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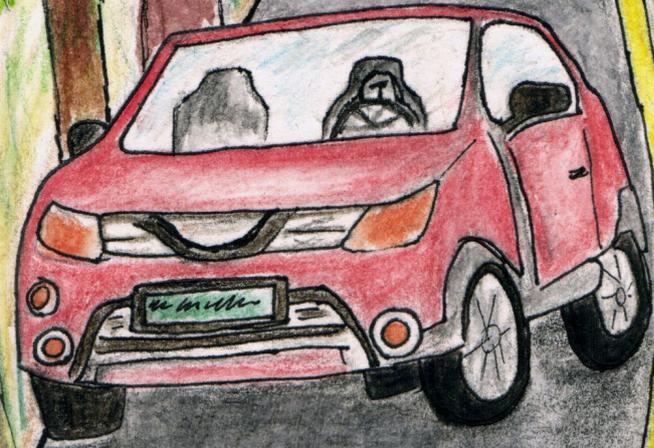
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Caption: Lowland Tapir *Tapirus terrestris* (Medium—watercolours on watercolour paper) © Aakanksha Komanduri.



Recovery of vulture population in roosting and scavenging areas of Bastar and Bijapur, Chhattisgarh, India

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Abstract: Chhattisgarh is home to seven of the nine vulture species in India. One reason for this high vulture diversity is the presence of large herds of bovines numbering over 11 million individuals (ratio of human to bovine population is approximately 0.38), from which carcasses are disposed off in the open for scavengers. The late 1990s saw large scale decimation of vulture population, and since then there have been few studies with no sighting estimates available. In this study, concurrent sighting records were collected from different locations of southern Chhattisgarh and corroborated to develop conservative sighting estimates for sympatric populations of *Gyps bengalensis* and *Gyps indicus*. We present the first report on population recovery, with an estimated 30–35 *Gyps bengalensis* & 20–25 *Gyps indicus* in/ around Rudraram of Bijapur and 18 *Gyps bengalensis* & five *Gyps indicus* at Jamguda village of Bastar. Krishna Swami Gutta hill is identified as a nesting-roosting habitat for both species, for which six scavenging areas were identified in Bastar and Bijapur districts. The human/bovine population ratio for Bastar is 0.4, similar to the state ratio, while in Bijapur the ratio is 1.07, which justifies considering Bijapur as a conservation refuge. The few vultures that survived the diclofenac catastrophe in wild habitats most likely consumed wildlife carcasses that sustained a residual population. In these areas, the age-old practise of disposing off dead domesticated bovines away from settlements near reserve forests may also have supported the recovery of vulture population.

Keywords: Bovines, concurrent, diclofenac, diversity, *Gyps bengalensis*, *Gyps indicus*, habitat, nesting-roosting, sighting, sympatric.

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Author contributions: SKD—supervised the study, identification of roosting and scavenging areas of vultures, conducted the vulture enumeration survey, collected information on daily movement of vultures from various sources, photographic documentation, compilation of data and drafted the research paper. MK—formulated the survey plan, protocols, participated in the survey, correlated information on vulture and habitat, analysis-interpretation of research data and finalized the research paper. PRSN—participated in the survey, photographic documentation, studied the bovine carrion in the study area and gave vital inputs for this research paper. SaD—MSc student participated in the survey to collect information on vultures from his designated survey site, photographic documentation and enumerated vulture numbers. SuD—graduate student participated in the survey and collected information on vulture from her designated survey site and enumerated vulture numbers.

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INTRODUCTION

Chhattisgarh is a land of dense forests, hill ranges, valleys, sheer cliffs, vast grasslands, agricultural land, waterfalls, and water-bodies. The estimated human population was 29 million for 2020 (Unique Identification Aadhar India updated 31 May 2019), with a rural population of about 22 million (i.e., 77 %). People generally maintain large herds of bovines totalling over 11 million animals (Livestock Census 2019) for agriculture and milk. The ratio of human to bovine population for Chhattisgarh state is approximately 0.38. Cattle are maintained largely on grazing, with basic shelters at night. Bovine death rates are relatively high owing to various factors. Many domestic bovines turn feral and enter forests, there are occasional outbreaks of disease since widespread vaccination is impractical, there are few veterinary personnel, many people prefer cheap traditional treatments over modern drugs, and most villages are far from the reach of emergency veterinary help. Dead animals are disposed off in a designated communal place on the outskirts of Bastar and Bijapur villages, where scavengers including vultures, feral carnivores and crows congregate.

