

TWO DECADES OF EXPANSION: POPULATION DYNAMICS AND SPATIAL DISTRIBUTION OF THE GOLDEN JACKAL IN ROMANIA BETWEEN 2004–2025

Dan C. POPOVICI¹ Ovidiu IONESCU^{1, 2}
Georgeta IONESCU^{1,2} Darius HARDALAU¹

Abstract: The golden jackal (*Canis aureus*) has undergone rapid and widespread expansion across Europe over the past two decades, with Romania emerging as a key region for both population growth and territorial colonization. This study examines the spatial distribution and population dynamics of the species in Romania between 2004 and 2025, based on official data collected from more than 2,100 hunting grounds. Using descriptive statistics, Compound Annual Growth Rate (CAGR) analysis, and GIS-based mapping, the research reveals a 31.65-fold population increase, from 1,291 individuals in 2004 to 40,861 in 2025, corresponding to a CAGR of 17.7%. The findings highlight the golden jackal's expansion from Danube-bordering counties to widespread presence across Romania's plain and hilly regions, reaching the northern national borders. As the species increasingly interacts with wildlife and forest managers through its predation behaviour, with farmers through livestock depredation, and with public health systems due to its role in disease transmission, there is an urgent need to understand how to manage its growth and promote coexistence. This study underscores the jackal's reproductive and dispersal capacity and emphasizes the necessity of implementing adaptive management strategies without delay.

Key words: Golden jackal, population dynamics, wildlife management, forest ecosystem.

1. Introduction

Jackals belong to the *Canis* genus of mesocarnivores: medium-sized predators

whose diet consists of approximately 50-70% meat, supplemented by fruits, insects, and other plant material [3, 29, 34]. They typically weigh between 6 to 15 kilograms,

¹ Department of Silviculture, Faculty of Silviculture and Forest Engineering, Transilvania University of Brasov, Șirul Beethoven no. 1, Brasov 500036, Romania;

² Wildlife Department, National Institute for Research and Development in Forestry Marin Dracea, 077190 Voluntari, Romania;

Correspondence: Darius Hardalau; email: darius.hardalau@unitbv.ro.

depending on the species and geographic location [39]. Members of this group are distributed across various parts of the world, including the black-backed jackal (*Canis mesomelas* Schreber), which inhabits the eastern and southern regions of the African continent [25, 37]; the side-striped jackal (*C. adustus* Sundevall), found primarily in central and southern Africa, often overlapping with the black-backed jackal [6, 31]; and the Ethiopian wolf, or Abyssinian jackal (*C. simensis* Ruppell), which is endemic to the highlands of Ethiopia [17]. A well-known relative from the same genus is the coyote (*Canis latrans* Say), widely distributed across North America. Among the most widely distributed and expansion-prone members of the *Canis* genus is the golden jackal (*Canis aureus* L.). This highly adaptable species originating from India [12], inhabits a broad geographic range, including northern Africa, southern Asia up to Burma and Thailand, and southeastern Europe [22], and has recently expanded its presence into Central Europe [7] and the Baltic region [42]. This study focuses primarily on the distribution and expansion of the golden jackal (*Canis aureus* L.) in Eastern Europe, with a particular emphasis on Romania, in a concept similarly to Marfiuc et al. [32].

Romania is located at the ecological intersection of the Balkans, the Carpathians, and the Danube Delta. Historically, the golden jackal was not considered a native species, as the first confirmed specimen was recorded on the left bank of the Danube, in the Wallachian Plain, during the 1920s [9, 28]. All the recent theories suggest that the golden jackal expansion in Europe came from Bulgaria [41]. In the 1960s, the species was regarded as an occasional visitor from the

Balkan Peninsula, likely entering the country across the frozen Danube during severe winters [28]. It was only in the 1970s that the first individual considered to be a resident was harvested and documented. By the 1980s, the entire Dobrogea region supported a permanent and robust population of golden jackals [28]. Beginning in the 1990s and continuing through the 2000s, the species began to gradually disperse throughout the southern part of Romania [32].

As a mesocarnivore, the golden jackal not only competes with native wildlife for prey, but also poses multiple threats: it can act as a vector for various diseases and parasites, and it represents a risk to livestock through direct predation. Studies linked golden jackals to the transmission of rabies, tick-borne protists (*Babesiidae*, *Theileriidae* and *Hepatozoidae*), *Echinococcus granulosus* and *Trichinella pseudopsiralis* raising concerns for both domestic animal health and public safety [15, 21, 33]. Their presence near rural settlements and agricultural areas increases the likelihood of conflict with farmers, particularly in regions where small-scale livestock operations lack adequate protective measures, as this species predated on calves and lambs under one year of age [45]. Additionally, the golden jackal's adaptability to human-modified landscapes enables it to thrive in areas with abundant food waste, further facilitating its expansion into altered habitats [16]. Studies across Europe suggest that golden jackals (*Canis aureus* L.) typically avoid habitat patches occupied by grey wolves (*Canis lupus* L.), with stable wolf presence often associated with the absence or low abundance of jackals, likely due to both direct predation and interspecific competition [13, 27]. For

wildlife managers, the golden jackal represents a major concern in the plains and hilly regions, as predation rates can be significant. In the Western Plains of Romania, golden jackal predation on fallow deer (*Dama dama* L.) has been reported to reach up to 46.4%. In the Western Plains of Romania, ungulate populations have reached levels 3.6 times higher than the sustainable population threshold [19]. As ungulate numbers continue to rise across Central-Eastern Europe and the Baltic region over the past decade [18, 20], this overabundance of food resources may be facilitating the expansion of the golden jackal.

