Diet of the Eurasian Black Vulture, *Aegypius monachus* Linnaeus, 1766, in Turkey and implications for its conservation

(Aves: Falconiformes)

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Abstract. We analysed 120 pellets of the Eurasian Black Vulture, *Aegypius monachus* Linnaeus, 1766, collected in Turkey during the breeding season in order to assess diet preference and implications for conservation. In addition, we were able to analyse the stomach content of a dead individual. The most abundant prey item was sheep, which was found in 76.6% of all pellets, followed by Wild Boar (44.1%) and chicken (22.5%). This shows that livestock plays an outstanding role in the diet of the Eurasian Black Vulture, and underlines its dependence on extensive livestock farming and grazing. Dumping livestock carcasses around the vultures' breeding sites should therefore be permitted. In order to minimise the risk of poisoning, it should be forbidden to dispose of contaminated or poisoned carcasses in natural areas.

Key words. *Aegypius monachus*, Eurasian Black Vulture, food preferences, Türkmenbaba Mountain.

Introduction

When there is an absence of prey, different strategies can be performed by raptor species. Changing foraging behaviour and prey items (COSTILLO et al. 2007a, DONÁZAR et al. 2010), expanding feeding home-ranges (BONAL & APARICIO 2008) and modifying breeding strategies (STEENHOF et al. 1997) are responses of birds of prey to the lack of food. But these strategies may not be enough to overcome insufficient food supplies in every situation. Numerous studies have documented that lack of a suitable food supply has led to nest desertion, a failure of nesting attempts, lower breeding success or the extinction of raptor species (TORNBERG et al. 2005, SALAFSKY et al. 2007). For example, because of the extinction of the insular mammal fauna as available raptor prey, the endemic large raptor species also became extinct on islands during the Holocene (BRETAGNOLLE et al. 2004). As another contemporary example, following the decline of suitable food, the breeding success of many raptor species decreased in the Iberian Peninsula (COSTILLO et al. 2007a, DONÁZAR et. al 2009a). On the other hand, legal protection and the high availability of food have led to increases in the population size of vulture species such as *Gyps fulvus* (Hablizl, 1783) in Spain (PARRA & TELLARIA 2004, DONÁZAR et al. 2010).

Vultures are very vulnerable species on account of several characteristics in their reproductive process, such as the 4-7 years needed to reach sexual maturity, hatching only one or two broods every one or two years, and an extended breeding season. In fact, several vulture species are categorised as Near Threatened, Vulnerable, Endangered, or Critically Endangered (BIRDLIFE INTERNATIONAL 2009, DEYGOUT et al. 2009). Among them, the Eurasian

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Black Vulture, *Aegypius monachus* Linnaeus, 1766, is considered 'near threatened' worldwide by the IUCN (2009) and is listed as 'vulnerable' at the European level (BIRDLIFE INTERNATIONAL 2009). It is included in Annex I of the EU Birds Directive and in Appendix II of the Bern and Bonn Conventions.

The Eurasian Black Vulture is a scavenging bird, feeding mostly on carrion and only rarely taking live prey. The species feeds mainly on small or medium-sized items such as rabbit, domestic sheep and wild ungulates in Europe (HIRALDO 1976, MORENO-OPO et al. 2010a). As with the other bird species, the Eurasian Black Vulture has higher nutritional needs during the breeding season, due to the metabolic demands of egg production, incubation and subsequent chick rearing (CORBACHO et al. 2007).

The global Eurasian Black Vulture population is estimated at 7,200-10,000 pairs with 1,700-1,900 pairs in Europe (BIRDLIFE INTERNATIONAL 2009). The species has suffered a drastic decline during the last century (DONÁZAR et al. 2002, MORÁN-LÓPEZ et al. 2006). Although the species was able to change its diet in the Extremadura region after a decrease in its main prey population (COSTILLO et al. 2007 a), reduction of food supply is one of the main threats to the species (SÁNCHEZ 2004). Even though the breeding success of the Eurasian Black Vulture is very high (up to 90%) under natural conditions (HEREDIA, 1996, MORÁN-LÓPEZ et al. 2006, DE LA PUENTE et al. 2007), it was reported as low as 59% in Mongolia because of a lack of prey (BATBAYAR 2004).

The other significant factor is the provision of safe food resources for the conservation of populations. It is known that the devastating effects of unsafe food on many scavenger predators are closely connected with carcasses contaminated with poisons or certain veterinary drugs (CLUTHBERT et al. 2007, HERNÁNDEZ & MARGALIDA 2008) Poisoning of the Eurasian Black Vulture by pesticide-contaminated carcasses is considered to have another important negative effect on the population (HERNÁNDEZ & MARGALIDA 2008). Therefore, to supply natural and safe food resources is one of the most valuable tools for the conservation of this species, for improving its breeding success and survival.

