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Research Article

Status and Threats for the Egyptian Vulture *Neophron percnopterus* (Linnaeus, 1758) in Albania

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Abstract: Albania marks the westernmost edge of the Egyptian vulture range in the Balkans. As one of the least numerous population clusters, it is also more susceptible to extinction than the other Balkan countries. The population size was estimated at 27 breeding territories in the 1980s. Further, the population size and range have declined severely in the last four decades. We found that the number of occupied Egyptian vulture territories in Albania has decreased by 33% between 2007 and 2022. Nevertheless, breeding success was high, and the productivity was 0.79 fledglings per occupied territory. Totally, 190 semi-structured interviews were accomplished to assess the risk of poisoning for the species in Albania. The brown bear (*Ursus arctos*), grey wolf (*Canis lupus*) and red fox (*Vulpes vulpes*) were identified as the main predators responsible for livestock damages with the grey wolf being the most frequently reported. Intentional poisoning was admitted as a practice to control wild carnivores by 9.2% of the respondents. No Egyptian vultures were found during the electrocution survey and the species was reported only once to have been intentionally killed. We suggest continuation of the monitoring of all occupied territories, increased research on potential threats and the development and endorsement of a national species action plan.

Key words: Balkans, scavenger, population, trend, limiting factors

Introduction

The Egyptian vulture *Neophron percnopterus* (L., 1958) is the smallest, the only migratory and the most threatened vulture species in Europe. Its breeding range covers the southern Palearctic and North Africa, while wintering grounds are located mainly in the Sahel zone (Botha et al. 2017). Because of the rapid population decline in many parts of its range, the species is listed as globally Endangered by the International Union for Conservation of Nature (IUCN), with a global population estimated at 21,000–67,000 individuals (BirdLife International 2021). The European population is estimated to

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number 3,300–5,050 breeding pairs and has declined by >50% over the last three generations (BirdLife International 2021). Most of it is concentrated in the south-western part of the continent: Spain, Portugal and France (36%), Turkey (53%), while the populations in the Caucasus (6%), Balkans (2%) and Italy (0.2%) are comparatively small (Iñigo et al. 2008).

The Balkan population of the species is of critical conservation concern as it forms a natural bridge between the European and the Asian populations. More than 50 years ago, the Egyptian vulture used to be common across the Balkans (Reiser 1894, 1905, 1939, Reiser & Führer 1896, Patev 1950, Grubač 1989, Handrinos & Akriotis 1997). However, in the last 30 years, the species has become extinct in Croatia (Sušić 1993), Montenegro (Ljucović 1995), Bosnia and Herzegovina (Marinković et al. 2007), Serbia (Grubač 1999) and Romania (Velevski et al. 2015). In Bulgaria, Greece and North Macedonia, the species declined by more than 80% between the 1980s and 2014 (Velevski et al. 2015). The main drivers for the population decline on the breeding grounds in Europe (Botha et al. 2017) as well as in the Balkans are related to poisoning, electrocution, disturbance and direct persecution (Nikolov et al. 2016). Currently, in the Balkans, the Egyptian vulture inhabits only five countries: Bulgaria, Greece, North Macedonia, Albania and Turkey (Velevski et al. 2015). In the last ten years, consistent monitoring of the Egyptian vulture population and threats has been implemented in Bulgaria, North Macedonia and Greece. These countries harbour ca. 80% of the Balkan population (Velevski et al. 2015). Albania marks the current westernmost edge of the species range in the Balkans and is, therefore, the most susceptible cluster to extinction compared to the rest of the Balkan countries (Velevski et al. 2015). Inexperienced juveniles are more likely to embark on a dangerous sea crossing on their first autumn migration (Oppel et al. 2015). Totally, 27 breeding territories have been described in previous studies on the species in Albania in the past (Hallmann 2013). Understanding the population numbers, breeding rates and the scale of the major threats are essential to address future actions and building up a proper conservation strategy for the species in this country.

