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Distribution of vultures in Uttar Pradesh, India

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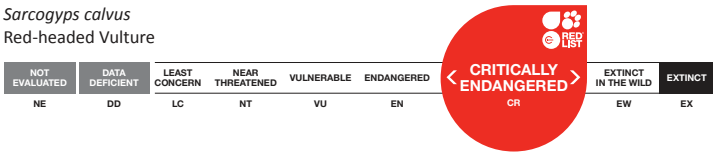
Abstract: As carrion feeders vultures play an important ecological role. Counts and qualitative assessments were done over three seasons to assess the richness and abundance of vultures in Uttar Pradesh during 2010–11. Of nine species found in India, Uttar Pradesh has six: Egyptian Vulture *Neophron percnopterus* (45.9%), Slender-billed Vulture *Gyps tenuirostris* (25.4%), Indian Vulture (Long-billed Vulture) *Gyps indicus* (16.8%), White-rumped Vulture *Gyps bengalensis* (10.3%), Red-headed Vulture (King Vulture) *Sarcogyps calvus* (0.8%) and Himalayan Griffon *Gyps himalayensis* (0.7%). We observed a total of 1993 adults and 91 juveniles, with the Tarai region having the greatest species richness and abundance. Nesting tree species included Silk Cotton *Bombax ceiba*, Teak *Tectona grandis*, Haldu *Haldina cordifolia* and Sissoo *Dalbergia sissoo*. A qualitative assessment indicated that the vulture population had declined in the past 10–15 years, with the main causes being the use of diclofenac, shortage of food and habitat loss. Disposal of dead animals was mainly done by removing carcasses to village outskirts, where dogs, crows and egrets compete with vultures. Such a small number of avian scavengers in a large area like Uttar Pradesh should be protected by ensuring safe and sufficient food, recovery from accidents and rehabilitation, and a protected environment.

Keyword: Abundance, nesting trees, protection, threats, vulture.

सारांश: गिद्ध सड़ा-मांस भक्षक के रूप में महत्वपूर्ण पारिस्थितिकीय भूमिका निभाते है। उत्तर प्रदेश में गिद्धों की समृद्धि एवं बहुतायत का निर्धारण गणना एवं गुणात्मक आंकलन वर्ष 2010-11 के तीन ऋतुओं मे किया गया। भारत में पायी जाने वाली नौ प्रजातियों में से छह : सफेद गिद्ध *नेफरॉन परक्नोप्टेरस* (45.9%), पतलचोच गिद्ध *जिप्स टेन्वीरोस्ट्रिस* (25.4%), देशी गिद्ध *जिप्स इन्डिक्स* (16.8%), चमर गिद्ध *जिप्स बेंगालेन्सिस* (10.3%), राज गिद्ध *सारकोजिप्स काल्वस* (0.8%) एवं हिमालयी गिद्ध *जिप्स हिमालयेन्सिस* (0.7%) उत्तर प्रदेश में रह गई है। हमारे द्वारा गौर से देखे गए कुल 1993 व्यस्क एवं 91 किशोरों की समृद्धि एवं बहुतायत तराई क्षेत्र में रही। सेमल *बॉम्बेक्स सीबा*, सागौन *टेक्टोना ग्रैंडिस*, हल्दू *हाल्दीना कॉर्डिफोलिया* एवं शीशम *डाल्बर्जिया सिसू* नीड्न वृक्षों में शामिल थे। गुणात्मक आंकलन से संकेत मिला कि मुख्यत: डायक्लोफिनैक के प्रयोग, भोजन की कमी और निवास समाप्त होने के कारण गिद्धो की संख्या में पिछले 10-15 वर्षो में गिरावट आई। मृत पशुओं के शव का निस्तारण मुख्य रूप से गाँव की सीमा पर किया गया जहाँ कुत्ते, कौवे और बगुले गिद्धों के प्रतियोगी थे। उत्तर प्रदेश जैसे व्यापक क्षेत्र में मेहतर पक्षी की इतनी कम संख्या को सुरक्षित एवं पर्याप्त भोजन देकर, दुर्घटना से उबार कर व पुनर्वासित कर एवं सुरक्षित परिवेश देकर संरक्षित किया जाना चाहिए।

Sarcogyps calvus
Red-headed Vulture



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Author Details: The author is currently a professor working in the field of conservation, livelihood and policy analysis. For more than 29 years the author has been part of the forestry administration and natural resource management. He has extensively worked on tree improvement, plantation ecology and aquatic habitat conservation.

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INTRODUCTION

Vultures feed on carrion including discarded dead animals, which makes them an important component of the ecosystem. They also play an important cultural role in southern Asia (parts of India, Nepal and Tibet) as they consume human cadavers which are left in the open during ritual sky-burials (Singh 1999; GON 2009; Liu et al. 2013). The decline of the vulture population in the Indian subcontinent has removed a major scavenger population, with effects on other scavenging species and the incidence of putrefying carcasses, both of which have associated disease risks for wildlife, livestock and humans (GOI 2006).

India has nine species of vultures in the wild., viz.: Oriental White-backed (White-rumped) Vulture *Gyps bengalensis*, Slender-billed Vulture *Gyps tenuirostris*, Long-billed (Indian) Vulture *Gyps indicus*, Egyptian Vulture *Neophron percnopterus*, Red-headed (King) Vulture *Sarcogyps calvus*, Indian Griffon Vulture *Gyps fulvus*, Himalayan Griffon *Gyps himalayensis*, Cinereous Vulture *Aegypius monachus* and Bearded Vulture or Lammergeier *Gypaetus barbatus* (GOI 2006). Vultures are known to inhabit tall trees in forests, smaller trees in open areas, rocky cliffs, old monuments and the countryside (Thompson et al. 1990; Liberatori & Penteriani 2001; Donazar et al. 2002b; Carrete & Donazar 2005; Monadjem & Garcelon 2005; Elorriaga et al. 2009; Thakur & Narang 2012; Harris 2013; Haenn et al. 2014). Except Griffons and Lammergeier, all Asian vultures are in the threatened or Near Threatened categories (IUCN Red List 2011).

