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Distribution and Nesting Sites of Critically Endangered Long-billed Vulture (*Gyps indicus*) in Barmer District of Rajasthan, India

Ashok Kumar Panchal¹, Ram Prakash Saran^{2*}, Ramesh Choudhary¹

¹ Research Scholar, Department of Zoology, Faculty of Science, Jai Narain Vyas University, Jodhpur, 342005, Rajasthan, India

² Assistant Professor, Department of Zoology, Faculty of Science, Jai Narain Vyas University, Jodhpur, 342005, Rajasthan, India

Abstract

Objective: The present study aimed to investigate the distribution and characteristics of nesting sites of Long-billed Vultures in the Barmer district of Rajasthan. The scientific study will be added to the conservation of the Indian Vulture, commonly known as the Long-billed Vulture (LBV) for saving the environment, ecological balance, and sustainability on a global platform. **Methods:** We investigated the distribution and nesting sites of LBV in the Barmer district by using direct or headcount methods (Supported by photographic and videographic counting). **Findings:** During the study period, a total of 12 sites were recorded, out of 7 nesting sites of LBV were observed with 14 nests recorded, and the characteristic nesting site was seen in hilly areas. In Barmer district 43 individuals of LBV were recorded in 12 sites with an average of 3.58 ± 2.57 . **Novelty:** This study provides better zoological observational data on LBV about population and nesting sites in respective study areas. The finding of new nesting sites and nests in the hilly region of Barmer district (Aadupura Hills, Jhanpura, Bhilo ki Dhani, Gogaji Temple Hills, Juna Patrasar, Viratra Mata Hills, and Balera) is relevant to scholarly research. As we conclude the earlier studies suggest a higher population of LBV in the study area, but the present investigation reports a much smaller population than that reported earlier. The suggested study is fully relevant to the environment, ecological balance, and sustainability.

Keywords: Long-billed Vulture; Distribution; Nesting sites; Hilly region; Barmer

1 Introduction

Vultures are essential to ecology because they clean up dead carcasses and give healthy habitats for other living beings, and because of this they are also known as “nature’s cleanup crew”⁽¹⁾. From a human perspective, vultures are the large birds of prey, nature’s most successful obligate avian scavengers, providing us with an array of economic,

ecological, and cultural services. Of the 9 species of vulture found in India, 7 species occur in the western Rajasthan. Long-billed Vulture (LBV) (*Gyps indicus*) is among the 7 species of vultures in Rajasthan⁽²⁾.

It is 1 of 3 resident *Gyps* species in India, commonly known as the Indian Vulture. According to a morphological study of LBV, the Indian Vulture is bald having broad wings and short tail feathers, the covert feathers are pale color whereas the flying feathers are darker. The bill, head and neck are long and nearly bald, respectively. Female LBV are smaller than male species⁽³⁾.

The Indian Vulture was previously reported from several regions of the world i.e., Nepal, Pakistan, and Bangladesh⁽⁴⁾. In India, nesting, roosting, and breeding sites of these vultures were recorded from various places viz., Mudumalai Tiger Reserve and Sathya Mangalam Tiger Reserve, Tamil Nadu⁽⁵⁾, Kaghaznagar forest division Telangana⁽⁶⁾ and in Gujrat state Indian Vulture nesting sites are reported⁽⁷⁾. In Rajasthan, the species was reported from many districts viz., Jaisalmer, Barmer, Bikaner, Churu, Udaipur, Jalore, Jodhpur, Pali, and Sikar⁽⁸⁾. The species typically breeds and builds its nests in colonies on cliffs and ancient buildings⁽⁹⁾. In the western Thar desert of Rajasthan, the LBV has been constructing nests on high cliffs of a mountain. In the Udaipur district of Rajasthan Indian Vulture mostly nests and breeds in colonies on rock cliffs and ruins⁽¹⁰⁾. Where absence of cliffs or mountains LBV nests construction on the tree in Kolayat tehsil of Bikaner, Rajasthan⁽¹¹⁾.

