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Total Economic Value of ecosystem services provided by vultures in Southern Africa

BirdLife AFRICA

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Executive Summary

Africa is home to eleven species of vultures. Seven face the risk of extinction, listed as Vulnerable, Endangered or Critically endangered on the IUCN Red List. The major threats are poisoning, belief-based use and electrocutions and collisions. The loss of vultures in Asia provided a window into a catastrophic scenario without vultures and the impact of the loss of the ecosystem services they provide. In the African context, there is a knowledge gap on the importance of vultures to humans and the impact that a loss of vultures would have. To address this gap, an economic valuation of the ecosystem services provided by vultures in Southern Africa, with a focus on Botswana, Zambia and Zimbabwe was conducted.

The valuation methods have been developed to estimate values that are separably attributable to vultures. An important issue to address is the challenge of measuring vulture specific values within bundled goods and services (e.g. non-use values for vultures within broader landscape conservation; vulture ecotourism activities within holidays that involve multiple activities). Data were collected through literature review and four surveys targeting different beneficiary groups: 1. local communities in the Kavango Zambezi Transfrontier Conservation Area; 2. the general public within each country; 3. the international public; and 4. rangers and park managers.

The main groups of ecosystem services identified include provisioning services, regulating services and cultural services. The specific values are provisioning of materials used in traditional medicine, waste disposal, control of disease through disposal of carrion and waste (sanitation and control of pest species, tourism value, sentinel value and existence and bequest value. The total economic value of ecosystem services in the three countries is estimated to be over USD $251 million per year. This is largely attributed to existence and bequest values and the sanitation and pest control service provided by vultures. Thus, although vultures are not as charismatic as the other species of interest in the continent, their conservation is highly important to the welfare and health of humans. The value of vultures to the SADC region is estimated at USD $1,8 billion per year.

An evaluation of welfare changes due to policy inaction and action for vulture conservation was conducted. The welfare loss, as a consequence of not acting on vulture conservation, equates to almost USD $47 million per year, whereas the welfare gains from taking policy action to conserve, manage and protect vultures is almost USD $30 million per year. As such, the economic benefits of investing in the conservation of vulture populations are huge but letting them decline or go extinct will result in large economic cost. Combined, this provides a strong rationale for governments and other institutions to fund vulture conservation programs.

Further work is required to be able to quantify the full value of vultures in controlling diseases in livestock and wildlife, which would enable a holistic One Health perspective on the value of this ecosystem service.

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Background

The purpose of this report is to provide estimates on the economic valuation of ecosystem services provided by vultures in Southern Africa.

1.1 Vulture status and threats

Vultures are facing many threats and declining populations worldwide (Ogada et al., 2012a; Safford et al., 2019), with 6 of 11 species in sub-Saharan Africa listed as either Endangered or Critically Endangered and 9 of 11 species facing decreasing populations (IUCN, 2023). The main threats to African vulture populations include poisoning, belief-based use, electrocutions and collisions, and direct persecution (Botha et al., 2024). The population decline is of great concern as vultures provide a number of ecosystem services that are of substantial benefit to people (Ogada et al., 2012a; Carucci et al., 2022; Santangeli et al., 2024). In order to inform decision-making regarding the conservation of vultures, BirdLife International has commissioned this study to estimate the Total Economic Value of vultures in southern Africa.

1.2 Need for information on economic value

Vultures provide a number of valuable benefits to people including provisioning services (e.g., vulture parts that are used in traditional medicines), regulating services (e.g., disposal of carrion and waste) and cultural services (e.g., aesthetic enjoyment, inspiration for art, nature tourism, existence and bequest values). Information on the contribution of vultures to human wellbeing can be useful to inform decision-making regarding their use and conservation (Wenny et al., 2011). In particular, economic values can be used to highlight the economic importance of vultures to policy makers and the public, to design policy instruments and conservation financing mechanisms, in appraisal of conservation plans, and to set compensation for damage to vulture populations that reflects full economic loss.

Carucci et al. (2022) conducted a recent systematic review of the literature on ecosystem services and disservices associated with vultures. They identify major knowledge gaps on the understanding of ecosystem services and disservices related to vultures and conclude that there is an urgent need to quantify the net contribution of vultures to people. The present study attempts to fill part of this knowledge gap by estimating the economic value of ecosystem services provided by vultures in three countries in Southern Africa (Botswana, Zambia and Zimbabwe) and assessing the benefits of policy action and the costs of policy inaction.

1.3 Study objectives

The overall objective of the study is to estimate the Total Economic Value of vultures in Southern Africa to inform decision-making regarding vulture conservation. The specific objectives are to:

- Identify the main ecosystem services and economic values provided by vultures;
- Design and implement valuation research to estimate values for key ecosystem services provided by vultures;
- Produce a project report detailing the economic value of ecosystem services provided by vultures in Southern Africa.

The results of this research are intended to provide the economic rationale for investing in and supporting vulture protection. The results will be framed for different target audiences,

including policy makers in the region, the general public, international policy fora, and the communities that benefit directly from vulture ecosystem services.

2. Conceptual framework

The conceptual framework for identifying and valuing the benefits that people derive from vultures makes use of both the Ecosystem Services (ES) approach and the Total Economic Value (TEV) framework.

2.1 Ecosystem services

The concept of ecosystem services provides a useful framework to identify the importance of the natural environment to humans. The Millennium Ecosystem Assessment (2005) defines ecosystem services as benefits that ecosystems provide for people while TEEB (2010) describes these services as direct and indirect contributions of ecosystems to human well-being. Put most simply, they are the variety of benefits that people obtain from the environment.

Ecosystems contribute to human wellbeing in a wide variety of ways and the processes by which ecosystems provide benefits to people has been described as an "ecosystem services cascade" in which bio-physical structures and processes ("ecosystem functions") can deliver inputs (ecosystem services) to the production of goods and services that are consumed by people (see Figure 1).

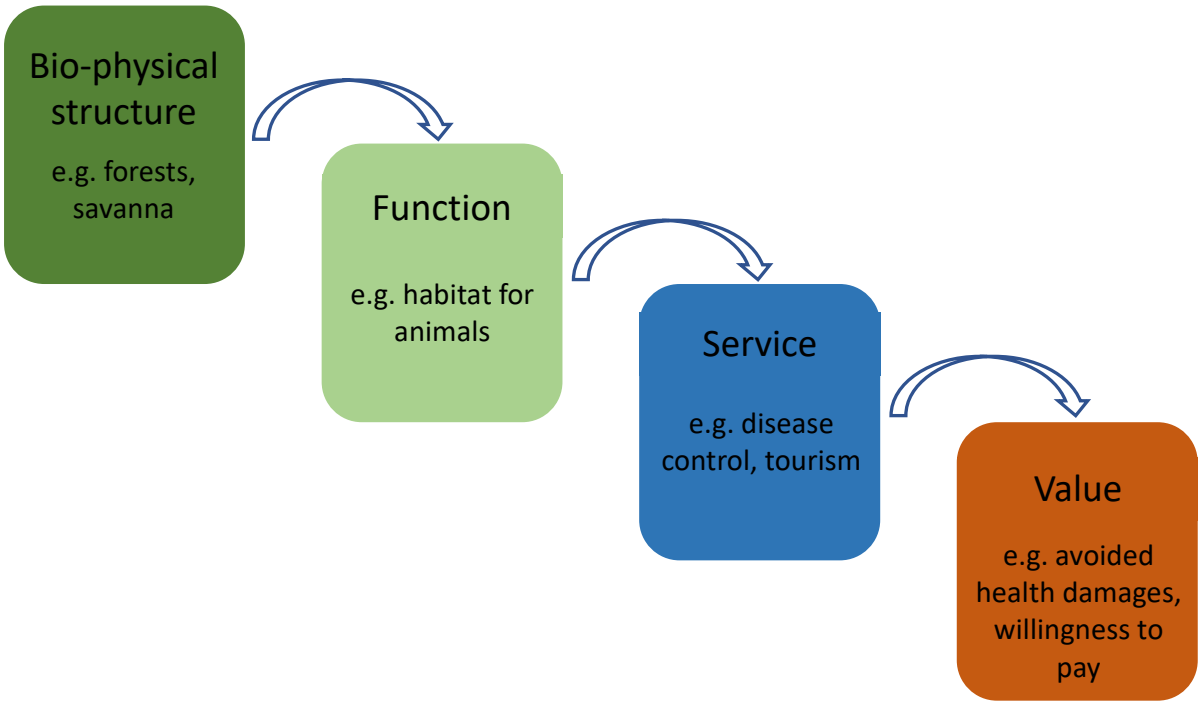

Figure 1 Ecosystem services "cascade". Adapted from Haines-Young and Potschin (2010)

The Millennium Ecosystem Assessment (MA, 2005) classification of ecosystem services introduced the following four categories of services:

- Provisioning services are the "products obtained from ecosystems". Examples include food, timber and fuel.

- Regulating services are the “benefits obtained from the regulation of ecosystem processes”. Examples include water flow regulation, carbon sequestration and protection from storms.
- Cultural services are the “non-material benefits people obtain from ecosystems through spiritual enrichment, cognitive development, reflection, recreation, and aesthetic experiences”.
- Supporting services “are necessary for the production of all other ecosystem services”. Examples include nutrient cycling, soil formation and primary production.

The inclusion of supporting services in the classification can potentially lead to the double counting of values and more recent classification systems (e.g. Common International Classification of Ecosystem services – CICES; and the SEEA Ecosystem Accounting reference list) have therefore omitted such “intermediate services”.

2.2 Total Economic Value

The concept of Total Economic Value (TEV) is used to describe the comprehensive set of utilitarian values derived from an ecosystem or natural resource (Pearce and Turner, 1990). The concept is useful for identifying the different types of value that may be derived from an ecosystem or species population. TEV comprises of “use values” and “non-use values”. Use values are the benefits that are derived from some physical use of the resource. “Direct use values” may derive from on-site extraction of resources (e.g. meat) or non-consumptive activities (e.g. nature based tourism). “Indirect use values” are derived from off-site services or other processes that are impacted by the resource (e.g. disposal of carrion; control of disease). “Option value**”** is the value that people place on maintaining the option to use a resource in the future (e.g. the option to develop tourism). “Non-use values” are derived from the knowledge that a species population is maintained without regard to any current or future personal use. “Non-use values**”** may be related to altruism (maintaining a species population for use by others), bequest (for future generations) and existence (preservation unrelated to any use) motivations. The constituent values of TEV are represented in Figure 2. It should be noted that the “total” in Total Economic Value refers to the *inclusion of all components* of value rather than the sum of all value derived from a resource.

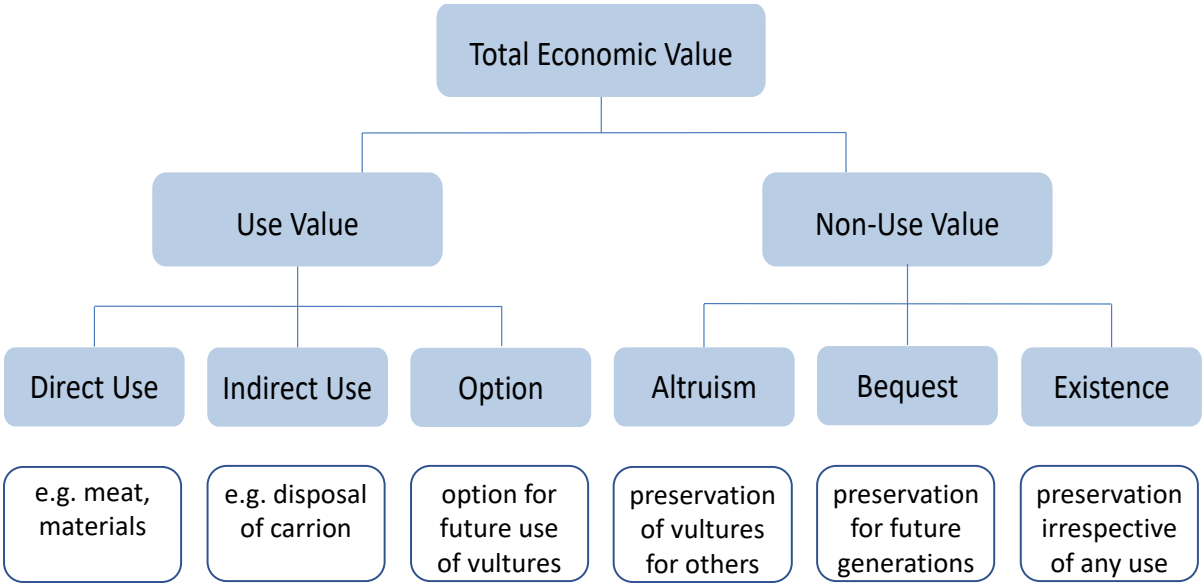

Figure 2: Components of Total Economic Value derived from vultures

The classification of different types of economic value within the concept of TEV is complementary to the classification of ecosystem services. Figure 3 sets out the correspondence between categories of ecosystem service and components of TEV.

Figure 3: Correspondence between ecosystem services and components of TEV with examples related to vultures

		Total Economic Value			
		Direct use	Indirect use	Option value	Non-use
Ecosystem service	Provisioning	Meat, materials		Option for future use	
	Regulating		Disposal of carrion	Option for future use	
	Cultural	Ecotourism		Option for future use	Existence value

3. Ecosystem services provided by vultures

The process of identifying the key ecosystem services provided by vultures in Botswana, Zambia and Zimbabwe was undertaken through two channels: 1. A review of the literature on vulture ecosystem services; 2. Consultation with BirdLife country representatives in Southern Africa.

The literature review builds on existing reviews and conducted a search of literature databases to provide an overview of the literature on the economic value of ecosystem services derived from vultures. The review includes peer reviewed journal articles, working papers and research reports, academic dissertations and theses, NGO publications, and government reports.

The literature search was conducted using a variety of sources to ensure a comprehensive collection of studies was obtained. Conventional online literature tools and libraries such as Google Scholar, Scopus, ResearchGate, Mendeley, and institutional libraries were utilized to gather relevant published literature. Reports and studies that cited a large number of sources were used as a source of references, which helped to identify additional relevant literature. Combinations of search terms were used to encompass a literature that uses a diverse terminology. The results of the literature review are summarised in Table 1, which lists ecosystem services provided by vultures, provides a brief description of the service, and cites relevant publications.

The consultation of BirdLife country representatives was subsequently conducted in order to identify which vulture ecosystem services are relevant in Botswana, Zambia and Zimbabwe. This was done to focus on the components of vulture Total Economic Value that are relevant in the Southern African context. The consultation was conducted through online interviews with representatives from Botswana (Mpho Williart; TT Busang), Zambia (Mary Malasa) and Zimbabwe (Leeroy Moyo).

The interviews were approximately one hour in duration and followed a semi-structured format around four questions:

1. What are the main threats to vultures in the country?
2. What are the key ecosystem services provided by vultures?
3. What are the practical considerations for conducting surveys of the communities living in areas with vultures (e.g. sampling, survey mode, length of interview, language, timing)
4. What are the practical considerations for conducting surveys of the general public (e.g. survey mode, distribution channels)

The results of the expert consultation on question 2 summarised are in Table 1. The countries for which an ES was identified as important are indicated in the fifth column in Table 1. In general, there is a high degree of consistency across the three countries (Botswana, Zambia, Zimbabwe) in the key ES identified. The following ES were identified as important in all three cases: materials (vulture parts used in traditional medicines), waste disposal, sanitation service, control of pests, sentinel role, and existence and bequest values. In addition, two ES were not identified as important in any of the three countries: food from wild animals and maintenance of soil quality. The the presence of vultures as a motivation for nature-based tourism was identified as relevant in two of the three countries

(Botswana and Zambia). Whereas the cultural significance of vultures was only identified in Botswana.

We note here that there is high correspondence in the benefits derived from the regulating services “waste disposal” and “sanitation and pest control services”. They are treated as separate services to make the distinction between the benefit of reduced human disposal of animal carcasses and the benefit of positive effects on human and animal health. Van den Heever et al (2021) describe two impact pathways through which the removal of carcasses from the environment by vultures can have postive health outcomes: 1. by directly preventing the development and spread of pathogenic microbes in carcasses; 2. by limiting the numbers and composition of mammalian scaveners that spread diseases to human and animal populations, including livestock.

Table 1. Ecosystem services provided by vultures (adapted from Fitzpatrick et al., 2018; Carucci et al. 2022; Sebele 2022)

	Ecosystem service	**Description of vulture ecosystem service**	**Reference**	**Key ES**
Provisioning services	Food from wild animals	Vultures used or traded for consumption	Saidu and Buij, 2013	
	Materials from wild animals	Vulture parts used in traditional practices (medicine, healing, prophecy)	Craig et al., 2018; Mdhlano et al., 2018; Mashele et al., 2021	BOT; ZAM; ZIM
Regulating services	Waste disposal	Disposal of dead livestock and organic waste produced by humans	Gangoso et al., 2012; Buechley et al., 2022	BOT; ZIM; ZAM
	Sanitation service through disposal of carrion and waste	Reduced accumulation of toxins from breeding micro-organisms in carrion. In addition, pathogens are destroyed in the digestive tract of vultures.	Margalida, A., and Colomer, 2012; Ishwar et al., 2016; Donazar et al., 2016; Grilli et al., 2019; Houston and Cooper 1975; van den Heever et al. 2021; Jalihal et al., 2022; Frank and Sudarshan, 2023	BOT; ZIM; ZAM

Ecosystem service	Description of vulture ecosystem service	Reference	Key ES
Controlling pests and invasive species	Presence of vultures reduces number of other scavengers (e.g. feral dogs, jackals, rats and hyenas) at carcasses that can be harmful to human and livestock health through disease transfer. This can also result in a reduction in human-wildlife conflict. Also reduction in invertebrate pest species that hatch their eggs in rotting meat.	Markandya et al., 2008; Ogada et al., 2012a; 2012b; Berlinguer et al., 2021; van den Heever et al. 2021; Beuchley et al., 2016; 2022; Brink, 2022; Frank and Sudarshan, 2023	BOT; ZIM; ZAM
Maintenance of soil quality	Soil microbial communities associated with vultures exhibit greater phylogenetic clustering in bacterial communities.	Ganz et al., 2012	
Global climate regulation	Vultures consume dead animals that would otherwise decompose and release greenhouse gases to the atmosphere	Plaza and Lambertucci, 2022	

	Ecosystem service	Description of vulture ecosystem service	Reference	Key ES
Cultural services	Cultural significance	Role in mythology. Seeing vultures in flight is uplifting for many people. Inspiration for art, music and creativity. Part of traditional stories and expressions.	Craig et al., 2018; Jacques-Coper et al. 2019; Aguilera-Alcala et al. 2020; Daboné et al., 2022	BOT
	Nature based tourism	Viewing and photographing vultures is among the reasons for visiting nature reserves.	Becker et al., 2005; 2010; García-Jiménez et al., 2021	BOT; ZAM
	Sentinel role for identifying the location of dead animals	The presence of vultures can help livestock farmers/park rangers to locate dead livestock/poaching sites	Safford et al. (2019)	BOT; ZAM; ZIM
	Existence and bequest values	People place value on the continued existence of vultures irrespective of any current or future use; or to ensure their existence for future generations	Baral et al., 2007; Zambrano-Monserrate, 2020;	BOT; ZIM; ZAM

4. Literature on economic valuation of vulture ecosystem services

In addition to identifying key ecosystem services provided by vultures, the literature review was used to obtain relevant existing vulture valuation studies, the results of which may potentially be transferred or scaled up to the Southern African context. The collected valuation studies may also provide guidance and recommendations for future valuations of vultures.

From the literature review, we identified ten studies that estimate the economic value of vulture ecosystem services. These studies are summarised in Table 2. The geographic coverage of these studies is broad, including locations in Europe, Asia, North and South America. Notably, there are currently no valuation studies for vultures in Africa.

Regarding the ecosystem services that have been valued in the literature, three studies estimate values for waste disposal (Margalida and Colomer, 2012; Ishwar et al., 2016; Grilli et al., 2019), three for ecotourism (Becker et al., 2005; García-Jiménez et al., 2021; Becker et al., 2010), three for existence values (Becker et al., 2010; Baral et al., 2007; Zambrano-Monserrate, 2020), and two for the control of pests (and in consequence the control of diseases spread by feral dogs – Markandya et al., 2008; Berlinguer et al., 2021). There are currently no valuation studies for provisioning services supplied by vultures.

The application of valuation methods corresponds closely to the ecosystem services that are valued. All three valuations of waste disposal use the replacement cost method, with the underlying assumption that carrion disposed of by vultures would need to be replaced by human-made processing, such as collection, burial or incineration. This valuation method can provide lower bound estimates of the value of an ecosystem service, but only if the following conditions are met: (1) the human-made infrastructure provides the same level of service as the ecosystem being replaced; (2) the human-made infrastructure should be the least-cost alternative; and (3) there should be substantial evidence that the service delivered by the infrastructure would be demanded by society if it were provided at cost (Shabman and Batie, 1978). In practice, most applications of the replacement cost method do not meet these conditions and tend to greatly over-estimate the value of ecosystem services (Barbier, 2016). This is because the cost of infrastructure is not a good proxy of the benefits that it delivers (benefits can be lower than costs if the infrastructure is redundant); and the selected replacement infrastructures used in many studies are not the least-cost alternative. The replacement cost method is widely used due to its relative convenience (costs of human-made infrastructure are widely available) (World Bank, 2016) but when used inappropriately, delivers misinformation on the value of ecosystem services.

The first study (Markandya et al., 2008) that examines the role of vultures in controlling pests estimates the value of changes in the prevalence of human health endpoints (morbidity and mortality) due to changes in the abundance of feral dogs that spread rabies using a combination of the costs of treatment and the value of a statistical life (VOSL). In this approach, the biophysical quantification of changes in pest populations in response to changes in vulture populations (controlling for other factors), and the associated changes in prevalence of disease (again controlling for other factors) presents a greater challenge that the monetary valuation of health endpoints, for which country specific data are generally available. The second study to estimate the value of this service (Berlinguer et al., 2021) applies the replacement cost method in a similar approach to the valuations of the waste disposal service.

Ecotourism associated with vultures has been valued using several methods, including the travel cost method, gross expenditure and time opportunity per trip, and the contingent valuation method. These methods measure different concepts of value derived from tourist activities. The travel cost and contingent valuation applications produce estimates of consumer surplus to tourists; whereas gross expenditure and time opportunity cost produce an estimate of exchange value. The latter approach is likely to substantially over-estimate the value of vulture viewing since it attributes the entire cost of a trip to this single motivation.

The values that people place on the continued existence of vultures have been estimated using the contingent valuation method. This approach enables the measurement of public willingness to pay (WTP) for a specified change in vulture population or conservation programme. It is notable that currently there are no valuations of existence values for vultures using discrete choice experiments (Hanley et al., 2001). This stated preference method has largely superseded the contingent valuation method over the past decade and enables the estimation of WTP for changes in defined attributes of conservation (e.g. population trends, population size, species diversity, species extinctions) and subsequently the valuation of alternative conservation programmes/outcomes defined in terms of these attributes.

Table 2. Economic valuations of ecosystem services provided by vultures

Ecosystem Service	Species	Valuation Method	Location	Reference
Waste disposal	European vultures	Replacement cost	Europe	Margalida and Colomer, 2012
Waste disposal	Griffon vulture	Replacement cost	India	Ishwar et al., 2016
Waste disposal	Turkey Vultures	Replacement cost	North and South America	Grilli et al., 2019
Control of pests	Vultures	Treatment costs; Value of statistical life	India	Markandya et al., 2008
Control of pests	Griffon vulture	Replacement cost	Sardinia	Berlinguer et al., 2021
Ecotourism	Avian scavengers	Market price; Opportunity cost	Spain	García-Jiménez et al., 2021
Ecotourism; Existence value	Griffon vulture	Travel cost; Contingent valuation	Israel	Becker et al., 2010
Existence value	White-rumped vulture	Contingent valuation	Nepal	Baral et al., 2007
Existence value	Andean Condor	Contingent valuation	Ecuador	Zambrano-Monserrate, 2020

5. Methods

This section provides a description of the selected valuation methods applied to value each ecosystem service, the data collection method, and the scenario analysis.

5.1 Valuation methods

This sub-section sets out the valuation methods that are applied in this study to estimate the key vulture ecosystem services identified in section 3. Given the very limited number of existing primary valuation studies for vulture ecosystem services (and none for Africa) reviewed in section 4, there is very limited scope for using value transfer methods[1] and we therefore apply mainly primary valuation methods.

An important issue to address is the challenge of measuring vulture specific values within bundled goods and services (e.g. non-use values for vultures within broader landscape conservation; vulture ecotourism activities within holidays that involve multiple activities). The valuation methods have been developed to estimate values that are separably attributable to vultures. In addition, the valuation methods are designed and applied to estimate values for each ecosystem service separately so as to avoid double counting values in the summation of Total Economic Value. The selected valuation method(s) for each ecosystem service are outlined in Table 3.

[1] Value transfer involved the use of results from existing primary valuation studies to estimate the value of ecosystem services at other locations or contexts (Brander, 2013).

