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A Study on Breeding Behavior of Egyptian Vultures in the Churu District of Rajasthan, India

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ABSTRACT: The Egyptian Vulture (*Neophron percnopterus*), an endangered avian scavenger, exhibits complex breeding behaviors critical to its survival and population stability. This study explores the breeding ecology of Egyptian Vultures in the Churu district of Rajasthan, a region characterized by semi-arid conditions.

KEYWORDS: Egyptian, vulture, breeding, success.

I. INTRODUCTION

The Egyptian vulture (*Neophron percnopterus*), sometimes known as the Scavenger vulture in South Asia, is a little Old-World Vulture that inhabits regions ranging from southwestern Europe and northern Africa to southern Asia. Smaller in size compared to other vultures, this white and black bird of prey with a bare yellow face captivates us with its cleverness and mysterious appearance. This vulture holds significant cultural significance. Studying the breeding behavior of species is essential for understanding their reproductive strategies, population dynamics and ecological roles. It helps identify factors influencing breeding success. This knowledge is crucial for formulating effective conservation strategies, especially for threatened species, ensuring their survival and ecological balance. Therefore, this study focuses on studying breeding behaviour of Egyptian vulture in the Churu district of Rajasthan, India.

II. BREEDING BEHAVIOR OF THE EGYPTIAN VULTURE

The methodology for studying the nesting and breeding ecology of the Egyptian vulture involves a combination of specialized techniques and systematic observations to gather comprehensive data. Clift and tree-entry techniques are employed to access nests located on cliffs or trees, which are the preferred nesting sites of these vultures. These techniques involve skilled climbing and the use of safety gear to closely inspect nesting materials, eggs, and nestlings while minimizing disturbance. This direct access provides accurate information about nesting patterns, egg-laying, and chick development. To classify reproductive efforts, several criteria are utilized. Territory occupancy is monitored by identifying and tracking breeding pairs within specific territories, which indicates active reproductive zones. Observation of egg-laying events helps determine clutch sizes and parental efforts. The study also focuses on nesting success and productivity, which are key indicators of reproductive health. Nesting success is assessed by the number of fledglings produced per nesting attempt, while productivity is evaluated based on the total offspring over a breeding season. Field techniques play a pivotal role in data collection, with regular visits to nests providing insights at every stage of the nesting cycle. Observations during these visits include nest site selection, incubation progress, chick growth, and parental behaviors such as feeding and brooding.

1. Clutch Size, Hatching Success and Fledgling Success Per Nest: The foot survey approach commenced in March to facilitate the observation of raptors and their aerial displays. Eggs, chick counts, and nest support were monitored utilizing a perched endoscopic camera for inaccessible nests, or alternatively, through binoculars and a high-zoom camera for accessible nests.

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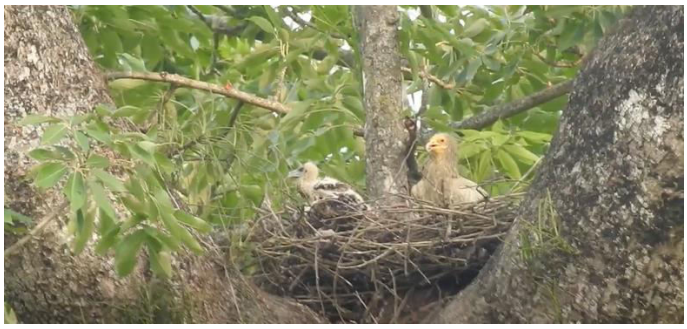
Fig 1: Adult with Chick in Nest



Nests were swiftly visited during the incubation or hatching period to reduce disturbance and the danger of abandonment. Hatching success was defined as the ratio of hatched eggs to the total of hatched and unhatched eggs, while fledging success was defined as the ratio of fledged chicks to hatched eggs. Clutch size ranged from 1 to 2 eggs, with a mean clutch size of 1.80 ± 0.45 eggs per nest. Among the five nests, 80% had 2 eggs, while only one nest (Nest 2) contained a single egg. No replacement clutches were observed in any of the nests following breeding failures.