During the mid-1990s, the population of the Long-billed Vulture and other *Gyps* vultures catastrophically declined by 90–98% in the subcontinental region of India⁽¹²⁾. Due to habitat loss and food scarcity, vultures have disappeared from several parts of the country⁽¹³⁾. Diclofenac, a non-steroidal anti-inflammatory drug (NSAID), was a primary factor in the vulture population's dramatic drop across the Indian subcontinent⁽¹²⁾.

Many other threats have been reported as potentially contributing to the decline in vulture populations including disease, electrocution, and mining activity⁽¹⁴⁾. The Indian Vulture has been listed under the “Critically Endangered” category in the IUCN Red Data Book of Threatened Species since 2000⁽¹⁵⁾.

There is very little information available about the Long-billed Vulture population in western Rajasthan, especially in the Barmer district, so this study aims to record the nesting sites and distribution of Indian Vultures.

2 Methodology

2.1 Geographical status of the study area

Nestled amidst the Thar Desert, Barmer district (25.7521° N, 71.3967° E) is situated in the western Rajasthan. The study was conducted in the Barmer district in an attempt, to find out the nesting sites and distribution of Long-billed Vultures. The survey area includes villages such as Jhanpura, Juna Patrasar, Balera, Munabao, Gadra Road, Gudisar, Chohtan, Khara, Viratra Mata Hills, Gogaji Temple Hills, Bhilo ki Dhani, and Aadupura Hills. In this region, xerophytic vegetation is adapted to dry and hot climatic conditions, which makes it a suitable habitat for residual species of vultures to build their nests⁽¹⁶⁾. The Thar Desert is characterized by extreme weather conditions, including high summer daytime temperatures of 40°C to 45°C while in the winter, the temperature ranges between 15°C to 25°C, and during Monsoon season in Thar Desert rainfall is less than 25cm⁽¹⁷⁾. Dry conditions are caused in this location by long dry intervals between rain and a high evaporation rate. Topographically, the area is undulating with dunes, a sandy plain, and a few rocky patches Figure 1.

2.2 Material used for research work

Location coordinates were collected using a Garmin Montana 680 GPS receiver. Olympus 8x40 binoculars were used to locate nesting, roosting, and drinking sites and for nest observations. Photographs were taken using a Nikon EOS 5D camera with a zoom lens. Identification of birds was achieved using the book “Field Guide to Birds of the Indian Subcontinent”⁽³⁾.

2.3 Data Collection /Methodology for set-up/Experimental Procedure

This study is on the distribution and nesting sites of Long-billed Vultures in the Barmer district, Rajasthan India, using direct or head count methods (supported by photographic and videographic counting)⁽²⁾. Both vehicular and walking transects⁽¹⁸⁾ were considered for the study and a transect of 634 km was achieved. The study was conducted from 7:00 AM–11:00 AM in the morning to 3:00 PM – 6:30 PM in the evening. We tracked vultures flying/soaring and leaving groups at carcasses and water sources to locate nesting sites, particularly during the breeding season. In addition to the nests recorded from high cliff regions, this study also estimated the population of the *Gyps indicus*. Different habitats, topography, proximity to the source of water and food (carcasses), surrounding the disposal of carcasses, and anthropogenic disruption towards this species were recorded during the study.

