

Full Length Research Paper

## 'Population status, nesting sites and seasonal fluctuation of Egyptian vultures (*Neophron percnopterus*): Dynamics and implications for the species conservation in and around Jodhpur

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Nine species of vulture were reported in India. Out of them, four species *Gyps indicus*, *Gyps bengalensis*, *Sacrogyps calvus* and *Neophron percnopterus* are permanent residents and remain in and around Jodhpur. The remaining three species *Gyps fulvus*, *Gyps himalayensis* and *Aegypus monachus* are migratory species and come to site from October to February in winter season. Resident species reproduce here due to availability of food through out the year. Egyptian vulture is a smaller bird with naked head and without long scrawny neck and is permanent resident of Thar Desert. It has maximum population as compared to other species of vultures observed in the area investigated in the present study.

**Key words:** Breeding, migratory, population, resident, vulture, Thar Desert.

### INTRODUCTION

Vultures are most important scavenger and play an important role in clearing animal carcasses and municipal dumps. Vultures are large birds carrion eaters and are divided into two groups: The New World Vultures and Old World Vultures. New World vultures are under the order Falconiformes of family Cathartidae and Old World vultures belong to the family Accipitridae. The New World vultures are distributed from Southern Canada to the Falkland Islands and the Old World vultures are widely distributed in Asia, Africa and Europe. The subfamily *Aegypinae* of *Accipitridae* contains 15 species of Old World vultures. Due to a lot of variations in geographical and environmental gradient nine species are reported to be present in India (Ali and Ripley, 1987), out of which, seven species have been reported and observed in and around Jodhpur on the tassel of the Great Indian Thar

Desert. These include King vulture (*Sarcogyps calvus*), Cinereous vulture (*Aegypius monachus*), Egyptian vulture (*Neophron percnopterus*), Eurasian griffon (*Gyps fulvus*), Himalayan griffon (*Gyps himalayensis*), Long-billed vulture (*Gyps indicus*) and White-rumped vulture (*Gyps bengalensis*) (Chhangani and Mohnot, 2002).

Thar Desert of India lies between 25° and 30° N latitude and 69.5° to 76° Longitude (Rahmani, 1997). Jodhpur, the part of Thar Desert situated at 26° 19' N latitude and 73° 8' S longitude is rich in vulture species. Dry and hot climate conditions favour xerophytes vegetation which is a favorable site for nest building for residual species of Vulture. Migratory species come to Jodhpur to avoid adverse conditions at their native places. King vulture, long-billed vultures, white-backed vulture and Egyptian vulture are residents of Jodhpur whereas Eurasian griffon,

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Himalayan griffon and Cinereous vultures are migratory and observed in Thar Desert during winter season (October to March). The population explosion in this region has generated several new challenges towards the habitats and food availability for vulture therein and thus has affected the eco-status of vultures in this region.

Vultures are large gregarious species that breed colonially in cliffs, forming large nesting groups (Cramp and Simmons, 1980; Mundy et al., 1992). Vulture nests are usually located on the trees or in the ridges of rocks. The nests may be built by a pair of bird; they are usually large and durable and used year after year; most of the nests are built by branches, twigs and sticks of local plants.

Vultures are nature's most successful scavengers and they provide an array of ecological, economic and cultural services. As the only known obligate scavengers, vultures are uniquely adapted to a scavenging lifestyle. Vultures' unique adaptations include soaring flight, keen eyesight and extremely low pH levels in their stomachs (Balmford, 2013). Presently, 14 of 23 (61%) vulture species worldwide are threatened with extinction and the most rapid declines have occurred in the vulture-rich regions of Asia and Africa (Ogada et al., 2012). The reasons for the population decline vary: poisoning or human persecution or both features in the list of nearly every declining species. Deliberate poisoning of carnivores is likely the most widespread cause of vulture poisoning.

