

Can Vulture Restaurant Protect Critically Endangered Species of Vultures in Lowland Nepal?

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Abstract: This study was aimed to analyze impact of vulture restaurant on vulture population and local community. The research was also focused the present status, habitat preference and change in people's perception after the establishment of vulture restaurant. The study was based on the distance sampling method in which twelve transects were established for the monitoring of vultures and their habitats. Individual and focus group discussion were performed to identify people's perception towards vulture restaurant and vulture conservation etc. The study was mainly concentrated in and around the vulture restaurant and a broad survey was performed to know the occupancy of vultures in other parts of Chitwan and Nawalparasi districts. Altogether 162 individuals of 5 species of vultures were recorded in 2016. White rumped vultures were the most abundant (n=75) followed by Himalayan griffon vulture (n=67), Egyptian vulture (n=12), Red headed vulture (n=5) and Slender billed vulture (n=3). Altogether 31 nests (30 nests of White rumped vultures and 1 Egyptian vulture) were recorded in 2016. In contrast, these species of vultures were not reported before the establishment of vulture restaurant. Local people shared their experiences that there were abundant numbers of vultures 20-25 years ago. However, this restaurant is a key success for coming back of the vultures after a very long time. The perceptions of the local people towards the vulture and vulture restaurant have been changed after the establishment of vulture restaurant as they are getting benefits from ecotourism and changing their minds towards the protection of such sweeper of the nature. Most of the locals (88%) were positive towards the vulture and vulture restaurant. The study further revealed that there was a great role of vulture restaurant in providing the safe diclofenac free carcass for vultures in different places in regular basis and local people were also got benefits of vulture restaurant through tourism to improve their livelihood.

Keywords: Vulture, Vulture restaurant, Diclofenac, Carcass, Chitwan National Park

1. Introduction

Vultures are the key species among the avifauna by playing a greater role in ecosystem services. Nine species of vultures are recorded from South Asia in which eight are resident and one is migratory [1]. Nepal supports six resident vulture species -White-rumped vulture (*Gyps bengalensis*), Slender-billed vulture (*Gyps tenuirostris*), Egyptian vulture (*Neophron percnopterus*), Red-headed vulture (*Sarcogyps calvus*), Himalayan griffon vulture (*Gyps himalayensis*), and Lammergeier or bearded vulture (*Gypaetus barbatus*), one winter visitor -Cinereous vulture (*Aegypius monachus*) and one passage migrant-Eurasian griffon vulture (*Gyps fulvus*) [2]. However, the Long-billed vulture (*Gyps indicus*) was recorded only once in vulture restaurant at Nawalparasi [3] which is critically endangered species as IUCN red list data book [4].

Vultures are specialized scavengers that play a crucial role in removal of dead animals that would otherwise rot and cause disease, despair and death to both human and animals [5]. Over the past 10 years field biologists working in the region have reported a decline in numbers of vulture throughout their range mainly in India, Nepal and Pakistan [6], [7]. Recent field surveys and monitoring have identified a catastrophic population decline of over 97% in Slender billed vulture and White rumped vulture. Due to such declines, these species were listed by IUCN as Critically Endangered, which is the highest category of endangerment [4].

The populations of Gyps vulture species across the Indian subcontinent have crashed over the past decade, in many areas by more than 95%. [8]. The dramatic decline and potential extinction of vultures have serious implications for a human dominated ecosystem in which scavengers (rather than predators) play such an important role, with heightened risk of disease from decaying unconsumed carcasses and from proliferating four-footed scavengers — dogs, cats, and rats. At first mysterious, the likely cause of the vulture decline in Pakistan was recently pinpointed as the widely-used veterinary anti-inflammatory drug diclofenac administered to cattle. Vultures fed on carcasses of diclofenac-treated cattle develop fatal kidney failure [9]. [10]. Green et al. now show that diclofenac is the probable cause of Gyps decline across the entire subcontinent. To minimize the possible imminent extinction of Gyps species, an urgent search for alternatives to diclofenac is required [11].

There was rapid progress in identifying that the veterinary drug meloxicam was safe for vultures and other scavenging birds [11] and as this was recently out of patent it could be made in South Asia. The government of India and Nepal immediately ban diclofenac. Unfortunately, these measures have not yet been sufficient to remove diclofenac from the environment, particularly as it now emerges that human formulations of the drug are being widely used by vets, and White-rumped Vulture populations continue to decline by 44% per year [12].