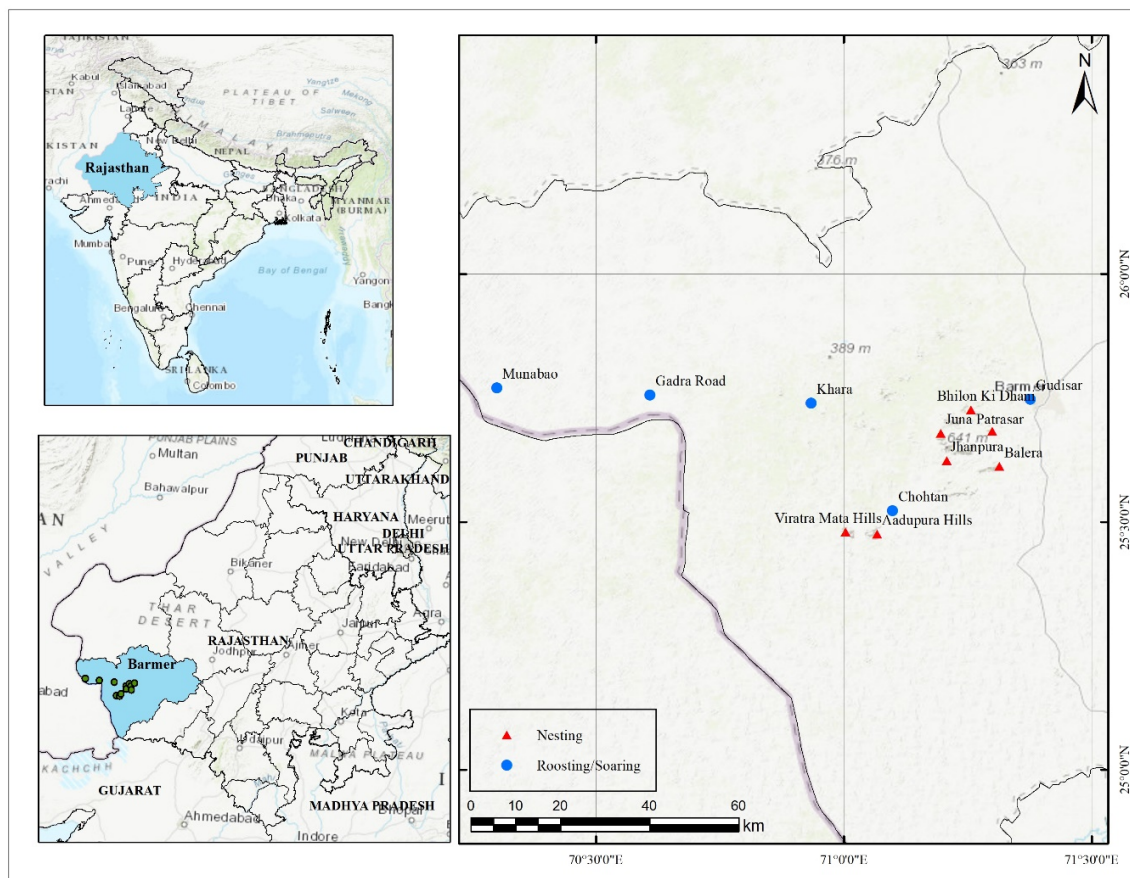


Fig 1. Map of the study area (Barmer)

3 Result & Discussion

3.1. Nesting site

All the nests in the Barmer district were observed in high, hilly areas Figure 2. The Long-billed Vulture selects the area for nesting based on the characteristics mentioned in Table 1. All the nests built by the Long-billed Vulture were found in places of negligible disturbance and the nests were constructed inside cavities and on ledges Figure 3. Nests are built in the cracks between the high hills so that vultures can avoid troubles and complete the breeding season. Long-billed Vultures prefer nesting on cliffs and steep rocky regions. Similarly, the nesting of Indian Vultures was recorded in the hilly region⁽⁵⁾. They usually build their nests at a height of 1,968 feet, or 600 meters. These areas have varying cliff heights, but Long-billed Vultures typically nest higher to protect their young from predators. Being near water sources is another prerequisite, though not as important as it is for some other bird species. We have recorded 5 vulture nests within 2 km, 7 nests within 3 km, and 2 nests within 4 km from the nearest water sources. A similar kind of observation was reported⁽¹⁹⁾. Long-billed Vulture nesting has been recorded at various places in the Barmer district such as Aadupura Hills, Jhanpura, Bhilo ki Dhani, Gogaji Temple Hills, Juna Patrasar, Viratra Mata Hills, and Balera. Vulture nests were found on rocky cliffs, hillocks, and isolated locations with little human influence in the study area. The vegetation in the study area includes shrubs like *Calligonum polygonoides* (Phog), *Calotropis procera* (Aak), *Capparis decidua* (Ker), *Euphorbia caducifolia* (Danda Thor), *Ziziphus nummularia* (Bordi), etc. and tree species like *Prosopis cineraria* (Khejari), *Ziziphus mauritiana* (Ber), *Acacia nilotica* (Kikar), *Acacia senegal* (Kumatia), *Anogeissus pendula* (Dhokda), *Salvadora persica* (Khari Jaal), *Salvadora oleoides* (Mithi Jaal) and *Tecomella undulata* (Rohida). In this nesting area, similar vegetation was observed⁽¹⁷⁾. Vultures inhabit old monuments, cliffs, and enormous trees in deserts. Similar nesting site habitat was reported⁽²⁰⁾. In the previous study, 36 nests were reported in 6 sites of the study area⁽²¹⁾ and 13 nests were reported from Nagana Hills, Kundal Hills, and Balotara region⁽⁸⁾. The present study reported that 14 nests were occupied in 7 different sites (Table 2). Out