Vultures are known to colonize wooded as well as open habitats with agriculture and tree cover (Robinson 1994; Donazar et al. 2002a,b). On the basis of forest and vegetation cover, Uttar Pradesh (UP) has been divided into three major eco-zones: the Tarai (moist deciduous forests), the Gangetic plains (agriculture landscape) and the Bundelkhand (dry deciduous forests) including Vindhyan regions (Islam & Rahmani 2004). The file record of the UP Forest Department suggested that the western part of the Gangetic plains, with a drier climate and ravined landscape, is different from the main Gangetic plains and thus could be categorized separately as a semi-arid zone. Knowledge of ecological factors in the habitat affecting large scale distribution and abundance of endangered species is an important tool for defining management recommendations (Sutherland & Green 2004). Vultures inhabiting varying habitats have declined from many parts of their former ranges owing mainly to food shortage and loss of habitat (Satheesan 1999; Pain et al. 2003). Thus the objective of this study is to assess species richness and abundance, ecology and conservation issues related to vulture species in varied eco-zones of UP and to keep the records for future reference.

MATERIALS AND METHODS

Study site

Uttar Pradesh is one of the northern states of India with a tropical climate and a wide range of temperature fluctuation from 2–48 ^{0}C. There are three main seasons, summer from March to mid-June, rainy season from mid-June to September and winter from October to February. There is great variation in rainfall from 600–2500 mm (Rahmani et al. 2011).

All the forest divisions (FD), the district level administrative units of the forest department of UP spread over the whole state (23^{0}52'–30^{0}24'N & 77^{0}5'–84^0 38'E) were involved in vulture survey and counting. A preliminary survey was done before the main counting which resulted in the identification of FD where vultures were historically reported to be seen. Sites of vulture roosting and nesting were searched and marked on the basis of physical and oral evidence in the respective FD during this survey exercise. These potential vulture sites were revisited for vulture counting and other data collection.

Population estimation

Three vulture counts were undertaken in different seasons: rainy season (August 2010), summer (May 2011) and winter (December 2011). The population estimation protocol was revised and improved after every count. All the vultures seen were counted during the first estimation in different forest beats of Territorial and Social Forestry divisions in the span of one week (second week of August 2010), assuming that vultures would not have changed their roosting or nesting sites during such a short period. In the second estimation a particular day was fixed (15 May 2011) for summer population estimation of vultures to avoid double counting in case of movement of vultures to another territory. Pre-estimation exercises were conducted to locate the roosting and nesting sites in advance. This time the coordinates of vulture sites were recorded and an attempt was made to identify the vulture species. 15 December 2011 was fixed for the third or winter population estimation keeping in view the arrival of migratory vultures during this period. An

additional exercise of intensive identification of vulture species was taken up during this estimation. For this a training workshop for the trainers was conducted and an identification booklet (Jha et al. 2011) was provided. The number of unidentified vultures was distributed proportionately to the recorded species. Flying vultures were not included in the count in any of the three population estimation exercises.

A team of two members, an observer and a data recorder, visited the potential vulture sites on the designated day(s) based on the pre-counting survey or the known area for vultures in all the vulture ranges (operational unit of a FD). Altogether 100 sites were visited by 58 members (29 teams) in the summer estimation while 144 sites were covered by 84 personnel (42 teams) in the winter estimation. They counted the number of vultures (adult and juvenile) and nests, recorded the details of roosting and nesting sites including geographical location. Binoculars, GPS instrument and a predesigned format were used for data recording. Data were compiled forest division wise and then district wise.

Map generation

Thematic maps providing roosting and nesting location of vulture population and species distribution were prepared by using geographical locations. Arc GIS 9.3 was used for the conversion of GPS reading to spatial data layer (point features providing the location). Vulture locations were overlaid on the state map. Using the retrieval function various thematic figures were designed.

Qualitative data

A questionnaire survey was conducted about vulture ecology like, habitat use, availability of trophic resources, other competitors for carrion, conservation issues etc. among the forest guards and the villagers of the FDs where vultures were recorded. Three-hundred-eighty-two completed questionnaires returned out of 500 circulated ones, 20 each in 25 vulture districts.

Some of the secondary data like cattle population, forest cover, and wild animals other than big cats, used in this article were adopted from UPFS (2010).

RESULTS

The qualitative perception of the respondents (n=374) indicated that the vulture population had declined in the past 10–15 years and the main cause of this decline was use of diclofenac (n=277), shortage of animal food (n=128) and habitat loss (n=117). The disposal of dead animals (n=296) was mainly carried out by throwing away the carcass to the outskirts of the village, which attracted dogs, crows and egrets that competed with vultures. They identified trees, monuments, cliffs, riversides, slaughter houses, fertilizer factories and agriculture fields as vulture inhabiting sites. The preferred trees for nesting and roosting in decreasing order were Sacred Fig *Ficus religiosa* > Banyan *Ficus bengalensis* > Silk Cotton *Bombax ceiba* > Sissoo *Dalbergia sissoo*. The prevalence of the vulture species as perceived by them in decreasing order was Egyptian Vulture > Indian Vulture > Slender-billed Vulture > Cinereous Vulture > others.