Turkey has the second largest Eurasian Black Vulture population (50-200 pairs) in Europe after Spain (HEREDIA et al. 1997). Despite a 'National Action Plan for *Aegypius monachus*' (KAD 2004) and a dissertation about its population biology in Turkmenbaba Mountain (YAMAÇ 2004), information on its food preferences is sparse. The data presented here will contribute to understanding the feeding ecology of the species and the implications for conservation strategies.

Material and methods

Study area. The study was carried out on the Türkmenbaba Mountain as this site has the largest known Eurasian Black Vulture colony in Turkey (YAMAÇ 2004). Türkmenbaba Mountain is situated between Eskişehir and Kütahya in northwest Turkey (39°24'N, 30°18'E) (Fig. 1). It covers an area of 17,500 ha, with an average altitude of about 1300 m a.s.l. and the highest point of 1826 m a.s.l. The average monthly temperatures range from 21.6°C in July to -1.1°C in December. The mean annual precipitation is 373.8 mm.

Steppe and forest are the two main habitat types in the study area. The forest vegetation starts above 1000-1100 m. with Black Pine, *Pinus nigra* (J. F. Arnold), as the most widespread tree. Scots Pine, *P. sylvestris* (Linnaeus), and Oriental Beech, *Fagus orentalis* (Lipsky), occur in more humid sites and the Turkish Oak, *Quercus cerris* (Linnaeus), at lower elevations (HÜNER 2003). Timber extraction is the main economic activity on the Türkmenbaba Mountain and restricted parts of the mountain are used for summer recreation. The study area includes a very rich

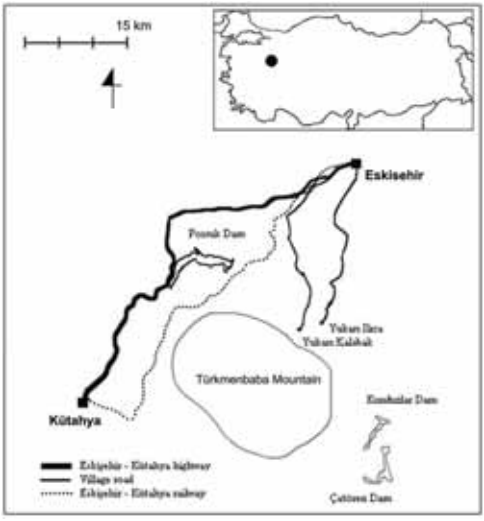

Fig. 1. Map of the study area.

diversity of wildlife, such as *Gypaetus barbatus* (Linnaeus, 1758), *Hieraaetus pennatus* (Gmelin, 1788), *Circaetus gallicus* (Gmelin, 1788), *Neophron percnopterus* (Linnaeus, 1758), *Lepus capensis* (Linnaeus, 1758) *Sciurus anomalus* (Gmelin, 1778), *Canis lupus* (Linnaeus, 1758), *Cervus elaphus* (Linnaeus, 1758), *Sus scrofa* (Linnaeus, 1758), and *Vulpes vulpes* (Linnaeus, 1758) (YAMAÇ 2004).

The hunting of wild boar is widespread in the Turkmenbaba Mountain, not only as a sport but also to control the detrimental effects of the species on crops (pers. comm. from local farmers and hunters). Livestock grazing is limited to no more than 7000 sheep in the area (pers. comm. from local authorities).

Field procedure. Pellet collection was carried out after the nestlings fledged, to obtain information about the feeding behaviour of the species during the breeding season. Pellets were collected under 20 nests between 2003 and 2005. Moreover, the stomach content of one dead individual was also analysed. Before the pellets were dissected, they were soaked in water for 1 day (MARTIN 1987). They were then separated under a stereoscopic microscope. To determine prey items, a regional reference collection was used. Mammalian hair was identified using the medullary pattern. Each prey item identified in the pellet was considered as one individual of that species (HIRALDO 1976). The total number of pellets, the number of prey (N) and their species, the percentage of each prey in relation to the total number of pellets (frequency of occurrence) and diversity index (H') are presented. To measure diversity of diet, the Shannon Index was used. Where identification was impossible, items were classified as 'unidentified'.

Results and discussion

A total of 412 items in 120 pellets were identified. The most notable prey in the diet was sheep, which occurred in 76.6% of the pellets, followed by Wild Boar (*Sus scrofa*, 44.1%) and chicken (22.5%). The dietary diversity index (H') was determined as 3.25 (Table 1). Sheep has also been found in Spain to be the single most significant food item (COSTILLO et al. 2007 b, MORENO-OPO et al. 2010 b). The other most notable livestock prey in the diet of

Table 1. Contents of the pellets of the Eurasian Black Vulture, *Aegypius monachus*, in the Türkmenbaba Mountain, Turkey. N = Number of prey items.