Monitoring the population size of vulture is often a difficult task as most species are territorial and widely distributed over a sizable area. Different species of vulture show local seasonal fluctuation and their number and activity may vary throughout a day or a season (Newton, 1979). As a result improved monitoring techniques consist of counting birds at their breeding or roosting sites early in the morning or late in the evening before or after their daily foraging trips (Robertson and Boshoff, 1986; Mundy et al., 1992; Marincovic and Orladie 1994; Borello and Borello, 2002).

There has been drastic decline in the vulture population in Indian sub-continent over last two decades (Rahmani, 1998; Prakash, 1999; Prakash and Rahmani, 1999; Virani et al., 2001; Prakash et al., 2003; Chhangani, 2005; Gilbert et al., 2006). Since 1996, the breeding ecology and population of vulture study in and around Jodhpur and in the Thar desert have been examined by monitoring the nesting site, making censuses, recording predation, observing inter-species interaction and locating seasonal migration (Chhangani and Mohnot, 2004; Chhangani, 2002a, b, c, 2005; Chhangani et al., 2002).

Egyptian vulture is resident species of Jodhpur and has maximum population compared to other vultures observed in the same area. It is playing a major ecological role in removing municipal waste and animal carcasses. It is a smaller bird, rather kite like vulture with naked head and without long scrawny neck. Its body size is 66 cm or 26 inch in length. Adult bird has overall dirty white color with naked yellow head, face and fore neck. Young one has

blackish or chocolate brown mottled with whitish blotches on back, breast and greater wing coverts. Many other intermediate colors phase out during its gradual transition from young to adult white plumage. In overhead aspect, it looks like some eagle, but its longer, narrower, wings and wedge shaped tail differentiate it from eagles. Its scarf is not completely developed and its legs are dirty white color in adult birds.

The aim of the present study was to examine population status, fluctuation and breeding of vultures in and around Jodhpur with special reference to Egyptian vulture (*N. percnopterus*).

## MATERIALS AND METHODS

### Study area

The study site, Jodhpur (26° 17'59 N and 73° 02'02E) is situated in the Western part of Rajasthan and is a prominent part of great Indian Thar Desert. Topographically, it is by and large, plain and openly interrupted by hillocks. During summer, the temperature ranges between 6°C to 45°C while in May and June it rises up to 49°C. The annual average rainfall is 300 mm, distributed over 20 rainy days. This wide range of climatic condition has led to the formation of different habitat types of vulture in and around the city of Jodhpur.

### Survey technique

The methodological approaches used in this investigation are as follows:

#### Exploration of vultures' nest site

The intensive survey of the study area was undertaken from September 2006 to December 2008 to locate vultures' nest and feeding sites in and around Jodhpur within a radius of 50 Km. Information about various nest and feeding site was collected from literature available, local people information, presence of water bodies, safe and large trees, large rock and cliffs, wild life, livestock population, high tension electricity line and carcasses dumping ground. The following is the list of various nesting sites of vultures studied during this investigation period (Figure 1).

1. Mehrangarh Fort (Jodhpur Fort)
2. Arna Jarna hillock
3. CAZRI Campus
4. Barli Village
5. Machia Safari Park
6. Nagana Hill Barmer
7. Guda Vishnoian (Protected area)
8. Ratkuriya
9. Sathin (Protected area)
10. Bheembhadak Kayalana
11. Machia Fort

After initial surveys of different sites, intensive study was carried out at Keru Barli dumping site of Jodhpur till the end of December 2008 to know the ecological specificities of the vulture species' inhabit therein. The reason for selecting this site was the maximum availability of vulture population because daily 15 to 20 dead cattle are carried in this area and vultures spend their maximum time in searching for food materials. Moreover, there are three small water bodies present and at 2-3 km distance, there is the presence of Kailana canal which provides drinking water throughout the year. Extensive survey for daily and seasonal fluctuations and their moni-

