Congregations and threats of migratory Egyptian Vultures *Neophron percnopterus* along the southwest coast of Saudi Arabia

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Summary: The Balkan population of the globally endangered Egyptian Vulture *Neophron percnopterus* has declined by 80% over the last 30 years, and is the subject of conservation management along the flyway, with an emphasis on migration bottlenecks and wintering congregations. The western coast of Saudi Arabia is one of these important sites, but there is little information on threats to the species in this region. We show that the area of the Wadi Qanuna along the southwest coast of Saudi Arabia supports an important wintering congregation (*c*200 birds) with good habitat and food availability. Birds roosted on high-voltage powerlines that have a safe pylon design. Significant threats to the Egyptian Vultures and other scavenging birds in the area appear to be the common practice of using poison baits to control stray dogs and other terrestrial predators and the wide use of diclofenac in veterinary practice. The presence of medium voltage powerlines with a hazardous pylon design should be considered a potential electrocution mortality risk for birds. We also identified collision with cars as another threat. To mitigate the potential mortality of Egyptian Vultures and other birds in the area, we suggest law enforcement and awareness raising to limit the use of poison baits, the banning and substitution of harmful veterinary products to eliminate the risk of secondary poisoning of vultures, and the replacement of the hazardous electricity transmission infrastructure with alternative infrastructure with a bird-safe design.

INTRODUCTION

The Egyptian Vulture *Neophron percnopterus* is sharply declining throughout its range and is currently classified as globally Endangered (BirdLife International 2020). In the last 20-50 years, the population has dropped by 90% in India and by 50% in Europe, and the populations in Africa, Central Asia and the Middle East also appear to have declined significantly (Ogada *et al* 2015, Symes *et al* 2015, Botha *et al* 2017).

The Balkan (south-eastern European) population is of special conservation concern having declined by 80% over the last 30 years (Velevski *et al* 2015), and currently numbers are estimated at about 50 pairs (LIFE16 NAT/BG/000874, unpubl. data). The Balkan population is migratory with mortality factors identified on the breeding grounds (Bounas *et al* 2016, Kret *et al* 2016, Saravia *et al* 2016) and along the flyway (Oppel *et al* 2015, Nikolov *et al* 2016, Kret *et al* 2018). In terms of migration routes and wintering areas, the Balkan population partly overlaps with other Egyptian Vulture populations from the Middle East, Caucasus and Anatolia (Arkumarev *et al* 2014, Buechley *et al* 2018) and sometimes from Central European populations (Botha *et al* 2017, Phipps *et al* 2019), as well as with many other migratory soaring birds (Oppel *et al* 2014). The migration bottlenecks and wintering congregations are therefore of high conservation concern. The southwest coastal region of Saudi Arabia has been identified among these very important sites (Buechley *et al* 2018), but there is little information on threats to Egyptian Vultures in this region.

Before the 1960s, Egyptian Vulture was the most common vulture in Saudi Arabia (Jennings 1995). It was observed all year round (Shobrak 1999), inhabiting not only the mainland but also the Farasan Islands (Jennings 2010, Islam & Ismail 2014). Congregations of up to 200 individuals have been reported from the southwestern part of the country (Rahmani *et al* 1994). However, in the last two decades the species has become scarce or absent from most known sites on the mainland of Saudi Arabia and the breeding population was estimated to have declined to one tenth of what it was 50 years ago (Shobrak 2003,

Jennings 2010). Therefore, the breeding population of the species is considered regionally (Arabian Peninsula) as Vulnerable (Symes *et al* 2015). However, a recent study from Oman revealed that the population is many times higher than previously estimated, indicating that more in-depth studies on the Egyptian Vulture's status in the Arabian Peninsula are needed (Angelov *et al* 2020). None of the 20 Egyptian Vultures tagged in Oman since 2015 has yet visited Saudi Arabia (M McGrady in litt).

Although some of the causes of the decline in Lapped-faced Vultures *Torgos tracheliotus*, such as food supply, competition and disturbance, have been studied (Shobrak 1996, 2000), most existing data on the threats to vultures in Saudi Arabia are anecdotal (Shobrak 2003). There is some evidence of a negative impact of poisoning, pesticides and road accidents on vulture populations (Shobrak 1996, 1999, Ostrowski & Shobrak 2001), and known mortality of other migratory birds due to electrocution and collision with powerlines in the region (Shobrak 2012). However, to date there is no systematic evaluation of the relative magnitude of these threats to allow informed efficient management.

