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RESEARCH ARTICLE

Vultures in human-distorted landscapes of Balrampur, Uttar Pradesh, India pertaining to roosting and feeding sites

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ABSTRACT

The Terai belt of Uttar Pradesh is blessed with a promising population of vultures, the chief obligate scavengers that have coexisted with humans for centuries. Balrampur district has the residential and migratory vulture population in their protected and unprotected areas. The study was undertaken from December 2016 to May 2019, to understanding how vultures persisted in human-altered landscapes with a focus on management of roosting and feeding sites. The results illustrated the presence of 7 vulture species in the study area that exhibited seasonal variations. The vulture population at roosting sites ranged from 10 to 600 comprising of individuals of Oriental white-rumped vulture (*Gyps bengalensis*), Himalayan Griffon (*Gyps himalayensis*) and 2-3 Cinereous vultures (*Aegypius monachus*). Being social foragers, vultures were seen feeding in flocks of 15-60 individuals. As per the observations, there was no dearth of carcasses for the scavengers; however, the presence of feral dog population is a key hindrance. The risk to nesting and roosting sites is high due to the uncontrolled collecting of woods for domestic and commercial uses such as in hotel kitchens, brick kilns and at furniture shops. This information will aid to know where and how to focus conservation efforts on a regional and global scale with the involvement of local people.

***Key words*:** Vultures, Roosting, Foraging, Humans, Conservation

1) INTRODUCTION

Plant The terai region of Uttar Pradesh is a very important ecosystem for many threatened species of tall wet grasslands and swamps [1, 2] and is the topmost priority for conservation [3]. The forests and grasslands of the terai region are the most important biodiversity hotspots of this State. The protected areas of the terai (Dudhwa, Kishanpur and Katerniaghat Wildlife Sanctuary) remain strong and vital reservoirs of terai biodiversity and are important social and economic assets [4]. Changes in river hydrology, associated siltation, and excessive ground water exploitation are causing changes in forest and grassland composition and structure [4]. Encroachment of forestland is still a major issue and vital corridors are still being lost (e.g. Dudwa and Katerniaghat, and Dudhwa and Kishanpur). Livestock grazing is a major problem, especially in sanctuaries. However, the immense potential can be seen by the persistence of most species, despite intense human pressure. The Terai belt of Uttar Pradesh is blessed with a promising population of vultures, the chief obligate scavengers that have coexisted with humans for centuries [5, 6, 7, 8, 9]. Besides Dudhwa National Park and Katerniaghat Wildlife Sanctuary, Suheldev Wildlife Sanctuary is also an important part of terai region. It is spread in Sravasti and Balrampur districts. Balrampur is in the north western part of Uttar Pradesh with Nepal border to its north side (Fig. 1). It has the residential and migratory vulture population in its protected and unprotected areas. The ecological and economical importance of vultures is known to all. Ecosystem services by vultures come under regulating categories of marketable services [10].

Remarkably, by eradicating the livestock and wild animal carcasses, scavengers contribute to nutrient cycling [11, 12] together with pest and disease regulation [3]. Since the earliest civilization, the close relationship between humans and scavengers has profited humankind and the domestication of animals around 12,000 years ago [14] further enhanced it. Thereafter, scavengers have largely relied on carcasses of livestock [15]. Therefore, this study was undertaken from December 2016 to May 2019, to understanding how vultures persisted in human-altered landscapes with a focus on management of roosting and feeding sites.

2) MATERIALS AND METHODS

Balrampur is located on the bank of west Rapti River having an area of 3,349 km^2, at 27.43°N 82.18°E. In the north lies Nepal and, in the east, it faces Siddharthnagar

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and Basti district. Shrawasti district lies to the west of it while in south; district is bounded by Gonda district. The hottest months are May and June with average mean temperature of 40°C. The coldest months are December and January with average mean temperature of 11°C. The maximum rainfall occurs during the monsoon period i.e. June to Sept. having the normal value of 870.67 mm which is 89.14 % of annual rainfall [16].

