio Ambiente. 2013. Real Decreto 630/2013, de 2 de agosto, por el que se regula el Catálogo español de especies exóticas invasoras. BOE 185, de 3 de agosto de 2013.

Miranda M., Sicilia M., Bartolomé J., Molina-Alcaide E., Gálvez-Bravo L. & Cassinello J. 2012. Contrasting feeding patterns of native red deer and two exotic ungulates in a Mediterranean ecosystem. *Wildlife Research* 39: 171-182. DOI: 10.1071/WR11146

Pfeffer P. 1967. Le Mouflon de Corse (*Ovis ammon musimon* Schreber, 1782); position systématique, écologie et éthologie comparées. *Mammalia,* 31: 1-262.

Puddu G. & Maiorano L. 2016. Combining multiple tools to provide potential distributions for the mouflon in Sardinia: species distribution models, spatial pattern analysis and circuit theory. *Hystrix,* 27: 11695. DOI: 10.4404/hystrix-27.1-11695

QGIS Development Team. 2025. *QGIS Geographic Information System.* Open Source Geospatial Foundation Project. https://qgis.org.

R Core Team. 2025. *R: A language and environment for statistical computing.* R Foundation for Statistical Computing, Vienna, Austria. Available online at: https://www.R-project.org/

Rodríguez-Luengo J.L. 1993. *El Muflón de Tenerife*. Tesis Doctoral. Universidad de La Laguna, Tenerife.

Rodríguez-Luengo J.L. & Fandos P. 1990. Dispersión del muflón de Córcega (*Ovis ammon musimon* Schreber, 1782) en Tenerife (Islas Canarias). *Ecología,* 4: 171-176.

Rodríguez-Luengo J.L., Fandos P. & Soriguer R. 2002. Muflón, *Ovis gmelini* Pallas, 1811. Pp. 334-337. En: L.J. Palomo & J. Gisbert (eds.). *Atlas de los Mamíferos Terrestres de España*. Dirección General de

Conservación de la Naturaleza - SECEM - SECEMU, Madrid.

Rodríguez-Luengo J.L., Fandos P. & Soriguer R.C. 2007. *Ovis aries* Linnaeus, 1758. Pp. 371-373. En: L.J. Palomo, J. Gisbert & J.C. Blanco (eds.). *Atlas y libro rojo de los mamíferos de España*. Dirección General para la Biodiversidad - SECEM - SECEMU, Madrid.

Ruiz-Fons F., Reyes-García A.R., Alcaide V. & Gortázar C. 2008. Spatial and temporal evolution of bluetongue virus in wild ruminants, Spain. *Emerging Infectious Diseases,* 14: 951-953. DOI: 10.3201/eid1406.071586

Santiago J., Toledano-Díaz A., Gómez-Brunet A. & López A. 2004. El muflón europeo (*Ovis orientalis musimon* Schreber, 1782) en España: consideraciones históricas, filogenéticas y fisiología reproductiva. *Galemys,* 16: 3-20. DOI: 10.7325/Galemys.2004.2.A1

Sarasa M., Alasaad S. & Pérez J.M. 2012. Common names of species, the curious case of *Capra pyrenaica* and the concomitant steps towards the "wild-to-domestic" transformation of a flagship species and its vernacular names. *Biodiversity and Conservation*, 21: 1-12. DOI: 10.1007/s10531-011-0172-3

Shackleton D.M. 1997. *Wild Sheep and Goats and Their Relatives: Status Survey and Conservation Action Plan for Caprinae.* IUCN/SSC Caprinae Specialist Group, Gland, Switzerland and Cambridge, Reino Unido, 391 pp.

Torres R.T., Herrero J., Prada C., García-Serrano A., Fernández-Arberas O. & García-Post R. 2014. Estimating the population density of Iberian wild goat *Capra pyrenaica* and mouflon *Ovis aries* in a Mediterranean forest environment. *Forest Systems* 23: 36-43. DOI: 10.5424/fs/2014231-03322

Valdez R. 1982. *The wild sheep of the world*. Wild Sheep International, Mesilla, New Mexico.

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