Population

The minimum number of vultures seen in the state over three seasons: rainy season, summer and winter during 2010 and 2011 were 2125, 2097 and 2029, respectively (average 2084). Out of these vulture populations, juveniles were recorded at 4.2%, 4.0% and 4.5%, in respective seasons. Eco-zone distribution of total vultures in rainy season was 1452, 639, 33 and 1; in summer 1237, 643, 110 and 107; and in winter 964, 279, 406 and 380, respectively in Tarai, Bundelkhand-Vindhyan, Gangetic and semi-arid eco-zones. This showed that the bulk of the vulture population was confined to Tarai and Bundelkhand-Vindhyan eco-zones.

Altogether six vulture species were recorded in the state during the winter season. They were Egyptian Vulture, Himalayan Griffon, Red-headed Vulture, Indian Vulture, Slender-billed Vulture, and White-rumped Vulture. There was a report of one group of Cinereous Vulture, in Tarai region after a couple of days of the counting day (Image 1). Species wise population distribution in order of decrease was Egyptian Vulture > Slender-billed Vulture > Indian Vulture > White-rumped Vulture > Red-headed Vulture > Himalayan Griffon (Fig. 1).

Distribution

The vultures were represented in all the four eco-zones but were missing in many districts of the state. The districts where vulture presence was recorded in all the three seasons were Bahraich, Balrampur, Bijnore, Lakhimpur Khiri, Maharajganj, Pilibhit, and Shravasti (Tarai eco-zone) and Banda, Jhansi and Lalitpur (Bundelkhand-Vindhyan eco-zone). When considering vulture occurrence in at least one season, the additional districts having vulture distribution were Agra and

Image 1. Different species of vulture in Uttar Pradesh. a - Egyptian Vulture; b - Red-headed Vulture, c - Slender-billed Vulture, d - Himalayan Griffon, e - Cinereous Vulture; f - White-rumped Vulture.

Etawah (semi-arid eco-zone), Basti, Gonda, Gorakhpur, Saharanpur and Sidharth Nagar (Tarai eco-zone), Chitrakoot, Mirzapur and Sonbhadra (Bundelkhand-Vindhyan eco-zone) and Etah, Firozabad, Gautambudh Nagar, Mainpuri, and Unnao (Gangetic eco-zone). Other districts in the state were devoid of vultures in all the three vulture counts conducted during 2010 and 2011 (Fig. 2). GPS location details of vultures provided by the field staff is given in Appendix 1 and 2.

The Tarai eco-zone recorded highest number of vultures in all seasons and all of the six species (Egyptian Vulture, Himalayan Griffon, Red-headed Vulture, Indian Vulture, Slender-billed Vulture, and White-rumped Vulture) but the Gangetic and Semi-arid eco-zones had only Egyptian Vulture and the Bundelkhand-Vindhyan region had Indian Vulture (Figs. 3 & 4). However, the concentration of all the vultures except Egyptian Vulture was very high in protected wildlife areas (national park and sanctuaries) as compared to the neighbouring forests.

Habitat use

Forest area, scattered trees, rocky cliffs, monuments, open agriculture fields and riversides were being used by different species of vultures for nesting and roosting. Tree species used for nesting or roosting were Silk Cotton, Sissoo, Sacred Fig, Banyan, Haldu *Haldina cordifolia*, Axlewood *Anogeisus latifolia*, Cluster fig *Ficus racemosa* and Tamarind *Tamarindus indica*. Egyptian Vultures were seen on Cluster Fig and Tamarind, Himalayan Griffon on Sissoo, Indian Vulture on Sacred Fig, Slender-billed Vulture on Sissoo, Haldu, Axlewood and Sacred Fig and White-rumped Vulture on Sacred Fig and Silk Cotton trees (Image 2). Egyptian Vultures were

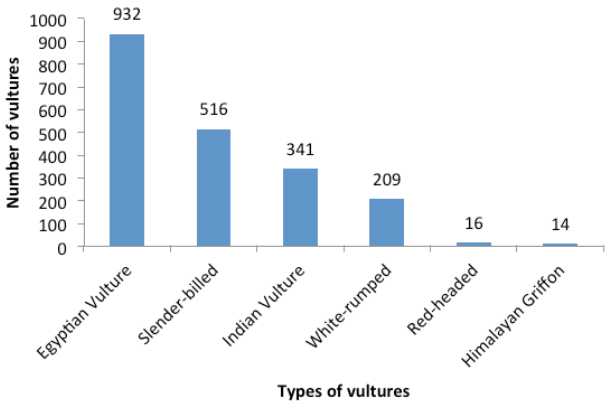

Figure 1. Species wise vulture population in Uttar Pradesh in 2011 winter.