Secondary data was collected to identify the possible vulture occurrence spots within the districts. Interviews and group discussions with forest rangers, forest guards, villagers, local herders and local residents were used as a main source of information. Questionnaire survey was conducted to assess carcass disposal methods, threats from persecution and conservation attitudes. Regular visits were made in the selected regions. Road surveys were conducted to count the number of vultures while driving along the roads or counts at carcasses seen beside roads. First the visits were made to see the area, locate potential places where vultures might be found and to question the local population. The survey considered the suitable time of the day and season of the year. Standards such as weather conditions, time of the survey and habitat type were recorded [17]. Surveys were carried out on the basis of the key criteria such as presence of water body, safe trees, livestock population; carcass dumping ground Sugar factories, Bone mills and fertilizer factories [18, 6]. Direct observations were made at roosting sites to assess the population size and roosting-tree availability. The morning and evening time was spent near the roosting sites while the afternoon time was used up at feeding sites. With the aid of a pair of binoculars, four hours were used each day to observe and record the birds of prey (vultures) within the area. This observation was done between the hours of 7:00 am to 9:00 am and 4:00 pm to 6:00 pm when vultures were seen at roosting sites. Point Count Method was also followed near the feeding sites [6]. The vulture species were identified with the help of Bird identifying books [19, 20, 21].

3) RESULTS AND DISCUSSION

The results showed the presence of 7 vulture species in the study area with seasonal variations. The residential species are the Oriental White-Rumped Vultures (*Gyps bengalensis*), Slender-Billed Vultures (*Gyps tenuirostris*), Red-Headed Vulture (*Sarcogyps calvus*) and the Egyptian Vultures (*Neophron percnopterus*). The migratory species are the Himalayan Griffon (*Gyps himalayensis*), Eurasian Griffon (*Gyps fulvus*) and the Cinereous Vultures (*Aegypius monachus*). Amongst all the reported species, three species are Critically Endangered, one Endangered, two Near Threatened and only one is Least concerned (Table 1).

Being social foragers, vultures were seen feeding in flocks of 15-60 individuals (Fig. 2). Social foraging is a pervasive trend and has several benefits such as plummeting uncertainty regarding food location and quality. Vultures choose their search path with respect to external conditions such as clear and sunny day with good thermals to aid them in long flights. Their keen eye sights help them to locate the carcass from great heights. There are traditional *cher khanas* in Balrampur, where the dead cattle are dumped and de-skinned (Fig. 3).

Table 1: Vulture species in Balrampur

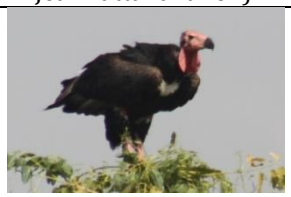
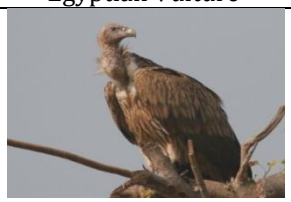
S.No	Vulture Species	Residential/ Migratory	IUCN Status
1.	 Oriental White-Rumped Vulture	Residential	Critically Endangered
2.	 Slender-Billed Vulture (PC:Ayuwat Jearwattanakanok)	Residential	Critically Endangered
3.	 Red-Headed Vulture	Residential	Critically Endangered
4.	 Egyptian Vulture	Residential	Endangered
5.	 Himalayan Griffon	Migratory	Near Threatened
6.	 Eurasian Griffon	Migratory	Least concerned
7.	 Cinereous Vulture	Migratory	Near Threatened

Figure 2: Flock of Vultures feeding on carcass

Figure 3: De-skinning at Cher khana

Table 2: Record of Feeding sites

S.No.	Site	GPS	Carcass type	Vulture species	Total no.
1.	*Cher khana*-Kukar Bhukwa village	N 27° 50′ 23.49″ E 82° 02′ 31.46″	Cow, Buffalo,	Himalayan Griffon, Oriental White-Rumped Vulture, Egyptian Vulture	**32±5**
2.	Vinhuni Khurd	N 27° 44′ 58.70″ E 82° 10′ 01.45″	Cow	White-Rumped Vulture, Himalayan Griffon	**49±5**
3.	Mehmod Nagar, BilwaHariya to Tulsipur road	N 27° 37′ 53.45″ E 82° 18′ 00.01″	Cow	White-Rumped Vulture, Himalayan Griffon	**100±5**
4.	Mahadev-Forest Chowki	N 27° 45′ 243″ E 82° 12′ 309″	Cow	White-Rumped Vulture, Slender-Billed Vulture	**4±5**
5.	Khairman Reservoir	N 27° 46′ 14.9″ E 82° 13′ 18.6″	Buffalo	White-Rumped Vultures, Himalayan Griffon and Cinereous Vulture	**45±5**
6.	Bankatwa Range	N 27° 45′ 56.82″ E 82° 10′ 45.80″	Cow	Himalayan Griffon, Oriental White-Rumped Vulture, Slender-Billed Vulture, Egyptian Vulture	**56±5**
7.	Shivpura		Cow	White-Rumped Vultures, Slender-Billed Vultures	**47±5**
8.	*Naala* on Bhinga Balrampur highway	27°50′32.71″N 082°01′13.34″E	Cow	Egyptian Vultures	**5±5**
9.	Harraiya Satgharwa (Haraiya to Tulsipur road)	27°38′20.52″N 082°17′50.53″E	Cow	White-Rumped Vultures, Slender-Billed Vultures and Egyptian Vultures	**80±5**
10.	Near Motipur reservoir	27°51′24.47″N 082°03′10.23″E	Buffalo	Himalayan Griffon, Oriental White-Rumped Vulture	**39±5**
11.	Bargadwa Kalan near Chittorgah reservoir	27°35′58.54″N 082°35′09.01″E	Calf	White-Rumped Vultures, Slender-Billed Vultures and Egyptian Vultures	**24±5**

