

Recent Population and Nesting Trends of the Endangered Vulture Gyps Species in India

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ABSTRACT

The information on population variation between the seven species of vultures in Rajasthan's Thar Desert is extremely important. In the Thar Desert of Rajasthan, a systematic study was conducted with the goal of obtaining data on the demography, breeding, and nesting records of vulture species beginning in 2016 and continuing for three consecutive years. The population of resident and migratory vulture species was trended using linear regression. White-backed vultures had the lowest population trends, whereas Egyptian vultures showed the highest. Potential records of resident vulture species nesting were also appropriately acquired. Even after Diclofenac was banned in 2006, patterns of decreases, the presence of dead birds, different unintentional tragedies, habitat degradation, and windmills point to some potential causes.

Keywords-- Population, Trends, Parameters, Sampling Blocks, Thar Desert

borders are *Sercogyps calvus* and *Neophron percnopterus*.

Since 1990, the Indian continent has seen a huge and severe decline in the population of gypsy vultures. The three vulture species (*Oriental White-backed Gyps bengalensis*, *Long-billed G. indicus*, and *Slender-billed G. tenuirostris*) are affected by this decline to the extent that they are now classified as "critically endangered" and on the verge of extinction not only in India but throughout the rest of south Asia. The use of the non-steroidal anti-inflammatory medicine *Diclofenac* to treat livestock and possibly other birds of prey that scavenge on the carcasses of recently treated livestock was determined to be the primary cause of this calamity.

An estimated 95% of the Gyps vulture population in Rajasthan's Keoladeo National Park in Bharatpur vanished between 1988 and 1999, according to population estimates. Similar declines were seen in Malaysia, Thailand, and Indonesia on the Indian continent during the same time frame. A similar decline in vulture populations has recently been observed in Cambodia as a result of poisoning.

There are seven different vulture species in Rajasthan. *Gyps fulvus*, *Gyps himalayensis*, and *Aegypius monachus* are three of the winter migrants, whereas *Gyps bengalensis*, *Gyps indicus*, *Sarcogyps calvus*, and *Neophron percnopterus* are four of the resident species.

Due to ample and suitable domestic cattle, the Thar Desert provides a habitat for agro-grass that is rich in biodiversity, open, and semi-arid. Although there has been little human interference in this area, it has abundant resources and plants. In relation to these extremely sensitive scavengers in the Thar area, very few investigations have been conducted in the area.

There is a dearth of fundamental data on demography, reproduction, and nesting ecology. Our survey focused mostly on the districts of Jaisalmer, Jodhpur, and Barmer in the Thar region, which is the probable vulture's habitat. We aimed to acquire an unmatched amount of data on population dynamics and nesting records of local and migratory species for this study.

In addition, we describe previously unreported White-backed, Red-headed, Long-billed, and Egyptian vulture colonies in the Thar region. We describe regional and temporal population trends and nesting records and

I. INTRODUCTION

The new parameters for research on threatened species like vultures depend on the proper implementation of appropriate conservation action, such as long-term population monitoring, availability of adequate food, favourable ecological conditions, and geographic distribution. Population dynamics are influenced by both intrinsic (such as life histories, first breeding, fertility, longevity, and dispersal) and extrinsic (such as food resources, topography, and abiotic factors) factors. Demography is defined as the addition (births and immigration) and loss (deaths and emigration) of individuals from a population.

In India, nine species of vultures have been recorded, of which five belong to the genus *Gyps*. This genus represents eight species worldwide; among them, four are resident species in Asia (*G. bengalensis*, *G. indicus*, *G. himalayensis*, and *G. tenuirostris*); three are found primarily in Africa (*G. africanus*, *G. coprotheres*, and *G. rueppellii*); and one breeds in Eurasia but migrates into Africa and South Asia (*G. fulvus*). The other vulture species found along the Indian and Asian

evaluate current threats and potential future conservation measures based on fieldwork from 2016 to 2018.