Table 1: Breeding success parameters of Egyptian Vulture

Nest	Clutch size	Hatching success (%)	Fledging success (%)
1	2	50	50
2	1	100	100
3	2	0	0
4	2	100	100
5	2	50	50
Mean ± SD	**1.80 ± 0.45**	**60.00 ± 40.00**	**60.00 ± 40.00**

Fig 2: Eggs in Nest Scrape

The mean hatching success across the nests was 60.00 ± 40.00%. Two nests (Nest 1 and Nest 5) achieved a 50% hatching success rate, while two others (Nest 2 and Nest 4) had a 100% hatching success. However, one nest (Nest 3) failed completely, with no eggs hatching. Similar to hatching success, Nests 1 and 5 recorded a fledging success of 50%, and Nests 2 and 4 achieved 100% fledging success. Nest 3, where no eggs hatched, naturally recorded a fledging success of 0%. The data highlights potential differences in environmental factors, parental care, or nest site characteristics influencing the observed outcomes.

2. Breeding Pairs: A total of 50 territorial pairs of Egyptian vultures were observed during the study period. Of these, 39 pairs made breeding attempts, while 27 pairs were classified as successful, having fledged at least one juvenile. The breeding fate of 12 pairs remained undetermined due to various limitations such as restricted observation time, poor

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visibility, and the large study area. Territorial pairs were identified based on observations of one or more adults engaging in territorial defense or seen in the nest. Regular monitoring of nests was conducted using binoculars to determine breeding outcomes. Observations were carried out from safe distances, ensuring minimal disturbance to the birds. Each nest was visited multiple times (4-8 visits per breeding season) for accurate data collection. The unknown fate of 12 breeding pairs reflects the challenges associated with field studies on raptors.

Table 2: Breeding pairs of Egyptian Vulture

Number of territorial pairs	Number of pairs with breeding attempts	Number of successful pairs	Number of breeding pairs with unknown fate
50	39	27	12

3. Duration of Courtship and Incubation Period: The duration between the deposition of the first egg and the second egg was five days. Eggs are round, matte, off-white, somewhat smeared, and stained with reddish-brown. The eggshell was 0.66 mm in thickness and exhibited a rough texture with little protrusions. The degree of reddish-brown streaking varied among the eggs. In breeding season, the clutch size was two eggs. No alteration in egg coloration occurred throughout the incubation period.

Fig 3: Incubation by (A) Male (B) Female Egyptian Vulture

A B

The breeding adults were differentiated based on sex using facial color differences, the presence or absence of a black smudge under the eyes, and the size and characteristics of brood patches. Consistent with these observations, the female exhibited a yellow facial coloration and lacked a black mark beneath the eyes, whereas the male displayed an orange-yellow facial coloration and possessed a black mark beneath the eyes. A prominent, yellow-hued brood patch was observable in the female from the initial week of incubation. A small-sized brood patch was observed in the male during the sixth week of incubation. The appearance of a black patch on the forehead of the guy, in conjunction with these characters, served as a distinctive marker. Both parents incubated the eggs. Partial incubation occurred during both the egg-laying and hatching periods. During partial incubation, the incubating parent maintained a position distinct from that of full incubation by elevating its neck above the rim of the nest scrape. The parents were noted to dedicate considerable time to complete incubation from the conclusion of the clutch until the hatching of the eldest chick. Throughout the complete incubation period, the eggs were positioned sequentially beneath the body of the incubating parent, which maintained consistent physical contact with the eggs by gripping the nest rim with its hooked beak. Throughout the incubation period, both parents upheld the cleanliness of the nest scrape and refrained from defecating within or over the rim of the nest scrape. An incubating parent vacated the nest scrape and relocated to the opposite side of the nest platform to defecate.

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Fig 4: Observation of Growth of Egyptian Vulture

A. Elder chick 3 days old

C. Elder chick 24 days old

E. Elder chick 33 days old

B. Elder chick 54 days old

D. Elder chick 94 days old

The incubating parent periodically softened and fluffed the nest scrape beneath the eggs with its bent beak.

Table 3: Partial incubation in Egyptian Vulture during hatching period: total observation time (OT)

Incubating parent	Total stay in nest	Stay with partial incubation	Stay without partial incubation	Nest unattended
Male	48.95% OT (31.75 hours)	16.45% OT (10.67 hours)	32.50% OT (20.82 hours)	0.05% OT (0.03 hours)
Female	51.00% OT (33.06 hours)	37.45% OT (24.27 hours)	13.55% OT (8.79 hours)	
Total	99.95% OT (64.81 hours)	53.90% OT (34.94 hours)	46.05% OT (29.61 hours)	

During the hatching period, observations of the Egyptian vulture's incubation behavior revealed differences in the roles played by males and females in the nest. The total observation time (OT) recorded was 64.81 hours, with both parents contributing significantly to nest duties. Males accounted for 48.95% of the total stay in the nest (31.75 hours), while females contributed slightly more, with 51.00% of the total stay (33.06 hours). When considering time spent with partial incubation, females exhibited a higher contribution, with 37.45% OT (24.27 hours) compared to 16.45% OT (10.67 hours) for males. This indicates that females were more actively engaged in incubation duties during periods of partial coverage of eggs. Conversely, males spent more time in the nest without engaging in partial incubation, accounting for 32.50% OT (20.82 hours), as opposed to females, who spent only 13.55% OT (8.79 hours) in such periods. The nest was left unattended for a negligible amount of time (0.05% OT, 0.03 hours), reflecting a high level of parental care and vigilance by both sexes during this critical phase.