The recent trend of catastrophic decline in the population of three *Gyps* vultures in the Indian subcontinent is being the alarming issue of vulture conservation [6], [7], [8]. To minimize such threats, conservation organizations have established vulture restaurants to provide the diclofenac free carcass for vultures in special locations [2]. However, there is no sufficient study about the role and impact of such restaurants in their conservation. Therefore, this study was designed to explore the recent status of vultures, impact of vulture restaurant and conservation challenges of vulture species in such human dominated areas.

2. Study Area

The study area covers a broad area in and around the vulture restaurant of Pithauli, Nawalparasi, Nepal (Figure 1). The vulture restaurant is located inside the Namuna Bufferzone Community Forest (NBCF). This area is one of the most important sites of the Terai-arc landscape and covers one of the most important ecoregion- Terai duar savanna and grasslands [14]. This community forest consists of riverine type of vegetation such as *Bombax ceiba*, *Trewia nudiflora*, khair (*Acacia catechu*) and sissoo (*Dalbergia sissoo*) along the old and large tracks rivers and streams [15]. This Bufferzone Community Forest have numerous trees suitable for nesting and roosting sites of vultures. Number of nests constructed by vultures in the area has steadily increased since the project began. All two species of vultures that nest in Terai have constructed nest in this area. Unproductive and old cattle are a burden to farmers as they cannot either be sold or killed. The cow rescue center collects such cattle from farmers. These cattle are provided good care, food, shelter and veterinary facility at the rescue center. When the animal dies a natural death, it is transported to the feeding site and skinned. Then, it is provided to the vulture (source: Vulture restaurant, Pithauli, 2016).

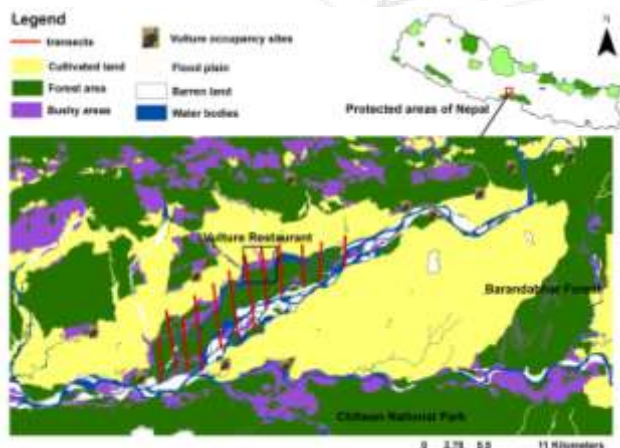


Figure 1: Map of the study area showing location of 12 transects, vulture restaurant, vulture occupancy sites outside of intensive study area, Chitwan National Park and Barandabhar Forest Corridor.

3. Methodology

There were both primary data collected from the field visit and secondary information collected from different concerned conservation organizations from October 2015 to September 2016. For intensive field study, birding routes

were identified and designed for data collection. The intensive study area is located in and around Jatau Restaurant Pithauli and Kawasoti areas of Nawalparasi district. The twelve transects were monitored in regular basis, and species and numbers of vulture species were identified by using 20*50 Binoculars.

Individual (structured questionnaires) and focal group discussion were carried out at local level in order to understand the current status of vulture species, current issues, future strategies and conservation challenges of the study area. Focal group discussion was done by consulting a group of people working in the field of conservation such as members of community forest, vulture restaurant, youth club, and community organizations etc. Individual interactions were performed by consulting with herders and forest guards. This method was used to assess different parameters such as presence/absence, distribution, diversity, abundance, religious and cultural aspects, potential threats etc. of vultures of the study area.