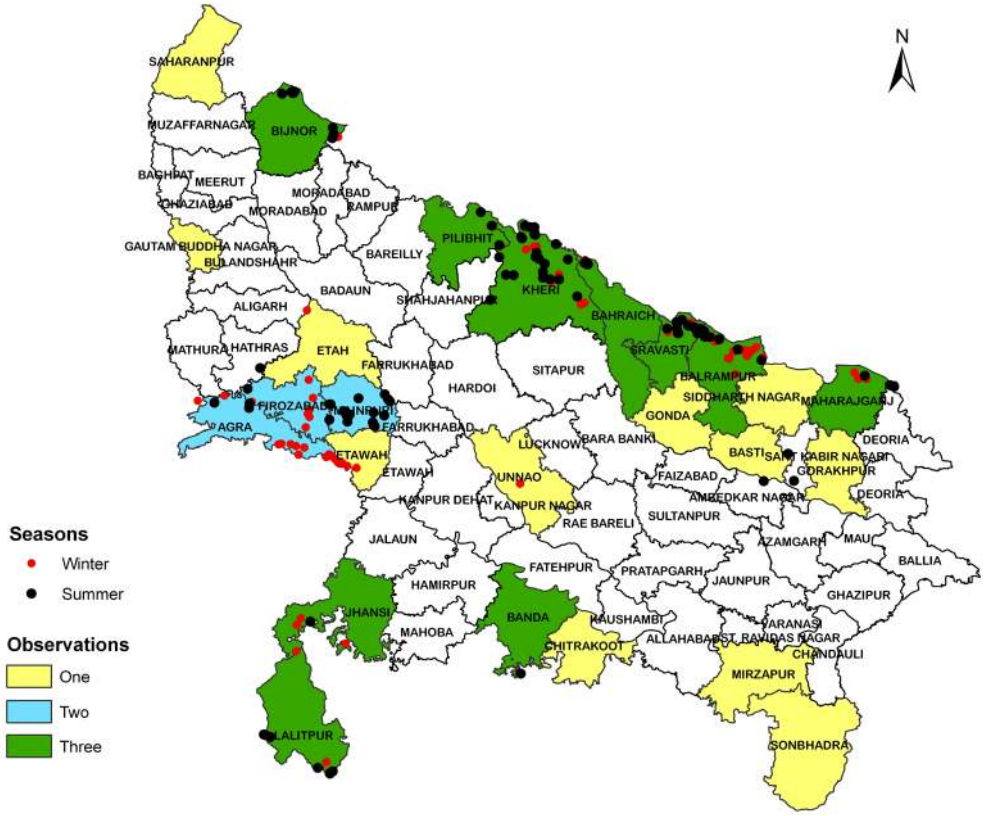

Figure 2. Vulture sighting frequency (coloured polygons are the districts of vulture occurrence). Coloured dots are the GPS data based vulture locations

Figure 3. GPS data based locations of different vultures in different eco-zones of UP

Image 2. Lofty trees: a - *Haldina cordifolia,* b - *Dalbergia sissoo*, c - *Tectona grandis* and d - *Bombax ceiba*, close up of nest on respective tree (inset).

also seen resting on high tension line support frames and wireless towers, and wandering in agriculture fields. Indian Vultures were found using the ledges of rocky cliffs and the cornices of monuments. White-rumped Vultures were seen basking in the sun, some with necks drooping, along the mud island of a river (Gerua in Katerniaght FD). Another colony of this species was seen roosting around a pair of nests on Silk Cotton tree in the proximity of a water body (at the bank of same river) and at the boundary of a hamlet. However, a vulture bathing in a water body was not recorded on the vulture counting dates. All the trees holding nests (5 Silk Cotton, 3 Sissoo, 2 Teak and 1 Haldu) and being used as roosting (4 Silk Cotton, 2 Sissoo, 1 Teak) visited during the summer and winter counting by the author, were tall (15–20 m) and with leafed crowns. In one case a Himalayan Griffon was seen roosting on top of a dry

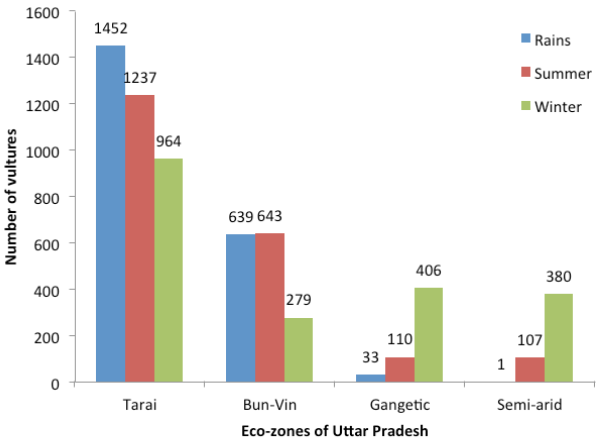

Figure 4. Distribution of vulture population in three different seasons of 2010–2011 in different eco-zones (Bun-Vin = Bundelkhand-Vindhyan eco-zone).

Sissoo tree. These trees were mostly old and matured. The presence of a large flock of Egyptian Vulture was recorded in and around the campus of a bone-based fertilizer factory.

The numbers of nests recorded during the summer and winter counts on the basis of direct evidence were 73 and 75, respectively (Fig. 5). The vultures were either sitting inside the nests or were seen resting very close to them. These nests were mainly located in the Tarai eco-zone followed by the Bundelkhand-Vindhyan eco-zone. During the winter 2011 count 18 nests of White-rumped Vulture, seven nests of Red-headed Vulture, three nests of Slender-billed Vulture and five nests of Indian Vulture were seen in the Tarai eco-zone, while 37 nests of Indian vulture and six unidentified nests were seen in the Bundelkhand-Vindhyan eco-zone. One nest each of Egyptian Vulture was seen in the Gangetic and the semi-arid eco-zone. One hundred twenty five additional nests were found empty but with faecal deposits and some vegetation material in the cliffs of the Kaimoor (Mahabir Swamy) Sanctuary (Bundelkhand-Vindhyan eco-zone). These nests were assumed to be of Indian Vultures since this species was recorded in large number (around 500 during summer count) in this locality.

