

# DEVELOP AND PILOT A RESTOCKING STRATEGY FOR EGYPTIAN VULTURES ON THE BALKANS

## Integrated report on the release of captive-bred Egyptian Vultures in the Eastern Rhodopes in 2018



PHOTO: Volen Arkumarev/BSPB

UNDER ACTION C3

LIFE PROJECT 'EGYPTIAN VULTURE NEW LIFE'

LIFE16 NAT/BG/000874

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## Introduction

The Egyptian vulture population is declining on a global scale in almost all parts of its' range. The Balkan population of the species has dropped down to about 70 pairs with a calculated decline of about 4-8 % per year over the past three decades (Velevski *et al.* 2015). Along with the long term negative trend, most of the threats to the species, namely the illegal use of poison baits and the high juvenile mortality during the first migration continue to operate which have led to the continuous reduction of the breeding territories across the Balkans (Oppel *et al.* 2015, Velevski *et al.* 2015). Hence, the reproductive potential of the Balkan population has been significantly reduced leading to an urgent need to reinforce the breeding population. Currently the most feasible approach that could be applied is by the means of captive breeding and reintroduction to ultimately increase the number of survivals and eventually the number of breeding pairs (VCF 2016). The most recent PVA (Population Viability Analysis) of the Egyptian vulture in FYROM suggests that with a sufficient number of restocked birds (with one of the methods mentioned above) and *in situ* conservation measures the negative population trend of the Balkan population could be reversed (Velevski *et al.* 2014).

The 'Egyptian vulture New LIFE' is a project that unites the efforts of 10 partners across three continents to reinforce the easternmost population of the Egyptian vulture (*Neophron percnopterus*) in Europe by delivering urgent conservation measures towards eliminating major known threats in the breeding grounds and along the flyway on one hand, and developing a restocking program for the species in the Balkans, on the other. The project objectives are in line with the aims of the most recent strategic document outlining the conservation tactic to save the species: the Flyway Action Plan for the Conservation of the Balkan and Central Asian Populations of the Egyptian Vulture *Neophron percnopterus* (EVFAP), as an integrated key component of the CMS Vulture Multispecies Action Plan (Botha *et al.* 2017).

Action C3 of the project LIFE16 NAT/BG/000874 aims to develop and pilot a restocking program for the Egyptian Vulture on the Balkans. More specifically, its primary objective is to test three different methods in Bulgaria (holding the most numerous Egyptian Vulture population in the Balkans) in order to establish the most efficient releasing techniques for the species in the region, more precisely – delayed release, fostering and hacking of captive-bred individuals. We will compare the results in terms of survival of the released birds during the post-release period and the first south migration. We aim to release at least 10 individuals per release technique in the next 5 years of the project implementation. All three release methods will be implemented in the same area which will allow direct comparison of the results and no spatial variance. The results from this action will be used to prioritize the future conservation work, to build and implement

a successful restocking program to reinforce and boost the recovery of the Egyptian Vulture population on the Balkans.

## Summary of the results

### Delayed release

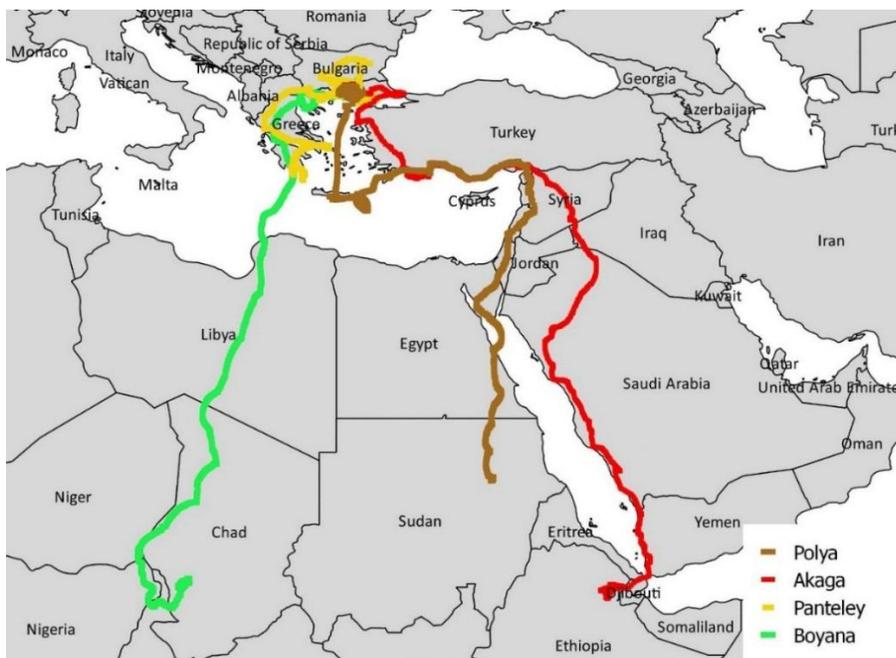
In 2018 four captive-bred Egyptian Vulture were released in the Eastern Rhodopes applying the method of delayed release – Akaga, Boyana, Polyta and Panteley. All four vultures showed attachment to the feeding station where they were released. They successfully adapted to the local conditions and the live into the wild. This was proved by the records of feeding on natural carcasses outside the feeding station. They were interacting and socializing well with the other Egyptian Vultures on the feeding station. All four released vultures initiated migration but they started on different dates and were migrating alone. Akaga started migration first and used the traditional migration route through Turkey and Middle East to reach Ethiopia. Polyta, Boyana and Panteley started migration in late September unlike the same age wild conspecifics which usually start migration until mid-September. Polyta migrated through the Greek islands reaching Crete and later again using the islands as stepping stones she reached southern Turkey and continued following the migration route through Middle East to reach Sudan. Boyana moved southwest from the release site and migrated through Greece crossing the Mediterranean Sea between Peloponnese and Libya. Panteley used similar migration route as Boyana and reached Peloponnese but he didn't try to cross the sea towards Africa and currently is on the island of Crete.

According to the criteria for success we can conclude that this year's experiment to release captive bred Egyptian Vulture through delayed release is successful as 100% of the released individuals adapted successfully to the wild and 80% of them completed their first migration successfully. At the time of compilation of this report it is still unclear whether Panteley will overwinter in Greece or will try to reach Africa on a later stage so we don't yet consider his migration attempt as successful.

**Table 1.** Overview of the delayed release individuals

	Polya	Akaga	Boyana	Panteley*
Sex	Female	Female	Female	Male
Parents origin	USSR x Kazakhstan	USSR/Kazakhstan x Bulgaria	USSR/Kazakhstan x Bulgaria	Spain x Spain
Migration start date	19/09/2018	25/08/2018	27/09/2018	18/09/2018
Average speed	94 km/day	200 km/day	140 km/day	NA
Total distance covered	>4800 km	>5600 km	>4600 km	NA
Duration of migration	51 days	28 days	33 days	NA
Distance of sea crossing	1300 km	0 km	500 km	117 km

\*Average speed, total distance and duration of migration are NA for Panateley as he hasn't finished his south migration at the time this report was compiled.



**Map 1.** Migration routes of the four captive-bred Egyptian Vultures released through delayed release

## Fostering

One captive-bred Egyptian Vulture chick (Blanka) was fostered in a wild nest in the Eastern Rhodopes. The first attempt was made at 16 days age and was unsuccessful due to aggression from the captive-bred towards the wild chick. A second attempt was made when Blanka was 60 days old. She was accepted by the parents and the wild sibling named Belgin. Both chicks successfully fledged. After fledging Blanka moved 1 km from the nest and never returned back to the breeding cliff. However, she was found by the wild pair and fed until the start of the fall migration. Blanka adapted well to the local conditions and before migrating she was feeding at the vulture feeding station together with other Egyptian Vultures. During migration Blanka used the traditional migration route through Turkey and Middle east, then through the eastern Red Sea flyway reached her wintering grounds in Ethiopia. Belgin also started his migration through Turkey but when reaching the Adrasan Peninsula, he initiated a sea crossing. No more data was received from his transmitter and we consider him drowned into the sea. Blanka unfortunately died in the wintering grounds in Afar, Ethiopia. The reason for her death is unclear but it seems most probable that she was injured by human or animal attack and consequently died of her injuries or exhaustion.

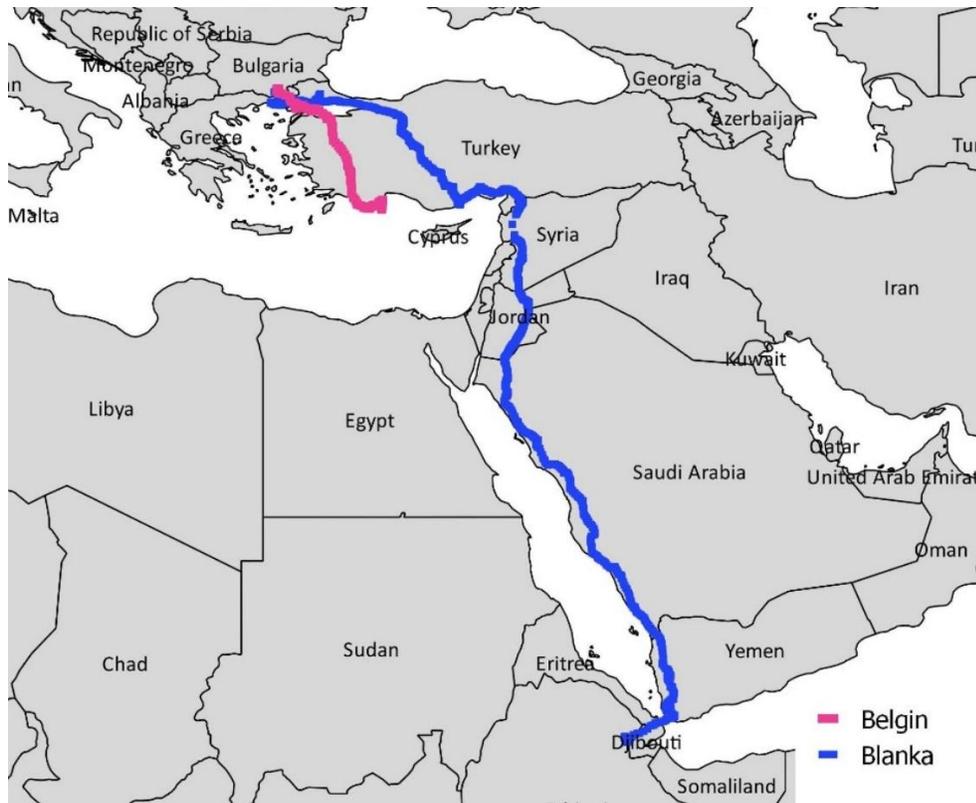
Even though Bkanka died in Africa we consider the fostering in 2018 as successful according to the criteria set for this technique. Blanka was accepted by the wild parent, she fledged, adapted well to the wild, survived the first month after fledging and the first migration.