Of the 22 vulture species worldwide, nine are resident to India, and seven—Indian Scavenger Vulture *Neophron percnopterus ginginianus* Latham, 1790; Oriental White backed Vulture *Gyps bengalensis* Gmelin, 1788; Indian Long-billed Vulture *Gyps indicus* Scopoli, 1786; Indian Griffon Vulture *Gyps fulvus fulvescens* Hume, 1869; Cinereous Vulture *Aegypius monachus* Linnaeus, 1766; and Black or King Vulture *Sarcogyps calvus* Scopoli, 1786—have been reported from Chhattisgarh (Ghosh et al. 2008). Information on vulture population and diversity for Chhattisgarh is scant from the southern part of the state.

Before the introduction of diclofenac (an anti-inflammatory drug) in India during the 1990s vultures were recorded in large groups and were common sight in many localities, but the following years witnessed a continuous and drastic decline in vulture populations (Prakash et al. 2003). In 2004, Dr. Lindsay Oaks and his team found that diclofenac causes fatal renal failure in vultures. A simulation model demonstrated that if only 1 % of the carcasses were contaminated by diclofenac, Indian vulture populations could decline 60–90 % annually, and it was reported that 10 % of carcasses in India were contaminated (Green et al. 2004). In 2006, the Government of India banned the manufacture, marketing and use of diclofenac. Following this ban, the declining population of *Gyps bengalensis* slowed,

but infrequent use of diclofenac continued (Prakash et al. 2012). Populations of White-rumped Vulture, Long-billed Vulture, and Slender-billed Vulture crashed during the mid-1990s throughout the Indian subcontinent, and the International Union for Conservation of Nature (IUCN) listed all of these species as ‘Critically Endangered’ (Birdlife International 2021). This study estimates vulture population in Bastar and Bijapur district of Chhattisgarh and attempts to correlate contributory factors for recovery post the decimation of the mid-1990s.

The White-rumped Vulture is identifiable by a conspicuous white ruff at base of neck, white inner thighs, a prominent broad white band on under-wings and 12 tail feathers. Head and neck are destitute of feathers and tinged pink, and the bill is dark at the tip and paler at the base with dark ceres. The nostril openings are slit-like. In flight, the white under-wing coverts are highly visible. The Long-billed Vultures is characterized by a narrow elongated head, long naked neck and head covered with woolly down sporting a prominent lanceolate ruff of feathers (longer in juvenile) at base of neck, and a long yellowish bill. It sports 14 tail feathers. The upper wings are sandy brown and darker head, have a buff ruff at the back of neck, feathers of back are sepia brown. *Gyps indicus* is smaller in size than *Gyps bengalensis*. Both are sociable, nest and roost communally on trees and cliffs (Grimmett et al. 2011; Naroji 2011). Both the species are medium-sized Old World vultures. White-rumped Vulture is native to southern and southeastern Asia. Long-billed Vulture is native to southern Asia.

MATERIALS AND METHODS

Opportunistic documentation of vultures in 2011–2016 gave the impetus to undertake dedicated surveys from June to October 2020, and in January 2021 in Bastar and Bijapur district of Chhattisgarh. Garmin GPSMap 78s was used to record the sighting position, Nikon Aculon A211 10–22 X 50 binoculars were used for spotting and identification of species. A Canon EOS 70D with an EF300mm f/4L IS USM lens and extender EF 1.4 X III were used for photographic documentation. The surveys were conducted in designated dead animal disposal places near villages. Concurrent sighting information was collected from different locations and corroborated to evolve conservative sighting estimates for vultures.

