

**REVIEW**

**by Dr. Dimitar Vladimirov Dimitrov - associate professor in  
Institute of Biodiversity and Ecosystem Research at the Bulgarian Academy of Sciences**

of a dissertation for awarding the educational and scientific degree "**doctor**"

by: field of higher education 4. Natural sciences, mathematics and informatics  
professional direction 4.3. Biological Sciences  
Doctoral Program *Ecology and Conservation of Ecosystems*

**Author** : *Emil Sashev Yordanov*

**Topic** : *Breeding parameters and phenology of the Egyptian vulture (*Neophron percnopterus* LINNAEUS, 1758) in Bulgaria*

**Scientific supervisor** : *Assoc. Prof. Dilyan Georgiev Georgiev DSc - Plovdiv University "Paisiy Hilendarski", Faculty of Biology*

**1. General description of the presented materials**

By order No. PD-21-588 of 28.02.2024, amended by order No. RD-21-542 of 7.03.2024 of the Rector of Plovdiv University "Paisiy Hilendarski" (PU), I have been appointed as a member of the scientific jury for provision of a procedure for the defense of a dissertation on the topic *Breeding parameters and phenology of the Egyptian vulture (*Neophron percnopterus* LINNAEUS, 1758) in Bulgaria* for the acquisition of the educational and scientific degree "doctor" in field of higher education 4. Natural sciences, mathematics and informatics, professional direction 4.3. Biological Sciences, PhD Program *Ecology and protection of ecosystems*. The author of the dissertation is *Emil Sashev Yordanov* - a full-time doctoral student at the Department of Ecology and Environmental Protection, supervised by *Assoc. Prof. Dilyan Georgiev Georgiev DSc - Plovdiv University "Paisiy Hilendarski", Faculty of Biology*.

The set of paper materials presented by Emil Yordanov **is** in accordance with Article 36 (1) of the Regulations for the Development of the Academic Staff of the PU, includes the following documents:

- request to the Rector of the PU to disclose the procedure for the defense of a dissertation work;
- CV in European format;
- protocol from the departmental council related to reporting the readiness to open the procedure and preliminary discussion of the dissertation work;
- a report from the scientific supervisor on the readiness of the doctoral student to open a procedure for preliminary discussion of the dissertation work;
- abstract in Bulgarian and English;
- declaration of originality and authenticity of the attached documents;
- certificate of compliance with the minimum national requirements;
- list of scientific publications on the topic of the dissertation;
- dissertation work;
- copies of scientific publications;

The doctoral student has attached 2 publications related to the topic of the dissertation.

The submitted documents comply with the Regulations for the Development of the Academic Staff of the PU and are in the necessary volume and sufficiently comprehensive in terms of textual content.

## **2. Brief biographical data of the PhD student**

From the CV provided, it is clear that Emil Yordanov has been actively working on conservation activities related to the conservation of the Egyptian vulture since 2011 as part of the team of two projects under the LIFE program of the Bulgarian Society for Protection of Birds (BSPB). His main activities are related to field work, such as - monitoring the species, capturing and placing satellite transmitters on the birds, surveying the food spectrum, identifying dangerous sections of the power grid with a risk of electric shock for the Egyptian vulture, feeding and guarding nests, research on pesticides and veterinary medicinal products as poisonous agents, participation in a pilot program for the reintroduction of the Egyptian vulture in Bulgaria, piloting a drone for filming and monitoring breeding birds and placing camera traps in the nests of the Egyptian vulture. In addition, the doctoral student actively participates in the educational activities of BSPB in educational institutions in Plovdiv region.

## **3. Actuality of the topic and appropriateness of the set goals and tasks**

Given its high conservation status and severely declining population (EN - endangered according to the IUCN), the Egyptian vulture is relatively well studied at the European and national level.

However, I consider the topic to be relevant, given the use of modern monitoring methods (surveillance and photo-documentation with camera traps and a drone) and the collection of new information about the breeding parameters and biology of the species in Bulgaria. More specifically, the relevance of the dissertation work is expressed in the following - 1) study of the breeding parameters of the Egyptian vulture in Bulgaria for the period from 2017 to 2022; 2) using a drone to determine the breeding success of the species; 3) study on the distribution of care between the parents during incubation and feeding of the young using camera traps; 4) a detailed study on the change of partners in pairs, by preparing individual facial profiles of the birds. The video observations in the nests also provide more accurate information about 5) the date of return of the birds to the nesting areas; 6) copulations in the nest; 7) the construction of the nest and 8) the loss of eggs and young and the reasons for this. Until now, in this kind of studies, the methods of direct visual observations using optical devices have been used, which have a number of disadvantages such as - much more effort in the field work done by the researcher, less accuracy due to poor or limited visibility to the nest, need to keeping a field diary and transferring the information in digital form, lack of a photo and video archive with the observed behavior in the nest, greater risk of disturbing the birds during the breeding period, etc. The application of remote methods for video recording in the nests of the Egyptian vulture make the dissertation work an actual and necessary scientific and scientific-applied study in view of the application of better conservation practices for the protection and restoration of the species in the country.