**Table 2.** Overview of the fostered individual and the wild sibling

	Belgin*	Blanka
Sex	Unknown	Female
Parents origin	Bulgaria	USSR x Kazakhstan
Migration start date	14/09/2018	02/09/2018
Average speed	157 km/day	167 km/day
Total distance covered	940 km	>5000 km
Duration of migration	6 days	30 days

Distance of sea crossing	NA	0 km
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\*Belgin died before completing the south migration



**Map 2. Migration routes of the fostered Egyptian vulture and its wild sibling**

### Hacking

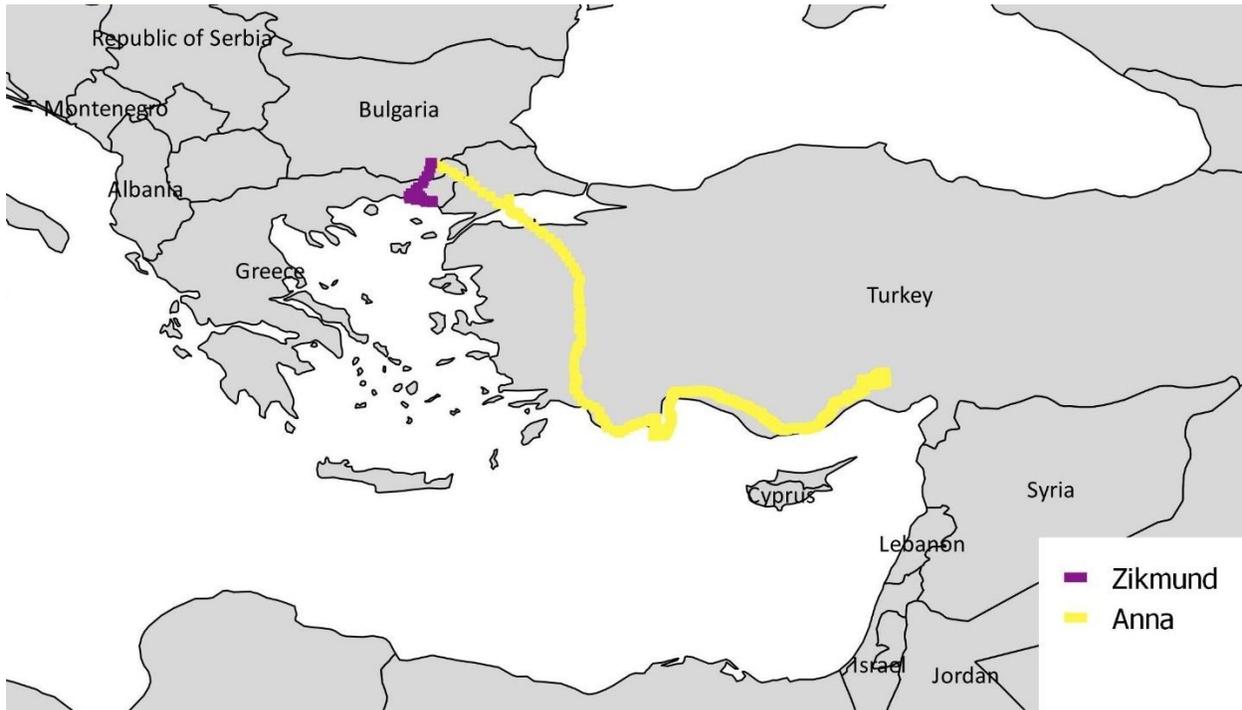
In 2018 two captive-bred Egyptian Vultures were released in the Eastern Rhodopes through hacking – Anna and Zikmund. Both chicks fledged successfully from the hack. They learned how to fly and were feeding on the food provided near and inside the hack. However, none of them visited the feeding station near the hack and was observed to exploit natural food resources. Zikmund was captured due to his unusual behavior and didn't show any fear from humans and settlements. He was roosting on the roof of the houses and allowed people to approach and capture him. We found out that the reason for this unusual behavior is that he was hand fed for about two weeks at very early age and was imprinted to people. Anna started fall migration but

was found exhausted in south Turkey. Probably she couldn't adapt well to the wild and was not able to find food.

Zikmund was excluded from the sample size and the analyses for the success of this method because his behavior was altered due to imprinting. Even though Anna survived the first month after the release, during the migration she fell exhausted showing signs of bad adaptation to the wild and she couldn't complete her first south migration. Due to these facts we consider the hacking in 2018 as unsuccessful.

**Table 3.** Overview of the captive-bred Egyptian Vultures released through hacking

	Zikmund	Anna
Sex	Male	Female
Parents origin	Uzbekistan x Bulgaria	USSR/Kazahstan x Bulgaria
Migration start date	10/09/2018	06/09/2018
Average speed	NA	192 km/day
Total distance covered	NA	1730 km
Duration of migration	NA	9 days
Distance of sea crossing	NA	0 km



Map 3. Movements and migration routes of the captive-bred Egyptian Vultures released through hacking

## Recommendations for 2019

Based on the experience gained in 2018 we make the following recommendations for the next year:

- The fostering of captive-bred chicks should be done at age >50 days
- Regular supplementary feeding at the feeding station near the hack should start in June in order to attract more adult and non-breeding Egyptian Vultures in the area. This is expected to increase the attractiveness of the place for the captive-bred vultures released from the hack
- Carcasses of different size animals can be scattered in the area around the hack so that the released vultures would have the chance to learn how to find and recognize different food items in the wild. This is expected to increase the success of their adaptation.
- Better communication with the zoos should be established in order to avoid inclusion of imprinted individuals into the release program.

## A. Delayed release

### Hypothesis and criteria for successful experiment

The delayed release technique has been applied for years in Israel where captive-born Egyptian Vultures are released in their 2nd or 3rd calendar year and show high survival rates (Israel NPA unpubl. data; Ohad Hatzofe pers. comm.). In 2017 the method was applied in Italy as a first attempt in Europe. Four captive-bred Egyptian Vultures were released but only one completed the first autumn migration (VCF 2017; Guido Ceccolini pers. comm.).

This method foresees releases of captive-bred Egyptian Vultures in spring when they are in their 2nd or 3rd calendar year. The first year is the most critical period for the wild Egyptian Vultures when they experience the highest mortality rates especially during the first south migration (Oppel et al. 2015). We hypothesize that when the birds are released in the spring of their 2nd or 3rd c.y. they would have enough time before the fall migration to gain experience, improve their physical fitness, socialize with other non-breeding Egyptian Vultures, gain knowledge for important feeding sites, communal roost sites, etc. This might increase their survival probability especially during the first south migration. It is recommended to implement this technique with a group of 3-5 birds at a time (VCF 2016). Egyptian vultures are very social especially during the non-breeding stages of their life and the social learning and social bonds between the individuals are of great importance throughout the implementation of this and other release techniques.

The delayed release method will be considered successful if both below listed assumptions are fulfilled:

- At least 80% of the released individuals adapt successfully to the wild and survive the first month after the release.

- At least 50% of the released individuals survive the first south migration.

**NB 1:** The percentage of the released individuals which migrate over the land, following the main migratory way of the species and avoiding long distance sea crossings between Europe and Africa, will be taken into account when comparing the results and efficiency between the tested release techniques.

**NB 2:** At this initial stage of the experiment, we would not consider that it failed if released birds become victims of human-induced factors along the flyway or in the wintering grounds. Human induced mortality will be accounted in the final analysis of this study.

### Origin of the released Egyptian Vultures

All captive-bred Egyptian Vultures were provided from the EEP (Endangered Species Programme, under EAZA). Three of the vultures were raised in Prague Zoo and one in the Jerez Zoo, Spain. Two of the birds provided by Prague Zoo originated from a cross between individuals from the Balkan and Central Asian population (USSR/Kazakhstan x Bulgaria), and one bird – from a pair carrying the genes of the Central Asian population (USSR x Kazakhstan). The bird provided by the Jerez Zoo originated from the Iberian population (Spain).

### Management in captivity

Three of the birds were kept in large aviary in Prague Zoo, together with other immature and subadult conspecifics, without being exposed to human presence. The fourth bird was kept in individual cage and exposed to human presence in Jerez Zoo.

### Release site

The selection of a suitable release site might be crucial for the overall success of this release technique. As a first release site in Bulgaria was chosen the vulture feeding station near otochnitsa village in Eastern Rhodopes. The release site was considered suitable as it meets the following conditions:

**Safety of the area.** The release site was located in a vulture safe area where no serious threats for vultures exist. It was located in the core area of the Egyptian Vulture breeding population on the Balkans. The area holds increasing and healthy population of Griffon Vultures and is regularly visited by foraging Cinereous Vultures. In the vicinity of the release site (5km radius) there are no poisoning or poaching events for at least 5 years, there are no windmills and the majority of the powerlines are safe or have been insulated and thus don't pose a risk for the vultures.

**Food availability.** The release site was located near a predictable food source - vulture feeding station. The adaptation aviary faces towards the feeding station which allows the captive-bred Egyptian Vultures to observe the behavior of the other scavengers and their wild conspecifics. Supplementary food was regularly provided at the vulture feeding station during the pre-release period and in the post-release period as well.