II. METHOD AND MATERIALS

Eleven sampling blocks make up the Thar, which includes the districts of Barmer, Jaisalmer, Bikaner, and Jodhpur. Each of these sampling blocks—Nagana Hills, Kundal Hills, Balotara, Nokha, Jorbeer, Sam, Lathi, Myajlar, Mehrangarh, Arna, and Keru Dumping—is divided into field stations. The significant locations mentioned and shown in Fig. 1 are the inquiry involved a thorough search for nesting vultures, which involved looking for suitable cliffs and nesting trees in open spaces.

Regular monitoring was done in the respective localities from January 2016 to December 2018 to accurately estimate the annual variation in population. Every other week was used to evenly distribute all of the visits to observe seasonal variation, with a focus on feeding grounds and roosting areas near eateries. By counting vultures at the same location (where they roost and nest) from sunrise to sunset at a rate of three to eight trips per month, annual changes in the colony were analysed. Arrival time was when at least two to three of the birds counted in the morning returned to the chosen site, while departure time was when more than 50% of the vultures in the colony left the study site.

2.1 Statistical Evaluation

For the crude population, the data comparison excludes the entire three-year period from 2016 to 2018. Analysis of migratory and resident species was done every six months (January to June) and every twelve months (July to December). With the standard error value, average mean data were utilised to create a histogram and scatter plot for each individual vulture species. For the period of 2016 to 2018, the population trends of resident vulture species (*Gyps indicus*, *Gyps bengalensis*, *Sercogyps calvus*, and *Neophron percnopterus*) and migratory vulture species (*Gyps himalayensis*, *Gyps fulvus*, and *Aegypus monachus*) were assessed using linear regression in Microsoft Excel 2010. The map was made using the QGIS desktop software, version 2.18.6.

III. RESULTS

3.1 Roughhousing

Roosting locations aid in evaluating the vulture population survey to a greater extent. In these four areas of the Thar Desert, we discovered numerous roosting places due to the heterogeneity of the varied ecosystems. The water bodies in Jodhpur (Badli Pond) and Nabhdungar and Myajlar (Jaisalmer) exhibited various inhabitants and migratory species in this area. Open terrain such as Jorbeer (Bikaner), Keru (Jodhpur), Nokha (Bikaner), and Lathi (Jaisalmer) also supports a number throughout the whole year, specifically in the winter

season. At the same time, high-tension light poles and windmills are situated as roosting spots for the vultures in the Desert National Park area in Jaisalmer. The semi-grasslands of Lathi, Jorbeer, and Sudasari are also vulture species' preferred roosting grounds. The roosting pattern varies among the species, with the Egyptian vulture, red-headed vulture, long-billed vulture, and cinereous vulture favouring solitary roosts. However, the Eurasian griffon, Himalayan Griffon, and White-backed vulture have been seen to roost in colonies on several occasions (Fig. 1).

3.2 Nutrition

We have access to both natural and man-made dumping sites for demographic data. Known as dumping grounds, Keru (Jodhpur), Lathi (Jaisalmer), Jorbeer, and Nokha (Bikaner) are where these huge scavengers exhibit a substantial population breadth. These locations provided an easy way to count flocks of birds. In the next year of research, the migratory vulture species Eurasian griffon, Himalayan griffon, and cinereous vulture frequently relied on these dumping sites during the winter season from October to March. In contrast, the vast, arid region of the Desert National Park exhibits a more untamed environment and the presence of a huge number of vultures, which occasionally forage on fields or in nearby rural areas (Fig. 2).

3.3 Nesting

In-depth, focused studies located vulture nesting locations all year round, but especially from April to August. Nest surveys centred on established nesting places, regions with emerging trees along watercourses, and tiny hills frequented by vultures in the Thar Desert. Data is recorded about vulture species such as location, habitat, roosting, and breeding locations. The size and trends of the vulture population are being observed at the supplemental feeding stations built at Lathi, Keru, Jorbeer, and Nokha. one of the additional feeding locations created by the municipal corporation and designated a "Vulture Conservation Reserve."

High cliffs in Barmer and Jodhpur, as well as *Prosopis cineraria*, *Acacia nilotica*, *Acacia tortalis*, *Anogeissus pendula*, *Tecomella undulata*, and *Azadirachta indica*, are places where nesting has been observed. Red-headed vultures and Long-billed vultures are more shy and isolated than other vulture species at feeding grounds, and they are frequently spotted in breeding pairs (Fig. 3).