Table 3. Key vulture ecosystem services and selected valuation methods

	Ecosystem service	Valuation Method
Provisioning services	Materials from vultures used in traditional medicines	Net factor income. Estimate producer surplus as gross revenue (market price equivalent * quantity traded/consumed) minus the costs of production. Data collected through household survey of local communities
Regulating services	Waste disposal	Replacement cost. Estimate the avoided costs of waste disposal attributable to the presence of vultures: 1. Estimate quantities of livestock carcasses consumed by vultures; 2. Identify use of alternative human processes for disposal of carcasses (in order to show effective demand for carcass disposal); 3. Estimate cost of human processes for disposal of carcasses. Data collected through household surveys of local communities.
	Control of disease through disposal of carrion and waste (sanitation and control of pest species)	Avoided damage cost. Estimate the avoided cost to human health from pathogens in carrion and waste attributable to the presence of vultures: 1. Obtain data on human populations living in vulture ranges; 2. Estimate reduction in human mortalities attributable to the sanitation service provided by vultures; 3. Estimate the reduced cost of human mortality in terms of the value of a statistical life. Data collected from national censuses and secondary sources.
Cultural services	Cultural significance	Contingent valuation; Discrete choice experiment. Two stated preference methods, administered through household surveys, are used to jointly estimate the value of cultural significance and existence/bequest values. Follow-up questions on the motivations underlying willingness to pay for vulture conservation used to disaggregate values across ecosystem services. Three separate beneficiary groups are targeted: 1. Local communities living in the vicinity of vulture habitats; 2. General public in Botswana, Zambia and Zimbabwe; 3. General public internationally (primarily in Europe due to

	availability of mailing lists). The payment vehicle for the local community survey is the number of days volunteered per month for vulture conservation[2]; and for the general and international public survey, a voluntary money contribution per month to a fund for vulture conservation administered by an environmental NGO. A payment card elicitation format is used for the contingent valuation question. The discrete choice experiment includes three attributes: 1. vulture population trends (declining, stable, increasing); 2. species diversity (number of vulture species becoming extinction in the study area); 3. Days/money donated to vulture conservation.
Nature based tourism	Net factor income. Estimate producer surplus derived from vulture related tourism: 1. Estimate the number of tourists that visit areas with vultures (from tourist operators); 2. Estimate mean tourist expenditure for whole trip (from tourist survey); 3. Estimate net revenue as expenditure*profit factor (from tourist operators); 4. Attribute share of producer surplus to vultures using information on relative importance of vultures in motivation for tourist trip (from tourist survey).
Sentinel role for identifying the location of dead animals	Replacement cost. Estimate the avoided costs of locating dead animals attributable to the presence of vultures: 1. Quantify use of vultures for locating dead livestock and wild animals of interest such as elephants and rhinos; 2. Identify use of alternative human processes for identifying dead animals (in order to show effective demand for this service); 3. Estimate cost of human processes for locating dead animals in terms of time and resources. Data to be

[2] The payment vehicle used in the local community stated preference questions was volunteered time for conservation activities instead of money, since households are likely to be cash-constrained and have limited past experience of donating money. Using time as a payment vehicle has been shown to enable the expression of preferences for conservation by households in developing country contexts (Hagedoorn et al., 2020).

	collected through household surveys of local communities and consultation/survey of rangers.
Existence and bequest values	Contingent valuation; Discrete choice experiment. See description of methods for cultural significance.

5.2 Data collection

The data collection for the study comprises of five surveys targeting different beneficiary groups: 1. Households in local communities in the vicinity of vulture habitats; 2. Households representing the general public in Botswana, Zambia and Zimbabwe; 3. Households in countries outside of the study area; 4. Tourist visitors to nature areas with vultures; 5 Ranger survey. Each of these surveys are outlined below.

The *local community survey* contains questions on the use, perception and traditional beliefs related to vultures and stated preference questions to quantify willingness to pay (contribute time) for vulture conservation. The survey was implemented through face-to-face interviews by BirdLife representatives in Botswana, Zambia and Zimbabwe. Details of the survey are summarised in Table 4.

Table 4. Local community survey

Sample size	The target sample size for each country is ~200 respondents to enable statistically significant WTP estimates from the discrete choice experiment.
Sampling method	A convenience sampling approach was used to enable the achievement of the target sample size in the limited time available for the survey. Target communities (4-6 in each country) were identified based on current BirdLife activities, representing different regions of each country, including locations in the Kavango-Zambezi Transfrontier Conservation Area (KAZA). Respondents within each target community were selected through simple intercept approaches (e.g. at convenient locations such as at home, markets, transport hubs).
Survey mode	The survey was implemented using face-to-face interviews. Survey enumerators used a web-based form (using a phone or tablet) in order to avoid the need for data entry.
Language	The survey questionnaire was developed and distributed in English. Care was taken to avoid using technical terms and jargon. Survey enumerators translated the questions into the relevant local language for respondents during the interview.
Duration of interview	The survey questionnaire was completed in 15-20 minutes on average.
Pre-testing	The survey questionnaire was tested on a small sample of respondents in each country to check the timing, clarity of the questions and response options, and the statistical design of the DCE.

Timing of survey	The survey was conducted in February-April 2024.

The *general public survey* contained questions on the perception of vultures and stated preference questions to quantify willingness to pay for vulture conservation. The survey was implemented as an online questionnaire distributed through available networks and mailing lists in Botswana, Zambia and Zimbabwe. A link to the online questionnaire was distributed to respondents with the request to share it further with their social networks in order for the sample to "snowball". The minimum target sample size is ~200 per country to enable statistically significant WTP estimates from the discrete choice experiment and larger sample would allow sub-sample effects to be analysed. The questionnaire was developed and administered in English. The length of the questionnaire was limited so that it could be completed in 5-10 minutes, in order to enable a higher response rate and sample size. The questionnaire for the general public survey was tested on a small sample of respondents in each country to check the timing, clarity of the questions and response options, and the statistical design of the DCE.

The *international survey* is similar in content, format, length and timing as the general public survey. It was distributed through available global networks and mailing lists. The purpose of this survey was to elicit existence and bequest values for vultures in Southern Africa for international beneficiaries. The questionnaire for the international survey was tested on a small sample of respondents to check the timing, clarity of the questions and response options, and the statistical design of the DCE.

The *tourist survey* contained questions on tourist expenditure and motivations, including the relative importance of vultures in visiting nature areas. The survey was distributed through tourism operators, targetting both domestic and international tourists. The effectiveness of this survey is therefore dependent on the agreement and cooperation of tourism operators.

The *ranger consultation/survey* contained questions on the use of vultures for identifying the location of carcasses, either identified as natural mortalities or poaching activities, and the time and cost savings attributed to the sentinel service.

5.3 Scenario analysis

A scenario analysis is developed to explore how the value of vulture ecosystem services might change over time under alternative conservation interventions. We make use of the results of the descrete choice experiment to estimate changes in the non-use values held by local community and general public under "Policy Inaction" and "Policy Action" scenarios. See Table 5 for scenario descriptions. These scenarios are explorative, "what if" storylines and are not based on predictive modelling of vulture populations and extinctions. The intention is to explore alternative plausible scenarios for vulture population trends and extinctions that could result from policy inaction or policy action. It is important to note that the term "Policy Action" implies not only the development of vulture conservation policy, but also subsequent implementation, enforcement and sufficient compliance to improve the survival of vulture species and populations. The time horizon for the scenario analysis

reflects a long-term perspective on the future of vultures, over which population trends can be reversed and/or extinctions of vulture species may occur.

Table 5: Scenario descriptions.

Scenario	Description
Current	This scenario describes the current trend ("business as usual") in which no vulture extinctions have occurred but populations in the region are declining.
Policy Inaction	This scenario represents a situation with no additional conservation intervention or regulatory enforcement. Vulture populations continue to decline and two species become extinct in the region.
Policy Action	This scenario describes a future in which conservation interventions are successful, resulting in increasing vulture populations and no species extinctions.

Applying the same approach as for the aggregation of existence and bequest values, we estimate the WTP per local community and general public household for each country. For the Policy Inaction scenario, we multiply the estimated WTP to avoid the loss of a vulture species by two (the number of vulture species that are lost under this scenario). For the Policy Action scenario, we used the estimated WTP to see a change from declining to increasing vulture populations. These household-level WTP amounts were then multiplied by the estimated number of households that are willing to contribute time/donate money in each country, to estimate the total welfare effects of each scenario nationally.

6. Results

6.1 Provisioning services

Respondents to the local community survey identified a number of uses of vulture parts. A summary of identified uses is provided in Table 6 and the full list of responses is provided in Appendix 2. Firstly, it is noteworthy that the use of vultures for food was not identified by respondents and in consequence, a value for this use is not estimated.

A moderate proportion of respondents (22%) indicated that vulture parts are used in traditional medicine in their community, although a higher proportion stated that this isn't the case (32%) or didn't know (45%). The responses to this question per country are presented in table 7. The proportions of respondents that indicate that they visit traditional healers that use vulture parts in their remedies is low (5.3%), which may partially reflect an unwillingness to share this information or a lack of knowledge of the variety of medicines or ingredients used in medicines by the traditional healers. In either case, we consider this an under-estimate of the actual proportion of households that visit traditional healers and the extent to which vulture parts are used based on the results of previously conducted market

surveys (BirdLife International, 2022). Respondents that indicated that they do visit such traditional healers were asked to give the cost of treatment when vulture parts are used. The mean cost of treatment is 57.33 USD/visit but responses varied substantially across respondents.

We use this information to estimate the net annual value of the use of vulture parts in traditional medicine by extrapolating the extent of use and cost per visit across local community populations living within vulture ranges in each country. We use the rural population as a proxy of the relevant local community population given that vultures are present in all areas. We further assume that each household that indicated that they visit traditional healers using vulture parts, makes one visit per year. In recognition that this is a sensitive topic, the local community survey questionnaire did not ask for detailed information on frequency of visits. We consider the assumption of one visit per year to be conservative (WHO, 2019). The gross revenue is computed as the number of visits multiplied by the average price of visiting a traditional healer; and the net value is computed by subtracting the costs of other inputs to the service (assumed to be 50% of gross revenu). The results are presented in Table 8 and show that approximately 250,000 households in the region (the three target countries) visit traditional healers that use vulture parts in medication; and that the net value of vulture parts as input to traditional medicine is over USD 7 million per year.

Table 6. Summary of uses of vulture parts identified by respondents to the local community survey

Vulture parts	Use
Bones and egg shells	Used by traditional healers to make medicine
Bones	Used by traditional dancers
Feathers and bones	Decoration and ornaments
Feathers and vulture nests	Used to perform rituals for children with walking difficulties
Feathers	Used to bring luck
Feathers	Used to make feather dusters
Feathers	Ritual purposes
Beak	In the past my elders used vulture nose when dead, they didn't kill directly
Head	Used to make dogs effective at identifying things very quickly because of vulture ability to identify things from far
Scull	Forecasting and prophecy
Claws, beak and feet	Used to make traditional medicine
Almost every part of a vulture	Used to make traditional medicine
	Treating epilepsy
	Treatment of headache
Head	Rituals
Brains	Used by traditional healers to dream

Table 7. Vulture parts used in traditional medicine (percentage of respondents)

	Botswana	Zambia	Zimbabwe	All
No	3.9	29.7	48.7	32.3
Yes	26.8	17.7	23.3	22.4
Do not know	69.3	52.6	28.0	45.3

Table 8. Value of vulture parts in traditional medicine

	Botswana	**Zambia**	**Zimbabwe**	**All**	**Source/Assumption**
Households in vulture ranges	130,463	2,339,610	1,957,185	4,427,258	Population census and expert input
Visit traditional healers (%/hhs)	0.03	0.06	0.06	0.53	Local community survey
Number of visits (visits/year)	4,305	145,056	109,602	258,963	Computation (Assuming one visit per year)
Cost of treatment (USD/visit)	57.33	57.33	57.33		Local community survey
Gross revenue (USD/year)	246,821	8,316,050	6,283,504	14,846,375	Computation
Net factor income (USD/year)	123,411	4,158,025	3,141,752	7,423,188	Assuming 50% cost factor

6.2 Carcass disposal

The service of livestock carcass disposal by vultures is estimated as the value of time saved by not having to incinerate or bury deceased livestock. Information on the quantities of livestock kept by households living in vulture ranges, livestock mortality rates, means of carcass disposal (including disposal by vultures), time required for alternative disposal methods, and value of time is obtained from the local community survey (see Table 9).

We find that a high proportion of households that participated in the local community survey keep livestock (cows, goats, sheep) ranging from 44% in Zimbabwe to 72% in Zambia. The average number of livestock kept per household also varies accross the countries from 22 in Zimbabwe to 53 in Botswana. The most common methods for disposing of livestock carcasses are to burn, bury or eat the carcass. A small proportion of respondents, however, dispose of carcasses by leaving them for vultures (approximately 9% of households that keep livestock “mostly” or “often” use vultures for carcass disposal). The value of this service is estimated as the time saved from not having to burn or bury the carcass (on average 2.3 hours per household per year). Other avoided costs, such as fuel wood for burning, are not included in the value estimate. The value of time is derived from information on household monthly income, converted to an hourly rate assuming 22 working days per month and 8 working hours per day. In monetary terms, the value of time

saved is approximately 0.77 USD per household per year. This is not a large amount and mainly reflects that relatively few households rely on vultures to dispose of their livestock carcasses.

Table 9. Value of livestock carcass disposal by vultures.

	Botswana	Zambia	Zimbabwe	All	Source
Households in vulture ranges	130,463	2,339,610	1,957,185	4,427,258	Population census and expert input
% HHs that keep livestock	0.69	0.72	0.44	0.59	Local community survey
Households that keep livestock	90,411	1,693,878	863,119	2,647,407	Computation
Livestock per HH	53	37	22	37	Local community survey
Mortalities (livestock/hh/year)	10	4	3	6	Local community survey
% carcasses disposed by vultures	0.037	0.049	0.183	0.092	Local community survey
Disposed by vultures (carcass/hh/year)	0.37	0.19	0.46	0.51	Computation
Time to burn/bury (hours/carcass)	3.71	3.70	6.51	4.49	Local community survey
Time saving (hours/hh/year)	1.36	0.71	2.98	2.28	Computation
Value of time (USD/hour)	0.45	0.45	0.45	0.45	Local community survey
Cost saving (USD/hh/year)	0.62	0.32	1.35	0.77	Computation
Cost saving (USD/year)	55,904	549,523	1,168,476	1,773,904	Computation

6.3 Sentinel role

The value of the sentinal role of vultures is estimated for two beneficiary groups: 1. Local communities that use vultures to locate the carcasses of missing livestock; 2. Protected Area managers and rangers that use vultures to locate the carcassess of dead/poached animals. In both cases, the service is valued as the avoided costs of searching for animal carcasses.

For the local communities, information on the quantities of livestock kept by households living in vulture ranges, the use of vultures to locate carcasses, time spent searching for missing livestock, and the value of time is obtained from the local community survey (see Table 10).

We find that a high proportion of households that keep livestock use vultures to help locate the carcasses of missing animals. This ranges from 52% of households in Zimbabwe to 84% of households in Zambia. The average time spent searching for missing livestock is lower when using vultures, with an overall mean of approximately 2.5 days (without the use of vultures), which falls to 1.7 days (with the use of vultures). For households that keep livestock, this translates into an annual time saving of just over 1 day per year. The time saving per household is higher in Botswana and Zambia (1.53 and 1.46 days per year respectively) than in Zimbabwe (0.53 days per year) because both the number of livestock kept and the use of vultures to find missing livestock is higher. In aggregate, the value of this time saving to households in Botswana, Zambia and Zimbabwe that keep livestock is estimated to be just over USD 11 million per year.

Table 10. Local community value of vultures for locating the carcasses of missing livestock

	Botswana	Zambia	Zimbabwe	All	Source
Households in vulture ranges	130,463	2,339,610	1,957,185	4,427,258	Population census and expert input
% HHs that keep livestock	0.69	0.72	0.44	0.59	Local community survey
Households that keep livestock	90,411	1,693,878	863,119	2,647,407	Computation
Livestock per HH	53	37	22	37	Local community survey
Livestock losses (%/year)	0.06	0.06	0.06	0.06	Statistics Botswana (2022)
Missing livestock (livestock/hh/year)	3	2	1	2	Computation
% of HHs use vultures to locate carcasses	0.62	0.84	0.52	0.67	Local community survey
Found using vultures (carcass/hh/year)	1.87	1.78	0.64	1.41	Computation
Time without vultures (days/carcass)	2.5472	2.5472	2.5472	2.5472	Local community survey
Time without vultures (days/carcass)	1.7287	1.7287	1.7287	1.7287	Local community survey
Time saving (days/carcass)	0.82	0.82	0.82	0.82	Computation
Time saving (days/hh/year)	1.53	1.46	0.53	1.15	Computation
Value of time (USD/day)	3.64	3.64	3.64	3.64	Local community survey
Cost saving (USD/hh/year)	5.56	5.31	1.92	4.26	Computation
Cost saving (USD/year)	502,691	8,990,777	1,653,967	11,147,435	Computation

Regarding the sentinel role of vultures in protected area management, vultures are used to identify locations of dead animals and poaching activities. Where there is an incursion or a dead animal which has clearly been poached, more rangers are brought in to comb the area for more carcasses or the trail of the poacher. The costs related to this include the rangers' time and expenditures on vehicles, fuel, food and communication. The use of vultures in early detection means they can be few ranger groups deployed per area for anti-poaching, hence reducing the cost of employing more rangers.

For the valuation of the sentinal roles of vultures to protected area management, information on the use of vultures to locate carcasses, and time and expenditure savings is obtained from the ranger and park manager survey (see Appendices 7 and 8; and Table 11).

Of the 12 protected areas represented in the survey responses, 11 use vultures to help to locate animal carcasses. The effectiveness of using vultures to locate animal carcasses is considered to be effective or very effective by 18% and 23% of respondents respectively, although 50% of respondents indicated that they don't know the effectiveness of this approach. Aggregating the reported cost savings in terms of time and expenditure across the number protected areas with vultures gives a value of this service of approximately USD 291,000 per year for the three countries jointly.

We note that the estimated value of the sentinel role of vultures in terms of avoided costs does not capture the full benefits of early detection of poaching activities. Early detection of a poisoned carcass also means further mortalities of vultures and other carnivores can be stopped by securing the carcass. In the case where elephants are drinking or licking a poisoned source, then the area can be secured to prevent further losses of these animals as well.

Table 11. Protected Area value of vultures for locating carcasses

	Botswana	**Zambia**	**Zimbabwe**	**All**	**Source**
Number of protected areas with vultures	6	20	16	42	BirdLife International
Time saved (hours/month/PA)	53.6	53.6	53.6	53.6	Ranger survey
Time saved (days/year/PA)	80.4	80.4	80.4	80.4	Ranger survey
Value of time (USD/day)	10	10	10	10	Literature review
Time cost saving (USD/year)	4,824	16,080	12,864	33,768	
Expenditure saved (USD/month/PA)	510	510	510	510	Ranger survey
Expenditure saved (USD/year)	36,720	122,400	97,920	257,040	
Total cost saving (USD/year)	41,544	138,480	110,784	290,808	

6.4 Sanitation and pest control

The service that vultures provide to protect human health through sanitation (removal of carcasses and waste that host pathogens causing human illness) and pest control (reduction in populations of mammalian scavengers such as rats and dogs that spread diseases to humans) is valued as the avoided damage to human health attributable to the presence of vultures.

Detailed data and quantified relationships for estimating the avoided health damages attributable to the role of vultures in Africa is largely unavailable (van den Heever et al., 2021). This includes data on vulture populations, quantities of carcasses and waste consumed, and the consequent reduction in exposure to pathogens and the prevalence of

diseases. To provide a first estimate of the value of this ecosystem service for the countries addressed by this report, we make use of quantified relationships from the literature. We caution, however, that these quantities are unlikely to reflect the biophysical and socio-economic context of this study, particularly in terms of the level of dependence on vultures to remove carcasses and waste.

Information on increased human mortality due to a large scale decline in vulture populations is taken from a study for India, which provides a central estimate of a 4.2% increase in mortality per year (Frank and Sudarshan, 2023). We apply this rate to the background mortality rate in each country and the human populations living in vulture ranges to estimate the number of additional deaths that would occur each year in the absence of vultures (see Table 12). The value of these avoided deaths is estimated using the Human Capital Approach (HCA), which assigns the value of foregone income due to pre-mature mortality (Hanly et al., 2022). We compute the HCA value of a mortality in each country as the difference in years between the average age of respondents to the local community survey and a retirement age of 65, multiplied by per capita GDP for each country.

The results show that the value of this service is substantial, with an annual value for the region of over USD 90 million. Using the value of a statistical life (VSL) as an alternative approach to valuing human mortality (we use a VSL of USD 580,633 obtained from a recent international review of VSL studies, Keller et al., 2021) results in a value for this service that is an order of magnitude higher and exceeds USD 1.3 billion per year.

It should be noted that this estimation of the value of sanitation and pest control service provided by vultures focuses on human health and does not include the value of reduced disease in livestock and wild animals or of the health of the broader ecosystem.Taking a broader One Health perspective of the integrated health of people, animals and ecosystems was not feasible within the present study given existing limitations on the quantification of functional relationships between vulture populations and the health of other animals and the ecosystems in which they live. This is considered as a potentially important avenue for future research.

Table 12. Value of sanitation and pest control

	Botswana	Zambia	Zimbabwe	All	Source
Population in vulture ranges	730,591	11,766,141	10,020,480	22,517,212	Population census and expert input
% increase in deaths per year	0.042	0.042	0.042	0.042	Frank and Sudarshan (2023)
Avoided mortalities (deaths/year)	85	1,168	1,048	2,301	Computation
Mean age	47.8	39.8	42.7		Local community survey
Human Capital Approach value (USD/mortality)	133,111	36,716	37,397		
HCA Value of avoided mortalities (USD)	11,356,492	42,873,484	39,189,984	93,419,959	

6.5 Existence and bequest value

The existence and bequest values that are placed on vultures in Botswana, Zambia and Zimbabwe are estimated separately for three groups of beneficiary: local community households living in vulture ranges, the general public in the three countries, and the international public. We describe the results for each beneficiary group separately and summarise them jointly at the end of the section.

Among local community households, a relatively high proportion state that they are willing to contribute time to support vulture conservation (see Table 13). This ranges from approximately 62% of households in Zambia to 82% in Botswana. The reasons for not being willing to contribute time are represented in Figure 4. The most frequently provided reason is that the respondent does not have time to contribute. The reasons for being willing to contribute time are given in Figure 5 and show that the most frequently cited reason is that vultures play an important role in the environment by disposing of animal carcasses (i.e., reflecting recognition of the sanitation and pest control service valued in the preceding section), which is in line with the findings of Manqele et al. (2023) for a case study of perceptions in three protected areas in KwaZulu Natal. The next most frequently selected

reasons are that it is important to conserve all animal species (i.e., existence value) and that it is important to conserve vultures for future generations (i.e., bequest value). The importance of vultures to the respondents' culture is the least frequently selected motivation for being willing to contribute time to vulture conservation.

The results of the contingent valuation question are summarised in Table 14 and show that, on average, local community households are willing to contribute a maximum of 1.6 days per month for vulture conservation. We convert from volunteered time to money using information on mean household income from the local community survey; and then extrapolate to the number of households living in vulture ranges in each country (see Table 15). The estimated existence and bequest value to local communities across the three countries is substantial at over USD 94 million per year. The value of this service is notably higher in Zimbabwe due to the higher proportion of households that are willing to contribute time and the stronger motivation attributed to non-use values.

Table 13. Local community willingness to contribute time to support vulture conservation (percentage of respondents)

	Botswana	Zambia	Zimbabwe	All
No	18.2	38.1	21.4	25.9
Yes	81.8	61.9	78.6	74.1

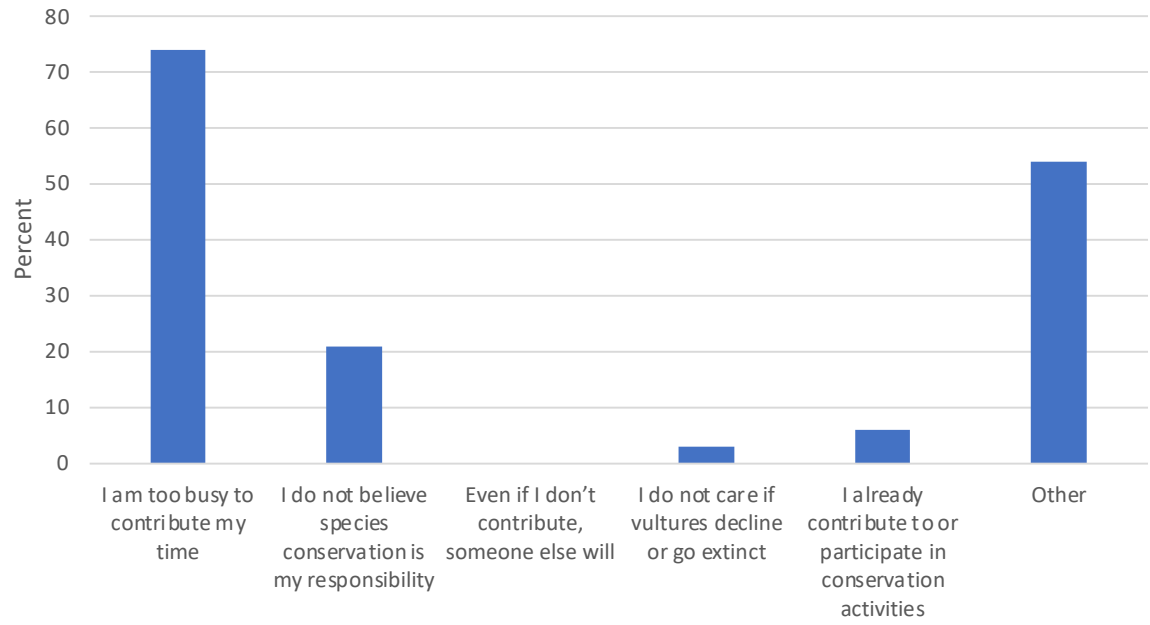

Figure 4. Local community reasons for not being willing to contribute time to support vulture conservation

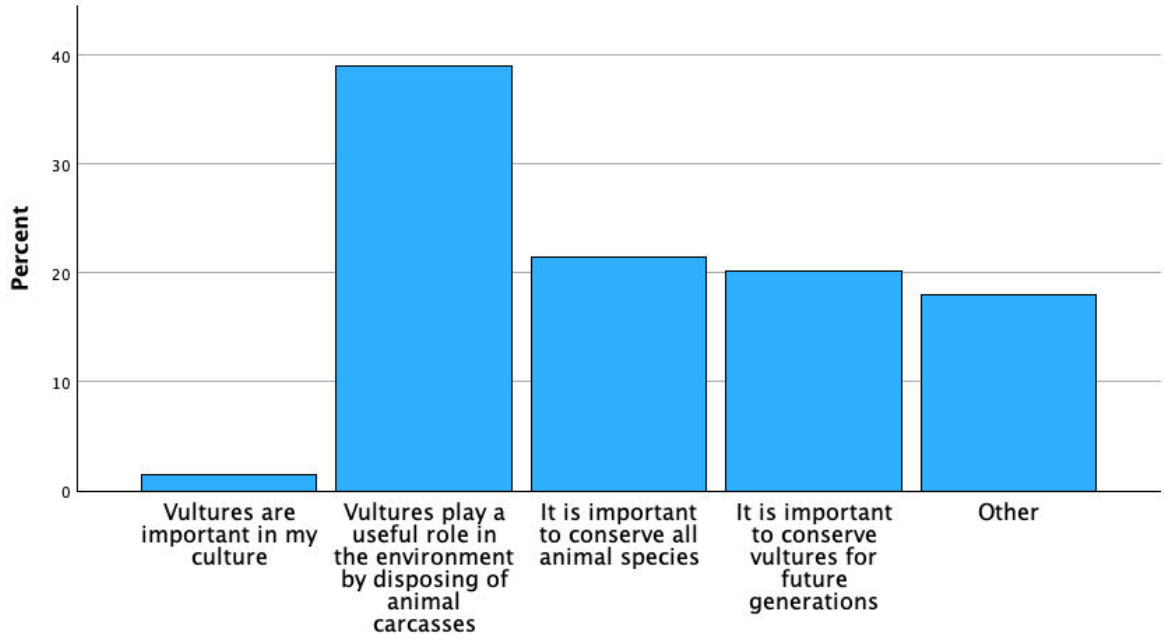

Figure 5. Local community reasons for being willing to contribute time to support vulture conservation

Table 14. Maximum willingness to contribute time for vulture conservation (days/household/month)

	Botswana	Zambia	Zimbabwe	All
Mean	1.2	0.9	2	1.6
Median	1	0.3	2	1
N	50	109	216	375

Table 15. Local community existence and bequest values

	Botswana	Zambia	Zimbabwe	Total	Source
Households in vulture ranges	130,463	2,339,610	1,957,185	4,427,258	Population census
In principle WTP (% of hh)	0.82	0.62	0.79	0.74	Local community survey
HHs that are WTP	106,718	1,448,219	1,538,348	3,093,285	
Mean WTP (days/hh/month)	1.20	0.90	2.00	1.60	Local community survey
Value of time (USD/hh/day)	3.64	3.64	3.64		Local community survey
Mean WTP (USD/hh/month)	4.36	3.27	7.27		
Non-use motivation (%)	0.23	0.44	0.51		Local community survey
Non-use value (USD/year)	1,285,278	25,252,719	67,799,172	94,337,169	

Among general public respondents, a relatively high proportion state that they are willing to contribute money to support vulture conservation (see Table 16). This ranges from approximately 71% of households in Botswana to 81% in Zimbabwe. The reasons for not being willing to contribute money are represented in Figure 6. The most frequently provided reason is that the respondent already participates in conservation activities. The reasons for being willing to contribute money are given in Figure 7 and show that the most frequently cited reasons are that it is important to conserve all animal species (i.e., existence value) and is that vultures play an important role in the environment by disposing of animal carcasses (i.e., reflecting recognition of the sanitation and pest control service valued in the preceding section). The importance of vultures to the respondents' culture is again the least frequently selected motivation for being willing to contribute to vulture conservation.

