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Population status of the Critically Endangered African White-Backed Vultures (*Gyps africanus*) in and around Wolkite town, Southwestern Ethiopia

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ABSTRACT: African white-backed vultures (*Gyps africanus*) are critically endangered bird species which are commonly found in areas where rubbish food sources and roosting and/or nesting sites are available. This study assessed the population size and threats of the African white-backed vultures in Wolkite town abattoir and the surrounding dumping site from April 2019 to March 2021. A total count method was employed to assess the population size of the species and analyzed using descriptive statistics. A questionnaire consisting semi-structured open-ended questions was used to study the attitude and perception of the local community. During the study period, 192 field visits were conducted to count the population size of African white-backed vultures. Individual African white-backed vultures were counted in the abattoir and dumping sites. About 472 individuals (36%) were counted in the dumping site (Mean ± SD: 20±7.4; Range: 8-29) and 839 individuals (64%) were counted in the abattoir (Mean ± SD: 34±8; Range: 22-47). The age category in the dumping site constituted 269 adults and 203 sub-adults with a statistically significant difference (x^2= 8.14, df =1, p< 0.05) between adults and sub-adult age groups. In the abattoir, 319 of the population were adults and 520 were sub-adults, a significant difference (x^2= 48.2, df =1, p< 0.05) in the age groups in the area. Threats such as human disturbance and competition for food and roosting with domestic and wild animals were observed during the study period.

Keywords/ phrases: Abattoir, Critically endangered, Population size, Threatened birds, Wolkite

INTRODUCTION

African white-backed vultures (*Gyps africanus*) are widely spread avian species in sub-Saharan Africa. Among the seven species of Old World vultures found in Ethiopia, African white-backed vultures are abundant residents throughout the year and are most numerous between 1820-3800 m above sea level (ASL) (Ash and Atkins, 2009). They occur in various habitats but prefer open savanna and dry woodlands with dispersed trees of *Acacia* and *Ficus* species, which they use for roosting and breeding purposes (Mundy *et al.*, 1992). It is also found in areas with smaller trees but absent from some grassland areas that lack trees (Mundy, 1997). However, its population has been declining for the past three decades (Ogada *et al.*, 2016) and at present, it is critically endangered in the IUCN Red list of threatened species (IUCN, 2022).

African white-backed vultures live closely associated with human beings. They are found near human settlements, slaughterhouses, landfills, open markets, and grasslands. Due to this, the species is prone to threats such as habitat loss, intentional or unintentional poisoning, and scarcity of food sources. According to Ogada *et al.* (2012) African white-backed vultures breed after their fourth year and the relatively low reproductive rates make vulture populations especially vulnerable to high mortality rates. African *Gyps* vultures are sensitive to the toxic effects of diclofenac and other NSAIDs, raising concerns of potential rapid population declines in the future (Naidoo *et al.*, 2009; Naidoo *et al.*, 2010).Their sociable feeding behavior and ability to forage over large areas also make *Gyps* vultures, particularly African white-backed vultures prone to mass poisoning (Virani *et al.*, 2011).

Among the eleven species of vultures found in Africa, all except the Palm-nut vultures (*Gypohierax angolensis*) are obligate scavengers (Buechley and Şekercioğlu, 2016; Botha *et al.*, 2017). Vultures are well-known to remove carrion from the environment and provide important ecosystem services such as nutrient cycling, and control of adaptable mammalian

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scavengers, thereby preventing the spread of livestock diseases by disposing of infected carcasses (Campbell, 2008; Ogada *et al.,* 2012; Dereje Mulu and Subramanian, 2013). They remove carcasses quickly and efficiently and keep the environment clean and protect humans, livestock, and wildlife from infectious diseases (Vijaikumar *et al.,* 2002). Their decline leads to environmental, economical, health, and cultural costs in a particular area (Markandya *et al.,* 2008; Ogada, 2011). They are also natural detoxifiers where that can detoxify the bacteria from carcasses and decomposing bodies using their low pH in the stomach (Khan, 2012). The absence of vultures allows other secondary scavengers (dogs, jackals, hyenas, crows, and eagles) to play a role as primary scavengers which can cause ecological imbalance affecting different species including humans, thereby enhancing economic cost and increase in human-wildlife conflict.