**Predator control.** The feeding station was electric fenced in order to avoid the presence and easy access of terrestrial predators (stray dogs, foxes, jackals, wolves, martens etc.).

**Conspecifics presence.** The release site was in area with regular presence of non-breeding Egyptian Vultures and breeding pairs. The adaptation aviary was located about 1.5km away from an active nest of a wild Egyptian Vulture pair in order to avoid unwanted aggressive interactions with the young birds after the release. However, the feeding station was regularly visited by adult wild Egyptian Vultures and non-breeding individuals. The permanent presence of other non-breeding Egyptian Vultures in the area is important for the socialization of the captive-bred vultures after the release.

**Other species' presence.** The release site was located outside the breeding territories of other territorial raptors in order to avoid aggressive interactions with the captive-bred Egyptian Vultures. Such species are Golden eagle (*Aquila chrysaetos*), Eagle owl (*Bubo bubo*), Long-legged Buzzard (*Buteo rufinus*). In addition, the feeding station was regularly visited by only low numbers of Corvids, e.g. up to 5 Ravens (*Corvus corax*) and 12 Crows (*Corvus cornix*). Ravens often congregate in big numbers near vulture feeding stations and compete with the vultures for food and roosting sites showing prominent aggressive behavior. Because only a few Ravens were present at the feeding station they were outcompeted by the Egyptian Vultures and there was no serious risk for the released birds. Griffon and Cinereous vultures were regularly present at the feeding station and in the vicinity of the release site. During the post-release period the captive-bred Egyptian Vultures has the opportunity to interact with the other scavengers at the feeding station and find their place in the intra-guild hierarchy.

**Roosting substrate:** The release site was located in area with high inaccessible cliffs which to be used as a safe roosting site by the released birds. The availability of dead trees was an advantage as well because very often Egyptian vultures roost on such trees. All pylons and powerlines in the vicinity of the release site were of safe types or were insulated. Egyptian Vultures can use pylons for roosting and the presence of dangerous types of pylons near the release site might be a serious threat for the birds.

### Adaptation aviary

**Location.** The adaptation aviary was located inside the electric fenced feeding station. It was installed about 100 m away from the area where the supplementary food for the wild vultures is placed. This allowed direct visual contact between the birds in the aviary and the feeding place without disturbing the wild vultures. In addition, the aviary was installed under the top of the hill in order to avoid the strongest winds and harsh weather conditions. The area around the aviary was open without bushes or dense forest which might make the vultures feel unsafe.

**Exposition.** The aviary was facing east, south and west. The northern exposition, from where harsher weather conditions usually occur, was covered.

**Size and structure of the aviary.** The dimensions of the aviary constructed for adaptation of 4 Egyptian Vultures were 6m/3m/3m. However, we consider that this is the minimum size and if possible width and the length of the aviary could be higher in order to provide more space for the vultures to fly from one perch to another. This will strengthen their wings and prepare them for their first flight after the release. The main construction was built of metal. Anchors and strong wire ropes were used for stretching the construction and fixing it to solid rock. This made the construction very stable even under harsh weather conditions such as strong winds or heavy rains, heavy snowfalls etc. Wire mesh with 25x25 mm openings was used for covering the aviary. The floor of the aviary remained uncovered to prevent vulture's legs from injuries while walking and feeding. The wire mesh on the sides was extended with additional 20 cm on the ground and covered by solid stones in order to prevent predators from entering in the aviary. One of the short sides of the aviary (the one facing north) was covered by wooden panels instead of wire mesh. This was the side from where the strongest and more frequent winds were expected. This side of the aviary should protect the birds from the harsh weather conditions. **All crevices or small holes between the base of the aviary and the solid ground were well covered either by strong wire net or by stones in order to prevent the entry of terrestrial carnivores such as foxes and stone martens.** (Fig1).

Wooden perches were mounted along the sides of the aviary. The perches were mounted at about 1.8 m height above the ground and about 1.2 m from the top of the aviary. They were about 20 cm wide and were placed about 20 cm away from the net in order to provide enough space between the vultures and the net, thus avoiding any unwanted damages on their flight feathers. Wooden platform was mounted on one of the aviary's corners. The platform was mounted about 10 cm higher than the perches because vultures feel safer when they roost on the highest possible place. This made the platform attractive and regularly used as a roosting site. A waterproof roof covered the platform and was providing shade for the birds. The platform was about 60 cm wide. Vultures were using it for roosting and as shelter during the hottest part of the days or when it rained.

The entrance was placed in the middle of the long side of the aviary. It was wide about 1.5 m and high about 2 m. The highest point of the entrance was higher than the perches. This dimensions and position of the entrance allowed the released birds to leave the aviary by flying out straight from the perches. After inserting the vultures into the aviary, the entrance was be locked with a padlock.

**Food and water delivery port.** The food and water delivery door was initially built in on the same side as the entrance. It was placed at the corner near the bottom of the aviary on the opposite site of the roosting platform. However, one week after the insertion of the birds it was decided to build in another food delivery port on the covered side of the aviary in order to avoid direct visual contact between the keeper and the vultures. For this purpose, tube with 25 cm diameter was installed from the covered side of the aviary. Secure locking mechanism was used to prevent predator attacks. Since then food was always delivered through the tube with only a few exceptions when whole livestock carcasses or their parts which were too big to pass through the tube, were used to feed the vultures. However, water was provided through the first delivery port once every 5-6 days until the release.

**Video surveillance.** Video camera with wide-angle lens was installed in the corner of the aviary. It allowed to closely monitor the behavior of the vultures during the adaptation period. The camera had good visibility towards the place where the food is delivered in order to closely monitor the food intakes by the different individuals in the aviary.



**Fig. 1.** Adaptation aviary for Egyptian Vultures with size 6/3/3m.

## Adaptation period

**Insertion in the adaptation aviary.** Three captive-bred Egyptian vultures were inserted in the adaptation aviary on 28th March, soon after the arrival of the first breeding pairs which visit the feeding station. For the Balkans this period is between the end of March and the first week of April. This allowed the young birds to observe their wild conspecifics since their first day in the adaptation aviary. The fourth vulture was inserted in the aviary two weeks later - on 13th April. All birds were ringed with different colored plastic rings to ease the identification during the adaptation period. The ring colors were easily recognizable and visible from the observation point and on the webcam.

**Feeding.** Everyday care and observations from a distance were conducted during the adaptation period. The vultures were fed 6 days a week with about 200-300 g per day per individual. However, in cases when whole carcass was provided or the food in the aviary was not completely consumed and is still fresh the frequency of the feedings was decreased until most of the food was consumed. During the first week of the adaptation period food and water were provided through the door on the bottom of the aviary. After that tube was inserted on the covered side of the aviary and food was delivered through the tube in order to avoid the direct visual contact between the vultures and the keeper. **It is important to ensure that vultures won't link the human presence with the food deliveries!** Water was kept clean and permanently available. It was provided in a shallow pot which was cleaned and refilled at least once per week. The food provided was as diverse as possible. As the birds have used to some specific type of food (rats, hares, chickens) as a main food source provided during the captivity period, the same food items were used in the first 4 days of the adaptation. After that period the quantity of these food items was gradually decreased and at the same time the quantity of other food items was increased. After the first week half of the food amount was from the one they were used to and the other half was presented by new food items. After the end of the first week start providing mainly new food items and rarely from the specific ones. However, we strongly recommend to provide diverse food items to the vultures even during the captivity period which will make the adaptation period, which is much shorter, easier and less stressful for the birds. The Egyptian Vulture is an opportunistic scavenger with very wide diet spectrum which includes carcasses of bigger animals, eggs, invertebrates, slow-moving small animals which are captured alive, faeces etc. (Negro et al. 2002, Hidalgo et al. 2005, Dobrev et al. 2015). Training the captive-bred Egyptian Vultures to recognize different food items might be crucial for their survival and successful adaptation into the wild. Thus, the food provided during the adaptation period was as diverse as possible including whole carcasses (e.g. sheep, goats, lambs) or parts of them, pieces of red meat

or skin and meat from the carcasses, small animals (e.g. lizards, snakes, hares, tortoises, hedgehogs, birds), bones with some meat on them, offal. When providing the food, the different food items were scattered near the food delivery port so that the birds could distinguish the different items and pick according to their interest and preferences. When a new food item was provided for the first time it was prepared to be as attractive as possible. **Example:** When a hedgehog was provided for a first time, a cut along the whole body was made which made it more attractive for the birds and increased the chances to be consumed. Next time a hedgehog was delivered it was already a known food item and was provided as whole carcass so the vultures would have to tear it apart by themselves. We found that suitable approach for finding and providing diverse food items is collecting road kills from the area around the release site. Many small animal species become victims of the traffic every day and especially at night. Some of them were collected and used, e.g. snakes, hedgehogs, small birds, tortoises, lizards etc. **Caution: When road kills were collected, predator species (e.g. dogs, martens, cats, foxes, badgers etc.) and mice were avoided as some of them might be poisoned at first place.** When bigger carcasses or their parts such as sheep or calf's legs were provided they were opened and cut beforehand. Their skin is too thick and the young Egyptian Vultures might not be able to tear it. The head of hares and smaller animals was opened as well in order to guarantee easy access to the brain which is very nutritious.

**Monitoring.** The behavior and the interactions between the vultures in the aviary were permanently monitored and recorded. Direct observations were made from a distant observation point (about 400m) in order to avoid any disturbance to the wild and captive-bred Egyptian Vultures which might alter their normal behavior. Observations and recordings with a camera mounted in the aviary were made as well. An experienced observer was recording how often and which individuals are feeding, which food items are consumed, any aggressive behavior between the birds or social exclusions.