The results of the contingent valuation question are summarised in Table 17 and show that, on average, general public households are willing to contribute a maximum of just over USD 7 per month for vulture conservation. We extrapolate these values to the number of households in each country living in urban areas, controlling for the proportion that are not willing to contribute money (see Table 18). The estimated existence and bequest value to the general public across the three countries is substantial at over USD 43 million per year. The value of this service is again notably higher in Zimbabwe due to the higher proportion of households that are willing to contribute money and the stronger motivation attributed to non-use values.

Table 16. General public willingness to contribute time to support vulture conservation (percentage of respondents)

	Botswana	Zambia	Zimbabwe	All
No	29.4	24.0	19.5	14.7
Yes	70.6	76.0	80.5	85.3

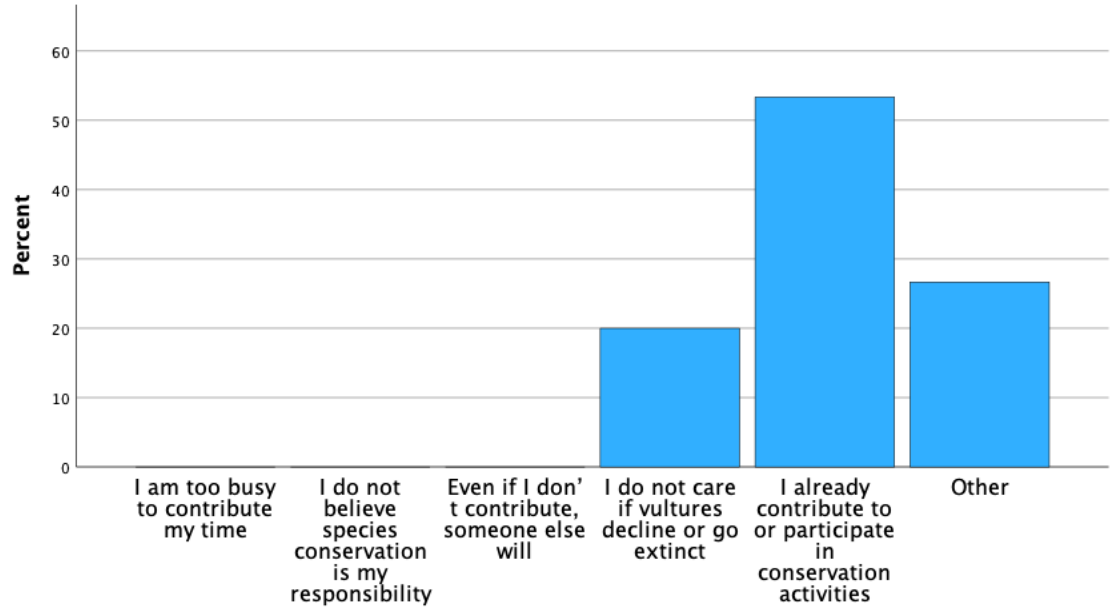

Figure 6. General public respondents' reasons for not being willing to contribute money to support vulture conservation

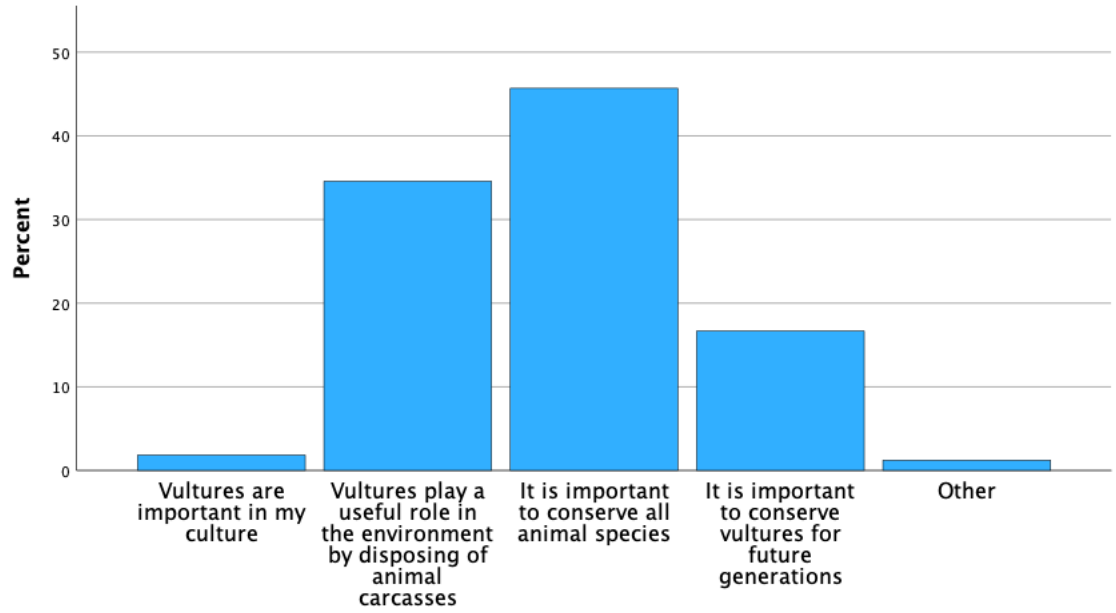

Figure 7. General public respondents' reasons for not being willing to contribute money to support vulture conservation

Table 17. General public maximum willingness to contribute money for vulture conservation (USD per month)

	Mean	Median	N
Botswana	4.950	5.000	10
Zambia	6.441	4.000	17
Zimbabwe	5.962	5.000	65

Table 18. General public existence and bequest values

	Botswana	Zambia	Zimbabwe	Total	Source
Households (urban)	666,507	1,716,995	2,453,626	4,837,128	Population census
In principle WTP (% of hh)	0.71	0.76	0.81	0.85	General public survey
HHs that are WTP	470,554	1,304,916	1,975,169	4,126,070	
Mean WTP (USD/hh/month)	4.95	6.44	5.96		General public survey
Use motivation (%)	0.50	0.42	0.26	0.35	General public survey
Non-use motivation (%)	0.17	0.11	0.20	0.17	General public survey
Use value (USD/year)	13,975,452	42,461,884	36,458,358	92,895,695	
Non-use value (USD/year)	4,667,801	10,590,256	27,838,359	43,096,416	

Among respondents to the international public survey, mainly from Europe (see Appendix 6), a relatively low proportion state that they are willing to contribute money to support vulture conservation (41%). The reasons for not being willing to contribute time are represented in Figure 4. The most frequently provided reasons are that the respondent does not have any spare money and already contributes to or participates in conservation activities. The main reasons for being willing to contribute money are that it is important to conserve all animal species (i.e., existence value) – 52%; and that vultures play an important role in the environment by disposing of animal carcasses (i.e., reflecting recognition of the sanitation and pest control service) – 35%. The motivation to conserve vultures for future generations (bequest value) is relatively unimportant – 7% of respondents.

From the contingent valuation question, we find that on average, the international public are willing to contribute a maximum of just almost USD 9 per household per month for vulture conservation. We extrapolate these values to the number of households in Europe controlling for the proportion that are not willing to contribute money (see Table 19). The estimated existence and bequest value to the international public in Europe is substantial at

over USD 5 billion per year and largely determined by the large population size over which the aggregation is made.

Table 19. International public existence and bequest values

		Source
Households	198,000,000	Eurostat
In principle WTP (% of hh)	0.41	International public survey
HHs that are WTP	81,774,000	
Mean WTP (USD/hh/month)	8.92	International public survey
Non-use motivation (%)	0.59	International public survey
Non-use value (USD/year)	5,164,322,486	

6.6 Tourism

The distribution of a survey to international tourists through safari tour operators proved not to be possible and secondary data on safari tourism is not available. We therefore focus on the value of vultures to domestic safari tourism, for which we obtained information through the general public survey. Future research could potentially examine the value of vultures to international tourism.

The proportion of respondents to the general public survey that have been on safari is surprisingly high, ranging from 84% in Zambia to 100% in Botswana. We make the conservative assumption, however, that each urban household only makes one safari tour and then estimate the total number of safari visits per year. Prices of safari tours are obtained from tour operators and multiplied by the estimated number of visits per year to estimate gross revenues. Net revenues are estimated by applying an assumed cost factor of 50%. The net factor income of vultures to safari tourism (i.e. the value of vultures as an input to tourism) is then estimated by applying a factor derived from the stated importance of vultures to the safari experience (from the general public survey). The value of vultures to domestic safari tourism is not high and estimated to be almost USD 345,000 per year. Although this is not a high value, it is noteworthy that respondents considered seeing vultures as important or very important to the overall safari experience (see Appendix 4 for detailed survey results).

Table 20. Value of vultures to domestic tourism

	Botswana	Zambia	Zimbabwe	Total	Source
Households	666,507	1,716,995	2,453,626	4,837,128	Population census
Safari (% of HHs)	1.0	0.84	0.976	0.926	General public survey
Annual visit rate (visits/HH/yr)	0.02	0.02	0.02	0.02	Assumption that HHs visits once
Visitors (visits/year)	15,148	32,779	54,426	102,353	
Price safari (USD/visit)	500	150	200		Safari tour operators
Cost factor	0.5	0.5	0.5	0.5	Assumption
Vulture factor	0.03	0.02	0.03	0.03	General public survey
Vulture domestic tourism value (USD/year)	122,509	58,511	163,822	344,841	

6.7 Total Economic Value

The results of the valuation are summarised in Table 21 and Figure 8. This summary focuses on the values of ecosystem services received by domestic beneficiaries. We therefore leave out values accruing to international beneficiaries in terms of existence and bequest value, which would otherwise dominate the result, and international tourism, which we were unable to estimate. All three countries receive substantial value from vulture ecosystem services. Jointly across the three countries, the total economic value is estimated to be just over USD 250 million per year. This is largely attributed to existence and bequest values and the sanitation and pest control service provided by vultures.

Table 21. Total economic value of vultures in Botswana, Zambia and Zimbabwe (USD/year; millions)

	Botswana	Zambia	Zimbabwe	All
Materials	0.12	4.16	3.14	7.42
Carcass disposal	0.06	0.55	1.17	1.77
Sentinel	0.54	9.13	1.76	11.44
Sanitation	11.36	42.87	39.19	93.42
Existence and bequest	5.95	35.84	95.64	137.43
Tourism	0.12	0.06	0.16	0.34
Total Economic Value	18.16	92.61	141.07	251.83

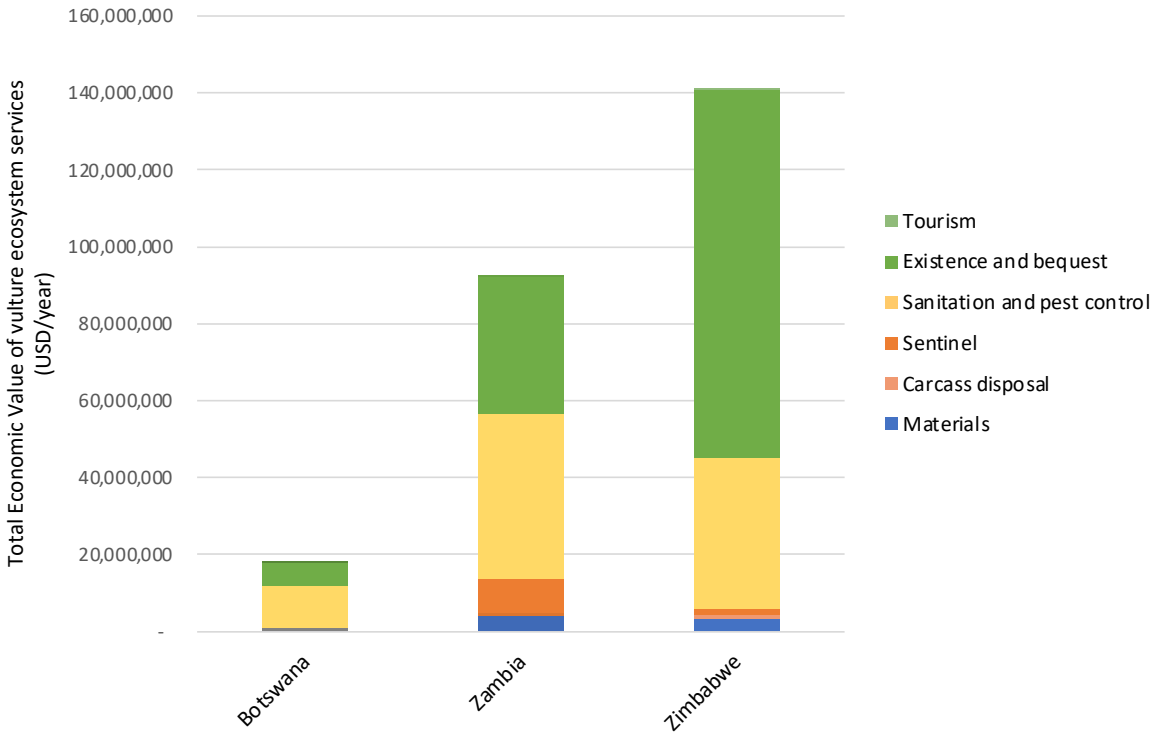

Figure 8. Total economic value of vultures in Botswana, Zambia and Zimbabwe

To provide a first estimate of the value of vulture ecosystem services in the South African Development Community (SADC) countries that are home to vultures, we make a simple extrapolation of the estimated values across rural (local community) and urban (general public) human populations. The mean annual value per local community household is estimated to be USD 47; whereas the mean annual value per general public household is USD 9. This difference in values is due to the broader range of ecosystem services assessed for local community households and in particular the inclusion and high value of the sanitation and pest control service. The estimated values for SADC countries are provided in Table 22, and show that the total annual value of vulture ecosystem services in the region is just under USD 1.8 billion.

Table 22. Total economic value of vultures in the South African Development Community (USD/year; millions)

Country	Local community	General public	Total
Botswana	13.37	4.79	18.16
Zambia	81.96	10.65	92.61
Zimbabwe	113.06	28.00	141.07
Angola	73.58	67.22	140.80
Democratic Republic of Congo	340.96	161.01	501.97
Lesotho	10.46	3.27	13.73
Malawi	108.41	25.91	134.32
Mozambique	132.01	50.09	182.10
Namibia	7.66	4.40	12.06
South Africa	122.85	113.31	236.16
Swaziland	5.47	1.75	7.22
Tanzania	268.64	98.29	366.93
SADC	1,204.44	583.83	1,788.27

7. Scenario analysis

As a further guide for decision-making, this section analyses the economic welfare impacts of alternative vulture conservation scenarios. The changes in domestic non-use value of vultures under “Policy Inaction” and “Policy Action” scenarios are estimated to show the welfare cost of taking no action versus the potential welfare gain of taking action to conserve vultures (see Table 5 for scenario descriptions). The monetary values of welfare changes are estimated using the results of the discrete choice experiments for the local community and general public in each country. In the case of “Policy Inaction”, the estimated willingness to pay to avoid declining vulture populations and two extinctions is multiplied by the numbers of households in each country that are willing to contribute to vulture conservation. In the case of “Policy Action”, the estimated willingness to pay to for increasing vulture populations is multiplied by the numbers of households in each country that are willing to contribute to vulture conservation.

The results are presented in Table 23 and show large welfare losses from allowing vultures to become locally extinct due to policy inaction; and welfare gains from taking policy action to enable vulture populations to increase.

Table 23: Welfare changes due to policy inaction and action for vulture conservation (USD/year; millions).

	Botswana	Zambia	Zimbabwe	All
Policy inaction	-3.95	-18.80	-24.00	-46.74
Policy action	2.06	12.68	15.24	29.98

The welfare loss, as a consequence of not acting on vulture conservation, equates to almost USD 47 million per year, whereas the welfare gain from taking policy action to conserve, manage and protect vultures is almost USD 30 million per year. As such, the economic benefits of investing in the conservation of vulture populations is huge, but letting them decline or go extinct will result in large economic cost. Combined, this provides a strong rationale for governments and other institutions to fund vulture conservation programs.

8. Conclusions

8.1 Summary of findings

Vulture species face loss of habitat, declining populations and, in some cases, extinction. Population trends vary among species, ranges and populations but, in general, vultures face high threats and continue to experience population declines. Understanding the associated loss in ecosystem services and human welfare can potentially motivate action and increased financing to protect and restore vulture populations. This study provides first estimates of the economic values of ecosystem services provided by vultures in Botswana, Zambia and Zimbabwe.

The total economic value of vulture ecosystem services to these three countries is esimated to be just over USD 250 million per year. This is largely attributed to existence and bequest values and the sanitation and pest control service provided by vultures.

Focusing on existence and bequest values, the results of an explorative scenario analysis revealed the large welfare losses people may experience from allowing vulture populations to continue to decline and two species to become extinct due to policy inaction (USD 47 million per year). The welfare gains from taking policy action to enable vulture populations to increase are also substantial (USD 30 million per year). As such, the economic benefits of investing in vulture conservation are large, but letting vulture species go extinct would result in huge economic cost. Combined, this provides a strong rationale for governments to explore publicly-funded vulture conservation programs.

We extrapolated the mean values per rural and urban household for Botswana, Zambia and Zimbabwe across the South African Development Community. This yielded an estimate of the total economic value of vulture ecosystem services in the region of just under USD 1.8 billion per year. This estimate is characterised by high uncertainty, but nevertheless conveys the economic importance of vultures in the region.

8.2 Caveats and directions for future research

The analysis and results described in this report are constrained by several limitations and uncertainties. These are identified below and intended to support future research.

The study made use of a number of surveys targeting different beneficiary groups to collect information on their knowledge and use of vultures and preferences for conservation. Such surveys were considered the only feasible means of obtaining information on which to base the valuation analysis. We recognise, however, that the sample sizes are generally low and the representativeness of the populations of beneficiaries is imperfect. This has implications for the level of certainty and potential biases in the results. Future research could expand the scope of the surveys conducted for this study and attempt to reach a more representative sample.

The valuation of the sanitation and pest control service is limited in several respects. Firstly, the analysis assesses only on human health and it was not possible to estimate values for the control of disease among livestock and other animals. This could be an important avenue for future research and would require quantification of the effect of changing vulture populations on the prevalence of diseases in other animals, including diseases that are transmitted by mammalian scavengers. Such research could apply the One Health perspective of the integrated health of people, animals and ecosystems. Secondly, the valuation of sanitation and pest control to human health makes use of information on the quantification of human health implications of vulture loss in India, which is unlikely to match the African context. Future research could try to address this limitation by compiling sufficient data for Africa to quantify the linkages between vultures and health.

The valuation of existence and bequest values for vultures using stated preference methods faces a gamut of limitations and potential biases. Potential future refinements might include the use of alternative payment vehicles to avoid hypothetical bias associated with voluntary donations; using quantitative measures of change in vulture populations; specifying attributes for specific vulture species; and testing for the influence of the survey mode on respondent choice and uncertainty.

The evaluation of vulture conservation measures would require a direct comparison of both the costs and benefits of alternative options. Such a cost-benefit analysis would require quantified measurement of the effectiveness of various conservation actions and their respective costs, including both implementation costs and the opportunity costs of restricted activities. At a national level, evaluating the extent to which the benefits of vulture conservation outweigh the costs (which could include many different actions addressing the threats facing vultures) and the relative cost-effectiveness of specific measures requires further research. Additional questions for future research include:

- How can we ‘capture’ public WTP for vulture conservation (i.e., turn hypothetical demand for conservation outcomes into real funding for conservation)?
- What are the social impacts of conservation interventions, especially for local communities that use vulture parts in traditional medicines and cultural practices?
- How can local communities be recruited to support vulture conservation?

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11. Appendix 1. Local community questionnaire

1) [Verbal consent received to conduct interview]

( ) Yes

( ) No

2) [Enumerator name]

_____

3) [Location - village name]

_____

4) [Time - 24h format e.g. 9:00, 15:00]

_____

5) [Date - dd/mm/yr]

_____

A. Instructions

When answering the questions, please keep the following in mind:

- Answer on behalf of your **whole household** (family members living under the same roof)
- All data collected by this survey will be treated as **confidential**
- **Rough estimates** of quantities and times are sufficient
- There are no right or wrong answers - we only want your **honest opinion**

B. General Environmental Awareness

6) Are you a member of an environmental group/organization?

( ) Yes

( ) No

7) Have you donated money to an environmental cause in the last 12 months?

( ) Yes

( ) No

8) If yes, how much money?

Amount: _____

Currency: _____

9) Have you volunteered your time for an environmental cause in the last 12 months (e.g., survey work, monitoring, fund raising, litter clean-up, tree planting)?

( ) Yes

( ) No

10) How concerned are you about the following environmental issues?

	Not at all concerned	**Slightly concerned**	**Moderately concerned**	**Very concerned**	**Extremely concerned**
Water Pollution	( )	( )	( )	( )	( )
Climate Change	( )	( )	( )	( )	( )
Species Extinction	( )	( )	( )	( )	( )
Deforestation	( )	( )	( )	( )	( )

C. Knowledge of Vultures

11) Vultures are birds of prey that feed on animal carcasses

( ) Agree

( ) Disagree

( ) Don’t know

12) Have you seen a vulture in the wild?

( ) Yes

( ) No

( ) Don't know

13) Do you know any traditional stories/tales about vultures?

( ) Yes

( ) No

14) In a few words, can you tell me what these traditional stories/tales are about?

_____

15) For each statement, mark one response that indicates your Agreement or Disagreement.

	Agree	**Disagree**	**Don't know**
Vultures prevent the spread of diseases by disposing of carcasses	( )	( )	( )
Sometimes vultures kill livestock in this area (e.g. lambs, calves, goats)	( )	( )	( )
Sometimes people in this area poison carcasses to kill vultures	( )	( )	( )

We should conserve vultures for future generations	( )	( )	( )

16) Has the abundance of vultures in your area changed during the past 5-10 years?

( ) Increased a lot

( ) Increased a bit

( ) No change

( ) Decreased a bit

( ) Decreased a lot

( ) Don't know

17) Are you aware of any vulture conservation efforts in your community?

( ) Yes

( ) No

( ) Don't know

18) How effective do you think these conservation efforts will be in protecting vultures?

( ) Not at all effective

( ) Not effective

( ) Neutral

( ) Effective

( ) Very effective

D. Use of vultures

19) Are vulture parts used in traditional medicine in your community?

( ) Yes

( ) No

( ) Don't know

20) Do you, or members of your family, visit traditional healers that use vulture parts in their remedies?

( ) Yes

( ) No

( ) Prefer not to answer

21) What is the cost of their services (per visit) when vulture parts are used?

( ) 10-20 USD

( ) 20-40 USD

( ) 40-60 USD

( ) 60-80 USD

( ) more than 80 USD

( ) Don't know

22) Do vulture parts (e.g. eggs, feathers, bones, etc.) have any other uses in your community?

( ) Yes

( ) No

( ) Don't know

23) What are vulture parts used for in your community?

24) Apart from the use of parts, do vultures have any other importance in your community?

( ) Yes

( ) No

( ) Don't know

25) What importance do vultures have in your community?

_____

E. Role of vultures for disposing of livestock carcasses

26) Does your household keep livestock (e.g. cows, sheep, goats)?

( ) Yes

( ) No

27) How many livestock do you keep? And how many mortalities (e.g. from disease, predation, starvation etc.) have there been in the past 3 years?

	Number of animals	**Number of mortalities (in past 3 years)**
Cows	_____ _____	_____ _____
Sheep	_____ _____	_____ _____
Goats	_____ _____	_____ _____

28) How do you dispose of livestock carcasses?

	Mostly	**Often**	**Rarely**	**Never**
Burnt/incinerated	( )	( )	( )	( )
Buried	( )	( )	( )	( )
Eaten	( )	( )	( )	( )
Disposed by vultures	( )	( )	( )	( )
Disposed by other scavengers (e.g. feral dogs, hyenas, lions)	( )	( )	( )	( )

29) How much time does it cost you to burn or bury a livestock carcass?