of 14 nests, 3 nests of LBV were observed near the honeybee comb. Indian Vulture nests were constructed on cliff regions, and similar observation was reported⁽²²⁾.

Table 1. Description of attribute of nesting sites in the study area

S. No.	Attribute of Nesting Sites	Description
1.	Open Areas	Nesting locations are frequently found in wide-open spaces with little surrounding vegetation, providing easy access and visibility.
2.	High altitude	Long-billed Vultures prefer nesting on cliffs, and steep hillsides, providing safety from ground predators.
3.	Minimal Human Disturbance	Prefer areas with minimal human disturbance, although they are increasingly facing threats from habitat encroachment.
4.	Colonial Nesting	They usually build their nests in colonies, which can vary in size.
5.	Safe Access	Adult vultures should be able to easily access the sites so they can safely feed the chicks and return to the nest.
6.	Proximity to Food	Locations near abundant food sources, such as grazing livestock or naturally occurring carcasses, are crucial for feeding adults and chicks.

Table 2. Nesting sites and number of nests

S. No	Sites	No. of Nests
1.	Aadupura Hills	5
2.	Jhanpura	3
3.	Bhilo ki Dhani	2
4.	Gogaji Temple Hills	1
5.	Juna Patrasar	1
6.	Viratra Mata Hills	1
7.	Balera	1
Total		14

3.2. Nest Type

Nests are structures built by birds for housing and care for their young ones. Every pair of vultures builds a nest in the high, hilly area. The nest is made of large, flat sticks and the core is filled with dry grass and leaves. A vulture nest is a platform of sticks lined with green leaves. The most common and widely used plant materials to build nests were *Boswellia serrata* (Dhup), *Moringa oleifera* (Sanjano), *Aristida funiculata* (Lamp), *Boerhavia diffusa* (Santhi), *Commicarpus grandiflorus* (Bel), *Prosopis juliflora* (Angreji bawal), *Azadiracata indica* (Neem), *Acacia senegal* (Kumta), *Prosopis cineraria* (Khejari), *Comicarpus granflorus* (Bel) and *Trianthema portulacastrum* (Sato) Figure 4. Similarly, various plant materials were observed to be used by Indian Vultures in nest-building⁽²³⁾.

3.3. Population estimates

The population of Long-billed vultures was counted at a total of 12 sites in the study area. Vulture nesting sites and characteristics observations were taken during the day and an accurate number of vultures at each nesting site, roosting site, and drinking site. As per observation, LBV are mostly dependent on livestock carrion. During the observation out of the total, 7 Long-billed Vultures were feeding on domestic carrion. One of the more significant elements affecting their existence in a particular location is the availability of food, particularly carrion, as well as drinking water from ponds, water holes, and bodies of water they reported similar findings⁽⁸⁾. During the observation, a maximum of 9 individuals were recorded at Juna Patrasar village Figure 5 and a minimum of 1 individual was recorded at Khara and Gudisar villages. In the previous study, 47 individuals were reported in 6 different sites of study area⁽²¹⁾. In 3 sites of total 126 ± 29 LBV were reported by⁽⁸⁾. In the present study, 43 individuals of LBV were recorded in 12 sites of Barmer districts. All the possible potential vulture sites, with an average $\pm$ SD of 3.58 ± 2.57 (Table 3). As we have concluded the earlier studies suggest a higher population of LBV in the study area, but the present investigation reports a much smaller population than that reported earlier.