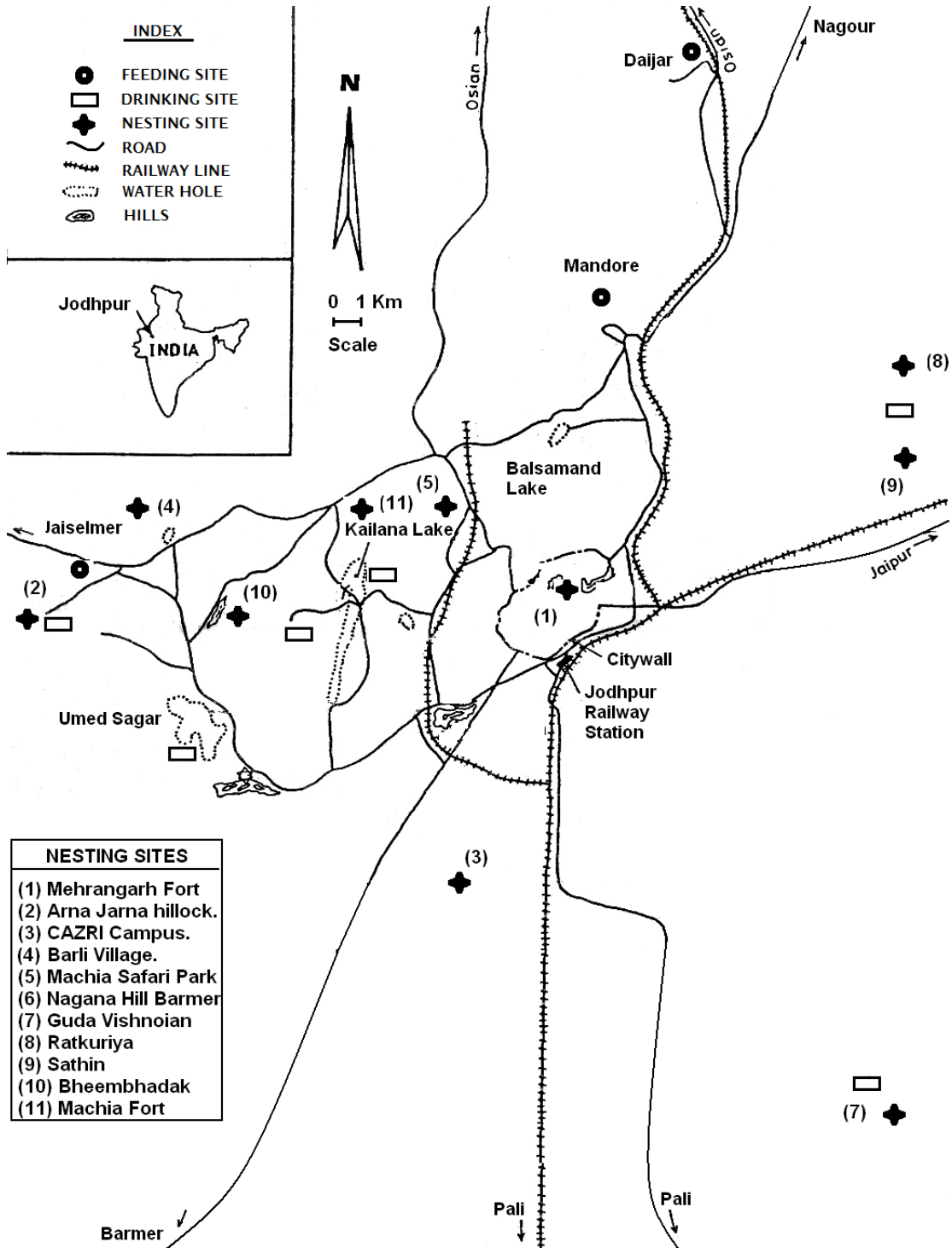


Figure 1. Location of nesting, feeding and drinking sites for Egyptian Vulture in and around Jodhpur, India

monitoring was undertaken in the study area by daily visits, using a motorbike.