Vultures are able to take advantage of such dumping sites as an important food source and spend less time and energy in searching for food [22]. Inspite of the *cher khanas*, the local people dump the carcasses anywhere in the fields and also along the roadsides.

As per the observations, at present there was no scarcity of carcasses for the scavengers (Table 2). In Balrampur district, more than 70% of rural household are directly or indirectly engaged with livestock husbandry [23]. However, the motive of cattle keeping is more for the reason of getting cow dung, rather than for dairy purposes. Like in most of the places, there is change in cattle keeping pattern due to various reasons in Balrampur also. Due to the mechanization of agriculture, the demand of cattle (Male Oxen) has reduced which were used to plough the land, and to transport the grains to the market. With the advent of good transportation facilities the demand of cattle has reduced to a considerable extent [6, 23]. This may lead to carcass shortage in future that in turn will have adverse effects on the breeding biology of vultures. Since vultures are known to scavenge dead cattle, [24, 25] the reduction of this potential food source might be responsible for the vulture decline. The alteration in food availability caused changes in vultures' behavior [26, 27],

decreased breeding success, and increased mortality among younger age classes [28, 29].

At present, the presence of feral dog population is a major encumbrance. They do not allow the vultures to feed on the carcasses and chase them as they try to closer to the carcass (Fig. 4, 5 & 6). At every carcass, vultures were seen waiting to feed while the feral dogs kept a keen eye and guarded the carcass. This is an emerging problem that is not only affecting the food availability to vultures but also leading to the change in the behavior of feral dogs, making them more aggressive. There are a number of incidences that report the attacks by feral dogs on wildlife as well as human beings [30, 31, 32]. The Forest department has taken the initiatives and started a vulture restaurant (Fig.7). It is located near Shivbalak Goswami Gaushala, Ahladnagar in East Suhelwa (27° 49′ 12.80″N 82° 03′ 51.25″E). The feral dogs captured the vulture restaurant as well, rendering it unfit for the vultures to feed in.

The observations at feeding sites lead to a comparable study of the feeding methods of different Vulture species. White-rumped vultures were always the first species to arrive followed by the Himalayan Griffons. Slender-billed

Figure 4 & 5: Vultures being chased by feral dogs around feeding sites

Figure 6: Feral dogs dominating the carcasses

Figure 7: Vulture Restaurant in East Suhelwa

Figure 8 & 9: Vultures sun basking after the meals

vultures and Cinereous vultures were late arrivals to join the feeding flocks. Egyptian vultures were mostly seen feeding on the left-over carcass, particularly the bones. King vultures were not seen feeding during the study period. After feeding, the vultures were seen resting and sun basking in the nearby areas particularly the sub-adults (Fig. 8 & 9). Sunning exterminate the bacteria and other microorganisms on their body. It will be about an hour before the meal is digested enough for the birds to take flight once more and the takeoff is very labour-intensive involving much running and leaping across the plains [6].

Most of the local people in the study area do not have any idea of the multitude benefits of vulture restaurant. The local people in the neighboring country, Nepal have established them as eco-tourist sites and benefitting from the vulture restaurants. Furthermore, the restaurant has been a major tourist destination in the Chitwan National Park. Per week, at least one carcass (dead body of cow) is provided in the vulture restaurant. At this particular day tourists are invited for watching different species of vultures feeding on carcass in the vulture restaurant. This ultimately increase the revenue of the vulture restaurant that further support in the conservation of vultures in the area [33].