As the golden jackal continues to expand in both number and range, this study aims to provide an updated and more comprehensive understanding of its distribution and dynamics in Romania. Building upon the study of [32], this research incorporates a broader dataset and more recent field observations to refine and expand current knowledge of the species. By examining a two-decade dataset (2004-2025) of golden jackal observations, this study analyses the species' distribution and population growth in order to better understand its expansion capacity. Ultimately, the goal is also to assess how this rapid growth can contribute to conflicts with wildlife and livestock, as well as the broader implications for coexistence and management strategies.

2. Materials and Methods

2.1. Study Area

This study was conducted across the entire territory of Romania, located in Southeastern Europe, covering approximately 238,397 km² [1]. Romania

lies at the intersection of several major biogeographical regions, including the Carpathian Mountains, the Transylvanian Plateau, the Danube River Basin, and the Black Sea coast [35]. The country features a balanced distribution of landforms, with approximately 35% mountainous terrain, 35% hills, and 30% plains [4]. This diverse topography supports a wide range of habitats and ecological conditions, making Romania a key area for studying species with high ecological plasticity, such as the golden jackal (*Canis aureus* L.) [38].

With over 2,100 designated hunting grounds, Romania has an extensive and regulated system for wildlife management. The country enforces a strict legal framework governing the monitoring, conservation, and control of both game and non-game species, including the golden jackal. The management of hunting grounds is assigned to wildlife managers, who are obligated, under Article 62 of Order No. 2847/2022 issued by the Ministry of Environment, Waters, and Forests, to record and report the population number estimates of golden jackals within each hunting ground [2].

2.2. Data Collection and Statistical Analysis

All official annual game population reports from 2004 to 2025, issued by the Ministry of Environment, Waters, and Forests, were analysed for this study. Specifically, all available population estimates for the golden jackal (*Canis aureus* L.) were extracted and compiled. The analysis was conducted in two stages. First, national-level population trends were examined using descriptive data visualization and the calculation of the Compound Annual Growth Rate (CAGR) to

assess the species' overall growth over time. Secondly, golden jackal population data at the county level were used to create spatial distribution maps at ten-year intervals (2005 and 2015). Because population size was not reported at the level of individual hunting grounds during those years, the maps for 2005 and 2015 were based on aggregated county-level data. In contrast, for 2025, a detailed distribution map was generated using data reported at the level of individual hunting grounds, providing a high-resolution overview of the species' current distribution.

Data compilation and initial visualization were performed using Microsoft Excel (version 16.93.1), while all statistical analyses, including CAGR computations and summary statistics, were conducted using IBM SPSS Statistics (version 29.0.2.0). The 2025 map was developed using QGIS to ensure an accurate geospatial representation of the species' range. All

datasets were checked for outliers and tested for collinearity to ensure the validity and reliability of the statistical analyses.

3. Results

Over the 21-year period from 2004 to 2025, the golden jackal (*Canis aureus* L.) population in Romania increased dramatically from 1,291 individuals in 2004 to 40,861 in 2025 (Figure 1). The data indicate an overall upward trend, albeit with some fluctuations in intermediate years. Notably, a dip occurred in 2008 and again in 2014. The linear regression model confirms a statistically significant upward trend ($R^2 = 0.9921$, $p < 0.001$), explaining nearly all of the variation in population size over time. The trend line illustrates a consistent and accelerating growth pattern, particularly after 2015, suggesting that the golden jackal's expansion has not yet plateaued.

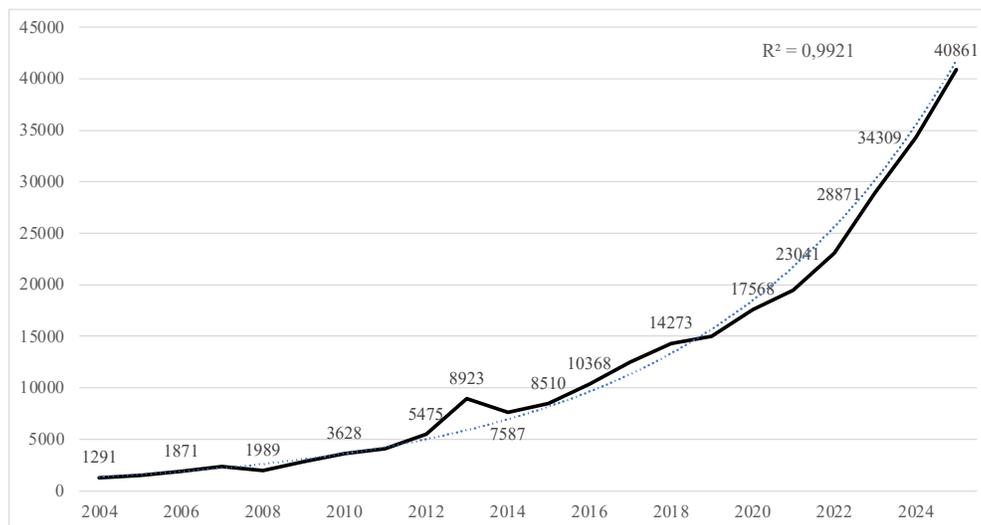


Fig. 1. Golden jackal (*Canis aureus*) population trend in Romania from 2004 to 2025, based on official annual reports

Over a 21-year observation period (2004-2025), the golden jackal population in Romania experienced a substantial increase, growing by a factor of 31.65. The Compound Annual Growth Rate (CAGR) for this period was calculated at 17.7% (Figure

2), indicating an accelerated increasing trend. This growth rate was found to be statistically significant at a 95% confidence level ($p < 0.01$).