**Identification**

Identification of different species of vulture is carried out on the basis of color pattern of body, upper and under wing color pattern,

length of bill, plumage orientation and shape, rump, head and neck regions colors. Identification of juvenile and adult birds is carried on the basis of feathers patterns such as juvenile birds have smaller and more pointed wing and tail feather than adult. Feathers of scarf are longer, more lanceolate or spiky and less fluffy than that of adult; while adult birds have large, more rounded flight and tail feather than juveniles and the feathers of the scarf are mostly whi-

tish and fluffy in appearance.

### Field measures

To estimate accurate population of vultures a regular monitoring was done for counting of birds which started from early morning to late afternoon from October 2006 to December 2008. All visits are spaced out by 2-3 days so as to cover all fluctuations homogeneously. Data collected on their population, daily activity, local and seasonal migration in relation to temperature, predation by cats, jackals, foxes and dogs on vulture eggs, chicks and on adults have also been recorded besides their intra species competition. Nest counts were made once in a month in the study area. The total count of the active nests was carried out during December and March, when maximum breeding pairs were found. More attention was given on feeding site counting because of all species availability for longer time at feeding station. The seasonal and daily fluctuation status of different species of Vulture was studied by means of head counting method, supported by photography and videography. Observations were made from a safe distance ranging 300-600 m from the cliffs or behind the walls with the aid of 10 x 50 binoculars and a spotting scope with 30x and 70x eyepieces.

### Microclimatic statistics

The Digital Minimum-Maximum Hygro Thermometer and a Digital Lux meter (LX-101A, LT Lutron) were used to record microclimatic parameters viz. temperature, relative humidity and light intensity at dumping ground. Relative humidity was assessed as, dry (0-44%), normal (45-74%) and wet (75% and onwards). All these microclimatic parameters were recorded in every week of a month of the study period.

## RESULTS AND DISCUSSION

Nine species of vulture have been reported by Ali and Ripley (1987) in India. Out of them seven species were reported in Thar Desert, Rajasthan by Chhangani (2002). Extensive surveys were conducted between October 2006 and December 2008 in Keru dumping site, Jodhpur to assess the vulture population. During present investigation, six species of vulture were observed in selected area during different phases of the year and one previously reported species *Sacrogyps calvus* was not observed. Out of the six species, three are migratory viz. *Gyps fulvus*, *G. Himalyensis* and *Aegypus monachus* and they are observed only in the months of breeding season (November-February). The remaining three species viz. *G. indicus*, *G. bengalensis* and *N. percnopterus* are resident species and are observed throughout the year.

### Population

The population status of Egyptian vulture (*N. percnopterus*) was counted at different nesting sites from month of October 2006 to December 2008. The maximum population of Egyptian vulture (815 individuals) was observed in 2006. In 2006 onwards the population of Egyptian vulture showed negative trend and was found to be 618 individuals in 2007 and 326 individuals in 2008. Population of Egyptian vulture gradually built up from October and reached its peak during January and February due to food

and water availability. While from March onwards their numbers started decreasing and the entire vulture population thinned down from May to August, with the increase in temperature and unfriendly environment.

### Seasonal fluctuation among Egyptian Vulture

The temporal variation in population of vultures is produced by different ecological pressures such as levels of human disturbance, climatic conditions and food availability (Thomson et al, 1990, Donazar and Feijoo, 2002). The number of vultures largely depends on regular food supplies (Donazar et al., 1996; Margalida and Boudet, 2003), although an element of social organization might also be involved (Rabenold, 1986; Parker et al., 1995).

The data obtained regarding the seasonal fluctuation of different species of vultures in the study area is of great significance. Egyptian vulture is present throughout the year and breeds in this region. Except from March-July, their number remained constant during most of the investigated phase (Table 1, Figure 2). The fluctuation in Egyptian vulture in this area during summer season is primarily due to scarcity of water, food and other unfriendly ecological parameter such as high temperature and very low humidity.