DISCUSSION

The risk of extinction greatly depends on the frequency of catastrophe, survival rate and reduction in the population growth rate (Pavokovic & Susic 2005). The total population figure of the state kept decreasing in subsequent counts. Although data was too scanty for strong quantitative assessment (three temporal populations of vultures in the span of 16 months) still, the apparently negative growth of vulture population was corroborated with the respondents' observation that vulture population had decreased in the past one and a half decade. The decreasing population trend conformed to the previous reports (Prakash 1999; Gilbert et al. 2002; Prakash et al. 2003; Gilbert et al. 2006). But the rate of decrease in mixed population was slow (3.2%) as compared to a very high mortality rate (11–18 %) in the earlier report in select *Gyps* species

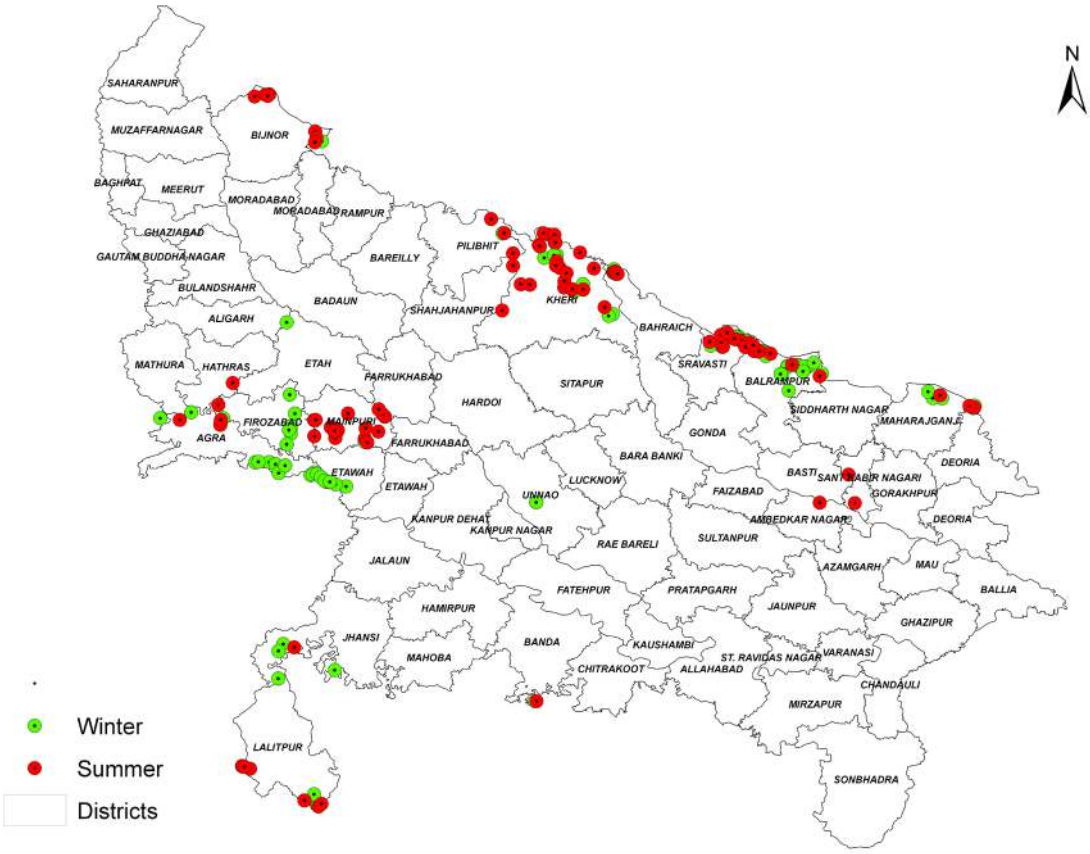

Figure 5. GPS data based location of vulture nesting sites in UP observed during summer and winter of 2010–1011

(Khan & Murn 2011).

Kendall et al. (2014) suggested that prey mortality may be a more important driver of vulture habitat use than prey abundance. UP is a highly populated and agriculture dominated state, with poor natural resource reserve and a livestock population of 64 million (UPFS 2010). The high livestock availability went in favour of vulture food security due to possible availability of carcasses and carrion. However, the situation on the ground was different, as informed by the respondents, since most of the cattle were sold before they grew old. This could be correlated to the fact that UP has a sizable beef eating population and also a well-established leather industry (Kumar 2010). The dead animals thrown at the outskirts of the village, by default available food for vulture, had the probability of the presence of diclofenac in the carrion as illegal diclofenac use was very common in rural areas. This could cause trophic resource stress and may have a negative impact on vulture conservation in the state.

The Tarai and Bundelkhand-Vindhyan eco-zones were the major vulture population centers, possibly due to higher forest cover of which a large part is managed as wildlife conservation reserve as compared to the Gangetic and the semi-arid eco-zones. In terms of vegetation Bundelkhand-Vindhyan, Tarai, Gangetic and semi-arid eco-zones have 44, 35, 15, and 6% of total forest cover in the state, respectively, compared to the geographical area 17, 25, 51 and 8 % of the state (UPFS 2010). This suggested a decreasing density order of forests in Tarai, Bundelkhand-Vindhyan, Semi-arid and Gangetic eco-zones. The occurrence of vultures in high vegetation areas was supported by previous reports as vultures require a relict wooded area, mature trees and a foraging range (Fargallo et al. 1998; Donazar et al. 2002a; Carrete & Donazar 2005). They occur in protected forests (Donazar et al. 2002a; Monadjem & Garecelon 2005; Sethi & Chauhan 2010; Das et al. 2011) and their density was higher in the interface of protected and unprotected area (Herremans & Herremans-Tonnocyr 2000 in Baral et al. 2005). As compared to Tarai, Bundelkhand-Vindhyan zone did not have a very low vegetation cover and yet very low number and types of vultures' occurrence indicated towards a quality difference in habitat. Rocky areas with dry deciduous vegetation in the region could be the reason as also suggested by Bogliani et al. (2011) in the case of Bearded Vulture.

Forested districts provided both domestic as well as wild animals for food to the vultures. The Tarai and the Bundelkhand-Vindhyan eco-zones (4.3 and 2.1 animals km^{-2}, respectively) had additional availability of food in the form of wild animals as compared to the Gangetic and the semi-arid eco-zones (3.0 and 2.7 animals km^{-2}, respectively; UPFS 2010). Under the prevailing circumstances of scarcity of domestic animal carcasses due to their selling, availability of wild animals was an added advantage for vulture presence as the dead bodies of wild animals, which were diclofenac-free trophic resources, were available.

