PROJECT REPORT

ASSESSMENT OF THE POPULATION SIZE, DISTRIBUTION, AND COMMUNITY'S PERCEPTIONS ABOUT VULTURES IN RWANDA

January 2023

ACKNOWLEDGEMENTS

We thank the African Bird Club and Rufford Foundation which funded Nature Rwanda to carry out this work. We are grateful to Akagera Management Company (AMC) for supporting this project with the research permit, and thanks to the Rwanda Environmental Management Authority (REMA) for providing recommendations when needed. We extend our thanks to VulPro for providing technical support to this project through training provided to the project staff about vulture identification and data recording. We are also indebted to all vulture conservation champions who contributed much to the survey and continue to work tirelessly with one aim of protecting Vultures and their habitat in Rwanda. We thank the local communities who contributed to this project by providing their invaluable time and information as part of the assessment of the community's perceptions about vultures. We thank Emmanuel ISHIMWE who guided the survey team during the two days of counting in Akagera National Park. Last but not least, we are also grateful for Mr. Prudence Ndabasanze who led the fundraising process to raise the required funds for the implementation of this project.

Survey Team Contribution: Jean Claude Dusabimana supervised the survey at all stages, including the study design, training, data collection, analysis, and report development. Thomas Kanyempura developed the research methodologies and contributed to data collection and analysis; Elie Sinayitutse led data collection, analysis, and report development, and co-facilitated the training on field data collection. Yvette Nishimwe, Vivette Igihozo Iradukunda, Assoumpta Nduwaweyezu, Protogène Kwitonda, Celestin Nsengiyera, Jean de la Croix M. Muhire, Clementine Bahati, Enock Ndayishimiye, Aimable Sibomana, and Emmanuel Muyobokimana contributed to data collection. Jeannette Iranzi contributed to data collection and revised the report.

TABLE OF CONTENT

ACKNOWLEDGEMENTS i

TABLE OF CONTENT ii

LIST OF TABLE AND FIGURES iii

EXECUTIVE SUMMARY iv

1. INTRODUCTION 1

2. METHODS 2

2.1. Vulture counting 2

2.2. Community perceptions assessment 4

2.3. Data Analysis 4

2.4. Vulture awareness campaign 4

3. RESULTS AND DISCUSSION 5

3.1. Vulture population in Rwanda 5

3.2. Threats assessment 8

3.3. Community Perception Assessment 9

3.3.1. Social Demographic description of respondents 9

3.3.2. Level of community awareness about vultures 10

3.4. Vulture awareness campaign 12

4. CONCLUSION AND RECOMMENDATIONS 13

5. REFERENCES 15

LIST OF TABLE AND FIGURES

Figure 1. Surveyed locations in Akagera National Park 3
Figure 2. Surveyed locations (map generated by Kobo Collect system). 3
Figure 4. An adult Hooded Vulture (Necrosyrtes monachus) in its nest in Busaga Forest (Photo Credit: Nature Rwanda) 5
Figure 5. Hippo's carcass, detected nearby Lake Ihema during the vulture counting in the Akagera National Park. Bird species: Cattle Egret (Bubulcus ibis) feeding on carcass invading insects (Photo Credit: Nature Rwanda). 7
Figure 6. Hooded vulture victim of electrocution in Nyamyumba 8
Figure 7. Hooded vulture victim of persecution in Rwaza 8
Figure 8. Hooded vulture victim of poisoning in Cyeza 8
Figure 9. Local communities attended a vulture awareness campaign at Gataraga Market (Photo Credit: Nature Rwanda). 12
Figure 10. Community members who attended the vulture awareness day (Photo Credit: Nature Rwanda). 12
Figure 11. Citizen Science exercise to observe and identify vultures at Gataraga Market, one of the identified vulture locations in Rwanda Photo credit: Nature Rwanda). 13
Table 1. Average number and standard deviation of vultures detected across the surveyed locations in Rwanda. 6
Table 2. Estimates of vulture population recorded at abattoirs and waste sites 7
Table 3. Community responses toward threats to vultures 9
Table 4. Social demographic details of interviewed respondent during the vulture knowledge assessment 9
Table 5. Community knowledge about vultures at surveyed locations (%) 11
Table 6. Community attitudes toward vultures at surveyed locations (%) 11
Table 7. Community awareness toward vultures at surveyed locations (%) 11

EXECUTIVE SUMMARY

White-headed vulture, White-backed vulture, Ruppell's Vulture, Lappet-faced vulture and Hooded vulture are the vulture species found in Rwanda that are threatened and globally declining. The Hooded vulture is the most widespread vulture species among other vulture species; however, its population trend is unknown due to a lack of baseline information and scientific research conducted on that matter. Also, hooded vultures are mostly associated with human settlements, exposing them to anthropogenic activities that exacerbate their decline.