Red-headed vulture nestlings were used in Sam, Kundal Hills, Kumbharkotha, Sudasari, and Ramgarh in the study region, while Long-billed vulture nestlings were used in Mehrangarh, Nagana Hills, and Kundal Hills. These landmarks are all situated in the central region of the Thar Desert. The majority of RHV nests were constructed above the Khejri tree, where LBV saw precipitous cliffs. More than 138 nests had breeding and nesting records that were found to be active and numerous during the study period. On cliffs and in trees, 76 are active and productive. 30 of them were Red-

headed vultures, 30 Egyptian Vultures, 13 Long-billed Vultures, and 3 White-backed vultures. The following stage involves keeping an eye on an active nest and looking for new nests nearby. High breeding success rates and nest occupancy are encouraging signs of the growth in these scavenger populations.

Beginning in January 2016 and continuing through December 2018, the demography was compared every six months after the vultures were counted. According to the study, there were 4332 344 Egyptian vultures, 100 36 Red-headed vultures, 126 29 Long-billed Vultures, 142 53 White-backed Vultures, 588 67 Eurasian Griffons, 332 78 Himalayan vultures, and 218 65 Cinereous vultures, all of which were counted over an average six-month period. In the main study locations, the vulture population was counted every month from January 2016 to December 2018. The Red-headed vulture has the lowest richness in the study, whereas the Egyptian vulture exhibits the most. In the research region, Cinereous vultures have the lowest population density, while Eurasian griffons have the greatest. Demographical information was gathered apart from each species of vulture.

In this investigation, the presence of resident vultures in the Thar region was not consistently noted. Averaging 100 sightings per 36 hours, red-headed vultures were observed in the Jaisalmer and Bikaner regions. Between July 2016 and December 2016, there were at least 18 documented, and between July 2017 and December 2017, there were a total of 234. In all four districts, the Egyptian vulture is the most prevalent and frequently seen vulture. In total, 4332,344 Egyptian vultures were counted on average throughout the course of six months. Between January 2016 and June 2016, there were at least 3297 vultures, and between July 2018 and December 2018, there were at least 5406. Overall, 126 long-billed vultures were counted on average in a half-year. The lowest number was 67 from July 2016 to December 2016, and the highest number was 239 from July 2017 to December 2017. In all the districts, there were 142 white-backed vultures. The lowest number of vultures was 17 between January 2016 and June 2016, while the highest number was 316 between July 2018 and December 2018.

Similar to migratory vultures, Eurasian griffons frequently visit the research site in Rajasthan's Thar Desert. The average number of vultures was 588, with the lowest number (380) being reported from July 2016 to December 2016 and the highest number (820) being recorded from July 2017 to December 2017. In the first six months of the era, the Himalayan Griffon reported 332,787 numbers. Vultures were counted at a minimum of 165 from July 2018 to December 2018 and at a maximum of 680 from July 2017 to December 2017. Cinereous vultures were counted on average 218 times and 65 times during the course of the three years.

Vultures were counted at a minimum of 74 from January 2017 to July 2017 and at a maximum of 501 from July 2017 to December 2017 (Fig. 1).

A population trend was estimated using data from all three research years. *Gyps indicus* ($R^2 = 0.2001$), *Gyps bengalensis* ($R^2 = 0.3239$), and *Neophron percnopterus* ($R^2 = 0.7632$) are examples of resident species with trends in catch rates. The Egyptian vulture's linear population trend has been increasing over the course of the succeeding research period. The trend came to a halt in the population range of 0 to 1000 (Fig. 2). Between 2016 and 2018, population trends in capture rates were seen for migratory species such as *Gyps himalyensis* ($R^2 = 0.2741$), *Gyps fulvus* ($R^2 = 0.0417$), and *Aegypus monachus* ($R^2 = 0.0111$). The trend came to a halt in the population range of 0 to 200 (Fig. 3).

IV. DISCUSSION

The Thar Desert significantly supported traditional agro-pastoral lifestyles that are extremely specialised for arid and semi-arid biogeography. The Thar landscape's vulture species and population composition received the study's top priority. systematic surveys carried out in 11 primary schools and opportunists' observations in the Thar Desert districts of Jodhpur, Jaisalmer, Bikaner, and Barmer. These study locations are surrounded by a lot of vulture activity (Table 1).