Since 2012, there have been ongoing satellite telemetry studies of the Balkan Egyptian Vulture population, with both wild (Oppel *et al* 2015; n = 26 birds) and released, captive-bred birds (Arkumarev *et al* 2019; n = 17) being tagged. In 2016, a tagged juvenile wild bird died along its first autumn migration in the region of Jebel Shar in northwestern Saudi Arabia. Although rangers from the Saudi Wildlife Authority (SWA) visited the site, the carcass was never found and thus the cause of death was not identified. In October 2019, a captive-bred bird released in Bulgaria settled to winter along the southwest coast of Saudi Arabia. It is known that outside the breeding season Egyptian Vultures generally form congregations around roosting or feeding sites (Arkumarev *et al* 2014, Buechley *et al* 2018). Thus, using these telemetry data we initiated an immediate field survey with the following objectives: (1) to investigate and count the number of wintering Egyptian Vultures; (2) to identify possible congregation sites for the species; and (3) to identify potential threats, particularly the use of poison baits, the veterinary use of Non-Steroidal Anti-Inflammatory Drugs (NSAIDs) such as diclofenac, and electrocution mortality at hazardous powerlines. Here we describe general information about the ecology of wintering Egyptian Vultures and the relative importance of these threats to large birds in this area.

METHODS

Survey area

Our survey was focused on two areas: (1) the Wadi Qanuna east of Al Qunfudhah, Makkah Province (Fig. 1), based on satellite tracking (Fig. 2) of a satellite tagged Egyptian Vulture released in Bulgaria in 2019 and (2) Wadi Ramlan in the area of Baish, Jizan Province, based on data about a congregation of about 200 birds present some 30 years ago (Rahmani *et al* 1994). Moreover, the survey covered part of the Al-Habrow al-Arabi Important Bird Area.

Data collection

Field data were collected between 10 and 15 November 2019. Roosting Egyptian Vultures and other birds of prey were censused along high-voltage (transmission) powerlines after 16:00 hrs local time (Arkumarev *et al* 2014). The counts were made simultaneously by two teams from vantage points located at heights with good visibility of the congregations of roosting birds. Each team was equipped with a telescope (x60) and binoculars (x10). As far as possible, Egyptian Vultures were aged following Clark & Schmitt (1998). However, some of the pylons with roosting birds were distant from the vantage points and this caused uncertainty about the exact age of the vultures. Thus, to present data correctly, in

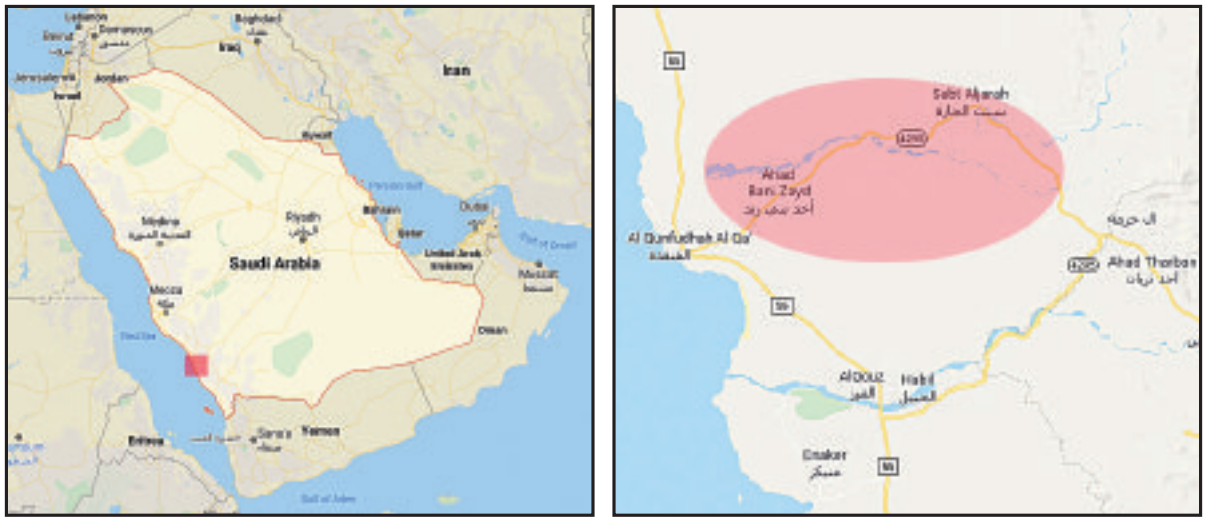

Figure 1. Location of the study area along the Wadi Qanuna in southwestern Saudi Arabia.