### Daily variation among Egyptian Vulture

Generally, vultures feed on dead carcasses and play an important role in environment clearing. Among different species of vultures particular species individuals play an important role during eating and different individual species' number fluctuate in a day during eating. It was observed that resident species *N. percnopterus* shows its presence around carcasses due to its nesting site close to dump area; *Gyps* species shows its presence at dump area between 9.00-10.00 AM and its number continuously increases till late afternoon. Vultures like to feed upon 2-3 days old carcasses which are easy to open. The opening of carcasses is a difficult task and it is mostly performed by *Aegypus monachus* because of its strong pointed and slightly tilted bills and generally this activity occurs between 10.00-12.00 AM with this species *N. percnopterus* (Table 2).

### Communal feeding

Different species of vultures feed along with others birds and mammals at the same feeding site. Common birds observed feeding at the dumping site along with vultures of different species were Cattle egret (*Bubulcus ibis*), common raven (*Corvus corax*), Drongo (*Dicrurus macrocercus*), Green bee-eaters (*Merops philippinus*), House crow (*Carvus splendens*) and Rosy pastar (*Strunus roseus*). Mammals incorporate feral dog (*Canis familiaris*) and Jackal (*Canis aureus*).

**Table 1.** Seasonal variation among the population of Egyptian vulture's species in 2006-08.

Year and Month	<i>Neophron percnopterus</i>
October 2006	635 ± 4.16*
November 2006	815 ± 9.46
December 2006	471 ± 1214
January 2007	618 ± 10.34
February 2007	480 ± 2.95
March 2007	383 ± 4.63
April 2007	223 ± 4.58
May 2007	166 ± 3.83
June 2007	106 ± 4.80
July 2007	68 ± 2.58
August 2007	135 ± 3.51
September 2007	237 ± 2.53
October 2007	243 ± 3.75
November 2007	184 ± 1.33
December 2007	254 ± 2.52
January 2008	259 ± 2.23
February 2008	285 ± 5.23
March 2008	289 ± 5.32
April 2008	239 ± 4.23
May 2008	215 ± 4.32
June 2008	154 ± 1.43
July 2008	63 ± 1.21
August 2008	76 ± 2.32
September 2008	88 ± 4.32
October 2008	211 ± 3.32
November 2008	264 ± 3.858
December 2008	326 ± 2.331

\*± = Standard error.

**Table 2.** Presence of Egyptian Vulture in feeding places during different time period of the day.

Time*	<i>Neophron percnopterus</i>
9.30 am	122 ± 2.22 <sup>#</sup>
10.30 am	132 ± 1.21
11.30 am	24 ± 0.23
12.30 pm	13 ± 0.24
1.30 pm	9 ± 0.21
2.30 pm	53 ± 0.97
3.30 pm	112 ± 1.23
4.30 pm	187 ± 1.12

\*± = Standard error; # = International Standard Time GMT +5.30 h.

Complete opening of carcasses takes approximately half an hour; during that time the remaining species of *Gyps* continuously produce heat in and around dumping area. When carcasses are completely opened, then *Gyps fulvus* and *Gyps himalayensis* come and dominate over

*Aegypus monachus* and *Neophron percnopterus* during eating. It was observed that a large number of individual population of *Gyps fulvus* mainly dominate over all species of vulture to eat soft tissue like liver, kidney, heart and stomach part of carcasses. During this investigation, it was observed that if there is no type of disturbance in dump area, then opened carcasses are completely eaten by vultures in half an hour. After feeding on the carcasses, *G. fulvus* and *G. himalayensis* go to field area; during that time *A. monachus*, *G. indicus* and *N. percnopterus* (Figure 3) will get the opportunity to eat the remaining carcasses with feral dogs (Table 2).