Table 1: Number and locations of the vulture in the study area

Vulture Species	Maximum (nk)	Second Maximum (nk-1)	Estimated population $N = 2n_k - (n_{k-1})$	IUCN Red list Category	Location in the study area
Egyptian vulture (EV)	11	10	12	Endangered	Namuna CF
White rumped vulture (WRV)	70	65	75	Critically Endangered	Namuna CF, Krishnashar CF, Gubdre Dakah CF, Shantikunja CF
Himalayan Griffon vulture (HGV)	62	57	67	Near threatened	Namuna CF, Krishansar CF, Gundre Dakah CF, Shantikunja CF
Slender billed vulture (SBV)	4	3	5	Critically Endangered	Namuna CF
Red headed vulture (RHV)	3	3	3	Critically Endangered	Namuna CF
Total			162		

For data analysis, MS-EXCEL with XLSTAT AddIn applications was used to assess the associations of the species variables with the environmental variables [16]. The number of vulture was confirmed by repeated count in one observation session. During the total count, the exact total numbers were different at the same place in different replicates. During the total count, the exact total numbers were different at the same place in different replicates. Hence to reduce biasness, estimated population was calculated by $N = 2n_k - n_{k-1}$ formula [22] and count was derived from first and second maximum counting such as:

Here, $N = 2n_k - n_{k-1}$

Where,

N= estimated population.

n_k = highest value of observed population
 n_{k-1} = second highest value of observed population.
 This method is useful for animals present in the open and dry wilderness areas [22]. This case is also similar to our study area where few numbers of trees are present in the open flood plain grass lands.

4. Results

The study provides the information about the status, habitat preferences, people's perception and conservation challenges of vulture species. Furthermore, it also evaluated the role of vulture restaurant in vulture conservation and impact on local community. The study also identified the other priority areas where vultures occurred.

The study provides the information about the status, people's perception and conservation challenges of vulture species.

Species diversity and distribution

Five species of vulture were recorded during study Period. A total of 162 individual (estimated population) of vultures were recorded during study period. Among them, White-rumped vultures were the most abundant (75 individuals) followed by Himalayan griffon vulture (67 individuals), Egyptian vulture (12 individuals), Slender-billed vulture (5), and Red headed vulture (3). The population of the vultures was recorded in and around the vulture restaurant, which is located inside the Namuna Bufferzone Community Forest (Table 1). The study also recorded the vultures outside the restaurant areas such as Jugedi, British camp, Nagarban, Gindakot, Chormara, Golaghat etc.



Figure 2: A flock of White rumped vulture roosting on *Bombax ceiba* tree.



Figure 3: A flock of vultures enjoying feeding on carcass near the vulture restaurant.

Habitat Selection

The study found that *Bombax ceiba* forest and riverine mixed forest were the most preferred habitats of vulture species. The partial least square regression analysis showed

the importance of variables used in the analysis. Among the nineteen environmental variables, *Bombax ceiba* forest was the most important habitat (Figure 4). Distance to vulture restaurant was the second most important variable. Most of the vulture species with their higher number of individuals were recorded at vulture restaurant and *Bombax ceiba* forest. The species and environmental variables relationship (Figure 5) shows that all three species positively preferred *Bombax ceiba* forest, slightly dense habitats and the area where the carcass was present. The negative relationship between species and distance to vulture restaurant revealed that increasing the distance from vulture restaurant number of species and individuals were decreased. The sightings of vultures were also decreased with increasing distance from nearest track/road or village /city attributed to their preference with the human disturbed areas (Figure 5).

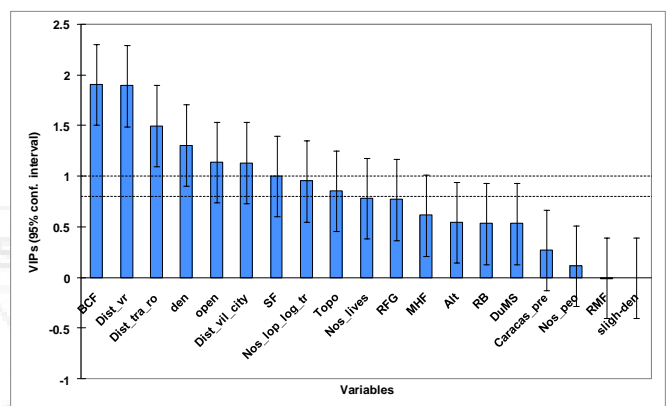
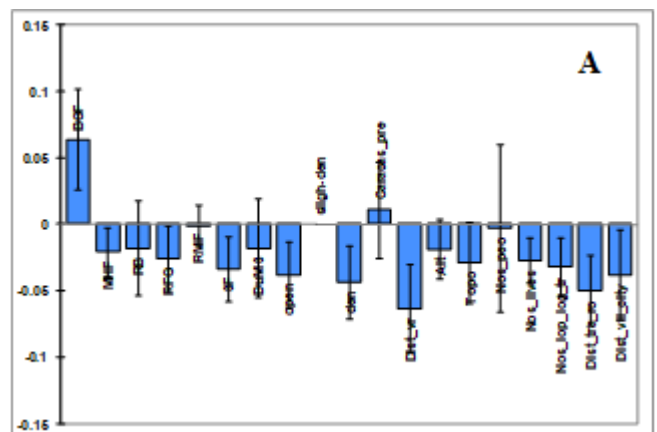