_____

30) If livestock are missing, how long does it usually take you to locate the animal/carcass? Please enter the approximate number of hours or days.

Hours: _____

Days: _____

31) Do you rely on vultures to locate the carcasses of missing livestock?

( ) Yes

( ) No

( ) Don't know

F. Vulture Conservation

32-35) In principle, would you be willing to contribute some of your time to support vulture conservation?

( ) Yes

( ) No

36) Which of the following best describes your reason for not being willing to contribute your time to support vulture conservation in principle?

( ) I am too busy to contribute my time

( ) I do not believe species conservation is my responsibility

( ) Even if I don't contribute, someone else will

( ) I do not care if vultures decline or go extinct

( ) I already contribute to or participate in conservation activities

( ) Other - Please specify: _____

37) Which of the following best describes your reason for being willing to contribute your time to support vulture conservation in principle?

( ) Vultures are important in my culture

( ) Vultures play a useful role in the environment by disposing of animal carcasses

( ) It is important to conserve all animal species

( ) It is important to conserve vultures for future generations

( ) Other - Please specify: _____

38) What is the maximum amount of time that you would be willing to contribute per month for vulture conservation?

( ) 1 hour

( ) 2 hours

( ) 4 hours

( ) 6 hours

( ) 8 hours

( ) 1 day

( ) 2 days

( ) 3 days

( ) 4 days

( ) Other - specify: _____

G. Choice question instructions

Your response to the following questions will help us understand your willingness to contribute time for vulture conservation.

You will be asked to choose between possible conservation options that are defined by the following features:

Vulture population − described by whether the population of vultures in your region is declining, stable or increasing.

Vulture species diversity − described by the number of species expected to become extinct in your region.

Time contribution per month − the amount of time that you would contribute each month to vulture conservation in your region.

On the next page you will be asked to choose between three options:

Options A and B represent two different possible outcomes based on additional conservation measures supported by your monthly contribution.

Option C shows the "business as usual" outcome with no additional conservation effort beyond what is already being done.

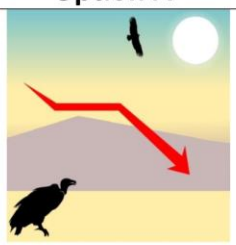
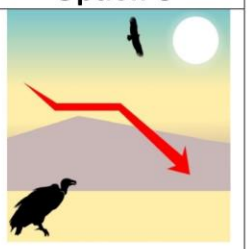
It is likely that none of the options represent your ideal outcome so please choose the option that you prefer out of the three. You may need to make trade-offs between vulture population, species diversity and the monthly contribution.

Please consider carefully how much time you can actually afford to contribute each month and where that time would come from, given the commitments that you have.

In total you will be **shown 6 choice cards** and asked to choose one option on each card. Note that Options A and B are different on each card and Option C remains the same.

H. Choice Questions (Block 1)

39) Please choose ONE of the three options:

	Option A	Option B	Option C
Vulture population			
	Declining	Increasing	Declining
Species diversity			
	0 species extinct	6 species extinct	6 species extinct
Volunteer Time Contribution per month			
	2 hours volunteered	10 hours volunteered	0 hours volunteered

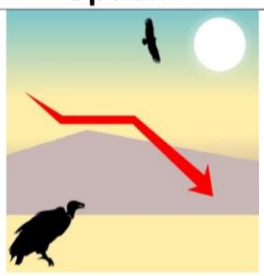
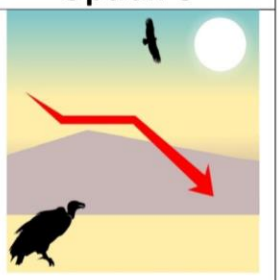
( ) Option A

( ) Option B

( ) Option C

H. Choice Questions (Block 1)

40) Please choose ONE of the three options:

	Option A	Option B	Option C
Vulture population			
	Increasing	Declining	Declining
Species diversity			
	6 species extinct	0 species extinct	6 species extinct
Volunteer Time Contribution per month			
	2 hours volunteered	10 hours volunteered	0 hours volunteered

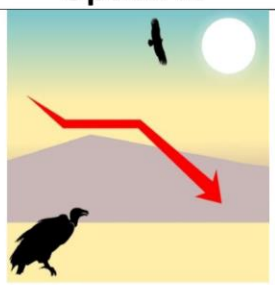
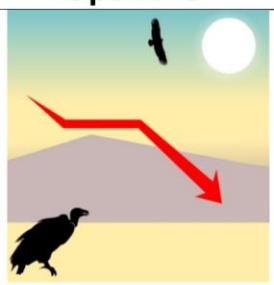
( ) Option A

( ) Option B

( ) Option C

H. Choice Questions (Block 1)

41) Please choose ONE of the three options:

	Option A	Option B	Option C
Vulture population			
	Declining	Stable	Declining
Species diversity			
	0 species extinct	3 species extinct	6 species extinct
Volunteer Time Contribution per month			
	10 hours volunteered	2 hours volunteered	0 hours volunteered

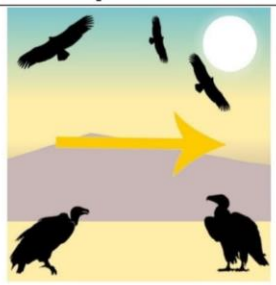
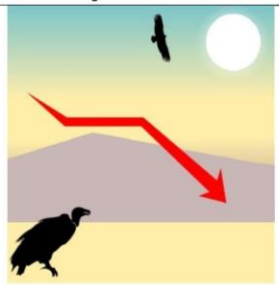
( ) Option A

( ) Option B

( ) Option C

H. Choice Questions (Block 1)

42) Please choose ONE of the three options:

	Option A	Option B	Option C
Vulture population			
	Stable	Increasing	Declining
Species diversity			
	6 species extinct	0 species extinct	6 species extinct
Volunteer Time Contribution per month			
	8 hours volunteered	2 hours volunteered	0 hours volunteered

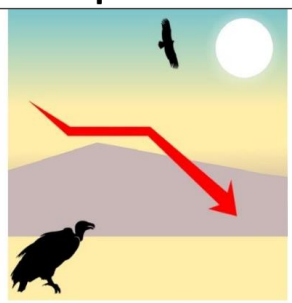
( ) Option A

( ) Option B

( ) Option C

H. Choice Questions (Block 1)

43) Please choose ONE of the three options:

	Option A	Option B	Option C
Vulture population			
	Stable	Increasing	Declining
Species diversity			
	0 species extinct	6 species extinct	6 species extinct
Volunteer Time Contribution per month			
	10 hours volunteered	2 hours volunteered	0 hours volunteered

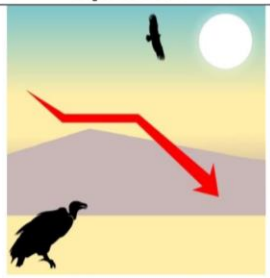
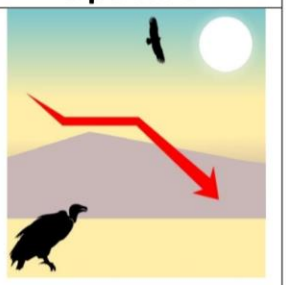
( ) Option A

( ) Option B

( ) Option C

H. Choice Questions (Block 1)

44) Please choose ONE of the three options:

	Option A	Option B	Option C
Vulture population			
	Increasing	Declining	Declining
Species diversity			
	6 species extinct	3 species extinct	6 species extinct
Volunteer Time Contribution per month			
	2 hours volunteered	10 hours volunteered	0 hours volunteered

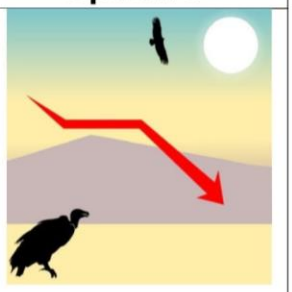
( ) Option A

( ) Option B

( ) Option C

H. Choice Questions (Block 2)

45) Please choose ONE of the three options:

	Option A	Option B	Option C
Vulture population			
	Declining	Stable	Declining
Species diversity			
	6 species extinct	0 species extinct	6 species extinct
Volunteer Time Contribution per month			
	4 hours volunteered	10 hours volunteered	0 hours volunteered

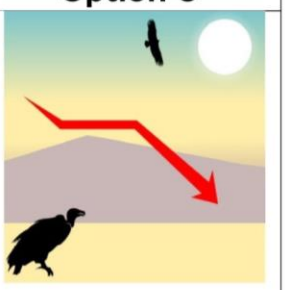
( ) Option A

( ) Option B

( ) Option C

H. Choice Questions (Block 2)

46) Please choose ONE of the three options:

	Option A	Option B	Option C
Vulture population			
	Increasing	Stable	Declining
Species diversity			
	6 species extinct	0 species extinct	6 species extinct
Volunteer Time Contribution per month			
	2 hours volunteered	8 hours volunteered	0 hours volunteered

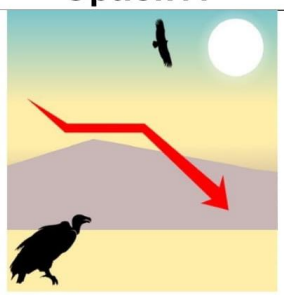
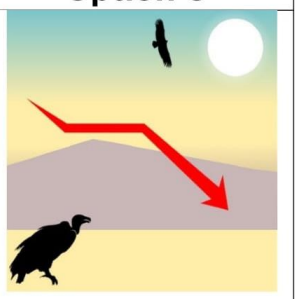
( ) Option A

( ) Option B

( ) Option C

H. Choice Questions (Block 2)

47) Please choose ONE of the three options:

	Option A	Option B	Option C
Vulture population			
	Declining	Stable	Declining
Species diversity			
	6 species extinct	0 species extinct	6 species extinct
Volunteer Time Contribution per month			
	8 hours volunteered	10 hours volunteered	0 hours volunteered

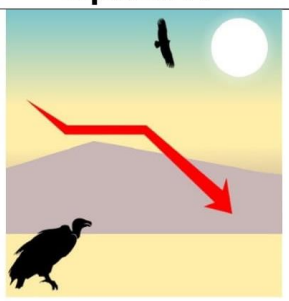
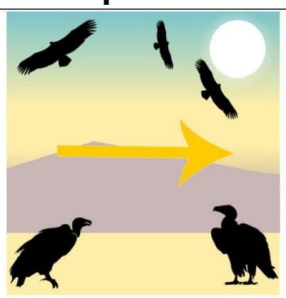
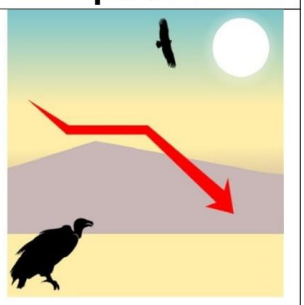
( ) Option A

( ) Option B

( ) Option C

H. Choice Questions (Block 2)

48) Please choose ONE of the three options:

	Option A	Option B	Option C
Vulture population			
	Declining	Stable	Declining
Species diversity			
	0 species extinct	6 species extinct	6 species extinct
Volunteer Time Contribution per month			
	2 hours volunteered	10 hours volunteered	0 hours volunteered

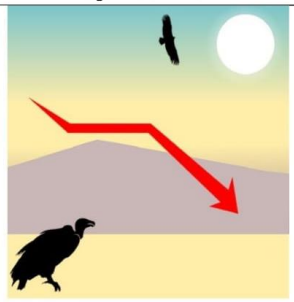
( ) Option A

( ) Option B

( ) Option C

H. Choice Questions (Block 2)

49) Please choose ONE of the three options:

	Option A	Option B	Option C
Vulture population			
	Increasing	Stable	Declining
Species diversity			
	0 species extinct	6 species extinct	6 species extinct
Volunteer Time Contribution per month			
	10 hours volunteered	2 hours volunteered	0 hours volunteered

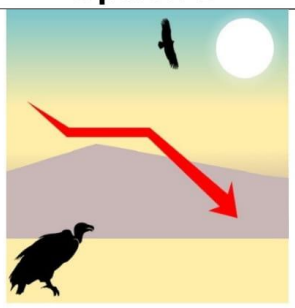
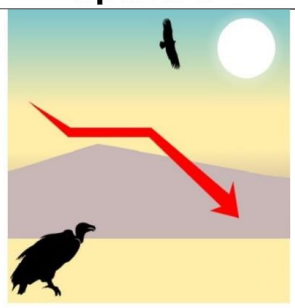
( ) Option A

( ) Option B

( ) Option C

H. Choice Questions (Block 2)

50) Please choose ONE of the three options:

	Option A	Option B	Option C
Vulture population			
	Increasing	Declining	Declining
Species diversity			
	0 species extinct	6 species extinct	6 species extinct
Volunteer Time Contribution per month			
	10 hours volunteered	4 hours volunteered	0 hours volunteered

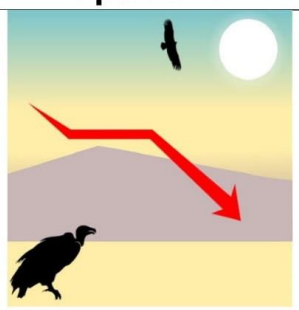
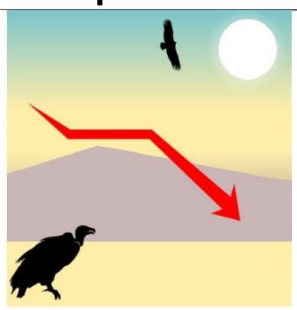
( ) Option A

( ) Option B

( ) Option C

H. Choice Questions (Block 3)

51) Please choose ONE of the three options:

	Option A	Option B	Option C
Vulture population			
	Declining	Stable	Declining
Species diversity			
	6 species extinct	0 species extinct	6 species extinct
Volunteer Time Contribution per month			
	2 hours volunteered	4 hours volunteered	0 hours volunteered

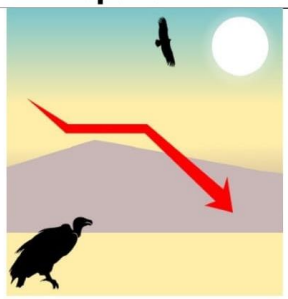
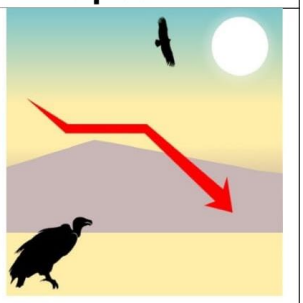
( ) Option A

( ) Option B

( ) Option C

H. Choice Questions (Block 3)

52) Please choose ONE of the three options:

	Option A	Option B	Option C
Vulture population			
	Increasing	Declining	Declining
Species diversity			
	0 species extinct	6 species extinct	6 species extinct
Volunteer Time Contribution per month			
	10 hours volunteered	2 hours volunteered	0 hours volunteered

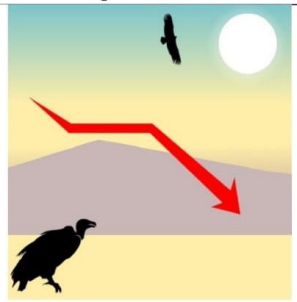
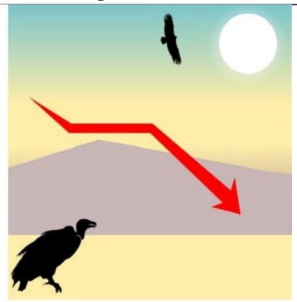
( ) Option A

( ) Option B

( ) Option C

H. Choice Questions (Block 3)

53) Please choose ONE of the three options:

	Option A	Option B	Option C
Vulture population			
	Increasing	Declining	Declining
Species diversity			
	6 species extinct	0 species extinct	6 species extinct
Volunteer Time Contribution per month			
	8 hours volunteered	2 hours volunteered	0 hours volunteered

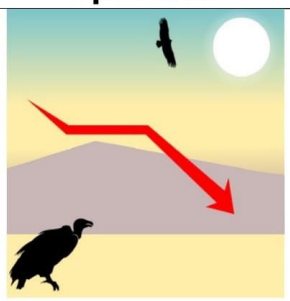
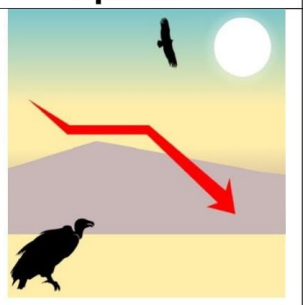
( ) Option A

( ) Option B

( ) Option C

H. Choice Questions (Block 3)

54) Please choose ONE of the three options:

	Option A	Option B	Option C
Vulture population			
	Declining	Stable	Declining
Species diversity			
	3 species extinct	6 species extinct	6 species extinct
Volunteer Time Contribution per month			
	10 hours volunteered	2 hours volunteered	0 hours volunteered

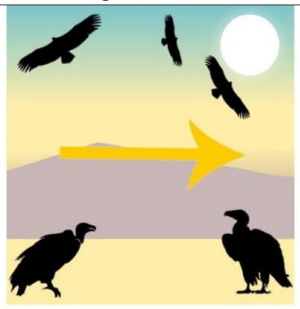
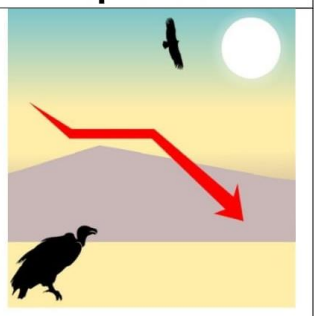
( ) Option A

( ) Option B

( ) Option C

H. Choice Questions (Block 3)

55) Please choose ONE of the three options:

	Option A	Option B	Option C
Vulture population			
	Stable	Increasing	Declining
Species diversity			
	6 species extinct	3 species extinct	6 species extinct
Volunteer Time Contribution per month			
	2 hours volunteered	10 hours volunteered	0 hours volunteered

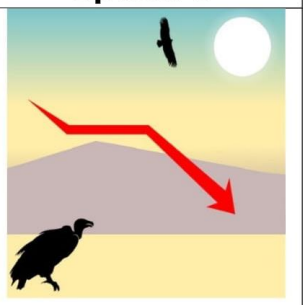
( ) Option A

( ) Option B

( ) Option C

H. Choice Questions (Block 3)

56) Please choose ONE of the three options:

	Option A	Option B	Option C
Vulture population			
	Stable	Increasing	Declining
Species diversity			
	3 species extinct	0 species extinct	6 species extinct
Volunteer Time Contribution per month			
	10 hours volunteered	2 hours volunteered	0 hours volunteered

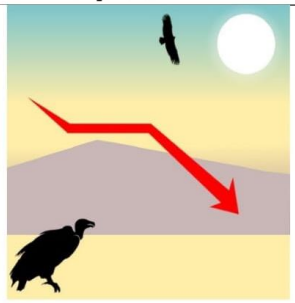
( ) Option A

( ) Option B

( ) Option C

H. Choice Questions (Block 4)

57) Please choose ONE of the three options:

	Option A	Option B	Option C
Vulture population			
	Stable	Increasing	Declining
Species diversity			
	6 species extinct	0 species extinct	6 species extinct
Volunteer Time Contribution per month			
	10 hours volunteered	2 hours volunteered	0 hours volunteered

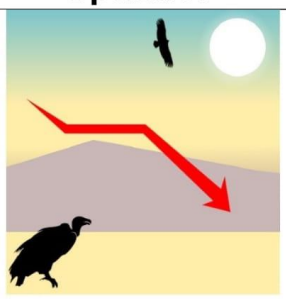
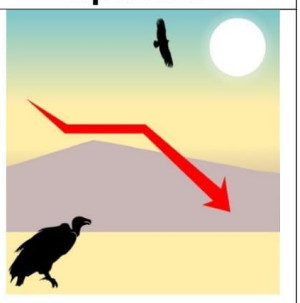
( ) Option A

( ) Option B

( ) Option C

H. Choice Questions (Block 4)

58) Please choose ONE of the three options:

	Option A	Option B	Option C
Vulture population			
	Declining	Increasing	Declining
Species diversity			
	0 species extinct	6 species extinct	6 species extinct
Volunteer Time Contribution per month			
	4 hours volunteered	10 hours volunteered	0 hours volunteered

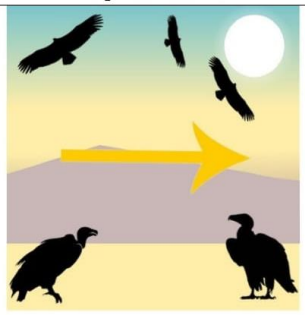
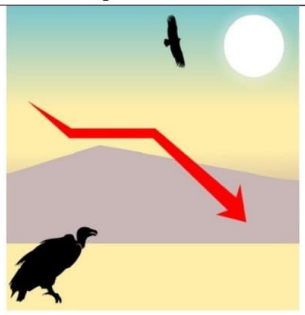
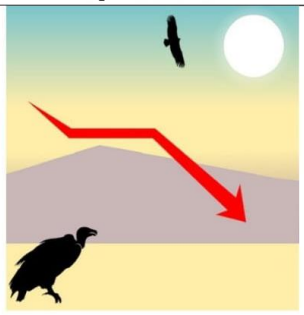
( ) Option A

( ) Option B

( ) Option C

H. Choice Questions (Block 4)

59) Please choose ONE of the three options:

	Option A	Option B	Option C
Vulture population			
	Stable	Declining	Declining
Species diversity			
	6 species extinct	0 species extinct	6 species extinct
Volunteer Time Contribution per month			
	2 hours volunteered	10 hours volunteered	0 hours volunteered

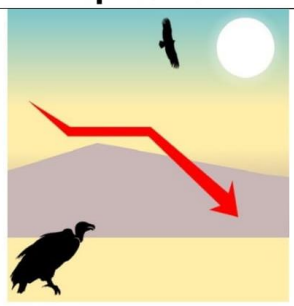
( ) Option A

( ) Option B

( ) Option C

H. Choice Questions (Block 4)

60) Please choose ONE of the three options:

	Option A	Option B	Option C
Vulture population			
	Increasing	Stable	Declining
Species diversity			
	0 species extinct	6 species extinct	6 species extinct
Volunteer Time Contribution per month			
	4 hours volunteered	10 hours volunteered	0 hours volunteered

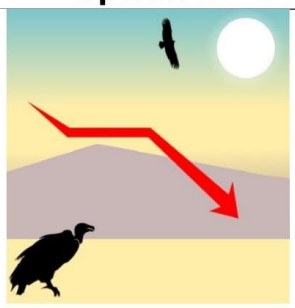
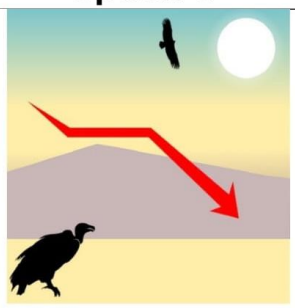
( ) Option A

( ) Option B

( ) Option C

H. Choice Questions (Block 4)

61) Please choose ONE of the three options:

	Option A	Option B	Option C
Vulture population			
	Stable	Declining	Declining
Species diversity			
	0 species extinct	6 species extinct	6 species extinct
Volunteer Time Contribution per month			
	10 hours volunteered	2 hours volunteered	0 hours volunteered

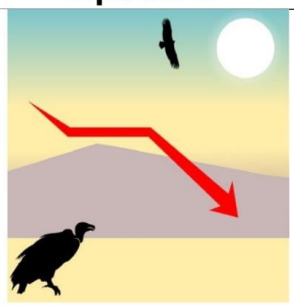
( ) Option A

( ) Option B

( ) Option C

H. Choice Questions (Block 4)

62) Please choose ONE of the three options:

	Option A	Option B	Option C
Vulture population			
	Stable	Increasing	Declining
Species diversity			
	3 species extinct	0 species extinct	6 species extinct
Volunteer Time Contribution per month			
	2 hours volunteered	10 hours volunteered	0 hours volunteered

( ) Option A

( ) Option B

( ) Option C

H. Choice questions

63) How did you make your choices?

( ) Considered all three features simultaneously

( ) Considered two of the features

( ) Considered only one of the features

( ) Used my intuition

( ) Made random choices

( ) Don't know

( ) Other - Specify: _____

64) In making your choice, how important were the following features to you?

	Not at all important	**Not important**	**Neutral**	**Important**	**Very important**
Vulture Population	( )	( )	( )	( )	( )
Species Diversity	( )	( )	( )	( )	( )
Volunteered days per month	( )	( )	( )	( )	( )

I. Demographic and Other Information

65) Age?

( ) Under 18

( ) 18-25

( ) 26-35

( ) 36-45

( ) 46-55

( ) 56-65

( ) Over 65

66) Gender?

( ) Female

( ) Male

( ) Other

( ) Decline to answer

67) What is the highest level of formal education you have completed?

( ) None

( ) Primary School

( ) Secondary School

( ) College/University

( ) Decline to answer

68) How many members are there in your household (living together under one roof)?

Children: _____

Adults of working age: _____

Adults over working age: _____

69) Please indicate your monthly household income (in US$)?

( ) Under $100

( ) $100 - $500

( ) $500 - $1,000

( ) $1,000 - $3,000

( ) $3,000 - $6,000

( ) $6,000 - $10,000

( ) Over $10,000

( ) Decline to answer

70) What is your household's primary source of income?

( ) Livestock

( ) Agriculture

( ) Wholesale and Retail trade

( ) Tourism

( ) Business

( ) Education

( ) Transportation

( ) Other employment - Specify: _____

71) How long have you been living in this area?

