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Nest characteristics of Egyptian vulture (*Neophron percnopterus*) in Middle and Upper Sakarya Region, Turkey

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Abstract

Egyptian vulture is an endangered vulture species all over the World. Turkey holds the substantial amount of the global population of the species in Western Palearctic. Middle and Upper Sakarya Region is an important host for the breeding Egyptian vulture population in Anatolia. In total 37 occupied nests were recorded in 2013 and 2014 years. In order to determine the nest characteristics 11 nest variables and cliff features were evaluated in this study. Egyptian vulture nests were determined both in hollows (n= 24) and on ledges (n= 13) at the middle part of the small limestone cliffs in the study area. The mean ± SD of cavity width and height are 2.0 ± 1.0 and 1.5 ± 0.6, respectively. Nests were situated predominantly southwestern exposure. Although the first data is given in this study about nest characteristics in the region, detailed studies are required on the relationship between nest site quality and breeding parameters to undertake conservation strategies for Egyption vulture in Turkey.

Key words: Anatolia, cave nesting, endangered vultures

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Orta ve Yukarı Sakarya Bölgesi' nde dağılım gösteren Küçük Akbaba (Neophron percnopterus)' nın yuva özellikleri

Özet

Küçük akbaba soyu küresel ölçekte tehdit altında olan bir akbaba türüdür. Batı Palearktik bölgede dağılım gösteren populasyonun büyük bir kısmı Türkiye' de yer almaktadır. Anadolu' da Orta ve Yukarı Sakarya Bölgesi küçük akbabalar için önemli bir üreme alanına sahiptir. 2013 ve 2014 yıllarında gerçekleştirilen çalışmalar ile bölgede küçük akbaba tarafından kullanılan 37 yuva tespit edilmiştir. Bu çalışmada populasyonun yuva özelliklerinin belirlenmesi amacıyla yuvaların yer aldığı kaya ve yuvalara ait 11 özellik değerlendirilmiştir. Küçük akbaba çalışma alanındaki kireç taşı oluşumlu kaya kütlelerinin orta kısımlarında yer alan oyuklara (n= 24) ve çıkıntı setlere (n= 13) yuva yapmaktadır. Yuva oyuğunun genişlik ve yükseklik için ortalama değerleri sırasıyla 2.0 ± 1.0 ve 1.5 ± 0.6 m olarak belirlenmiştir. Yuvalar çoğunlukla kayaların güneybatı yönüne bakan yüzeylerinde konumlanmaktadır. Bu çalışmayla yuva özelliklerine ait bölgedeki ilk veriler elde edilmiştir. Ancak Türkiye'de küçük akbaba türünü korumaya yönelik yapılacak çalışmalarda, yuva alanı özelliklerinin üreme başarıları üzerine etkilerini detaylı bir şekilde değerlendirmek gerektiği düşünülmektedir.

Anahtar kelimeler: Anadolu, mağara tipi yuva, tehlike altındaki akbabalar

1. Introduction

Egyptian vulture is a medium sized Old World vulture species. Global populations mainly distrubute in north of the equator in Africa, southern Europe, Middle East, Caucasus and in India easternmost. Some populations in northwest of Africa and Asia and all European populations are migratory while others are resident in Sahel Region, East Africa, Ethiopia, India and Spanish archipelagos [1]. Populations mostly concentrate below 2000 asl. except some resident populations such as Caucasian, Himalayan and Ethiopian [1; 2]. Egyptian vulture is found in high rocky plains, savannas,

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semi-desert grasslands and croplands in wintering sites. However in the breeding season, it is seen in montainous terrains, woodlands, plateaus, canyons and cultivated areas near human settlements [1; 3; 4; 5].

Species is one of the sixteen threatened vultures worldwide and classified globally endangered [6; 7]. The underlying reasons for this threat level of Egyptian vulture populations are reported as food source reduction, direct and indirect poisoning, illegal hunting, habitat degradation, electrocution and wind turbine collision both in wintering and breeding areas [8; 9; 10; 11; 12; 13; 14]. These threats have negative impacts on adult survival rate and accordingly viability of populations result in decrease of populations [15; 16; 17; 18].

Even though Turkey holds one of the largest breeding population in Europe [7; 19], only two detailed studies were perfomed [19; 20]. Apart from these studies, there are limited data on distrubution of the species in Turkey [21]. Although it has been published records on the altitude, nest height and slope of the nests in Beypazarı [19], detailed information on the nest characteristics of the Egyptian vulture in Turkey remains unknown.