Fig 2. Nests observed on the cliff region



Fig 3. Low predator disturbance near nesting site



Fig 4. Various plant materials used in nest construction

Table 3. Nesting sites and number of individuals recorded different areas of Barmer

S. No.	Sites	No. of Individuals	Activity
1.	Juna Patrasar	9	Nesting, Roosting, Soaring
2.	Aadupura Hills	8	Nesting, Roosting, Soaring
3.	Jhanpura	5	Nesting, Roosting, Soaring
4.	Gogaji Temple Hills	4	Nesting, Roosting, Soaring
5.	Bhilo ki Dhani	3	Nesting, Roosting, Soaring
6.	Viratra Mata Hills	3	Nesting, Roosting, Soaring
7.	Munabao	3	Roosting, Soaring
8.	Chohtan	2	Roosting, Soaring
9.	Gadra road	2	Roosting, Soaring
10.	Balera	2	Nesting, Roosting, Soaring
11.	Gudisar	1	Roosting, Soaring
12.	Khara	1	Roosting, Soaring
Total		43	
Average $\pm$ SD		3.58$\pm$2.57	

SD=Standard Deviation

3.4. Threats

During the field survey interaction with local rural people was done and their perception of different threats such as anthropogenic disturbance, mining activity, electrocution, food scarcity, and deforestation was noted. Twenty-seven villagers from 12 villages were surveyed and questionnaires were taken from them. During the survey, it was found that anthropogenic disturbance near nesting sites is considered the biggest threat to the vulture species and 45% of the people agreed to this Figure 6. Demography and distribution are mostly affected by anthropogenic activities⁽²⁴⁾. Besides these, electrocution⁽¹⁴⁾ and trichobezoar⁽²⁵⁾ are some recent causes identified in the decline of vultures. Threats like mining and deforestation resulted in a decline in the long-lasting nesting site of vultures in the Thar Desert⁽¹⁶⁾.



Fig 5. Indian Vulture Roosting Site at Juna Patrasar Village

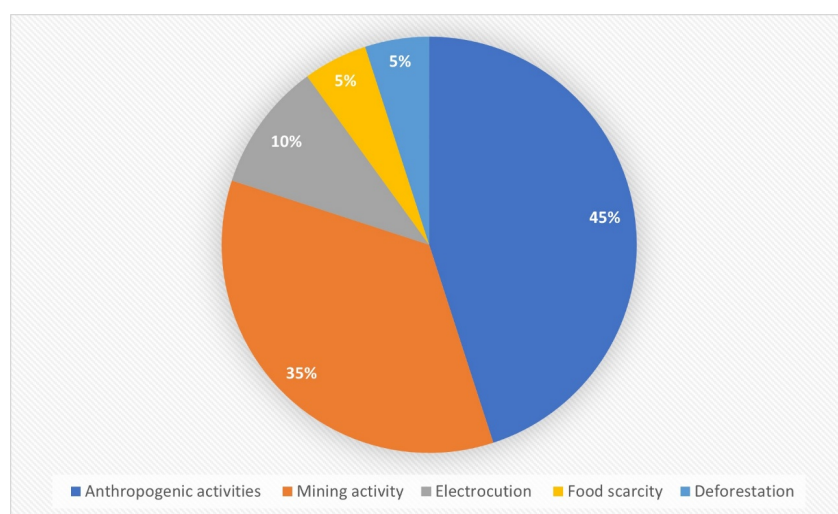


Fig 6. Various threats for *Gyps indicus* in the study area

3.5. Conservation

During the study, we visited villages, towns, and public areas and conducted awareness programs among residents about vulture conservation. Conservation of vultures is important for nature and human health because vultures clean the carcasses resulting in the contain of spreading deadly diseases. Even if the situation is dire, we must act quickly to save the regions that offer this species ideal nesting grounds, which will conserve this critically endangered species.