**Tagging.** All Egyptian Vultures were tagged with GSM/GPS transmitters prior to release. They were tagged on 13th May or 3 days before the release. If the birds are tagged earlier they might start pecking the transmitters as they are bored in the aviary and doesn't have much other activities. However, the transmitters were mounted a few days before the release because the birds need some time to get used wearing the devices. During the tagging the birds were thoroughly examined by vets and treated against ecto- and endoparasites because this was their last handling prior to release. The transmitters will allow to closely follow the behavior of the birds after the release and their survival which aims to successfully evaluate the success of this release technique. We used 30g solar powered Ornitela GSM/GPS transmitters. The tags were

set to provide high frequency of GPS points (GPS locations every 5 min) and high frequency of data deliveries (30min). This would allow the field team to immediately react if the birds experience some problems after the release. The transmitters were mounted as backpacks with Teflon harness. All vultures were ringed with metal rings. The color rings used during the adaptation period were removed as in the wintering grounds in central Africa some birds are killed because of the color rings. Color rings are much more visible than the transmitter or the metal ring and might attract unwanted attention in the wintering grounds.

### Release technique

**Release period.** The adaptation period lasted 50 days for the three Egyptian Vultures which arrived first and 34 days for the last one. All vultures were released on 16th May. The release took place after the arrival of the first non-breeding Egyptian Vultures in order to allow the inclusion of the captive-bred birds into the social structure of the wild conspecifics near the feeding station. In the Balkans the non-breeding birds start arriving in early May.

**Feedings.** One week prior to release the quantity and quality of the delivered food was increased. Food items with high nutritious value such as 1-2 days old chickens were provided to compensate any weight losses experienced during the adaptation period. In the day of the release supplementary food was provided at the feeding station. About 300 kg of offal was provided and was scattered on the feeding station. The aim was to ensure that the released vultures will have access to food even if Griffon Vultures monopolize the food and outcompete the other vultures. Food was delivered on the roof of the adaptation aviary as well in case the vultures return to feed there after the release.

**Release.** The vultures were released in the early afternoon on 16th May by opening the main entrance of the adaptation aviary. The field team opened the aviary and left the place as fast as possible with little disturbance to the birds. All further observations were held from a distance of about 400 m in order to avoid disturbance. The vultures should leave the aviary whenever they are ready. It may take a few hours before they realize that the entrance is open and leave the aviary. The first vulture left the aviary about 15 mins after the entrance was open. Last was the vulture which arrived latest, it left the aviary on the next morning.

### Post-release monitoring and actions

**Monitoring.** After the release the captive-bred Egyptian Vultures were closely monitored by experienced field team of 3 people. The most critical period was expected to be the first night when the birds might not roost on a high safe place. All released birds spent the first night after the release on small rock on the hills around the feeding station. They didn't choose the highest and most inaccessible cliffs as it was expected. However, none of them was roosting on the ground or other place where its life was at risk from predation. The monitoring of the released birds continued 10 days until they started regularly feeding on the feeding station and roosting on safe, inaccessible for terrestrial mammals, places. After that period the released birds were closely monitored by the GPS transmitters and visual observation about once per week. We worked in close collaboration and exchanged information with other NGOs which maintain vulture feeding station in Bulgaria and in the Greek part of the Eastern Rhodopes in order to ensure that if the released vultures move to neighboring areas they would find safe food in good quantity.

**Feeding.** Supplementary food was permanently present at the feeding station after the release and until the start of the fall migration. This approach aimed to attach the birds to a safe food source and in area visited by other non-breeding Egyptian Vultures. Whole carcasses and offal were regularly provided. Food items were scattered in order to ensure easy access to food for the released vultures even when the Griffon Vultures are feeding as well. The released birds have never fed on the food provided on the roof of the adaptation aviary and haven't return to roost there either. Therefore, the food deliveries on the roof of the aviary were stopped one week after the release.

### Movements and migration

#### Akaga

**Post-release movements.** After the release Akaga remained near the release site and was regularly feeding on the feeding station. Most of her movements were up to 15 km from the feeding station. She made one longer trip of 34 km in eastern direction on 3rd June. Akaga was roosting near the feeding station. She was observed to feed on natural carcasses outside the feeding station. In one occasion she was observed feeding with other Egyptian and Griffon vultures on a dead fallow deer, on another occasion she spent a few days near the carcasses of few goats.

**Migration.** Akaga started her south migration on 25th August. She reached the Bosphorus on the next day but instead crossing through there she returned back and followed the coast to the Dardanelles. She crossed the strait on 28th August and continued south reaching the Adrasan Peninsula just two days later. She spent 3 days on the Adrasan Peninsula trying to find her way and wandering over the entire peninsula. Eventually, on 02nd September Akaga continued north towards Antalya and two days later flew over the Gulf of Iskenderun to enter into the Middle East. She passed through Syria, Iraq and the Arabian Desert following the eastern Red Sea migration flyway. On 20th September Akaga reach Bab el Mandeb and crossed the strait with no hesitation. On the next day she reached the wintering grounds in Afar, Ethiopia and settled down. On her first fall migration Akaga flew over 5600 km for 28 days or approximately ca. 200 km per day.

**Wintering.** Akaga is wintering in Afar, Ethiopia neat the towns of Serdo and Logya. She is regularly roosting on high-voltage pylons passing through that area.



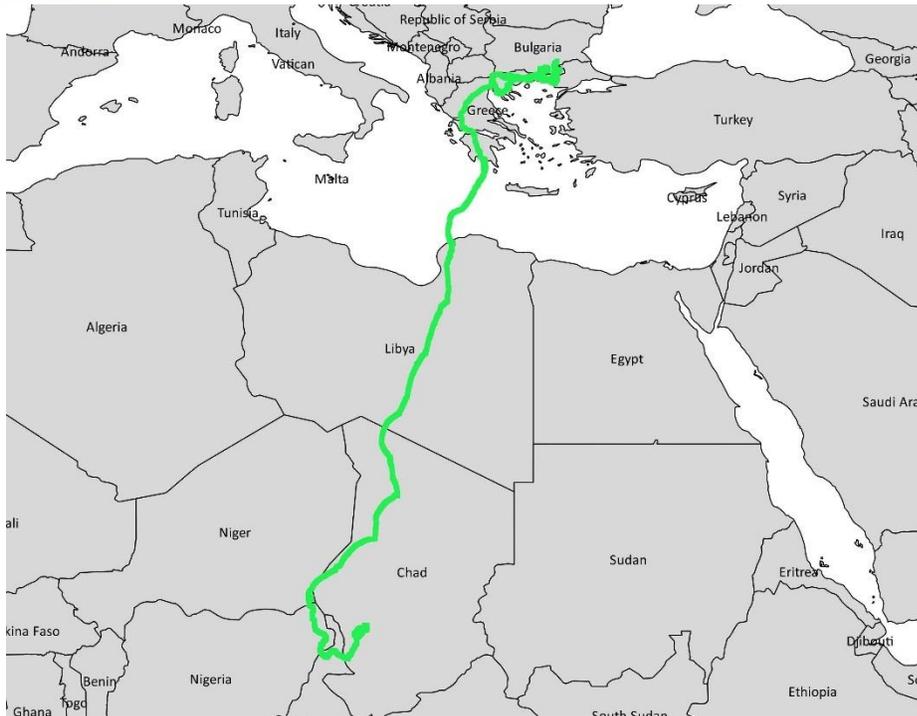
**Map 4.** Migration route of Akaga

## Boyana

**Post-release movements.** After the release Boyana remained near the release site and was regularly visiting the feeding station. Most of her movements were up to 15 km from the feeding station. She made two longer up to 40 km in western and southwestern direction. Boyana was regularly roosting near the feeding station. She was also recorded feeding on natural carcasses outside the feeding station which proves her ability to find food in the wild. On 08<sup>th</sup> September she moved south to Xanthi in Greece and continued west to the Chalkidiki. However, she returned back east through Alexandroupolis. After that Boyana moved north to Svilengrad and again south to Greece. On 15<sup>th</sup> September she settled in Dadia visiting the vulture feeding station. She spent 4 days in the area and on 19<sup>th</sup> September started her south migration.

**Migration.** Boyana started her south migration on 19<sup>th</sup> September and again decided to go west but this time she went further than the Chalkidiki. She continued through central Greece and on 23<sup>th</sup> September reached Peloponnese. On the next day she was already on the Mani Peninsula and roosted near the sea. One day later Boyana started flying over the sea but after only 10 km returned back to the land. On the next 10 days Boyana was wandering across the Mani Peninsula. Finally, on the 06<sup>th</sup> October she got tailwinds towards Africa and at 12:44 local time initiated a sea crossing. Boyana reached the Libyan shore at 02:10 a.m. after 500 km flight over the sea, half of which was during the night. After a day rest she continued south through the Sahara Desert. In the next 7 days she flew over 2300 km to reach the Lake Chad in Niger. However, this was not her final destination. Boyana continued south into Cameroon afterwards turning north towards Chad and reached her wintering area on 22<sup>nd</sup> October. During her first south migration Boyana covered a distance of more than 4600 km in 33 day with speed of approximately 140 km per day.