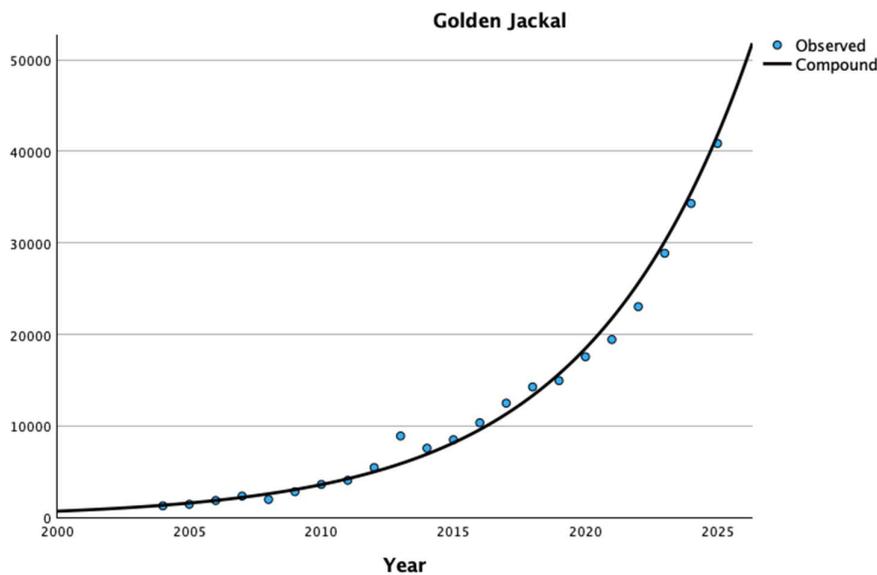


Fig. 2. Compound Annual Growth Rate of the Golden Jackal Population in Romania (2004-2025)

In 2005 (Figure 3), the presence of the golden jackal (*Canis aureus* L.) in Romania was still limited and spatially constrained. Distribution data show that the species was primarily concentrated in the southern and southeastern parts of the country, particularly in counties bordering the Danube and the Black Sea coast, such as Constanța with 286 individuals, Tulcea with 324 individuals, Călărași with 105 individuals, Teleorman with 136 individuals and Dolj with 199 individuals. The limited distribution pattern observed in 2005 reflects the species' early colonization

phase, with dispersal corridors starting to take shape along the Danube.

By 2015 (Figure 4), the golden jackal (*Canis aureus* L.) had undergone a substantial range expansion in Romania, with confirmed populations in most southern, southeastern, and southwestern counties. The highest densities were recorded in Tulcea with 1,786 individuals, followed by Dolj with 1,111 individuals and Constanța with 787 individuals, indicating that the species had firmly established itself in the Danube Delta and adjacent lowland ecosystems.

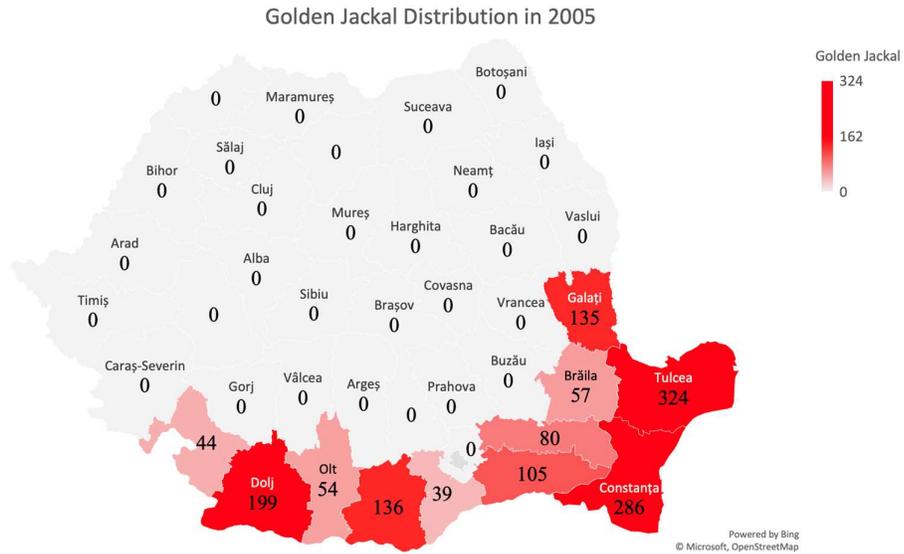


Fig. 3. Spatial distribution of the golden jackal (*Canis aureus*) in Romania based on reported population estimates for the year 2005