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Table 4: Full incubation in Egyptian Vulture: total observation time (OT)

Incubating parent	Total stay in nest	Stay with full incubation	Stay without incubation	Nest unattended
Male	42.15% OT (142.37 hours)	41.95% OT (141.72 hours)	0.20% OT (0.65 hours)	0.18% OT (0.60 hours)
Female	57.85% OT (195.63 hours)	57.62% OT (194.89 hours)	0.23% OT (0.74 hours)	
Total	100.00% OT (338.00 hours)	99.57% OT (336.61 hours)	0.43% OT (1.39 hours)	

The total observation time (OT) for full incubation in Egyptian vultures was 338.00 hours, during which both male and female parents demonstrated a high degree of involvement. Males contributed 42.15% OT (142.37 hours), while females had a larger share, with 57.85% OT (195.63 hours). This indicates a balanced yet slightly female-dominant division of incubation duties. Regarding time spent with full incubation, females were responsible for 57.62% OT (194.89 hours), reflecting their primary role in maintaining consistent incubation conditions. Males, meanwhile, contributed 41.95% OT (141.72 hours), showing their active participation but to a slightly lesser extent than females. Time spent in the nest without engaging in incubation was minimal for both sexes. Males accounted for 0.20% OT (0.65 hours), while females spent 0.23% OT (0.74 hours) in non-incubation activities within the nest. This low duration of non-incubation activity reflects the dedicated effort by both parents to ensure successful hatching. Nest unattended periods were almost negligible, with only 0.18% OT (0.60 hours) of total observation time recorded as unattended. This indicates a high level of parental vigilance and commitment during the incubation period, minimizing risks to the eggs.

4. Selection of Nest Material: The nests are built from a diverse array of materials. There is an absence of nest concealment. The nest materials can be categorized into ornamental, structural, and lining materials based on their construction type and the range of materials utilized. The layers, from the innermost to the outermost, consist of:

a) **The Lining Layer:** It is the delicate layer that maintains direct contact with the eggs and the nestling. Primarily composed of softer materials such as hosiery fabrics, wool, foam, linen, cotton, leather, jute, earth, and various other particles. In certain circumstances, manmade materials may serve as a valuable resource, facilitating nest construction in areas where natural resources are scarce.

b) **The structural layer:** It constitutes the foundation of the nest, primarily composed of plant materials, notably dried mesquite sticks and fibers. All of these are significant in relation to their function. The Structural layer is vital since it imparts strength and longevity to the nest design, hence averting distortion and disintegration. The materials of this layer are regarded as components of the structural layer. Multiple structural layers may exist.

c) **Outer Decorative Layer:** This layer consists of decorative nesting materials positioned externally to the structural layer, including bones, cow dung, feces, and roots. Its presence or absence is determined by the type of nest.

d) **Attachment:** It comprises the items employed to stabilize the nest's location. Its presence or absence is contingent upon the type of nest. It is typically lacking in nests that receive support from beneath.

Significant disparities existed between the characteristics of the materials employed and their configuration within the nest. The materials in the outer portion of the nest were much stronger, sharper, and more rigid than those in the inner half, which comprised relatively softer and smoother elements. The pointed and spiny mesquite branches and bones were likely employed as a defensive barrier, complemented with cow dung and the feces of mammals or ungulates for decorative purposes on the exterior.