#### **4. Knowing the problem**

The PhD student demonstrates an excellent knowledge of the problem, both from the point of view of the conservation and recovery of the population of the Egyptian vulture, as well as the necessary methods and tools that must be applied to obtain more accurate data on the breeding biology of the species. Emil Yordanov shows a skillful interpretation of the information from the scientific literature and innovation in the application of new methods for the study of the species in Bulgaria.

#### **5. Research methodology**

The chosen methodology and means are adequate for the fulfillment of the tasks set in the dissertation work. A significant part of the methodology is planned in such a way as to compare the methods of remote photo-documentation with the traditional methods of visual observations by the researcher. Appropriate methods are applied for statistical analysis of the obtained data and comparison between methods.

#### **6. Characterization and evaluation of the dissertation work**

The dissertation is written on 144 pages, of which chapters "Introduction" - 2 pages, "Literature review" - 16 pages, "Aim and tasks" - 1 page, "Physico-geographic characteristics of the studied area" - 2 pages, "Materials and methods" - 10 pages, "Results and discussion" - 49 pages, "Conclusions" - 2 pages, "Contributions" - 2 pages. The list of used literature includes 410 sources, of which 24 are in Bulgarian language and 386 foreign editions (mostly in English), and occupies a volume of 32 pages. There are 4 Appendices to the dissertation work, mainly with photographic material from the field work and the collection of the photo-archive for the purposes of the research, located on 18 pages.

In the introductory part, the author directs the reader's attention to the object of study - the Egyptian vulture and the study of its breeding parameters and phenology as key elements of its life cycle. The planned new methodological approaches that will be applied and their advantages over conventional ones are also indicated. The literature review is divided into 6 subsections that provide a detailed review of available published information regarding Egyptian vulture population trends and distribution, breeding parameters, and drone use for bird monitoring. One goal has been formulated that clearly corresponds to the topic of the dissertation and six tasks that enable its achievement. The physical-geographical characteristics of the studied area briefly, but to a sufficient extent, present the climatic features, the landscape and the characteristic habitats in the studied areas. The Materials and Methods chapter is divided into 7 sub-sections and numerous sub-sub-sections. In general, the methodology corresponds to the implementation of the set tasks, but I have some remarks about its structure. Chapter "Results and discussion" occupies a major part of the book body of the dissertation (about 1/3) and is presented sufficiently comprehensively and with the necessary scientific evidence to formulate the conclusions and contributions of the dissertation work.

## **7. Contributions and significance of the development for science and practice**

From the obtained results and their discussion, 15 conclusions were drawn, which adequately represent the main scientific achievements of the dissertation work. Higher values of the breeding parameters of the Egyptian vulture were reported in Bulgaria for the period of the study (Conclusion 1), which logically reflects on the registered stabilization of the trend in the population of the species in the country for the first time since 40 years (Conclusion 4). It seems that the condition of the subpopulation in northeastern Bulgaria is not so favorable and lower productivity and breeding success were observed compared to the main population in the Eastern Rhodopes (Conclusion 2). However, apparently the productivity and breeding success of the Egyptian vulture in Bulgaria is one of the highest in Europe (Conclusion 3). Regarding the distribution of effort in the reproductive process between the sexes, the following differences were observed - male birds arrive earlier in the nesting

territories (Conclusion 7, it should be 6) and play a major role in the construction of the nest (Conclusion 8), females participate more actively in stirring the eggs at night, but both sexes distribute this duty evenly during the day (Inference 10), and both parents exert similar efforts in providing food and feeding the young (Inference 11). The species was found to copulate actively in the nest, which is most likely due to the larger rock niches where the camera traps were placed (Conclusion 9).

In relation to the scientific and applied achievements of the dissertation, it should be noted that the use of a drone to determine breeding success in the Egyptian vulture is a significantly faster and more accurate method than traditional visual observations (Conclusion 5). However, it is necessary to observe specific rules when using it to limit disturbance to the birds and the risk of nest abandonment (listed in item 6.7.2.). As scientific and applied achievements of the dissertation, the manual for placing camera traps in the nests, the prepared photo-documentary archive with the faces of the adult birds from the observed pairs and the determination of the age of the young before leaving the nest (described in item 8.3) should also be mentioned .).

To my knowledge, this is the first such detailed study of the breeding biology of the species worldwide. Placing camera traps in the nests and analyzing the video footage provide much more detailed and accurate information about the arrival of adult birds in the nesting territories, nest building, copulations, egg laying and their number, hatching and feeding of the young and their number (Conclusion 12 ), the loss of eggs and young (Inferences 14-16), and the replacement of partners in pairs (Inference 13).

