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Journal of Threatened Taxa

Building evidence for conservation globally

www.threatenedtaxa.org

ISSN 0974-7907 (Online) | ISSN 0974-7893 (Print)

COMMUNICATION

OBSERVATIONS ON BREEDING BEHAVIOUR OF A PAIR OF ENDANGERED EGYPTIAN VULTURES *NEOPHRON PERCNOPTERUS* (LINNAEUS, 1758) OVER THREE BREEDING SEASONS IN THE PLAINS OF PUNJAB, INDIA

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26 June 2020 | Vol. 12 | No. 9 | Pages: 16013–16020

DOI: 10.11609/jott.4539.12.9.16013-16020



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Observations on breeding behaviour of a pair of endangered Egyptian Vultures *Neophron percnopterus* (Linnaeus, 1758) over three breeding seasons in the plains of Punjab, India

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Abstract: The present study has been conducted to document information on breeding behaviour of Egyptian Vultures *Neophrons percnopterus* from Punjab. This study is based on 688 hours of video records documenting breeding behaviour of a pair of endangered Egyptian Vultures *Neophrons percnopterus* occupying the same nesting site over three consecutive breeding seasons from 2015 to 2017. The site is located in the hollow of a ventilation window of the Space Observatory in Punjabi University, Patiala, Punjab. During the third breeding period (February to August 2017), the nest activity has been extensively video-recorded in egg laying and incubation period, and chick rearing period using a Dome CCTV Camera. Both parents participated in nest building, and of the total recorded incubation time of 339.39h over 23 days the nest was attended for 199.35 and 139.46h by the female and male respectively, and unattended for 0.58h. The incubation period was 42 to 43 days, and the egg laying/hatching intervals between eggs/chicks was five days. A total of six young ones hatched and fledged from three broods of two eggs each. All chicks survived to fledging and no mortality or siblicide of younger chick occurred due to aggression/starvation by elder chick. The high fledging success rate indicates a healthy habitat and food source in the nesting area.

Keywords: Ecological role, feeding, habitat, incubation, nest, scavengers.