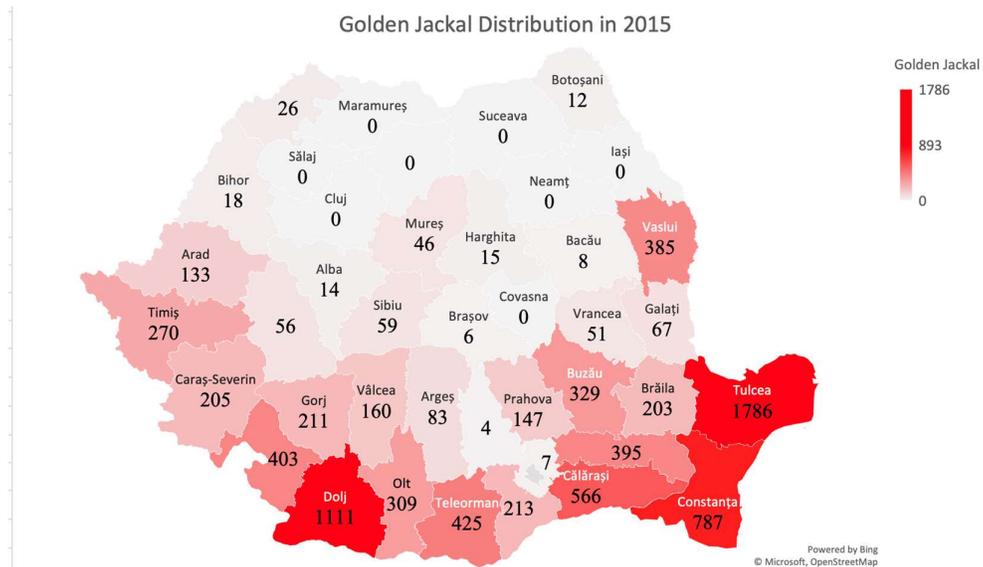


Fig. 4. Spatial distribution of the golden jackal (*Canis aureus*) in Romania based on reported population estimates for the year 2015

Additionally, significant populations were observed in Călărași with 566 individuals and Teleorman with 425 individuals, while the case of Vaslui with 385 individuals indicated a broader dispersal corridor along the Danube and into eastern Moldavia. The species had also begun to expand westward and northward, with increasing presence in counties such as Caraș-Severin, Timiș, Arad, Bihor, although northern regions such as Suceava, Cluj, and Sălaj still reported either zero or minimal numbers. This spatial pattern reflects a mid-phase expansion, where the species had moved beyond its initial southeastern stronghold and was now actively colonizing new regions.

The distribution of the golden jackal (*C. aureus* L.) in Romania by 2025 shows a clear and widespread expansion across the

national territory, with high-resolution data revealing a strong population presence at the scale of individual hunting grounds. Unlike in earlier years, when jackals were concentrated in the southern and southeastern regions, the 2025 map indicates a near-complete colonization of the lowland and hilly regions across much of the country. The most densely occupied areas remain in southern Romania, including the Danube Delta, Dobrogea, and Oltenia, but extensive clusters of high population densities are now also clearly visible throughout western Banat, southern and eastern Muntenia, and parts of Moldova. Only mountainous or heavily forested zones display visibly lower or no jackal presence, indicating limitations to their expansion.

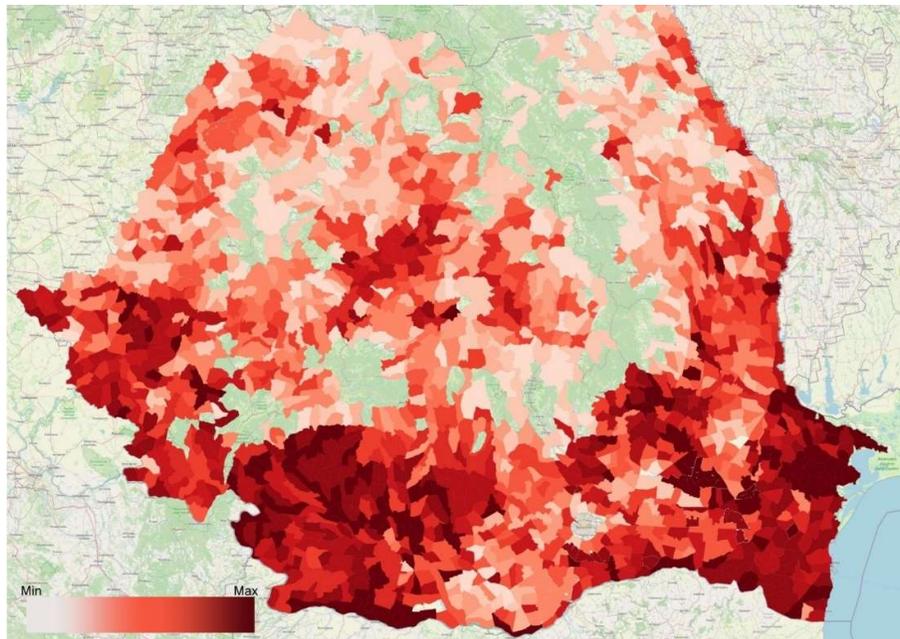


Fig. 5. *Spatial distribution of the golden jackal (Canis aureus) in Romania at the hunting ground level, based on reported population estimates for the year 2025*

4. Discussion

The golden jackal (*C. aureus* L.) has exhibited a remarkable and consistent population increase in Romania over the past two decades, as evidenced by the official annual records analyzed in this study. From a population of just 1,291 individuals in 2004, the species expanded to an estimated 40,861 individuals by 2025. This corresponds to a Compound Annual Growth Rate (CAGR) of 17.7% and represents a population increase of approximately 31.65 times within only two decades. These findings do not represent isolated cases, but rather reflect a broader trend across Europe. In none of the countries studied has there been a recorded recent decline in golden jackal populations. Bulgaria has played a central role in the recent expansion of the golden jackal across Europe, serving as a key core population from which dispersal into neighbouring regions originated [41]. The implementation of protective measures and habitat changes in Bulgaria after the 1960s facilitated a population explosion, which significantly contributed to the species' northward and westward spread [41]. In Hungary, a country which consists predominantly of plains and hilly regions, the golden jackal has shown an exponential increase in the hunting bag from the mid-1990s to 2021, with an average annual growth rate of approximately 40% and occupancy reaching around 86% of the national territory [5]. In this case, the only stabilizing factor was considered to be intensive year-round hunting of jackals, carried out without any hunting quota restrictions [5]. In Serbia, golden jackals now occupy more than half the country's territory, expanding dramatically since the

early 2000s, from initial populations along the Danube and southeastern regions, driven by favourable winters, abundant human-derived food sources, and diminished wolf presence [11, 43]. In Slovenia, the golden jackal has exhibited a slow initial expansion with minimum territorial densities of around 0.06 to 0.29 groups per 10 km² by 2016-2017, but despite the delayed and gradual growth, recent data suggest that the population is now increasing exponentially, demonstrating the species' successful colonization even in regions with lower anthropogenic food resources [26]. The golden jackal population in Bosnia and Herzegovina has increased substantially over recent decades, with an average annual growth rate of 35%, primarily driven by immigration from neighbouring countries such as Croatia and Serbia [44].