Study area

Two southern districts of Chhattisgarh; i.e., Bastar and Bijapur were covered to record the population of

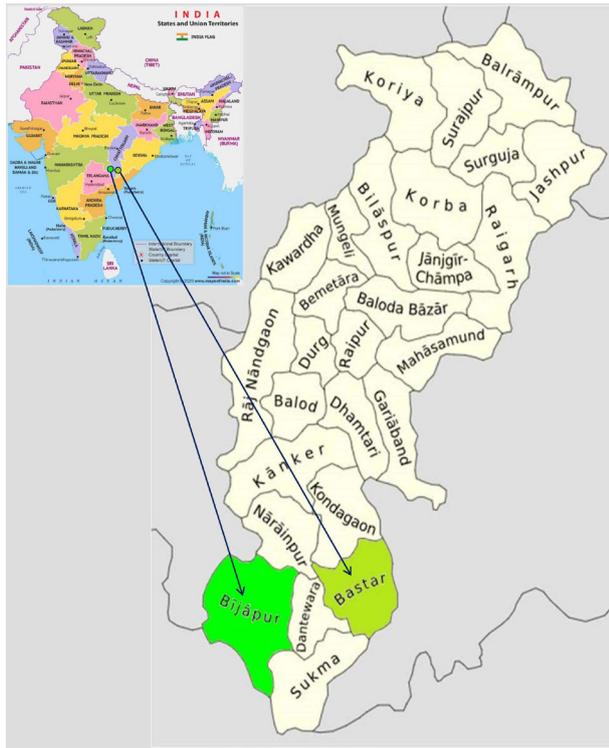


Figure 1. Outline map of Chhattisgarh districts with study area of vultures shaded green (Source: Wikipedia)

vultures (Figure 1). Bastar district covers an area of 6,596.90 km². The district is bounded on east by Odisha, north by Kondagaon district, west by Narayanpur and Dantewada, and south by Sukma. It is situated at a height of 606 m plateau from sea level. Kanger Ghati National Park (also called Kanger Valley National Park) is a protected area in the Bastar district of Chhattisgarh.

Bijapur district covers an area of 6562.48 km². The district is bounded on east by Dantewada and Sukma districts, north by Narayanpur district and Maharashtra, west by Maharashtra and south by Telangana. The major river is Indravati and flows through Bastar, Dantewada and Bijapur uniting with Godavari near Bhadrakali River. The district is a rocky hilly terrain with an altitude ranging 177–599 m. District is covered by rich and thick dense mixed forest interspersed by moist and intermediated forest with diverse forest species. Indravati Tiger Reserve (Biosphere reserve), lies within this district with high and rocky hills.

OBSERVATION

Sightings of vultures in Bastar

Bastar district has a human population of 0.83 million

as per 2011 census, and more than 70 % are tribal. The domesticated livestock population (cows and buffalos) is 0.34 million as per the 20th Livestock Census, 2019. The ratio of human population to cattle population for Bastar district is approximately 0.4. Bastar district is covered with very and moderate dense forest of 3072.34 km² or 47 % (Indian State of Forest Report 2019).

The first and third author sighted 18 *Gyps bengalensis* and five *Gyps indicus* at Jamguda village of Bastar district in 2011 during post-mortem of 12 bovines succumbed to sudden death, and second sighting of one individual vulture gliding and soaring was recorded during 2015. Vultures sighted in Bastar are both resident and migrant. Sporadic records are available of their earlier sightings with no estimates of vultures.

Sightings of vultures in Bijapur

Bijapur district has human population of 0.26 million (2011 census), and more than 70 % are tribal. The domesticated livestock population (cows and buffalos) is 0.28 million as per the 20th Livestock Census, 2019. The ratio of human population to cattle population for Bastar district is approximately 1. Moderate/dense forest cover is 4,975 km² or 76 % (Indian State of Forest Report 2019). Frequent and regular sightings of White-Rumped Vulture and Indian Vulture have been made in this area.

Occasional Sightings of vultures in Dantewada

On 04 February 2020, one migrating sub-adult Himalayan Griffon found in Geedam (18.974°N, 81.399°E), a village in Dantewada district. A group of crows attacked the vulture which succumbed to injuries even after its treatment in the zoo.

Table 1 presents chronological sighting records of vultures in Bastar and Bijapur (Image 4–8). Image 1, is GoogleEarth Map showing the sighting locations of *Gyps bengalensis* and *Gyps indicus* in Bastar and Bijapur districts. Figure 2, is a graphical presentation of vulture population in various roosting and scavenging sites.