This study was conducted to assess the vulture population at 15 frequently used locations throughout the country, as well as to document the level of community awareness about vultures in general, in order to identify key priorities for vulture conservation in Rwanda. A customized data collection sheet was uploaded into Kobo Collect and deployed to smartphones that were used by data collectors at the 15 selected locations. Vulture counting used to happen twice a month for a period of six months at the same hour on the same day. Additional data were collected from e-bird by considering reported vulture sightings by birders during the period of the study. A total of 515 community members were selected at the 15 locations by using stratified sampling methods to assess their knowledge about vultures through interviews.

A total of 1811 vultures were counted at 15 locations; of which 99% were Hooded vultures, and 88.1% of these vultures were spotted at feeding sites (waste sites and abattoirs). 50.8% of all vultures were adults, 49% were juveniles, and 0.2% were immatures. It has been surprising that there is no record of Hooded and Lappet-faced vultures in and around ANP during the period of this assessment. White-backed vultures, White-headed vultures, and Ruppell's vultures were only found in small numbers in ANP, whereas the average number of hooded vultures recorded at other locations during the assessment period was 128; this supports the existing narrative that the hooded vulture is Rwanda's most common and abundant vulture species.

Poisoning and human persecution were respectively found to be major threats, which led to the mortality of 7 reported vultures in 6 months, and the level of community awareness about vultures was found to be very low at all locations but extremely low around ANP. In this regard, there is a need for multisectoral collaboration for the implementation multi-species Action Plan to conserve African-Eurasian vultures to back the vulture population at a favourable level.

1. INTRODUCTION

Globally, vultures are facing a catastrophic decline that has never been expected due to many anthropogenic activities as the leading threats (BirdLife International 2014, 2018, 2019; del Hoyo & Collart 2019; HBW & Wetlands International 2020). African vulture species have experienced catastrophic population declines of up to 97% over the last 50 years, which led to seven of the 11 species being listed as globally threatened on the IUCN Red List (BirdLife International 2022). Vultures are threatened by poisons and other dietary toxins set by human, habitat loss from deforestation, agriculture extension and infrastructure development, direct persecution, collision with infrastructures and electrocution, and many other human-led disturbances (Botha et al. 2017; Safford et al. 2019; Santangeli et al. 2019). In addition, illegal trade for bush meat, traditional medicine and belief-based use have led to the mortality of many African vultures, and were known as the driving threats in West and Central Africa (Williams et al. 2014; Buij et al. 2016; Botha et al. 2017; BirdLife International 2022).

In Rwanda, six vulture species are found in Rwanda, of which four are classified as Critically Endangered, namely Ruppell's Vulture (*Gyps rueppellii*), White-headed Vulture (*Trigonoceps occipitalis*), White-backed Vulture (*Gyps africanus*) and Hooded Vulture (*Necrosyrtes monachus*). Others are Lappet-faced Vulture (*Torgos tracheliotus*) which is listed as an Endangered species and Palm-nut Vulture (*Gypohierax angolensis*), listed as Least concern (HBW & Wetlands International 2020). Regarding their roles, Vultures clean environment, recycle wastes, control vectors and pests, prevent diseases spread and support the world economy (BirdLife International 2004, 2018, 2022; Botha et al. 2017). However, there is no documented information on vulture populations in Rwanda, and how communities perceive vultures which may be having adverse impacts on conservation of vultures in Rwanda as well as lead to continuous population decline. This study aimed to (1) estimate the population size and distribution of Vultures in Rwanda, (2) identify the possible threats at their locations and (3) document the community perceptions towards vulture conservation. The study findings are important in determining new interventions for conservation of vultures in Rwanda. While vultures are catastrophically declining globally, linked with limited information resulting from the lack of scientific research to understand the trend in population of these species, our research provides baseline information that will assist in the further conservation and monitoring of vultures in Rwanda.

2. METHODS

2.1. Vulture counting

The project involved field data collection through citizen science. Thirty (30) Youth volunteers (vulture guardians) from 15 locations frequently utilized by vultures were trained on vulture identification, monitoring, and data recording, as well as on the methodologies to assess community perception about vultures. Engaging these vulture guardians has not only been important for data collection, but also increased the quality of data because it was easy for them to reach to the sites at twice a month. Data collection tools were developed and uploaded into CyberTracker and Kobo Collect for vulture population counting and assessment of community perceptions about vultures respectively. CyberTracker and Kobo Collect are faster, more accurate, easy-to-use, free and customizable research instruments that facilitate collecting different kinds of data both online and offline (Nampa et al. 2020).