The present study aims (1) to present the changes in the distribution and population size of the Egyptian vulture in Albania over the last 15 years, (2) to present the basic breeding parameters of the species and (3) to summarize the major threats.

Materials and Methods

Study area

The study area covered most of Albania. Nevertheless, from 2012 to 2022, the work was focused on the area where the occupied territories are situated (around 5,300 km^2) in southern Albania (Fig.1). Mountain ranges (mainly limestone and dolomite) with deep valleys (Kabo et al. 1991) characterise the study area. The climate is typical Mediterranean, with average annual temperatures ranging between 11.4º C and 17.6º C and average annual rainfall from 1,163 to 1,279 mm (Kabo et al. 1990). The vegetation is dominated by forested landscapes of evergreen Mediterranean species (Rivers et al. 2019).

Monitoring data collection

Data presented in this article have been collected in three different periods from 2003 to 2022. During the first period, from 2003 to 2007, searches for the presence of the Egyptian vulture were carried out in the whole territory of Albania. In this period, the presence of the species in the country has been mapped, and the population has been estimated (Hallman 2007). In the second period, from 2012 to 2017, territories identified in the first timeframe (2003 to 2007) were surveyed for the presence of Egyptian vulture and data on some breeding parameters were collected. Finally, during the third period, from 2018 to 2022, systematic work was carried out to survey the occupancy of the territories and the breeding parameters. In this regard, a territory was considered occupied by a pair when courtship behaviour, displays or nest building were observed (Steenhof & Newton 2007) and occupied by a single bird if one displaying bird was recorded near a nest or a breeding territory.

Several visits were conducted to quantify the breeding output during the breeding season between 2018 and 2022 in each territory. We followed, where possible, well-established monitoring techniques to do so (Arkumarev et al. 2018). Thus, the first visit took place in late March or early April to determine which territories are occupied by pairs or single birds; the second visit was conducted in May to confirm in which territories incubation had started; the third visit was conducted in June and July to inspect the number of hatchlings; and the last visit was in August to confirm the number of fledglings (Arkumarev et al. 2018). If needed, additional visits to some territories were done to confirm their occupancy. In some cases, the breeding output was difficult to access as the species breeds in deep caves in cliffs, sometimes in remote areas. In these cases,