_____

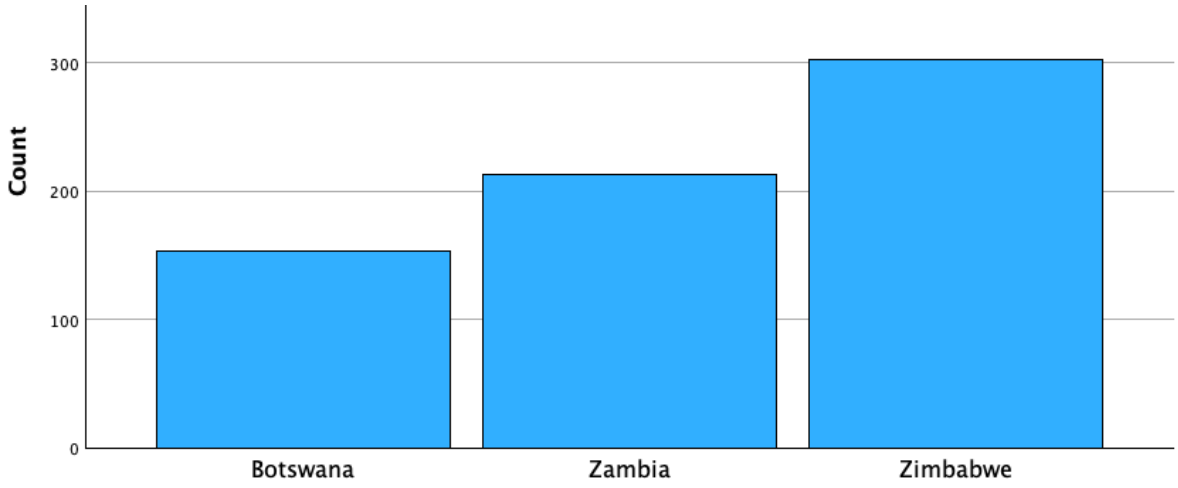
Thank You!

Thank you for taking our survey. Your response is very important to us.

12. Appendix 2. Local community survey results

Sample size by country

	N	Percent
Botswana	153	22.9
Zambia	213	31.9
Zimbabwe	302	45.2
Total	668	100.0



General Environmental Awareness

Member of an environmental group/organization (percentage of respondents)

	Botswana	Zambia	Zimbabwe	All
No	73.2	85.1	62.3	72.0
Yes	26.8	14.9	37.7	28.0

Donated money to an environmental cause in the last 12 months (percentage of respondents)

	Botswana	Zambia	Zimbabwe	All
No	93.5	96.2	91.7	93.5
Yes	6.5	3.8	8.3	6.5

Volunteered time for an environmental cause in the last 12 months (percentage of respondents)

	Botswana	Zambia	Zimbabwe	All
No	49.0	78.0	35.0	51.8
Yes	51.0	22.0	65.0	48.2

Water pollution level of concern (percentage of respondents)

	Botswana	Zambia	Zimbabwe	All
Not at all concerned	21.6	18.2	10.4	15.5
Slightly concerned	22.2	1.0	5.0	7.7
Moderately concerned	7.2	3.8	5.4	5.3
Very concerned	37.3	45.5	31.9	37.4
Extremely concerned	11.8	31.6	47.3	34.1

Climate change level of concern (percentage of respondents)

	Botswana	Zambia	Zimbabwe	All
Not at all concerned	1.3	8.1	2.3	3.9
Slightly concerned	2.0	2.4	3.0	2.6
Moderately concerned	2.6	3.8	1.0	2.3
Very concerned	48.4	21.5	31.4	32.2

Extremely concerned	45.8	64.1	62.2	59.0

Species extinction level of concern (percentage of respondents)

	Botswana	Zambia	Zimbabwe	All
Not at all concerned	15.7	23.6	9.4	15.3
Slightly concerned	19.6	3.4	7.7	9.1
Moderately concerned	13.1	7.2	4.7	7.4
Very concerned	38.6	46.6	33.4	38.8
Extremely concerned	13.1	19.2	44.8	29.4

Deforestation level of concern (percentage of respondents)

	Botswana	Zambia	Zimbabwe	All
Not at all concerned	7.8	9.1	6.0	7.4
Slightly concerned	15.0	5.3	6.0	7.9
Moderately concerned	8.5	3.8	6.0	5.9
Very concerned	51.6	36.5	28.2	36.3
Extremely concerned	17.0	45.2	53.8	42.6

Knowledge of Vultures

Vultures are birds of prey that feed on animal carcasses (percentage of respondents)

	Botswana	Zambia	Zimbabwe	All
Agree	95.4	88.9	91.3	91.5
Disagree	0.7	1.9	0.7	1.1
Do not know	3.9	9.2	8.0	7.4

Seen vultures in the wild (percentage of respondents)

	Botswana	Zambia	Zimbabwe	All
No	2.6	12.0	7.3	7.7
Yes	96.1	84.1	89.7	89.4
Do not know	1.3	3.8	3.0	2.9

Know traditional stories/tales about vultures (percentage of respondents)

	Botswana	Zambia	Zimbabwe	All
No	67.8	73.6	61.5	66.7
Yes	32.2	26.4	38.5	33.3

Vultures prevent the spread of diseases by disposing of carcasses (percentage of respondents)

	Botswana	Zambia	Zimbabwe	All
Agree	75.8	56.9	80.0	71.8
Disagree	2.6	3.8	3.0	3.2
Do not know	21.6	39.2	17.0	25.1

Sometimes vultures kill livestock in this area (percentage of respondents)

	Botswana	Zambia	Zimbabwe	All
Agree	11.8	7.7	9.3	9.4
Disagree	53.6	78.5	67.8	67.9
Do not know	34.6	13.9	22.9	22.8

Sometimes people in this area poison carcasses to kill vultures (percentage of respondents)

	Botswana	Zambia	Zimbabwe	All

Agree	52.3	8.7	21.7	24.7
Disagree	18.3	63.9	45.3	44.9
Do not know	29.4	27.4	33.0	30.4

We should conserve vultures for future generations (percentage of respondents)

	Botswana	Zambia	Zimbabwe	All
Agree	96.1	86.5	92.7	91.5
Disagree	0.7	4.3	0.7	1.8
Do not know	3.3	9.1	6.6	6.6

Perceived change in abundance of vultures during the past 5-10 years (percentage of respondents)

	Botswana	Zambia	Zimbabwe	All
Increased a lot	2.0	18.3	42.3	25.4
Increased a bit	2.6	10.1	10.3	8.5
No change	13.7	8.7	4.7	8.0
Decreased a bit	30.1	22.1	7.0	17.1
Decreased a lot	43.1	11.1	2.0	14.4
Do not know	8.5	29.8	33.7	26.6

Aware of vulture conservation efforts in your community (percentage of respondents)

	Botswana	Zambia	Zimbabwe	All
No	9.2	76.0	25.1	37.4
Yes	42.5	15.4	60.9	42.3
Do not know	48.4	8.7	14.0	20.3

Perceived effectiveness of conservation efforts in protecting vultures (percentage of respondents)

	Botswana	Zambia	Zimbabwe	All
Not at all effective		1.4		0.4
Not effective	7.2	3.3		2.7
Neutral	15.0	1.9	2.0	4.9
Effective	17.0	8.0	20.2	15.6
Very effective	3.3	0.5	38.4	18.3
Do not know	57.5	85.0	39.4	58.1

Brief summary of traditional stories/tales
Vultures help us by cleaning the ozone layer
A lot of prophets use vulture heads to make predictions
A pregnant woman is not allowed to walk under vulture nest because it may affect the child birth
A proverb that says a vultures eat every meat but don't kill
A vulture is a very patient animal
Appeasement of spirits
Belief vulture stop rain when nesting
Believe if you kill vulture all family members will die too
Carcasses are used for rituals by traditional healers
Clean environment and decorate environment
Cleaning of ozone layer & reduction of diseases to our animals
Cleaning the environment

Cultural tale thats say dont see vulture flying far it will come down
Culturally associated with prophet due to its ability do locate things from far
Culturally, their parts have medicinal properties, and the head is used by prophets and traditional healers
Detecting dead animals
Eating dead animals
Eating dead cows
Eggs, bones and further are for traditional use
Enabling them to locate dead livestock
Fat from vulture head , heart mixed with food to fed dog which enhances its ability to sniff things
for healing and other ritual purposes
For making traditional healers to dream of madicine in their sleep
Gizzard use to perform lucky rituals
Grow up knowing vulture is not consumed by humans because vultures can eat dead people too
Guessing work
Hearsay of other people using nest
Hearsay of traditional healers use2C and2C no rain are sign of vulture nesting in nearby areA
Hearsay of Use of vulture parts for traditional use
Hearsay of vulture fats used to treat human illnesses
Hearsay that it is a sign of good luck
Hearsay traditional healers use vulture parts
Hearsay vulture chicks if they are very small in the nest prevent rainfall because they will be still nesting
Hearsay when saying vulture laying eggs when the chick open the month its a sign of stopping the rain in my culture

help to treat child physical problems
Helps to locate a dead animal
His culture belief vultures stop rain when there is time for vultures to lay eggs on trees
I hear that vultures dream about where there is a dead animal.
I know of traditional that they use vulture parts as medicine.
I see from a distance I don't feed on live animals ,but on dead animals
I've heard they bring some form of luck
If vulture lay egg before time there will be no rain
If you see vultures, sign of dead animal
In calture the ez a phrase which says uzodliwa ngamanqe (you will be eaten by vultures if you keep on doing doing your bad deeds)
In kedia people kill vultures as a belief that they prevent rainfall
In short tradittional healers used vulure parts to enhance their medicine
It feeds on dead animals
It feeds on dead animals / human and in the process it keeps the environment clean.
Its rare for rain to rain where there is Vulture nest
Know that trad healers use parts for ritual purposes
Let us know
Locating dead livestock
Lucky to make money and run away from the police2C and also predicting
Mixed vulture bill ,heart to boast dog sniffing ability
Mostly traditional healers are a threat to the vulture community
Mostly used by Traditional healers
Nganga use it for dreaming like what the valuture use to do
Not

Old cultural saying to mean helping each other
Once you see them, you know that there is a carcass.
One lost cow was being eaten by the vultures
People say vulture body parte help to heal
Pregnant women will have difficulties when she see vulture nest in my culture
Prophets uses vultures legs to catch thieves en eyes
Proverb says don't see vulture flying up it will go down meaning even of you get rich you will be poor sometimes - tswana saying
Rituals are performed using vultures parts
Sangoma need dead vultures in a serious way
She grow up in old days told to not eat vulture
Should not pass understand vulture nest with chicks,as it associated with risk to children
Sign of dead carcass in the area if spotted
some people believe that vulture parts make powerful traditional medicine.
Some people say vultures dream about where there is meat.
Some people say vultures dream about where there is meat
Some prophets use vulture parts to gain the ability to guess then pose as if they're prophesying
Some say they signify rains
Still born child can have walking difficulties if the mother walk under Vulture nest
Stories say vulture parts enhance ce traditional medicine
That once they eat too they cant fly
That parts of vultures enhance traditional healers to dream for the future
That traditional healers believe that vulture parts can enhance their prowess in their medicine
That traditional healers use vulture parts and mix them with their medicine.

That traditional healers use vultures for ritual purposes
That vultures clean the environment
The bird should not be eaten and can never be eaten
The bones are used by traditional dancers and some people use the head to gain the ability to dream/guess
The feathers are used for treating epilepsy
The head and beak are used for some traditional stuff
The head is used for juju in order to run away from police, and for lucky in making money
The head is used to bring luck
The head of a vulture gives one the ability to guess correctly
The head of a vulture is used for prophecy
The head of a vulture is used to bring you the power of guessing correctly
The let us know were cows are
The let us know what is going on the wild
The need the brains & bones for vulture becoz the believe they dream
The traditional healers says a vultures ez a good dreamer for its food
The traditional healers use vultures bones
The use bones
The vultures some ailments & are used by traditional healers
Then a person passes in an area where they are breeding, the chase away the person.
There ez a belief that if you put the vulture head head you will dream.//prophetic
There ez a belief that the vulture head and bones make them to dream dream of their remedies
There flights around the area signifies presence of carcass
There is a bird (chapungu) that feeds on carcasses and then sends a signal to the vultures so that they come and feed

These birds guided hunters to animals, dead or close to dying
They are used by traditional healers
They are used to bring luck to someone who's looking for money or riches
they believe that vulture bones and feathers make them to have powers obove others hence the vultures is the only bird which flies over other birds and have good eye sight
They clean the ecosystem
They clean the environment
They don't step on each other's feet
They dream of where to find food
They ez that it's head ez mixed with their remedies for dreaming at nite to for see the future
They help reduce livestock diseases
They just dream of there's a dead animal
They think that the vulture bones make them to dream better and above all for seeing the future
They use vultures feet, brains and bones
They use it for medicine in treatments of their clients
They use vultures bones for their remedies
To clean the environment
To locate dead animals
To locate the dead carcasses
Traditional healers use vulture parts
Traditional believe that vulture bones mixed with their remedies makes them to forsee their medicines in their sleep
Traditional doctors and ptophets use vulture heads to gain powers to see
Traditional healer believe that when use vulture bones you can fortell the future
Traditional healers and prophets use vultures in predictions

Traditional healers believe that vulturesbones and feathers can make them to forsee future
Traditional healers foretell using vulture heads
Traditional healers need vulture bones to enhance their medicines
Traditional healers use bones & head of vultures for their medicine
Traditional healers use the vultures for dreaming,to forsee future
Traditional healers use them as their juju
Traditional healers use vultures as part of their medicine
Traditional healers used vulture feathers to make their head gears & also hullilating to seee vultures flying over his strad ez a simbol of being recognised by ancestral spirits
Traditional healers uses some parts of vulture carcass
traditional healers uses vulture bones for healing their patients
Traditional leaders said if you put the vultures bones on neck your you will super dream and have more power
Traditional medicine
Traditional purposes
Traditional uses vultures brains mixed with their remedies to predict green pastures
Treat children diseases
Use for ritual purposes
Use of vulture nest use for ritual purposes
Use of vulture nose for dogs to be able to sniff things much better
Use vulture nest for to perform ritual
Used by traditional healers for prophetics
Vulture are believed to used on remedies for vulture brainse to make them dream
Vulture bones and heads are used by some people to bring luck to themselves
Vulture bones make traditional healers to dream more

Vulture carcass is a muti in African belief
Vulture eat on same flock in tswana culture proverb
Vulture head for dreaming too much
Vulture head is used for predictions by traditional healers and prophets
Vulture head is used in escaping the police
Vulture head mixed with traditional medicine for ritual purposes
Vulture heads, eggs and feathers are used by traditional healers, and they have some medicinal properties
Vulture is a conserved bird in my area
Vulture is symbol identification of death of any animal or human being
Vulture nest and meat used for ritual purposes
Vulture nest believed as a cause of lack of rain
Vulture nesting cause rain short if found
Vulture parts are used by traditional doctors
Vulture parts are used for rituals
Vultures are used by traditional healers. For trat healing some dirase but you should have authority from wildlife agency
Vultures are
Vultures are "prophets" and with that, people hunt them down for that ability
Vultures are only seen when there's a dead animal
Vultures are special birds used in rituals
Vultures are used by people from ZINATA
Vultures are used by some to acquire the power to prophesy
Vultures are used for witchcraft
Vultures are used in traditional medicines in order to gain the power of guessing correctly (kufembera)

Vultures are used to bring luck
Vultures are used to bring luck and the ability to guess
Vultures are used to gain the ability to dream
Vultures are very special birds which feeds on dead animals
Vultures believed by people that they have certain during ceremonies like rain calling if you see them flying actrooss were you held the ceremony it's sign of acceptance for the rain to come to in shot period
Vultures bones & feathers are used for dreaming good
Vultures bring luck
Vultures bring luck or the ability to guess. They also draw money or riches towards one
Vultures can be kilometers away but still detect the animal
Vultures can dream where their next meal will be so people hunt them down for that ability
Vultures can fly long distances to feed the dead animal
Vultures can in a dry pull of water to eat fish and also dead animals
Vultures can see a dead animal at a distance of 36Km
Vultures can see from afar the carcasses
Vultures can spot dead animals
Vultures can warn you about dangerous animals in the environment
Vultures carry diseases away from children and people
Vultures dream about where there will have their next meal
Vultures dream were there ez carcass / when you secure the chick of of vulture on with legs with a string hope that they do not escape when they grow up it is said the parent one will come with a root that will cause the string to bread and believed that if take the root and crush inti powder and introduced it into one blood through incision marking if handcuffes are put on the arms of such a person they don't work & will fall down due to magic of vultures roots
Vultures feathers treat ailments & head &bones are traditional healers
Vultures have some medicinal properties

Vultures have the ability to dream so people hunt them down for that reason. However, it is impossible to get them otherwise they would've been extinct by now
Vultures have the ability to dream so people want the heads for that reason
Vultures live by feeding on animal carcass
Vultures works too much to traditional healers for making dream better and forsee future
When sick they hide to avoid detection when dead.
When a child doesn’t listen to his/her parents will follow vultures law that is related to vultures dead animals
When an animal dies they go to it. And when animal is sick they attack it by spearing the eyes first.
When livestock die, vultures are seen.
When see them, there's a dead animal
When vulture seen flying is spotting something on the ground
When we see a vulture we know there's something there
When we see a vultures, there is a carcass somewhere
When we see vultures flying we know that something has died.
When we see vultures flying, we know there's a dead animal
When we see vultures it's a sign that an animal has been killed.
When we see vultures we know something is dead
When you see a vulture there is a carcass
When you see that bird it means there's something dead
When you see them, there's a dead animal
When you see vultures circling, there is carcass.
When you see vultures, there's carcass
When you vultures there's carcass

Use of vultures

Vulture parts used in traditional medicine (percentage of respondents)

	Botswana	Zambia	Zimbabwe	All
No	3.9	29.7	48.7	32.3
Yes	26.8	17.7	23.3	22.4
Do not know	69.3	52.6	28.0	45.3

Visit traditional healers that use vulture parts in their remedies (percentage of respondents)

	Botswana	Zambia	Zimbabwe	All
No	96.1	87.1	83.4	87.5
Yes	3.3	6.2	5.6	5.3
Prefer not to answer	0.7	6.7	11.0	7.2

Cost of services when vulture parts are used (USD/visit)

	Mean	Median	N
Botswana	15.0000	15.0000	2
Zambia	43.3333	15.0000	3
Zimbabwe	70.0000	85.0000	10
All	57.3333	50.0000	15

Other use of vulture parts (percentage of respondents)

	Botswana	Zambia	Zimbabwe	All
No	3.9	57.4	57.7	45.2
Yes	13.7	11.5	18.3	15.1
Do not know	82.4	31.1	24.0	39.7

Brief description of other uses of vulture parts
Bones and egg shells make medicine
Bones and egg shells make traditional medicine
Bones and eggs are used for making medicine
Bones and eggs are used for traditional medicine
Bones are for making medicine
Bones are used by traditional dancers
Bones are used by traditional dancers and doctors
Bones are used for making traditional medicine
Bones are used in African traditional religion (dancing) and by traditional healers
Bones are uses for medicine preparation
Brain is used for intelligence
Brain for magic
Brain for medicinal purposes like detections
Clean of all dead animals carcass
Clean of ozone layer
Clean of ozone layers & reducing of diseases of livestock
Cleaning of ozone layers & reduction of animal diseases
Cleaning of ozone layer
Cleaning of ozone layer and reduction of diseases
Cleaning of ozone layer to show us were there is a dead or trapped animals
Cleaning of the ozone layer & reduction of animal diseases
Cleaning ozone layers
Cleaning up dead animals

Disposal of carcasses
Do not know what they use them for
Eggs and bones are used for traditional medicine
Eggs help to reproduce more vultures in our area
Eggs shells are used by traditional healers
Feathers
Feathers and bones are used for decoration
Feathers and vulture nest used to perform rituals for child with walking difficulties
Feathers are used for decoration
Feathers bring luck
Feathers for dusting
Feathers help to treat child physical problems
Feathers use for ritual purposes
For decoration
For prophesies and rituals
For ritual purposes
For ritual purposes and treating child diseases
For rituals purposes and help child with walking difficulties
From the past my elders Used vulture nose when dead, they didn't kill directly
Head use to make dogs effective to identity things very quickly as because of vulture ability to indentify things from far
Help to perform rituals for child with walking difficulties
I am not sure but people definitely use the beaks and feathers
I just know that people use the feathers
It is believed they protect families from bad omen

Making feather duster with feathers
Making of traditional medicine
Medicinal purposes
Medicinal use
Medicine
Mix vulture feather plus wood particle from nest to perform ritual to the child joint to boost walking capability
Mostly used by traditional healers
Ornaments
Scull for forecasting
The claws, beak and feet are used to make traditional medicine
The help by vulture they can show you where there is a dead animal
Used to know where the cows are
The nose can be used to detect someone's program
The use head
They help by reducing the animal diseases & cleaning of ozone layer
They are used to give power to an individual
They help prevent diseases.
They help to reduce the animal disease spreading in our community
They identify the location of missing animal carcass
To bring luck to individuals
To clear carcass; reduction of diseases
To eat the carcass and ozone layer cleaning
Tourism
Traditional healers use almost every part of a vulture

Traditional medicine
Treating epilepsy
Treatment of headache
Use of feathers for ritual use to child not walking
Use of feathers to stillbirth child with walking difficulties
Use of vulture head to mix with traditional medicine for lucky
Used to made traditional medicine to heal sicknesses
Vulture bones are used for child with walking difficulties
Vulture head is used for ritual purposes
Vulture brains are used by traditional healers to dream

Apart from the use of parts, do vultures have any other importance (percentage of respondents)

No	0.7	27.3	22.3	18.9
Yes	90.8	55.5	59.0	65.3
Do not know	8.5	17.2	18.7	15.9

Brief description of importance of vultures in the community

Cleaning the area against all dead and smelling animals
Clean environment by eating carcasses
Are an important component of the ecosystem
As scouts we usually check on vultures for dead and snared animals thus why they are very important
Attract tourists in the country
Balance ecosystem by eating dead animals

Balancing ecosystems
Balancing the ecosystem
Beautifying our environment
Bird tourism
By cleaning and eating dead animals
By cleaning the area of dead animals to prevent smell
By eating all carcasses of our livestock and reducing the smell of rotten carcasses
By eating carcases of animals that could have died as a result of diseases.
By eliminating the smell and the spread of disease around
By feeding on animal carcasses and reduction of diseases
By keeping our environment super clean
By keeping the environment clean in and around Gwayi
By keeping the environment clear of smell and spread of diseases
By reducing diseases
By reducing disease in our area
Clean animal carcasses in the environment
Clean carcases of dead animals
Clean carcases to stop pollution
Clean dead animals from the environment
Clean environment
Clean environment and help to locate dead animals
Clean environment and help locate dead animals
Clean environment and help to locate dead animals
Clean environment and helped to locate dead person 40 years back
Clean environment and locate dead animals

Clean environment and locate dead animal carcasses
Clean environment and signal of carcasses
Clean environment by disposing carcasses of dead animals
Clean environment by eat dead animals and tourist attraction too
Clean environment by eating carcasses
Clean environment by eating carcasses
Clean environment by eating carcass
Clean environment by eating carcasses
Clean environment by eating carcasses of dead animals hence stopping spread of diseases
Clean environment by eating dead animals
Clean environment by eating discomposed bodies of animals
Clean environment by eating left overs of carcasses
Clean environment by feed on carcasses
Clean environment by feed on dead animals
Clean environment by feeding on animal carcasses
Clean environment by feeding on carcasses
clean environment by feeding on dead animals
Clean environment by feeding on dead animals
Clean environment through eating carcass
Clean environment through eating dead animals
Clean environment through eating dead animals
Clean of ozone layer and reducing animal diseases
Clean of ozone layer en disposing of carcass
Clean surroundings and reduce carcasses and pollution
Clean the environment

Clean up team for carcass are vultures
Clean up the outbreak and identify if there's a dead animal in the area
Cleaning
Cleaning of ozone layer
Cleaning of ozone layer & diseases reduction
Cleaning of ozone layer & cleaning of carcass of our livestock by disposing it
Cleaning of carcases disposed.
Cleaning of dead animal carcass
cleaning of dieases and ozone layer
Cleaning of environment /ozone layer
Cleaning of environment & reducing dease
Cleaning of ozone layers & reduction of animal diseases by disposing the carcass
Cleaning of ozone layer
Cleaning of ozone layer, plus reducing diseases for our animals
Cleaning of ozone layer & diseases reduction
Cleaning of ozone layer & reduction of animal diseases
Cleaning of ozone layer & reduction of animal diseases
Cleaning of ozone layer & reduction of cattle diseases
Cleaning of ozone layer & reduction of diseases
Cleaning of ozone layer & reduction of diseases on our community
Cleaning of ozone layer & reduction of diseases
Cleaning of ozone layer & reduction of diseases
Cleaning of ozone layer & reductions diseases in our animals
Cleaning of ozone layer & reduction of diseases
Cleaning of ozone layer and reduction of animal diseases

Cleaning of ozone layer and deposing of carcass
Cleaning of ozone layers, reduces animal diseases
Cleaning of ozone layers & reduction of diseases
Cleaning of ozone & reduction of diseases
Cleaning of the diseases and maintain fresh air of carcass smells
Cleaning ozone, reduction of animal diseases
Cleaning ozone layer & reduction of diseases
Cleaning ozone layer &diseases. Reduction
Cleaning ozone layer and reducing our livestock disease
Cleaning the environment
Cleaning the environment of carcasses
Cleaning the Park
Cleaning the parks
Cleaning the parks and comments
Cleaning up of dead carcasses
Cleaning up the environment
Cleaning up the environment by feeding on carcasses
Cleaning up the environment by feeding on the carcasses
Cleaning up the environment of the carcasses
Cleaning of ozone layer
Contribute to beaty of the environment
Controlling of diseases by feeding on carcasses
Cultural reasons
Culture enhancement
Culture wise

Diseases reduction on our anal in our community
Diseases reduction on our live. Stock by disposing of carcass on animals
Detecting dead animals
Detecting dead livestock
Detecting/signalling dead animals
Disposal of carcasses
Disposing carcasses
Disposing the carcasses
Eat all dead and smelling animals
Eat carcasses that could be decomposed in the environment causing bad smell and help to locate dead animals
Eat dead animals and leave clean environment
Eating carcasses
Eating dead animals
Eating diseased dead animals
Eating diseased dead livestock
Feed on carcasses of dead animals in the environment
Feed on dead animals
Feed on dead animals and help to locate dead animals
Feeding on dead animals
Feeding on dead animals and leaving a clean environment
For detecting dead animals
For ecosystem balancing
For kids to know about vultures.
For signal of carcasses

For signal of the dead animal
For the next generations to see vultures.
Getting rid of all dead &smelly animals in the vicinity
Getting rid of smell and the spread of diseases
Giving signal of the carcasses
Guide farmers to locate dead animals and it clean everything environment
Help farmers to locate dead animals and clean discomposed bodies of animals
Help farmers to locate dead animals and clean environment
Help farmers to locate dead animals and clean environment
Help farmers to locate missing animals
Help heal to locate dead animals and clean environment
Help locate animal carcasses killed by predators
Help locate dead animals
Help locate dead animals and clean environment
Help locate dead animals, also clean environment
Help reduce the likelihood of diseases and help locate dead cows
Help to clean environment
Help to guide farmers dead animals and clean environment
Help to guide farmers to dead animals
Help to identify dead animals and clean environment
Help to identify dead animals in the environment
Help to keep the environment clean
help to locate dead animals
Help to locate dead animals
Help to locate dead animals and clean carcasses of dead animals