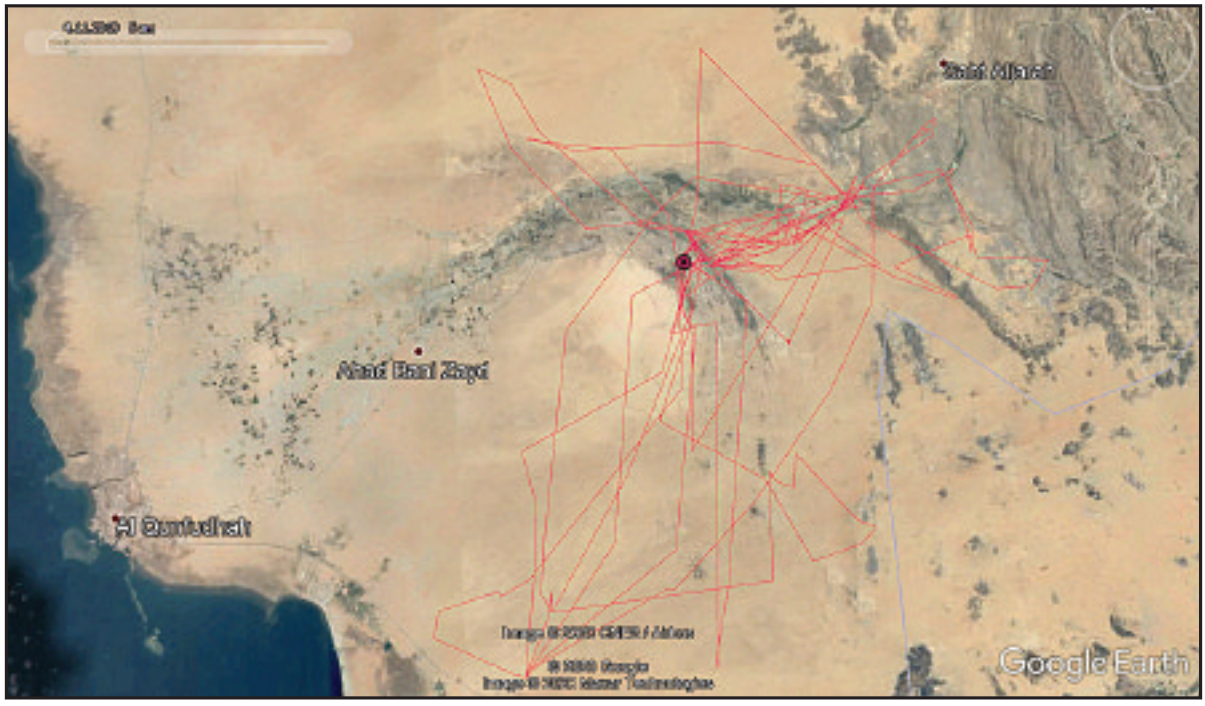

Figure 2. Telemetry track (4-17 November 2019) of one of the released Egyptian Vultures from Bulgaria in 2019.

the results we pooled the adult and sub-adult birds in one age group, while immature and juvenile birds were pooled in another age group.

We conducted a powerline survey of low or medium voltage distribution lines with hazardous pylon design – those on which the wires are supported above the pylon or the crossbar support structure (Demerdzhiev 2014) – situated in habitats favorable for Egyptian Vulture foraging and feeding. We also searched for electrocution and collision victims under the high voltage pylons where roosting birds were detected (Arkumarev *et al* 2014). Transects under the identified powerlines were conducted on foot during the day by searching for dead birds on the ground following as much as possible the method of Demerdzhiev (2014). The transect length was measured and recorded, but was not fixed as it depended on accessibility and terrain. Birds found dead beneath the powerlines were assumed to have been electrocuted if found within 5 m of a pylon, or to be victim of collision if found under the lines further than 5 m from the pylons

(Demerdzhiev *et al* 2009). As far as possible, the species identity of each carcass found was identified.

Data on the use of dangerous veterinary medical products for vultures (particularly NSAIDs such as diclofenac) were collected by investigating nine veterinary pharmacies along the trip from Jeddah to the study area. Additionally, eight local livestock breeders were interviewed about the use of poison baits and veterinary medical products (six in the Wadi Qanuna; two in the Wadi Ramlan) to understand the prevalence of the use of poisons and other harmful substances. This is considered the leading cause of vulture population declines in Africa and on the Balkan breeding grounds (Ogada *et al* 2015, Kret *et al* 2016, Mengistu *et al* 2020).

RESULTS

Roosting sites

In the Wadi Qanuna area between Ahad Bani Zayd and Sabt Aljarah, 208 Egyptian Vultures (Table 1) were counted roosting on high-voltage (transmission) power pylons with low electrocution risk (Plate 1), together with 52 Steppe Eagles *Aquila nipalensis* and two (one adult and one immature) Eastern Imperial Eagles *Aquila heliaca*. The latter birds were among the roosting group near Sabt Aljarah. Egyptian Vultures were split in two roosting clusters, one close to Ahad Bani Zayd (116 birds) and the other around Sabt Aljarah (92 birds), both of which were located on rocky hills with limited human access

Table 1. Numbers of roosting birds of prey in the area between Ahad Bani Zayd and Sabt Aljarah in November 2019.