Vulture counting was conducted at all locations on the same day and time i.e. from 6:30 a.m. to 5:00 p.m. CAT across the country to avoid double counting at different sites the next day. To ensure reliability and reduce bias, total counting was made three times using the same methods (April, May during the rainy season, and July during the dry season). This allowed us to estimate the population densities and size (Bibby et al. 2000) in different seasons. Nests were counted, and the nest occupancy, breeding status and general behavior of vultures were recorded. Vulture counting was also conducted in Akagera National Park (ANP) by using the total counting method (Bibby et al. 2000), we counted vultures at random carcasses and on slow driving along existing roads from 6:30 a.m. to 5:00 p.m. Kigali Time. Carcasses were located by watching flying vultures (Houston 1973) and visiting the frequent carnivorous mammals' locations with the help of the AMC professional guide. During the counting, observers stationed in or by the vehicle observed vultures using naked eyes (as vultures are large birds easy to be detected), and where needed to scan birds at distance, binoculars were used up to 500 m of radius (Pomeroy et al. 2015). On the occasions we failed to find carcasses, we counted opportunistic flying or roosting vultures along the drive in the park. The GPS of carcass or sites where vultures were detected, their activity, age-sex class, and the type of carcass (where possible) were recorded. The Observer team was made of 4 members (1 recorder, 2 observers and

1 driver). The checklists of all birds detected were uploaded on eBird, including vulture species. To compensate for the data, data submitted to eBird by birdwatchers and other bird lovers on the same day and or period of vulture survey were considered.

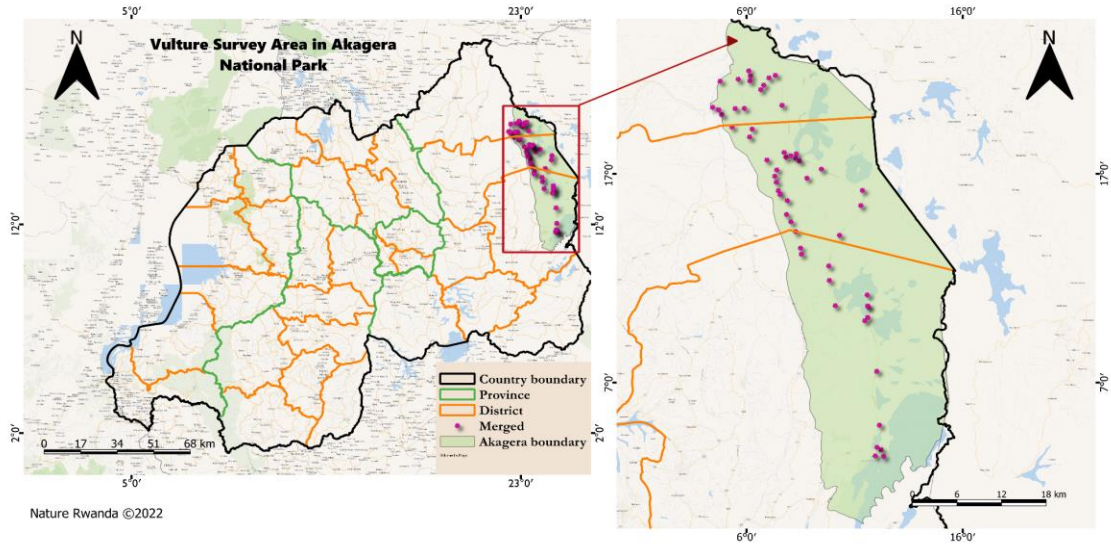

Figure 1. Surveyed locations in Akagera National Park

Figure 2. Surveyed locations (map generated by Kobo Collect system).

2.2. Community perceptions assessment

Stratified random sampling was used to select respondents on community's perceptions about vultures. Six strata were considered: (i) waste collection site workers and managers, (ii) abattoir workers and managers, (ii) local government authorities, (iv) school teachers and students, and (v) agrovet practitioners, (vi) general community members. Since the community around these locations is more than 10,000 people, and the number of people interacting with vultures was unknown, the sample size was determined using the following Cochran's formula (Cochran 1963).

$$n = \frac{\frac{Z^2 * p * (1-p)}{e^2}}{1-r} = \frac{n_o}{1-r}$$

Where n is the sample size, p is the proportion of the people who interact with the vulture at their locations (p=0.5), (1-p) is the proportion of the people who do not interact with the vulture, e is the acceptable margin error/level of precision required (e=0.05), Z is the value of the standard normal random variable, for this study, the value of the standard normal random variable at 95% level of confidence is used, i.e. Z=1.96, and r is the non-response rate, r=10% for this study. From the above formula, the minimum sample size was 427, but to get more information, a total of 515 respondents were interviewed, i.e. 36 respondents per each of the 15 sites. The households were selected in different villages, respondents were preferably households' heads where possible, and youth were given priority.