All eight Gyps vulture species found globally are threatened due to habitat loss, reduced food availability, direct persecution, climate change, and fatal collisions with wind turbines and electricity cables (Pain *et al.,* 2008; Ogada *et al.,* 2012). Threats to vultures in Africa are much similar to the ones across the globe, even though the depth of a few threats seems to be greater excessive than others, main to unremarked declines in a few species including vultures (Ogada *et al.,* 2015). The fundamental element affecting these vultures in sub-Saharan Africa is the rapid human populace growth (United Nations, 2017). This population pressure has a significant effect on landscape functioning and its capability to help flora and fauna, consisting of vultures and their food sources, in the continent. The majority of vulture decline is related to human activities and their interaction with the species (Virani *et al.,* 2010). So understanding the attitude and needs of the local community helps create applied conservation strategies to address and solve the problem of vultures in the area.

The latest information in the population of this species suggests a rapid decline (Ogada *et al.,* 2016; Bird *et al.,* 2020); over 90% in West Africa (Thiollay 2006), Sudan (Nikolaus, 2006), Kenya (Virani, 2006), South Africa and Botswana (Thorley and Clutton-Brock, 2017; Murn *et al.,* 2017) to 52% in Masai Mara (Kenya) Virani *et al.* (2011). African white-backed vulture populations seem to be stable in Ethiopia (Nikolaus, 2006), but there is no detailed study on the current population number and status of the species. The research is aimed at investigating the population status of the species in and around Wolkite town, Ethiopia; to set a conservation and management plan to protect this globally threatened vulture species in Ethiopia.

METHODOLOGY

Study area

Wolkite town is one of the emerging towns with fast urbanization in the southwestern part of Ethiopia. It is also the nearest town to the Gibe Sheleko National Park which is just 18 km away. There are abattoirs and open dumping sites in and around Wolkite town that serves as vulture restaurant. The town is an administrative city of the Gurage zone located at a distance of 158 km away from Addis Ababa in the southwest direction. The study was carried out in two sites, an abattoir ($8^0$28'65N and 37^0 77'45 E) and a dumping site (8^0 24 '25N and 37^0 75'82 E) in and around Wolkite town (Fig. 1). The dumping site is found at the edge of forest areas around 7.5 km from Wolkite town. This is a permanent open waste disposal site, which serves as a main dumping site for the town. *Eucalyptus* and *Acacia* trees are the main plant species found around this site. The abattoir is located at the center of Wolkite town, with a high-population settlement. There are large trees and residences in the area including a small stream within a km radius.