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Table 5: Constituents of Egyptian Vulture Nest layers

S. No	Nest Materials	Nest layer	Physical and Mechanical Properties
1.	Bones	Decorative	Decoration and defence
2.	Linen	Lining	Natural fabric for coolness and comfort in warm weather
3.	Mesquite Sticks (Acacia nilotica)	Structural	Protective fence
4.	Cow dung	Decorative	Keeps soil evenly moist
5.	Faeces	Decorative	Pigmentation from ungulate faeces
6.	Woolen sweater	Lining	To keep the nest dry and warm
7.	Hosiery clothes	Lining	Provides softness
8.	Cotton	Lining	Moisture control
9.	Rubber	Lining	Provides resistance to scratches and injury
10.	Thread	Structural	As a binding material
11.	Leather	Lining	Resistance to fire, fungal infection and other mites
12.	Soil and other particles	Lining	Probably helps in maintaining temperature balance and sticking together the particles.
13.	Foam	Lining	Insulation
14.	Jute	Lining	Ecofriendly and provides strength
15.	Root	Decorative	Maintains Nest architecture

5. Nest Site Selection: The nests located were primarily in isolated places with minimal human interference, typically situated distant from the major road. The criteria examined for habitat selection were distance from the nearest road, proximity to water bodies, human habitation, nearest neighbor, and substrate height. Old nests are frequently repurposed. The Egyptian Vulture favors elevated nesting sites often situated in undisturbed regions, distant from human populations, yet proximate to high-quality habitats that provide food and water resources. Nests constructed were in proximity to other conspecific nests. They favor older trees for nesting, likely because substantial trees are required to support their massive nests.

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Fig 5: Abandoned Nest

6. Nestling Period: The maximum weight and tarsus growth for all examined nestlings occurred at 40 and 30 days of age, respectively. The growth rates of these structures during the final phase of the development period exhibited significant variability. The weight recession exhibited a significant coefficient of variation.

Fig 6: Adult Egyptian Vulture with Chick

Despite the diversity in weight and tarsus growth, the ultimate size of the nestling (defined by maximum weight attained, weight at fledging, and tarsus asymptote) was notably consistent. The rate of feather length growth remains rather stable during the nestling period. The hatching sequence and brood size appeared unrelated to the growth equation. The growth rates of second-hatched nestlings were, however, markedly different from those of single and first-hatched nestlings. In all structures, second-hatched nestlings experienced a significant delay during the early stages of the nestling phase. At the conclusion of the growth period, there were no discrepancies in tarsus size and weight. The postponement in attaining the requisite feather length for the inaugural flight causes a delay of 7-12 days for the maiden flight of second nestlings relative to their older siblings.

7. Factors Affecting Nest Building: The nesting distribution of the Egyptian vulture seems to be affected by climatic, environmental, and human-induced factors. Of the climatic conditions, annual precipitation had the greatest impact, potentially due to its role in prolonging carcass decomposition, hence facilitating vulture scavenging. Egyptian vulture nests are predominantly found in the regions which get considerable yearly precipitation. In these regions, refuse sites are prevalent in numerous communities, which surely attract Egyptian vultures for sustenance. East-facing slopes had a higher likelihood of hosting Egyptian vulture nest sites, and elevated temperatures resulting from early solar exposure may enhance thermals, hence facilitating earlier flight for foraging activities.

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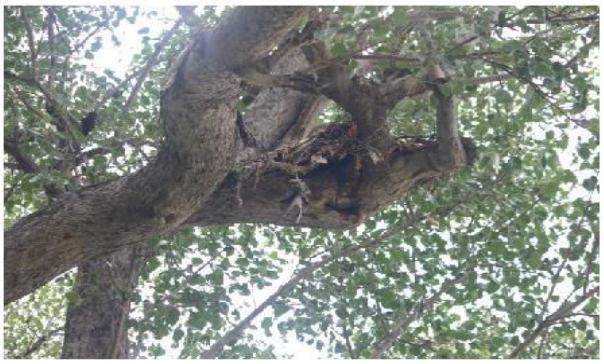
Fig 7: A Destroyed Nest on Peepal Tree



Forests and cliffs are more abundant near water sources, particularly rivers, which may be essential for vultures to cleanse themselves of waste from consuming carcasses and human rubbish. The proximity to agricultural land did not affect the presence of Egyptian vultures. The presence of Egyptian vultures near human settlements is likely attributable to increased food availability, such as slaughterhouses in the region. Nonetheless, anthropogenic disturbances such as roadways and associated vehicular traffic might diminish vulture populations.

III. CONCLUSION

The study on the breeding ecology of Egyptian Vultures in the Churu district of Rajasthan highlights the intricate behaviors and ecological adaptations of this species. Their careful selection of nest sites and materials underscores their dependence on specific environmental conditions for successful reproduction. Understanding these factors provides valuable insights into their life cycle and emphasizes the need for habitat preservation to ensure their survival. Conservation efforts focusing on protecting nesting sites and minimizing human disturbances are crucial for sustaining Egyptian Vulture populations in this region.

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