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First Data on Breeding Ecology of the Egyptian Vulture Neophron Percnopterus (Linnaeus, 1758) in Oum El Bouaghi Cliffs (Eastern Algeria)

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ABSTRACT

This paper presents the first detailed description and investigation of the Egyptian vulture's breeding ecology in Algeria. The study was carried out during the period 2014-2017 in Tarf Mountain in the semi-arid High Plateaux region. Characteristics of 7 nests were studied. The height was different among the nests ranging from 4 to 38m. They were all settled on cliffs (height between 12 and 33.4 m) either in shallow caves (71.43%) or on ledges (28.57%). The nests' orientation was towards the north-east located (4816.02±273.73m) away from the dump, and (50.63 ±30.12 m) away from the nearest neighbor. The laying period lasted for 40 days and the mean clutch size was (1.86±0.38) egg. The mean hatching success was (57.14±44.99%), and the fledging success was (71.43±48.80%). Only 2 nests failed. The results of this study contrasted with some previous studies, carried out mainly in Europe and Asia. The presence of the global endangered Neophron percnopterus with high breeding success confirmed the importance of Tarf Mountain for raptors' conservation.

Keywords: *Egyptian Vulture, Breeding Ecology, Nest Characteristics, Algeria.*

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1. INTRODUCTION

The Egyptian Vulture Neophron percnopterus is a medium-sized scavenger distributed throughout southern Europe, north, west, central, and east Africa, the Middle East, Transcaucasia, central Asia, and the Indian subcontinent (Ferguson-Lees, 2001; Arkumarev et al., 2014). Its global population has been estimated to be about 20,000 - 61,000 individuals (BirdLife International, 2014), 3,000 – 47,000 pairs were estimated in Europe (BirdLife International, 2008), < 2,000 pairs in central Asia, just few thousands pairs in the Indian subcontinent, 1,000 pairs in Middle East, and about 1,000-2,000 pairs in Africa (BirdLife International, 2017).

The Egyptian Vulture has been qualified as endangered worldwide owing to a recent and rapid population decline in Asia and severe long-term decline in Europe and Africa. From 3 known subspecies (Cramp and Simmons, 1983), the Neophron percnopterus is the only one who breeds in North African regions (Heim De Balsac and Mayaud, 1962).

This species is very common in Morocco. It breeds on cliffs all over the country's regions, and its wintering ground is in tropical Africa (Dakki, 1987). In Tunisia, the Egyptian Vulture is present all over the Tunisian cliffs as a migrant breeder. The breeding population kept decreasing because of both poaching and illegal traffic (Isennman et al., 2005).

In Algeria, breeding extends from the coast southwards to Saharan Atlas and beyond (Beni Ounif, Bechar and Tindouf) (Ledant et al., 1981). Moali and Gaci (1992) censused 32 nests in 1989. In the south, there exists a small, probably sedentary population in the Ahggar and also in the Tassili (Isennman and Moali, 2000).

In Europe and Asia, many studies on the Egyptian vulture's breeding ecology have been undertaken (Bergier and Cheylan, 1980; Donázar and Ceballos, 1989; Carlon, 1992; Liberatori and Penteriani, 2001; Angelov et al., 2013).

This aspect was only undertaken in Morocco by EL Khamlichi and Prat Duran (2014), and Amezian and El Khamlichi (2016).

In Algeria, Neophron percnopterus has received a very little attention by ornithologists. The main carried out studies were based on the dispatched observations recorded intermittently in limited geographical area (Heim de Balsac and Mayaud, 1962; Dupuy, 1966; La Ferrère, 1968; Ledant et al., 1981; Moali and Gaci, 1992).

The aims of the present study were to monitor the Neophron percnopterus during the breeding season, and provide information on some aspects of its breeding ecology and its nests' characteristics in Algeria.

2. MATERIAL AND METHODS

Study area

The High Plateaux is located between the Saharan Atlas and the narrow coastal plains of Algeria. This transition area contains a large diversity of habitats such as mountains, valleys and plateaux, where the landscape is dominated by steppe vegetation.

Egyptian Vulture reproduction takes place in Tarf Mountain (35°50' N, 07°10' E), located in the eastern High Plateaux of Algeria (Figure 1). The breeding site was located around 1 km from the road, and at 4 Km from the nearest slaughterhouses' wild dump.