The Gangetic plain and the semi-arid eco-zones only had Egyptian Vultures. Food supply appears to be the limiting factor in these regions. The food supply available to any large scavenging animal came largely from the carcasses of ungulates and these were widely dispersed, transient and unpredictable in this location (Houston 2005). Domestic ungulates were available outside forests but a majority of the cattle were sold, resulting in non-availability of carcass as vulture feed, and whatever was left from the transaction had the potential danger of diclofenac infestation, possibly forcing the vultures to avoid feeding on them. Egyptian Vultures could be seen in non-forested areas (semi-arid and Gangetic eco-zones) as they chose to feed on small animals, debris or rubbish dump, human and ungulate faeces, and vegetable matter (Whistler 1949; Prakash & Nanjappa 1988; Negro et al. 2002) available in plenty, and lived in an open landscape in arid and rugged areas (Liberatori & Penteriani 2001; Donazar 2002b). Their presence in large numbers in the campus of the bone factory indicated that they could feed on bony remains of old dry carcasses collected for fertilizer making. A similar habit has been reported earlier in the case of Cape Vulture *Gyps coprotheres* (Vernon 2004).

Generally, lofty and sparsely branched trees in the forest area were used by large vultures for nesting and roosting. Such trees were helpful in providing safety from predators, a better view of surroundings and an easy take off (Yamac 2007). This also facilitated nocturnal perches with favourable microclimate by causing temperature inversion (Thompson et al. 1990). The use of large trees for nesting and roosting, including Silk cotton or Kapok or Semal, Sissoo, Teak, Haldu, Sacred Fig, Banyan etc., had also been reported in different areas by other workers (Baral et al. 2005; Satheesan & Khan 2005; Das et al. 2011; Kambale 2011). In the absence of tall trees, smaller trees in the open landscape including Mango *Mangifera indica*, Babool or gum Arabic *Accacia nilotica*, Margosa *Azadirachta indica* (Kambale 2011) and *Prosopis cineraria* (Khatri 2013) were also reported to be used by the vultures in different areas. Taller trees were, however, dominant in

number, 90% in the present case which is very similar to the 86% reported by Baral et al. (2005). The use of taller trees for nesting and roosting has been reported for White-rumped Vulture (Thakur & Narang 2012) and White-backed Vulture *Gyps africanus* (Chomba & M'Simuko 2013).

It was suggested that some vulture species had a tendency to choose dead trees for roosting (Ceballos & Donazar 1990) which did not conform to present findings. There is a report like the present one, where almost all the trees observed with vultures had leafed crowns (Yamac 2007). The selection of artificial yet dangerous structure like electricity pylons for roosting and nesting by some other vulture species had also been reported earlier (van Rooyen 2004; Anderson & Hohne 2007; Chhangani 2009; Phipps et al. 2013).

The neck drooping posture in vulture was earlier recorded by some workers (Cunningham et al. 2003; Pain et al. 2003; Prakash et al. 2003) and described as an indicator of approaching death but contradicted later by Gilbert et al. (2007) stating that it is an unsuccessful predictor of mortality and has a probable role in thermoregulation. Until further reports sun basking, dozing off with a limping and hanging neck appearance in White-rumped Vulture could be taken as a normal activity of this species.

MANAGEMENT PRESCRIPTION AND CONCLUSION

The population of the vulture in UP was very low, especially the critically endangered ones (Indian Vulture, Red-headed Vulture, Slender-billed Vulture, White-rumped Vulture). Vulture species in general are carrion feeders and old world vultures are slow breeders with low growth rates (Donazar & Ceballos 1989). Therefore, there is a need to take necessary steps to save them from all possible threats, primarily by ensuring safe and sufficient food, recovery from accidents and rehabilitation, and a protected environment.

Other than diclofenac-tainted food, the most serious threat to vulture species is the loss and alteration of habitat (Donazar et al. 2002a). Vultures are selective about tree species and individual trees for nesting and roosting as they use tall trees with sparse but strong branching. These trees in the forest must be located, marked and protected because loss of large trees in general would affect nesting negatively and in turn the population (Monadjem & Garcelon 2005; Chomba & M'Simuko 2013). Since vultures are sensitive to disturbance during the breeding season there should be an effort to maintain an anthropogenic disturbance free zone around such nested and roosted trees. A buffer zone of a minimum of 500m (Margalida et al. 2010) between source of disturbance and breeding colony should be used as shock absorber, since minimum human disturbance is critical to successful breeding of raptors (Bamford et al. 2009; Chomba & M'Simuko 2013).

However, the base line data generated in this study could be used for future monitoring and further detailed study. Better supported findings could define better management action in the direction of the conservation of this highly endangered group of species.

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Appendix 1. Geographical position of vultures recorded in different forest divisons of UP during winter (15 December 2011)