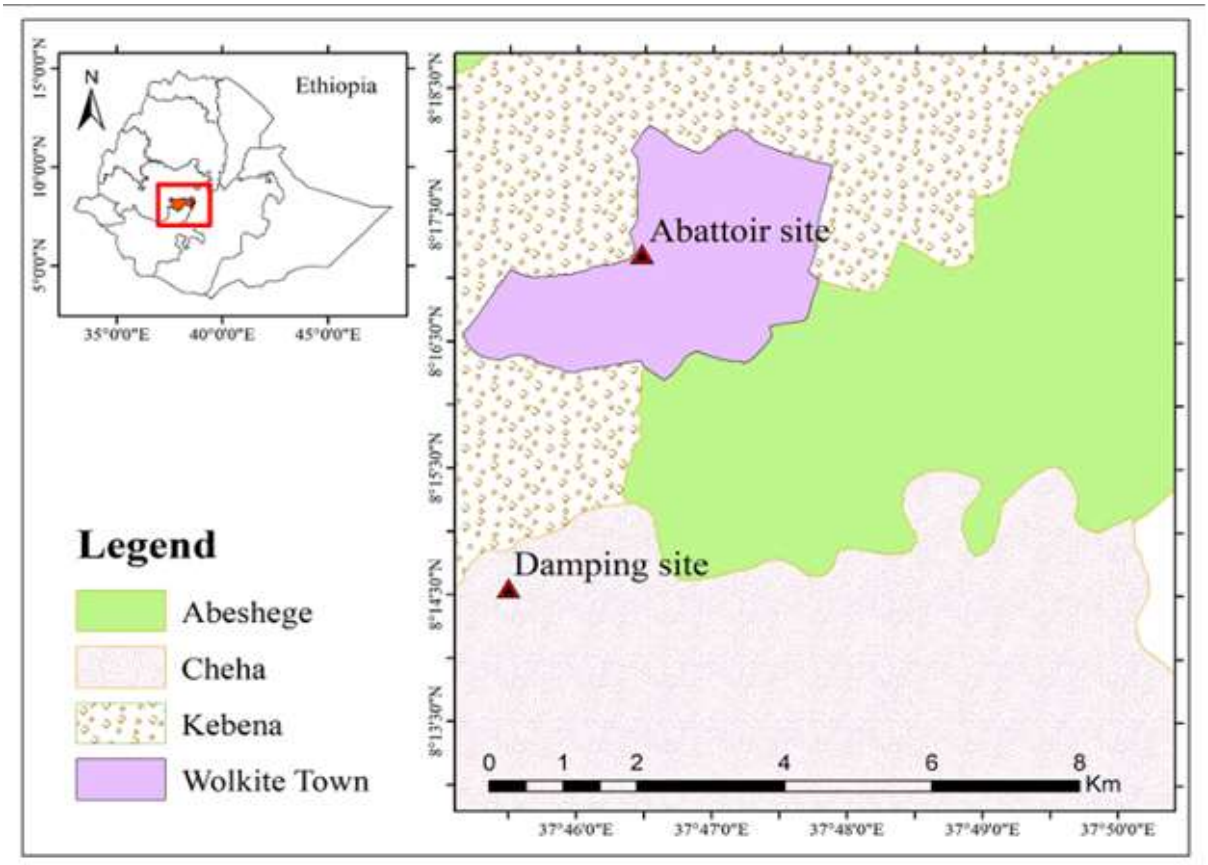

Figure 1:- Map of Wolkite Town and locations of study sites.

Data collection

A preliminary surveying was conducted in March 2019 to locate and identify sites that are the primary sources of carcasses for African white-backed vultures. The total count method was applied to count the population of African white-backed vultures following Pomeroy (1992). Survey was conducted two times a day early in the morning from 6:00 to 10:00 hr. and late afternoon from 2:00 to 6:00 hr. following the methods of Shimelis Aynalem and Afework Bekele (2008).

Counting of African white-backed vultures were conducted in their foraging and roosting areas, from a fixed location for a fixed time without width limits following Sutherland (2006). It was carried out as quickly as possible to reduce the risk of double-counting; following the methods of Sutherland (2000). To minimize disturbance during counting,3 to 5 minutes interval was allowed for birds to settle down (Wondimagegnehu Tekalign and Afework Bekele, 2011). Information such as date, time, altitude, GPS location, total count and age groups were recorded (Bayih Wubie and Mesele Yihune, 2018). To understand the attitude of the local community towards vulture, a mixed method approach was employed. The data were collected beside its population study to get information on the attitude of the local community towards vultures specifically to the African white-backed vultures. A questionnaire consisting semi-structured open-ended questions was used to study the attitude and perception of 80 individuals from the local community about African white-backed vultures. The data was collected by qualitative data in the form of stories and perceptions that gave an added element to the survey data. Participants were asked on how frequently they saw vultures in their private property, death of vultures and the population trend. Pictures were also used to determine respondents' knowledge following Bignante, (2010) and Pam *et al.* (2018).

Data analysis

Collected data were computed using Microsoft excel sheet and presented using descriptive statistics in the form of tables. The statistical significance of differences between age groups and population size across seasons, morning and afternoon in each sites were compared and Chi-

Square analysis (X^2) was used to analyze data.Pearson correlation analysis was also applied to show the relationship between socio-demographic variables and attitudes toward vultures.

RESULTS

Population size

The result from the total count of African white backed vultures is indicated in Table 1. A total of 1311 individuals of African white-backed vultures were counted in both sites during the study period. About 472 (36%) were counted in the dumping site (Mean ± SD: 20±7.4; Range: 8-29) and 839 (64%) in the abattoirs (Mean ± SD: 35 ±7.5; Range: 22-47). The highest population size was recorded in the abattoir during the dry season (Mean ± SD: 32±7.4 and Range: 21-47). The lowest population record was in the dumping site in the wet season (Mean ± SD: 24±4.5; Range: 16-28). Although the highest population size were recorded during the dry season and less in the wet season, the was no statistically significant seasonal difference in mean population size in both the Abattoir (x^2= *40.7, df =1, p>0.05*) and the dumping site (x^2= *17.9, df =1, p>0.05*). However, there was a significant difference in the mean population size between these two sites (x^2= *17.2, df =1, p<0.05*). The population size in the abattoir is higher than the dumping site on both seasons which indicates the area is more suitable for the African white backed vultures than the dumping site.

