Innovative Techniques in Egyptian Vulture Conservation

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Preventing the next vulture poisoning

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Despite extensive efforts and partial success, the Griffon Vulture (*Gyps fulvus*) population in Israel has dropped from hundreds of nesting pairs to ca. 50 pairs in 60 years. The main cause for this decline is poisoning. Overpopulation of predators and stray dogs leads farmers to conflicts and fear and results in illegal measures such as the use of poisoned baits. This overpopulation is the consequence of the very high and uncontrolled availability of food, mainly livestock carcasses.

It is imperative to detect the arrival of vultures to areas where they can be exposed to "uncontrolled food source" that might expose them to poisoned baits, poisoned animals or livestock that was treated with NSAID prior to the mortality or animals that were shot with lead bullets. Thus, we have developed a Location-aware alert system to warn about possible exposure of vultures to poison source. The system is based on the information that is sent by high resolution GPS-loggers attached to the vultures.

Since 2021 over 100 Griffon vultures in Israel are tagged with OrniTrack-50 tags in addition to a few dozens of Egyptian vultures with OT-30. Automatic analysis of the vultures' movements in near real-time, using location, altitude and speed produces automated alerts, e.g. landing that is not related to cliffs and therefor may indicate landing near food source.

The alerts are automatically directed to the relevant regional rangers enabling fast on-ground response and preventing potential poisoning. Identifying vultures' landings near carcasses support the Israel Nature and Parks Authority's sanitation program which includes the removal of livestock carcasses to reduce the carrying capacity for the overpopulation of canids, which leads for poisoning.

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The use of drones for Egyptian Vulture conservation

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Nowadays the use of drones is everywhere. They are used for delivery of various goods, videography, photography, science projects, mapping, to their extensive use in wars.

In this presentation we will discuss their use in the nature conservation filed with the focus specifically of their use based on the experience of the Bulgarian Society for the Protection of Birds (BSPB). In the last couple of years, we started using drones in the frame of different BSPB conservation projects for different purposes.

There are three main categories of drone usage currently and three more with future use for which we are experimenting now or planning to develop capacity in the future.

1. Photography and video footage of different habitats, species, different activities performed by the teams of the projects etc. As we are preparing different video materials in the form of short movies and clips as well as various printing materials and for use for the social media platforms. With most of the drones this is probably their most typical usage.
2. Monitoring of distant and hard to observe nests, artificial nests on electric pylons, rock crevices, rock wreaths and other rock formation. Monitoring for nest on trees. Search for carcasses in remote or difficult to access places including illegal dumps and similar places from a distance.
3. Low enforcement: anti-poaching activities, collecting evidence of activities of intruders, offenders, and prevention by simply being present – which can be very effective in some cases (patrolling during the hunting season for white great fronted geese for example in the protected territory for Red-breasted Geese where hunting is prohibited).

The other 3 activities that will be developed or are in an experimental faze or there is discussion about them includes:

1. Mapping: creating georeferenced layers with high-quality images for the need of various GIS analysis
2. Testing (ongoing) a dedicated adopted system for mounting divertors on wires of electric pilons (these are small well visible devises with the purpose of making the electric wires visible for the birds to prevent the collisions of flying birds with the wires)
3. Feeding with small quantities of food in case of emergency of abundant nest of Egyptian Vulture (we never did it, but we discussed the possibilities in needed as the price and availability of suitable dropping devises are cheap and it is feasible to do it with the models of drones that we already have)

In the presentation we will discuss in detail the basic and most important aspects of the usages of drones for conservation.

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Alternative methods to monitor phenology, breeding outcome and demography in the Egyptian Vulture: using online cameras, trail cameras, and drones

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The Egyptian Vulture (EV) is a globally endangered species, declining in the most of its range. In the Balkans, its decline rate is about 7% per year over the past three decades, although recently there are signs of stabilization. The main mortality causes are electrocution, illegal use of poison baits, illegal shooting along the flyway and high juvenile mortality into the sea during the first migration. Yet, it is also known that mortality due to genetic problems, diseases, or Cainism occurs during early chick rearing period but its magnitude is not well studied. Here we aim to assess the mortality rate of hatchlings and the replacement rate in pairs in the EV nests in Bulgaria. We used trail cameras and an online camera from 2019-2021 to describe the events around hatchling and detect any mortality afterwards.

We successfully observed five nests each year (18% of the national population; N = 27 pairs in Bulgaria). During three years of our study, all five pairs laid two eggs per year, except for two pairs. The productivity was 1.3 ± 0.2 (1.6 in 2019, 1.4 in 2020 and 1.3 in 2021) and the hatchling rate was 0.8 ± 0.04 (0.8 in 2019, 0.9 in 2020 and 0.8 in 2021). The spring arrival of adults took place between 23rd March and 15th April with peak in early April. The most frequent hatchling date was 3rd of June and the average duration of incubation was 41.6 ± 0.61 days. Out of the 26 eggs laid, 22 were hatched and only 20 of the chicks survived until fledgling. By use of trail cameras, we identified two cases of chick mortality in two nests. In one of the cases this was due to poisoning, and in the other case the reason was unknown, but we assume a health problem.