It is known that nest-site features have an important role to promote adult survival and breeding success which are crucial for population viability of threatened vulture species such as Egyptian vulture [22; 23; 24; 25; 19]. Cave type nests provide safer place and positive impact on breeding success for cliff nesting vulture species [26]. According to studies on nest characteristics, Egyptian vulture is a cliff nesting species typically nests in caves, sheltered or open ledges on limestone cliffs in Italy, Spain, Yemen, Bulgaria, Greece, Macedonia and Ethiopia, [2; 4; 5; 23; 26; 27; 28; 29]. They occassionally nest on large trees, electric pylons, buildings and even on the ground in Canary Islands and Bulgaria [30; 31; 32]. The goal of this study is to collect data about nest characteristics of the Egyptian vulture in Turkey and to contribute to national conservation activities of the species classified globally endangered.

2. Materials and methods

1.1. Study Area

The study was conducted in Upper and Middle Sakarya Region, in the western part of the Central Anatolia comprising 7970 km² area (Figure 1). Vegetation vary by the regions in the study area. Northern and southwestern parts are covered by fir, pine, oak and juniper forests. In contrast, cultivated areas, highland and lowland steppes, grassland and shrub vegetation are mostly found in central and eastern part [21].

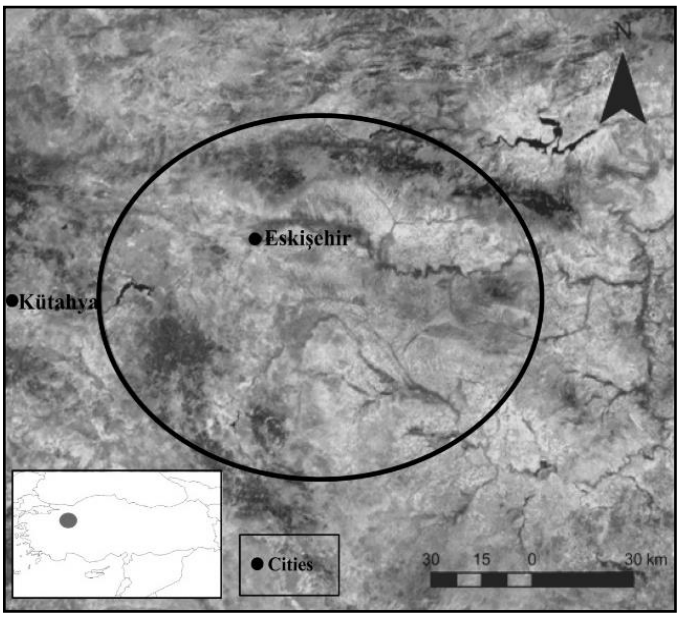

Figure 1. The study area

Climate is continental Central Anatolian thermal regime with the average temperature of 11 °C and annual rainfall 403.2 mm [33]. Besides there is Mediterranean climate in Sarıcakaya region which shows microclimatic features along the Sakarya river. Sakarya and Porsuk rivers are the main water resources in the region [21].

Alluvial plains, sand stone, clay stone, limestone, basalt, tufa and granite rocks are common geological formations. The highest and lowest altitudes are 1826 m and 190 m to asl in the study area [21].

Other than *Neophron percnopterus*; two vulture species, Bearded vulture (*Gypaetus barbatus*) and Cinereous vulture (*Aegypius monachus*), breed in the region. Some cliff nesting species breed in the study area such as Long-legged buzzard (*Buteo rufinus*), Black stork (*Ciconia nigra*), Peregrine (*Falco peregrinus*), Raven (*Corvus corax*) which have similar breeding habitat with Egyptian vulture [21; 34; 35].

1.2. Nest Survey and Measurements

The field surveys were carried out in 2013 and 2014 years to determine the nests occupied by Egyptian vulture at least for one breeding season. Occupied nests were located during the breeding season between April and August. In order to avoid disturbance, the measurement of the nest characteristics was conducted in September after birds left the area. Totally 37 occupied nests were determined and located by GPS. Because of the rough land structure, approaching to sufficient distance or climbing every occupied nest for measurements was not possible. To determine nest characteristics 11 variables were evaluated. In order to determine the dominant rock structure, geological formation of the nesting cliffs were identified based on database of general directorate of mineral research and exploration [36]. Study area include historical man made caves which is used for the nesting by the species. Thus, it was assessed whether the nest cave is natural formation or man-made based on the locational data of the ancient settlement [37; 38]. Also nests were classified as cave or ledge type. Furthermore Cliff Height (CH): Vertical distance between peak and base of the cliff, Nest Height (NH): Vertical distance between cliff base and nest, Nest Position (NP): Lower/middle/upper parts of each cliff, Cavity Length (CaL): Distance between enterance and end of the cave/ledge, Cavity Width (CaW): Distance between left and right side of the cave/ledge, Cavity Height (CaH): Distance between bottom and top of the cave/ledge, Altitude (A), Nest Aspect (NA) were also determined [39]. Measurements were performed by tapeline and Vertex IV altimeter. Altimeter device was used to measure the nest height and cliff height at a distance from the nest. To determine NP, it was hypothetically divided every single cliff in 3 parts as lower, middle and upper and classified each nest as where they situated on the cliff. In order to determine altitudes, it was used GPS and Google Earth programme. Nest aspects were recorded by using compass. Data were reported as minimum, maximum and mean ± standard deviation for ratio variables (SD).