Table 1 Seasonal population size of African white-backed vultures.

Season	Dumping Site			Abattoir		
	Total	**Range**	**Mean ±SD**	**Total**	**Range**	**Mean ±SD**
Dry	282	8-29	18 ±7.8	512	21-47	32 ±7.4
Wet	190	16-28	24 ±4.5	327	38-46	41 ±3.2
Total	472	8-29	20 ±7.4	839	22-47	35 ±7.5

The population size during morning and afternoon hours in the two sites showed that the morning count in the abattoir was lower (Mean ± SD 33±10.34; Range: 13-53) than the afternoon hours (Mean ± SD 36±7.9; Range: 21-55) which was not statistically significant (x^2=*3.3, df =1, p > 0.05*) (Table 2). However, in the dumping site, the morning (Mean ± SD 26±11.7; Range: 9-44) and afternoon (Mean ± SD: 13±3.8; Range: 6-19) population count has a significant difference (x^2=*110.4, df =1, p < 0.05*) indicating there was high population concentration during the morning time than the afternoon (Table 3).

Seasonally, the population size recorded during the wet season was high in both the abattoir and dumping sites during both morning and afternoon hours (Tables 2 and 3). There is also a statistically significant difference in the population size of African white-backed vultures between morning and afternoon hour counts in the abattoir (x^2=*12.6, df =1, p < 0.05*) and in the dumping site (x^2= *40.7, df =1, p < 0.05*).

Table 2: Diurnal abundance of African white-backed vultures in the abattoir.

Season	Morning			Afternoon		
	Total	Range	Mean ±SD	Total	Range	Mean ±SD
Dry	438	13-44	27 ±8.3	547	21-55	34 ±9
Wet	344	39-53	43 ±4.3	311	35-46	39 ±3.7
Total	782	13-53	33 ±10.4	857	21-55	36 ±7.9

Table 3: Diurnal abundance of African white-backed vultures in the Dumping area.

Season	Morning			Afternoon		
	Total	Range	Mean ±SD	Total	Range	Mean ±SD
Dry	368	9-41	23 ±11.9	196	6-19	12 ±4.2
Wet	266	20-44	33 ±8.3	115	12-18	14 ±2.3
Total	634	9-44	26 ±11.7	311	6-19	13 ±3.8

Age category

The mean age categories of African white-backed vultures observed during the study period are given in Table 4. The population age category of African white backed vultures in the dumping site constituted 269 individual (57%) adults (Mean ± SD: 11 ±8.2; Range: 0-24) and 203 (43%) sub-adults (Mean ± SD: 9±5; Range: 3-24). The chi-square test indicated a statistically significant difference (x^2= *8.14, df =1, p< 0.05*) between adult and sub-adult age groups. Adults were dominant in the dumping area.

In the abattoir, sub-adults were dominant in population size, 520 (62%) sub-adult (Mean ± SD: 21±2.9; Range: 17-28) and 319 (38%) of the population were adults (Mean ± SD: 13±7.8; Range: 3-26). The statistical result also shows there is also a significant difference (x^2= *48.2, df =1, p< 0.05*) in the population of adult and sub-adult age groups in the area.

The mean adult population is relatively lower in both sites during the dry season with Mean ± SD; 9 ±8.2; Range: 0-24 in the dumping site and in the abattoir with Mean ± SD: 9±6.8; Range: 3-26. On the other hand, the mean sub-adult population was almost the same in the Abattoir in both seasons with total Mean ± SD: 21±2.9; Range: 17-28 Mean ± SD: 9±5.5; Range: 3-24 in the dumping site during the dry season and in the abattoir during the wet season Mean ± SD: 23±3.2; Range 17-28 (Table 4).

Table 4. Age structure of African white-backed vultures in the dumping and abattoir sites on both dry and wet seasons.