Regarding the replacement rate, we compared photos of different birds between seasons, using the birds' face masks as a marker to see whether a partner is being replaced. In the three years of the study, we had only two cases of change of partners and in both cases, it was the female. In the first case the female was poisoned and the following year the male paired to a new female. In the second case the reason for the change of female remained unknown.

Overall, our survey demonstrated that trail cameras can be efficiently used to study the hatchling rate, hatchling mortality and in some cases event to help determining the mortality cases. Furthermore, the use of cameras in the nest can account for the replacement rate in EV pairs and indicate for mortality in the territorial adults.

Peer-reviewed research derived from the abstract:

Yordanov E., Dobrev, V. & Jambon, A. 2023, Trail cameras reveal new details of the breeding behaviour of an endangered vulture. *Acta Zoologica Bulgarica*, Supplement 17, in print.

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Captive breeding program for Egyptian Vultures

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Within the EAZA (European Association of Zoos and Aquariums), the European Studbook (ESB) was established in 2002, and the Prague Zoo was entrusted with its management. In 2012 was established European Endangered Program (EEP) nowadays renamed as the EAZA Ex-situ Program.

In 2012 also started cooperation of the EEP with the Vulture Conservation Foundation (VCF) and Green Balkans (Bulgaria), followed by the breeding station CERM in Italy and the Bulgarian Society for Protection of Birds (Birdlife Bulgaria).

Prague Zoo thus became a connecting link between European zoos on the one hand and nature conservationists and rescue stations on the other.

The two of the three described subspecies of the Egyptian Vulture (EV) are found in European zoos: the Western subspecies '*percnopterus*' and the Eastern '*ginginianus*'. Therefore, the initial task was to create pairs consisting of individuals from the same subspecies. In some zoos, there were mixed pairs, and somewhere they even succeeded in breeding. Only a healthy and fertile population under human care can provide enough individuals to sustain future reintroductions. Thus, increasing the EV productivity in captivity is a main goal within the EEP.

Since 2015 EEP has provided 25 young EVs for releasing programs in Bulgaria and Italy.

In collaboration with Birdlife, CITES authorities and rescue centres in Bulgaria, Belgium, Spain, Lebanon and Syria, the Prague Zoo helps to include wild-caught injured or illegally kept and confiscated EVs into the EEP. Birds are reallocated to dating aviary in Prague Zoo and subsequently reallocated to another zoo within the EEP network.

Currently the European Studbook includes 80 zoos and breeding centres across the Europe and Middle East with more than 250 living EV specimens.

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Video surveillance as a tool for vulture monitoring

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Obtaining detailed information on vultures' behaviour to allow adaptive management during wild and captive breeding, pre-releasing period in adaptation aviaries, and feeding at vulture restaurants is of critical importance for the successful delivery of adequate conservation activities. However, direct observation requires substantial human and time resources and is therefore challenging to implement.

The current study presents our experience in using video surveillance as a tool for vulture monitoring in Bulgaria. We used standard security IP cameras with resolution 2-8 megapixels that record any movement 24/7 to standard NVR devices. The video records are kept for 30-45 days depending on the season. Our video surveillance systems are online based which allows for remote control.

All breeding aviaries (n = 3) of Egyptian Vultures (EV) in the Wildlife Rehabilitation and Breeding Centre (WRBC) in Stara Zagora are constantly monitored with such cameras (two per aviary). In every aviary, one camera follows every movement of the birds, while the second one is focused on the breeding platform to record specific behaviour related to copulation, incubation and chick rearing. The information collected through the video surveillance system helps the WRBC team to decide when and how to feed the vultures, if/when to foster chicks, and when to intervene in case of concern, especially during the night. It is quite often that there are conflicts between the male and female EVs in captivity, increasing the risks for breaking of eggs or injury or even death to the hatchlings. In aviaries where mature non-breeding birds are kept, there are PTZ (patrolling) cameras to observe which individuals show signs of bonding.

Similar approach is used to monitor vultures at the supplementary feeding stations (SFS) and adaptation aviaries located in the wild. The main challenge there is to provide source of electricity and good network coverage. At the SFS in Potochnitsa (Eastern Rhodopes) we used two patrol cameras *(*2 MP H.265+ AI Starlight+ True DAY/NIGHT); an IP PTZ camera with auto tracking function and new generation lens with 45x optic zoom; and 2 MPix H.265 AI Starlight True DAY/NIGHT IP PTZ camera with automatic autofocus lens with 25x optic zoom and 4.8-120mm/F1.6-F4.4. These cameras enable the identification of marked birds (wing-tag or ring) from distance. The adaptation aviary in Potochnitsa is observed through 2 and 5 MP H.265+ Starlight True DAY/NIGHT IP water-resistant dome cameras. These cameras record remotely through the NVR - WRBC 24/7 and also locally on SD cards (as a backup). They can also record and keep the photo or video footage until the intervention of an operator. For remote sites, solar systems with MPPT controllers and lithium iron phosphate batteries with a much higher coefficient of energy accumulation are used. All the systems are automated with a GSM alarm system dialer with four independent relays. This way the system operator has the ability to monitor the battery charge and control four devices of the system, thus being able to save energy on dark days and winter months. This allows for complete independence from the internet connection.