2.3. Data Analysis

The data was processed in Excel, analysed using Microsoft Excel and Statistical Package for Social Sciences (SPSS) for descriptive statistics, and locational data were processed and analysed using QGIS.

2.4. Vulture awareness campaign

As part of the celebration of the Vulture Awareness Day of 2022, we conducted an awareness campaign at Gataraga sector in Musanze District which is a site where a big number of hooded

vultures were recorded compared to other sites across the country. The campaign also followed an incident of death of two vultures resulting from human persecution. The campaign has been an opportunity to explain to the community members about the ecological role of vultures, threats they are facing today, and the urgent need of their conservation. A mobile sound system was used to transmit the message and community members were invited to the site of the campaign, and it involved participatory discussion, citizen science exercise to identify vultures using binoculars.

3. RESULTS AND DISCUSSION

3.1. Vulture population in Rwanda

A total of 1811 vultures were recorded in six months, including 1791 hooded vultures recorded at 14 locations, and 6 White-backed vulture, 4 White-headed Vulture, 1 Ruppell's Vulture, and 9 Palm-nut Vulture were recorded in Akagera National Park from April-November 2022. Up to 50.8% of the counted vultures were adult, 49% were juvenile, and 0.2% were immature (Table1). 88.1% of hooded vultures were recorded at feeding sites (abattoir and waste sites). This suggest that hooded vultures are more likely to be detected in urban centers and nearby human settlements (Pomeroy et al. 2015; Buij et al. 2016; Kibuule 2016; Mullié et al. 2017; ACNR 2018; Nosazeogie et al. 2018; Santangeli et al. 2019; Kankam & Abukari 2020). The remainder (11.9%) were recorded in Busaga forest, the only location where immature vultures and seven active nests were recorded (Table1; Figure 3), which qualifies Busaga forest as the breeding site of hooded vulture in Rwanda. Busaga is a natural montane forest that ranges between 1900-2000 m of elevation and at 2190 m of altitude, and has different large tree species (REMA 2015), which may provide good structures that facilitate nesting, roosting and breeding activities (Kibuule 2016)

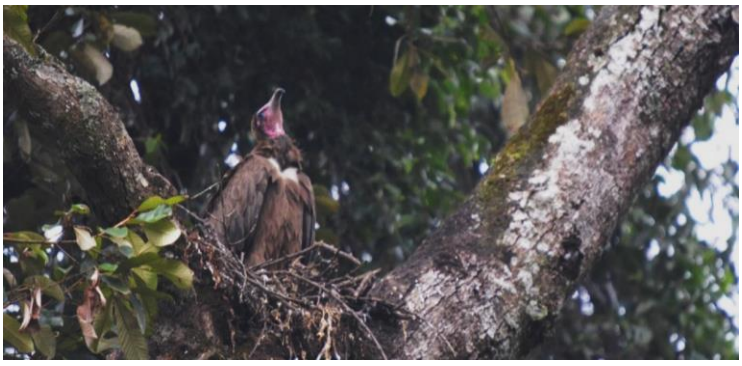

Figure 3. An adult Hooded Vulture (Necrosyrtes monachus) in its nest in Busaga Forest (Photo Credit: Nature Rwanda)

Recordings of active nests from later March to May indicates that hooded vulture breed in this period, and reveals that March, April and May is the breeding season of the species in Rwanda, and this period matches the breeding season of the hooded vulture in Nigeria (Adang et al. 2019).

Gataraga, Mwendo, Remera, Busaga, and Rwaza were the most respectively prevalent sites where many hooded vultures were recorded in abundance and on regular basis, as it is presented by the high average numbers (Table1). However, there was no significant difference between the number of hooded vultures recorded in dry and rainy season at all surveyed locations (ANOVA; $F_{1, 191} = 3.89$, $p = 0.47$). However, this does not mean that seasonal fluctuation does not have an influence on vulture population in Rwanda, it rather shows that vultures can be detected across all seasons in Rwanda.

Table1. Average number and standard deviation of vultures detected across the surveyed locations in Rwanda.