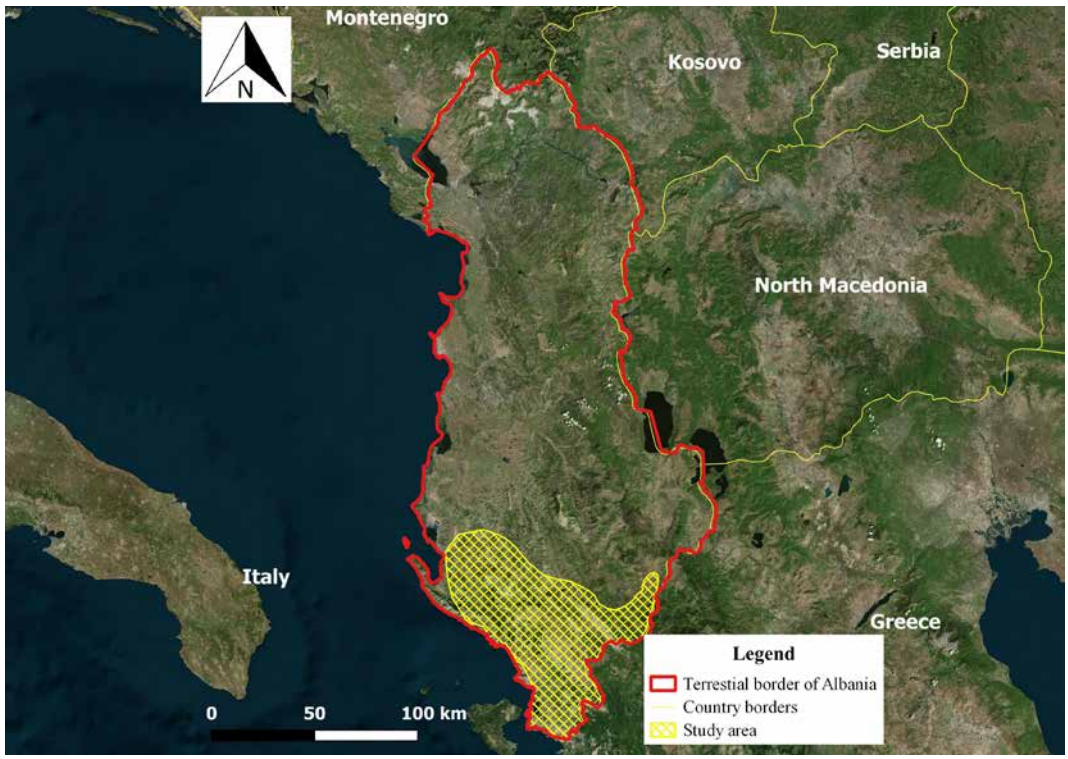

Fig. 1. Map ot the study area

a drone was used. All observations were conducted from stationary viewpoints following the recommendations of Zuberogoitia et al. (2008) to avoid disturbance.

We calculated the following breeding parameters: (a) proportion of laying pairs (the number of laying pairs divided by the number of occupied territories); (b) proportion of successful pairs (the number of successful pairs divided by the number of laying pairs); (c) productivity (the number of fledglings divided by the number of occupied territories) and (d) breeding success (the number of fledglings divided by the number of incubating pairs) (Donazar et al. 2002, Steenhof & Newton 2007). A pair was considered successful when it had raised at least one fledgling until the age of the first flight or the nestling reached 80% of the average age of the first flight (Steenhof & Newton 2007), which is estimated as 75 days (Donázar & Ceballos 1990). Linear regression analyses with normal error distribution based on the number of occupied territories were used to calculate the population trend. Results are presented as mean ± standard error (SE). All analyses were performed in Statistica 10 (StatSoft 2011).

Assessment of the threats

To assess the prevalence of different threats to the species in Albania, we undertook both field research and interviews with specific target groups. To collect information on the use of agrochemicals and their impact on the Egyptian vulture and other wildlife, as well as their potential use in poisonous baits, we collected information from 37 structured questionnaires with farmers only in the study area in 2018. In addition, desk research on the presence of harmful agrochemicals was conducted. Furthermore, to register the most commonly used Veterinary Medical Products and the impact they could have on the population of the Egyptian vulture, a total number of 48 structured questionnaires with livestock breeders were filled out within and around the species' territories in 2018. In addition, interviews with veterinary pharmacists and a desk research were carried out to gather more information on the availability of harmful veterinary medical products. Finally, to investigate the use of poison baits and the scale of this practice in Albania as the single most severe threat to the scavengers in general (Ogada et al. 2016), 190 semi-structured interviews were carried out. This study was done in two phases. In the winter season of 2016-2017, 51 semi-structured interviews were carried out selecting as respondents only shepherds. During September – November 2019, 139 more interviews were carried out, including apart from shepherds, also livestock breeders, farmers and local inhabitants.

Regarding the illegal killing of the Egyptian vulture, questions have been posed in the interviews for poisoning. We assumed an illegal killing of an

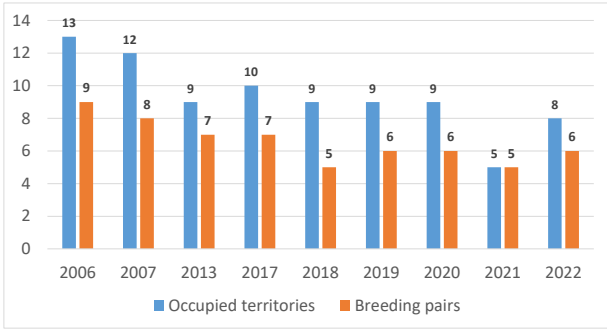

Fig. 2. Number of Egyptian vulture territories in Albania (2007–2022)