**Wintering.** Boyana was wintering in an area of about 820 km<sup>2</sup> north of Dourbali in Chad.



**Map 5.** Migration route of Boyana

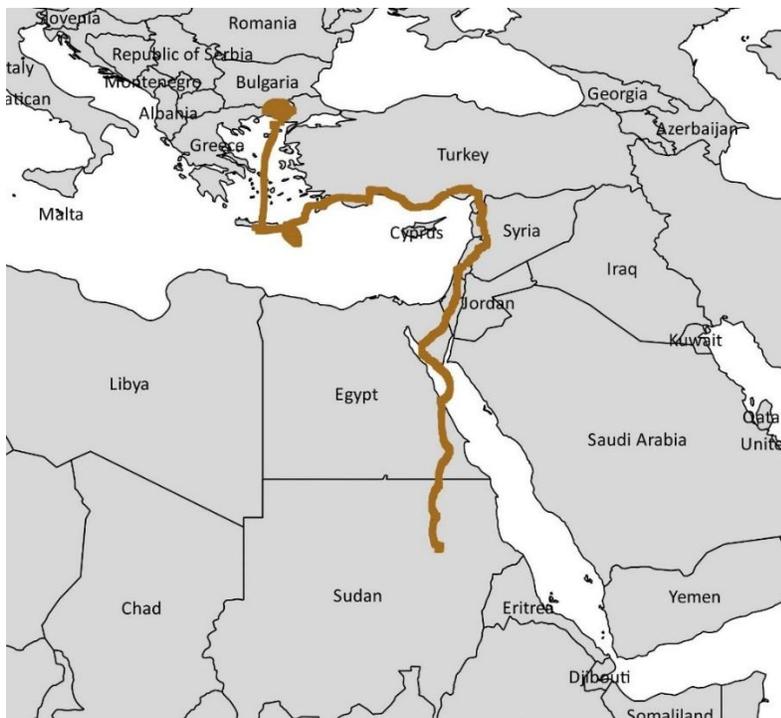
## Polya

**Post-release movements.** After the release Polya remained near the release site and was regularly visiting the feeding station. Most of her movements were up to 15 km from the feeding station. Polya was regularly roosting on the cliffs near the feeding station. She was also recorded feeding on natural carcasses outside the feeding station which proves her ability to find food in the wild. Her first longer move was on 07<sup>th</sup> September when she visited the area near Ivaylovgrad and in the afternoon returned back to the feeding station. On 11<sup>th</sup> September she moved south reaching Alexandroupolis. In the next 16 days she was wandering between Dadia and the release site making multiple trips.

**Migration.** We can consider the 27<sup>th</sup> September as the start of her fall migration when she crossed the sea between Alexandroupolis and the island of Samothraki. She spent on the island over a week but on 04<sup>th</sup> October strong north currents made her continue south. Taking advantage of the strong tailwinds Polya flew straight south over the Aegean Sea and after 320 km reached the island of Tinos where she roosted. On the next day she continued south and made 244 km more over the sea to reach Crete. Polya moved to the eastern most part of Crete

and on 08<sup>th</sup> October made an attempt to cross the sea. However, after 100 km she decided to go back and returned to land. She moved to the central south part of the island and remained stationary for 18 days. She was roosting on a suitable cliff near the village Pompia and feeding in the area. She was observed in the field by Stavros Xirouchakis. On 26<sup>th</sup> October Polya moved to the easternmost part of the island once again and this time took advantage of the western winds to use the islands on the east as stepping stones to Turkey. She made another 270 km over the sea and through the islands reached the mainland near Dalaman on 29<sup>th</sup> October. She crossed the Adrasan Peninsula and on 06<sup>th</sup> November passed over Iskenderun. Polya continued through Syria, Lebanon and Israel to reach the southern part of Sinai in Egypt on 22<sup>th</sup> November. On the next day instead of crossing through the Gulf of Suez she decided to fly over the Red Sea and made a 220km detour over the sea to reach the shore of Egypt near Quseer. She continued straight south for another 900 km entering into Sudan. On 28<sup>th</sup> November Polya stopped near Nile in the Nubian Desert in Sudan. During her migration she crossed in total over 1300 km of open sea.

**Wintering:** On 29<sup>th</sup> November she settled in the Nubian Desert of Sudan, near the town of Berber. It is not clear if she will remain in this area for wintering or after short break will continue further south.



Map 6. Migration route of Polya

## Panteley

**Post-release movements.** After the release Panteley remained near the release site and was regularly feeding on the feeding station. He was roosting on the cliff just above the feeding station. Most of the time his movements were up to 17 km from the release site but on a few occasions he made trips of over 100 km in different directions exploring the whole Eastern Rhodopes. He was also recorded feeding on natural carcasses outside the feeding station which proves his ability to find food in the wild and good adaptation to the local conditions. On 11<sup>th</sup> July he started a long journey through Western Rhodopes, Central Balkan Mountain and Northern Bulgaria to reach Kotel just two days later. In the next 3 weeks he was regularly visiting the vulture release site and feeding station in Kotel which is maintained and regularly provided with food by FWFF. During his stay in Kotel he made three one-day exploratory trips for 50-80 km to the north and east. On 06<sup>th</sup> August Panteley moved south and after a roost in Sakar mountain he returned back to the release site. On the next day he made another exploratory flight this time south to Greece and returned again near the release site. On 29<sup>th</sup> August he visited Dadia National Park in Greece but on the next day returned to the feeding station in Bulgaria. On 2<sup>nd</sup> September Panteley moved southwest to Kavala but afterwards returned to Dadia and settled near the feeding station. In two consecutive days – 7<sup>th</sup> and 08<sup>th</sup> September he was making trips to Marmara Sea south of Tekirdag but in both occasions was returning to roost in Dadia. In the next week he was wandering between Dadia and the release site. On 15<sup>th</sup> September he reached the Dardanelles again but similar to the previous occasions he returned back to Dadia.

**Migration.** We can consider 18<sup>th</sup> September as the start of Panteley's fall migration when he moved in western direction. He entered southwestern Bulgaria, moved into Macedonia and continued south to central Greece. He passed north of Ioannina and followed the Pindos Mountain. On 24<sup>th</sup> September Panteley passed north of Athens and crossed the strait between mainland Greece and Euboea Island. After three days he was already on the eastern most part of the island but didn't initiate sea crossing to islands on the east. Instead he was wandering over the island following the coastline. On 02<sup>nd</sup> October he settled near the village of Figias in the central southern part of the island. He was roosting on different small cliffs. Panteley spend the next three weeks in this area. He was observed in the field by a team of HOS/BirdLife Greece. They observed him feeding on something in the field near the village. Panteley was also landing near and inside sheep pens. On 21<sup>th</sup> October he moved again to the most eastern part of the island but a week later returned and crossed the sea toward mainland Greece. He reached

Peloponnese and continued south. On 02<sup>th</sup> November Panteley was on the Mani Peninsula. He roosted on the cliffs near the sea. After two days he moved back north and then east to reach the Cape Maleas Peninsula. He settled in a small valley near the village of Agios Nikolaos. Local collaborator visited the place and observed Panteley flying and roosting on small cliffs in the valley. Every morning Panteley was visiting a specific location in the valley where the local collaborators found old remains of dead livestock – skin and bones with no fresh meat. On 15<sup>th</sup> November Panteley moved some 10 km north near the village Dermatianika. There he was roosting on a high cliff. The local collaborators two times provided food close to the roosting cliff and observed Panteley feeding on it. On 24<sup>th</sup> November Panteley crossed 17 km over sea to reach the island of Kythira. On 01<sup>st</sup> December he crossed 100 km more over the sea to reach Crete.

**Wintering:** At the time of compilation of this report (4<sup>th</sup> December) Panteley is still on Crete. He might remain wintering in southern Greece or cross the sea towards Africa.



**Map 7.** Migration route of Panteley

## B. Fostering

### Assumptions, hypotheses and criteria for successful experiment

The fostering is a well-known method to restock wild populations, but it has not been applied on a large scale in wild Egyptian vultures. Two experiments have been done in Italy and even though they were successful (Ceccolini & Cenerini 2005, Di Vittorio et al. 2006), still it seems that the empirical experience with this method in situ is not sufficient. For the aim of restocking, the fostering represents a technique where captive bred birds (in Zoos or a Wildlife breeding centers) or wild chicks who have been rescued and then rehabilitated, are introduced in a wild foster nest of the species. Once they have been accepted and raised by the foster parents they leave the nest as wild birds. For the captive bred individuals, the fostering provides the chance to develop the instincts and imprint the behavior of wild birds.

All the releases will be done in Bulgaria, if not all the most of them in Eastern Rhodopes, where the stronghold of the Balkan population of the species is (Velevski et al. 2015) and where the use of poison baits and poisoning are considered not a common and wide spread practice (Skartsi *et al.* 2014), and to be able to compare the results with the other releasing methods under the same experiment. Another point to consider is that the more eastern the origin of the juveniles from the Balkans is, the greater is the chance that they follow the safer way over land to the wintering grounds and not crossing the sea, where mortality is very high (Oppel et al. 2015). We assume this should be valid at some extent also for the restocked chicks because the more to the east they are released, the higher is the probability to find migrating conspecifics or other migrating soaring birds.

### The fostering method will be considered successful if all below listed assumptions are fulfilled:

- At least 80% of the cases: the fostered chicks are accepted by the wild foster parents; no aggression is shown between the two chicks and between the parents and chicks; adults take care of the two chicks and they both grow and develop proportionally and normally (none of the chicks is sluggish, lifeless, languid and not feeding) and the two chicks fledge successfully.
- At least 80% of the fostered individuals adapt successfully to the wild and survive the first month after fledgling (i.e. after leaving the nest).
- At least 30% of the fostered individuals survive the first south migration.

**NB 1:** The percentage of the released individuals which migrate over the land, following the main migratory way of the species and avoiding long distance sea crossings between Europe and Africa, will be taken into account when comparing the results and efficiency between the tested release techniques.

**NB 2:** At this initial stage of the experiment, we would not consider that it failed if released birds become victims of human-induced factors along the flyway or in the wintering grounds. Human induced mortality will be accounted in the final analysis of this study.

### Selection of the foster pairs

Not all pairs were suitable for fostering, that's why we chose pairs who fulfilled the following criteria:

- The pairs should have been subject of long-term monitoring (at least for the last five years)
- The age of the chick of the foster pair should be very similar to the fostered chick (the difference in the age between the two chicks should not exceed 4-8 days, which is usually the natural difference in the age of the siblings in the wild).
- To be an experienced pair (the ratio of successful breeding is at least 80%; the ratio of successful breeding is calculated by dividing the number of years when the pair has raised successfully chicks by the number of years the pair has been monitored).
- To be located close to a secure source of food (i.e. vulture restaurant): up to 5 km.
- To be located in a territory with high occupation rate (Arkumarev et al. 2018).
- To be a traditionally successful pair (that have successfully raised and fledged chicks at least three times in the last five years).
- To have no antagonistic behaviour towards its brood.
- To be a pair that has raised only one chick in the given breeding season because when the number of pairs is limited (the experiment is implemented in a small population) we aim to keep adults safe and increase the breeding success in the same time. In this line introducing an extra chick (third one) to pairs already raising two chicks could potentially increase the risk of extra energy loss in the adults prior to migration. Additionally, this can

decrease the amount and frequency of food delivered to all three chicks resulting in poorer fitness before their first migration. Last but not least, it is very often that in Bulgaria Egyptian vulture pairs breed in small caves or ledges where the coexistence of three chicks will not be comfortable in terms of space needed.