4 Conclusion

This study records the LBV species distribution and nesting sites in the Barmer district in Rajasthan, India. During the study period, a total of 43 individuals of Long-billed Vultures were recorded in 12 sites, with an average $\pm$ SD of 3.58 ± 2.57 . The

population count of Indian Vultures present in nesting sites, roosting sites, drinking sites, and feeding sites was also recorded. The nesting sites of Long-billed Vultures were observed in the hilly region of the study area. The finding of new nests and nesting sites in the hilly region of Barmer district (Aadupura Hills, Jhanpura, Bhilo ki Dhani, Gogaji Temple Hills, Juna Patrasar, Viratra Mata Hills, and Balera) is relevant to the research field. Recorded a total of 14 nests of LBV in 7 different sites. They used various plant materials in nest construction. The study also highlights the importance of green plant material as an important component of Long-billed Vulture nests. Availability drinking water sources were found to be a pond, Nadi, khadin, and a damaged water pipeline. A study on the nesting sites and characteristics of the “critically endangered” Long-billed Vulture in the Great Indian Thar Desert of Rajasthan has revealed a decline in the species population. Indian Vultures are declining in the study area due to anthropogenic activities, mining activity, electrocution, and deforestation. The study emphasizes the need to protect the remaining nesting sites for the critically endangered species, as the population remains extremely low.

This study has noted that the Indian Vulture based ecological importance already exists, but deeper comprehension is needed. During research work on LBV, promising results for the sustainable management of agroecosystems were observed. Additionally, LBV is considering for sustainable approach towards enhancing the ecological health of soil, plant growth, and the development of ecological behavior. Therefore, the present study gains importance in providing a wide range of current investigations on Long-billed Vultures. Continuous observation and research are required to effectively implement conservative measures to ensure that the *Gyps indicus* remain in its natural habitat. This observation not only contributes to our knowledge of Indian Vultures but also emphasizes the wider implications of biodiversity conservation in the study area.

The study suggests establishing vulture restaurants in the Thar Desert to increase the population and prevent deaths due to the lack of food. Water bodies should be constructed to meet vulture needs for drinking water. Habitat conservation and awareness programs should be organized in local areas i.e., villages, towns, and dhanis. Establishing breeding centers, hospitals, and rehabilitation centers in the study area. Vulture conservation policies, captive breeding, and rehabilitation are recommended.

