

Thesis Abstracts

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YORDANOV, E., S. (2023). *Breeding parameters and phenology of the Egyptian Vulture (Neophron percnopterus Linnaeus, 1758) in Bulgaria*. PhD thesis, Plovdiv University “P. Hilendarski”, Department of Ecology, Plovdiv, Bulgaria. Correspondence: gorataem@gmail.com

The Egyptian Vulture (*Neophron percnopterus*) is one of the well-studied vulture species and many of the studies on its biology and ecology support evidence-based conservation actions that have been undertaken across the range of the species in the last two decades. However, some aspects of the species' breeding behaviour, more precisely the share of parental care between the sexes within a pair (i.e. nest building, incubation, food provisioning), remain poorly documented and accurate data on hatchlings mortality and replacement rate of the partners in the pairs are scarce. Most of the studies on the breeding cycle of the Egyptian Vulture lack a robust method to detect these important events from a close distance as they rely primarily on physical observations. Alternative monitoring methods can heavily contribute to a more accurate study of the breeding biology of the species. The aim of this thesis is to calculate the main breeding parameters of the Egyptian Vulture and to study its phenology using alternative methods for monitoring such as trail cameras and UAV (Drones). Furthermore, it aims to describe these alternative methods for monitoring and to give guidance on the proper usage of these methods, so as not to compromise the breeding of the birds. Based on these studies, conservation measures can be outlined and undertaken to help the species survival.

Chapter1: The breeding performance of Egyptian Vultures in the stronghold of Bulgaria still remains excellent and the highest recorded in the Balkans. Three out of the four main breeding parameters of the species (proportion of successful pairs, productivity and breeding success) have increased marginally for the last five years. Furthermore, using UAV to register the number of hatchlings has proven to be time and cost efficient and a more accurate way of monitoring compared to the standard methods.

Chapter2: Using trail cameras inside the nests gives much more accurate information about the phenology of the species. This includes copulation rate inside the nest and the contribution of the adult birds to the rearing of the young and the sharing of parental responsibilities. In general, throughout the breeding season, with the exception of the pre-laying period, adult birds invest almost equally in parental care. Only during the pre-laying period, the male bird contributes more to nest building than the female. The observation of the copulation behaviour of the birds shows that most of detected copulations in the nests were in the morning or afternoon before laying, with only one copulation recorded after laying. Moreover, the rate of the observed copulations in the nest remains the same throughout the years.

Chapter 3: Direct observation through trail cameras shows food items that will not be found in the nest at the end of the season. Therefore, relying only on traditional methods may underestimate and or overlook parts of the diet of the Egyptian Vultures. In this regard, incorporating the use of cameras to monitor the nest is very valuable for providing a complete picture of the species diet composition.

Chapter 4: The hatchling mortality and egg loss for all breeding attempts of all pairs was established during the monitoring. Overall, two cases of chick mortality were recorded. The cause for one of them was identified using the trail camera records. However, there was no visible cause for the second one,

suggesting a health-related problem. Furthermore, some egg losses were a result of unfertilised eggs, while the cause of others remained unclear due to a technical problem with the cameras.

Chapter 5: We were able to calculate the replacement rate of the partners in the Egyptian Vulture pairs that we studied. There were two cases of partner replacement. In both cases the replaced partner was the female. The reason in the first case was revealed and described using the camera records, while the cause for the second remained unclear.

Chapter 6: In general, the trail camera reveals more information about the phenology of the Egyptian Vulture. In addition, it helps to identify the type and quantity of the delivered food in the nests. This knowledge will aid in making informed decisions when organizing various conservation practices. This includes supplementary feeding of the breeding pairs to provide them with enough safe food to successfully rear their hatchlings. Furthermore, insights about the growth of the fledglings could help organising conservation initiatives such as nest guarding. This is a good tool to halt post fledgling mortality on one hand, and to engage students or other specialist who are willing to gain experience in vulture conservation. Using UAVs to detect the number of hatchlings is an alternative to the method of physical observation that is more time-efficient and provides more accurate results. Guidance on the proper usage of these two alternative methods (UAVs and trail cameras) is provided in the text. It strives to mitigate disturbance of the birds as not to compromise their reproduction.

Research articles derived from the thesis:

Dobrev, V. D., Yordanov, E.S., & Popgeorgiev, G. S. 2021. Copulatory Behaviour of the Egyptian Vulture (*Neophron percnopterus*) in the Eastern Rhodopes, Bulgaria. *Ecologia Balkanica*, 13(1).

Yordanov, E.S. *et al.* 2023. Trail cameras reveal new details of the breeding behaviour of an endangered Egyptian vulture. *Acta Zoologica Bulgarica*, Suppl. 17. in print.

Technical reports derived from the thesis:

Yordanov, E. 2022. Using trail cameras to monitor Egyptian Vulture nests in Bulgaria to identify early age mortality in Egyptian Vulture chicks (2022). Technical report under action D1 of the Egyptian Vulture New LIFE project (LIFE16 NAT/BG/000874). Plovdiv, 12 p. <https://lifeneophron.eu/#downloads>

Yordanov, E. *et al.* 2021. Identifying hatchlings mortality in the Egyptian Vulture (*Neophron percnopterus*) through the means of trail cameras. Technical report under action D1 of the LIFE project “Egyptian Vulture New LIFE” (LIFE16 NAT/BG/000874). BSPB, Plovdiv, 18 p. <https://lifeneophron.eu/#downloads>

Yordanov, E. & Dobrev, V. 2021. Guidelines for installing trail cameras in nests of Egyptian Vultures (*Neophron percnopterus*) in Bulgaria. Under action D1 of the LIFE project “Egyptian Vulture New LIFE” (LIFE16 NAT/BG/000874). BSPB, Plovdiv. 10 p. <https://lifeneophron.eu/#downloads>

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