

*Roe deer (*Capreolus capreolus*) with atypical three antlers*

Rusko Petrov^{1,2}, Lora Petrova¹*

¹Department of General Animal Husbandry, Section Ecology, Faculty of Veterinary Medicine, Trakia University – Stara Zagora, 6000 Stara Zagora, BULGARIA

²Green Balkans – Stara Zagora NGO, Stara Zagora, BULGARIA

*Corresponding author: rpetrov@greenbalkans.org

Abstract. Roe deer (*Capreolus capreolus*) is a common sight in the forests, bringing joy to nature lovers. Like all wild animals they also have their own unique characteristics and anomalies that can cause amazement and confusion. Although there are well-documented problems related to the growth, replacement and regeneration of antlers in male specimens, there are few known documented cases of animals with three antlers. In this study, we present photographic material and information about three cases in Bulgaria, where three-antlered roe deer bucks have been observed. This unusual phenomenon raises many questions and stimulates interest in further studies and observations in order to establish the causes of this anomaly.

Key words: Roe deer, roe buck, antlers, abnormality.

Roe deer (*Capreolus capreolus*) are native to Bulgaria, with a population of 147,349, showing an increase of 5,391 individuals compared to the previous year (Hunting Council, 2025), indicating a healthy population. Male roe deer, or roe bucks, are distinguished from females by the presence of antlers, which are short, branched, and typically have three points, except in young “spike” bucks whose first antlers are unbranched (Wright, 2022). Antlers are shed annually beginning in October, and new growth occurs over several months. They function in defense, intraspecific competition, and dominance during the breeding season.

Antler regeneration begins after shedding, involving osteoclastic and osteoblastic activity that smooths and strengthens the pedicles. Initial intramembranous ossification is followed by cartilage formation at the tips, later replaced by bone via endochondral ossification, with periosteal cells playing a key role as potential stem cells (Kierdorf et al., 2003). Studies have explored cellular mechanisms, histology, and evolutionary aspects of antler regeneration (Kierdorf & Kierdorf, 1992; Goss, 1983).

Abnormalities in antler development, such as retention, incomplete shedding of the velvet, or atypical growth, have been linked to genetic, environmental, and anthropogenic factors, including pollution with heavy metals or pesticides (Atkins, 2013; Li, 2023; Collas et al., 2024a,b). Morphological defects affecting the reproductive system may also contribute, as seen in both roe deer and mule deer, sometimes associated with viral infections (Sosnovsky et al., 2020; Fox et al., 2015).

In our study, three male roe bucks, of different ages and from non-adjacent territories, exhibited an unusual additional third antler (processus cornualis), representing a distinct morphological abnormality.

Case 1. A three-antlered roe buck named Ardin. The third antler grown from the forehead. A roe buck, approximately 4–5 years old, observed on 10.04.2025, in the Svetulka area within the hunting and fishing association “Beli Brezi,” Ardino, Kardzhali Municipality.

The animal was recorded on 10.04.2025 by a camera trap set by the local hunting party. After noticing the anomaly, the individual was sought for removal from the local population. No other

three antlered deer have been observed in this area, and there were no prior records or sightings of this particular individual.

In this case, two main fully developed antlers are present (with normal branching for its age). A

third antler protrusion is located in front of and at an equal distance from the two main antlers. It is shorter than the other two and has no branches (Fig. 1).



Fig. 1. Roe buck with a third antler grown from the forehead, Svetulka area within the hunting and fishing association “BeliBrezi,” Ardino, Kardzhali.

Case 2. Lozevo, Shumen Region (2022) 3–4-year-old male roe deer was harvested during selective hunting on 29.05.2022 in the Pyasaka area, Lozevo.

Prior to culling, the animal was observed in normal condition without behavioral or health abnormalities. Upon post-harvest inspection, a

third antler was confirmed. The individual had two normally developed antlers, and a significantly smaller third antler positioned posterior to the right pedicle, approximately half the length and diameter of the main antlers (Fig. 2). No other animals with similar anomalies were recorded in the area.



Fig. 2. Roe buck with a third antler grown from the back of the head, Pyasaka area, within the hunting and fishing association of the village of Lozevo, Shumen municipality.