Figure 4: Variable Importance in the Projection (VIP) at 95% confidence interval

Where, Environmental variable codes: *Bombax ceiba* forest (BCF), Mixed hardwood forest (MHF), River bank (RB), Riverine forest grassland (RFG), Riverine mixed forest (RMF), Sal forest (SF), Dumping site (DuMS), Open canopy forest (Open), Slightly dense forest (Sli_den), Carcass present (Carcass_pre), Distance to vulture restaurant (Dist_vr), Altitude (Alt), Topography (Topo), Number of people (Nos_peo), Number of livestock grazing inside the habitat (Nos_lives), Number of lopped and logged trees (Nos_lop_log_tr), Distance to track/road (Dist_tra_ro), Distance to village or city (Dist_vil_city).



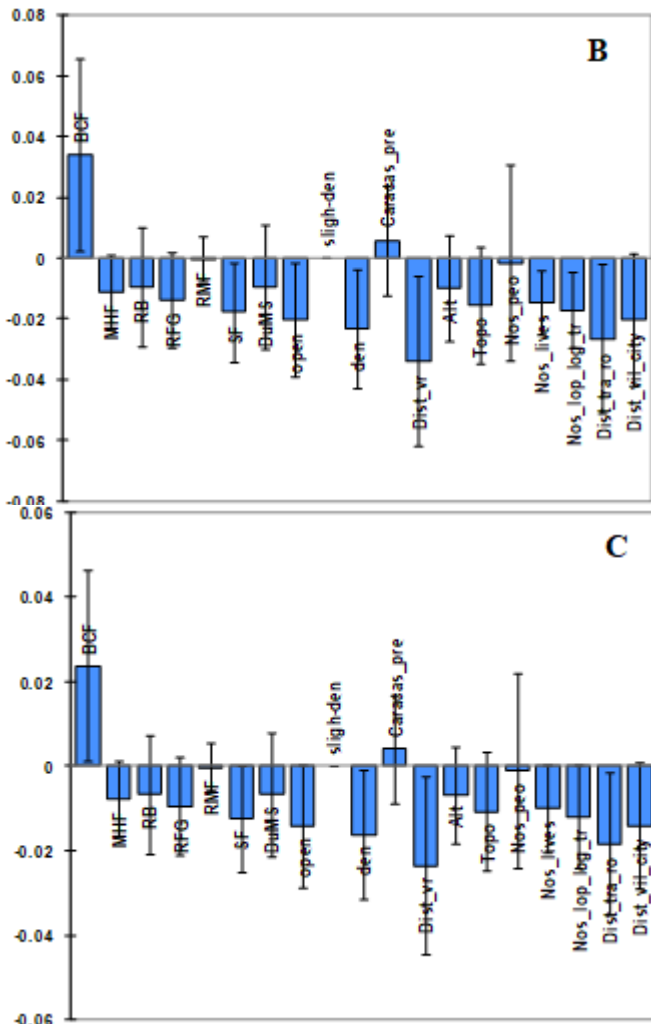


Figure 5: Species and environmental variable relationship. Figure A- White rumped vulture, Figure B- Himalayan griffon and Figure C- Egyptian vulture.

The species- Slender billed vulture, Red headed vulture were not used in this analysis because they were present only once during the study period. The figure shows the strength of relationship between species and environmental variables. The Y axis shows the standardized coefficients of determination at 95 % confidence interval and the X axis shows the variables obtained from partial least square regression.