Forest Division	Longitude	Latitude	Number of nests	Number of vultures
Agra	78.09	27.21	0	200
Agra	77.60	27.21	0	130
Banda	80.52	25.01	2	12
Banda	80.51	25.01	5	15
Dudhwa	80.68	28.47	0	16
Dudhwa	80.66	28.47	0	5
Firozabad	78.62	27.09	0	4
Firozabad	78.62	27.15	0	9
Firozabad	78.61	27.39	0	7
Firozabad	78.60	27.11	0	8
Firozabad	78.58	27.00	0	2
Firozabad	78.58	27.95	0	4
Firozabad	78.65	27.24	0	8
Jhansi	78.56	25.45	3	6
Jhansi	78.52	25.40	0	2
Jhansi	78.96	25.25	0	2
Jhansi	78.52	25.19	3	12
Kaimoor	78.23	24.51	0	75
Kaimoor	78.24	24.50	164	75
Katarniyaghat	81.12	28.34	4	6
Katarniyaghat	81.12	28.34	2	4
Katarniyaghat	81.12	28.34	1	1
Katarniyaghat	81.12	28.34	4	1
Katarniyaghat	81.12	28.36	1	22
Katarniyaghat	81.14	28.34	6	14
Katarniyaghat	81.12	28.34	4	7
Katarniyaghat	81.15	28.33	3	30
Lalitpur	78.30	24.49	0	25
Lalitpur	78.82	24.21	15	4
Lalitpur	78.82	24.20	0	35
Lalitpur	78.79	24.29	1	4
Lalitpur	78.72	24.24	14	2
Lalitpur	78.72	24.24	0	10
Mainpuri	78.07	27.16	0	4
Mainpuri	78.07	27.19	0	40
Mainpuri	78.05	27.31	0	2
Mainpuri	79.06	27.24	0	2
Mainpuri	78.80	27.19	0	26
Mainpuri	78.81	27.19	0	2
Mainpuri	78.92	27.14	0	2
Mainpuri	78.97	27.10	0	9
Mainpuri	78.96	27.05	0	2
Mainpuri	78.80	27.07	0	4
Mainpuri	78.98	27.11	3	3

Forest Division	Longitude	Latitude	Number of nests	Number of vultures
Mainpuri	78.95	27.10	0	4
Mainpuri	78.95	27.11	0	11
Mainpuri	79.19	27.05	0	9
Mainpuri	79.19	27.04	0	1
Mainpuri	79.21	27.02	0	3
Mainpuri	79.29	27.10	0	3
Mainpuri	79.20	27.13	0	5
Mainpuri	79.34	27.22	0	12
Mainpuri	79.33	27.23	0	5
Mainpuri	79.30	27.28	0	5
North Kheeri	80.58	28.45	0	7
North Kheeri	81.11	28.01	0	18
North Kheeri	80.88	28.25	1	13
North Kheeri	80.81	28.19	1	12
North Kheeri	81.08	28.00	0	18
Pilibheet	80.26	28.64	0	20
Pilibheet	80.26	28.64	2	2
Pilibheet	80.26	28.64	0	34
Rastriya Chambal	79.19	27.02	1	3
Rastriya Chambal	78.34	26.86	0	1
Rastriya Chambal	78.52	26.78	0	3
Rastriya Chambal	78.45	26.87	0	3
Rastriya Chambal	78.57	26.84	0	4
Rastriya Chambal	78.50	26.85	1	2
Rastriya Chambal	78.77	26.76	0	1
Rastriya Chambal	78.36	26.87	0	1
Rastriya Chambal	78.52	26.78	0	4
Rastriya Chambal	78.57	26.84	0	2
Rastriya Chambal	78.80	26.79	0	2
Rastriya Chambal	78.79	26.77	0	4
Rastriya Chambal	78.82	26.77	0	1
Rastriya Chambal	78.85	26.75	0	1
Rastriya Chambal	78.89	26.72	0	6
Rastriya Chambal	78.91	26.71	0	2
Rastriya Chambal	78.91	26.71	0	2
Rastriya Chambal	78.91	26.71	0	1
Rastriya Chambal	79.05	26.68	0	1
Rastriya Chambal	78.96	26.69	0	2
Rastriya Chambal	78.91	26.71	0	1
Rastriya Chambal	78.88	26.72	0	1
Rastriya Chambal	78.92	26.71	0	1
Rastriya Chambal	77.84	27.25	0	4
SF Bijnaur	78.86	29.35	0	30
Shravasti	81.96	27.80	0	2

Forest Division	Longitude	Latitude	Number of nests	Number of vultures
Shravasti	81.87	27.77	0	2
Shravasti	81.95	27.80	0	3
Sohagibarwa	83.92	27.30	0	2
Sohagibarwa	83.91	27.29	0	1
Sohagibarwa	83.92	27.29	0	1
Sohagibarwa	83.92	27.29	0	1
Sohagibarwa	83.67	27.36	0	25
Sohagibarwa	83.60	27.36	0	6
Sohagibarwa	83.56	27.41	0	3
Sohelwa	82.55	27.61	0	25
Sohelwa	82.51	27.62	1	0
Sohelwa	82.47	27.60	0	12
Sohelwa	82.55	27.62	0	4
Sohelwa	82.06	27.82	0	14
Sohelwa	82.07	27.82	0	18
Sohelwa	82.64	27.61	3	12
Sohelwa	82.62	27.61	0	8
Sohelwa	82.59	27.61	0	5
Sohelwa	82.59	27.57	0	4
Sohelwa	82.59	27.57	0	12
Sohelwa	82.68	27.64	2	5
Sohelwa	82.74	27.55	0	5
Sohelwa	82.47	27.61	0	1
Sohelwa	82.47	27.60	0	1
Sohelwa	82.51	27.62	0	3
Sohelwa	82.42	27.55	0	1
Sohelwa	82.43	27.55	0	1
Sohelwa	82.42	27.55	0	1

Forest Division	Longitude	Latitude	Number of nests	Number of vultures
Sohelwa	82.55	27.62	0	35
Sohelwa	82.09	27.84	0	4
Sohelwa	82.12	27.81	0	14
Sohelwa	82.14	27.81	2	1
Sohelwa	82.14	27.81	0	22
Sohelwa	82.14	27.81	0	30
Sohelwa	82.14	27.81	1	1
Sohelwa	82.07	27.84	0	37
Sohelwa	82.06	27.82	0	18
Sohelwa	82.07	27.84	0	3
Sohelwa	82.07	27.82	0	125
Sohelwa	82.16	27.78	0	2
Sohelwa	82.16	27.78	0	3
Sohelwa	82.16	27.78	0	7
Sohelwa	82.29	27.71	0	6
Sohelwa	82.27	27.73	0	6
Sohelwa	82.27	27.73	0	21
Sohelwa	82.27	27.71	0	11
Sohelwa	82.30	27.69	0	11
Sohelwa	82.23	27.73	0	22
Sohelwa	82.14	27.76	0	15
Sohelwa	82.21	27.73	0	25
Sohelwa	82.48	27.42	0	30
Sohelwa	82.06	27.82	0	18
Sohelwa	82.07	27.82	0	57
Unnav	80.52	26.55	0	71
Unnav	80.52	26.55	0	68
Unnav	80.52	26.55	0	68