Punjabi abstract: ਖੇਤਰੀ ਅਧਾਰ 'ਪੱਖੋ', ਹਾਲੇ ਤਕ ਅਣਫਰੇਲੇ ਪ੍ਰਜਨਣ ਵਤੀਰੇ ਦੇ ਵੱਖ-ਵੱਖ ਪਹਿਲੂਆਂ ਸਬੰਧੀ ਜਾਣਕਾਰੀ, ਗਿੱਧਾਂ ਦੇ ਜੀਵਨ ਨਾਲ ਜੁੜੇ ਗਿਆਨ ਵਿੱਚ ਹੋਰ ਵਾਧਾ ਕਰਨ ਅਤੇ ਉਹਨਾਂ ਦੇ ਸੁਰੱਖਿਅਣ ਲਈ ਚੁੱਕੇ ਕਦਮ ਵਿਉਂਤਣ ਲਈ ਅਤਿ ਜ਼ਰੂਰੀ ਹੈ। ਇਹ ਖੋਜ-ਕਾਰਜ ਪੰਜਾਬ ਵਿੱਚ ਚਿੱਟੀ ਗਿੱਧ ਨੀਓਫ਼੍ਰਾਨਸ ਪ੍ਰਕਨੋਪਟੇਰਸ ਦੇ ਪ੍ਰਜਨਣ ਵਤੀਰੇ ਸਬੰਧੀ ਜਾਣਕਾਰੀ ਇਕੱਠੀ ਕਰਨ ਲਈ ਕੀਤਾ ਗਿਆ ਹੈ। ਇਹ ਖੋਜ-ਕਾਰਜ ਇੱਕ ਹੀ ਆਲੂਣਾ-ਸਥਾਨ ਮੱਲਣ ਵਾਲੇ ਇੱਕ ਚਿੱਟੀ ਗਿੱਧ ਜੋੜੇ ਦੇ 2015 ਤੋਂ 2017 ਤੱਕ ਤਿੰਨ ਲਗਾਤਾਰ ਪ੍ਰਜਨਣ ਸਮਿਆਂ ਦੇ 688 ਘੰਟਿਆਂ ਦੇ ਵੀਡੀਓ ਰਿਕਾਰਡਾਂ ਉੱਪਰ ਅਧਾਰਿਤ ਹੈ। ਇਹ ਆਲੂਣਾ-ਸਥਾਨ, ਪੰਜਾਬੀ ਯੂਨੀਵਰਸਿਟੀ, ਪਟਿਆਲਾ, ਪੰਜਾਬ ਸਥਿਤ ਸਪੇਸ-ਆਬਜ਼ਰਵੇਟਰੀ ਦੀ ਇੱਕ ਰੇਸ਼ਨਦਾਨ-ਖਿੜਕੀ ਵਿੱਚ ਹੈ। ਤੀਸਰੇ ਪ੍ਰਜਨਣ ਕਾਲ (ਫਰਵਰੀ ਤੋਂ ਅਗਸਤ 2017) ਦੌਰਾਨ ਆਲੂਣੇ ਵਿੱਚ ਅੰਡੇ ਦੇਣ, ਅੰਡਿਆਂ ਉੱਪਰ ਬੈਠਣ ਅਤੇ ਚੂਚਿਆਂ ਦੇ ਪੋਸ਼ਣ ਆਦਿ ਨਾਲ ਸਬੰਧਿਤ ਵਤੀਰੇ ਨੂੰ ਸੀ.ਸੀ.ਟੀ.ਵੀ ਡੋਮ ਕੈਮਰੇ ਦੁਆਰਾ ਵਿਸਥਾਰ ਨਾਲ ਵੀਡੀਓ ਰਿਕਾਰਡ ਕੀਤਾ ਗਿਆ। ਦੋਵੇਂ ਮਾਂ-ਬਾਪ ਆਲੂਣਾ ਬਨਾਉਣ ਵਿੱਚ ਭਾਗ ਲੈਂਦੇ ਹਨ। ਅੰਡਾ-ਪ੍ਰਫੁੱਲਣ ਕਾਲ ਦੇ 23 ਦਿਨਾਂ ਦੌਰਾਨ 339.39 ਨਿਰੀਖਣ-ਘੰਟਿਆਂ ਵਿੱਚੋਂ ਮਾਦਾ ਅਤੇ ਨਰ ਗਿੱਧ ਨੇ ਕ੍ਰਮਵਾਰ 199.35 ਅਤੇ 139.46 ਆਲੂਣੇ ਵਿੱਚ ਹਾਜ਼ਰੀ ਭਰੀ, ਜਦਕਿ 0.58 ਘੰਟੇ ਲਈ ਆਲੂਣਾ ਸੱਖਣਾ ਰਿਹਾ। ਅੰਡਾ-ਪ੍ਰਫੁੱਲਣ ਕਾਲ 42 ਤੋਂ 43 ਦਿਨ ਸੀ ਅਤੇ ਅੰਡੇ-ਦੇਣ/ਬੱਚੇ-ਨਿਕਲਣ ਸਮੇਂ ਅੰਡਿਆਂ/ਚੂਚਿਆਂ ਵਿਚਕਾਰਲਾ ਅੰਤਰਾਲ ਪੰਜ ਦਿਨ ਸੀ। ਦੋ ਦੋ ਅੰਡਿਆਂ ਦੇ ਤਿੰਨ ਪੂਰਾਂ ਵਿੱਚੋਂ ਕੁੱਲ ਛੇ ਚੂਚੇ ਨਿੱਕਲੇ। ਸਾਰੇ ਹੀ ਚੂਚੇ ਆਲੂਣੇ 'ਚੋਂ ਉਡਾਰੀ ਮਾਰਨ ਤੱਕ ਜਿਉਂਦੇ ਰਹੇ ਅਤੇ ਕਿਸੇ ਵੀ ਛੋਟੇ ਚੂਚੇ ਦੀ ਵੱਡੇ ਚੂਚੇ ਦੇ ਮਾਰਧੇਰੀ-ਵਤੀਰੇ/ਬੁੱਖਮਰੀ ਕਾਰਨ ਮੌਤ ਜਾਂ ਭਰਾ-ਹੱਤਿਆ ਨਹੀਂ ਹੋਈ। ਚੂਚਿਆਂ ਦੇ ਸਫਲਤਾ ਨਾਲ ਉਡਾਰੀ ਮਾਰਨ ਦੀ ਉੱਚ ਦਰ ਇਹ ਦਰਸਾਉਂਦੀ ਹੈ ਕਿ ਇਸ ਆਲੂਣਾ-ਖੇਤਰ ਵਿੱਚ ਚਿੱਟੀ ਗਿੱਧ ਲਈ ਇੱਕ ਸਿਹਤਮੰਦ ਰਹਿਣ-ਬਸੋਦਾ ਮੌਜੂਦ ਹੈ।