Table 1. Breeding parameters of the Egyptian vulture in Albania

Breeding parameters	2019	2020	2021	2022	Average
Laying pairs (%)	83.3	83.3	80.0	67.0	78.4
Successful pairs (%)	100.0	80.0	50.0	75.0	76.3
Productivity	1.00	0.67	0.8	0.67	0.79±0.07
Breeding success	1.20	0.80	1.0	1.0	1.00±0.08

Egyptian vulture was any deliberate action that targeted the species and resulted in the death or removal of an individual from the wild (Brochet et al. 2016).

We also studied the electrocution and collision risk to the species along 121 km of power lines of low and medium voltage in four Egyptian vulture territories in 2018 and 2020 (Fig. 4). To map the potentially hazardous electricity pylons and collect data on bird mortality, the field researchers walked under the power lines. They recorded the type of each pylon, the species found under pylons or power lines (carcasses and feathers) in a standard protocol (Demerdzhiev 2014). Photos of all types of pylons and dead birds found were also taken.

Results

Population numbers and breeding parameters

The number of occupied Egyptian vulture territories in Albania decreased by 33% (from 12 to 8) between 2007 and 2022. However, most of this decrease should have happened before 2012, as both, the number of occupied territories (mean = 8, range: 5-9) and the number of territorial pairs remained stable afterwards (mean = 6, range: 5–7) (Fig. 2).

Between 2019 and 2022, the proportion of laying and successful pairs was 78% and >76%, respectively (Table 1). The productivity was 0.79 ± 0.07 fledglings per occupied territory, and the breeding success was 1.00 ± 0.08 fledglings per incubating pair (Table 1).

The 190 semi-structured interviews were carried out with respondents with an average age of 48.5 (ranging from 20 to 82) years old from 87 villages situated within the study areas (Fig. 3).

Most respondents (80%) were shepherds and livestock breeders; the rest were farmers and local inhabitants. The presence of wild carnivores as a possible threat to livestock was mentioned by 94% of the respondents, while 73% suffered damages. The Brown bear (*Ursus arctos*), the Grey wolf (*Canis lupus*) and the Red fox (*Vulpes vulpes*) were identified as the main predators responsible for livestock damages, with the grey wolf being the most frequently reported. Intentional poisoning was admitted as a practice to control wild carnivores by 9.2% of the respondents. Furthermore, 23% of all respondents mentioned of being aware that intentional poisoning occurs in the area, but they do not practice this.

Most respondents (82.5%) left carcasses of predated livestock on-site without applying any action. In this case, the carcass would be consumed by wildlife or decomposed. The rest of the respondents said that they would get the left of the carcass to feed the dogs.

In addition, results from 37 structured questionnaires with farmers investigating the prevalence of agrochemicals used for crop protection in the area indicated no threat to the Egyptian vulture. On the other hand, using veterinary medical products could pose a potential threat as substances such as Ketoprofen and Diclofenac (which cause kidney failure and death in vultures (Cuthbert et al. 2006) were found to be available in the veterinary pharmacies visited. Nevertheless, the use of these substances was not found in the livestock treatment programs of the 48 livestock breeders interviewed.

From the 121 km of power line survey, we found six bird victims of electrocution and collision – two Lesser kestrels (*Falco naumanni*), two Common kestrels (*Falco tinnunculus*), one Common buzzard (*Buteo buteo*) and one Hooded crow (*Corvus cornix*) – thus, resulting in a mortality rate of 0.05 bird victims/km of a power line. We did not find any carcasses of Egyptian vultures during the power line surveys (Fig. 4).