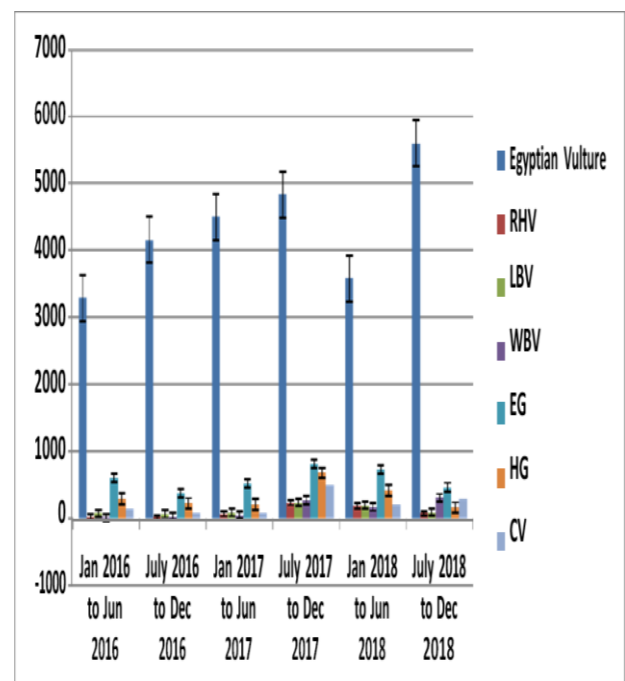


Figure 1: Shows a comparative overview of the vulture population in the Thar Desert.

Figure 2: Shows the study's X-axis years, which were 2016 to 2018, and its Y-axis population numbers, which range from 0 to 1000 on average for the resident vulture species.