Editor: Chris Bowden, Royal Society for the Protection of Birds, Sandy, UK.

Date of publication: 26 June 2020 (online & print)

Citation: Kumar, C., A.S. Kaleka & S.K. Thind (2020). Observations on breeding behaviour of a pair of endangered Egyptian Vultures *Neophron percnopterus* (Linnaeus, 1758) over three breeding seasons in the plains of Punjab, India. *Journal of Threatened Taxa* 12(9): 16013–16020. <https://doi.org/10.11609/jott.4539.12.9.16013-16020>

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Funding: None.

Competing interests: The authors declare no competing interests.

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Author contribution: Study design and field work: Sandeep Kaur Thind and Amritpal Singh Kaleka; video-reviews, analysis and article drafting: Charn Kumar.

Acknowledgements: The authors are grateful to the head, Department of Physics for giving permission to install the CCTV camera in the space observatory of the department to record various stages of brooding. The authors also thank Mr. Ravinder Singh, incharge, Space Observatory, Punjabi University, Patiala for extending logistic support during the tenure of this study.



INTRODUCTION

Punjab is primarily an agrarian state, with 84 percent of its area under agriculture and 6.5 percent under forest (Singh et al. 2014). Since independence many local environments have been impacted by deforestation, industrialization, increased transportation networks, modern agricultural practices, urbanization, and other anthropogenic factors. As a result, Punjab has lost much of its forest and dominant wildlife. Vultures are important to human beings and the environment because they feed upon the carcasses of dead animals and act as scavengers. On the basis of road transect surveys conducted from 1991 to 2003 in and around 18 national parks and wildlife sanctuaries spread across the northern, western, and eastern parts of India, Cuthbert et al. (2006) recorded an 80% decline in the population of Egyptian Vulture (EV) *Neophrons percnopterus*, due to poisoning by the veterinary drug diclofenac and other factors. The rapid decline in populations in India (Cuthbert et al. 2006), combined with severe long-term declines in Europe, western Africa and the rest of its African range, has led this species to be classified as Endangered in the IUCN Red List of Threatened Species since 2007 (BirdLife International 2017).

As per Grimmett & Inskipp (2010), there are seven species of vultures in Punjab and the EV is an not-common resident. Nevertheless, Punjab is not an exception to the global population decline of vultures, and Kler & Kumar (2014) while monitoring 18 animal flaying/disposal sites located in nine districts of Punjab under an All India Network Project on Agricultural Ornithology, reported occurrence of only EV from only two sites located in districts of Ropar and Kapurthala. Presently, this species is sighted at only a few animal carcass dumping sites located nearer to Shivalik foothills in Punjab and there exists no study documenting the breeding aspects of any vulture species from the agricultural plains of Punjab. Vultures provide a variety of economic, ecological, and cultural services (Ogada et al. 2012), and studies on habitat requirements of endangered species are crucial for conservation purposes (Manly et al. 1993; Noss et al. 1997).