Help to locate dead animals and clean dead animals from environment
Help to locate dead animals and clean environment
Help to locate dead animals and clean environment
Help to locate dead animals and clen environment
Help to locate dead animals and curb stock thefts in my area
Help to locate dead animals and it clean environment
Help to locate dead animals and leave clean environment
Help to locate dead animals and they clean environment by eating dead animals
Help to locate dead animals and traditional belief
Help to locate dead or about to die animals
Help to locate lost domestic animal
Help us locate dead or dying animals
Helps showing of the dead animal
Helps the community to detect dead animals
Helps to locate a dead carcass
Helps us clean the environment
Helps us identify the dead animal
I heard some people saying vultures can eat an antiras killed animal carcass & don't die
Importance for tourism
They would attract tourist to this area. They also clean the environment
Indicating the dead animal
Keep our place fresh from smells of animal carcasses
Let us know where cows are
Let us know where cows
Let us know where cows are

Let us to know where cows are
Locate dead animal and clean up environment to stop spread of diseases
Locating dead cows
Locating dead livestock
Locating livestock
Locating lost domestic animals
Locating the Lost cow and cleaning up dead animals
Locating the missing livestock
Medicine boosting
Mostly helps prevent people from feeding on the poisoned carcasses
Ozone layer cleaning & disease reduction
Part of the ecosystem
Prevent spread of diseases
Prevent spread of diseases by eating animal carcasses and help to locate dead animals of
Reduction of animal diseases
Reduction of animal diseases by disposing carcasses
Reduction of diseases
Reduction of diseases and carcass clearance
Reduction of diseases on our livestock & cleaning of ozone layer
Scavenge carcasses of dead animals hence cleaning environment
Showing dead animals
Signal presence of carcasses
Signalling dead
Signalling of carcasses
Signalling of the carcasses

Signalling of the carcasses in the area, even the lost dead person
Signalling of the dead animal
Some people say they prevent the spreading of diseases
Sometimes they show you where your dead animal is
Spotting carcasses
Spotting dead livestock
Stopping the spread of diseases by eating dead animals
The availability of vultures in the area is important.
The availability of vultures in our area help people to know about vultures
The clean the comments
The clean the environment
The cleaning of Park
The get rid of smell and diseases in our community
The help clean the environment
The help generate tourism revenue
The help locate carcasses
The let us know where cows are
They clean the environment
They act as sign language to show where dead animals are
They act as a municipality force.
They act as municipality workforce
They act as the ministry of health
They alert us in case of dead livestock
They are a component of the ecosystem
They are a municipality workforce

They are garbage cleaners as far as carrion is concerned
They are part of our beautiful environment
They are very important in cleaning the ozone layer and protect the spread of diseases
They clean the ozone layer
They clean our environment and reduce diseases
They clean the area and dispose of any dead animals
They clean the area and protect against diseases
They clean the bush from smelling dead animals
They clean the environment
They clean the environment
They clean the ozone layer
They clean up forests and help us locate our livestock/carcasses
They clean up forests by disposing carcasses
They direct us to where meat is (dead animals)
They dispose of any animals that could have died of any disease or leftovers from lions and hyenas
They do a lot of welfare against rotten meat from dead exposed animals
They eat all dead animals and prevent smell and diseases in our community
They feed on carcases in the area and they help us locate livestock carcasses
They get rid of all dead and smelly carrion helping the environment to be super clean
They get rid of all rotten meat in our community
They get rid of any dead animal and that help keep surrounding clean
They get rid of the spread of diseases
They give signal the presence of carcasses
They give signals in case we have dead livestock

They generate income through tourists who want to see vultures.
They help balance up the ecosystem
They help clean int environment
They help clean the environment by getting rid of all carrion and smell at the same time.
They help clean the environment
They help locate carcasses of our dead livestock
They help locate dead/list livestock
They help locate livestock carcases
They help patrollers identify dead animals
They help prevent the likelihood of spread of diseases
They help reduce the spread of diseases
They help to clean the environment by eating the dead carcass
They help us identify our dead livestock
They help us locate livestock carcasses
They help us locate our livestock carcasses
They help us locate our missing and dead livestock
They help us locate where dead animals are
They keep the bush clean by eating all rotten stuff.
They keep the ozone clean
They lead us to our dead animals killed by lions and clean the ozone layer
They play an important role by leading you to a dead animal
They prevent all the odour and the spread of diseases in our community
They protect and clean the ozone layer
They protect the spread of diseases
They protect the spread of diseases.

They raise alarm in case of dead livestock
They reduce the animal diseases
They reduce diseases and maintain clean fresh air at all the times
They reduce the spread of diseases
They serve as cleaners and protect the environment
They show us where our dead animals are
They show us where our dead animals are
They show us where there is a carcass or an animal that's about to die
They show us where there is an animal carcass
They signal presence of carcasses
They signal the presence of carcasses
They're important in the ecosystem
They're part of our culture and environment
To clean environment by eating dead animals
To clean environment by feeding on the carcasses
To clean the environment
To clean up dead animals
To consume dead carcases around
To locate a dead animal for example our livestock
To locate a dead carcass
To locate dead animal
To locate dead animal eg. our cattle or game animal
To locate dead animals
To locate dead carcass
To locate dead carcasses

To provide a balance in the ecosystem
To reduce the spread of diseases and clean the ozone layer
To reduces diseases & clean ozone layer
To stop the spread of diseases by eating the carcass
Tourism purposes
Used for signal of dead animals
Used to detect missing livestock
Vulture mucus is used by traditional healers and spiritual healing prophets
Vulture's the let us know where cows are
Vultures act as the municipality workforce as they clean the environment and the ozone layer as they clean the environment
Vultures brains are used to dream more by traditional healers
Vultures clean environment
Vultures clean the environment
Vultures clean the environment by eating all dead animals around
Vultures get rid of diseases that kill animals around
Vultures help reduce the spread of diseases
Vultures help to locate carses
Vultures keep the environment cleansed
Vultures keep the forest tidy by eliminating all carrion and purifying the ozone layer by eating all dead animals at the earliest possible time.
Vultures prevent the spread of diseases
Vultures protect the spread of diseasess
Vultures reduce the spread of diseases

Vultures though some people consider them as ugly birds they play a very important role by consuming all dead and rotting mammalia keeping the ozone layer as fresh and healthy as ever
Vultures can easily lead you to your missing and dead animal
We see by vultures where dead animals are

Role of vultures for disposing of livestock carcasses

Household keeps livestock (percentage of respondents)

	Botswana	Zambia	Zimbabwe	All
No	30.7	27.6	55.9	41.2
Yes	69.3	72.4	44.1	58.8

Mean number of livestock per household

	Botswana	Zambia	Zimbabwe	All
Cows	27.56	18.69	8.67	18.09
Goats	20.88	12.5	10.98	14.84
Sheep	4.85	6.1	2.24	4.03
Chickens		16.11		16.11

Mean number of livestock mortalities per household during the past 3 years

	Botswana	Zambia	Zimbabwe	Total
Cows	17.03	5.81	2.43	8.38
Goats	11.77	4.83	4.28	7.31
Sheep	0.93	1.17	0.79	0.9

Chickens		10.14		10.14

Dispose of livestock carcasses by burning/incineration (percentage of respondents)

	Botswana	Zambia	Zimbabwe	All
Never	52.8	59.4	61.1	58.1
Rarely	28.7	18.9	13.0	19.6
Often	0.9	9.8	9.9	7.3
Mostly	17.6	11.9	16.0	14.9

Dispose of livestock carcasses by burying (percentage of respondents)

	Botswana	Zambia	Zimbabwe	All
Never	51.9	53.8	64.6	56.9
Rarely	31.5	11.0	12.3	17.2
Often		17.9	13.1	11.2
Mostly	16.7	17.2	10.0	14.6

Dispose of livestock carcasses by eating (percentage of respondents)

	Botswana	Zambia	Zimbabwe	All
Never	30.6	26.5	61.8	39.6
Rarely	52.8	12.2	18.3	25.6
Often	1.9	19.0	9.9	11.1
Mostly	14.8	42.2	9.9	23.6

Dispose of livestock carcasses by vultures (percentage of respondents)

	Botswana	Zambia	Zimbabwe	All

Never	66.7	83.3	70.2	74.2
Rarely	29.6	11.8	11.5	16.7
Often	0.9	3.5	7.6	4.2
Mostly	2.8	1.4	10.7	5.0

Dispose of livestock carcasses by other scavengers (percentage of respondents)

	Botswana	Zambia	Zimbabwe	All
Never	63.9	87.7	59.5	71.4
Rarely	33.3	6.8	22.1	19.5
Often		4.1	7.6	4.2
Mostly	2.8	1.4	10.7	4.9

Mean time cost of burning or burying a livestock carcass (hours)

Botswana	Zambia	Zimbabwe	All
3.71	3.7	6.51	4.49

Use vultures to locate the carcasses of missing livestock (percentage of respondents)

	Botswana	Zambia	Zimbabwe	All
No	38.5	16.1	48.4	33.2
Yes	61.5	83.9	51.6	66.8

Mean time cost to locate missing livestock animal/carcass (days)

	Botswana	Zambia	Zimbabwe	All
Without vultures	2.1143	2.9447	2.1686	2.5472
With vultures	2.0972	1.1875	1.7263	1.7287

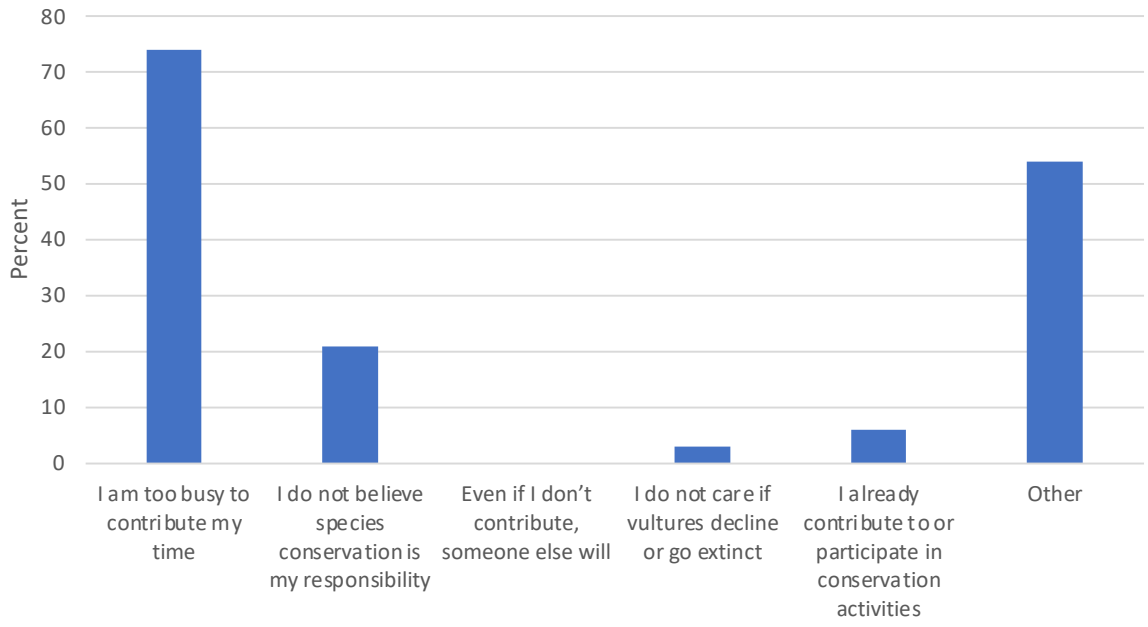
Vulture Conservation

In principle, would you be willing to contribute some of your time to support vulture conservation (percentage of respondents)

	Botswana	Zambia	Zimbabwe	All
No	18.2	38.1	21.4	25.9
Yes	81.8	61.9	78.6	74.1

Reason for not being willing to contribute your time to support vulture conservation in principle (percentage of respondents)

	Botswana	Zambia	Zimbabwe	All
I am too busy to contribute my time	44.8	60.5	28.3	46.8
I do not believe species conservation is my responsibility	3.4	10.5	22.6	13.3
I do not care if vultures decline or go extinct		1.3	3.8	1.9
I already contribute to or participate in conservation activities			11.3	3.8
Other	51.7	27.6	34.0	34.2



Other specified reasons for not being willing to contribute your time to support vulture conservation in principle

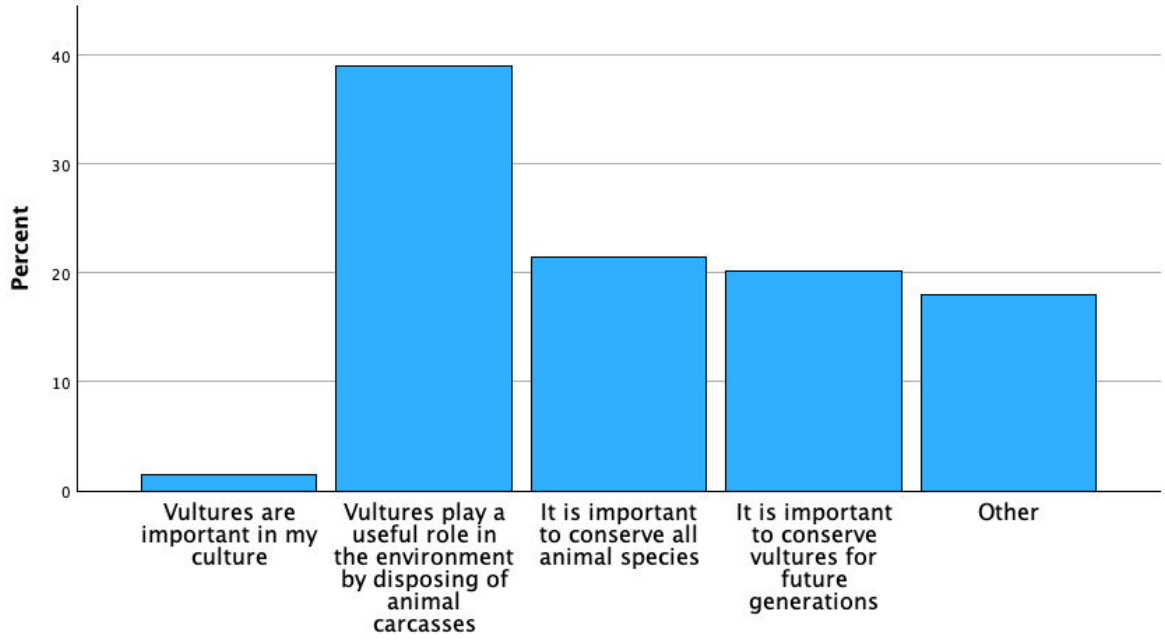
Collective responsibility
Do not know about importance of vultures
Due to health issues
health issues
Health issues
Health issues and aging
I am just not interested unlessI'm getting paid
I am too old
I can't answer
I Do not know because they are not seen
I Do not know it so I Do not know how to keep it
I Do not know much about vultures
I Do not know the importance of the bird

I Do not know them just see them.in TV
I Do not know what to do
I do not see the reason to
I do not understand anything so how can I contribute
I do not usually see them or get close to them for me to help.
I don't see the benefit of the bird
I don't see the birds
I don't see the importance
I don't see the importance of the bird
I don't see the importance of the bird and I wouldn't contribute my time for free
I don't understand anything
I don't understand what this program is all about and how I can benefit from it
I would only contribute if I'm asked to do so and if I am paid.
I'm just not interested
I20do20not20understand20anything20about20vultures20
If it happens i can join
If it's not paying then it's not worth it
It's tricky because they move at night I can't know
Need to to be educated first to contribute my time
No particular reason
Not interested
Old age
Other commitments
People in my area not usually kill vultures

People should conserve vultures because it is important animal which does not destroy anything for humans
Poor health
There is nothing
They are not seen here
They are rarely seen
They don't come close to where I live
They move too much it's difficult to conserve them
Why should I help if I'm not getting paid
Will encourage others
Total

Reason for being willing to contribute your time to support vulture conservation in principle (percentage of respondents)

	Botswana	Zambia	Zimbabwe	All
Vultures are important in my culture	1.6	2.4	0.9	1.5
Vultures play a useful role in the environment by disposing of animal carcasses	20.6	43.7	46.8	39.0
It is important to conserve all animal species	6.3	19.0	31.4	21.4
It is important to conserve vultures for future generations	16.7	25.4	19.1	20.1
Other	54.8	9.5	1.8	18.0



Other specified reasons for being willing to contribute your time to support vulture conservation in principle

1 and 2 and all other importance
All of above and there is No life without vulture
1 and 2
1 and 2 above
1 and 4
1,2
1,2,3 and help to locate dead animals
2 , 3 and 4
2 and 3
2 and 4
2 and help to locate dead animals
2 and help to show you where there is dead animals
2 and vulture help farmers to locate dead animals

2, 3,4
2, 4 and for tourism use
2, and help to locate dead animals
2,3, and 4 and vulture is part of tourism attraction
2,3,4
2,4 and Help to locate dead animals
2,4 and vulture help to identify dead animals
3
3 and 4
4
All of above
All of above and help to locate dead animals
All of above and also help to locate dead animals
All of above and helping to locate dead animals
All of above and vulture help to locate dead animals
All of the above
All the above except option 3
All20of20above
Because they help clean they environment
Because they help locate carcasses
Because they prevent diseases from affectin my livestock
Depends on the importance
Environmental preservation and solutions
For future generation and to locate livestock carcasses
Help to guide us locate dead animals

Help to identify dead animals, 2
Help20to20locate20dead20animals20
I don't see the importance of the bird
I encourage others to conserve vultures
If I'm getting paid, I'd be willing to contribute my time
If it brings in some cash flow then why not
Just to know more about vultures
Source of income
The reasons are many. All of the above.
They bring balance to ecosystems
They give signal
To acquire knowledge
To know more about vultures
To know the importance of vultures
To learn about vultures
To learn about vultures.
Vulture are used as guide to locate dead animals in my areas
Vultures can bring income to the society
Vultures dont cause any destruction to anyone
Vultures20are20important20and20need20to20be20conserve20for20future20generations20

Maximum willingness to contribute time for vulture conservation (days per month)

	Botswana	Zambia	Zimbabwe	All

Mean	1.2	0.9	2	1.6
Median	1	0.3	2	1
N	50	109	216	375

Choice questions

Consideration of features when making choices (percentage of respondents)

	Botswana	Zambia	Zimbabwe	All
Considered all three features simultaneously	20.0	47.2	69.3	51.6
Considered two of the features	20.0	21.1	14.1	17.5
Considered only one of the features	48.4	20.3	7.5	20.6
Used my intuition	9.5	9.8	3.0	6.5
Made random choices	2.1	1.6	6.0	3.8

In making your choice, how important was Vulture Population? (percentage of respondents)

	Botswana	Zambia	Zimbabwe	All
NA	18.3	42.3	30.1	31.3
Important	36.6	32.4	18.9	27.2
Neutral	13.7	9.4	7.6	9.6
Not at all important	0.7	0.5	0.3	0.4
Not important		5.2	4.0	3.4
Very important	30.7	10.3	39.1	28.0

In making your choice, how important was Species Diversity? (percentage of respondents)

	Botswana	Zambia	Zimbabwe	All

NA	18.3	42.3	29.5	31.0
Important	42.5	30.0	18.5	27.7
Neutral	14.4	9.9	4.0	8.2
Not at all important		1.9		0.6
Not important	0.7	6.6	1.3	2.8
Very important	24.2	9.4	46.7	29.6

In making your choice, how important was the number of volunteered days per month? (percentage of respondents)

	Botswana	Zambia	Zimbabwe	All
NA	19.0	42.7	29.5	31.3
Important	22.2	29.1	25.8	26.0
Neutral	24.2	8.5	4.0	10.0
Not at all important	1.3	0.9		0.6
Not important	0.7	8.9	1.0	3.4
Very important	32.7	9.9	39.7	28.6

Demographic and other information

Age of respondent (years)

	Botswana	Zambia	Zimbabwe	Total
Mean	47.8	39.8	42.7	43.0
Median	51	41	41	41
N	152	208	289	649

Gender

	Botswana	Zambia	Zimbabwe	Total
Female	42.8	37.5	47.4	43.2
Male	56.6	62.5	52.2	56.5
Other			0.3	0.2
Decline to answer	0.7			0.2

Education

None	18.4	5.4	3.1	7.4
Primary School	19.1	40.5	14.0	23.6
Secondary/High School	40.1	46.8	55.8	49.3
College/University	22.4	3.9	21.6	16.2
Decline to answer		3.4	5.5	3.5

Members of household

		Children	Adults working	Adults retired	Total
Botswana	Mean	2.5	0.6	2.5	5.6
	Median	2.0	0.0	2.0	4
Zambia	Mean	4.5	1.2	3.1	8.8
	Median	4.0	1.0	2.0	7
Zimbabwe	Mean	4.1	0.7	2.6	7.4
	Median	3.0	0.0	2.0	5

Household income (USD/month)

	Botswana	Zambia	Zimbabwe	All
Mean	217	138	334	256
Median	80	80	300	80
N	146	141	289	576

Livelihood (percentage of respondents)

	Botswana	Zambia	Zimbabwe	All
Livestock	0.7	2.4	10.7	5.7
Agriculture	10.5	55.3	40.9	38.4
Wholesale and Retail trade	2.0		12.7	6.1
Tourism	1.3	3.4	9.3	5.5
Business		17.3	18.6	13.8
Education		1.0	2.4	1.4
Transportation			2.4	1.1
Other	85.5	20.7	3.1	28.0

Other livelihood specified

Agriculture and harvesting wild fruits
Agriculture and old pension fund
Agriculture and professional guide
Agriculture field work casual labour
Borehole drilling and agriculture
Brick making

Brick making and carpentry
Brick work piece jobs
Bricklaying and plastering
Builder
Builder, Painting and welding piece jobs
Building construction labour
Campsite attendant
Carpenter
Carpentry and joinery
Casual labor work
Casual labour
Casual labour and agriculture
Casual labour and old age fund
casual labour work
Casual labour work
Cattle post herd man
Children send money from time to time
Cleaner
Collect waste and dispose to landfill and rely on agriculture
Commission based jobs
Construction works
Crane operator
Dish installation technician piece jobs
Drought relief government programme
Employed

Employment
Fishing20
Freelancer
Gainful employed at the hotel
Gainfully employed
Government drought relief programme
Government drought programme
Government subsidiary minimum wage programme
Government subsidiary programme
Government subsidiary programme and old pension fund
Government subsidiary programme and street vendor
Government subsidiary programme minimum wage
Government subsidiary programme Minimum wage
Growing crops for others in exchange of money
Hair dresser
Hairdresser
Handouts
Harvest wild fruits and selling
Headman benefits and old pension fund
Health issues
Livestock, selling
Machine operator
Media
Mechanics
Minimum wage

Monthly Salary
NGO
No formal work
No source of income
None of the above
Nothing
Old age pension fund
Old pension
Old pension fund
Old pension fund and agriculture
Old pension fund, pensioner and agriculture
Piece jobs
Piece jobs, home assistant
piece jobs and agriculture
Piece jobs and agriculture activities
Piece jobs maintenance in lodges
Piece work (commission based work)
Piece work (commission based job)
Piece work (commission based work)
Piece works
Piece works and small loans
Piece works
Plant and sell trees - self employment
Professional tour guide
Residential plot leasing

Running a restaurant
Salary
Salary professional guide freelance
Salary, police Gardner
Salary, lodge mechanic
Salary, security officer
Scout
Security services
Self catering
Self catering and agriculture
Self catering and street vendor
Self employed
Social destitute support
street vendor
Street vendor
Street vendor by fast food and drinks
Street vendor and piece jobs
thatching and brick work for home assistance
Traditional healer
Traditional home brewing
Tree nursery farm piece jobs
Tuck shop
Tuck shop supplier
Village headman
Volunteer in Drought government programme

Volunteer
Working at restaurant
Working at the fish farm

Years living in the area

	Botswana	Zambia	Zimbabwe	Total
Mean	29.97	26.02	19.66	24.09
Median	29.5	24	20	22
N	152	205	291	648

13. Appendix 3. General public questionnaire

A. Instructions

B. General Environmental Awareness

1) Are you a member of an environmental group/organization?

( ) Yes

( ) No

2) Have you donated money to an environmental cause in the last 12 months?

( ) Yes

( ) No

3) If yes, how much money?

Amount: _____

Currency: _____

4) Have you donated money to an environmental cause that specifically includes vulture conservation in the last 12 months?

( ) Yes

( ) No

5) Have you volunteered your time for an environmental cause in the last 12 months (e.g., survey work, monitoring, fund raising, litter clean-up, tree planting)?

( ) Yes

( ) No

6) Have you volunteered your time for an environmental cause that specifically includes vulture conservation in the last 12 months?

( ) Yes

( ) No

7) How concerned are you about the following environmental issues?

	Not at all concerned	Slightly concerned	Moderately concerned	Very concerned	Extremely concerned
Air Pollution	( )	( )	( )	( )	( )
Water Pollution	( )	( )	( )	( )	( )
Climate Change	( )	( )	( )	( )	( )
Species Extinction	( )	( )	( )	( )	( )
Deforestation	( )	( )	( )	( )	( )
Desertification	( )	( )	( )	( )	( )

C. Knowledge of Vultures

8) Vultures are birds of prey that feed on animal carcasses

( ) Agree

( ) Disagree

( ) Don't know

9) Have you seen a vulture in the wild?

( ) Yes

( ) No

10) Have you been on safari to see wild animals?

( ) Yes

( ) No

11) On safari, how important to the overall experience do you consider seeing vultures?

( ) Not at all important ( ) Not important ( ) Neutral ( ) Somewhat important ( ) Very important

12) Do you know any traditional stories/tales about vultures?

( ) Yes

( ) No

13) Do you, or members of your family, visit traditional healers that use vulture parts in their remedies?

( ) Yes

( ) No

14) What is the cost of their services (per visit) when vulture parts are used?