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Appendix 2. Geographical position of vultures recorded in different forest divisons of UP during summer (15 May 2011)

Forest division	Longitude	Latitude	Number of nests	Number of vultures
Agra	78.16	27.48	0	67
Agra	77.75	27.19	0	40
Banda	80.52	25.01	0	12
Basti	82.94	26.77	0	2
Basti	82.72	26.55	0	1
Basti	82.99	26.55	0	1
Bijnaur	78.33	29.70	0	30
Bijnaur	78.45	29.72	0	20
Bijnaur	78.42	29.72	0	4
Bijnaur	78.44	29.71	0	3
Dudhwa	80.75	28.33	0	32
Dudhwa	80.86	28.49	0	2
Dudhwa	80.61	28.63	0	44
Dudhwa	80.58	28.64	0	35
Dudhwa	80.66	28.63	0	65
Dudhwa	80.67	28.57	0	6
Dudhwa	80.55	28.54	0	8
Dudhwa	80.55	28.54	0	13
Dudhwa	80.54	28.55	0	5
Dudhwa	80.68	28.42	0	46
Dudhwa	80.67	28.39	0	104
Dudhwa	80.66	28.57	0	23
Jhansi	78.64	25.43	0	32
Kaimoor	78.24	24.51	127	412
Kaimoor	78.25	24.50	0	88
Katarniyaghat	81.14	28.33	1	13
Katarniyaghat	81.14	28.33	0	6
Katarniyaghat	81.12	28.34	3	14
Katarniyaghat	81.13	28.34	1	1
Katarniyaghat	81.13	28.34	1	2
Katarniyaghat	81.14	28.34	3	1
Katarniyaghat	81.15	28.33	1	1
Lalitpur	78.30	24.49	2	19
Lalitpur	78.83	24.20	6	18
Lalitpur	78.85	24.21	11	32
Lalitpur	78.72	24.24	8	30
Mainpuri	78.07	27.16	0	12
Mainpuri	78.07	27.19	0	2
Mainpuri	78.05	27.31	0	3
Mainpuri	79.06	27.24	0	4
Mainpuri	78.80	27.19	0	5
Mainpuri	78.81	27.19	0	3
Mainpuri	78.92	27.14	0	4
Mainpuri	78.97	27.10	0	3
Mainpuri	78.96	27.05	0	2
Mainpuri	78.80	27.07	0	3
Mainpuri	78.98	27.11	0	2
Mainpuri	78.95	27.10	0	6
Mainpuri	78.95	27.11	0	7
Mainpuri	79.19	27.05	0	4
Mainpuri	79.19	27.04	0	6
Mainpuri	79.21	27.02	0	19
Mainpuri	79.29	27.10	0	6
Mainpuri	79.20	27.13	0	11
Mainpuri	79.34	27.22	0	3
Mainpuri	79.33	27.23	0	3
Mainpuri	79.30	27.28	0	2
North Kheeri	80.74	28.22	1	1
North Kheeri	80.74	28.22	0	4
North Kheeri	80.74	28.27	1	1
North Kheeri	80.88	28.20	0	6
North Kheeri	80.70	28.37	1	12
North Kheeri	80.97	28.37	0	50
North Kheeri	80.80	28.21	0	3
North Kheeri	80.88	28.20	1	1
North Kheeri	81.05	28.07	0	40
Pilibheet	80.27	28.64	1	16
Pilibheet	80.17	28.75	0	6
SF Bijnaur	78.81	29.43	0	12
SF Bijnaur	78.81	29.38	0	4
SF Bijnaur	78.80	29.35	0	10
Shravasti	81.96	27.80	1	2
Shravasti	81.87	27.80	1	3
Shravasti	81.96	27.76	1	2
Shravasti	81.96	27.76	1	2
Shravasti	81.97	27.76	1	25
Shravasti	81.97	27.76	2	5
Shravasti	81.96	27.80	1	3
Shravasti	81.96	27.80	1	2
Sohagibarwa	83.92	27.29	2	5
Sohagibarwa	83.66	27.38	2	6
Sohagibarwa	83.88	27.30	4	5
Sohelwa	82.21	27.73	0	33
Sohelwa	82.11	27.81	2	1
Sohelwa	82.18	27.79	0	35
Sohelwa	82.06	27.82	0	250
Sohelwa	81.95	27.85	0	4
Sohelwa	82.00	27.87	0	13

Forest division	Longitude	Latitude	Number of nests	Number of vultures
Sohelwa	82.72	27.53	1	3
Sohelwa	82.51	27.62	2	9
Sohelwa	82.51	27.62	0	6
Sohelwa	82.25	27.73	0	35
Sohelwa	82.34	27.71	0	19
Sohelwa	82.14	27.76	0	66

Forest division	Longitude	Latitude	Number of nests	Number of vultures
Sohelwa	82.20	27.77	0	35
South Kheeri	80.47	28.24	0	12
South Kheeri	80.34	28.48	0	2
South Kheeri	80.26	28.04	1	2
South Kheeri	80.34	28.39	0	1
South Kheeri	80.40	28.25	0	2