The present study documents aspects of the breeding biology of EV that include breeding time, nesting site, clutch size, incubation, nestling period, feeding and nestling growth pattern, reproductive success, and parental care.

BACKGROUND

Perusal of available sources reveals that barring a

few studies documenting EV sightings at animal carcass disposal sites, by Malhi & Kaur (1999), Kler (2004), and Kler & Kumar (2014), no attempt has been made to study the breeding biology, habitat ecology, distribution, and impact of human disturbances of vultures living in the plains of Punjab. Naoroji (2006) gave definitive account of status, distribution, feeding, and breeding aspects of EV from the Indian subcontinent. Although the EV was well known to ornithologists of the 19th and 20th centuries, detailed accounts of nesting are few (Ramirez et al. 2016). Cuthbert et al. (2006) and Galligan et al. (2014) documented population declines of EV from India. Other studies exploring aspects like distribution, dispersal, effect of human activities, and conservation of EV from different regions include: Donazar & Ceballos (1989), Liberatori & Penteriani (2001), Margalida & Boudet (2003), Sara & Vittorio (2003), Carrete et al. (2007), Zuberogitia et al. (2008), Hernández & Margalida (2009), Elorriaga et al. (2009), Angelov et al. (2013), Zuberogitia et al. (2014), and Tauler-Ametller et al. (2017).

STUDY AREA

The study area is located within a radius of 3km from the Space Observatory located at geographical coordinates 30.359°N & 76.445°E in Punjabi University, Patiala (Punjab). The university campus of over 323 acres is situated in the outskirts of Patiala City, surrounded by adjoining semi-urban and cropland areas. This territory is characterized by the presence of urban patches, open croplands, an old drain 'Badi Nadi', small forest patches, slaughter houses and rubbish dumps/animal carcass disposal sites. The climate is typical of the Punjab plains in being hot in summer and cool in winter. Habitat components around the nesting site provide a mixture of feeding sites, natural vegetation, agricultural lands, and human settlements suitable for EV breeding.

MATERIALS AND METHODS

During the course of weekly field surveys (2015–2017) undertaken to document the avifauna dwelling in the agricultural plains of district Patiala, a pair of EV was first sighted at a rubbish dump/animal carcass dumping site located at 30.361°N & 76.441°E near the village Saifdipur at the time of pre-laying period in February 2015. Municipal waste and animal carcasses are dumped at this site. Following the direction of flight over the fields and examining likely sites, a nesting site was located about 1km away from rubbish dump/animal

carcass dumping sites in the Space Observatory of Punjabi University. Repeated site visits were undertaken from 2015 to 2017, and video data was recorded in 2017. During the first and second breeding periods (February–August, 2015 & 2016) observations on incubation, feeding, breeding success, and activities of chicks were made from a secure distance using Olympus 10x50 DPS binoculars, and also via direct nest visits. During the third breeding period (February–August 2017) the nest was monitored during egg laying, incubation, and chick rearing period using a Dome CCTV camera with inbuilt-SD Card (32GB) recording. The camera (9.3 x 7 x 9.3 cm) was mounted in the window corner opposite to the nest, and data were extracted every third/fourth day by replacing the SD card without disturbing incubating birds or chicks. The nest was built on the ventilation window platform of the observatory store, allowing observation to be performed discretely from inside the store through a partly-opened frosted glass window. A 3.5m long wooden ladder was placed against the wall in the store to reach the window. The incubating parent did not directly notice the presence of the observer except for observer's hand extending in the window corner to remove the camera. The parent never left the nest during the first week, and at times tried to attack the observer's hand. Before the start of incubation, the nest site was inspected twice a day to document egg laying. Still photography was done using a Sony A-57 DSLR camera fitted with Tamron 18-200mm telephoto lens. Nest activities were also monitored from a secure distance using binoculars. Location measurements were obtained using a Bosch GLM 40 laser distance meter. Video records spanned 23 days and 688 hours, supplemented by photographs and direct observations.