Regarding the illegal killing of the Egyptian vulture, during the fieldwork from 2012 to 2022, we never heard about a case of killing the species. However, in 2007, a shepherd shared with the inquirer that before the years 2000 has killed a territorial pair.

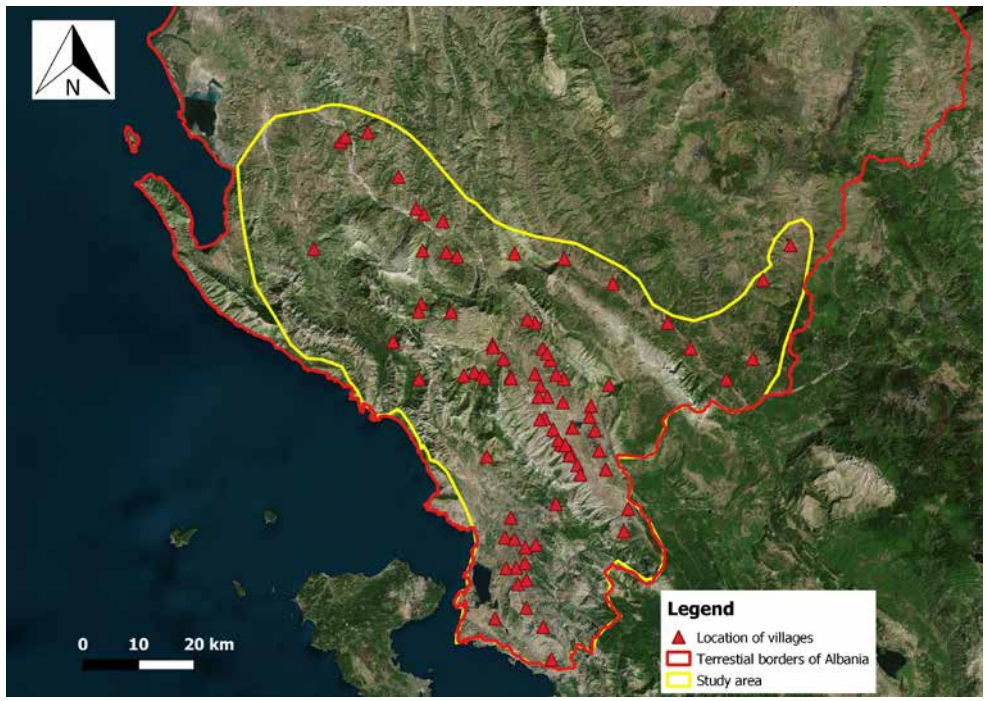

Fig. 3. Study area and villages where semi-structured interviews were completed

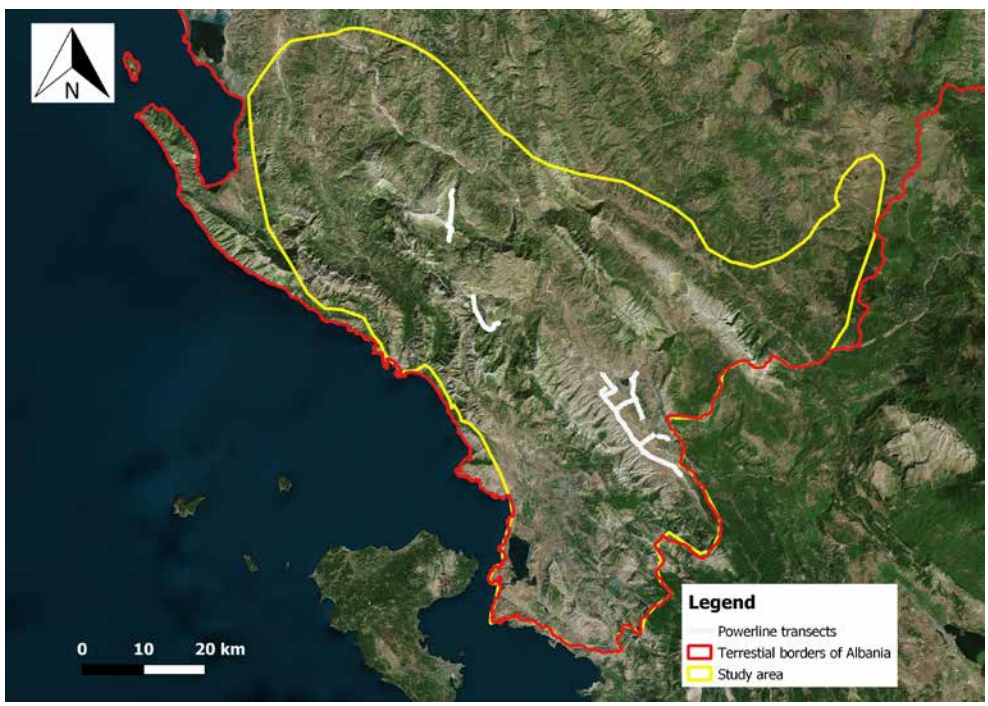

Fig. 4. Power line surveys

Discussion

The Egyptian Vulture population in Albania has decreased significantly in the last 16 years. This trend is in line with the observed decline in the rest of the species population range in Europe and the Balkans (Velevski et al. 2015, BirdLife International 2022). For example, the population in Bulgaria decreased by 51.7% between 2003 and 2016 (Arkumarev et al. 2018). The annual population growth rate was negative for North Macedonia and Greece between the 1980s and 2012 (Velevski et al. 2015). Despite the decline, the breeding performance of the population in Albania is comparable with the rest of the Balkan countries, with a mean productivity of 0.79 (Grubač et al. 2014, Arkumarev et al. 2018)

and thus higher than some regions in Spain (Del Moral 2009). The main drivers of this decline are most likely the illegal use of poison baits in the wild and the risk of electrocution and collision, causing adult and juvenile mortality (Oppel et al. 2021a). In addition, another cause could be the loss of adults along migration or while foraging in neighbouring countries. For instance, one adult breeding in Albania close to the Greek border was found poisoned in Greece. Fortunately, it was rehabilitated and released again. Such high mortality cannot be compensated by the current breeding success, despite being in a good rate, and improvement of the annual survival probability is needed (Oppel 2021b). Furthermore, Albania holds a small and the westernmost breeding nucleus of the species in the Balkans that, apart from the high mortality, also lacks sufficient immigration rates due to its isolation (Velevski et al. 2015). Thus, natural recovery is unlikely to occur without undertaking measures to halt the decline and to release birds in both Albania and the rest of the remaining population clusters in the Balkans in the long term. In any case, a detailed monitoring effort is further needed to collect long-term and more structured data on the breeding rates and survival of the Egyptian vulture in Albania.