Site	**Mean ± SD**		
	Adult	Juvenile	Immature
Busaga	4.3 ± 5.8	3.6 ± 5.7	0.24 ± 0.18
Remera	8.87 ± 5.9	5.9 ± 5.9	0 ± 0
Gataraga	15.7 ± 5.9	17.2 ± 6	0 ± 0
Rwaza	5.2 ± 5.8	4.6 ± 5.8	0 ± 0
Mwendo	11.8 ± 5.9	12.3 ± 5.8	0 ± 0
Rugarika	2.5 ± 6	3.7 ± 5.8	0 ± 0
Cyeza	3.5 ± 5.9	3.7 ± 5.9	0 ± 0
Kayumbu	8.5 ± 6.1	8.5 ± 5.3	0 ± 0
Gisenyi	3 ± 5.9	3.7 ± 5.8	0 ± 0
Nyamyumba	0.85 ± 5.8	0.8 ± 5.8	0 ± 0
Nyakabuye	1.26 ± 5.8	0.5 ± 5.8	0 ± 0
Cyamudongo	0.46 ± 5.9	1.07 ± 5.8	0 ± 0
Gisiza	3.25 ± 5.4	3.16 ± 5.7	0 ± 0
Kibungo	0.9 ± 5.8	0.18 ± 5.7	0 ± 0
ANP	18	2	0 ± 0

Since Hooded vultures were only recorded at abattoirs and waste sites at 14 locations, the estimates mean for this species is 128±136.7 (Table 2) which represent national population estimates. The higher SD than the mean means that there was a high variation in number of vultures recorded at

different locations. It has not been possible to determine national population sizes for the six-remaining species; each of which only recorded rarely in ANP.

Table 2. Estimates of vulture population recorded at abattoirs and waste sites

	Mean ± SD					
	HV	WHV	WBV	RV	PNV	LFV
Vulture Population	128 ±136.7	0 ± 0	0 ± 0	0 ± 0	0 ± 0	0 ± 0

Neither Hooded Vulture nor Lappet-faced Vulture was detected in the Akagera National Park (ANP) during the period of the survey, as well as a very limited number of White-backed Vultures, White-headed Vulture, Ruppell's Vulture, and Palm-nut Vulture. Nothing is known yet to be behind the absence of hooded vultures and Lappet-faced Vulture, and a limited number of other vulture species in Akagera National Park; however, local communities disclosed that poisoning is still happening to fight against predators such as hyenas left outside the fence of the park. These poisoning cases might be still affecting the vulture population in ANP because vultures are free to forage outside the park. The situation of rare sights of vultures on carcasses in the ANP is certainly different from other East African savanna parks where vulture species are in high number and diversity (Houston 1973; Kendall et al. 2014; IUCN World Heritage Outlook 2020).

Figure 4. Hippo's carcass, detected nearby Lake Ihema during the vulture counting in the Akagera National Park. Bird species: Cattle Egret (Bubulcus ibis) feeding on carcass invading insects (Photo Credit: Nature Rwanda).

3.2. Threats assessment

In terms of potential and existing threats to vultures, the risk of mortality due to poisoning and human persecution were respectively observed as major threats. Out of 7 recorded death of vultures, 5 of them resulted from unintentional poisoning targeting feral dogs in Cyeza, and 2 of these deaths resulted from human persecutions in Rwaza and Mwendo. 10 out of 15 surveyed locations were in the vicinity of the high-power transmission line and two hooded vultures were found dead in Remera and Nyamyumba and Muhanga district (*Figure* 5;*Figure* 6;Figure 7). Moreover, loss of nesting sites (nesting trees), expansion of human settlements and change in waste disposal systems at abattoirs and waste sites were considered potential threats to vultures.

Figure 5. Hooded vulture victim of electrocution in Nyamyumba

Figure 6. Hooded vulture victim of persecution in Rwaza

Figure 7. Hooded vulture victim of poisoning in Cyeza

The human conflict between Akagera National Park and local communities has decreased remarkably. 82.1% of all respondents said that there is a significant decrease in predators because

the park is now fenced by an electric fence to avoid unwanted animal visits to the neighbouring farmlands. However, 60.6% of them said that poisoning cases are still happening in response to predation cases resulting from predators such as hyenas left outside the park after fencing. The likelihood of killing carnivores in retaliation for livestock loss has a positive relationship with gender, $X^2 = 13.7$, $P = 0.001$, indicating that male respondents are more likely to kill carnivores than females. These cases may still be affecting the vulture population in and around the park as 68.1% of respondents who know about vultures said that the vulture population is still decreasing in the area

Table 3. Community responses toward threats to vultures

	Vultures generally decrease around Akagera National Park	There is a significant decrease in predators	People kill carnivorous in relation to their livestock killed
	n= 72	n= 240	n=240
Agree	68.1%	82.1%	60.6%
Disagree	13.9%	15.3%	33.6%
Neutral	18.1%	2.5%	5.8%
Total	**100**	**100**	**100**

3.3. Community Perception Assessment

3.3.1. Social Demographic description of respondents

A total of 515 individuals responded to the questionnaire; 55.5% were men and 45.5% were women. Most of respondents were young people ranging between 18 and 32 years old (47.6%) followed by people having between 32 and 45 years old (27.4 %). A large number of respondents (51.3%) was represented by farmers who do agriculture and smallholder farming as their main source of income (Table 4).