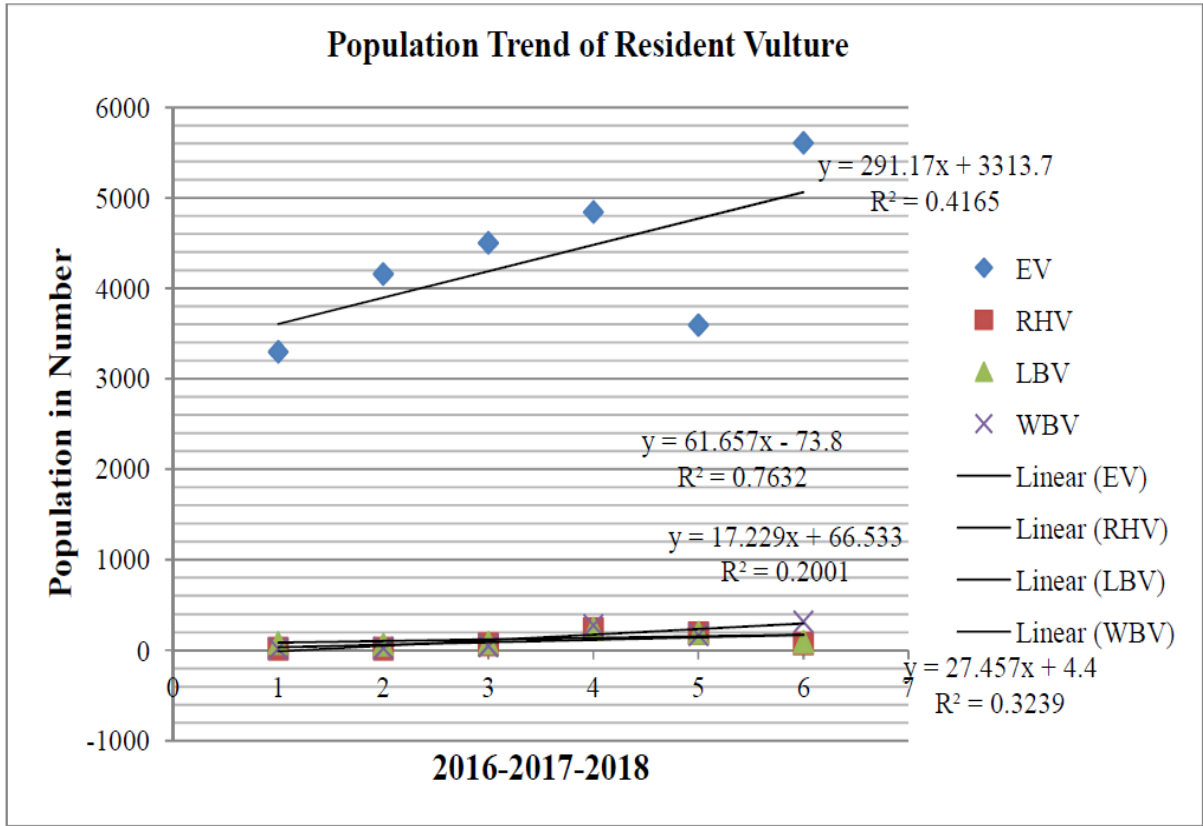


Figure 3: Shows a graphic representation of the migratory species' average population size, which ranges from 0 to 900.

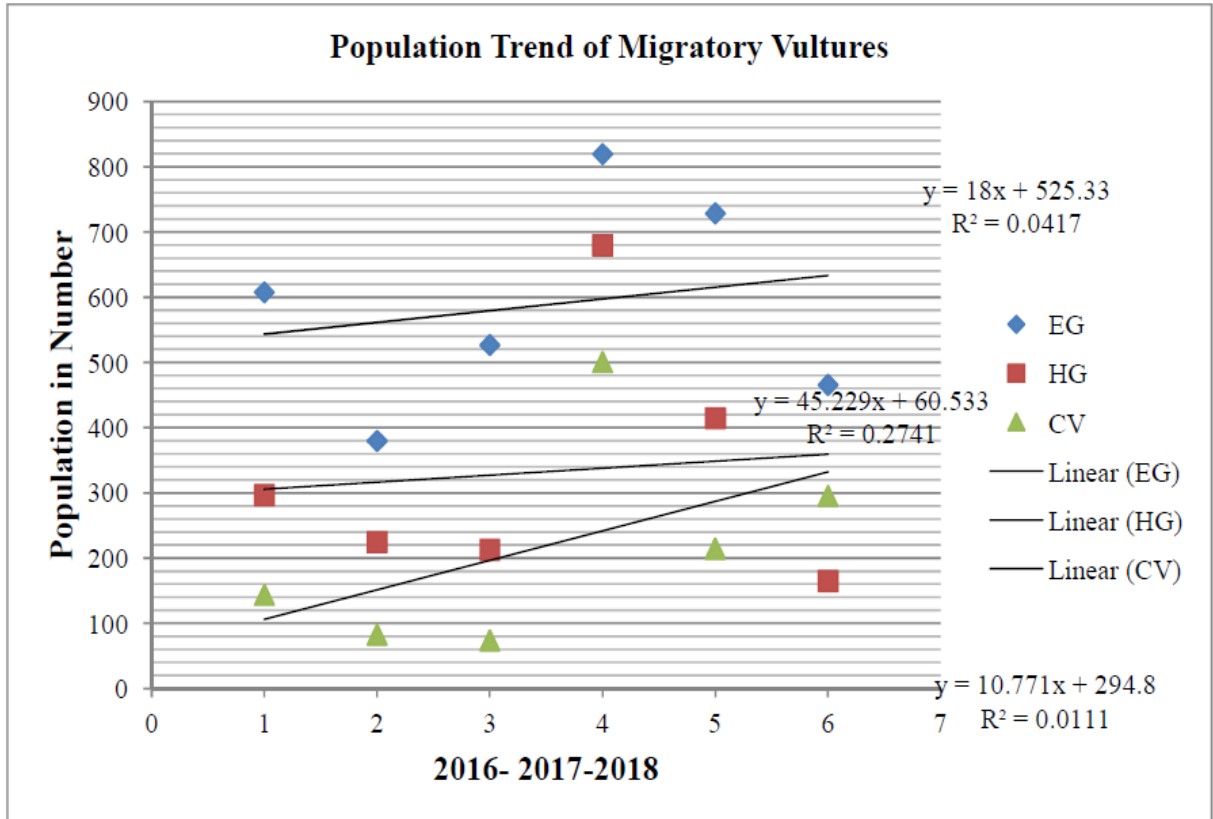


Table 1: Lists specifics on the different roosting, breeding, and feeding locations of vulture species in the 11 study areas.