Season	Dumping site (Mean ±SD)			Abattoir (Mean ±SD)		
	Total	Adult	Sub-adult	Total	Adult	Sub-adult
Dry	18 ±7.8	9 ±8.2	9 ±5.5	32 ±7.4	9 ±6.8	23±3.2
Wet	24±4.5	16 ±5.6	8 ±3.9	41±3.2	20 ±2.6	21±2.6
Mean ±SD	20±7.4	11 ±8.2	9 ±5	34 ±8.1	13±7.8	21±2.9
Range	8-29	0-24	3-24	22-47	3-26	17-28
Total	472	269	203	839	319	520
%	100	57	43	100	38	62

Threats

A total of 80 (63 male and 17 female) local communities were contacted to get information about their perception, threats, and population trend of vultures in the area. From the pictorial identification of birds revealed that 73(91.25%) of the respondents did not identify African White-backed vultures with other vultures. Only 7 (8.75%) respondents identify the species at adult level. Also no significant relationship with regard to attitudes toward vultures was found for the level of education, age and respondent income (Table 5).Disturbance from waste collectors and domestic animals was observed in

both sites. Especially in the dumping site is an open area for humans and other animals like domestic dogs, cattle, and wild animals. Such activities were observed affecting the number and activities of the species. Purposive firing and dumping poisoned dead animals are also problems mentioned by respondents in the dumping site. From the interview in the abattoir, 63 (80%) of the respondents observed vultures in their private property. Concerning challenges from the presence of vultures in their surroundings, 65% of the respondents were not comfortable with the presence of vultures and the abattoir.

From direct observation and discussion with the local community, it was possible to understand the attitude of the local community towards vulture species in the area. Even though they have no direct negative attitude about the birds, 64(80%) of the local community who participate in the discussion does not want the abattoir near to their settlement. Anthropogenic factors such as human-induced fire, human or domestic animal disturbance like dog and cattle, chasing, accumulation of various non-edible waste products such as plastic bottles, and feeding competition with other animals like scavenger birds, wild mammals, and domestic animals mainly dogs were found to be threats observed in the dumping area. Whereas, competition with other vultures and domestic animals, chasing, purposive firing to decrease the bad smell and volume, were the main threats in the abattoir site.

Dead African white-backed vultures were not observed from the interviewed waste material collectors in the dumping site and evidence of carcasses in the dumping site. All respondents (100%) also reported that they did not see any deceased vultures in both sites (Table 6).However, threat due to unintentional poisoning of vultures in the dumping site was observed where carcasses of dead animals were disposed off. Throughout the study period, an intentional firing and a high accumulation of plastic bags and bottles was observed where carcasses were dumped with these waste materials in the dumping site creating potential risk to African white backed vultures.

Table 5. Socio-demographic characteristics of the respondents.

Variable	Description	n	%	x^2	*df*	*p*
Gender	Male	63	78.8	26.5	1	0.00
	Female	17	21.3			
Age	18-35	40	50	17.5	2	0.00
	36-59	30	37.5			
	>60	10	12.5			
Education	Illiterate	15	18.8	17.5	3	0.00
	Primary School	35	43.8			
	Secondary school	20	25			
	College/University	10	12.5			
Occupation	Government employee	27	33.8	18.2	2	0.00
	Self employee	38	47.5			
	Dependent	15	18.8			
Residence	Near abattoir	70	87.5	45	1	0.00
	Near dumping site	10	12.5			

Table 6. Attitude and perception of the local community towards vultures.

Attitude and perception	Agree to	Disagree	Neutral
Consider vultures are unattractive	75	25	0
Consider vultures as a symbol of bad luck	13	87	0
The vegetation cover around this area in recent years been decreasing	80	5	15
Vultures have an important role in the environment	18.8	31.2	50
Noticed the decline of vulture population in area	50	31.3	18.7
Have you ever seen vultures mass dead?	10	72.5	17.5
Have you ever killed vultures?	0	100	0
Have you ever faced challenges from the presence of vultures?	43.8	50	6.3
Do you have any domestic animals?	90	10	0
Seen vultures killing livestock in your area?	25	75	0
Seen other carnivores in the area?	100	0	0
Check-up with a veterinary doctor?	15	85	0
Give medicine to sick domestic animals	11.3	89.7	0
Saw people poison carcasses to target vultures?	0	100	0
Used the vulture parts as medicines?	0	100	0