Communal roosting is an important aspect associated with vultures (defined as the "aggregation of more than two birds that sleep together") [34]. The stratagem of communal roosting bestows several benefits such as reduced thermoregulation costs, lesser predation risk, and/or increase foraging effectiveness [35, 36, 37], opportunities for social communication, information sharing, and facilitation of group foraging [38, 39]. In actual fact communal roosts are complex and consist of a series of spatially closed roosts used by a local population of vultures that interchange between such roosts in a given area, form a roosting system [40]. In the present study, after regular monitoring at the roosting sites, it was observed that the roosting system ranged from 10 to 600 comprising of individuals of Oriental white-rumped vulture (*Gyps bengalensis*), Himalayan Griffon (*Gyps himalayensis*) and 2-3 Cinereous vultures (*Aegypius monachus*). Within an area of 500-600 meters, large flocks of vultures were seen mainly on Sacred Fig (*Ficus religiosa*), North Indian rosewood (*Dalbergia sissoo*), Red-silk cotton (*Bombax ceiba*), Haldu (*Haldina cordifolia*) and Teak (*Tectona grandis*) (Table 3). As per enhanced monitoring technique, counting of birds should be done at their breeding and roosting sites early in the morning and late in the evening before or after their foraging trips [41]. The behavior of communal roosting is well documented among old and new world Vultures as well as in some flocking eagles. There was a strong seasonal pattern in roost use and also varied among roosts, possibly due to differences in their environmental characteristics, size, and room available for roosting, as well as proximity to nest sites and stage of the breeding season. Differential use of roosts among age classes, spatial segregation seems probable and concludes that intensive censuses of communal roosts can provide useful information about the size, status, and dynamics of local populations. During the winters, there were more sub-adults in the roosts because the adults were occupied with the breeding cycle and most of these were the migratory vultures. In the summers, the roosts included the fledglings as well but only that of residential species. Xirouchakis [42] suggested that morning and evening counts in Griffon Vulture *Gyps fulvus* colonies and communal roosts revealed that their numbers fluctuated by season and time of the day. In the colonies the vultures built up high numbers during the pre-breeding and incubation periods (November–February) with maxima in December–January and dropped during the fledging and dependence periods (July–October) with

Table 3: Roosting sites recorded

S.No.	Site	GPS	Tree species/number	Vulture species	Total no.
1.	Ratanwa	N 27° 45′ 21.95″ E 82° 09′ 18.46″	Sacred fig-1, North Indian rosewood-2	Himalayan Griffon, Oriental White-Rumped Vulture, Cinereous	20±5
2.	Ratanwa	N 27° 45′ 20.27″ E 82° 09′ 44.30″	Red-silk cotton-3, Haldu-2, Teak-2	Himalayan Griffon, Oriental White-Rumped Vulture	80±5
3.	Ratanwa to Pipra rest house trail	N 27° 45′ 57.83″ E 82° 09′ 22.31″	Sacred fig -1	Himalayan Griffon	8±5
4.	Bankatwa Range	N 27° 45′ 56.82″ E 82° 10′ 45.80″	North Indian rosewood -3, Saagon-1	Himalayan Griffon, Oriental White-Rumped Vulture	38±5
5.	Bhaisahi nullah, Gabbapur	N 27° 15′ 22.356″ E 82° 56′ 46.264″	Sacred Fig-1	Himalayan Griffon, Oriental White-Rumped Vulture	30±5
6.	Outskirts of Patkauli village	N 27° 46′ 05.95″ E 82° 08′ 06.00″	North Indian rosewood -4	Himalayan Griffon, Oriental White-Rumped Vulture	42±5
7.	Khairman Reservoir	N 27° 46′ 14.9″ E 82° 13′ 18.6″	North Indian rosewood -4 Red-silk cotton -1	Himalayan Griffon, Oriental White-Rumped Vulture, Cinereous Vulture	38±5

minima in June–July.

The risk to roosting sites is high. Amongst the various regional reasons, the major is the uncontrolled collecting of woods for domestic and commercial uses such as in hotel kitchens and brick kilns. Roosting and nesting sites of vultures are being continuously destroyed at a rapid rate due to illicit felling for fuel wood and brick-kilns in Suhelwa WLS (Fig.10 & 11). For the brick-kilns alone, about 80-100 quintals of timber is extracted on a daily basis from Bankatwa and Poorvi Suhelwa ranges. On an average 160 quintals of fuel wood reaches the local markets daily (Table 4). Unemployment is also accountable for over exploitation of the forests in Suhelwa. The local people are totally depending on the woods and regularly seen with their bicycles loaded with the chopped wood (Fig.12 & 13).