3. Results

Overall 37 Egyptian vulture nests were recorded in the area during the field surveys in 2013 and 2014 years. Geological formations of nesting cliffs vary by the region. But the dominant formation was limestone (n= 11) following by pyroclastic rocks (n= 8). The rest of the nesting cliffs were several different rock type such as granitoid, marble, schist and other clastic rocks. Other than the 31 nests on natural rock formations, 6 nests were found in hollows on ancient man-made structures. Twentyfour nests were found in hollow and thirteen on ledge. The minimum, the maximum, the mean and the standard deviation values of the cliff and nest measurements were presented in table (Table 1). NP and NA data of the nests were given as diagrams (Figure 2 and 3).

Table 1. Outcomes of cliff and nest measurements

	N	Min(m)	Max(m)	Mean±SD (m)
CH	25	3.5	37.7	11.8±6.7
NH	25	2.0	26.2	6.7±4.5
CaL	12	0.8	3.5	1.9±0.9
CaW	13	0.7	5.0	2.0±1.0
CaH	13	0.5	3.0	1.5±0.6
A	37	288.0	1292.0	858.0±236.0

CH: Cliff Height, NH: Nest Height, CaL: Cavity Length, CaW: Cavity Width, CaH: Cavity Height, A: Altitude

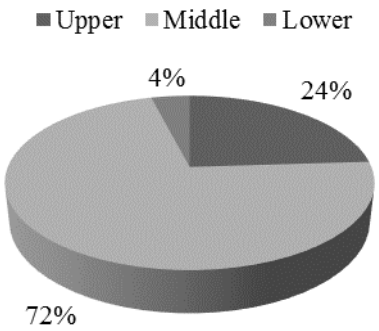

Figure 2. Nest positions in the cliff

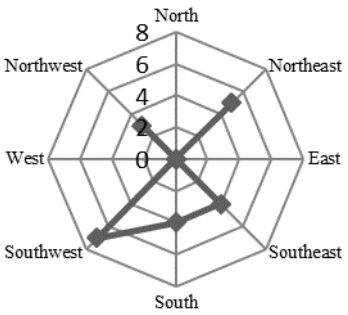

Figure 3. Aspects of the nests

4. Conclusions and discussion

In Middle and Upper Sakarya Region, the majority of the 37 Egyptian vulture nests were located on the limestone and pyroclastic cliffs. Similarly, limestone is the common rock formation of nesting cliffs in Europe and Africa, also [2; 26; 27]. Depends on the proportion of mineral composition, limestone and pyroclastic cliffs easily erodible and may provide many hollows and ledges. These natural formations offer a save shelter for Egyptian vultures to nest and raise their fledgelings [2; 23; 27; 40].

Other than natural formations some hollows carved by ancient civilizations were recorded as a nest site in our study area. These ancient settlements ruins such as symbolic tombs are from the Phrygians. Similar case was reported in different area in Turkey [41].

Egyptian vulture nests on small cliffs in the Middle and Upper Sakarya Region. This phenomenon has been reported in other breeding areas in Europe [4; 27; 29; 42; 43]. Nevertheless the mean cliff height (11.8 ± 6.7 m) is much more lower in our study area when compare to the other populations in European such as Balkan populations with 37 ± 38 m [29], Sicilian population with 78.1 ± 51 [4], Italian population with 135 ± 125 m [23] and the population in norhtern Spain with 53.6 ± 68.7 m [40].

The mean nest height (6.7 ± 4.5 m) is similar to the findings of populations in Bulgaria and Greece. Although the mean value is relatively higher in Balkan populations, most of the nests (53%) situated 1-10 m height [29]. However the mean nest height is quite high in other regions in Europe; Sicily with 47.3 ± 41.7 and Italian penninsula with 41.6 [4; 23].