- To be a pair that breeds in easily accessible ledges or caves (mostly in small cliffs not exceeding 15-20 meters in height).
- To be a pair easy to observe from a close distance without being disturbed (e.g. pairs that breed in large caves or wide ledges open towards the observation point).
- It is necessary to choose always at least two potential foster pairs for each captive bred chick in case something goes wrong with one of the pairs right before the fostering technique is carried out. For instance, if one of the selected foster pairs unexpectedly loses their chick for more than 2-3 days before the captive-bred one is foreseen to be introduced, then the fostering should be implemented with the other foster pair.
- The nest was easily accessible by the project team in a short time, e.g. 1 hour (a very important particular which allowed the field team to reach the nest as fast as possible in the case of emergency).

### Pre-intervention monitoring

Once the potential foster pairs were selected and all permits were granted, we carried out an intense monitoring to ensure that:

1. The pairs fulfil all selection criteria also in the given breeding season.
2. To set the timing between the dates of hatching of the chicks in captivity and in the wild population.

*NB: If the fostering is done with early age chicks, it is very important to check the targeted potential foster pairs a couple of days before the intervention to ensure that there is no second chick. This could be done by a drone if the traditional monitoring methods (e.g. observation by a telescope) cannot provide this information. However, the inspections of the nest with invasive methods which will disturb the parents should be as quick as possible and during appropriate part of the day – not during hottest parts of the day or in cold and rainy weather. The absence of the adults during such conditions might be detrimental for the wild chicks.*

## Origin of the released Egyptian Vultures

The fostered chick originated from a captive pair formed by birds from the Balkan population (Bulgaria) and Central Asian population (Kazakhstan).

## Management in captivity

The captive-bred Egyptian Vulture was hatched and raised by a captive pair in Prague Zoo, in the frame of the EEP (Endangered Species Programme, under EAZA) for the Egyptian Vulture.

## Introducing the captive-bred chicks into the wild foster nests

### *Introducing early age chicks*

#### **Implementation**

Fostering of early age Egyptian vulture chicks is a common practice in the EEP of EAZA, thus we were advised to proceed so. We received a 16 days old chick from the Prague Zoo on the 19th of June 2018. On the next day, 20th of June 2018, afternoon, we approached the nest as closer as we can with the vehicles but still on the distance that doesn't disturb the pair. We put the chick in a transport box, walked for about 10 minutes and introduced it into the chosen nest as follows:

- a) The field team reached the breeding cliff and 3 persons climbed to the nest while the rest stayed under and passed the transport box to the team member who was in the nest.
- b) The chick was taken out of the box and placed on the opposite site of the nest, away from the wild chick.
- c) The field team left the nest and went back to the vehicles where 3 team members remained to observe the foster nest.

#### **Complications**

Once the observation of the nest started, approximately 15 minutes after the captive bred chick was placed into the foster nest, an antagonistic behaviour between the chicks in the nest was observed. The captive bred bird was approximately 6-8 days older and bigger in size compared

to the wild chick and almost immediately showed aggression against the wild chick. The introduced chick started pecking the wild chick in the head and the legs. Meanwhile the adult birds were in the air and about 10 minutes after the observation started, the male landed on the top of the cliff. The captive bred chick was still attacking the wild one making short breaks of several minutes. About 5 to 10 minutes later the male landed in the nest close to the chicks and seemed calm with no signs of aggression towards the „new“ chick in the nest. On contrary, in the moment when the introduced chick started a new attack the male tried to feed it but the chick refused the food and continued pecking the smaller chick. The male bird observed the fight passively. Due to the risk of serious injuries and even death of the wild chick it was decided to visit the nest again and extract the captive bred bird. An hour after the insertion, the captive-bred chick was removed from the nest. The wild chick was injured but not seriously and was left into the nest. The captive-bred chick was transported to the Green Balkans Wildlife Rehabilitation and Breeding Center in Stara Zagora where it was introduced to the captive breeding pair there. This pair already had a chick in similar age and turned into foster parents accepting the „newcomer“. However, the introduced chick showed aggression towards its foster sibling again. Thus, under the permanent and professional care of the personnel of the center, and because the environment in the center is controlled (i.e. by video observation), the introduced chick was extra fed, taken out of the nest whenever shows aggression and brought back in the nest again, repetitively many times until to the antagonistic behavior was suppressed and the chick successfully adapted to the new environment.

### Conclusions and recommendations

The fostering with the early age captive bred chick failed due to aggression towards the wild chick. It is supposed that this behavior is due to the long period (ca. 3 days) the chick was separated from the parents at so early age.

Further experiments with fostering in situ seem more reasonable with older chicks (45-60 days) because:

- ✓ It is easier to observe and control the development of the chicks in the nest;
- ✓ They are less vulnerable to potential lack of food and aggression;
- ✓ The foster nest is less vulnerable to the disturbance created.

### *Introducing 45-60 days old chicks*

The fostering was tried again in the same wild nest, with the same chick when it was 60 days old (based on the previous experience from Italy; Ceccolini & Cenerini 2005, Di Vittorio et al. 2006).

On the 2nd of August, the captive bred chick was transported from the Green Balkans' Wildlife Rehabilitation and Breeding Centre to Eastern Rhodopes, tagged with a 30 g GSM/GPS Ornithela tag and placed into the foster nest. Some extra food (rabbits and rats) was provided directly into the nest for both chicks.

In the very beginning, the chicks tried the food provided, and the wild chick picked several times the fostered chick at the bill. Then for a while, no interactions were observed between the two juveniles. In less than an hour, it was observed that the wild chick is protecting its position in the bottom of the nest and not allowing the captive bred to go inside the niche. Meanwhile the adult female entered the nest bringing food for the chicks, showing no aggression towards the introduced juvenile. This behavior continued till the end of the day and the wild chick did not allow to the fostered chick to enter deep inside or to feed on the food except for the cases when it was able to steal some food. However, there was no direct aggression.

On the next day, hierarchy between the two chicks in the nest was observed. The wild chick seemed to dominate over the fostered bred chick. Under this behavior, the captive bred chick was allowed to enter deep into the niche and to feed along with the wild chick. The foster parents were providing food regularly, five times during this second day.

On the third day (4th of August) everything in the foster nest looked fine and juveniles behaved just if they were raised together – laying into the nest, feeding and pecking feathers each other. The provided by the project team additional food close to the nest the same day was later brought by the parents into the nest.

### Post-fostering monitoring and actions

#### **Monitoring**

After the chick was brought back in the wild nest again a solid monitoring was carried out in order to follow the development of both chicks in the nest. A field assistant observed the captive-bred chick and the wild sibling in the nest for 3 days during the daytime after the experiment was tested again. The observation was made from the observation point which is close enough to the nest, so the observer was able to tell if both chicks were fed by the parents, if some aggression exists between the juveniles. The close up observations would allow also to intervene in a case of emergency.

## Feeding

Supplementary food was permanently present at the feeding station within the range of the foster nest. Pieces of meat were be delivered in the vicinity of the foster nest in the first days when the fostered chick was inserted again in order to decrease the stress for the adults who had to feed one extra chick. The delivery were made by the field team member responsible for the observation.

## Human resources

The implementation of the fostering method requires not only a strict logistic and staff time to be implemented, but also at least one team member subsequently who will need to take care of the foster nest in the first days after the fostering is implemented. The same team member should be also involved in the preparation of the food for the food deliveries in the first days.