OBSERVATIONS AND RESULTS

Nest Site and Nest Construction

During January and February (the pre-laying period), both members of the pair were first sighted visiting the nest site (Space observatory and nearby academic block) in the early morning and evening hours, carrying nest material to the cuboid hollow (1.9m x 0.66m x 0.5m) of the ventilation window of the space observatory (Image 1), 25.9m above ground level. The aspect of the hollow was towards the south. The addition of nest material continued during the incubation period. The nest material haphazardly placed over the entire platform (1.9m X 0.66m) included branched/unbranched dried twigs, dried bark and leaves of *Eucalyptus*, pieces of cardboard packing boxes, towel and soiled cloth pieces, thick strips of sawdust board, polythene sheet pieces, empty poly milk pouches, coconut coir, wool, cotton pulled from disposed beddings, jute rug pieces, dried human faeces, pieces of writing paper, sanitary napkins, animal fur, pieces of polypropylene cement bags, pieces of sink hose, rotten pumpkin, and other debris. At the time of laying the first egg (03 March 2017), these contents of the nest were seen scattered all over the nest platform, however, after laying of the second egg (08 March 2017), contents including cotton, woolen fragments and jute rug pieces were arranged to form a scrape (inner width 10" & outer width 14") around the eggs (Image 2). Most of this nest material was from waste items, and about four days before the hatching of first chick (10 April 2017) both the parents piled dry twigs along the open side of the platform, as if to form a barricade to prevent chicks from falling. During the chick rearing period, remains of food items including



Image 1: Nesting site: Space Observatory, Punjabi University, Patiala. © Charn Kumar.

the bones of pigeons, rats, snakes and dogs, and bird feathers appeared in the nest. During the subsequent 42 days of incubation till hatching of the second egg (19 April 2017), the incubating parents maintained the scrape edges by repeatedly arranging the lining material (cotton, soiled cloth pieces, jute rug pieces, sanitary napkins) using their hooked beaks.

Egg Laying and Incubation

The interval between the laying of the first (03 March 2017) and second eggs (08 March 2017) was five days. Eggs are oval, non-glossy, dull-white, partly smeared, and streaked with reddish-brown. Egg shell was 0.66mm in thickness and rough with small protrusions. The extent of reddish-brown streaking was variable between eggs. During the three consecutive successful breeding seasons (2015, 2016, 2017), the clutch size was two eggs/per year. No change in egg coloration happened during the course of incubation.

The breeding adults were sexed on basis of difference in face colour (Newton & Olsen 1990; Clark & Schmitt 1998), presence or absence of black smudge below eyes (Levy 1990) and the size and appearance of brood patches. In consonance with these, the female had a yellow face colour and no black smudge below the eyes, whereas the male had an orange-yellow face colour and a black smudge below the eyes. A yellow coloured, well-marked, larger brood patch was visible since the first week of incubation in the female. In case of the male a small sized brood patch was seen during the sixth week of incubation. Coupled with these characters, the presence of a dark patch on forehead of male proved as a distinct marker in all the video records.

Both the parents incubated the eggs (Images 3 & 4). Partial incubation was observed during the egg laying period and hatching period. Wang & Beissinger (2011) also observed such incubation. In partial incubation, the adult/s attended the nest but were observed sitting on the egg less regularly in a non-rhythmic manner as compared to the intensity of incubation after completion of the clutch. A review of 131 video clips spanning 64.99 hours of observation time (OT) spread over five days and four nights of hatching period (Table 1) revealed that the nest platform remained unoccupied by the parents only for two short diurnal absences of 0.07% (0.05 hour) OT and the parent/s were in the nest for 99.93% (64.94 hours) OT. During their stay in the nest, the parents were engaged in partial incubation of the egg for 53.96% (35.07 hours) OT, male incubating for 15.94% (10.36 hours) OT and female incubating 38.02% (24.71 hours) OT. They alternatively changed the incubation shifts 20



Image 2. Eggs in nest scrape.