This mountain is situated at 1,134 m above sea level and covers around 3.98 km². It's limited:

- On North by Sidi Reghis mountain (1635 m) and El Medfoune plain;
- On North-west by Guellif mountain (1161 m);
- On East by El Medfoune and F'Kirina plains;
- On West by Guellif wetland and the national road N° 83;
- On West-south by Fdjoudj (1248 m) and Gouriret (1188 m) mountains.

The climate is semi-arid, with an annual mean temperature of 15.5°C and an average annual rainfall of less than 400 mm. This fissured calcareous type (Karst) is rich in boulders, cliffs and degraded formations in gorse. Cliffs and shrubs that grow on their faces which are dominated by Pistacia lentiscus are shelters and refuges for Black Kites while boulders are used for hunting. The landscape is dominated by xerophilous vegetation adapted to aridity. Trees are dispatched, except for steppe plants which are mainly represented by Diss Ampelodesmos mauritanicus and White wormwood Atemisia herba alba.

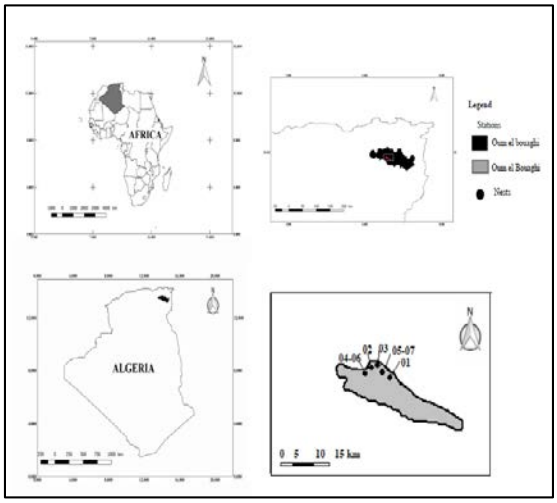

Figure 1: Study area with geographical locations of the 7 nests of the Egyptian Vulture in Tarf mountain (Algeria)

3. DATA COLLECTION

Egyptian Vulture nests were monitored in Tarf Mountain every year between 2014 and 2017.A territory was considered occupied if a pair or a single bird was observed with territorial behavior at the beginning of the breeding season (Oppel et al., 2016). Surveys were stretched on 180 days per year, with the aim to identify breeding sites and nests' locations. The foot survey method started in March to provide an opportunity to seek for raptors and observe their flights and displays (Fuller and Mosher 1987). Therefore, this last method also provides an access to Roadless tracts and rugged field (Forsman, 1983). Nests' locations were recorded using a Garmin GPS. The geographic position of each nest was calculated from the nearest accessible point. Also, information was collected on variables influencing the physical environment, landscape composition, food availability, human disturbance, and interspecific biological interactions for the studied territory (Table 1).

A laser altimeter was used to calculate both cliff and nest heights. The orientation of nests was measured by using Garmin GPS with a compass. All distances were determined using ArcGIS 10.2.2 software after geographic positioning of the nests.

Eggs, chick numbers and nest support were observed using a perched Endoscopic Camera for the inaccessible nests or simply by using binoculars and a high zoom camera (Canon x46) for the accessible ones. To minimize disturbance and risk of desertion, nests were rapidly visited during incubation or hatching period.

The hatching success was defined as the proportion of hatched eggs / hatched + unhatched ones, and fledging success was defined as the proportion of fledged chicks / hatched eggs.

Table 1. List and description of 08 environmental variables used in the current study

Variables	Definition
Nest Site	
NestHeight	Vertical distance from the base of the cliff to the nest (m)
Cliff Height	Vertical distance from the base to the top of the cliff (m)
Orientation	Compass direction into which the nest faces
Altitude	Height of the nest above the sea level
Support	Nest type: ledge, shallow cave
Landscape	
DistForest	Distance to the nearest forest
DistDump	Distance to the nearest Dump
NND	Nearestneighbour distance (m)

4. RESULTS:

4.1. Occupation of territories

The Egyptian Vulture starts courtship displays over Tarf Mountain in the second week of March. The first coming individuals were observed on march 12th in 2014, march 18th in 2015 and march 13th in 2016. The copulation behaviour was first recorded a few days after their arrival.