Breeding and Nesting sites

Most of the vulture species breed from November to April. Although five species of vultures were recorded from the study area, only two species (White rumped vulture and Egyptian vulture) breed in this area. Altogether 31 nests were recorded from the different community forests located in and around the vulture restaurant. Interestingly, all the nests were recorded in the tall and large Simal tree (*Bombax ceiba*) to the vicinity but undisturbed area from the village. Only one nest of Egyptian vulture was recorded from the Namuna community forest and other 30 nests were of White rumped vulture. Among them only 28 nests were active and productive nests. Most of the nests of White rumped vultures were recorded a bit far from the vulture restaurant (Table 2).

Table 2: Number of nests of the vulture species in different localities of the study area

Vulture Species Recorded	No of nests found	Active nests	Location
Egyptian vulture	1	1	Namuna CF
White rumped vulture	30	28	5-Namuna CF, 19-Krishnashar CF, 6-Gundredakaha CF (Amaltari area)
Himalayan Griffon	0	0	-
Slender billed vulture	0	0	-
Red headed vulture	0	0	-
Total	31	29	

Conservation role of vulture restaurant

The study found that the vulture restaurant area is the most important and highly preferred area for vultures. This is attributed to the availability of safe food or diclofenac free carcass in a regular basis. However, in other areas there were very less availability of carcass. In the study area, more than 88% of the respondents strongly agreed with the idea of the vulture restaurant and same number of respondents told that they have got benefits from the vulture restaurants.

Vultures were not recorded before the establishment of vulture restaurant in this area since a long time. During the study period, some of the local people believed that there were abundant numbers of vultures 20-25 years ago (Figure 6). There were sparse occurrence of vultures outside the restaurant area revealed that they start to reestablish new colonies/homes for roosting and breeding (Figure 1).

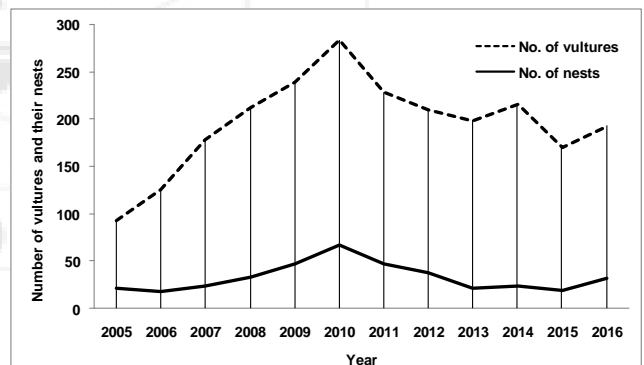


Figure 6: Reappearing trends of vultures after the establishment of vulture restaurant in locally extinct areas (Data source: 2005 to 2014 from vulture restaurant Pithauli, 2015-2016 from this study).

Furthermore, some of the respondents near the vulture restaurant believed that no vultures were visited the vulture restaurants. This implies that there is still some people are in dilemma about the role of vulture restaurants in vulture conservation. However, most of the respondents (more that 70%) were agreed that vultures frequently visited the vulture restaurant to get safe and enough food. In the study area 84% of the respondents at the peripheries of the vulture restaurant told that vulture population has been increased after the establishment of vulture restaurant. However, 7% of the respondents said decreased and 12% of the respondents said neither increased nor decreased the population of vultures after the establishment of the vulture restaurant. Vultures were recorded in all seasons but higher

in winter. There is the provision of at least one carcass (dead body of cow) per week in the vulture restaurant. At the day of carcass supply, the people from vulture restaurant also invite tourists for watching different species of vultures feeding on carcass. This ultimately increase the revenue of the vulture restaurant that further support in the conservation of vultures in the area. Furthermore, the restaurant has been a major tourist destination in the Chitwan National Park after Crocodile Breeding Center at Kasara. The records show that there is at least twenty people visit the restaurant including both local and foreign tourists.

5. Discussion

Vultures play an important role in ecosystem services as they clean the environment by consuming carcasses that may spread diseases to human and livestock. Nepal is considered as one of the major hotspots of vulture species. The country provides home for nine species of vultures in which four species are critically endangered, one species is endangered, one species is near threatened, and three species are least concerned [4], [23]. The surveys undertaken in this study provide the first quantitative estimate of the impacts of vulture restaurant on population of threatened *Gyps* vultures in Nepal. However, the first quantitative estimate of *Gyps* vultures in lowland Nepal was documented in Baral *et al.* (2004) [17].