Numbers (individuals)	Roosting cluster near Ahad Bani Zayd	Roosting cluster near Sabt Aljarah	Total numbers
Egyptian Vultures			
Adult & subadult	71	70	141
Immature & juvenile	45	22	67
Other species			
Steppe Eagle	44	8	52
Eastern Imperial Eagle	0	2	2

Plate 1. Egyptian Vultures roosting on high voltage transmission pylons in the area of Wadi Qanuna. These pylons pose a very low risk of electrocution to roosting birds as the conducting wires are suspended far below the support structure. © *Stoyan Nikolov*

and an absence of asphalt roads. Additionally, a total of 120 Black Kites *Milvus migrans* were found roosting in two different sites on small rocks and shrubs along the Wadi.

We also visited the area of Wadi Ramlan near Baish for a day, but did not find any Egyptian Vultures, thus we did not conduct roosting counts there. According to the information collected from two interviews with local livestock breeders, Egyptian Vultures used to be common in this area, but now only a few individuals are observed during the migration season.

Feeding sites

During the four days that we spent in the area of the roosting congregation site in Wadi Qanuna, we did not find any large diurnal feeding congregation of Egyptian Vultures. Single individuals or very small groups (2-3 birds) were spread around the Wadi and feeding near livestock farms. We also visited the municipal rubbish dumps of Al Qunfudhah, Ahad Bani Zayd and Sabt Aljarah, but did not find any Egyptian Vultures feeding there. The telemetry data from the tagged Egyptian Vulture from the Balkans also showed that this bird was not feeding at a rubbish dump but at different sites within the Wadi. The most recent feeding site of the tagged Egyptian Vulture was visited by the team, where a further two immature Egyptian Vultures were also observed around a fresh goat carcass. In the feeding areas of the Egyptian Vultures, four different Eastern Imperial Eagles were identified.

Hazardous powerlines

Overall, we surveyed 25 km of medium-voltage distribution powerlines and 3 km of high-voltage transmission powerlines for dead birds in the areas along Wadi Qanuna around the Egyptian Vulture roosting congregations. In total, three victims were found: old remains of two Fan-tailed Ravens *Corvus rhipidurus* and the fresh carcass of an immature Steppe Eagle. All victims were found under the medium-voltage powerlines and all these fatalities were probably due to electrocution (Table 2).

Table 2. Bird mortality caused by hazardous medium-voltage powerlines in the Wadi Qanuna estimated from surveys along 25 km of powerlines in November 2019. No bird mortality was found along high-voltage transmission lines, and no Egyptian Vulture was found dead under the survey powerlines.

Mortality factor	Overall density of bird victims found (dead birds/km)	Density of dead raptors found (dead raptors/km)
Electrocution	0.12	0.04
Collision	0	0
Overall mortality	0.12	0.04

Use of poison baits

In Wadi Qanuna, three of the six interviewed livestock breeders confirmed the use of poison baits to control stray dogs. In Wadi Ramlan, one of the two interviewed people confirmed the use of poison baits for the same cause. One of the interviewed livestock breeders in Wadi Qanuna mentioned an organized campaign by the local authority in the past (exact year not mentioned) to poison stray dogs. However, there was no information on how the carcasses of poisoned dogs were disposed of. All people who reported using poison stated they use pesticides ('soluble white powder' – exact chemical was not identified) bought from agricultural shops. To mitigate human-wild carnivore conflict, all interviewed people stated they shoot the carnivores harmful to their livestock, such as stray dogs, wolves and hyenas.

Plate 2. Poisoned hyenas (n = 11) hanging on a tree along the road. © *Stoyan Nikolov*

On the way to Riyadh, north of Turabah in the Makkhah province (outside the study area) we found evidence of poisoning. Based on the information provided by local people (n = 3) poison was embedded in a carcass of a sheep or goat to kill terrestrial predators (mainly targeting wolves and hyenas) and in this specific case hyenas were poisoned (Plate 2).

Plate 3. Veterinary medical products (NSAIDs) poisonous for vultures are widespread and easily available in veterinary pharmacies along the southwest coast of Saudi Arabia.

Use of veterinary medical products dangerous to vultures

The use of NSAIDs (and specifically diclofenac) in veterinary practice was confirmed by all nine veterinary pharmacies visited between Jeddah and Al Qunfudhah (Plate 3) and by all eight interviewed livestock breeders in the areas of Wadi Qanuna and Wadi Ramlan. Veterinary drugs that are lethal for vultures (containing "–fenac" substances) were imported from Spain, India, Pakistan and Jordan, but were also produced locally in Saudi Arabia (e.g. Lafenac).