DISCUSSION

Informal interviews with forest department personnel and local people of rural villages near Rudram and Cherpalli revealed that vultures nest on Krishna Swami Gutta hill on the plain between the cliffs, 30–50 m above ground level. The hill is located south of Cherpalli in Bijapur district. Consistent sightings of vultures were documented in Bijapur district from March 2016, with photographic documentation and GPS co-ordinates.

Table 1. Chronological sighting record of vultures in Bastar and Bijapur.

Date	Time	District	Location	Species wise number of individuals		Position Landed / perched / gliding / soaring
				<i>Gyps bengalensis</i>	<i>Gyps indicus</i>	
31 Jul 2011	1208	Bastar	Jamguda village 19.30333°N 81.96555°E	18	5	Landed Perched
?? 2015	1545	Bastar	Bastar village	1	0	Gliding and soaring
05 Mar 2016	1142	Bijapur	Cherpalli 18.83246°N 80.43249°E	4	0	Gliding and soaring
06 Jun 2020	1128	Bijapur	Indravati Tiger Reserve, 18.81324°N 80.47578°E	13	12	Landed
12 Jun 2020	1103	Bijapur	Rudraram 18.83700°N 80.41471°E	30–35	20–25	Landed Perched
	1630			3–4	1–2	
13 Jun 2020	1115	Bijapur	Rudraram 18.83702°N 80.41475°E	18–20	15–17	Landed
14 Jun 2020	1600	Bijapur	Rudraram 18.83758°N 80.41465°E	4–5	2	Gliding and soaring
30 Jun 2020	1428	Bijapur	Krishna Swami Gutta hill 18.79739°N 80.41125°E	6–7	3	Gliding and soaring
22 Jul 2020	0921	Bijapur	Rudraram 18.83681°N 80.41521°E	2	0	Landed
24 Aug 2020	1122	Bijapur	Rudraram 18.83695°N 80.41392°E	10–12	0	Landed and perched
03 Sep 2020	0928	Bijapur	Rudraram 18.83682°N 80.41521°E	30–31	18–20	Landed
01 Oct 2020	1015	Bijapur	Rudraram 18.83711°N 80.41482°E	17–19	10–12	Landed
12 Jan 2021	1000	Bijapur	Rudraram 18.83711°N 80.41482°E	13	4	Landed Perched

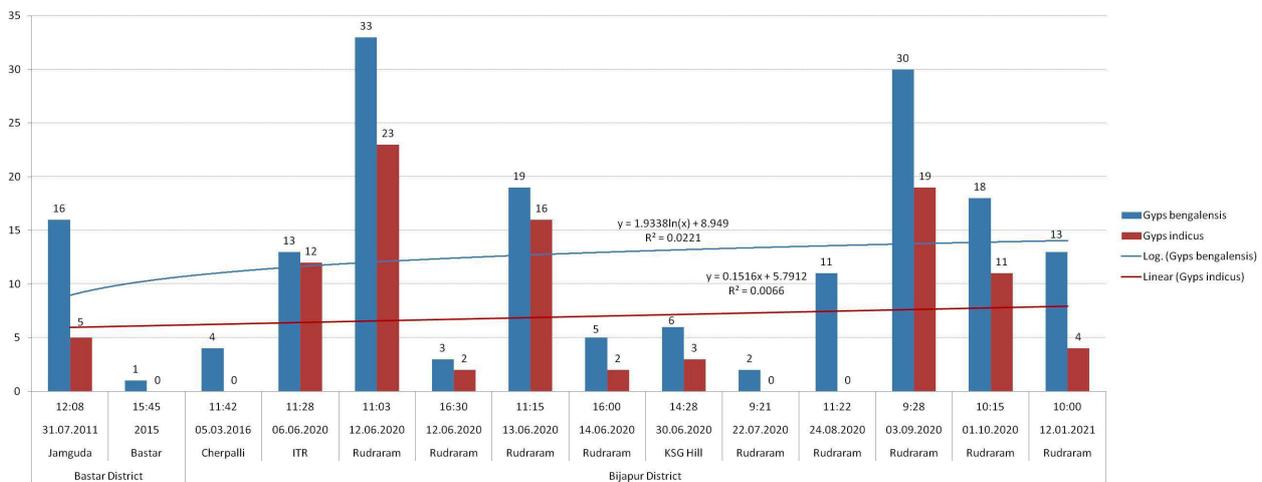


Figure 2. Graph represents vulture population in scavenging and roosting sites of southern Chhattisgarh (ITR – Indravati Tiger Reserve, KSG hill – Krishna Swami Gutta hill).