The Egyptian vulture nests are mainly located at the middle part of the rocks in the Middle and Upper Sakarya Region (Figure 2.). Although some researchers report that nest are situated at the upper part of the rocks which is possibly the most inaccesible [23; 26] alternatively nesting at the base of the cliffs may minimise the energy consumption in carrying food to the nest [42] or provide good weather conditions to individuals [2]. These are also might be the possible explanations of the low cliff and nest height in our study area.

In addition, low pressure of being hunted by predators or lower human disturbance might have an impact on choice of small rocks. It has been emphasized in a study with another cliff nesting raptor species Bonelli's eagle (*Hieraaetus fasciatus)* that cliff height is effected by human related disturbance. Lower cliffs were prefered more when they are far from the paved road whereas higher cliffs were used in the case of heavy human pressure [44]. Raven *Corvus corax*, stone marten *Martes foina* and Eurasian eagle owl *Bubo bubo* are common possible predators and threats for Egyptian vulture among European populations [19; 29; 45]. There is a phenomenon which eggs or juveniles may be hunted by predators if the nest are easily accessible. Clutch replacement in order to tolerate this type of reproductive failures is less frequent among large size and single brooded raptors [46]. It has been recorded that Egyptian vulture succesfully breed after clutch replacement in case of failure [22; 45]. Still prevalance of replacement is low. Alternatively constructing inaccessible nest seems required less energy comparing to cost of relaying process. Accordingly we expect the nest would be located high in our study area as well. However according to the results of measurement not only but one of the possible explanations of the low nest height may be associated with low presure of preadators in the study area.

The dominant nest type was cave form and the nests are deep (mean ± SD= 1.9 ± 0.9 m) and wide (mean ± SD= 2.0 ± 1.0 m) according to the outcomes of the nest measurements in Middle and Upper Sakarya Region (Table 1). Deep hollows may offer individuals a shelter to overcome unfavorable weather conditions during the breeding season. This argument also could explain the abundance of cave type nests in the study area. There are only few informations about the nest type, CaL, CaW and CaH for other Egyptian vulture populations. It has been reported that nests are approximately 1 m in width and depth in Greece and Yemen [26; 43]. Similar study has conducted with another cliff nesting vulture population (*Gyps fulvus*) in Gamla Nature Reserve and authors reported that the nest-sites in caves are more successful and productive than the nest-sites on open ledges [47]. However we did not analyze statistically whether the nest-site features are preference or not. Thus interpretations of nest-site preference remain limited.

The mean altitude value of nest sites is relatively higher than the one in Beypazarı region where another significant population exist close to our study area. Unlike the elevation report of Beypazarı population [19] the half of the nest sites (n:19) are above 900 m in our study area. Also the data of other European populations are consistent with the mean altitude in the study area in Middle and Upper Sakarya Region [1; 4].

It is known that Egyptian vulture's nests are predominantly southfacing [4; 19; 23; 28]. In our study area southwestern exposure was relatively higher which is identical to findings in Balkan populations [29] . Use of sunlight [29] or exploitation of potential good microclimatic features [28] might be related with preference of the southfacing nest. A study conducted with other cliff-nesting raptor Bonelli eagle *Aquila fasciata* reported that sunny orientation offers a dry environment thus decreases the number of ectoparasites in the nest [48]. This is also a strong argument considering the self protection of adults from arthropods and other parasites and the raising chicks in a healthier environment.

As a conclusion, Turkey holds one of the largest Egyptian vulture populations in Europe [10; 19]. Middle and Upper Sakarya Region population is an important constituent with 53 territorial pairs [20]. Individuals mainly use limestone rock formation and nests are located on small rocks and the mean nest height is low. Aspect of the nests is predominantly southwestern and the most abundant nest type is cave which provides individuals wider and safer breeding environment. Also ancient man-made constructions were alternative nesting fields in our study area. Middle and Upper

Sakarya Region is an important area where individuals may use different types of nesting areas. Although we did not evaluate the anthropogenic impacts on nest characteristics, low cliff and nest height may be indicate the low predator stress and human disturbance in our study area. Contrary to this, abundance of the cave type nest in our study area which provides more inaccessible and invisible breeding environment may link to better protection against predators. In order to clarify these factors detailed researches are required on the nest-site quality and habitat use in relation to breeding parameters and stress factors as predators and human induced activities. Furthermore threats to the species should be determined both locally and throughout the country in order to undertake essential conservation actions for the Egyptian vulture in Turkey.

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