Image 3. Incubation by Egyptian Vulture - male.



Image 4. Incubation by Egyptian Vulture - female.

Table 1. Time budget of partial incubation in Egyptian Vulture during hatching period (14–19 April 2017) On basis of video records: total observation time (OT) of 64.99 hours.

Incubating parent	Total stay in nest	Stay with partial incubation	Stay without partial incubation	Nest unattended
Male	49.94% OT (32.45 hours)	15.94% OT (10.36 hours)	34% OT (22.09 hours)	0.07% OT (0.05 hours)
Female	49.99 % OT (32.49 hours)	38.02% OT (24.71 hours)	11.97% OT (7.78 hours)	
Total	99.93% OT (64.94 hours)	53.96% OT (35.07 hours)	45.97% OT (29.87 hours)	

Table 2. Time budget of full incubation in Egyptian Vulture (09 March–10 April 2017). On basis of video records: total observation time (OT) of 339.39 hours.

Incubating parent	Total stay in nest	Stay with full incubation	Stay without incubation	Nest unattended
Male	41.09% OT (139.46 hours)	40.90% OT (138.81 hours)	0.19% OT (0.65 hours)	0.17% OT (0.58 hours)
Female	58.74 % OT (199.35 hours)	58.52% OT (198.61 hours)	0.22% OT (0.74 hours)	
Total	99.83% OT (338.81 hours)	99.42% OT (337.42 hours)	0.41% OT (1.39 hours)	

times, and male and female stayed two nights each in the nest. While sitting on the eggs in partial incubation, the incubating parent adopted a posture different than that in the full incubation by keeping the neck raised above the edge of the nest scrape.

The parents, however, were observed investing much time in full incubation after completion of clutch till the hatching of elder chick. A review of 688 video clips spanning 339.39 hours OT referable to 23 days and 17 nights of full incubation (Table 2) revealed that the nest platform remained unattended by the parents only for 16 short diurnal absences of 0.17% (0.58 hour) OT and the parents stayed in the nest for 99.83% (338.81 hours) OT, male incubating for 40.90% (138.81 hours) OT and female incubating 58.52% (198.61 hours) OT. There occurred 32 incubation shift changes during 339.39 hours full incubation OT.

During full incubation period, the eggs were kept below the body one behind the other and the incubating parent used to maintain a firm body contact with the eggs by exerting a grip over the nest rim with its hooked beak. In avian incubation, egg turning behavior plays an important role in ensuring proper embryonic development (Taylor et al. (2018). Both the incubating parents regularly turned the eggs using beak or feet for a total of 983 times, male and female 416 and 567 times, respectively.

The incubating male was very sensitive to disturbances near the nest and produced hoarse warning hisses to the Black Kites flying near the nest. During the course of incubation, both the parents maintained

sanitation of the nest scrape and never defecated inside or over the rim of the nest scrape. An incubating parent left the nest scrape and moved away to other side of the nest platform to defecate. While sitting on the eggs, they also maintained the scrape rim by resetting the nest material. The male and female parent contributed 181 and 177 nest resetting attempts, respectively. The floor material of the nest scrape below the eggs was made soft and fluffy from time to time by the incubating parent using its curved beak. The male and female made 278 and 693 nest softening actions, respectively.

Hatching, Feeding and Fledging of nestlings

During the 2017 breeding season, an incubation period of 42 days and asynchronous hatching period of five days were recorded as the two eggs laid on 03 March and 08 March 2017 hatched on 14 and 19 April respectively. After hatching of the elder chick, both the egg and chick were incubated by the parents till hatching of the younger chick. Newly hatched chicks had naked faces, open eyes and bodies with fluffy, creamish down (Image 5). Both the parents brought food (dead pigeons, rats, snakes, human faeces, etc.) for the nestlings at regular intervals, and food was also kept in reserve scattered on the nest platform. Parents held food items in their claws and broke small pieces provided to the chicks. The body plumage markedly changed after four weeks with emergence and growth of new feathers (Image 6–9). During third week after hatching, the nestlings left the nest crater and were confined to one corner of the nest platform till completion of fifth