In our study, we found that 1/10 of the livestock owners admit to using poison currently and only few admitted to having used poison in the past. However, the experience from other neighbouring countries, where poisoning is severe, shows dramatic losses in the Egyptian vulture population in a short time due to poisoning (Veleski et al. 2015, Ntemiri et al. 2018). Moreover, the threat of carnivores to livestock was highlighted in >65% of interviews in Albania in a recent study that indirectly leads to a high risk of poisoning (Oppel et al. 2021a). Nevertheless, we did not find evidence of the poisoning of Egyptian vultures in the current study. This might be related to the sensitivity of the information, the lack of detailed research, the short period of data collection and the lack of an institutional system for tracking and treating poisoning events in Albania (Pantović & Andevski 2018). We further revealed that substances used as a poison in Albania are agrochemicals, similar to neighbouring countries in the Balkans (Pantović & Andevski 2018; Ntemiri et al 2018). Although poisoning is usually based on similar root causes and practices as elsewhere in the Balkans (Ntemiri et al 2018, Dobrev et al. 2021), it occurs mainly during winter in Albania, when attacks from wolves are more frequent and severe. The few poisoning evidences that were collected in Albania during this research have occurred in winter. In addition, information received from shepherds confirm that the wolf attacks are, apparently, more frequent in the winter period. This might be related to the fact that more livestock is concentrated in the territories of the Egyptian Vulture in the winter period. The study area is situated in a rather low altitude o.s.l and below the snowfall line. Hence, shepherds from mountainous areas migrate their livestock in the study area in the winter. For example, two poisoning events have been documented in two territories of the Egyptian vulture in Albania, with several birds of prey poisoned: Golden eagle (*Aquila chrysaetos*), Common buzzard (*Buteo buteo*), Rough-legged buzzard (*Buteo lagopus*). Because these events occurred in winter, they did not affect any Egyptian vultures. In conclusion, it is recommended that the government of Albania addresses the problem of wildlife poisoning and increases conservation efforts in this direction (Oppel et al. 2021a). An important step to reduce poisoning is the current development of the National anti-poison road map in Albania.