In conclusion, using such cameras significantly help to improve the overall quality of monitoring, saves time and effort, facilitates decision-making and optimizes conservation and management effort, while ensuring minimum disturbance and behaviour impact on the species monitored.

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Conservation and the genetics of the declining Egyptian Vulture population in the Balkans: the role of ecological and microevolutionary processes

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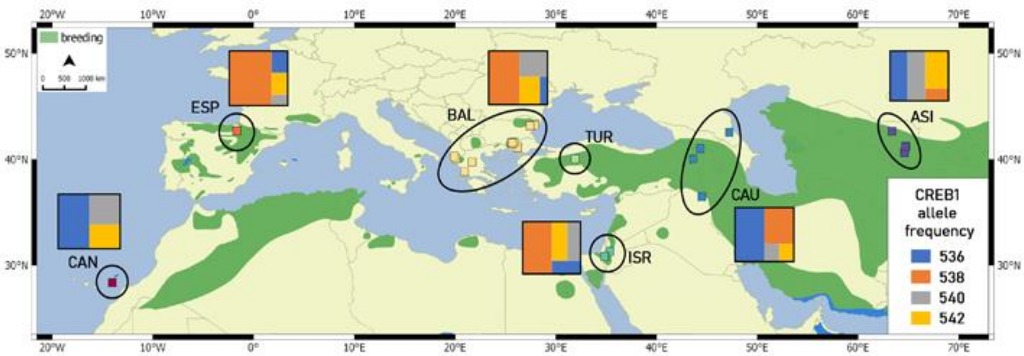
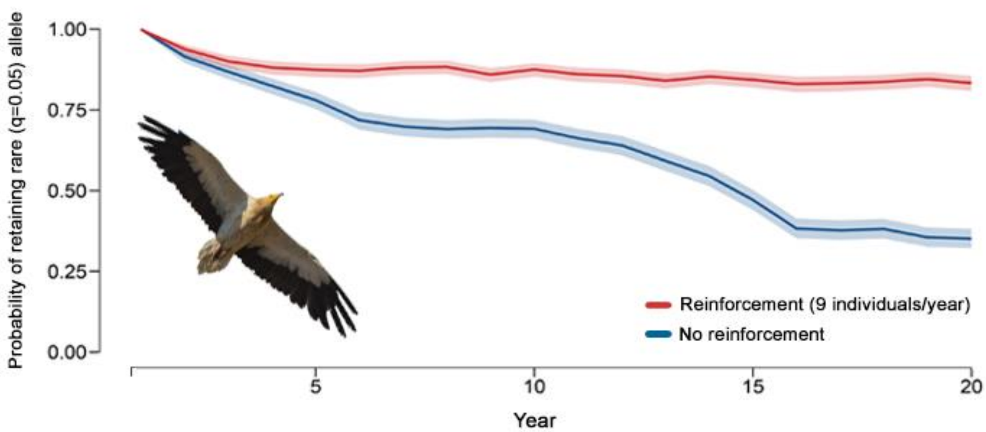
One of the primary goals of conservation translocation programs should be the maintenance of both population demographic stability and genetic diversity. Here, we studied the current genetic status of Egyptian Vulture (EV) populations, that have suffered a severe population reduction in the Eastern Palearctic in the last three decades, and we provide genetic management recommendations to inform a population reinforcement of the declining EV population in the Balkans. Specifically, we examined whether the number of released individuals is sufficient to prevent genetic diversity loss due to random genetic drift and what the origin of the individuals should be that comprise the captive breeding pool. To this aim we estimated and assessed genetic diversity levels and genetic structure of EV populations across much of the species' range. We then evaluated the effects of the currently proposed population management scheme and candidate source populations on retaining allelic diversity.

Our results suggest that a formerly panmictic population is evolving into different units, losing genetic diversity, and increasing in differentiation due to the absence of current gene flow. Furthermore, there was no predicted significant impact of different source populations on the genetic diversity of the recipient Balkan population. We also found that the declining EV population in the Balkans still retains high levels of genetic diversity and therefore genetic diversity restoration is not currently needed. However, without any management diversity is likely to decrease fast because of increased genetic drift as the population size continues to decline. Population reinforcement with nine birds per year for 20 years would provide sufficient demographic support for the population to retain >85% of rare allelic diversity. Birds originating from the Balkans would ensure ecological and behavioural similarity and thus would be the best option for reinforcement. Nevertheless, our results demonstrate that to prevent further population contraction and loss of adaptive alleles, releasing individuals of different origin would also be appropriate.





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