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References

- 1) Grilli MG, Bildstein KL, Lambertucci SA. Nature's clean-up crew: Quantifying ecosystem services offered by a migratory avian scavenger on a continental scale. *Ecosystem Services*. 2019;39. Available from: <https://doi.org/10.1016/j.ecoser.2019.100990>.
- 2) Suthar S, Sharma A, Chauhan PS, Chauhan K, Nagar B, Maurya IB. Assessment of diversity, population and related threats to vultures in Hadoti region of Rajasthan. *International Journal of Current Microbiology and Applied Science*. 2020;9(12):1302–1309. Available from: https://www.researchgate.net/publication/349909030_Assessment_of_Diversity_Population_and_Related_Threats_to_Vultures_in_Hadoti_Region_of_Rajasthan.
- 3) Grimmett R, Inskipp C, Inskipp T. Field guide to birds of the Indian subcontinent. 1st ed. Bloomsbury Publishing. 2019. Available from: <https://www.bloomsbury.com/in/field-guide-to-birds-of-the-indian-subcontinent-9788193315095>.
- 4) Kumar A, Mishra S, Yadav R, Sinha A, Kanaujia A. Vultures of Pilibhit tiger reserve (PTR), Uttar Pradesh. *Advances in BioResearch*. 2018;9(2):135–144. Available from: https://www.researchgate.net/publication/327861296_Vultures_of_Pilibhit_Tiger_Reserve_PTR.
- 5) Manigandan S, Byju H, Kannan P. Monitoring observations of the southernmost breeding population of Long-billed Vultures *Gyps indicus* (Scopoli, 1786) (Aves: Accipitriformes: Accipitridae) in the Nilgiri Biosphere Reserve, India. *Journal of Threatened Taxa*. 2024;16(2):24730–24736. Available from: <https://doi.org/10.11609/jott.8700.16.2.24730-24736>.
- 6) Ravikanth M, Baskaran N. Abundance and age structure of critically endangered Long-billed vulture (*Gyps indicus*) and White-rumped vulture (*Gyps bengalensis*) vultures at the breeding colonies of Kaghaznagar forest division and its adjoining areas in the Deccan Plateau, India. *Journal of Biosciences*. 2024;49(2):1–10. Available from: https://www.researchgate.net/publication/380848519_Abundance_and_age_structure_of_critically_endangered_long-billed_Gyps_indicus_and_white-rumped_G_bengalensis_vultures_at_the_breeding_colonies_of_Kaghaznagar_Forest_Division_and_its_adjoining_areas_in.
- 7) Tatu K, Vyas V, Munjapara S, Pathak B, Pandey CN. Population status of White-Backed Vulture *Gyps bengalensis* and Long-Billed Vulture *Gyps indicus* in Gujarat, India. *Journal of the Bombay Natural History Society*. 2012;109:37–42. Available from: <https://www.bnhsjournal.in/index.php/bnhs/article/view/156170>.
- 8) Saran RP, Kumawat R, Purohit A. Recent trends of population and nesting of threatened vulture species in Thar desert of Rajasthan, India. *Uttar Pradesh journal of zoology*. 2020;41(18):44–53. Available from: <https://mbimph.com/index.php/UPJOZ/article/view/1723>.
- 9) Jha KK, Campbell MO, Jha R. Vultures, their population status and some ecological aspects in an Indian stronghold. *Notulae Scientia Biologicae*. 2020;12(1):124–142. Available from: <https://doi.org/10.15835/nsb12110547>.
- 10) Chishty N, Choudhary NL. Successful breeding rate and population status of Indian Vulture (*Gyps indicus*) at Kailashpuri, Udaipur District, Rajasthan. 2020;38(4):929–936. Available from: <https://www.researchgate.net/publication/349895605>.
- 11) Khatri PC. First nesting of critically endangered vulture in Bikaner: the nest site record of Long-billed vulture (*Gyps indicus*) in kolayat tehsil, Bikaner. *International Journal of Innovative Research and Review*. 2015;3(2):8–13. Available from: <https://www.cibtech.org/J-Innovative-Research-Review/Publications/2015/Vol-3-No-2/02-JIRR-002-PRABODH-ENDANGERED.pdf>.