4.2. Nest placement characteristics

Neophronpercnopterus tends to build its nest in shallow caves and ledges on Tarf cliffs with a preference to shallow caves (71.43%) (Fig.3). It can either resettle the old nests of other raptors species or also reuse its own from the last breeding season when the last breeding was successful.

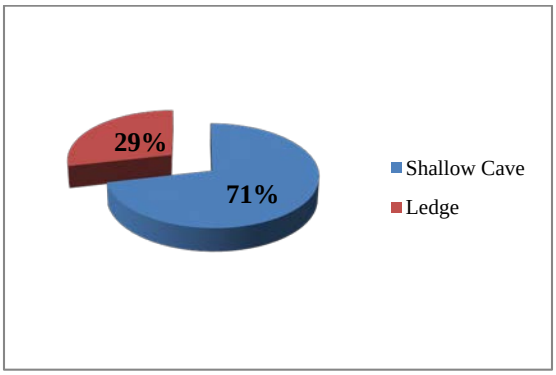

Figure 2: Nest supports of the Egyptian Vulture.

The largest nests were constructed of two layers. The first layer was made of dry sticks forming a basis, and the second one that was made of sheep's wool and old rags (Fig.4).
The nests were settled on altitudes that range from 942m to 1043m with a mean of 988.71±41.95 m. Their height varied from 4 m to 27.38m with a mean of 18.38±13.00 m in cliffs whose height ranged from 12m to 44m with a mean of 26.69±10.82 m.
According to Fig.4, Egyptian Vultures tend to construct their nests on the north-eastern side (85.71%) of Tarf mountain.
The data were obtained regarding the different variables of the landscape that showed a distance to the nearest dump varying from 4 to 5 kilometers (mean=4816.02±273.73 m) and a near neighbor distance ranging from 9.16m to 78.56m with a mean of 50.63±30.12 m.

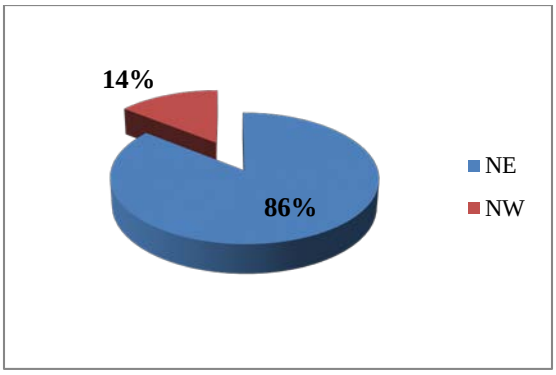

Figure 3. Nest orientations of the Egyptian Vulture

Table 2: Nest placement and breeding success parameters of Egyptian Vulture breeding in Tarf Mountain, Algeria

Nests	Alt (m)	CH (m)	NH (m)	DD (m)	NND (m)	Clutch size	Hatching success (%)	Fledging success (%)
1	974	12	4	4821.41	78.56	2	0	0
2	982	44	38	4811.57	67.43	1	100	100
3	995	24	18	4592	45.98	2	0	0
4	942	20	6.96	5182.79	72.06	2	100	100
5	1043	33.4	27.38	4560.79	9.16	2	50	100
6	942	20	6.96	5182.79	72.06	2	100	100
7	1043	33.4	27.38	4560.79	9.16	2	50	100
Mean ± SD	988.71±41.95	26.69±10.82	18.38±13.00	4816.02±273.73	50.63±30.12	1.86±0.38	57.14±44.99	71.43±48.80

CH: cliffs height (m); NH: nest height (m); Alt: altitude (m), DD: distance to dump (m)

4.3. Laying period and clutch size

The first egg was laid respectively on April 18th, 17th and 19th in 2014, 2016 and 2017, respectively. In 2015, the laying period was postponed of 10 days to April 30th.
Clutch size ranged from 1 to 2 eggs (Tab. 2). Mean clutch size was 1.86±0.38 eggs per nest. 85.71% of nests have 2 eggs per nest except for the nest number 2 (one egg). No replacement cases of clutches in the same nest were observed after breeding failures.