Image 1. Google Earth map of vulture sighting locations in Bastar and Bijapur district of southern Chhattisgarh.

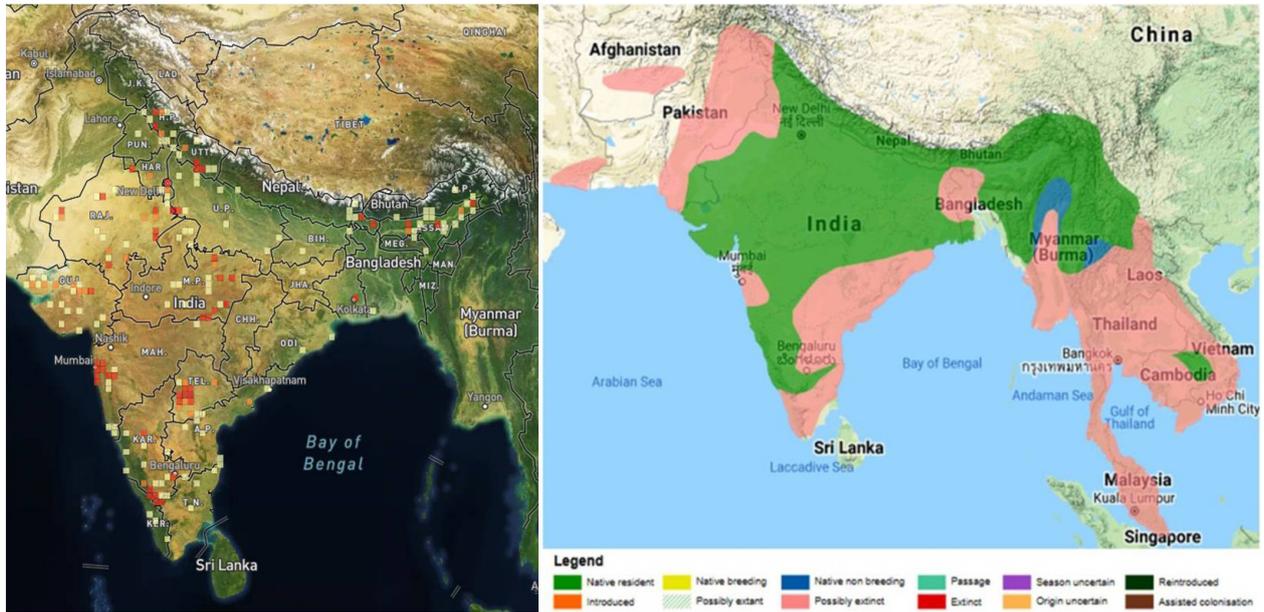
Primary food source for both species of vultures are carcasses of Wild Asian Buffalo, Indian Bison, Nilgai, Blackbuck, Chausinga, Sambar, Chital, Indian Muntjac, Indian Spotted Chevrotain, and Wild Boar in reserve forest (Wildlife Officials, pers. comm. 27th July 2020). Both species of vultures in outskirts of reserve forest feed on carcasses/carrion of domesticated bovines.

Estimates of vulture sightings started from 2011 at Jamguda village, with 18 *Gyps bengalensis* and five *Gyps indicus*. A single individual was sighted gliding and soaring in 2015 at Bastar village of Bastar district of southern Chhattisgarh. In 2016, four *Gyps bengalensis* were sighted at Cherpalli in the Bijapur district. In 2020, frequent sighting of vultures were encounter at various locations in the Bijapur; 13 *Gyps bengalensis* and 12 *Gyps indicus* were sighted at Indravati Tiger Reserve (Buffer Area). More and regular sightings were recorded in Rudraram; 30–35 individuals of *Gyps bengalensis* and 20–25 individuals of *Gyps indicus* were sighted at Rudraram and Krishna Swami Gutta hill often referred as nesting-roosting habitat was visited and confirmed. Both species are now exploring six identified scavenging areas