Other threats

We did not observe indications of illegal shooting or trapping of Egyptian Vultures during our survey (local people were not asked if they shoot or trap vultures). Two Black Kites were found as victims of vehicle collisions on the road in the area of Ahad Bani Zayd (Plate 4) with other vehicle collision victims found by chance between Jeddah and Al Qunfudhah (besides two Steppe Eagle, there were no other large birds).

Plate 4. Two Black Kites killed by collision with vehicles in the area of Ahad Bani Zayd. © *Stoyan Nikolov*

DISCUSSION

The study confirmed that the area of the Wadi Qanuna (Makkah Province) along the southwest coast of Saudi Arabia supports an important wintering congregation of Egyptian vultures (*c*200 birds). The habitat appeared optimal – rocky areas with high structures for perching (high-voltage pylons in our case), accessible water and food widely available to vultures (Jennings 2010). Much larger congregations of the species are known further south in Oman and Yemen (McGrady *et al* 2019), but considering the lack of existing data about the status of Egyptian Vultures in Saudi Arabia (Shobrak 2003, Jennings 2010) and the concentration of birds during migration in this area (Buechley *et al* 2018), our study adds valuable information on the wintering population of Egyptian Vultures in the Kingdom.

In contrast to large congregations of Egyptian Vultures found around rubbish dumps in Oman (Al Fazari & McGrady 2016), the birds in Wadi Qanuna were feeding in small groups widely dispersed across the area. This behaviour can be explained by the fact that the study area was very fertile with abundant livestock (goats, sheep and camels) and carcasses frequently found in the vicinity of livestock camps. Dead animals were not disposed of at designated sites but removed from the camp and discarded in open places to be utilized by avian or mammalian scavengers. This tradition has its roots in Islam, which believes in a reward for helping any living creature (Abdul Rahman 2017), and this practice appears to be beneficial to vultures in terms of availability and accessibility of food. However, considering the recent widespread use of NSAIDs in veterinary practices in the area, this traditional habit of livestock disposal (Plate 5) may pose a serious threat to vulture populations in the country.

All roosting Egyptian Vultures used high-voltage pylons that posed low electrocution risk. During the day, vultures were observed perching on the ground or on high-voltage pylons, but not on hazardous low- or medium-voltage pylons, although the latter were quite abundant in the survey area (all medium-voltage powerlines observed in the Wadi Qanuna used a hazardous design of the support structure increasing the potential risk for bird electrocution). Birds observed perching on the hazardous electric poles were Fan-tailed Ravens (several times) and a Common Kestrel *Falco tinnunculus* (once), and our findings of birds that had been electrocuted confirmed that these species are at risk. Although we did not find any Egyptian Vulture carcasses during powerline surveys, there is still a potential risk of electrocution, even if the risk is low. We frequently

Plate 5. Livestock carcasses that might have been treated with veterinary substances are disposed of in the field and are thus available for scavenging birds like these Black Kites. © *Stoyan Nikolov*

found livestock carcasses along roads under hazardous powerlines, which can potentially increase the risk of electrocution or collision of avian scavengers (Plate 6). We also assume that the magnitude of this threat could be of concern during migration when more birds may pass through the area (Buechley *et al* 2018), or in areas without alternative roosting substrate where a single transmission powerline can potentially cause large mortality (Angelov *et al* 2013).

Although we did not observe any Egyptian Vultures feeding along the roads in the study area, it is possible they could become victims of accidents with vehicles. This threat to vulture populations in the country has been reported in the past (Shobrak 2003), and is also pertinent to the Egyptian Vulture population on Farasan Island (M Shobrak, pers obs).

Overall, unintentional poisoning appears to be the main threat to Egyptian Vultures and other scavenging birds in the area. This is in line with the global threat analysis of Botha *et al* (2017). The practice of using poison baits to control stray dogs and other terrestrial predators

Plate 6. Medium voltage pole of hazardous design where the conducting wires are propped up from the support structure, allowing birds to be electrocuted. Disposing of livestock carcasses under the powerline increases the probability of electrocution of scavenging birds. © *Stoyan Nikolov*

has been proved to severely affect, even if unintentionally, Egyptian Vulture populations in different parts of their range from Europe (Hernández & Margalida 2009, Ntemiri *et al* 2018) to Africa (Mengistu *et al* 2020, Ogada *et al* 2015), and even on remote islands (Freitas *et al* 2019). We found that NSAIDs, which caused the vulture population collapse on the Indian subcontinent and may affect many other bird species (Cuthbert *et al* 2007), are widely used in veterinary practice in Saudi Arabia. The veterinary use of NSAID can cause kidney failure in vultures consuming treated livestock carcasses (Green *et al* 2006). Although there is no direct evidence whether diclofenac administered to livestock is lethal to wild Egyptian Vultures (Cuthbert *et al* 2006, Galligan *et al* 2014), the prevalence of these drugs is of great conservation concern as these substances can affect other vulture species that are steeply declining in Saudi Arabia (Shobrak 2003).