Case 3. A three-antlered roe buck named Izvor. The third antler grown from the forehead. A skull of a male roe deer was found in the Izvora area, Aleksandrovo village, Shumen municipality.

In 2014, during a walk in the forest, the skull was discovered and due to its unusual number of antlers for the species, it was collected and preserved.

In this individual we have two fully grown and correctly formed antlers (well branched, each with three branches, typical for the species, indicating an age of over 3 years), which have no contact and do not interact with the third. The third antler is located in front of the left antler at the beginning of the osseous process. It measures about 5 cm in length and curves slightly forward at its tip (Fig. 3).



Fig. 3. Roe buck skull with a third antler grown from the forehead, Izvora area, Aleksandrovo village, Shumen municipality.

To investigate the causes of these anomalies, a thorough assessment of the habitats is necessary, including environmental factors and the animals' living conditions (Ferretti et al., 2012; Greenwood & Jones, 2019). Comparative genomic analyses, as used by Kierdorf et al. (2023), could help determine a genetic basis. However, studies on red deer in northern Arizona found no significant genetic differences between individuals with deformed and normal antlers, suggesting that malformations are more likely influenced by non-genetic factors such as nutrition or environmental conditions (Hicks & Rachlow, 2006).

In all three cases, the roe bucks exhibited additional antler growth that deviated from the typical morphology of the species. These extra antlers differed in both size and location, suggesting that multiple developmental pathways may be involved. The third antlers were observed in

various positions, appearing on the forehead, posterior to the main pedicles, or at the base of the left pedicle. In all instances, the additional antlers were much smaller than the primary antlers and displayed limited development, being either unbranched or weakly formed. This variation in morphology and placement indicates that the underlying causes are likely complex and multifactorial, potentially involving genetic, environmental, and epigenetic factors, as suggested by Brown and White (2020). The fact that these cases were geographically and temporally separated further supports the idea that each occurrence arose independently, rather than as part of a localized or shared environmental influence.

The occurrence of three antlers in roe bucks may result from genetic mutations, environmental factors, or their interactions. While mutations can cause abnormal antler development, stressors

such as pollution, nutrition, and habitat changes may also play a role, and epigenetic modifications can further influence gene expression (Peters et al., 2022; Li et al., 2024).

Further research is needed to clarify the mechanisms behind this trait. Comparative genomics could identify associated genetic variants, while environmental studies could reveal external influences. Investigating the evolutionary consequences may also provide insight (Anderson & Clark, 2017; Wilson & Harris, 2016).

Environmental stressors, including drought, disease, and nutritional deficiencies, are known to affect antler morphology. Peterson et al. (2019) reported smaller or atypical antlers in white-tailed deer exposed to extreme conditions, with some effects persisting into later years. Large-scale climatic fluctuations, such as PDO, NAO, and ENSO, have also been linked to reduced antler size and body mass in young deer (Strickland et al., 2020).

These findings suggest that environmental stress during critical growth periods may contribute to anomalies like a third antler. The discovery of three-antlered roe bucks represents an intriguing finding in the field of wildlife biology. These cases highlight the complexity of antler development and emphasize the importance of continued research into the factors influencing morphological variation in wild populations.

Acknowledgments

We hereby express our sincere gratitude to all who contributed to the successful collection of data on roe deer in the regions of Ardino, Pyasaka and Izvor.

Special thanks to the chairmen, Rengin Feradov and Iliya Velichkov, game warden Ayden Hadzhidormushe and for the camera traps provided by Ayden Tefikov. Special appreciation to Mihail Naydenov, Diyana Altae and Dilyana Terzieva for their support and assistance.

The support and efforts are invaluable and contribute significantly to the adequate conservation of wildlife, as emphasized by Price et al. (2005).