( ) 10-20 USD

( ) 20-40 USD

( ) 40-60 USD

( ) 60-80 USD

( ) more than 80 USD

( ) Don't know

15) Do vulture parts (e.g. eggs, feathers, bones, etc.) have any other uses in your community?

( ) Yes

( ) No

16) What are vulture parts used for in your community?

_____

17) Apart from the use of parts, do vultures have any other importance in your community?

( ) Yes

( ) No

18) What importance do vultures have in your community?

_____

19) For each statement, mark one response that indicates your Agreement or Disagreement.

	Agree	Disagree	Don't know
Vultures prevent the spread of diseases by disposing of carcasses	( )	( )	( )
Sometimes vultures kill livestock (e.g. lambs, calves, goats)	( )	( )	( )
Sometimes people poison carcasses to kill vultures	( )	( )	( )
We should conserve vultures for future generations	( )	( )	( )

F. Vulture Conservation

20) In principle, would you be willing to contribute money to support vulture conservation?

( ) Yes

( ) No

21) In principle, would you be willing to contribute money to support vulture conservation?

( ) Yes

( ) No

22) In principle, would you be willing to contribute money to support vulture conservation?

( ) Yes

( ) No

23) In principle, would you be willing to contribute money to support vulture conservation?

( ) Yes

( ) No

F. Vulture Conservation

24) Which of the following best describes your reason for not being willing to contribute money to support vulture conservation in principle?

( ) I do not have any spare money to contribute to vulture conservation

( ) I do not believe species conservation is my responsibility

( ) Even if I don't contribute, someone else will

( ) I do not care if vultures decline or go extinct

( ) I already contribute to or participate in conservation activities

( ) Other - Please specify: _____*

25) Which of the following best describes your reason for being willing to contribute money to support vulture conservation in principle?

( ) Vultures are important in my culture

( ) Vultures play a useful role in the environment by disposing of animal carcasses

( ) It is important to conserve all animal species

( ) It is important to conserve vultures for future generations

( ) Other - Please specify: _____*

26) What is the maximum amount of money that you would be willing to contribute per month (in US dollars)?

( ) US$ 0.5

( ) US$ 1

( ) US$ 2

( ) US$ 3

( ) US$ 4

( ) US$ 5

( ) US$ 6

( ) US$ 8

( ) US$ 10

( ) US$ 15

( ) US$ 20

( ) Other - specify: _____*

27) How effective do you think conservation efforts will be in protecting vultures?

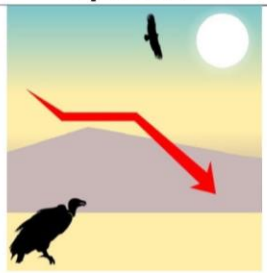
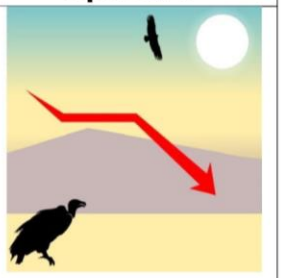
( ) Not at all effective ( ) Not effective ( ) Neutral ( ) Effective ( ) Very effective

---

G. Choice question instructions

H. Choice Questions (Block 1)

28) Please choose ONE of the three options:
*

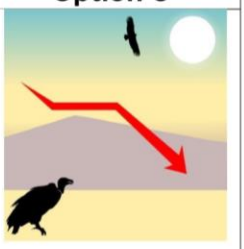
	Option A	Option B	Option C
Vulture population			
	Increasing	Declining	Declining
Species diversity			
	6 species extinct	0 species extinct	6 species extinct
Money contribution per month			
	US$ 2	US$ 10	US$ 0

( ) Option A

( ) Option B

( ) Option C

29) Please choose ONE of the three options:

	Option A	Option B	Option C
Vulture population			
	Increasing	Stable	Declining
Species diversity			
	0 species extinct	6 species extinct	6 species extinct
Money contribution per month			
	US$ 8	US$ 2	US$ 0

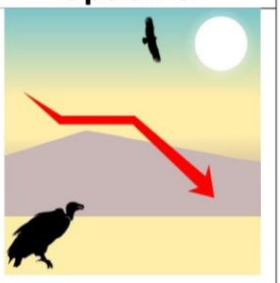
*

( ) Option A

( ) Option B

( ) Option C

30) Please choose ONE of the three options:

	Option A	Option B	Option C
Vulture population			
	Declining	Stable	Declining
Species diversity			
	0 species extinct	3 species extinct	6 species extinct
Money contribution per month			
	US$ 2	US$ 10	US$ 0

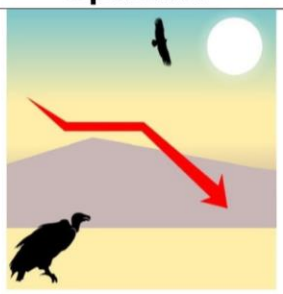
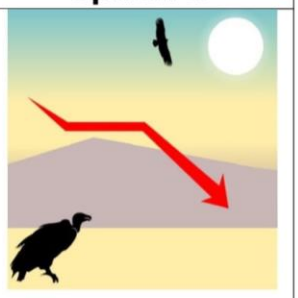
*

( ) Option A

( ) Option B

( ) Option C

31) Please choose ONE of the three options:

	Option A	Option B	Option C
Vulture population			
	Declining	Increasing	Declining
Species diversity			
	3 species extinct	6 species extinct	6 species extinct
Money contribution per month			
	US$ 8	US$ 2	US$ 0

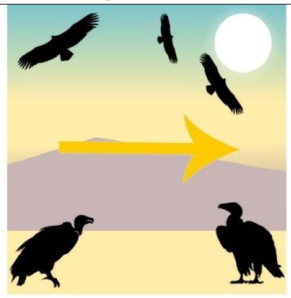
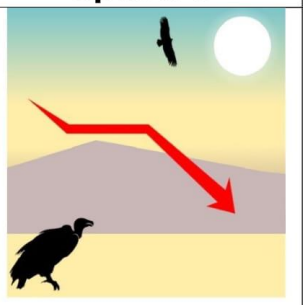
*

( ) Option A

( ) Option B

( ) Option C

32) Please choose ONE of the three options:

	Option A	Option B	Option C
Vulture population			
	Increasing	Stable	Declining
Species diversity			
	6 species extinct	0 species extinct	6 species extinct
Money contribution per month			
	US$ 8	US$ 2	US$ 0

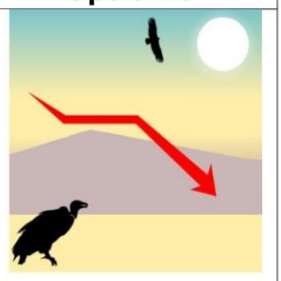
*

( ) Option A

( ) Option B

( ) Option C

33) Please choose ONE of the three options:

	Option A	Option B	Option C
Vulture population			
	Stable	Increasing	Declining
Species diversity			
	6 species extinct	0 species extinct	6 species extinct
Money contribution per month			
	US$ 4	US$ 8	US$ 0

*

( ) Option A

( ) Option B

( ) Option C

52) How did you make your choices?

( ) Considered all three features simultaneously

( ) Considered two of the features

( ) Considered only one of the features

( ) Used my intuition

( ) Made random choices

( ) Don't know

( ) Other - Specify: _____*

53) In making your choice, how important were the following features to you?

	Not at all important	Not important	Neutral	Important	Very important
Vulture Population	( )	( )	( )	( )	( )
Species Diversity	( )	( )	( )	( )	( )
Money contribution per month	( )	( )	( )	( )	( )

I. Demographic and Other Information

54) In which country do you live?

( ) Botswana

( ) Zambia

( ) Zimbabwe

( ) Other - Specify: _____*

55) Age?

( ) Under 18

( ) 18-25

( ) 26-35

( ) 36-45

( ) 46-55

( ) 56-65

( ) Over 65

56) Gender?

( ) Female

( ) Male

( ) Other

( ) Decline to answer

57) What is the highest level of formal education you have completed?

( ) None

( ) Primary School

( ) Secondary School

( ) College/University

( ) Decline to answer

58) How many members are there in your household (living together under one roof)?

Children: _____

Adults of working age: _____

Adults over working age: _____

59) Please indicate your monthly household income (in US$)?

( ) Under $100

( ) $100 - $500

( ) $500 - $1,000

( ) $1,000 - $1,500

( ) $1,500 - $2,000

( ) $2,000 - $3,000

( ) $3,000 - $4,000

( ) $4,000 - $6,000

( ) Over $6,000

( ) Decline to answer

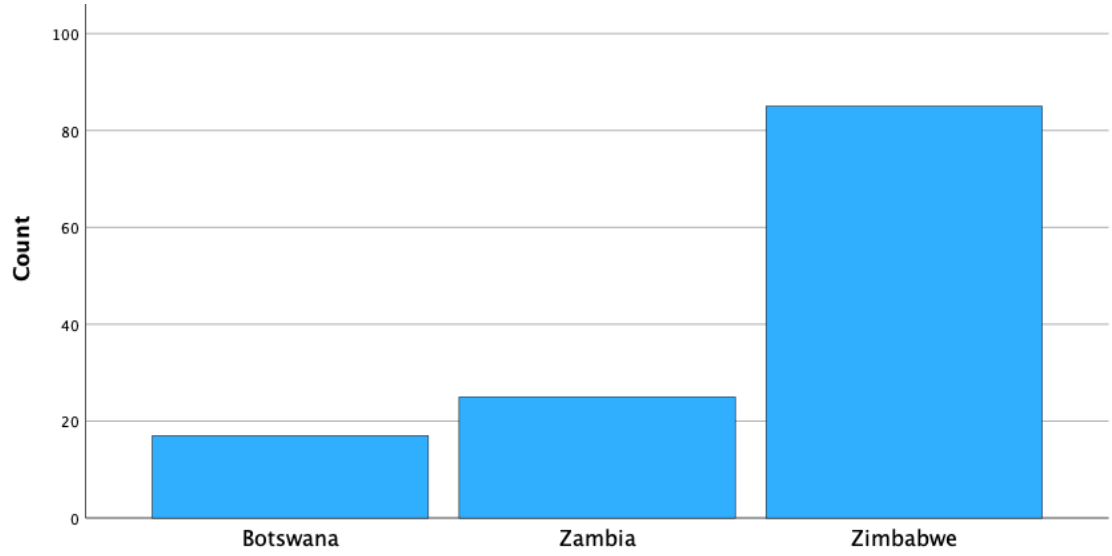
Thank You!

---

14. Appendix 4. General public survey results

Sample size by country

	N	Percent
	138	50.4
Botswana	17	6.2
Other - Specify	9	3.3
Zambia	25	9.1
Zimbabwe	85	31.0
Total	274	100.0



General Environmental Awareness

Member of an environmental group/organization (percentage of respondents)

	Botswana	Zambia	Zimbabwe	All
No	41.2%	20.0%	25.9%	25.5%
Yes	58.8%	80.0%	74.1%	74.5%

Donated money to an environmental cause in the last 12 months (percentage of respondents)

	Botswana	Zambia	Zimbabwe	All
No	81.3%	72.0%	74.1%	71.6%
Yes	18.8%	28.0%	25.9%	28.4%

Volunteered time for an environmental cause in the last 12 months (percentage of respondents)

	Botswana	Zambia	Zimbabwe	All
No	11.8%	32.0%	16.5%	20.1%
Yes	88.2%	68.0%	83.5%	79.9%

Air pollution level of concern (percentage of respondents)

	Botswana	Zambia	Zimbabwe	All
Not at all concerned			1.2%	0.5%
Slightly concerned	5.9%	4.0%	5.9%	5.2%
Moderately concerned	29.4%	8.0%	18.8%	16.0%
Very concerned	11.8%	48.0%	37.6%	36.8%
Extremely concerned	52.9%	40.0%	36.5%	41.5%

Water pollution level of concern (percentage of respondents)

	Botswana	Zambia	Zimbabwe	All
Not at all concerned			2.4%	0.9%
Slightly concerned		4.0%		0.9%
Moderately concerned	5.9%	8.0%	2.4%	2.8%
Very concerned	41.2%	20.0%	30.6%	31.5%
Extremely concerned	52.9%	68.0%	64.7%	63.8%

Climate change level of concern (percentage of respondents)

	Botswana	Zambia	Zimbabwe	All
Not at all concerned			2.4%	0.9%
Slightly concerned		8.0%	3.5%	3.8%
Moderately concerned	5.9%	4.0%	11.8%	8.5%
Very concerned	29.4%	16.0%	30.6%	26.4%
Extremely concerned	64.7%	72.0%	51.8%	60.4%

Species extinction level of concern (percentage of respondents)

	Botswana	Zambia	Zimbabwe	All
Not at all concerned			1.2%	0.5%
Slightly concerned		4.2%	2.4%	2.8%
Moderately concerned	11.8%	8.3%	4.7%	5.2%
Very concerned	29.4%	29.2%	27.1%	30.7%
Extremely concerned	58.8%	58.3%	64.7%	60.8%

Deforestation level of concern (percentage of respondents)

	Botswana	Zambia	Zimbabwe	All
Not at all concerned			1.2%	0.5%
Slightly concerned		8.0%		1.9%
Moderately concerned	12.5%		4.7%	4.3%
Very concerned	37.5%	20.0%	28.2%	29.0%
Extremely concerned	50.0%	72.0%	65.9%	64.3%

Desertification level of concern (percentage of respondents)

	Botswana	Zambia	Zimbabwe	All
Not at all concerned			2.4%	1.4%
Slightly concerned		12.0%	2.4%	4.7%
Moderately concerned		8.0%	7.1%	6.6%
Very concerned	52.9%	36.0%	36.5%	39.4%
Extremely concerned	47.1%	44.0%	51.8%	47.9%

Knowledge of Vultures

Vultures are birds of prey that feed on animal carcasses (percentage of respondents)

	Botswana	Zambia	Zimbabwe	All
Agree	100.0%	100.0%	98.8%	99.0%
Disagree			1.2%	1.0%

Seen vultures in the wild (percentage of respondents)

	Botswana	Zambia	Zimbabwe	All
No		20.0%	14.1%	11.8%
Yes	100.0%	80.0%	85.9%	88.2%

Been on safari to see wild animals (percentage of respondents)

	Botswana	Zambia	Zimbabwe	All
No		16.0%	2.4%	7.4%
Yes	100.0%	84.0%	97.6%	92.6%

Importance of vultures to the overall safari experience

	Botswana	Zambia	Zimbabwe	All
Not at all important		4.8%		1.1%
Not important		4.8%	1.2%	2.1%
Neutral	5.9%	33.3%	13.3%	13.3%
Important	29.4%	9.5%	25.3%	22.9%
Very important	64.7%	47.6%	60.2%	60.6%

Visit traditional healers that use vulture parts in their remedies (percentage of respondents)

	Botswana	Zambia	Zimbabwe	All
No	93.8%	100.0%	98.8%	97.5%
Yes	6.3%		1.2%	2.5%

Cost of services when vulture parts are used (USD/visit)

Mean	76.67
Median	100.00

Minimum	30.00
Maximum	100.00
N	3

Other use of vulture parts (percentage of respondents)

	Botswana	Zambia	Zimbabwe	All
No	82.4%	84.0%	73.5%	78.0%
Yes	17.6%	16.0%	26.5%	22.0%

Brief description of other uses of vulture parts

Arrow wing
Beliefs in foretelling things
Bones, brain, feathers
Eggs, feathers and bones are used for spiritual reasons
Feathers
Feathers and head
Feathers, bones, head and brain
Feathers, claws and beak
Feathers as a feather duster
Feet
For rituals by Sangomas and Madzibaba
For traditional beliefs and myths
Feathers for making bow arrows
Head
Head and legs
Head, feathers, and bones
Healing, rituals related to protection
Internal organs
Luck
Magic
Medicine
Place feathers on doors to chase away evil spirits and also use vulture heads for ritual purposes
Predicting football results
Rituals
Spiritual rituals
The brain used for rituals and some chicks and nest sticks/branches.
The head, the legs and the feathers
They are used for witchcraft. They use mostly the beaks, eyes and claws
They use vulture heads to foretell the future
To predict the future, to gain fame
Traditional medicine
Traditional beliefs, spirituality and displays
Traditional potions to give you powers to predict the future

Vulture parts are used in traditional medicine for healing
Vulture skull
Vulture skull for dreaming and prophesying

Apart from the use of parts, do vultures have any other importance (percentage of respondents)

	Botswana	Zambia	Zimbabwe	All
No	29.4%	64.0%	37.6%	45.5%
Yes	70.6%	36.0%	62.4%	54.5%

Brief description of importance of vultures in the community
A sign of a carcass
Aesthetic and Environmental Services
Balance ecosystem
Balance ecosystems
Balance the ecosystem....I stay in wildlife management areas...
Being part of our eco system and help clean up dead decaying carcasses and their presence is great to see them out in the bush.
Biodiversity
Carcass disposal
clean carcasses
Clean the environment by eating dead animals in wild that could lead to different kinds of disease if left lying there.
Clean the environment of deadly bacteria found in carcasses
Clean up animal carcasses in the bush
clean up dead animals from our environment
Clean up rotting carcasses
Clean up the bush
Cleaning carcasses and signalling death of livestock
Cleaning carcasses
Cleaning dead cattle carcasses
Cleaning dead carrion and so reduce the spread of zoonotic diseases with in our society
Cleaning dead carrion thereby cleaning the environment reduce the spready of zoonotic diseases to domestic animals etc
Cleaning environment
cleaning the environment
Cleaning the environment
Cleaning the environment through eating dead animals
Cleaning up carcasses
Cleaning up carcasses, therefore disease factors, in the bush.
cleaning up the environment
Cleaning up the environment
Contribution to the ecosystem

Decomposition and aesthetic value
Decomposition of dead animal carcasses
Detecting animal carcasses
Diversity important. Scavenging has important role
eating all the carrion and stop the spreading of disieses
eating bad meet like bashed dogs
Eating snakes
Ecological role
Ecological services.
Ecosystem balancing
Ecosystem cycling
environmental cleaners
Find and dispose of the dead animal with instinct
For cleaning the environment
General health by removing carcasses
Get rid of carcasses and prevent spread of diseases in this way which is valuable when looking at the ecosystem
Helps in identifying location of dead livestock
In wildlife areas they are vital to the ecosystem and clean up crew of the wild
Increase biodiversity
Indicate health environment
Indicate location of dead carcass
Indicates that there is an animal species about to die
Indicating livestock conflict from predators
indicator species
Indicator Species: Vultures serve as important indicators of ecosystem health. Their decline or disappearance from an area can signal an imbalance in the environment. Since vultures are at the top of the scavenger hierarchy, they are exposed to toxins and pollutants that accumulate in the food chain. Monitoring vulture populations can provide valuable insights into the overall health of ecosystems and alert scientists to potential environmental issues.
Intrinsic. A key stone species for conservation
It keeps the cycle of life
Keeping the 'waste' somewhat controlled.
Killing vermin etc.
Maintaining ecosystem services
Maintenance of a balanced ecosystem
Natures clean-up crew, they are part of the ecosystem
Natures undertakers. Control spread of diseases and pathogens.
Part of biodiversity and "cleaners"
Play a vital role of ecosystem life circle
Play an exceptional role in contributing to balance of ecological systems. Their extinction would cause imbalance.
prevent disease
Related to death... If one is seen in or around your homestead, death is around the corner

Removal of carcasses
Sanitary service
Scavengers
Scavenging dead animals there by cleaning the environment
Scavenging on dead animals. Cleaning the environment in the process
Sign of healthy ecosystem and they help clean up carcass
They are a crucial part of the ecosystem
They are extremely interesting and a good
They are nature's clean-up crew taking care of carcasses that could otherwise cause the spread of diseases like anthrax
They clean the ecosystem
they clean the environment
They clean the environment
They clean the environment by getting rid of dead bodies
They clean the environment for the community
they clean the environment they eat dead animal that where hit by cars
They clean up carcasses
They clean up carcasses and disseminate nutrients
They clean up dead animals and reduce risk of disease spread.
they clear up carcases of animals that die in the bush
They consume carrion of dead wildlife and livestock helping clean the environment.
They direct where there is a dead animal/livestock
They eat carcasses, thereby reducing diseases that might be caused by those carcasses
They eat carcases which result in reduce air pollution.
They eat carrion
They eat dead carcasses
they eat dead rotting animals
They eat livestock's that naturally died
They help keep the environment clean. They are an important part of our ecosystem
They help prevent diseases
They help to clean carcass of dead meat from domestic animals such as catt
They play an important role in an ecosystem
They remove dead carcasses
To balance the ecosystem
Tourism
Tourist attractions
Vacuum cleaner of our wildlife space
Vultures are important for ecosystems
Vultures provide vital ecosystem services in our natural, agricultural, and rural environments. The important role they play in the cycling of nutrients through the highly-efficient disposal of organic waste from the environment is of utmost importance to human health and environmental integrity.
When hovering in circles, they indicate a dead animal nearby

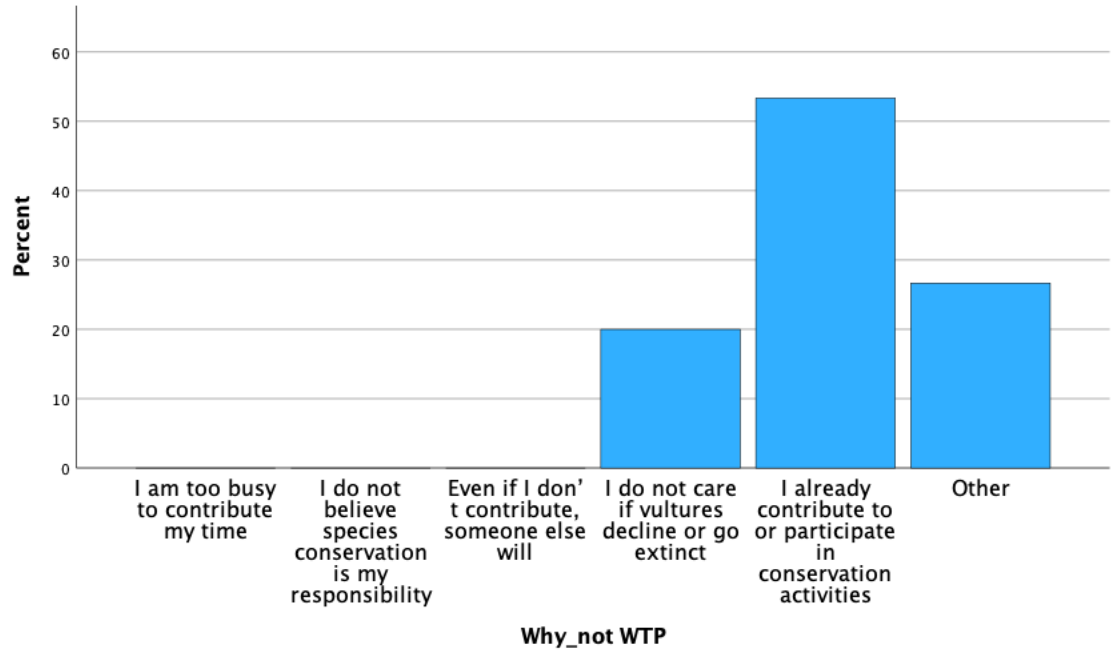
Vulture Conservation

In principle, would you be willing to contribute some of your time to support vulture conservation (percentage of respondents)

	Botswana	Zambia	Zimbabwe	All
No	29.4%	24.0%	19.5%	14.7%
Yes	70.6%	76.0%	80.5%	85.3%

Reason for not being willing to contribute your time to support vulture conservation in principle (percentage of respondents)

	Botswana	Zambia	Zimbabwe	All
I do not care if vultures decline or go extinct		33.3%	14.3%	20.0%
I already contribute to or participate in conservation activities	66.7%	66.7%	42.9%	53.3%
Other	33.3%		42.9%	26.7%

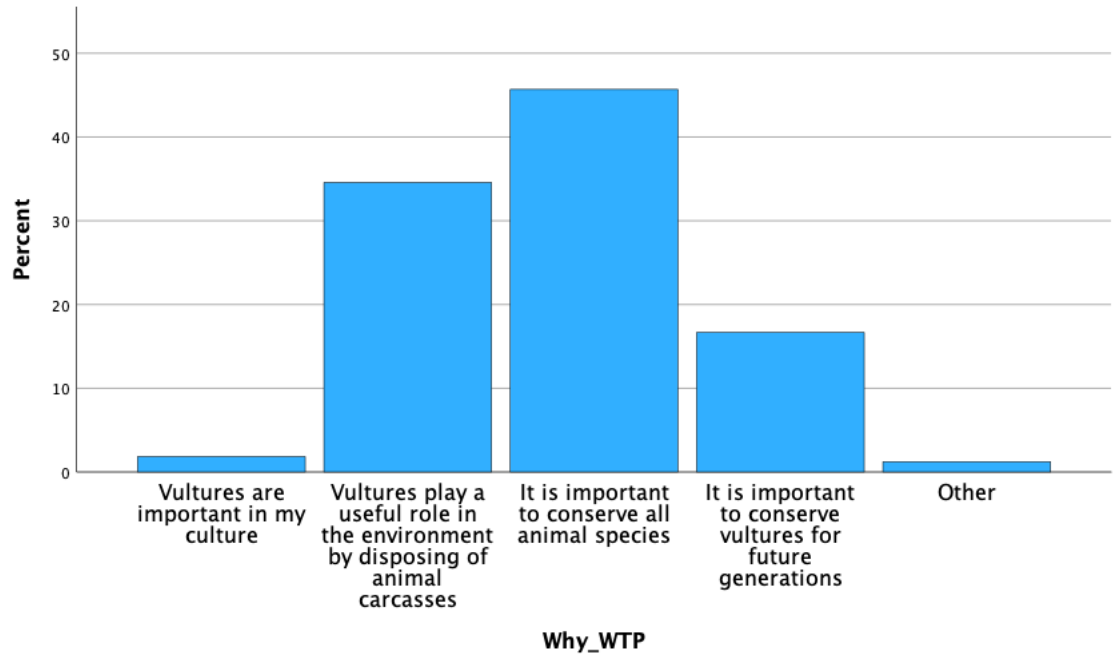


Other specified reasons for not being willing to contribute your time to support vulture conservation in principle

I already contribute to other key causes
I am not convinced that donating money will assist in vulture conservation/protection
I believe in conservation as an enterprise that has the capacity to fund itself
I do not have money surviving on hand to mouth

Reason for being willing to contribute your time to support vulture conservation in principle (percentage of respondents)

	Botswana	Zambia	Zimbabwe	All
Vultures are important in my culture		5.3%	1.5%	1.9%
Vultures play a useful role in the environment by disposing of animal carcasses	50.0%	42.1%	25.8%	34.6%
It is important to conserve all animal species	33.3%	42.1%	51.5%	45.7%
It is important to conserve vultures for future generations	16.7%	10.5%	19.7%	16.7%
Other			1.5%	1.2%



Other specified reasons for being willing to contribute your time to support vulture conservation in principle

All of the above
It'll a disgrace to the current generation to have a species going extinct under their watch

Maximum willingness to contribute money for vulture conservation (USD per month)

	Mean	Median	N
Botswana	4.950	5.000	10
Zambia	6.441	4.000	17
Zimbabwe	5.962	5.000	65

Total	7.023	5.000	149

Demographic and other information

Age of respondent (years)

	Mean	Median	N
Botswana	51.4118	61.0000	17
Zambia	40.2000	31.0000	25
Zimbabwe	42.8941	41.0000	85
Total	44.0292	41.0000	137

Gender

	Botswana	Zambia	Zimbabwe	All
Female	47.1%	48.0%	43.5%	43.1%
Male	52.9%	48.0%	55.3%	55.5%
Other			1.2%	0.7%
Decline to answer		4.0%		0.7%

Education

	Botswana	Zambia	Zimbabwe	All
None			1.2%	0.7%
Secondary/High School	11.8%		9.4%	7.3%
College/University	88.2%	100.0%	89.4%	92.0%

Household income (USD/month)

	Mean	Median	N
Botswana	265.0000	190.0000	6
Zambia	435.0000	300.0000	10
Zimbabwe	467.0000	300.0000	50
Total	448.4286	300.0000	70

15. Appendix 5. International public questionnaire

A. Instructions

B. General Environmental Awareness

1) Are you a member of an environmental group/organization?
( ) Yes
( ) No

2) Have you donated money to an environmental cause in the last 12 months?
( ) Yes
( ) No

3) If yes, how much money?
Amount: _____
Currency: _____

4) Have you donated money to an environmental cause that specifically includes vulture conservation in the last 12 months?
( ) Yes
( ) No

5) Have you volunteered your time for an environmental cause in the last 12 months (e.g., survey work, monitoring, fund raising, litter clean-up, tree planting)?
( ) Yes
( ) No

6) Have you volunteered your time for an environmental cause that specifically includes vulture conservation in the past 12 months?
( ) Yes
( ) No

7) How concerned are you about the following environmental issues?