S. N.	Name of Place/ Natural or artificial site	Location	Activity	Vulture Species
1.	Mehrangarh/ Natural	26.29689 E 73.01741 N	Nesting	LBV
2.	Keru dumping Site/ Artificial	26.32798 E 72.88699 N	Feeding, Roosting	EV, EG, HG, CV
3.	Arna Jharna and Badli/ Natural	26.28387 E 72.88677 N	Roosting	EV, EG, HG, CV
4.	Balotara/ Natural site	25.83663 E 72.20978 N	Nesting, Roosting	LBV
5.	Nagana Hills/ Natural site	26.10356 E 72.51669 N	Nesting, Roosting	LBV, EV
6.	Kundal Hills/Natural Site	25.55860 E 72.29283 N	Nesting, Feeding, Roosting	LBV, WBV, EV, EG,HG
7.	Jorbeer Vulture conservation reserve/ Artificial	27.92728 E 73.42121 N	Feeding, Roosting	EV, LBV, WBV, KV, EG, HG, CV
8.	Nokha Dumping/ Artificial	27.54331 E 73.48576 N	Feeding, Roosting	EV, EG, HG, LBV, CV
9.	Sam, Sudasari, Khumbhar khota, Khuhri	26.68553 E 70.59755 N	Feeding, Roosting	EV, LBV, WBV, KV, EG, HG, CV
10.	Myajlar	26.30740 E 70.28433 N	Roosting	EV, EG, HG, LBV, CV, WBV, KV
11.	Shri Bhadariya Lathi	27.09106 E 71.56485 N	Feeding, Roosting	EV, EG, HG, LBV, CV, WBV

Anthropogenic activities mostly influence demography and distribution. The creation of modern artificial cow dumps that house sizable vulture populations was one of these efforts. Similar to this, huge livestock is kept in Thar's wild areas, which has an impact on the vultures' population, breeding success, and occurrence.

Data on vulture population trends, nesting locations, and prospective roosting places were gathered for this study. Thorough research was needed to determine the population status and presence boundaries, much of which was done through videography, photo analysis, and routinely checking probable Thar Desert locations. The number of permanent and migratory vulture species is estimated to be large, according to recent research at the Jodhpur carcass dump.

Besides vultures, scavengers also include Steppe eagles, Eastern imperial eagles, Black-headed White Ibises, Common crows, Large-billed crows, and Black kites, which entered the area because of the abundance of food. With the exception of the Egyptian vulture, this effect may be to blame for the decline in the vulture population. Hunting with uncontrolled and feral dogs, electrocution, and in the Thar region, trichobezoar is the cause of vulture deaths. At some point in the study, we looked at semi-arid woodland, open scrubland, rocky, barren land, meadows, barren and moving dunes, dead animals in the wild, and artificial feeding stations. We have also seen instances of these birds dying. The study uncovers numerous instances of vulture deaths,

including a Himalayan griffon caught in a Khejri tree at Lathi and a Cinereous vulture hurt by wind turbines near Sam. In addition, feral dog hunting in Keru dumping Jodhpur, Eurasian griffon at Lathi, electrocuted Egyptian vulture in Jodhpur, trichobezoar in Eurasian griffon in Jodhpur, and mortality at railway tracks in Jorbeer and Dholiya (Jaisalmer) were observed on various occasions during the course of the study.

V. CONCLUSION

Aegypus monachus exhibited a pitiful quantity in the study region, but this study found an intriguing increasing trend of *Neophron percnopterus* at a significant level and a consistent trend of *Gyps bengalensis*, *Gyps indicus*, *Gyps fulvus*, and *Gyps himalyensis*. The key locations where a large number of vultures move to collect food throughout the year include the Keru biological treatment plants in Jodhpur, the Jorbeer vulture conservation reserve in Bikaner, and the Lathi carcass dump in Jaisalmer. Instead, the local vultures are conspicuous across the area.

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