References

Collas, C., Helder, R., Guillon, E., Sayen, S., Quintaine, T., Feidt, C., Jurjanz, S., & Fournier, A. (2024). Roe deer exposure to trace metals and pesticides in forests and agricultural plains of

North-eastern France. *Environmental science and pollution research international*, 32(37), 21828–21844. doi: [10.1007/s11356-024-34926-y](https://doi.org/10.1007/s11356-024-34926-y)

Ferretti, F., Sforzi, A., & Lovari, S. (2012). Avoidance of fallow deer by roe deer may not be habitat-dependent. *Hystrix*, 23, 28-34. doi: [10.4404/hystrix-23.2-4698](https://doi.org/10.4404/hystrix-23.2-4698)

Fox, K.A., Diamond, B., Sun, F., Clavijo, A., Sneed, L., Kitchen, D.N., & Wolfe, L.L. (2015). Testicular lesions and antler abnormalities in Colorado, USA mule deer (*Odocoileus hemionus*): a possible role for epizootic hemorrhagic disease virus. *Journal of Wildlife Diseases*, 51(1), 166-176. doi: [10.7589/2014-03-067](https://doi.org/10.7589/2014-03-067)

Hicks, J.F., & Rachlow, J.L. (2006). Is there a genetic basis for antler and pedicle malformations in reintroduced elk in northern Arizona? *The Southwestern Naturalist*, 51(2), 276–282.

Kierdorf, U., Gomez, S., Stock, S.R., Antipova, O., & Kierdorf, H. (2023). Bone resorption and formation in the pedicles of European roe deer (*Capreolus capreolus*) in relation to the antler cycle - A morphological and microanalytical study. *Journal of Anatomy*, 243(5), 842-859. doi: [10.1111/joa.13908](https://doi.org/10.1111/joa.13908).

Kierdorf, U., Stoffels, E., Stoffels, D., Kierdorf, H., Szuwart, T., & Clemen, G. (2003). Histological studies of bone formation during pedicle restoration and early antler regeneration in roe deer and fallow deer. *The Anatomical Record Part A: Discoveries in Molecular, Cellular, and Evolutionary Biology*, 273(2), 741–751. doi: [10.1002/ar.a.10082](https://doi.org/10.1002/ar.a.10082)

Kierdorf, U., & Kierdorf, H. (1992). Studies on the Parietal Region of the Cervid Skull. *Anatomia, Histologia, Embryologia*, 21(2), 112-117. doi: [10.1111/j.1439-0264.1992.tb00327.x](https://doi.org/10.1111/j.1439-0264.1992.tb00327.x)

Li, C. (2023). Deer antler renewal gives insights into mammalian epimorphic regeneration. *Cell Regen*, 12(1), 26. doi: [10.1186/s13619-023-00169-4](https://doi.org/10.1186/s13619-023-00169-4)

Li, L., Chen, R., Zhang, H., Li, J., Huang, H., Weng, J., Tan, H., Guo, T., Wang, M., & Xie, J. (2024). The epigenetic modification of DNA methylation in neurological disorders. *Frontiers in Immunology*, 15, 1401962. doi: [10.3389/fimmu.2024.1401962](https://doi.org/10.3389/fimmu.2024.1401962)

Peters, L., Huisman, J., Kruuk, L.E.B., Pemberton, J.M., & Johnston, S.E. (2022). Genomic analysis reveals a polygenic architecture of antler morphology in wild red deer (*Cervus elaphus*).

Molecular Ecology, 31(7), 1958–1974. doi:
[10.1111/mec.16314](https://doi.org/10.1111/mec.16314)

Peterson, B.C., Schoenebeck, C.W., & Fryda, N.J. (2019). Effects of extreme environmental conditions on white tailed deer antlers. *Wildlife Society Bulletin*, 43(4), 708–716.

Price, J. S., Allen, S., Faucheux, C., Althnaian, T., & Mount, J. G. (2005). Deer antlers: A zoological curiosity or the key to understanding organ regeneration in mammals? *Experimental Biology and Medicine*, 207(5), 603–618. doi:
[10.1111/j.1469-7580.2005.00478.x](https://doi.org/10.1111/j.1469-7580.2005.00478.x)

Strickland, B.K., Dixon, P.G., Jones, P. D., Demarais, S., Owen, N.O., Cox, D.A., Landry-Guyton, K., Baldwin, W.M., & McKinley, W.T. (2020). Cohort antler size signals environmental stress in a moderate climate. *International Journal of Biometeorology*, 64(4), 611–621.
doi: [10.1007/s00484-019-01850-7](https://doi.org/10.1007/s00484-019-01850-7)

Received: 14.08.2025
Accepted: 19.11.2025