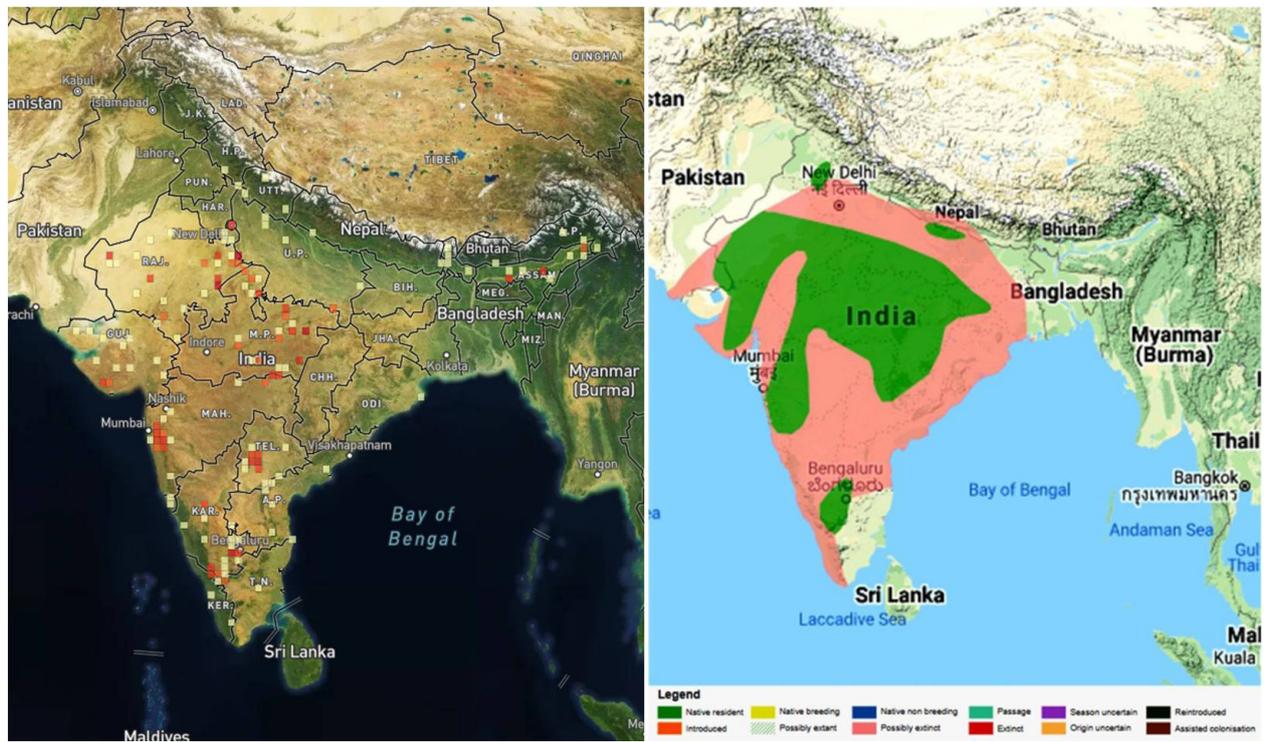
and possibly homing range of both species covers Bastar and Bijapur district of southern Chhattisgarh. Rudraram and Krishna Swami Gutta hill are two hot spot for these species. These observations are an indication of population recovery of both *Gyps bengalensis* and *Gyps indicus*. This sighting result as seen from the logarithmic trend lines in the graph is in conformity with the surveys conducted in 2011 by Prakash and his research team. The population of vulture species remains low, but the decline has slowed and may even have reversed for *Gyps bengalensis* in India (Prakash et al. 2012).

In recent times vultures have been sighted in good numbers, often in the outskirts of remote villages surrounded with dense trees, higher cliffs and flat-tops on higher rocky hills, particularly near protected areas and far from urbanization. These habitats must have served as last refuges for those few vultures that survived the Diclofenac era. The factors contributing to the recovery of vulture population in Bastar and Bijapur district are:

a) Conducive habitable places for resting and breeding in Bijapur district, is the first and foremost



(A) Source: India Biodiversity <https://indiabiodiversity.org/biodiv/species/show/239129> [Accessed date Jan 7, 2021] (B) Source: BirdLife International 2021
 Image 2. A—Map of India showing no record of *Gyps bengalensis* in Chhattisgarh | B—Map of India showing no records of *Gyps bengalensis* in southern Chhattisgarh.