The current distribution range of the golden jackal in Europe has significantly expanded beyond its historical core areas [45] in the Balkans, with established populations now confirmed across much of southeastern, central, and even parts of northern and western Europe. In Central Europe, the first confirmed evidence of golden jackal reproduction in Germany was documented in 2021, with at least five individuals observed, indicating ongoing westward dispersal into Western Europe [7]. At the northern edge of its marginal range, the presence of golden jackals in Lithuania is likely the result of natural spread from Belarus, facilitated by milder winters and increased landscape connectivity, but their dispersal to northern regions is uncertain [42]. This distribution shift reflects the species' exceptional ecological flexibility and dispersal capacity. In countries such as

Hungary, Serbia, and Bulgaria, the species occupies more than 70-85% of national territory, forming dense, contiguous populations [5, 11]. Romania has followed a similar trajectory, being a good example of a diffusion dispersal on short-distance with high gradual spread, with golden jackals now distributed across nearly all lowland and hilly regions as seen in Figure 5, while remaining largely absent from mountainous and densely forested areas. In just two decades, the species has rapidly expanded from the southern part of the country toward the north, reaching even its northernmost regions. Due to the stable and dense wolf (*Canis lupus* L.) populations across the Carpathians Mountain [10], golden jackals have not been able to establish themselves in these areas, likely as a result of interspecific competition [36]. However, in regions where wolves are absent, and particularly where food resources are abundant, such as areas with high densities of ungulates or intensive sheep and cattle farming, the jackal population has exploded. Interspecific interactions with another mesocarnivore, the red fox (*Vulpes vulpes* L.), do not appear to significantly influence the ongoing distribution of the golden jackal [30]. The golden jackal's success is strongly tied to its generalist diet and ability to exploit anthropogenic food sources, including livestock carrion, urban waste and wildlife species [8, 13, 47]. The golden jackal's rapid expansion across Romania and other parts of Europe is not only a result of increased dispersal but also of a possibly enhanced reproductive success under favourable environmental conditions. In regions where food resources are abundant and where winter severity has decreased, females may exhibit increased fecundity, producing

larger litters than under natural or resource-limited conditions. Additionally, the higher availability of stable food sources [40] and reduced predation pressure in these areas likely contribute to greater pup survival rates. This suggests a form of ecological adaptation, where golden jackals adjust their reproductive output in response to improved habitat quality and reduced interspecific competition.

To address these challenges, wildlife management strategies must transition toward a more adaptive and evidence-based framework. Currently, the presence of golden jackals does not appear to significantly reduce populations of ungulates or small mammals in areas where these species are abundant, as the quantification can be difficult. However, in regions where ungulate densities are low or within natural ranges, jackal predation may negatively impact population growth and place these species at ecological risk. Rather than acting as a controlling force, jackals tend to benefit from the high reproductive rates and overabundance of certain prey species, exploiting them as a stable and predictable food source. This dynamic highlights the need for regionally differentiated management approaches that consider local prey availability and ecosystem vulnerability. In Romania, golden jackals are still managed under a quota-based hunting system, in which harvest numbers are determined using population estimates from the previous year. This approach may be outdated and ineffective given the species' rapid expansion and ecological flexibility. To improve management, two practical options can be considered: 1) removing hunting quotas for golden jackals and requiring the mandatory reporting of each

harvested individual, allowing for flexible population control throughout the year; or 2) implementing a minimum harvest target per hunting ground to ensure that local populations are actively managed. Both strategies would support more responsive, localized management that reflects real-time population dynamics and regional conflict levels.

As golden jackals continue to expand their range into peri-urban zones and agricultural landscapes [40], their role as potential vectors of zoonotic diseases is becoming an increasing concern for both veterinary and public health authorities. Their scavenging behaviour [24] and close proximity to livestock-grazing areas enhance the risk of cross-species transmission of pathogens. Studies in southeastern Europe have linked jackals to several high-risk infectious agents, including *Echinococcus granulosus* Batsch, *Trichinella spp.*, and tick-borne protozoans such as *Babesia* and *Theileria* [14, 15, 21, 33, 43]. As a result, golden jackals may serve as bridge hosts between wildlife reservoirs and livestock, complicating existing disease control measures, imposing the need for adaptive prevention measures. Golden jackals may also pose a significant public health risk through their role in rabies transmission [46].

While this study provides a comprehensive overview of golden jackal distribution and population trends in Romania over a two-decade period, several limitations should be acknowledged. First, the analysis is based primarily on official hunting data, which, although extensive, may be affected by underreporting, estimation errors, or inconsistent data collection methods across regions. Second, ecological variables such as habitat quality, prey density, and predator-prey

interactions were not integrated into the spatial models, limiting the ecological resolution of the distribution analysis. Future research should no longer focus solely on the expansion and population growth of the golden jackal in Romania, as this trend has been thoroughly documented in the present study. Instead, efforts should be directed toward understanding the underlying causes of this growth, particularly through studies on litter size, reproductive biology, morphometric characteristics of the species and co-existence with local communities and wildlife managers, as the species has undergone ethological changes.