To mitigate the impact of poisons for Egyptian Vultures along the southwest coast of Saudi Arabia, legislation and enforcement are needed with an effective awareness program in the short term to eliminate the risk of secondary poisoning for vultures due to the use of poison baits. In the long-term, alternative methods to control the number of stray dogs and reduce the willingness to use poison to reduce livestock predation by wild terrestrial carnivores need to be developed. Adequate measures should also be taken to ban the use of diclofenac and other NSAIDs dangerous for vultures in veterinary practice at the national level, and to substitute them with safe alternatives such as meloxicam (Naidoo *et al* 2008).

In terms of mitigating the risk of electrocution and collision with powerlines, the hazardous electricity transmission infrastructure should be substituted by alternative infrastructure with a bird-safe design, especially those adjacent to documented congregation and feeding sites.

Scavenging bird collisions with vehicles are often linked to carcasses dumped near roads. Regular awareness programs for livestock camps near main roads could help to limit carcass disposal by roads and thus reduce collisions with vehicles. Carcass disposal near dangerous low or medium voltage powerlines that may cause electrocution should also be discouraged.

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LITERATURE CITED

Abdul Rahman, S. 2017. Religion and Animal Welfare - An Islamic Perspective. *Animals (Basel)* 7(2): 11. doi:10.3390/ani7020011

Al Fazari, WA & MJ McGrady. 2016. Counts of Egyptian Vultures *Neophron percnopterus* and other avian scavengers at Muscat's municipal landfill, Oman, November 2013–March 2015. *Sandgrouse* 38: 99–105.

Angelov, I, I Hashim & S Oppel. 2013. Persistent electrocution mortality of Egyptian Vultures *Neophron percnopterus* over 28 years in East Africa. *Bird Conservation International* 23:1–6.

Angelov, I, C Bougain, M Schulze, T Al Sariri, M McGrady & B-U Meyburg. 2020. A globally important stronghold in Oman for a resident population of the endangered Egyptian Vulture *Neophron percnopterus*. *Ardea* 108(1): 1–10. https://doi.org/10.5253/arde.v108i1.a4

Arkumarev, V, V Dobrev, YD Abebe, G Popgeorgiev & SC Nikolov. 2014. Congregations of wintering Egyptian Vultures *Neophron percnopterus* in Afar, Ethiopia: present status and implications for conservation. *Ostrich* 85: 139–145.

Arkumarev, V, V Dobrev, I Klisurov, R Petrov, A Delchev & SC Nikolov. 2019. *Develop and pilot a restocking strategy for the Egyptian Vultures on the Balkans: Integrated report on the release of captive-bred Egyptian Vultures in the Eastern Rhodopes, Bulgaria in 2019*. Technical report under action C3 of the LIFE project

"Egyptian Vulture New LIFE" (LIFE16 NAT/BG/000874). BSPB & Green Balkans, Bulgaria, 51 pp, http://www.lifeneophron.eu. [Retrieved 6 April 2020]

BirdLife International. 2020. Species factsheet: *Neophron percnopterus,* http://www.birdlife.org. [Accessed 6 April 2020]

Bounas, A, M Ganoti, E Giannakaki, A Akrivos, D Vavylis, I Zorrilla & V Saravia. 2016. First confirmed case of lead poisoning in the endangered Egyptian Vulture (*Neophron percnopterus*) in the Balkans. *Vulture News* 70: 22–29.

Buechley, ER, MJ McGrady, E Çoban & ÇH Şekercioğlu. 2018. Satellite tracking a wide-ranging endangered vulture species to target conservation actions in the Middle East and East Africa. *Biodiversity & Conservation* 27: 2293–2310.

Buechley, ER, S Oppel, WS Beatty, SC Nikolov, V Dobrev, V Arkumarev, V Saravia, C Bougain, A Bounas, E Kret, T Skartsi, L Aktay, K Aghababyan, E Frehner & ÇH Şekercioğlu. 2018. Identifying critical migratory bottlenecks and high-use areas for an endangered migratory soaring bird across three continents. *Journal of Avian Biology* 49:1–13.

Clark, W & N Schmitt. 1998. Ageing Egyptian Vultures. *Alula* 4: 122–127.