(A) Source: India Biodiversity <https://indiabiodiversity.org/species/show/239132> [Accessed date Jan 7, 2021] (B) Source: BirdLife International 2021
 Image 3. A—Map of India showing no record of *Gyps indicus* in Chhattisgarh | B—Map of India showing records of *Gyps indicus* in Bijapur and Bastar districts of Chhattisgarh.

important factor for survival and population recovery of vultures. The numbers of vultures were so low that not a single sighting report from this areas exists from 2005–2011 (Image 2 and 3 except for *Gyps indicus* by BirdLife International).

b) Availability of adequate dead wildlife carcasses in these wild habitats (Indravati Tiger Reserve and Kanger Valley Tiger Reserve) likely sustained the decimated vulture population. Forest staff confirm that mortality of wild animals due to natural factors in protected areas is sufficient to sustain present vulture population. Carcasses of wild beasts and feral domesticated animals in the protected areas and peripheral remote village areas are generally free of Diclofenac contamination. This has ensured a safe and continuous source of food, but vigilance against misuse of Diclofenac is necessary to ensure conservation and recovery of vulture populations.

c) The ban on veterinary use of Diclofenac (i.e., from May 2006 till date) by the Indian Government might had a positive impact on recovery of vulture population, as witnessed in Bastar and Bijapur districts of southern Chhattisgarh. Two years after the ban, 1,150 of 1,251 liver samples from livestock carcasses collected across India between August 2007 and June 2008 were negative (Saini et al. 2012). Similarly, Cuthbert et al. (2011) reported that the concentration of diclofenac before and soon after the ban was 10.8–10.7 %, but had dropped to 6.5% in 31 months after the implementation of the ban, leading to a drop in the annual death rates of vultures from 80 % to 18 %.

d) Traditional practises of disposing off dead bovines in designated communal sites in rural villages. An

average of 10 bovines (i.e., 2–3 per month) are disposed in each village during the dry season, and 4–5 (i.e., 1–2 per month) in the wet and cold seasons. This is an important contributing factor for recent sightings of vultures in Bastar and Bijapur district.

The southern Chhattisgarh region is possibly a migratory route of vultures. On 04 February 2020, one migrating sub-adult Himalayan Griffon was recorded in Geedam village of Dantewada district. The repeated sightings of vultures around the same area and their nesting in the Krishna Swami Gutta hill is an opportunity to plan for the conservation of both species *Gyps bengalensis* and *Gyps indicus* vultures in India.

Suggestions

1. The traditional practise of disposing off dead bovines free of diclofenac contamination should be promoted in other designated communal sites instead of burying - to ensure a safe, constant source of food enabling vulture populations to grow further.

2. Camera traps should be fixed in nesting, roosting and scavenging areas to monitor inter and intra species interactions.

3. Long-term vulture monitoring projects should be undertaken; fitting of satellite telemeters on discrete population in roosting and scavenging areas for understanding movements, other parameters and physical challenges due to vast home range.

4. Krishna Swami Gutta hill must be designated as a ‘Vulture Sanctuary’ to protect the nesting sites of these vultures.

5. Vigilance and legal actions should be adopted on any diclofenac use in veterinary. Sensitization of chemists and drug associations, pharmacists, veterinary councils and farmers should be undertaken along



Image 4. Himalayan Griffon *Gyps himalayensis*.



Image 5. Vulture sighting at Jamguda, Bastar.



Image 6. Vulture sighting at Indravati Tiger Reserve, Bijapur.
© Forest Officials of Indravati Tiger Reserve.



Image 7. Vulture sighting at Rudraram, Bijapur.



Image 8. Vulture sighting at Krishna Swamy Gutta Hill, Bijapur.

with understanding the implications of substitute of diclofenac drug in veterinary use. Lead contamination is also a serious concern for vultures and need to be monitored for future of vultures recovery.

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