- 12) Prakash V, Bajpai H, Chakraborty SS, Mahadev MS, Mallord JW, Prakash N, et al. Recent trends in populations of Critically Endangered Gyps vultures in India. *Bird Conservation International*. 2024;34. Available from: <https://doi.org/10.1017/S0959270923000394>.
- 13) Singh V, Bisht SS. Records of Critically Endangered Species of Avian fauna: Vultures *Gyps indicus* (Scopoli, 1786) and *Sarcogyps calvus* (Scopoli, 1786) from Surai Reserved Forest at Foot Hills of Kumaun Himalaya. In: Arya MK, 'Bharti' PK, et al., editors. *Experimental Animal Science-Birds and Insects*;vol. 2019. New Delhi. Discovery Publishing House Pvt Ltd. ;p. 140–147. Available from: https://www.researchgate.net/publication/342199337_Records_of_Critically_Endangered_Species_of_Avian_fauna_Vultures_Gyps_indicus_Scopoli_1786_and_Sarcogyps_calvus_Scopoli_1786_from_Surai_Reserved_Forest_at_Foot_Hills_of_Kumaun_Himalaya.
- 14) Saran RP, Purohit A. Eco-transformation and electrocution. A major concern for the decline in vulture population in and around Jodhpur. *International journal of conservation science*. 2012;3(2):111–118. Available from: <https://www.researchgate.net/publication/288743033>.
- 15) Gyps indicus. . Available from: <https://www.iucnredlist.org/species/22729731/204672586>.
- 16) Saran R, Purohit A. Population status, nesting sites and seasonal fluctuation of Egyptian vultures (*Neophron percnopterus*): Dynamics and implications for the species conservation in and around Jodhpur. *International Journal of Biodiversity and Conservation*. 2014;6(1):100–107. Available from: https://academicjournals.org/article/article1386261438_Saran%20and%20Purohit.pdf.
- 17) Charan PD, Sharma KC. Floral diversity of Thar Desert of western Rajasthan, India. *Journal Phytological Research*. 2016;29(1):55–71. Available from: https://www.jphytolres.org/system/files/old_papers/7.%20Charan%20%26%20Sharma.pdf.
- 18) Anderson DR, Laake JL, Crain BR, Burnham KP. Guidelines for line transect sampling of biological populations. *The Journal of Wildlife Management*. 1979;43(1):70–78. Available from: <https://www.jstor.org/stable/3800636>.
- 19) Jha KK, Jha R, Campbell MO. The distribution, nesting habits and status of threatened vulture species in protected areas of Central India. *Ecological Questions*. 2021;32:7–22. Available from: [https://apcz.umk.pl/EQ/article/view/33926#:~:text=The%20probability%20of%20vulture%20occupancy,%2D2%20\)%20and%20agricultural%20areas](https://apcz.umk.pl/EQ/article/view/33926#:~:text=The%20probability%20of%20vulture%20occupancy,%2D2%20)%20and%20agricultural%20areas).
- 20) Sahu R. Study of scavenger birds in some region of Bundelkhand to assess the promising breeding sites for their breeding conservation. *International Journal for Research Publication and Seminar*. 2024;15(3):344–356. Available from: https://www.researchgate.net/publication/384126903_STUDY_OF_SCAVENGER_BIRDS_IN_SOME_REGION_OF_BUNDELKHAND_TO_ASSESS_THE_PROMISING_BREEDING_SITES_FOR_THEIR_BREEDING_CONSERVATION.
- 21) Chhangani AK. Present Status of Vultures in the Great Indian Thar Desert. In: Sivaperuman C, Baqri QH, Ramaswamy G, Naseema M, editors. *Faunal Ecology and Conservation of the Great Indian Desert*. Springer Berlin Heidelberg. 2009;p. 65–83. Available from: https://link.springer.com/chapter/10.1007/978-3-540-87409-6_7.
- 22) Manigandan S, Byju H, Kannan P. Assessing the accuracy of population estimation methods for vulture populations: a case study from the Mudumalai Tiger Reserve, Tamil Nadu, India. *Environmental and Experimental Biology*. 2023;21(2):45–52. Available from: <https://dx.doi.org/10.22364/eeb.21.06>.
- 23) Kushwaha S. Utilisation of green plant material in nests of Long-billed Vultures *Gyps indicus* in Bundelkhand Region, India. *Vulture News*. 2016;71(1):7–21. Available from: https://www.researchgate.net/publication/315808027_Utilisation_of_green_plant_material_in_nests_of_Long-billed_Vultures_Gyps_indicus_in_Bundelkhand_Region_India.
- 24) Biju T, Mize D. Distribution, Population trend and Threats of three critically endangered Gyps vulture in Indian subcontinent: a review. *Dera Natung Government College Research Journal*. 2021;6(1):55–65. Available from: <https://dx.doi.org/10.56405/dngcrj.2021.06.01.06>.
- 25) Saran RP, Purohit A. Trichobezoar: a possible cause of death in Eurasian Griffon (*Gyps fulvus*) a case study. *Zoos'Print*. 2016;31(12):15–16. Available from: <https://zoosprint.org/index.php/zp/article/view/554>.