4.4. Hatching and fledging success

Eggs in the years 2014 and 2016 similarly hatched on May 28th and 27th with an incubation period of 41and 40 days, respectively. However, in 2015, it lasted for 45 days with the first recorded egg hatching in June 15th.
The mean of hatching success was relatively high (57.14±44.99 %). Out of 7 recorded nests, there were two failed hatchings, and two others succeeded with a hatching rate of 50%. The rest (3 nests) 100% succeeded in hatching (Tab.2).
100% chicks fledged form the five active nests. The mean of fledging success was 71.43± 48.80% (Tab.2)

5. DISCUSSION AND CONCLUSION

The Neophron percnopterus was up-listed in 2007 from a least concern to Endangered on the IUCN Red List of threatened species (BirdLife International 2014). The situation is more worrying in Algeria as there has been no information about this species in recent decades, and its current status has not been well known.

One of the main aims of this study was to provide preliminary information on breeding ecological aspects of Egyptian Vulture Neophron percnopterus in Algeria and, particularly, in the High Plateaux region.
In this study, the total Egyptian Vulture breeding population in Tarf mountain was estimated to be 7 monitored pairs since the first arrival from the second week of march with a delay of 5 days in 2015 comparing to the other years.
Some of them were faithful to their old nests especially when they succeed in the previous breeding season (Snow and Perrins, 1998). Others chose to use old nests of other species as the case of Bubo ascalaphus nest in this study.
Selection of nest site and nest materials is considered as an important factor determining the breeding success of many birds' species (Coulson, 1968; Mc Crimmon, 1978; Ryder and Ryder, 1981; Rendell and Robertson, 1989; Lip, 1991; Tuomenpuro, 1991). The Egyptian Vulture nest is large and quite complex. The two structured layers of the nest give it strength and durability, thereby preventing it from the distortion and falling apart (Shivangi et al., 2017). Their nests were placed on suitable cliffs with shallow caves and ledges which were very common for this species (Ferguson-Lees, 2001). Most of these nests (85.71%) were settled in the north-east side of the cliffs unlike the Southeastern side reported by Liberatori and Penteriani (2001) in Italy. The possible reasons for this preference have not been discussed extensively in raptor literature, but it might be related to the optimal use of sunshine (Carlon, 1992).
The recorded low altitude (mean=988.71±41.95 m) proved that the Neophron percnopterus has a strong preference for

nesting at low elevations as reported in Turkey by Şen (2017). Mateo-Tomas and Olea (2009), attributed the general negative trend between the probability of nesting and elevation to the adverse climatic conditions on high altitudes.

According to Şen (2017), the most important variable affecting the breeding success of the Egyptian Vultures was cliffs' height followed by the distance to dump site.

Liberatori and Penteriani (2001), Donázar et al. (2002), Mateo-Tomas and Olea (2010), found that the Neophron percnopterus tends to occupy territories which contained higher cliffs in contrast with the case of this study in which the Egyptian vulture chooses to occupy lower cliffs (mean=26.69±10.82 m) in similar lower nests on a height of 18.38±13.00m.

Food supply is considered as the most important factor limiting raptor densities (Donázar and Ceballos, 1989). Moreover, food shortage seems to be responsible for the decline of the Egyptian Vulture in many places in Europe (Thiollay 1966; Bergier and Cheylan, 1980). Most Egyptian vultures nest on the North-west side of Tarfmountain which is the nearest point to the Dump to minimize the energy investment in finding and carrying food to the nest (Eltringham, 1975; Bergier and Cheylan, 1980). In comparison to other European and Asian populations (Bulgaria: 2750 m, Pyrenean chain: 6830m, Catalonia: 7000m, Italian peninsula: 24,511 m, Turkey: 1510 m; see references in Şen, 2017), our NND is very low (mean=50,63±30,12m).

The abundance in food sources might alter a raptor's territorial behavior in terms of reduced aggressiveness and increased attacking distance when an intruder bird is present within the territory (Newton, 1979).

Egyptian Vulture breeds once a year. In Morocco, it starts egg-laying from late March to early May (Thévenot et al. 2003). However, egg- laying during this research occurred a little bit earlier between April 17th and 19th.

After an incubation period of 40 days, 57.14% (±44.99) of eggs succeeded hatching. Only two nests failed since the eggs were found broken probably as a result of raven attacks. It can be declared that higher breeding rates along this study period might be related to increased food supply from the dump site. The influence of food supply on breeding rates of raptors is well established phenomenon (Newton, 1979).

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