Table 4. Social demographic details of interviewed respondent during the vulture knowledge assessment

	# respondents	*%*	*Sample size (N)*
Gender			
Male	286	55.5	515
Female	229	44.5	
Age class			
18-32	245	47.6	515

33-45	141	27.4	
46-55	77	15.0	
56-70	42	8.1	
Above 70	10	1.9	
Level of education			
College/ University	16	3.1	
Upper Secondary	78	15.1	
Lower Secondary	95	18.4	515
Primary	223	43.3	
None	103	20.0	
Time living in the area			
< 1 year	20	3.9	
>20 years	157	30.5	515
1-10 years	164	31.8	
11-20 years	174	33.8	
Occupation category			
Farmers	264	51.3	
Business	126	24.5	
Students	46	8.9	
Teachers	34	6.6	
Casual worker	22	4.3	515
Abattoir Workers	8	1.6	
Local Government Leader	8	1.6	
Waste site workers	4	0.8	
Agrovet practitioners	3	0.6	

3.3.2. Level of community awareness about vultures

Three indicators we built to assess the level of community awareness about vultures.

- ***Level of knowledge about vultures***

This was indicated by the ability of interviewed community members at all surveyed locations to 1) identify vulture species on pictures, 2) know that vultures are birds of scavengers mostly that feed on carcasses, and 3) can list at least threats they are facing.

Of the respondents at 14 locations, 63.7% have been able to identify only hooded vulture of the seven-vulture species found in Rwanda; equivalent to 14.3 % (Table 5). 12% of the community members around ANP have been able to identify two vulture species, White-headed Vulture and Palm-nut Vulture; equivalent to 28.6%. This shows that most of the people from the 14 locations only know hooded vultures, but a very few numbers of community members around the ANP can identify vultures from other species; however, they know more than one species which is different from where most of community members know only hooded vulture (Table 5).

Table 5. Community knowledge about vultures at surveyed locations (%)

	Around ANP	Other Locations
	N=242	N=273
Males	4.5	9.9
Females	1.2	7.7
>33 Years Old	4.1	9.2
<33 Years Old	1.6	8.4
All	**5.7**	**17.6**

- ***Positive attitude towards vulture conservation***

This was indicated by 1) the willingness of interviewed community members to support vulture conservation, and 2) their ability to acknowledge the contribution of community awareness to conservation.

85% of respondents at 14 locations showed that they have a positive attitude toward vultures, while 23.1% of respondents around ANP showed that they have positive attitudes toward vultures.

Table 6. Community attitudes toward vultures at surveyed locations (%)

Variable	Around ANP	Other Locations
	N=242	N=273
Males	17.3	49.1
Females	5.8	35.9
>33 Years Old	5.8	46.5
<33 Years Old	17.3	38.5
All	**23.1**	**85**

- **Overall awareness**

The overall awareness was indicated by the combination of having required knowledge about vultures (knowledge indicator) and positive attitude towards vulture conservation (attitude indicator) (Table 7).

Table 7. Community awareness toward vultures at surveyed locations (%)

	Around ANP	Other Locations	All
	N=242	N=273	N=515
Level of knowledge about vultures	5.7	17.6	12.0
Positive attitude towards vulture conservation	23.1	85	55.9
Level of awareness	**0.8**	**9.5**	**5.4**

The level of community awareness about vulture is low at ANP (0.8%) compared to other surveyed locations (9.5%). Generally, the level of community awareness about vultures at all surveyed locations is 5.4% (Table 7).

3.4. Vulture awareness campaign

During this project implementation, Nature Rwanda engaged 1500 community members in Awareness-raising campaigns at 14 locations in collaboration with the local vulture guardians on different occasions. The 2022 vulture awareness day was celebrated in Gataraga sector to connect people with the story and ecological importance of vultures. This vulture awareness day attracted 400 students and 250 community members. Out of 400 students, 65% of them were girls and 35 % were boys, while out of 250 community members, 58% were women and 42% were men (Figure 8; *Figure 9*). During this day, community members and students were invited to discuss and share stories about vultures and the role they contribute to the ecosystem. The central message of the day was about the role community members around vulture sites can play in supporting the conservation of vultures in Rwanda. Through drama, songs and cartoons, students demonstrated the role of this majestic bird for people and the planet. Participants were motivated and inspired by the stories shared about the role of community in vulture conservation across other African countries.