Image 5. Elder chick 3 days old



Image 8. Elder chick 54 days old



Image 6. Elder chick 24 days old



Image 9. Elder chick 94 days old



Image 7. Elder chick 33 days old

week, and then they started moving around the window platform. During this phase the parents were seen sitting on the observatory dome nearer to the nest window. The fledglings were observed out of nest platform exploring adjacent windows 94 days after hatching, and on the dome of the space observatory 98 days after hatching. They left the nesting site 112 days (16 weeks) after hatching. At the time of fledging they had a darker body, grayish face and short feathers on neck and crown.

DISCUSSION

Food availability is an important determinant of nest site quality and productivity of breeding pairs (Newton 1979; Levy & Segev 1996; Liberatori & Penteriani 2001). As opportunistic scavengers (Ali & Ripley 1983; Naoraji 2006), vultures feed on the remains of small animals, debris or rubbish dump, insects in dung,

human and ungulate faeces, and vegetable matter (Prakash & Nanjappa 1988; Naoroji 2006; Angelov et al. 2013; Jha 2015). Active nesting sites are present near rubbish dumps (Liberatori & Penteriani 2001). During the present study, the vicinity of the observed nesting site contained urban patches, open croplands, an old drain, rubbish dumps, patches of trees and slaughter houses. Adults were often seen feeding at rubbish/carcass dumps, which served as a source of consistently available food for their young, and also primary sources of nest material.

It has been reported that an EV clutch generally contains two eggs (Brown & Amadon 1968; Cramp & Simmons 1980; Naoroji 2006), of which one usually hatches (Naoroji 2006), although Angelov et al. (2013) reported an EV clutch of four eggs from Masirah Island. In the present study the clutch size was two eggs per year, and all eggs (n=6) hatched and nestlings fledged successfully over three consecutive years (2015–2017). According to Mendelssohn & Leshem (1983), hatching interval in EV varies from three to eight days, and when the age difference between siblings is large the younger chick generally dies due to competition with the elder chick. In the present study the hatching interval was five days, nestlings faced no shortage of food supply by the parents and sibling aggression was not observed (Morandini & Ferrer 2015). Margalida et al. (2004) have reported siblicide of the younger chick due to sibling aggression during feeding bouts in the Bearded Vulture *Gypaetus barbatus*. In the 2017 breeding season the EV nestlings fledged 94–98 days after hatching, whereas fledging periods of 70 days (Donazar & Ceballos 1989), 75–80 days (Naoroji 2006), and 70–90 days (Bilgecan 2012) have been reported. The complete breeding season stretched from February to July in the years 2015, 2016, and 2017. As per Dharmakumarsinhji (1955) the breeding season of EV extends from end February/March to June, mainly February to May and some birds may initiate as early as December.

EV shows recognizable philopatry and long-term nest occupancy year after year (Newton 1979; Donazar et al. 1996; Sara & Vittorio 2003; Carrete et al. 2007). Ramirez et al. (2016) reported long-term occupancy (1900–2015) of an EV nest and suggested that some high-quality breeding sites provide important resources for long term nest occupancy. The authors have monitored this nesting site since 2015, but it may have been under long-term occupancy prior to this study. In view of sharp decline in EV populations throughout Punjab, the present observations on breeding biology have important implications for future management and

conservation initiatives for breeding sites at the regional level.

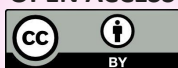
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ISSN 0974-7907 (Online) | ISSN 0974-7893 (Print)

June 2020 | Vol. 12 | No. 9 | Pages: 15967–16194

Date of Publication: 26 June 2020 (Online & Print)

DOI: 10.11609/jott.2020.12.9.15967-16194

www.threatenedtaxa.org

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