Cuthbert R, RE Green, S Ranade, S Saravanan, DJ Pain, V Prakash & AA Cunningham. 2006. Rapid population declines of Egyptian vulture (*Neophron percnopterus*) and red-headed vulture (*Sarcogyps calvus*) in India. *Animal Conservation* 9: 349–354.

Cuthbert R, J Parry-Jones, RE Green & DJ Pain. 2007. NSAIDs and scavenging birds: potential impacts beyond Asia's critically endangered vultures. *Biol Lett* 3: 90–93.

Demerdzhiev, D. 2014. Factors Influencing Bird Mortality Caused by Power Lines within Special Protected Areas and undertaken Conservation Efforts. *Acta Zool Bulg* 66 (2): 411–423.

Demerdzhiev, D, S Stoychev, Tz Petrov, I Angelov & N Nedyalkov. 2009. Impact of power lines on bird mortality in southern Bulgaria. *Acta Zool Bulg* 61(2): 175–183.

Freitas R., C Monteiro, I Rodrigues, A Tavares, G Monteiro, P López, S Martins, J Ferreira, L Lima, JP Tavares & L Palma. 2019. Cabo Verde Egyptian Vulture *Neophron percnopterus* on the brink: community perceptions, inferences and facts of an extreme population crash. *Bird Conservation International*. https://doi.org/10.1017/S0959270919000376.

Galligan, TH, T Amano, VM Prakash, M Kulkarni, R Shringarphure, N Prakash, S Ranade, RE Green & RJ Cuthbert. 2014. Have population declines in Egyptian Vulture and Red-headed Vulture in India slowed since the 2006 ban on veterinary diclofenac? *Bird Conservation International* 24: 272–281.

Green, RE, MA Taggart, D Das, DJ Pain, CS Kumar, AA Cunningham & R Cuthbert. 2006. Collapse of Asian vulture populations: risk of mortality from residues of the veterinary drug diclofenac in carcasses of treated cattle. *Journal of Applied Ecology* 43: 949–956.

Hernández, M & A Margalida. 2009. Poison-related mortality effects in the endangered Egyptian vulture (*Neophron percnopterus*) population in Spain. *Eur J Wildl Res* 55: 415–423.

Islam, MZ & K Ismail. 2014. Egyptian Vultures in the Farasan Islands, Saudi Arabia. *Phoenix* 30: 10.

Jennings, MC. 1995. *An interim atlas of breeding birds in Arabia*. NCWCD, Riyadh.

Jennings, MC. 2010. Atlas of the breeding birds in the Arabia Peninsula. *Fauna of Arabia* 25: 1–751.

Kret, E, V Saravia, V Dobrev, G. Popgeorgiev & SC Nikolov. 2016. *Assessment of major threats in Natura 2000 sites for the Egyptian Vulture (Neophron percnopterus) in Bulgaria and Greece (2012–2015)*. Fact sheet under action A3 of the LIFE+ project "The Return of the Neophron" (LIFE10 NAT/BG/000152). WWF Greece, Athens, 8 p, http://www.lifeneophron.eu. [Retrieved 6 April 2020].

Kret, E, T Rabeil, SI Muhammad, M Shiiwua, P Hall, V Arkumarev, V Dobrev & SC Nikolov. 2018. First documented case of the killing of an Egyptian Vulture (*Neophron percnopterus*) for belief-based practices in Western Africa. *Vie et Milieu - Life and Environment* 68: 45–50.

McGrady, M, T Al Amri & A Spalton. 2019. Protecting nature's waste managers. *Nature Middle East*: doi:10.1038/nmiddleeast.2019.80

Mengistu, S, AD Ruffo, V Arkumarev, S Bakari & SC Nikolov. 2020. *Wessal Case: Evidence for poisoning of Egyptian Vultures in Somali region, Ethiopia*. Technical report under action A3 of the "Egyptian Vulture New LIFE" (LIFE16 NAT/BG/000874) project. EWNHS, BSPB and BirdLife Africa, Addis Ababa. 22 p, http://www.lifeneophron.eu. [Retrieved 6 April 2020].

Naidoo, V, K Wolter, D Cromarty, P Bartels, L Bekker, L McGaw, M Taggart, R Cuthbert & G Swan. 2008. The pharmacokinetics of meloxicam in *Gyps* vultures. *J Vet Pharmacol Ther* 31: 128–134.