5. Conclusions

The golden jackal has established itself as a rapidly expanding species within Romania's ecosystems, including forests, demonstrating remarkable ecological plasticity and resilience. Its wide geographic spread, coupled with a significant rise in population density, underscores a shift in the regional predator dynamics and calls attention to its growing role in human-wildlife interactions. Effective population control, coupled with robust monitoring of ecological impacts and disease transmission risks, will be critical to balancing conservation goals with agricultural and public health interests.

References

1. Anastasiu, P., Miu, I.V., Gavrilidis, A.A. et al., 2024. Alien plant species distribution in Romania: A nationwide survey following the implementation of the EU Regulation on invasive alien

- species. In: Biodiversity Data Journal, vol. 12, ID article e119539. DOI: [10.3897/BDJ.12.e119539](https://doi.org/10.3897/BDJ.12.e119539).
2. Anonymous, 2022. Ordinul nr. 2847 din 2 noiembrie 2022 privind aprobarea instrucțiunilor pentru evaluarea efectivelor unor specii de faună cinegetică admise la vânătoare și pentru reglementarea modului de stabilire a cotelor de recoltare pentru acestea. Published in Official Monitory of Romania, no. 1094 on November 14, 2022. Available at: <https://legislatie.just.ro/Public/DetaliuDocument/261342>. Accessed on: June 15, 2025.
 3. Atkinson, R.P.D., Macdonald, D.W., Kamizola, R., 2002. Dietary opportunism in side-striped jackals *Canis adustus* Sundevall. In: Journal of Zoology, vol. 257(1), pp. 129-139. DOI: [10.1017/S0952836902000729](https://doi.org/10.1017/S0952836902000729).
 4. Bălțeanu, D., Jurchescu, M., Surdeanu, V. et al., 2012. Recent landform evolution in the Romanian Carpathians and Pericarpathian regions. In: Lóczy, D., Stankoviansky, M., Kotarba, A. (Editors), Recent landform evolution – The Carpatho-Balkan-Dinaric Region, Springer, Dordrecht, Netherlands, pp. 249-286. DOI: [10.1007/978-94-007-2448-8_10](https://doi.org/10.1007/978-94-007-2448-8_10).
 5. Bijl, H., Schally, G., Márton, M. et al., 2024. Form invaders to residents: The golden jackal (*Canis aureus*) expansion in Hungary since the mid-1990s. In: PLoS One, vol. 19(7), ID article e0306489. DOI: [10.1371/journal.pone.0306489](https://doi.org/10.1371/journal.pone.0306489).
 6. Bingham, J., Purchase, G.K., 2002. Reproduction in the jackals *Canis adustus* Sundevall, 1846, and *Canis mesomelas* Schreber, 1778 (Carnivora: Canidae), in Zimbabwe. In: African Zoology, vol. 37(1), pp. 21-26. DOI: [10.1080/15627020.2002.11657150](https://doi.org/10.1080/15627020.2002.11657150).
 7. Böcker, F., Weber, H., Collet, S., 2023. First documentation of golden jackal (*Canis aureus*) reproduction in Germany. In: Mammal Research, vol. 68(2), pp. 249-252. DOI: [10.1007/s13364-022-00666-y](https://doi.org/10.1007/s13364-022-00666-y).
 8. Bošković, I., Šperanda, M., Florijančić, T. et al., 2013. Dietary habits of the golden jackal (*Canis aureus* L.) in the Eastern Croatia. In: Agricultural Conspectus Scientific, vol. 78(3), pp. 245-248.
 9. Calinescu, R., 1931. Schakale in Rumänien. In: Zeitschrift für Säugetierkunde, vol. 5, pp. 364-366.
 10. Chapron, G., Kaczensky, P., Linnell, J.D.C. et al., 2014. Recovery of large carnivores in Europe's modern human dominated landscapes. In: Science, vol. 346(6216), pp. 1517-1519. DOI: [10.1126/science.1257553](https://doi.org/10.1126/science.1257553).
 11. Ćirović, D., Milenković, M., Paunovic, M. et al., 2008. Present distribution and factors of range spread of golden jackal (*Canis aureus* L. 1758) in Serbia. In: Proceeding of the International Conference on Large Carnivores, pp. 93-102.
 12. Cotta, V., Bodea, M., Micu, I., 2001. Vânatul și vânătoarea în România. Ceres Publishing House, Bucharest, Romania, 786 p.
 13. Cunze, S., Klimgel, S., 2022. From the Balkans towards Western Europe: range expansion of the golden jackal (*Canis aureus*) – A climatic niche modeling approach. In: Ecology and Evolution, vol. 12(7), pp. e9141. DOI: [10.1002/ece3.9141](https://doi.org/10.1002/ece3.9141).
 14. Duscher, G.G., Kübber-Heiss, A., Richter, B. et al., 2013. A golden jackal (*Canis aureus*) from Austria bearing *Hepatozoon canis* – Import due to