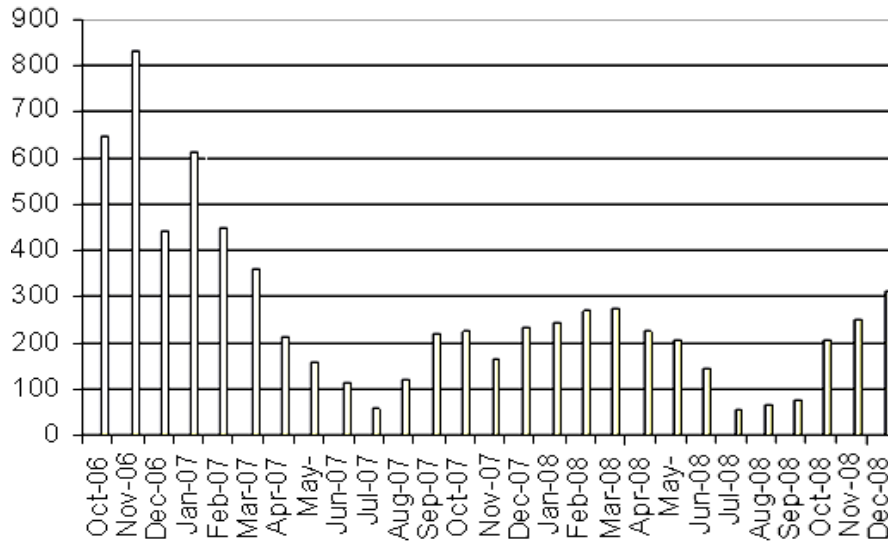
During eating of soft tissue of carcasses, there were a lot of inter and intra specific competitions observed. In intra-specific competition, *G. fulvus* and *G. himalayensis* dominate over other species of vultures and even dogs. Many times, it was observed that feral dogs bark and follow the vultures to get opportunity to feed upon carcasses. Mainly, *Gyps* species leave the carcasses area in late afternoon and show their presence near water bodies like Kailana Canal in Machia Safari Park and Barli pond in Barli village for drinking water. During that time, the remaining carcasses would be eaten by *A. monachus*, *N. percnopterus*, *G. indicus* and *G. bengalensis* as well as feral dogs, hawk and common crows.

### Breeding of Egyptian Vulture

Seven species of vultures have been observed in and around Jodhpur on the tassel of the Great Indian Thar Desert. Of them, King Vulture (*S. calvus*), long-billed vultures (*G. indicus*), white-backed vulture (*G. bengalensis*) and Egyptian vulture (*N. percnopterus*) are residents and breed in Jodhpur (Chhangani and Mohnot, 2002). As far as the habitat use of nest is concerned, *Neophron percnopterus* is observed on high tension electricity poles, *Prosopis cineraria* and *Tecomela undulata* in old heritage building. A total of 67 nests of Egyptian vultures were found during October 2006 to December 2008 at 11 different nesting sites as shown in Table 3.

### Mortality

At Jodhpur site from 2006 to 2008, 21 dead Egyptian Vultures were observed at various location in and around Jodhpur and when average total population of Egyptian vulture was recorded, it was more than 400; total death rate of 5.25% was observed in total population. Forty percent (eight) of them were due to electrocution and the remaining was due to natural death or another reason. Most deaths due to electrocution were observed at Keru dumping site. Two sides of this area are road track and parallel to this high voltage electricity line passes. Maximum death observed in *N. percnopterus* is due to electrocution and road accidents (Figure 4).



**Figure 2.** Seasonal variation among Egyptian Vulture in and around Jodhpur from October 2006 to December 2008.



**Figure 3.** *Nephron perchnopterus* feeding on remaining carcasses.

### Conservation status and recommendations

The findings of this investigation suggest that the human population explosion had insisted various kinds of new building network of electricity lines, increase in mining and use of explosive matter in mining activity, renovation

of forts and cutting of large trees and as well as other graphical changes in this region. Simultaneously, such kinds of eco-transformations have occurred either due to introduction of IGNP (Indra Gandhi Nahar Pariyojna) in the Thar Desert or some other kind of ecological parameters including drought, in this region. All these changes