The day was concluded by a birdwatching event which involved 50 students and community members to learn more about vulture identification (*Figure 10*), and the whole event was covered in media (https://t.co/SktpJ8rAaV).

Figure 8. Local communities attended a vulture awareness campaign at Gataraga Market (Photo Credit: Nature Rwanda).

Figure 9. Community members who attended the vulture awareness day (Photo Credit: Nature Rwanda).

Figure 10. Citizen Science exercise to observe and identify vultures at Gataraga Market, one of the identified vulture locations in Rwanda Photo credit: Nature Rwanda).

4. CONCLUSION AND RECOMMENDATIONS

This survey revealed the current status of vulture species and their population trends in Rwanda. Hooded vulture was found to be the most widespread vulture species in Rwanda and found at abattoirs and waste sites. This reflects the importance of proper waste sites and abattoirs as the major foraging sites for hooded vultures in Rwanda. For example, with the fact that urban areas are the most global populated zones and wastes producers, vultures should be protected for their irreplaceable role of cleaning environment and disease prevention. At all surveyed locations, Busaga forest was identified as a potential breeding site of hooded vulture. Based on the State of Environment and Outlook Report 2015; Busaga forest was classified as critically endangered forest, which suggests that this forest needs urgent interventions of conservation to make it a safe habitat for biodiversity including critically endangered vultures. Further studies such as the movement patterns, feeding and breeding ecology are needed to develop a more understanding about population trends and dynamics of hooded vulture in Rwanda, to inform sustainable conservation measures for this species.

It has been found that the number of recorded vultures in ANP during the study period was extremely low, and this is not common compared to records from other parks in East Africa that have the similar ecological conditions. Something strange might be happening on the vulture population in ANP. Therefore, there is a need of conducting an extended vulture population monitoring in this park to develop a more understanding about population trends, habitat use, and threats to vulture in this park.

In Rwanda, there is significant limited knowledge about vultures and their ecology, though this varies by age and gender, implying that community members presented more myths than facts about vultures, unless education and awareness are initiated to assist people of various categories in developing a good understanding of vulture ecology in the long run.

Although the communities are aware of the legal ramifications of using poison to respond to predation cases that continue to occur due to predators such as hyenas left outside the park fence, they are likely to do so in a very confidential manner, so there is a need to develop management measures for carnivores that continue to visit the community despite the existing fence. To avoid the difficulties associated with reporting offenders, a system involving self-reporting and self-policing within the community at the 15 vulture sites across the country should be implemented.

5. REFERENCES

ACNR. 2018. Assessment of Vulture Distribution , Population size , Threats of Critically Endangered and Endangered Vultures in Kigali city, Rwanda. Association pour la Conservation de la Nature au Rwanda:1–11.

Adang KL, Tanko D, Saliu KL, Abdulwahab UA. 2019. Breeding Record of the Hooded Vulture Necrosyrtes monachus (Timminek, 1823) at Emi Abumo Woro, Kogi State, Nigeria. Asian Journal of Biological Sciences **12**:222–230.

Bibby C, Jones M, Marsden S. 2000. Expedition Field Techniques: Bird surveys. BirdLife International.

BirdLife International. 2004. State of the world's birds2004: Indicators for our changing world. BirdLife International, Cambridge, UK.

BirdLife International. 2014. Important Bird and Biodiversity Areas: A global network for conserving nature and benefiting people. Cambridge, UK. BirdLife International.

BirdLife International. 2018. State of the world's birds: taking the pulse of the planet. BirdLife International, Cambridge, UK.

BirdLife International. 2019. Handbook of the Birds of the World and BirdLife International digital checklist of the birds of the world : Version 4 **4**.

BirdLife International. 2022. State of the World's Birds 2022: Insights and solutions for the biodiversity crisis. BirdLife International.

Botha A, Andevski J, Bowden CGR, Gudka M, Safford RJ, Williams N. 2017. Multi-species action plan to conserve African-Eurasian Vultures. CMS Raptors MOU Technical Publication No. 5 CMS Technical Series. CMS Raptors MOU Technical Publication No. 5 CMS Technical Series No. xx. Coordinating Unit of the CMS Raptors MOU, Abu Dha- bi, United Arab Emirates.

Buij R, Nikolaus G, Whytock R, Ingram DJ, Ogada D. 2016. Trade of threatened vultures and other raptors for fetish and bushmeat in West and Central Africa. Oryx **50**:606–616.