- immigration into a non-endemic area? In: Ticks and Tick-borne Diseases, vol. 4(1-2), pp. 133-137. DOI: [10.1016/j.ttbdis.2012.10.040](https://doi.org/10.1016/j.ttbdis.2012.10.040).
15. Gherman, C.M., Mihalca, A.D., 2017. A synoptic overview of golden jackal parasites reveals high diversity of species. In: Parasites and Vectors, vol. 10(1), ID article 419 DOI: [10.1186/S13071-017-2329-8](https://doi.org/10.1186/S13071-017-2329-8).
16. Giannatos, G., 2004. Conservation action plan for the golden jackal (*Canis aureus* L.) in Greece. WWF Greece, 47 p. Available at: <https://www.wwfmmi.org/?13252/Conservation-Action-Plan-for-the-Golden-Jackal-in-Greece>. Accessed on: June 15, 2024.
17. Gottelli, D., Sillero-Zubiri, C., Applebaum, G.D. et al., 1994. Molecular genetics of the most endangered canid: the Ethiopian wolf *Canis simensis*. In: Molecular Ecology, vol. 3(4), pp. 301-312. DOI: [10.1111/J.1365-294X.1994.TB00070.X](https://doi.org/10.1111/J.1365-294X.1994.TB00070.X).
18. Hardalau, D., Codrean, C., Iodache, D. et al., 2024. The expanding thread of undulate browsing – A review of forest ecosystems effects and management approaches in Europe. In: Forests, vol. 15(8), ID article 1311. DOI: [10.3390/f15081311](https://doi.org/10.3390/f15081311).
19. Hardalau, D., Fedorca, M., Popovici, D.C. et al., 2025. Insights in managing ungulates population and forest sustainability in Romania. In Diversity, vol. 17(3), ID article 194. DOI: [10.3390/d17030194](https://doi.org/10.3390/d17030194).
20. Ionescu, O., Hardalau, D., Bakševičius, M. et al., 2025. Tracking population trends: Insights from deer hunting harvests in the Baltics, Central and Eastern Europe. In: Central European Forestry Journal, vol. 71, pp. 83-96. DOI: [10.2478/forj-2025-0001](https://doi.org/10.2478/forj-2025-0001).
21. Ionică, A.M., Matei, I.A., D'Amico, G. et al., 2016. Role of golden jackals (*Canis aureus*) as natural reservoirs of *Dirofilaria* spp. in Romania. In: Parasites and Vectors, vol. 28(9), ID article 240. DOI: [10.1186/s13071-016-1524-3](https://doi.org/10.1186/s13071-016-1524-3).
22. Kebede, Y., 2017. A Review on: Distribution, ecology and status of golden jackal (*Canis aureus*) in Africa. In: Journal of Natural Sciences Research, vol. 7(1), pp. 32-43.
23. Kemenszky, P., Jánoska, F., Nagy, G. et al., 2020. Rabies control in wildlife: the golden jackal (CANIS AUREUS) requests for attention – A case study. In: Acta Agraria Kaposváriensis, vol. 24(2), pp. 38-46. DOI: [10.31914/aak.2441](https://doi.org/10.31914/aak.2441).
24. Kirilov, K.B., 2020. Study on carrion sharing between the golden jackal (*Canis aureus* Linnaeus, 1758) and sympatric scavengers over the winter period in Central Bulgaria using camera trapping. In: Ecologia Balkanica, vol. 12(2), ID article 77.
25. Klare, U., Kamler, J.F., Stenkewitz, U. et al., 2010. Diet, prey selection, and predation impact of black-backed jackals in South Africa. In: The Journal of Wildlife Management, vol. 74(5), pp. 1030-1041. DOI: [10.2193/2009-211](https://doi.org/10.2193/2009-211).
26. Krofel, M., Berce, M., Berce, T. et al., 2023. New mesocarnivore at the doorstep of Central Europe: Historic development of golden jackal (*Canis aureus*) population in Slovenia. In: Mammals Research, vol. 68, pp. 329-339. DOI: [10.1007/s13364-023-00686-2](https://doi.org/10.1007/s13364-023-00686-2).
27. Krofel, M., Hočevár, L., Fležar, U. et al., 2022. Golden jackal as a new kleptoparasite for Eurasian lynx in Europe. In: Global Ecology and