In the study area, there were eight species of vulture recorded near by the vulture restaurant (official records of vulture restaurant) [23]. Among these species, five species were recorded in our study (Table 1). This means that restaurant has played the important role in vulture conservation [10]. A vulture restaurant was established for the White-rumped vulture *Gyps bengalensis* colony at Toawala, in Punjab province Pakistan, to test the effectiveness of the technique in modifying ranging behavior and mortality at the colony. Six male vultures were fitted with satellite transmitters to measure variation in movement and home-range during periods when safe food was alternately available and withheld at the vulture restaurant. These all species are the resident breeder except one passage migrant-Eurasian griffon vulture (*Gyps fulvus*) in Nepal. These species are mainly distributed in Nepal, India, Pakistan and Bangladesh [3]. There were very few records of vultures from eastern Nepal. Pokhara, Chitwan, Nawalparasi and Kathmandu were the major hotspots of vultures where the vultures were frequently observed [17]. A total of 162 individuals of vultures were recorded during this study period in which White-rumped vultures were the most abundant (75 individuals). The highest number of vultures was recorded in and around the vulture restaurant which is located in the Namuna Bufferzone Community Forest. This number is 62% more than the number of the vulture during the time of establishment. The occurrence of vultures outside the restaurant area showed that they establish new homes for roosting and breeding.

The habitat preference of three species of vultures were higher in *Bombax ceiba* forest, similar to the studies of White rumped vulture from India where vulture species usually prefer to stay well-foliaged pine trees along the water courses in Chir-Pine Forests [18]. The negative relationship between species and distance to vulture

restaurant means that the species prefer to stay nearby the vulture restaurant because of the regular availability of food/carcass. The sightings of vultures were also decreased with increasing distance from nearest track/road or village /city because vultures are mostly found near by the human settlement. All the nests in the study area were found in the *Bombax ceiba* trees because these trees are taller than other trees in the study area where the study found the average height of *Bombax ceiba* trees was 37 m and DBH was 5 m respectively. In India forests Thakur and Narang (2012) [18] found that taller pine trees were the most preferred tree species for nesting of White rumped vultures in the pine forests.

The CF administration has been encouraging the locals to stop the use of diclofenac in their livestock. Although, the ban in use and trade of diclofenac, it was found to be in use in veterinary practices and was illegally kept for sale by retailers [19]. The restaurant and community forest also play various roles to protect the local cultures and their indigenous knowledge that assist to lure tourists. A vulture breeding center has also been established to breed vultures in captivity. Similar program has also been established in India [20].

People's perception on vulture conservation programs has also changed in positive way after the establishment of vulture restaurant. As much as more than 88% of the respondents believed the need of safe diclofenac free carcass for vultures as they know that there is the effect of diclofenac in vulture population decline. Similar study [21] from Kaski district of western Nepal found that young, educated and those who involved in conservation organizations were most likely to support the vulture conservation.

6. Conclusion

The study was carried out in different parts of Chitwan and Nawalparasi districts of southern Nepal. In the study area vultures were mostly recorded in and around the vulture restaurant. The restaurant provides diclofenac free carcass that supports more than 90% of the total food supply of the vultures in the study area. The study concludes that food availability is the most important factor the protection of vultures. During the study period, a total of five species of vultures (Egyptian vulture, White-rumped vulture, Slender-billed vulture, Himalayan Griffon and Red headed vulture) were recorded. Among these species White rumped vulture (75) is the most dominant one followed by Himalayan griffon (67), Egyptian vulture (12), Slender billed vulture (5) and red headed vulture (3). The vulture species were mostly found nearby the human settlements. However different species had different level and types of habitat preferences. The White rumped vulture mostly recorded in *Bombax ceiba* forest. All the nests were recorded in Nawalparasi area extending from Gidaha to Amaltari. All together 31 nests were recorded in which maximum nest were of White rumped vulture (30). Only one nest of Egyptian vulture was recorded inside the vulture restaurant. The sparse occurrence of vultures outside the restaurant area has clarified that vultures have been establishing new sites for roosting and breeding. Local people and conservation experts working in

the area believed that the numbers and species diversity of vultures have been increased after the establishment of the restaurant.

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