Cochran w. G. 1963. Sampling Techniques (John Wiley & Sons, 2nd edition, 1963), ix+413 pp., 72s. Cambridge University Press:342–343. Available from https://www.cambridge.org/core/journals/proceedings-of-the-edinburgh-mathematical-society/article/w-g-cochran-sampling-techniques-john-wiley-sons-2nd-edition-1963-ix413-pp-72s/6C0E70831E28C1DB6CA367A384751902.

del Hoyo J, Collart NJ. 2019. Handbook of the Birds of the World and BirdLife International digital checklist of the birds of the world. Lynx Editions and BirdLife International **4**. Available from http://datazone.birdlife.org/userfiles/file/Species/Taxonomy/HBW-BirdLife_Checklist_v4_Dec19.zip.%0AIntroduction.

HBW, Wetlands International. 2020. Handbook of the Birds of the World and BirdLife International digital checklist of the birds of the world. Version 5. Available at: http://datazone.birdlife.org/userfiles/file/Species/Taxonomy/HBW-

BirdLife_Checklist_v5_Dec20.zip.

Houston DC. 1973. The Ecology of Serengeti Vultures. University of Oxford:8–193. Available from https://ora.ox.ac.uk/objects/uuid:9aaea992-9734-475d-9afe-6869247159a1/download_file?safe_filename=601870531.pdf&file_format=application%2Fpdf&type_of_work=Thesis.

IUCN World Heritage Outlook. 2020. 2020 Conservation Outlook Assessment in Serengeti National Park. IUCN World Heritage Outlook. Available from https://worldheritageoutlook.iucn.org/explore-sites/wdpaid/2575.

Kankam BO, Abukari H. 2020. Predicting residents' intention to conserve the hooded vulture (Necrosyrtes monachus) in the Birem North District, Ghana. Heliyon **6**:e04966. Elsevier Ltd. Available from https://doi.org/10.1016/j.heliyon.2020.e04966.

Kendall CJ, Virani MZ, Hopcraft JGC, Bildstein KL, Rubenstein DI. 2014. African vultures don't follow migratory herds: Scavenger habitat use is not mediated by prey abundance. PLoS ONE **9**.

Kibuule M. 2016. Population status of the critically endangered hooded vulture Necrosyrtes monachus in Uganda's major urban centres:1–36.

Mullié WC, Couzi FX, Diop MS, Piot B, Peters T, Reynaud PA, Thiollay JM. 2017. The decline of an urban Hooded Vulture Necrosyrtes monachus population in Dakar, Senegal, over 50 years§. Ostrich **88**:131–138.

Nampa IW, Mudita IW, Riwu Kaho NPLB, Widinugraheni S, Lasarus Natonis R. 2020. The KoBoCollect for Research Data Collection and Management (An experience in Researching the Socio-Economic Impact of Blood Disease in Banana). SOCA: Jurnal Sosial, Ekonomi Pertanian **14**:545–556.

Nosazeogie E, Tende T, Monadjem A. 2018. Hooded Vultures (Necrosyrtes monachus) nearly extirpated from Edo State, Nigeria: A report on the avian scavenger community **4**:88–100.

Pomeroy D, Shaw P, Opige M, Kaphu G, Ogada DL, Virani MZ. 2015. Vulture populations in Uganda: Using road survey data to measure both densities and encounter rates within protected and unprotected areas. Bird Conservation International **25**:399–414.

REMA. 2015. State of Environment and Outlook Report 2015. Rwanda Environment Management Authority.

Safford R et al. 2019. Vulture conservation: the case for urgent action. Bird Conservation International **29**:1–9.

Santangeli A, Girardello M, Buechley E, Botha A, Minin E Di, Moilanen A. 2019. Priority areas for conservation of Old World vultures. Conservation Biology **0**:1–10.

Williams VL, Cunningham AB, Kemp AC, Bruyns RK. 2014. Risks to birds traded for African traditional medicine: A quantitative assessment. PLoS ONE **9**.

This project has been conducted for 6 months, yet we still need to develop a long-term monitoring plan to understand the vulture population ecology in Rwanda, in order to develop sustainable measures for their conservation.

stay connected Learn more about what we do on our website: **naturerwanda.org**

like us
facebook naturerwanda1

follow us
@nature_rwanda

visit us
Nova Complec Market
NM 11 ST, Musanze
Rwanda

call us
+250 788 869 445 (ED)
+250 788 773 177 (Office)

connect with us
LinkedIn Nature Rwanda (NR)

watch us
YouTube Nature Rwanda NGO