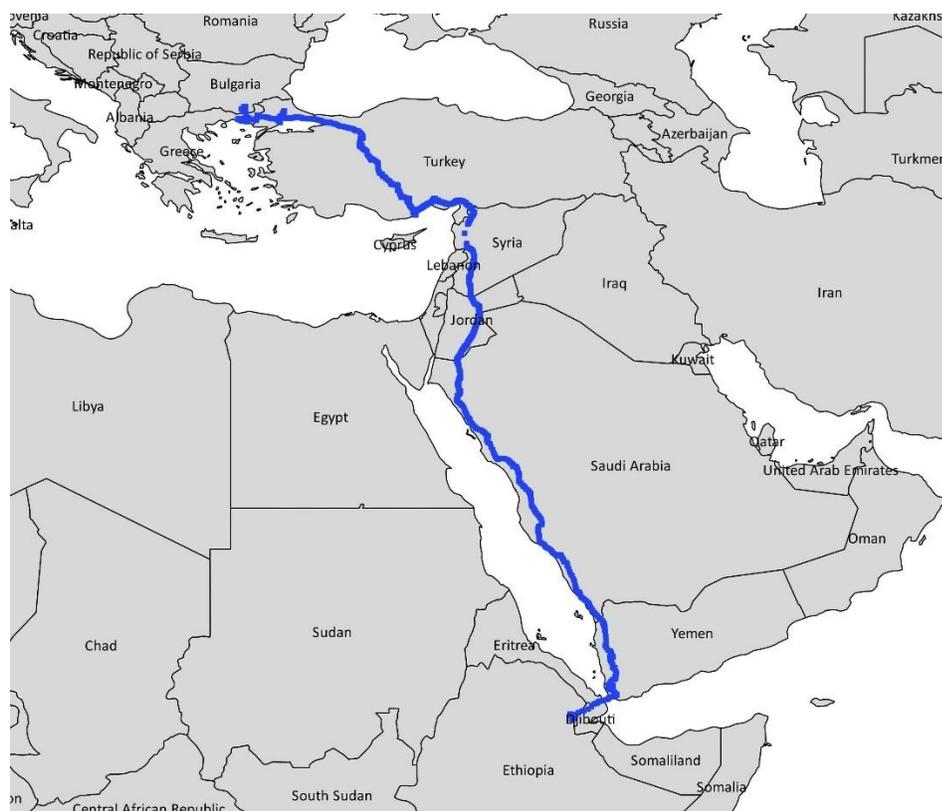
## Post-fledging behaviour

The fostered Egyptian Vulture named Blanka fledged on 14<sup>th</sup> August (aged 72 days). Immediately after fledging she moved 1 km north to another small valley with cliffs. The wild sibling Belgin fledged on 19<sup>th</sup> August at approximately 71 days old. He remained in the vicinity of the nest in the following days. Supplemental food was delivered on high rocks near both vultures during the first 2-3 weeks after fledging. Blanka was found by the wild pair on the fourth day and both parents started feeding her. The pair was visiting both places – the nest where Belgin remained and the small valley north of the nest where Blanka was located. During the first two weeks after fledging Blanka was not flying further than 1.4 km from the cliff where she was roosting and never returned back to the nesting cliff. On 31<sup>st</sup> September she visited the vulture feeding station which was 5 km from her roosting cliff. This feeding station is also regularly visited by the wild pair. Three days later Blanka started her migration. Belgin remained stationary in the vicinity of the nest for three weeks not going further than 300m from the nest. On 09<sup>th</sup> September he made his first longer flight and visited the same feeding station. He stayed near the feeding station and was regularly feeding on it in the next 3 days. After that he moved south and visited another wild nest where the pair has successfully raised one fledgling. Belgin spent two days roosting on this cliff and on 14<sup>th</sup> September started his south migration.

## Migration and wintering

### Blanka

**Migration.** Blanka started the south migration on 02<sup>th</sup> September (aged 91 days). On the first day she reached Alexandroupolis and took western direction towards Komotini. However, after 42 km she changed the direction and moved to the east along the coast. On 06<sup>th</sup> September Blanka crossed the Bosphorus and continued south. She made one day stops near Nallihan and Eskisehir. On 12<sup>th</sup> September Blanka reached the sea coast southwest of Mersin. Due to bad weather conditions she stopped for 4 days (13<sup>th</sup> – 17<sup>th</sup> September) between Mersin and Adana. After that Blanka flew over the Iskenderun and continued south through the Middle East. She chose the eastern Red Sea migratory flyway and on 02<sup>th</sup> October reached the Bab el Mandeb strait in Yemen. Three days later she crossed the strait and on 05<sup>th</sup> October reached the wintering ground in Afar, Ethiopia. During her migration Blanka flew over 5000 km for 30 days with average speed ca. 167 km per day.



Map 8. Migration route of Blanka

**Wintering.** After reaching the wintering grounds in Ethiopia Blanka settled near the village of Hayu in Afar. She was often roosting on the roof of an abandoned large enterprise building inside the village. During the day she was feeding behind the houses and in the surroundings of the village. On the morning of 17<sup>th</sup> October Blanka visited usual feeding place behind the last houses of the village. Since that moment an unusual behavior was observed – started moving only by walking. On that day she walked about 500 m to the south and roosted on the ground. On the next day Blanka walked another 400 m south. On 19<sup>th</sup> October she changed the direction and walked 700 m to the west and in the evening was roosting near or on the top of a building. On the 20<sup>th</sup> October the bird moved 500 m further west and stopped for roosting on a spot where finally she died. Judging from the accelerometer of the transmitter we can conclude that the bird was alive during the night and died in the early morning on the 21<sup>st</sup> at the same location. Yilma Dellelegn Abebe from EWNHS conducted a field mission to investigate the case. On 28<sup>th</sup> October he found the dead body of Blanka. The body has been moved about 50 m by a predator the previous night. Because the body was already decomposing and partly consumed by predators it was impossible to judge if it had any injuries. The investigation with local people near the village and the feeding location revealed that there were no poisoning incidents in the area. People stated that they don't mind the vultures and are not deliberately chasing them. Most probably Blanka has been physically harmed by dogs, baboons or even people and was unable to fly. She suffered a few days walking away of the village and consequently died of her injuries or exhaustion.





Pictures: The dead body of Blanka (top left and right), the feeding place regularly visited by her (bottom left) and the habitat at the location where the body was found (bottom right). (Photos: Yilma Abebe/EWNHS)

## Belgin

**Migration.** Belgin started his south migration on 14<sup>th</sup> September (aged approximately 97 days). He moved southeast and crossed the Dardanelles on 15<sup>th</sup> September. Afterwards Belgin continued flying straight to the south and after two days reached the seacoast near Fethiye in Turkey. On 18<sup>th</sup> September he reached the Adrasan Peninsula. He immediately continued south initiating sea crossing but after 13 km he returned back to the coast. On the same day he moved some 20 km to the north but in the evening returned to roost on the cliffs near the southern most point of the peninsula. On the 19<sup>th</sup> September at 08:30 Belgin entered into the sea and since then we lost signal with the transmitter. We consider that the wild sibling has drowned into the sea on that day. During his unfortunately unsuccessful migration Belgin flew over 940 km for 6 days with average speed ca. 157 km per day.



**Map 9.** Migration route of Belgin

## C. Hacking

### Assumptions, hypotheses and criteria for successful experiment

Hacking has been successfully applied for releases of captive-bred Egyptian Vultures in Italy (Ceccolini & Cenerini 2005) and Israel (Ohad Hatzofe pers. comm.). This method foresees releases of captive-bred Egyptian Vultures at age of fledging from hack, which is specially designed and installed on natural breeding substrate. The hack can be a big cage mounted on cliffs or natural cliff niche which is netted preventing early fledging of the vultures. The juveniles spend a few weeks in the hack adapting to the local conditions. When they reach the age of fledging the entrance of the hack is opened so that vultures can fledge naturally.

**The hacking method will be considered successful if all below listed assumptions are fulfilled:**

- At least 80% of the released individuals adapt successfully to the wild and survive the first month after fledging (i.e. after leaving the nest).

- At least 30% of the released individuals survive the first south migration.

**NB 1:** The percentage of the released individuals which migrate over the land, following the main migratory way of the species and avoiding long distance sea crossings between Europe and Africa, will be taken into account when comparing the results and efficiency between the tested release techniques.

**NB 2:** At this initial stage of the experiment, we would not consider that it failed if released birds become victims of human-induced factors along the flyway or in the wintering grounds. Human induced mortality will be accounted in the final analysis of this study.

### Origin of the released Egyptian Vultures

All captive-bred Egyptian Vultures were provided from the EEP (Endangered Species Programme, under EAZA). The female chick named Anna was raised in Prague Zoo and the male named Zikmund was raised in the Zoo of Zlin.

### Management in captivity

Anna was raised by its parents in Prague Zoo. The male Zikmund was raised by different foster pairs in the Zoo of Zlin and for two weeks period was hand fed by a zookeeper.

### Release site

The selection of a suitable release site might be crucial for the overall success of this release technique. As a release site was chosen a cliff niche historically used as a nest by an Egyptian Vulture pair. The hack was located near the town of Madzharovo approximately 800m from a vulture feeding station. The release site was considered suitable as it meets the following conditions:

**Safety of the area.** The hack was located near the border of a protected area in a vulture safe area where no serious threats for vultures exist. It was located in the core area of the Egyptian Vulture breeding population on the Balkans. The area holds increasing and healthy population of Griffon Vultures. In the vicinity of the release site (5km radius) there are no poisoning or poaching events for at least 5 years, there are no windmills and the majority of the powerlines are safe or have been insulated and thus don't pose a risk for the vultures.

**Food availability.** The release site was located near a vulture feeding station. Supplementary food was regularly provided at the vulture feeding station since the vultures were inserted in the hack. The provision of food continued until the start of the fall migration.

**Conspecifics presence.** The release site was in area with regular presence of two Egyptian Vulture pairs. The hack was located about 1.2km away from an active nest of a wild Egyptian Vulture pair. This pair was not breeding this year.

**Other species' presence.** The release site was located outside the breeding territories of other territorial raptors in order to avoid aggressive interactions with the captive-bred Egyptian Vultures. Such species are Golden eagle (*Aquila chrysaetos*), Eagle owl (*Bubo bubo*), Long-legged Buzzard (*Buteo rufinus*). There was one pair of Ravens breeding 1.5km from the hack. In addition, the feeding station was regularly visited by only low numbers of Corvids, e.g. up to 3 Ravens (*Corvus corax*) and 3-4 Crows (*Corvus cornix*).

**Roosting substrate:** The hack was built on a cliff which is part of a big cliff complex with high inaccessible cliffs which to be used as a safe roosting sites by the released birds. All pylons and powerlines in the vicinity of the release site were of safe types or were insulated. Egyptian Vultures can use pylons for roosting and the presence of dangerous types of pylons near the hacking site might be a serious threat for the birds.

### Hack specifications

**Location.** The hack was built in a natural cliff niche which has been used by an Egyptian Vulture pair for over 20 years but was abandoned 5 years ago. The cliff is situated near the border of protected area on the south shore of Arda river. The distance between the feeding station and the hack was about 800 m.