**Figure 4.** Death of *N. percnopterus* owing to road accident near nesting site.

**Table 3.** Nesting sites and number of nest of Egyptian Vulture in and around Jodhpur.

Nesting site	Total number of nests
Mehrangarh Fort (Jodhpur Fort)	3
Arna Jarna hillock	7
CAZRI Campus	2
Barli Village	2
Machia Safari Park	8
Nagana Hill Barmer	2
Guda Vishnoian (Protected area)	11
Ratkuriya	12
Sathin (Protected area)	14
Bheembhadak Kayalana	4
Machia Fort	2
<b>Total</b>	<b>67</b>

ges have adversely affected the eco-status and demography of vultures in and around Jodhpur.

This study shows clearly that vulture diversity in this region declines day by day rather than increasing. The main reason behind this declination is loss of habitat, electrocution, unavailability of food and feral dog competition. Safe nesting and roosting sites are declining for the vulture in and around Jodhpur City. The insufficiency of good and safe nesting sites reduces their breeding success and increases chick mortality of the Egyptian vulture as found in the present study. Deforestation for agricultural interests, urbanization and firewood are also serious threat to nesting sites. Uncontrolled mining activity has

vanished many of the cliffs and rocks, which were safe for nesting and roosting. These conditions have forced vultures to nest in risky cliffs, trees like *P. cinerara*, *T. undulata* and high tension electricity poles. Such cliffs are accessible by jackals, foxes and jungle cats, which are potential predators of the vulture eggs and chicks. Nesting on electricity poles is very risky and maximum death observed among Egyptian vulture is due to electrocution. Scarcity of nesting sites also increases intra and inter species competition for food and to occupy nests. During this interaction, many a time chicks and juveniles fall from the nests and are killed or injured and often become victim of dogs and other animals. It is high time to pro-

pose a remedial measure for increasing the vulture population in this area which is important for eco balance point of view. It is suggested that exhaustive study is required to know about the vulture eco status in the remaining districts of the Thar Desert. It will help to prepare the vulture conservation policy in the Thar Desert.

## Conclusion

Monitoring of Egyptian Vulture during the winter season, that is, November-February would produce the most reliable population estimate. Surveys later than February should be avoided as non-breeding individuals of migratory species abandon the colonies. Colonies void of birds during May-October every year do not reflect a decline in population size and should not be regarded as deserted. Serious efforts must be taken to conserve and protect the breeding and feeding habitats of all species of vultures in the area investigated.