- Conservation, vol. 36, ID article e02116. DOI: [10.1016/j.gecco.2022.e02116](https://doi.org/10.1016/j.gecco.2022.e02116).
28. Krystufek, B., Murariu, D., Kurtonur, C., 1997. Present distribution of the golden jackal *Canis aureus* in the Balkans and adjacent regions. In: Mammal Review, vol. 27(2), pp. 109-114. DOI: [10.1111/j.1365-2907.1997.tb00375.x](https://doi.org/10.1111/j.1365-2907.1997.tb00375.x).
29. Lange, P.N.A.M.J.G., Lelieveld, G., De Knegt, H.J., 2021. Diet composition of the golden jackal *Canis aureus* in south-east Europe – A review. In: Mammal Review, vol. 51(2), pp. 207-213. DOI: [10.1111/mam.12235](https://doi.org/10.1111/mam.12235).
30. Lanszki, J., Heltai, M., Szabó, L., 2006. Feeding habits and trophic niche overlap between sympatric golden jackal (*Canis aureus*) and red fox (*Vulpes vulpes*) in the Pannonian ecoregion (Hungary). In: Canadian Journal of Zoology, vol. 84(11), pp. 1647-1656. DOI: [10.1139/Z06-147](https://doi.org/10.1139/Z06-147).
31. Loveridge, A.J., MacDonald, D.W., 2003. Niche separation in sympatric jackals (*Canis mesomelas* and *Canis adustus*). In: Journal of Zoology, vol. 259(2), pp. 143-153. DOI: [10.1017/S0952836902003114](https://doi.org/10.1017/S0952836902003114).
32. Marfiuc, L., Simon, D.C., Sirbu, G.E., 2018. Distribution and expansion of the golden jackal (*Canis aureus* L. 1758) in Romania. In: Revista de Silvicultura și Cinegetică, vol. 23(42), pp. 70-74.
33. Marin, A.M., Popovici, D.C., Marucci, G. et al., 2023. First Identification of *Trichinella pseudospiralis* in a golden jackal (*Canis aureus*) in Romania. In: Pathogens, vol. 13(1), ID article 32. DOI: [10.3390/PATHOGENS13010032](https://doi.org/10.3390/PATHOGENS13010032).
34. Matusal, M., Megaze, A., 2023. Diet of Black-backed jackal (*Canis mesomelas*, Schreber, 1775), impacts on livelihood and perceptions of farmers in Konasa Pulasa community conserved forest, omo valley of Ethiopia. In: BMC Zoology, vol. 8(1), ID article 27. DOI: [10.1186/s40850-023-00186-5](https://doi.org/10.1186/s40850-023-00186-5).
35. Micu, D.M., Dumitrescu, A., Cheval, S. et al., 2014. Climate of the Romanian Carpathians – Variability and trends. In: Atmospheric Sciences Series, vol. XI, Springer, 208 p. DOI: [10.1007/978-3-319-02886-6](https://doi.org/10.1007/978-3-319-02886-6).
36. Mohammadi, A., Kaboli, M., López-Bao, J.V., 2017. Interspecific killing between wolves and golden jackal in Iran. In: European Journal of Wildlife Research, vol. 63(4), ID article 61. DOI: [10.1007/s10344-017-1124-3](https://doi.org/10.1007/s10344-017-1124-3).
37. Natrass, N., Conradie, B., Drouilly, M. et al., 2017. Understanding the black-backed jackal. CSSR Working Paper No. 399. Published by the Centre for Social Science Research, University of Cape Town, South Africa, 50 p. DOI: [10.13140/RG.2.2.14650.70085](https://doi.org/10.13140/RG.2.2.14650.70085).
38. Ranc, N., Alvares, F., Banea, O.C. et al., 2017. The golden jackal (*Canis aureus*) in Europe: Predicting habitat suitability for a rapidly establishing carnivore. In: 33rd IUBG Congress, 14th Perdix Symposium Wildlife under Human Influence: “What can we do?”. August 22-25, 2017, Montpellier, France, pp. 320-322.
39. Roemer, G.W., Gompper, M.E., van Valkenburgh, B., 2009. The ecological role of the mammalian mesocarnivore. In: BioScience, vol. 59(2), pp. 165-173. DOI: [10.1525/bio.2009.59.2.9](https://doi.org/10.1525/bio.2009.59.2.9).
40. Roten, G., Berge, H., King, R. et al., 2011. The effect of anthropogenic resources on the space-use patterns of golden jackals. In: Journal of Wildlife Management, vol. 75(1), pp. 132-136. DOI: [10.1002/jwmg.9](https://doi.org/10.1002/jwmg.9).
41. Spassov, N., Acosta-Pankov, I., 2019. Dispersal history of the golden jackal

- (*Canis aureus moreoticus* Geoffroy, 1935) in Europe and possible causes of its recent population explosion. In: Biodiversity Data Journal, vol. 7, ID article e34825. DOI: [10.3897/BDJ.7.e34825](https://doi.org/10.3897/BDJ.7.e34825).
42. Stratford, J., 2015. Golden jackal in Lithuania, a consideration of its arrival, impact and status. In: Zoology and Ecology, vol. 25(4), pp. 277-287. DOI: [10.1080/21658005.2015.1073894](https://doi.org/10.1080/21658005.2015.1073894).
43. Sukara, R., Chochlakis, D., Ćirović, D. et al., 2018. Golden jackal (*Canis aureus*) as hosts and ticks and tick-borne pathogens in Serbia. In: Ticks and Tick-borne Diseases, vol. 9(5), pp. 1090-1097. DOI: [10.1016/j.ttbdis.2018.04.003](https://doi.org/10.1016/j.ttbdis.2018.04.003).
44. Trbojević, J., Trbojević, T., Malešević, D. et al., 2018. The golden jackal (*Canis aureus*) in Bosnia and Herzegovina: Density of territorial groups, population trend and distribution range. In: Mammals Research, vol. 63(3), pp. 341-348. DOI: [10.1007/s13364-018-0365-1](https://doi.org/10.1007/s13364-018-0365-1).
45. Trouwborst, A., Krofel M., Linnell, J.D.C., 2015. Legal implications of range expansion in a terrestrial carnivore: The case of the golden jackal (*Canis aureus*) in Europe. In: Biodiversity and Conservation, vol. 24(10), pp. 2593-2610. DOI: [10.1007/s10531-015-0948-y](https://doi.org/10.1007/s10531-015-0948-y).
46. Vodopija, R., Racz, A., 2016. The incidence of jackal bites and injuries in the Zagreb Anti Rabies Clinic during the 1995-2014 period. In: Acta Clinica Croatica, vol. 55(1), pp. 151-155. DOI: [10.20471/acc.2016.55.01.20](https://doi.org/10.20471/acc.2016.55.01.20).
47. Yom-Tov, Y., Ashkenazi, S., Viner, O., 1995. Cattle predation by the golden jackal *Canis aureus* in the Golan Heights, Israel. In: Biological Conservation, vol. 73(1), pp. 19-22. DOI: [10.1016/0006-3207\(95\)90051-9](https://doi.org/10.1016/0006-3207(95)90051-9).