DISCUSSION

Population fluctuation is a common characteristic of most birds which results from population process and individual movements within and between habitats. Vulture's population also shows seasonal and diurnal fluctuation in both number and activity (Ramprakash, 2017). Their population size and distribution are highly affected by environmental conditions, the quality and quantity of food resources (Somayeh *et al.,* 2014). In this research, the population size of African white-backed vultures were higher in the abattoir than the dumping site. The abundance and availability of food sources in the abattoir throughout the year may explain the higher count of birds at this site compared to the dumping site. Food availability has also been reported as a cause of the increment of the number of African white-backed vultures in different studies (Ceballos and Donázar, 1990; Kushwaha and Kanaujia, 2010). So, the higher population size in the abattoir than the dumping site may result from the food availability, less human and other animal's activity in the abattoir than the dumping site due to its protected compound.Researchers also stated that food availability may not be the only factor affecting population size of African white-backed vultures (Ogada and Keesing, 2010; Dereje Mulu and Subramanian, 2013). Other factors, such as the level of human disturbance, competition, climatic condition, availability of roosting area were also reported to have an impact on the population of vulture (Getachew Mulualem *et al.,* 2016; Kassahun Abe *et al.,* 2019).

Human activities near to birds including vultures influence their abundance (Margalida *et al.,* 2014). High human disturbance and other factors such as intruder animals, fire and less food availability in the dumping site may result in low population size. Human interference in the dumping area had an effect on the vulture population (Seyoum Kiros *et al.,* 2018; Mohammed *et al*., 2019). Other researchers also suggest that ecological pressures such as human disturbance, climatic conditions, and availability of food can lead to variation in vulture

populations (Thomson *et al.,* 1990; Donazar and Feijoo, 2002).

The relatively low population of adults during the dry season could be attributed to the breeding activity of African white-backed vultures where adults travel far for nestling which results in a small number during this season since there is no nest recorded near to these two roosting and feeding sites. Studies in African white-backed vultures state that they nest and breed during the dry season in East Africa (December to January and April to May) where they lay eggs during the dry season in March and May (Mundy *et al.,* 1992). Vultures show large levels of seasonal fluctuation to meet their requirement for food, nest and roost (Ramprakash and Purohit 2013). Also, Dereje Mulu and Subramanian (2013) reported that population size of African white backed vultures show significant seasonal variation which has direct relationship with breeding season and rainfall pattern. It was also testified that the population pattern of birds increment during the dry season in breeding areas and decrease during the wet season in non-breeding areas. The weather condition may not have a direct effect on the population size but the nesting and breeding ecology of African white-backed vultures influence the population.

Vultures are known to coexist in direct competition for the same resource. Habitat destruction and disturbance in feeding and nesting areas are the main threats of vultures (Ogada *et al.* 2016). Like other vultures of Africa, African white-backed vultures also face threats such as habitat loss, reduced food availability, and poisoning (Botha *et al.* 2017). In East Africa, intentional and unintentional poisoning is also a primary issue in vulture conservation (Roxburgh and McDougall 2012; Ogada *et al.* 2016). Improved animal husbandry and carcass disposal also reduce the number of carcasses available for food in dumping areas. African white-backed vultures nest exclusively on large trees in sub-Saharan Africa (Salewski, 2019). Illegal logging of large trees affects the population, nesting and roosting of African white backed vultures (Mundy *et al.,* 1992). Regarding these two sites there was a difference between the attitude of the local community in the abattoir and the dumping site. The local community near to the abattoir show negative attitude towards vultures and the abattoir while the local people in the dumping site show have relatively good perception about the species. The negative attitude may raise from poor understanding of the ecological significance and status of vultures in the local community. Negative attitude and perception of local community towards vultures raises form low understanding of ecological values of vultures (Pem *et al.,* 2021). Also attitude and perception affects the willingness of the local community to protect these critically endangered bird species.

CONCLUSION

The study provided baseline information on the population status, local distribution and possible threats of African White-Backed Vultures in and around Wolkite town. The abundance of the species varied spatially and temporally due to the variation in food sources, roosting site and level of disturbance between the two sites and seasons. The presence of human and/or livestock disturbance, firing and unintentional poisoning were major threats observed affecting the survival of the species that play an important role in environmental sanitation. Vultures are harmless, environmentally and economically essential birds. Therefore, to minimize the threat, emphasis should be given to awareness creation and conservation activity in the area.

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