	Not at all concerned	Slightly concerned	Moderately concerned	Very concerned	Extremely concerned
Air Pollution	( )	( )	( )	( )	( )
Water Pollution	( )	( )	( )	( )	( )
Climate Change	( )	( )	( )	( )	( )
Species Extinction	( )	( )	( )	( )	( )
Deforestation	( )	( )	( )	( )	( )
Desertification	( )	( )	( )	( )	( )

C. Knowledge of Vultures

8) Vultures are birds of prey that feed on animal carcasses
( ) Agree
( ) Disagree
( ) Don’t know

9) Do you know any traditional stories/tales about vultures?
( ) Yes
( ) No

10) For each statement, mark one response that indicates your Agreement or Disagreement.

	Agree	**Disagree**	**Don't know**
Vultures prevent the spread of diseases by disposing	( )	( )	( )

of carcasses			
Sometimes vultures kill livestock (e.g. lambs, calves, goats)	( )	( )	( )
Sometimes people poison carcasses to kill vultures	( )	( )	( )
We should conserve vultures for future generations	( )	( )	( )

11) Have you seen a vulture in the wild?
( ) Yes
( ) No

12) Have you ever visited Botswana, Zambia or Zimbabwe?
( ) Yes
( ) No

F. Vulture Conservation

13) In principle, would you be willing to contribute money to support vulture conservation in three countries in Southern Africa (Botswana, Zambia, Zimbabwe)?
( ) Yes
( ) No

14) In principle, would you be willing to contribute money to support vulture conservation in three countries in Southern Africa (Botswana, Zambia, Zimbabwe)?
( ) Yes
( ) No

15) In principle, would you be willing to contribute money to support vulture conservation in three countries in Southern Africa (Botswana, Zambia, Zimbabwe)?
( ) Yes
( ) No

16) In principle, would you be willing to contribute money to support vulture conservation in three countries in Southern Africa (Botswana, Zambia, Zimbabwe)?
( ) Yes
( ) No

F. Vulture Conservation

17) Which of the following best describes your reason for not being willing to contribute money to support vulture conservation in principle?

( ) I do not have any spare money to contribute to vulture conservation
( ) I do not believe species conservation is my responsibility
( ) Even if I don't contribute, someone else will
( ) I do not care if vultures decline or go extinct
( ) I already contribute to or participate in conservation activities
( ) Other - Please specify: _____*

18) Which of the following best describes your reason for being willing to contribute money to support vulture conservation in principle?
( ) Vultures are important in my culture
( ) Vultures play a useful role in the environment by disposing of animal carcasses
( ) It is important to conserve all animal species
( ) It is important to conserve vultures for future generations
( ) Other - Please specify: _____*

19) What is the maximum amount of money that you would be willing to contribute per month (in US dollars)?
( ) US$ 2
( ) US$ 4
( ) US$ 6
( ) US$ 8
( ) US$ 10
( ) US$ 15
( ) US$ 20
( ) US$ 25
( ) US$ 30
( ) US$ 40
( ) US$ 50
( ) Other - specify: _____*

20) How effective do you think conservation efforts will be in protecting vultures?

( ) Not at all effective ( ) Not effective ( ) Neutral ( ) Effective ( ) Very effective

G. Choice question instructions

H. Choice Questions (Block 1)

H. Choice questions

45) How did you make your choices?
( ) Considered all three features simultaneously
( ) Considered two of the features
( ) Considered only one of the features
( ) Used my intuition
( ) Made random choices
( ) Don't know
( ) Other - Specify: _____*

46) In making your choice, how important were the following features to you?

	Not at all important	**Not important**	**Neutral**	**Important**	**Very important**
Vulture Population	( )	( )	( )	( )	( )
Species Diversity	( )	( )	( )	( )	( )
Money contribution per month	( )	( )	( )	( )	( )

I. Demographic and Other Information

47) In which country do you live?

48) Age?
( ) Under 18
( ) 18-25
( ) 26-35
( ) 36-45
( ) 46-55

( ) 56-65
( ) Over 65

49) Gender?
( ) Female
( ) Male
( ) Other
( ) Decline to answer

50) What is the highest level of formal education you have completed?
( ) None
( ) Primary School
( ) Secondary School
( ) College/University
( ) Decline to answer

51) How many members are there in your household (living together under one roof)?
Children: _____
Adults of working age: _____
Adults over working age: _____

52) Please indicate your monthly household income (in US$)?
( ) Under $1,000
( ) $1,000 - $2,000
( ) $2,000 - $3,000
( ) $3,000 - $4,000
( ) $4,000 - $6,000
( ) $6,000 - $8,000
( ) $8,000 - $10,000
( ) Over $10,000
( ) Decline to answer

Thank You!

Thank you for taking our survey. Your response is very important to us.

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16. Appendix 6. International public survey results

General Environmental Awareness

Member of an environmental group/organization (percentage of respondents)

	All
No	51.0%
Yes	49.0%

Donated money to an environmental cause in the last 12 months (percentage of respondents)

	All
No	61.2%
Yes	38.8%

Volunteered time for an environmental cause in the last 12 months (percentage of respondents)

	All
No	54.9%
Yes	45.1%

Level of concern (percentage of respondents)

	Air pollution	Water pollution	Climate change	Species extinction	Deforest-ation	Desert-ification
Not at all concerned	3.6	3.1	3.6	1.0	1.0	2.1
Slightly concerned	4.6	3.1	0.5	3.6	4.1	3.6
Moderately concerned	19.4	12.8	11.2	12.8	10.8	17.9
Very concerned	42.9	39.3	34.2	29.7	38.1	30.8
Extremely concerned	29.6	41.8	50.5	52.8	45.9	45.6

Knowledge of Vultures

Knowledge about vultures (percentage of respondents that agree or disagree with statement)

	Agree	Disagree
Vultures are birds of prey	97.2	2.8
I have seen vultures in the wild	9.6	90.4
I know traditional stories about vultures	50.8	49.2
Vultures prevent the spread of diseases	98.2	1.8
Vultures sometimes kill livestock	23.2	76.8
People sometimes poison vultures	93.2	6.8
It is important to conserve vultures for future generations	100	0

Perceived effectiveness of vulture conservation (percentage of respondents)

Not at all effective	.3
Not effective	3.4
Neutral	12.6
Effective	33.4
Very effective	8.2
Do not know	42.0

Vulture Conservation

Willing to contribute money to support vulture conservation (percentage of respondents)

No	58.7%
Yes	41.3%

Reason for not being willing to contribute your time to support vulture conservation in principle (percentage of respondents)

Even if I do not contribute, someone else will	2%
I already contribute to or participate in conservation activities	30%
I do not believe species conservation is my responsibility	5%
I do not care if vultures decline or go extinct	1%
I do not have any spare money to contribute to vulture conservation	44%
Other	18%

Reason for being willing to contribute your time to support vulture conservation in principle (percentage of respondents)

It is important to conserve all animal species	52%

It is important to conserve vultures for future generations	7%
Vultures are important in my culture	3%
Vultures play a useful role by disposing of animal carcasses	35%
Other	3%

Maximum willingness to contribute money for vulture conservation (USD per month)

Mean	8.92
Median	4.00

Demographic and other information

Age of respondent (years)

Mean	45.4082
Median	51.0000

Gender (percentage of respondents)

Female	38.1
Male	60.5
Decline to answer	1.4

Education (percentage of respondents)

Secondary/High School	14.3
College/University	85.0
Decline to answer	.7

17. Appendix 7. Ranger and protected area manager questionnaire

A. Instructions

B. Experience of Vultures

1) Name of the protected area in which you work?

_____

2) Are vultures present in the protected area?

( ) Yes

( ) No

3) Have you previously worked in a protected area with vultures?

( ) Yes

( ) No

4) What is the name of the protected area with vultures at which you worked?

_____

B. Experience of Vultures

5) How many vulture species are present in the protected area?

_____

6) Has the abundance of vultures in the protected area changed during the past 5-10 years?

( ) Increased a lot

( ) Increased a bit

( ) No change

( ) Decreased a bit

( ) Decreased a lot

( ) Don't know

C. Role of vultures for locating animal carcasses

7) Do you use the presence of vultures to help locate animal carcasses in the protected area?

( ) Yes

( ) No

8) How effective is the use of vultures to locate animal carcasses?

( ) Limited effectiveness

( ) Effective

( ) Very effective

9) How much time do you save by using vultures to locate animal carcasses on average? (i.e., how much longer would it take without the use of vultures?)

_____

10) How much money do you save per month by using vultures to locate animal carcasses on average? (i.e., in terms of fuel, equipment, man-hours?). A rough estimate is fine.

_____

D. Use of vulture parts

11) Are vulture parts are used in traditional medicine in the communities living nearby to the protected area?

( ) Yes

( ) No

( ) Don't know

12) What is the cost of traditional medicine (per visit) when vulture parts are used?

( ) 10-20 USD

( ) 20-40 USD

( ) 40-60 USD

( ) 60-80 USD

( ) more than 80 USD

( ) Don't know

13) Do vulture parts (e.g. eggs, feathers, bones, etc.) have any other uses in the nearby communities?

( ) Yes

( ) No

( ) Don't know

14) What are vulture parts used for in the nearby communities?

_____

15) Apart from the use of parts, do vultures have any other importance in the nearby communities?

( ) Yes

( ) No

( ) Don't know

16) What importance do vultures have in the nearby communities?

_____

E. Importance of vultures to tourism

17) How many tourists visit the protected area per year?

_____

18) For tourists, how important to the overall experience do you consider seeing vultures?

( ) Not at all important

( ) Not important

( ) Neutral

( ) Somewhat important

( ) Very important

19) For tourists, how important to the overall safari experience do you consider the animals below?

_____Lion

_____Elephant

_____Vulture

_____Hyena

_____Giraffe

_____Buffalo

_____Fish eagle

_____Rhinoceros

_____Antelope

Thank You!

Thank you for taking our survey. Your response is very important to us.

18. Appendix 8. Ranger and protected area manager survey results

Names of protected areas represented by survey responses

Chewore North
Chirisa Safari Area
Hwange National Park
Kafue National Park
Kafue National Park south
Kasungu National Park
Mana pools
Sioma Ngwezi National Park
Thuma and Dedza Salima forest
Tshabalala sanctuary
Vwaza Marsh Wildlife Reserve
Zambezi National Park

Number of vulture species in surveyed protected areas

Mean	3.31
Median	3.00
Minimum	1
Maximum	5

Observed change in vulture abundance during past 5-10 years (percentage of responses)

Increased a lot	18.2
Increased a bit	36.4
Decreased a bit	27.3
Decreased a lot	18.2

11 out of the 12 protected areas use vultures to locate carcasses

Effectiveness of using vultures to locate animal carcasses (percentage of responses)

Limited effectiveness	9.1
Effective	18.2
Very effective	22.7
Do not know	50.0

Time and money saved attributed to the use of vultures for locating animal carcasses

	Hours per month	USD per month
Mean	53.60	510.00
Median	31.50	250.00
Minimum	7	0
Maximum	180	2000

Vulture parts used in traditional medicine in the communities living nearby to the protected area (percentage of responses)

Yes	76.9
Prefer not to answer	23.1

Cost of services when vulture parts are used (USD/visit)

Mean	53.33
Median	30.00
Minimum	30.00
Maximum	100.00

Brief description of other uses of vulture parts

Brain, crawls, beak
Charm for luck and hunting
Feathers, legs, eyes, head
Head
Ritual
Traditional Medicine
Vulture heads are believed to help people have night visions/dreams for protection against enemies or intruders
Witchcraft

Apart from the use of parts, do vultures have any other importance (percentage of respondents)

No	8.3
Yes	58.3
Do not know	33.3

Brief description of importance of vultures in the community

By using to signal
Carcass removal
Cleaning agents for dead animal carcasses
Cleaning of the environment by eating carcasses
Detect animal carcasses
It helps to clean the dead carcasses
To clean the environment for example the rotten carcasses are being eaten by the vultures

Importance of vultures to the overall safari experience (percentage of respondents)

Neutral	45.5
Important	27.3
Very important	27.3

19. Appendix 9. Choice experiment results

19.1 Introduction

In this section, we describe the modelling approach that was used to estimate the choice models for local communities near vulture populations. The estimated choice models and the resulting willingness-to-pay (WTP) estimates are presented separately for local communities in Botswana, Zambia, and Zimbabwe, along with a comparison of the same for all local communities combined. Additionally, choice models were estimated for the general public in the aforementioned countries combined, and for an international public.

19.2 Modelling approach and results evaluation

The response data from the choice experiment were analyzed using a mixed logit (MIXL) model (Revelt and Train 1998). The MIXL model is a generalization of the standard logit model (McFadden 1974) in that the MIXL model accounts for the possibility that the preferences determining choices differ between individuals. MIXL models generally fit the data better than standard logit models.

We assume that the random parameters of the MIXL models are normally distributed, except for the parameter for the variable 'Payment' for local communities and the general public. The choice data indicated that, among these respondent groups, the preference for 'Payment' tended to zero, which implies respondents have infinite WTP for other attributes in the choice tasks.

Following Scarpa et al. (2009) and Koetse (2017), we investigated whether respondents had been ignoring the variable 'Payment' altogether, using an Equality-Constrained Latent Class (ECLC) model. While there was evidence to suggest this was indeed so, the ECLC models did not converge correctly. While the enumerators did receive instructions on how to conduct the interviews, actual response collection protocols may have deviated from the ideal and caused issues.

We proceeded by assuming a symmetrical triangular distribution for the local communities and the general population models. This is a bounded distribution that can prevent incorrect signs or infinite estimates of WTP that can occur under other distributional assumptions (e.g., Hess et al. 2005).

We normalized the alternative-specific constants (ASC), which capture unobserved biases, on the status-quo option. The choice experiment included a categorical attribute for the development of vulture populations, which could decline, be steady, or grow. The estimated model includes this attribute as two variables that are both normalized on the possibility of declining vulture populations. The coefficients of these estimates show changes in utility over declining vulture populations.

The software we used to estimate the choice model was the Apollo package version 0.3.1 (Hess and Palma 2019; 2023) for use with R version 4.3.3 (R Core Team 2024).

19.3 Results

The estimated choice models for local communities are shown in Appendix 1. Considering first the model estimated using the combined data from all countries, the ASCs for options 1 and 2 were both positive. Respondents were more likely to select a conservation option than the status quo option. These coefficients were of similar size, suggesting there were no unobserved biases in respondents' choices between the alternatives they were shown.

The estimated coefficients for the main effects all had the expected signs and were statistically significant at the 1% level. Respondents had a stronger preference for a growing vulture population trend than for a neutral population trend over declining vulture populations. Losing a vulture species caused a decline in respondents' utility, as did volunteering their time for vulture conservation.

Furthermore, the model estimated on the combined data indicated the existence of statistically significant variation at the individual level for all main effects.

The remaining columns of Appendix 1 show that the models estimated on country-specific data were qualitatively similar to the combined model. However, the sizes of some of the estimated coefficients were quite different from the combined model, particularly in the case of Botswana. These respondents displayed much stronger preferences for positive vulture population development and the avoidance of species loss than the combined respondents did. At the same time, their choices appeared less affected by the payment requirement.

While the estimated coefficients for Zambia appeared and Zimbabwe were more comparable to the combined model, there were notable differences. Local communities in Zambia appeared to respond more strongly to the payment requirement than other respondents. The choices from the respondents in Zimbabwe appeared to have been influenced to a larger extent by considerations not captured by the main effects, as indicated by the comparatively large ASCs.

Overall, there was mixed evidence for variation in preferences at the level of individual respondents in the country-specific models compared to the combined model. The adjusted ρ, a measure of goodness-of-fit, of the country-specific models is higher for Botswana compared to the combined model, but lower for Zambia and Zimbabwe.

Appendix 2 shows the estimated models using responses from the general and international public. These model results should be considered to be indicative only. There was no explicit strategy in place to collect data from either group in an unbiased manner, and the number of respondents is very small compared to the actual sizes of their respective populations. Only 138 respondents from the general populations completed at least one choice task, and only 71 respondents from the international population did.

For both models, estimated coefficients were generally in line with the previously described results. The notable difference appeared to be that the general public seemed to prefer stabilizing over growing vulture populations, while the international public seemed to consider both population trend outcomes equally desirable. The goodness-of-fit of these models was on the low end of all estimated models.

The distribution of WTP for vulture conservation outcomes was simulated using the method proposed by Krinsky and Robb (1986; 1990), which accounts for estimation errors and variations in individual preferences and allows non-symmetric confidence intervals. The WTP estimates for local communities are presented in Table 1. It shows the median of WTP for the outcomes of vulture conservation and its confidence interval. Using medians negates the influence of outsized WTP values.

Median WTP to maintain steady vulture populations over letting them decline was 0.5 (confidence interval: 0.28-0.76) days/month for the combined respondents. As described earlier, local communities in Botswana appeared willing to volunteer no less than 4.25 days/month (1.78 – 9.22). WTP for a steady vulture population in Zambia (0.23 days/month; 0.03 – 0.46) and Zimbabwe (0.89 days/month; 0.19 1.74) were more in line with the combined WTP.

The median WTP to increase vulture populations over allowing population decline was markedly higher. The combined WTP was 1.11 days/month (0.83 – 1.43). Respondents in Botswana appeared willing to volunteer 8.33 days/month (4.33 – 17.51), while the WTP estimates of local communities in Zambia (0.39; 0.15 – 0.66) and Zimbabwe (1.84; 0.97 – 2.97) seemed more realistic. Note that to arrive at WTP for increasing vulture populations over maintaining them, the latter WTP estimates can be subtracted from the former.

The compensation for a vulture species being lost amounted to value equal to 0.37 (0.45 – 0.31) days/month among the combined respondents. It was noticeably higher at 2.5 (5.1 – 1.4) day/month

among local communities in Botswana. This value amounted to 0.07 (0.12 – 0.04) days/month and 0.72 (1.03 – 0.49) days/month in Zambia and Zimbabwe, respectively.

Table 1. Distribution of WTP for vulture conservation outcomes among local communities

Hours volunteered/month						
	Combined			**Botswana**		
	Median	*Median CI low*	*Median CI high*	*Median*	*Median CI low*	*Median CI high*
Population trend: neutral	0.51	0.28	0.76	4.25	1.78	9.22
Population trend: increasing	1.11	0.83	1.43	8.33	4.33	17.51
Species loss (per species)	-0.37	-0.45	-0.31	-2.50	-5.07	-1.37
	Zambia			**Zimbabwe**		
	Median	*Median CI low*	*Median CI high*	*Median*	*Median CI low*	*Median CI high*
Population trend: neutral	0.23	0.03	0.46	0.89	0.19	1.74
Population trend: increasing	0.39	0.15	0.66	1.84	0.97	2.97
Species loss (per species)	-0.07	-0.12	-0.04	-0.72	-1.03	-0.49

Table 2 presents the median WTP estimates for vulture conservation outcomes among respondents from the general and international public. Due to the data concerns for these groups described earlier, these estimates are indicative only and should not be used for policy development.

WTP among the general public for maintaining vulture populations of allowing them to decline was 0.37 US dollar/month, with a confidence interval of 0.13 – 0.64 US dollar/month. WTP for increasing vulture populations was slightly lower, at 0.25 (0 – 0.52) US dollar/month. The compensation equivalent to losing a vulture species was 0.10 US dollar/month (0.16 – 0.06). Overall, it appeared that members of the general public in Botswana, Zambia, and Zimbabwe have slightly lower WTP for vulture conservation than local populations do.

The estimated median WTP for vulture conservation among the international public was unexpectedly high for all conservation outcomes. It appeared that the international public was willing to pay 80 US dollar/month to maintain vulture populations, 64.56 dollar/month to increase them, and receive 8 dollar/month when a vulture species was lost. These estimates are unfortunately not credible, as they would accumulate to an unrealistically large amount of money over a very small amount of time. Considering the very small sample, the results may have been skewed by just a few respondents that either paid no attention to the 'Payment' variable or in fact had an exceedingly high WTP.

The appropriate conclusion must be that WTP for vulture conservation among the international public remains unknown at this time. If this group's WTP is of interest for future policies to conserve vultures, a study needs to be designed with a carefully considered data collection plan that can deliver better data.

Table 2. Distribution of WTP for vulture conservation outcomes among the general and international public

US dollar/month						
	General			**International**		
	Median	*Median CI low*	*Median CI high*	*Median*	*Median CI low*	*Median CI high*
Population trend: neutral	0.37	0.13	0.64	80.03	6.27	259.02
Population trend: increasing	0.25	0.00	0.52	64.56	3.16	232.37
Species loss (per species)	-0.10	-0.16	-0.06	-8.14	-25.32	-0.96

19.4 References

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19.5 Annex 1 – estimated choice model for local communities

	Combined [a] [b]		Botswana		Zambia		Zimbabwe	
Option 1	1.9469	***	1.4689	***	1.9508	***	2.7179	***
	(0.198)		(0.517)		(0.289)		(0.304)	
Option 2	2.1458	***	1.6288	***	1.8679	***	3.0334	***
	(0.195)		(0.510)		(0.289)		(0.306)	
Population trend: neutral	0.3796	***	1.1547	***	0.3370	*	0.2723	**

	(0.101)		(0.326)		(0.175)		(0.128)	
Population trend: increasing	0.8430	***	2.2552	***	0.5598	***	0.5701	***
	(0.117)		(0.375)		(0.206)		(0.138)	
Species lost (per species)	-0.2857	***	-0.6831	***	-0.1045	***	-0.2262	***
	(0.026)		(0.1000)		(0.028)		(0.028)	
Time volunteered (hours/month)	-0.4030	***	-0.1859	**	-0.6774	***	-0.2031	***
	(0.048)		(0.089)		(0.138)		(0.047)	
Random parameters								
Population trend: neutral	-0.4849	**	-0.7773		0.6456	**	-0.0041	
	(0.198)		(0.592)		(0.257)		(0.018)	
Population trend: increasing	-0.8141	***	-0.7792		0.9460	***	0.4121	*
	(0.152)		(0.492)		(0.270)		(0.233)	
Species lost	0.3286	***	-0.4651	***	-0.2068	***	-0.2502	***
	(0.028)		(0.100)		(0.043)		(0.027)	
Time volunteered	0.9066	***	0.5907	***	1.1754	***	0.5863	***
	(0.095)		(0.194)		(0.232)		(0.093)	
Observations	2930		761		780		1389	
Log Likelihood	-1892.7		-303.0		-659.7		-814.8	
Adj ρ (observed shares)	0.22		0.47		0.11		0.20	

[a] robust standard errors in parentheses

[b] *** p < 0.01; ** p < 0.05; * p < 0.1

19.6 Annex 2 – estimated choice model for general and international populations

	General [a] [b]		International [c]	
Option 1	0.8981	***	1.7956	***
	(0.303)		(0.374)	
Option 2	0.9653	***	1.7891	***
	(0.270)		(0.389)	
Population trend: neutral	0.5785	**	0.6044	**
	(0.228)		(0.247)	
Population trend: increasing	0.3965		0.6003	**
	(0.241)		(0.253)	
Species lost (per species)	-0.1610	***	-0.1710	***
	(0.040)		(0.058)	
Payment (dollars/year)	-0.6917	***	-4.6812	***
	(0.118)		(1.117)	
Random parameters				

Population trend: neutral	0.2877		0.1225	
	(0.508)		(0.286)	
Population trend: increasing	1.0690	***	-0.4405	
	(0.242)		(0.605)	
Species lost	-0.3157	***	-0.3692	***
	(0.047)		(0.067)	
Payment	1.3095	***	2.4186	***
	(0.200)		(0.593)	
Observations	729		405	
Log Likelihood	-647.5		-335.4	
Adj ρ (observed shares)	0.13		0.12	

[a] robust standard errors in parentheses

[b] *** p < 0.01; ** p < 0.05; * p < 0.1

[c] Payment is assumed to have a negative lognormal distribution