Nikolov, SC, B Barov, C Bowden & NP Williams (eds). 2016. *Flyway Action Plan for the Conservation of the Balkan and Central Asian Populations of the Egyptian Vulture (Neophron percnopterus) (EVFAP)*. BSPB Conservation Series No. 32, Sofia, 124 pp, http://www.lifeneophron.eu. [Retrieved 6 April 2020]

Ntemiri, K, V Saravia, C Angelidis, K Baxevani, M Probonas, E Kret, Y Mertzanis, Y Iliopoulos, L Georgiadis, D Skartsi, D Vavylis, A Manolopoulos, P Michalopoulou & SM Xirouchakis. 2018. Animal mortality and illegal poison bait use in Greece. *Environmental Monitoring and Assessment* 190: 488. https://doi.org/10.1007/s10661-018-6838-5

Ogada, D, P Shaw, RL Beyers, R Buij, C Murn, JM Thiollay, CM Beale, RM Holdo, D Pomeroy, N Baker, SC Krüger, A Botha, MZ Virani, A Monadjem & ARE Sinclair. 2015. Another continental vulture crisis: Africa's vultures collapsing toward extinction. *Conservation Letters* 9: 89–97.

Oppel, S, P Iankov, S Mumun, G Gerdzhikov, M Iliev, S Isfendiyaroglu, C Yeniyurt & E Tabur. 2014. Identification of the best sites around the gulf of Iskenderun, Turkey, for monitoring the autumn migration of Egyptian Vultures and other diurnal raptors. *Sandgrouse*, 36: 240–249.

Oppel, S, V Dobrev, V Arkumarev, V Saravia, A Bounas, E Kret, M Velevski, S Stoychev & SC Nikolov. 2015. High juvenile mortality during migration in a declining population of a long-distance migratory raptor. *Ibis* 157: 545–557.

Ostrowski, S & M Shobrak. 2001. Pesticide poisoning in a free-ranging Lapped-faced Vultures *Torgos tracheliotus*. *Veterinary Record* 149: 396–397.

Phipps, WL, P López-López, ER Buechley, S Oppel, E Álvarez, V Arkumarev, R Bekmansurov, O Berger-Tal, A Bermejo, A Bounas, IC Alanís, J de la Puente, V Dobrev, O Duriez, R Efrat, G Fréchet, J García, M Galán, C García-Ripollés, A Gil, JJ Iglesias-Lebrija, J Jambas, IV Karyakin, E Kobierzycki, E Kret, F Loercher, A Monteiro, J Morant Etxebarria, SC Nikolov, J Pereira, L Peške, C Ponchon, E Realinho, V Saravia, CH Sekercioğlu, T Skartsi, J Tavares, J Teodósio, V Urios & N Vallverdú. 2019. Spatial and temporal variability in migration of a soaring raptor across three continents. *Frontiers in Ecology and Evolution* 7. https://doi.org/10.3389/fevo.2019.00323

Rahmani, R, M Shobrak & S Newton. 1994. Birds of the Tihamah coastal plain of Saudi Arabia. *OSME Bulletin* 32: 1–19.

Saravia, V, E Kret, V Dobrev & SC Nikolov. 2016. *Assessment of mortality causes for the Egyptian Vulture (Neophron percnopterus) in Bulgaria and Greece (1997–2015)*. Fact sheet under action A1 of the LIFE+ project "The Return of the Neophron" (LIFE10 NAT/BG/000152). HOS, Athens, 6 p, http://www.lifeneophron.eu. [Retrieved 6 April 2020].

Shobrak, M. 1996. *Ecology of the Lapped-faced Vulture* (Torgos tracheliotus) *in Saudi Arabia*. Unpubl. Thesis, Glasgow Univ, Glasgow, UK.

Shobrak, M. 1999. *Conservation strategy of vultures in Saudi Arabia*. National Commission for Wildlife Conservation and Development in Saudi Arabia, Riyadh.

Shobrak, M. 2000. The role of avian scavengers in locating and exploiting carcasses in central Saudi Arabia. *In:* Chancellor, RD & B-U Meyburg (eds) *Raptors at Risk*. WWGBP / Hancock House, pp 213–224.

Shobrak, M. 2003. Vultures in Saudi Arabia. *Vulture News* 48: 20–23.

Shobrak, M. 2012. Electrocution and collision of birds with power lines in Saudi Arabia. *Zoology in the Middle East* 57: 45–52.

Symes, A, J Taylor, D Mallon, R Porter, C Simms & K Budd. 2015. *The Conservation Status and Distribution of the Breeding Birds of the Arabian Peninsula.* Cambridge, UK and Gland, Switzerland: IUCN, and Sharjah, UAE: Environment and Protected Areas Authority.

Velevski, M, SC Nikolov, B Hallmann, V Dobrev, L Sidiropoulos, V Saravia, R Tsiakiris, V Arkumarev, A Galanaki, T Kominos, K Stara, E Kret, B Grubac, E Lisicanec, T Kastritis, D Vavylis, M Topi, B Hoxha & S Oppel. 2015. Population decline and range contraction of the Egyptian Vulture (*Neophron percnopterus*) in the Balkan Peninsula. *Bird Conservation International* 25: 440–450.

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