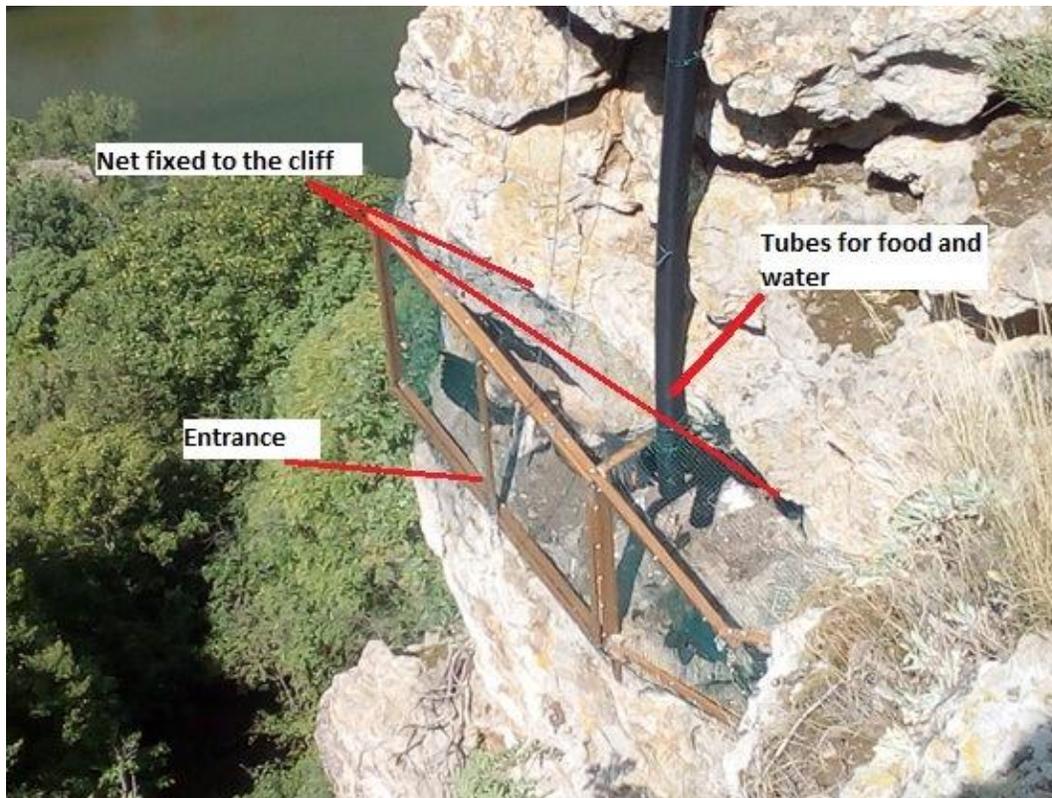
**Exposition.** The hack was facing southwest and receives direct sunlight from the afternoon until the evening.

**Size and structure of the hack.** The niche was long about 4 m, deep about 1.3 m and 1 m high. The front of the niche was covered with wire mesh with 25x25 mm openings. The wire mesh was extended to cover part of the cliff closing all openings in order to prevent predators from entering. The door dimensions were 2x1.5 m. During the adaptation period the door was kept closed by two metal nails mounted on both sides of the door. The nails were hanging on metal strings leading to the top of the cliff. This allows to open the door without descending to the hack but just by pulling up the nails out of their holes which releases it. The door was tied with separate

long metal string which allows to pull the door up when releasing the birds. By tying this rope on the top of the cliff the door would remain open so that the vultures can return to the hack after fledging

**Food and water delivery port.** The food and water were provided through tubes from the top of the cliff. The tube for the food was with 25 cm diameter, while the water tube was about 4 cm.

**Video surveillance.** Video camera with wide-angle lens was installed in the corner of the hack. It allowed to closely monitor the behavior of the vultures during the adaptation period. The camera had good visibility towards the place where the food is delivered in order to closely monitor the food intakes by the different individuals in the hack.



**Fig. 2.** Hack for release of Egyptian Vultures

### Adaptation period

Insertion in the adaptation aviary. Anna and Zikmund were inserted in the hack on 10th August at age respectively 63 and 71 days old. The adaptation period lasted 10 days.

**Feeding.** Everyday care and observations from a distance were conducted during the adaptation period. The vultures were fed 5 days a week with about 200-300 g per day per individual. Food items with high nutritious value were provided to the vultures during the adaptation period. This includes 1-2 days old chickens, rats, rabbits, red calf meet etc.

**Monitoring.** The behavior and the interactions between the vultures in the aviary were permanently monitored and recorded. Direct observations were made from a distant observation point (about 600m) in order to avoid any disturbance. Observations and recordings with a camera mounted in the hack were made as well. An experienced observer was recording how often and which individual is feeding, which food items are consumed, any aggressive behavior between the birds or social exclusions.

**Tagging.** All Egyptian Vultures were tagged with GSM/GPS transmitters prior to insertion in the hack. During the tagging the birds were thoroughly examined by vets and treated against ecto- and endoparasites because this was their last handling prior to release. The transmitters will allow to closely follow the behavior of the birds after the release and their survival which aims to successfully evaluate the success of this release technique. We used 30g solar powered Ornitela GSM/GPS transmitters. The tags were set to provide high frequency of GPS points (GPS locations every 5 min) and high frequency of data deliveries (30min). This would allow the field team to immediately react if the birds experience some problems after the release. The transmitters were mounted as backpacks with Teflon harness.

### Release technique

**Feedings prior to release.** Food and water were regularly provided. About 300 kg of offal was provided and was scattered on the feeding station on the day of the release. Food was delivered on few suitable spots visible from the hack and on the top of the cliff as well in case the vultures return to feed there after the release.

**Release.** The entrance of the hack was open in the early afternoon on 20th August. The field team opened the hack and left the place as fast as possible with little disturbance to the birds. All further observations were held from a distance of about 600 m in order to avoid disturbance. The vultures should leave the aviary whenever they are ready. It may take a few days before they fledge from the hack. Zikmund (aged 83 days) left the hack first on 22nd August. Anna (aged 74 days) fledged second on 24th August.

### Post-release monitoring

**Monitoring.** After the release the captive-bred Egyptian Vultures were closely monitored by experienced field team. The most critical period was expected to be the first night when the birds might not roost on a high safe place. After the fledging we worked in close collaboration and exchanged information with other NGOs which maintain vulture feeding station in Bulgaria and in the Greek part of the Eastern Rhodopes in order to ensure that if the released vultures move to neighboring areas, they would find safe food in good quantity.

**Feeding.** Supplementary food was permanently present at the feeding station after the release. Food was delivered in the hack as well and on the top of the cliff. In addition, pieces of meat and rabbits were delivered to other suitable visible places between the hack and the feeding station. On 03th September 400kg cow was provided on the other side of the river well visible from the hack and the cliff used by the vultures for roosting.

### Post-fledging behaviour

After fledging from the hack Zikmund landed on the ground about 80m away. He spent two days on the ground without making attempts to return back to the hack. The field team captured the bird on 24th August and returned it back to the hack. Meanwhile on the same day Anna fledged. Since the first evening she was roosting on a safe rock. On 25th Zikmund left the hack again and started roosting on safe cliffs as well. During the post-fledging period Anna and Zikmund did not visit the feeding station. They were feeding only on the food provided near the hack. In three cases Zikmund returned back to the hack to feed overnight there. Anna never visited the hack again. Both birds started roosting together and flying short distances landing on different cliffs near the hacking site. They were also landing on the river bank and drinking water. In one occasion Zikmund fell in the river and was spotted by tourists struggling in the water but eventually he reached the bank. In terms of post-fledging movements Anna and Zikmund were not flying further than 1.7 km from the hacking site. On 08th September Zikmund landed in the town of Madzharovo and was found perching on a house roof. He allowed to be approached by people and was captured by the field team. After physical examination it was concluded that the bird is in good health and was released near the hack.

## Migration and wintering

### Anna

**Migration.** Anna started her migration on 06<sup>th</sup> September (aged 87 days) only two weeks after fledging. She moved in southeastern direction and reached Marmara seacoast near Tekirdag in the late afternoon. Anna started crossing the sea but remained for roosting on the island of Marmara. On the next morning she crossed and continued in southwestern direction. Only 3 days after the start of migration on 09<sup>th</sup> September she reached the coast south of Marmaris and started following the coastline. On the next day she was already on the Adrasan Peninsula and undertook a sea crossing. However, after 17 km she returned back on the land and soon after made a second attempt. This time Anna flew 23 km south into the sea but again decided to return back and started flying over the sea but along the coast towards the Gulf of Antalya. In the late afternoon she reached the shore near Antalya after a flight of 113 km over the sea. Since then Anna continued flying east following the coast. On 13<sup>th</sup> September she stopped in the area of Mersin. On the next day Anna explored the lower parts of the mountains northeast of Mersin and settled for roosting on a tree located on a steep slope near the village Sanlica. In the next 3 days Anna was forced to remain still due to harsh weather conditions. However, even after that Anna remained stationary only moving between neighboring trees. On 21<sup>st</sup> September a team of BSPB and Doga Dernegi/BirdLife Turket visited the place to inspect her condition. Anna was found exhausted and very weak in a cliff niche on the ground filled with water. It seems that she was starving for long and was visiting the water place to keep herself hydrated. Her weight was only 1440 g or 500 g under the normal weight. She was transported to Ceyhan and was treated with vitamins and food with very high nutritious value. On 24<sup>th</sup> she was transported to Faruk Yalcin Zoo in Istanbul.

As a summary for the 9 days spent on migration Anna passed 1730 km or on average 192 km per day. Close inspection of the data shows that she might have fed only once during that period. This probably led to the complete exhaustion in combination with the bad weather streak at the end of her travel.



**Map 10.** Migration route of Anna

## Zikmund

**Migration.** Zikmund started his migration on 10<sup>th</sup> September (aged 102 days) 19 days after fledging. He moved in southwestern direction and entered into Greece reaching the village of Mesti. In the evening he was roosting on a street lamp over a road with intensive traffic. The bird was observed by a field team of WWF-Greece. On the next day Zikmund continued east along the coast and stopped in the eastern suburbs of Alexandroupolis. He demonstrated unusual behavior by landing in house yards and perching on the roof of the houses. He allowed to be approached by people within 3-4 m distance. Due to his abnormal behavior it was decided to be trapped and examined. A team of WWF-Greece visited the house where Zikmund was roosting. He was attracted with meat and glossy plastic wrappings and allowed to be captured. The vulture was transferred to Wildlife Rescue and Rehabilitation Center of Green Balkans in Bulgaria. Zikmund was in good health condition but was imprinted to humans probably because he was fed by hand for about two weeks in the Zoo of Zlin where he has hatched. Due to the fact that he was imprinted and consequently unable to adapt into the wild Zikmund won't be included in the sample size when analyzing the effectiveness and success of the hacking method.



Map 11. Movements of Zikmund

## Acknowledgements

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