	N	% frequency
Mammalia		
Lepus capensis (Linnaeus, 1758)	2	1.60
Canis lupus (Linnaeus, 1758)	13	10.83
Canis lupus familiaris	6	5.00
Vulpes vulpes (Linnaeus, 1758)	13	10.83
Felis domesticus (Linnaeus, 1758)	3	2.50
Equus caballus (Linnaeus, 1758)	6	5.00
Cervus elaphus (Linnaeus, 1758)	3	2.50
Capra aegagrus hircus (Linnaeus, 1758)	3	2.50
Ovis ammon aries (Linnaeus, 1758)	92	76.66
Sus scrofa (Linnaeus, 1758)	53	44.16
Unidentified bone	27	22.50
Unidentified skin	8	6.66
Aves		
Gallus gallus domesticus (Linnaeus, 1758)	27	22.50
Unidentified feathers	19	15.85
Reptilia		
Testudo graeca (Linnaeus, 1758)	3	2.50
Unidentified snake	4	3.33
Plant		
Plant material (unident.)	113	94.16
Pine cone	6	5.00
Stone	8	6.66
Garbage	3	2.50
Total number of prey	412	
Total number of pellets	120	
Diversity (H')	3.25	

the species is chicken. COSTILLO et al. (2007b) reported that poultry was the main prey item in just one colony, because of the extensive poultry farming in Sierra de Gata, Spain. According to the Export Promotion Center of Turkey, Turkey rates 17th in chicken meat production in the world (CIVANER 2009). More than 150,000 chickens are reared in 19 chicken farms close to the Türkmenbaba Mountain. It seems that they are an important food resource for the Eurasian Black Vulture because chicken carcasses are frequently found around the farms (pers. observation) and vultures were also observed feeding on them.

Wild boar was the second most important prey in the diet of the species (44.1%), as also reported by COSTILLO et al. (2007b) in Extremadura. Wild boar hunting is a widespread practice in the study area. The species is shot both for recreational purposes by hunters and to diminish damage to crops by farmers. As consuming Wild Boar meat is forbidden according to Islamic lew, shot wild boars are often left and abandoned to the natural environment. As a result, this activity provides an available food supply not only for the Eurasian Black Vulture but also for other scavenger species in the area.

Although the Eurasian Black Vulture is a scavenging bird, one of the most common food items was plant material (Table 1). A hundred and thirteen pellets contained plant material.

Fig. 3. Black Vulture, *Aegypius monachus* (photograph: Zafer TEKIN).

In addition, 14 pine cones were detected in six of the pellets. In the analysis of the stomach contents of one dead individual, two entire pine cones were determined (Fig. 2). It is reported that vultures ingest plant matter to aid in pellet formation (CEBALLOS & DONÁZAR 1990). On the other hand, there is no available report concerning pine cones in the diet of the vulture. For the first time, pine cones up to a 5% proportion were detected in the *A. monachus* pellets as well as two entire cones in the stomach contents of one dead individual.

While it is illegal to dispose of livestock carcasses in natural areas in Turkey, farmers do illegally dump domestic carrion in fields (pers. observation). On the other hand, cattle farming has decreased in recent years in Turkey (TÜİK 2010), and this could lead to a decline of the Eurasian Black Vulture population in the future. Although species may shift to other prey species in the case of a decreasing main prey item, this is hardly possible for the Eurasian Black Vulture population as there are no alternative prey species available in the area. Furthermore, in spite of the fact that the species can forage over wide areas for carrion, the existence of food sources near breeding sites is important in order to maintain energy and to reduce the time necessary to locate food, especially in the breeding season as has been shown in some studies (CARRETE & DONÁZAR 2005).

Fig. 4. Black Vulture, *Aegypius monachus* (photograph: Zafer TEKIN).

In conclusion, the survival of the Eurasian Black vulture colony on Türkmenbaba Mountain seems, firstly, to be dependent on livestock production. If livestock farming and grazing continue to decrease, then this could produce an unfavourable effect on the population in the way of the availability of good quality food. The management of extensive livestock farming and grazing should therefore be improved by giving much more attention to livestock productivity through the provision of modern production techniques, which will encourage the maintenance and growth of the vulture population. It should also be permitted to abandon livestock carcasses, especially around the vultures' breeding sites.

Although livestock is the main food item for the species, there has been no study about the effects of poisoned or contaminated carcasses on the population in Turkey. It has been reported that the use of the non-steroidal anti-inflammatory drug Diclofenac used in treating domestic livestock has led to a rapid decline of the vulture populations in the Indian subcontinent (PRAKASH et al. 2003, GILBERT et al. 2007). It has been shown that scavengers consuming livestock carcasses are exposed not only to antibiotics but also to multiple veterinary drugs in Spain. Furthermore, the alteration effect of antibiotics on the normal gut flora may promote pathogen acquisition in vulture species (BLANCO et al. 2009). Special care should therefore be taken not to dispose of contaminated or poisoned carcasses in natural areas.

While the provision of supplementary food (feeding station or "vulture restaurant") has provided an important and hygienic resource for scavenger birds (GILBERT et al. 2007, DEYGOUT et al. 2009, DONÁZAR et al. 2009b), there have also been reports about the unfavourable effects of feeding stations on the species (MARGALIDA et al. 2008, CORTÉS-AVIZANDA et al. 2009). Before deciding upon the establishment of feeding stations, comprehensive further studies are needed to demonstrate that they are necessary.

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