The pruned trees do not serve as ideal roosting sites for the vultures (Fig.14 & 15) and may lead to reduction in

Table 4: Quantum of fuel wood sold daily

Forest range	Markets	Distance from sanctuary	No. of cycles par day	Wood quantity per cycle (kg.)
Barahwa	1. Harriya 2. Mahmodnagar 3. Mahrajganj	8-10 km 8-10 km 15-25 km	60	60x80=4800kg or 48 qt.
Bankatwa	4. Bardolia 5. Shivpura 6. Chaudrih-Dih 7. Manipur 8. Lallia 9. Mathura	6-8 km 12-15 km 12 km 20 km 30 km	50	50x80=4000kg or 40 qt.
East Suhelwa	10.Bechai purwa 11.Sirsia 12.Bhinga (by bus)	4-6 km 8-10 km	60	60x80=4000kg Or 40 qt.
West Suhelwa	13. Sirsa 14.Chilaria Modh	6-8 km 8-10 km	40	40x80=3200kg Or 32 qt.
Total			**210**	**16000 kg or 160 qt.**

Figure 10 & 11: Illicit felling for fuel wood and brick-kilns in Suhelwa WLS

Figure12 & 13: Dependency of local people on the Forest woods


Figure14 & 15: Pruned trees do not serve as ideal roosting sites for the vultures


Figure16 & 17: Big trees with few leaves are ideal for roosting by vultures

their population in future. Being large in size, vultures require preferably large dead trees or trees with few leaves for roosting as well as nesting (Fig. 16 & 17). According to Ceballos and Donazar [43], 1990 the large bird tendencies in tree-selection suggest that trees are chosen on the basis of 2 fundamental factors: First is size of the tree (trunk diameter) which is obligatory for sustaining several birds at a time; and second is facility to enter and leave without the foliage of the roost tree and neighboring trees obstructing the way (inclination towards dead, isolated trees with an open crown). Roosting New World vultures and large eagles have also been reported to show a preference for large trees with easy access [44, 45].

The disturbance and destruction of the reported roosting sites of vultures may lead to establishment of new roosts. These complex communal roosts have been the subject matter of quite a lot of studies that concentrate on habitat characteristics, social behavior, movements between roosts, seasonal and daily use patterns, and population dynamics [38, 46, 47, 48, 40, 49, 50]. The vultures normally used roosts on the fringes of protected areas and near human dwellings, irrespective of the disturbances due to human activities. Roosts are also often located near structures that generate upward-flowing air that facilitates early-morning flights [51]. Vultures are known to use several types of roosting substrates, such as trees, cell towers or tall buildings, however in Balrampur they were seen roosting only on the trees. Therefore, it becomes all the more important to mark and protect the big trees that may serve as potential roosting sites for the vultures.

Recommendations

To avoid the rapid rate of wood exploitation, it is of utmost importance to divert and indulge people in other professions. The other sources of income will divert the local people from depending on forest wood as a means of livelihood. Initiatives have been taken to involve the local communities in the making of lantana furniture and various crafts (Fig.18). However, the products need good marketing as well so as to get best price for the products. It is also recommended to involve the students through various awareness programmes as well as field activities that may lead to the protection of the natural habitats of vulture and their conservation.

Figure 18: Lantana furniture prepared by local community

4) CONCLUSION

There have been few studies on vultures of Balrampur that quantified their importance in developing and maintaining the ecosystem, although their role is widely recognized. The decline in the population of vultures, the chief obligate scavengers is by now leading to an increase in the abundance of other facultative scavenger species particularly the stray dogs causing health issues such as rabies infection. The knowledge and information about the roosting and feeding sites can play an important role in protecting the master scavengers. These scientific information will aid to know where and how to focus conservation efforts on a regional and global scale with the involvement of local people. As for the roosting sites, it is important to mark the big trees and ensure their protection. In present situation local people particularly the farmers and herders have extensive information about vultures and can play a key role in vulture conservation. Vulture restaurants managed by local people may serve as an important conservation tool. Inescapably conservation solutions in Balrampur, must involve local people and communities who live in close proximity of vulture habitats and get the advantage from their ecological services.

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