The contributions of the dissertation work are divided into 3 subsections - "Original contributions", "Confirmatory contributions" and "Contributions of a scientific and applied nature". The original contributions are 7 and clearly reflect the contribution of the dissertation work to determine the current trend of the population of the Egyptian vulture in Bulgaria for a period of 6 years and the advantages of remote photo-documentation methods (drone and camera traps in the nests) to obtain more accurate and new information on breeding success, breeding biology and phenology of the species. The confirmatory contributions are 6 and show similar results to previous studies on the distribution of the species in Bulgaria, the effectiveness of the drone for bird monitoring, the copulations in the nesting areas and its daily activity for the studied species, the greater effort of the male birds in the construction of the nest and the equal effort of both sexes in providing food and feeding the young, for the number of eggs laid, the average duration of incubation and the average difference in days between laying, and for the high proportion of soft tissue in the diet of the young of the Egyptian vulture (65%). The scientific-applied contributions are 4 (mentioned above) and reflect the prepared

methodological guides for the application of a drone and camera traps in the monitoring of the Egyptian vulture, and the prepared archive with faces of adult birds and a photographic determinant of the age of the young in the nest. Both methods are increasingly used in ecological research and allow the accumulation of significantly more detailed and accurate information about specific species, interspecific and intraspecific relationships, density and distribution, and a number of other parameters. I believe that the contributions are very well formulated and adequately present the main results of the dissertation work.

## **8. Evaluation of publications on the dissertation work**

The dissertation presents two scientific publications in refereed and indexed international journals with an impact factor in English. The first publication is in *Animal Conservation* in Q1 Ecology, SJR 1.21, IF 3.4, published in 2023 with an authorship of 30 co-authors. The PhD student is the 29th author on the list. The publication presents an analysis of the results of conservation practices for the conservation of the Egyptian vulture carried out by the European LIFE program projects in the Balkans, comparing the survival and population trends of the species for long term period. For the period 2018 – 2022, a stable trend was recorded with the population increasing by 6.9% compared to the period 2006 – 2017. The survival of adults and young birds also increased for the period, from 2014 and from 2018 respectively. Here, the contribution of the dissertation work is clear and consists in the part of the data collected from the monitoring of the Egyptian vulture in Bulgaria, where the species is the most numerous on the Balkan Peninsula. In my opinion, the PhD was actively involved in the field work and the initial processing of the data from the visual observations, the drone and the camera traps. The second publication is in *Acta Zoologica Bulgarica* in Q4 Animal Science and Zoology, SJR 0.2, IF 0.5, published in 2023 with an authorship of three co-authors. Emil Yordanov is the first author on this publication. The publication presents new data on the breeding biology of the Egyptian vulture as a result of the analysis of more than 200,000 photos from the camera traps located in 6 nests. The results of the thesis, which are reflected in this publication, are about distribution of effort between the sexes in the pair during nest building, incubation of the eggs and feeding of the young, on copulations in the nest and their activity, and on the analysis of diet composition and percentage of soft tissues that would not have been established in the nest after fledging. A large part of the results related to the breeding biology and phenology of the Egyptian vulture in Bulgaria, which occupy a major part of the dissertation, are published here.

From the CV of E. Yordanov, it is understood that the results of the dissertation work are described in 4 technical reports in English (10-18 pages) related to the use of camera traps in the nests to determine the early mortality of the Egyptian vulture, the loss of eggs and the nesting phenology

of the species. One of the reports is practically a technical guide for placing camera traps in the nests of the Egyptian vulture. The PhD student is the only author of one of the reports, the first author of two and the last author of one. These reports demonstrate the rich field experience of the PhD student and his great knowledge of the methodological and technical part of the dissertation implementation.

The PhD student participated in 4 scientific conferences, where he presented a total of 3 reports on the topic of the dissertation and 3 reports outside the topic of the dissertation (mentioned in the Abstract).

In addition, the PhD student co-authored another scientific publication that I believe is related to the thesis topic - Dobrev, VD, **Yordanov, E. S.**, & Popgeorgiev, GS (2021). Copulatory Behavior of the Egyptian Vulture ( *Neophron percnopterus* ) in the Eastern Rhodopes, Bulgaria. *Ecologia Balkanica*, 13(1) and three other publications outside the thesis topic.

At the moment, no citations have been found for the publications indicated by the doctoral student on the topic of the dissertation.

## **9. Personal participation of the doctoral student**

My assessment of the doctoral student's personal involvement in the dissertation research is that E. Yordanov participated to a significant extent in the field research, the initial processing of the raw data, the processing and analysis of the photo materials, the analysis of the data, the interpretation of the results and the formulation of the conclusions and the contributions from them.