Surveys conducted in 2019 and 2020 to study the hazardous power lines did not find evidence of collision or electrocution of Egyptian vultures despite the presence of victims belonging to other birds of prey. The lack of cases also coincides with the lack of observations of Egyptian vultures perching on electric poles. The absence of electrocution cases might be explained by the fact that the existing electric poles are of limited height and close to road infrastructure. As such, they are not very attractive to Egyptian vultures, as they might prefer higher natural perching sites such as rock outcrops or taller trees, which are widely available in the landscape. Angelov et al. (2013) report that perching on power poles along main roads is typical behaviour for scavengers in desert landscapes. However, the few Egyptian vultures in Albania and the lack of congregations of the species make it unlikely that perching sites are limited. Both facts reduce the chances of the appearing and especially finding the carcasses of dead individuals due to electrocution. Despite this, the threat of electrocution and collision has been ranked high for Albania and thus, considering the small population size, adaptive measures are recommended where applicable (Oppel et al. 2021a).

Albania has been ranked among the 10 Mediterranean countries worst affected by the illegal killing of birds (IKB), with around 270,000 birds illegally killed every year during 2004 – 2014 (Brochet et al. 2016). The most problematic areas were located in the coastal part of Albania, while the species suffering the most from IKB were the Eurasian Sky-

lark (*Alauda arvensis*), Eurasian goldfinch (*Carduelis carduelis*), Eurasian blackbird (*Turdus merula*), Common teal (*Anas crecca*) and Common coot (*Fulica atra*). The assessment of the impact of the illegal killing of vultures in Albania in 2010 – 2018, based on expert opinion and data collected through relevant stakeholders and social media groups, showed that approximately 1 – 3 vultures are killed annually (Bino & Sevo 2019). Nevertheless, the authors considered that the Griffon vulture (*Gyps fulvus*) had been the main subject of poaching, as cases of shooting and trapping are documented in at least three different areas. The report estimated that 0–1 Egyptian vulture might perish from illegal killing but could not validate whether the cause of death was persecution or poisoning. Therefore, we can conclude that there is currently no direct-targeted persecution of Egyptian vultures in Albania. From the interviews with locals, only a single case of direct persecution has been mentioned in years 2000. Furthermore, hunting activity is not considered a potential cause of concern because the hunting targets only game species and occurs in late October – February. In this period, the Egyptian vulture is not present in Albania.

In conclusion, we suggest that more effort is invested in recording the species population size and its dynamics to better inform conservation measures. The primary conservation actions should first focus on combating the use of poison and mitigating the threat of electrocution and collision. In addition, the Egyptian vulture strategy for population reinforcement in the Balkans (Oppel et al. 2021b) will benefit Albania's population cluster, which could ultimately attract birds released in the restocking program. Hence, further actions upon rescuing wild birds in Albania through breeding territories monitoring and intensive work with local stakeholders and authorities are strongly recommended, along with preparing National Action Plan for the species.

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