## REFERENCES

- Ali S, Ripley R (1987). Compact handbook of the birds of India and Pakistan. Oxford University press, Delhi. pp. 296-314.
- Balmford A (2013) Pollution, Politics, and Vultures. *Science* 339:653-654.
- Borello WD, Borello RM (2002). The breeding status and colony dynamics of Cape Vulture *Gyps coprotheres* in Botswana. *Bird Conserv. Int.* 12: 79-97.
- Chhangani AK (2002a). Vultures the most eco-friendly birds. *Sci. Rep.* 39: 56-59.
- Chhangani AK (2002). Avifauna in and around Jodhpur city, Rajasthan, India. *Newsletter for Birdwatchers* 42: 24-26.
- Chhangani AK (2002b). Successful rescue and rearing of India long billed Vulture at Jodhpur zoo. *India. Zoos Prints* 17:20-22.
- Chhangani AK (2002c). Ecology of Vulture of different species and an around Jodhpur (Rajasthan), India. *Tiger Paper* 29: 28-32.
- Chhangani AK (2005). Population ecology of Vultures in the western Rajasthan, India. *Indian Forester* 131: 1373-1382.
- Chhangani AK, Mohnot SM (2004). Is diclophenac the only cause of Vultures decline? *Curr. Sci.* 87: 1496-1497.
- Chhangani AK, Mohnot SM, Purohit AK (2002). Population status of vultures in and around Jodhpur with special reference to long billed vulture (*Gyps Indicus*). *J. Natcon.* 14: 121-130.
- Cramp S, Simmon KEL (1980). The birds of Western palearctic. Oxford University Press, Vol. II. Oxford.
- Donazar JA, Ceballos O, Tella JL (1996). Communal roosts of Egyptian Vultures (*Neophron percnopterus*): dynamics and implications for the species conservation In *Biología y Conservación de las Rapaces Mediterráneas*, Monografías; Edn: Muntaner J, Mayol J. 4:189-201.
- Donazar JA, Feijoo JE (2002). Social structure of Andean Condor roosts: influence of sex, age and season. *Condor* 104: 832-837.
- Gilbert M, Watson RT, Virani MZ, Oaks JL, Ahmad S, Jamshed M, Choudhary I, Arshad M, Mahmood S, Ali A, Khan AA (2006). Rapid population declines and mortality clusters in three Oriental White Backed Vulture *Gyps bengalensis* colonies in Pakistan due to diclophenac poisoning. *Oryx* 40: 388-399.
- Margalida A, Boudet J (2003). Dynamics and temporal variation in age structure at a communal roost of Egyptian Vultures (*Neophron percnopterus*) in north-eastern Spain. *J. Raptor Res.* 37: 252-256.
- Marincovic S, Orladie L (1994). Status of the Griffon Vulture *Gyps fulvus* in Serbia. In *Rapton Conservation Today*; Ed. Meyburg BU, Chancellor RD: The Pica Press, Berlin. pp. 163-172.
- Mundy PJ, Butchart d, Ledger J, Piper S (1992). The Vultures of Africa. Acorn Books and Russel Friedman Books, Randburg.
- Newton I (1979). Population Ecology of Raptors. Buteo Books, Vermillion.
- Ogada DL, Keesing F, Virani MZ (2012). Dropping dead: causes and consequences of vulture population declines worldwide. *Ann. N. Y. Acad. Sci.* 1249: 57-71.
- Parker PG, Waite TA, Decker MD (1995). Kinship and association in communally roosting black Vultures. *Anim. Behav.* 49: 395-401.
- Prakash V (1999). Status of Vulture in Keoladeo National Park, Bharatpur, Rajasthan, with special reference to population crash in Gyps species. *J. Bombay Nat. Hist. Soc.* 96: 365-368.
- Prakash V, Rahmani AR (1999). Notes about the decline of Indian Vultures, with particular reference to Keoladeo National Park. *Vulture's News* 41:6-13.
- Prakash VD, Pain J, Chunningham AA, Donald PF, Prakash N, Verma A, Gargi R, Kumar SS, Rahmani AR (2003). Catastrophic collapse of Indian white backed Gyps bengalensis and long billed Gyps indicus Vulture population. *Biol. Conserv.* 109:381-390.
- Rabenold P (1986). Family associations in communally roosting black Vultures. *Auk* 103: 32-41.
- Rahmani AR (1997). The effect of Indra Gandhi Nahar Project on the avifauna of the Thar Desert. *J. Bombay Nat. Hist. Soc.* 94: 233-236.
- Rahmani AR (1998). Decline of Vultures in India newsletter. *Bird watchers* 38(5):80-81.
- Robertson AS, Boshoff AF (1986). The Feeding Ecology of Cape Vultures *Gyps coprotheres* in a Stock Farming Area. *Biol. Conserv.* 35: 63-86.
- Thomson WL, Yahner RH, Storm GL (1990). Winter use and habitat characteristics of Vulture communal roosts. *J. Wildl. Manage.* 54: 77-83.
- Virani M, Gilbert M, Watson R, Oaks L, Benson P, Khan AA, Baral HS, Giri JB (2001). Asian Vulture crisis project: field results from Pakistan and Nepal for the 2000-2001 field season; Edn. Katzner T, J. Parry Jones Eds. Reports from the workshop on Indian Gyps Vultures, 4th Eurasian congress on raptors, Sevilla, Spain, September 2001. *Seville, Spain: Estacion Biologica Donana Raptor Research Foundation.* pp. 7-9.