## **10. Abstract**

The abstract is presented in Bulgarian and English and has a volume of 32 and 30 pages, respectively. It clearly reflects the main results and contributions of the dissertation work and is prepared in accordance with Art. 36 of the Rules for the Development of the Academic Staff of the PU.

## **11. Critical remarks and recommendations**

I have several more significant remarks and recommendations on the dissertation work, which are expressed in the following:

1. In my opinion, subsection 2.1. "Trend, abundance and distribution of the population of the species" from point 2. "Literature review" is a little outside the topic of the dissertation and could be significantly shortened. I mean the detailed overview of the population trends of the species in Asia, Africa and Europe. It can be reduced to one paragraph and only give an idea of the state of the species at a global level. The information

about the Balkan Peninsula and Bulgaria is in the necessary volume and is comprehensive enough.

2. On the other hand, I think that point 2. "Literature review" should provide information on the use of camera traps and cameras to study breeding biology in birds, similar to that for drones in point 2.3. "Using Unmanned Aerial Vehicles (UAVs) for Monitoring".
3. Technical reports and publications that are part of the published results of the dissertation should not be cited in the literature review. In general, in my opinion, this also applies to the entire text of the dissertation. Self-citations do not contribute much to the credibility of the presented hypothesis.
4. Task 2 is difficult to understand. As written, it gives the impression that there is a "standard and alternative method" for drone monitoring. In fact, it is meant that there is a standard method with visual observations with optics and an alternative which is with the help of a drone with a camera.
5. In my opinion, it is more logical that point 4 "Physico-geographic characteristics of the researched area" should be part of the "Materials and methods" chapter.
6. The Materials and Methods section contains too many sub-points and sub-points of sub-points with minimal textual content. I think this unnecessarily breaks up the text and does not contribute to its better understanding.
7. I also notice the way Tables 4 and 5 look. I mean the incorrect abbreviations in Tab. 4 and the lack of total numbers for the composition of the diet in Tab. 5.
8. The numbering in the Conclusions after Conclusion 5 is wrong and Conclusion 6 is missing. Conclusion 9 should be edited in its second part.
9. I think in Original Contribution 8.1.4. the second sentence should be shortened and added to the first once if it is formulated as one contribution.
10. In the first scientific publication of the dissertation in *Animal Conservation* PU is not mentioned as affiliation of the PhD student.

As less important critical notes on the text of the dissertation, I would point out wrong page numbering (page 90 has it twice), inaccuracies in the numbering of points (Aim and tasks is item 2 in the text and 3. in the table of contents), in the table of contents 3. is "Aims and tasks", and in the text "Aim and tasks".



There are false statements such as the first sentence on page 24, which contradicts the text below. Some information on the matter is available in the literature, and the word "missing" should be replaced by few or limited no.

The mixed use of commas and points when writing the numerical values from the analyzes in the text makes an unpleasant impression.

In fig. 7 it is not clear what the values on the abscissa mean.

In fig. 11 don't understand what the blue line means.

From fig. 25 it is clear that there is a supply of food in the nest before the young hatch. What is the point of these deliveries and why is it not discussed in the text?

I have also noticed some technical, terminological and spelling errors, which are generally few and insignificant.

## **12. Personal impressions**

I know the PhD student through mutual family friends, but I have no direct impressions of his work as a researcher. The opinion I share here is only based on the materials provided to me.

## **13. Recommendations for future use of dissertation contributions and results**

In the future, it would be good to compare the breeding biology of the population in North-Eastern Bulgaria with that in the Eastern Rhodopes, in order to gain a clearer picture of the factors that determine the differences in the numbers of the species in the two areas.

## **CONCLUSION**

Despite the critical remarks made, they are not so significant and the dissertation has its merits and is a very well-formed and presented scientific work. The dissertation *contains scientific, scientific-applied and applied results, which represent an original contribution to science* and **meet all** the requirements of the Law on the Development of the Academic Staff in the Republic of Bulgaria (ZRASRB), the Regulations for the Implementation of ZRASRB and the relevant Regulations of PU "Paisiy Hilendarski".

The dissertation shows that the doctoral student Emil Sashev Yordanov **possesses** in-depth theoretical knowledge and professional skills in the scientific specialty "Ecology and Ecosystem Protection" by **demonstrating** qualities and skills for independent conduct of scientific research.

Due to the above, I confidently give my *positive assessment* of the conducted research, presented by the above-reviewed dissertation work, abstract, achieved results and contributions, and *offer to the honorable scientific jury to award the educational and scientific degree "doctor"* to Emil Sashev Yordanov in the field of higher education: 4. Natural sciences, mathematics and informatics; professional direction 4.3. Biological Sciences; doctoral program Ecology and Ecosystem Protection.

01.04.2024

Reviewer: .....

(signature)

Assoc. Prof. Dr. Dimitar Dimitrov

( ac. dl., n. st., name, surname )