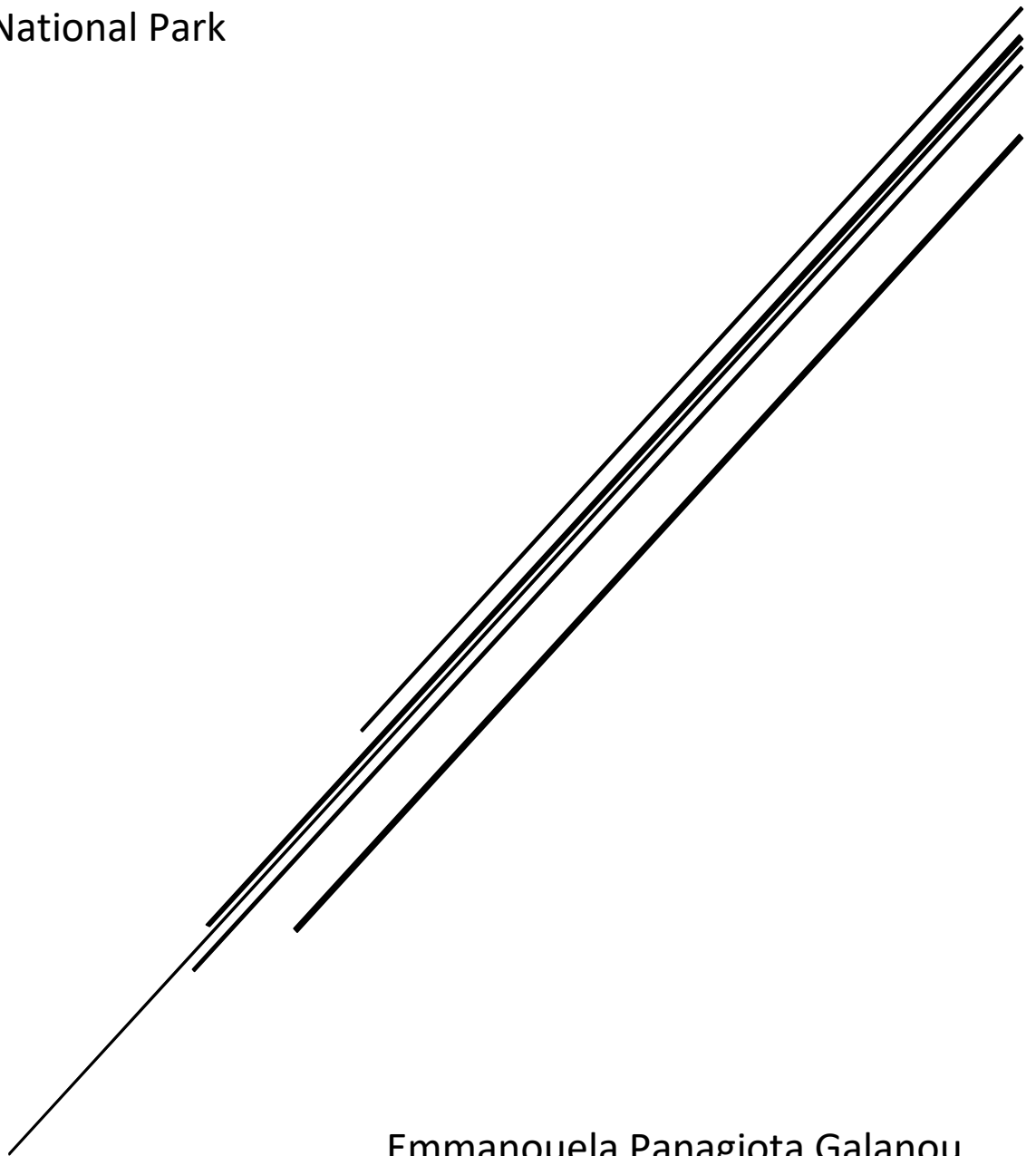


NYIKA VWAZA TRUST RESEARCH STUDY REPORT 2016/17

Vulture's Ecosystem Services Valuation: the case study of
Nyika National Park



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ABSTRACT

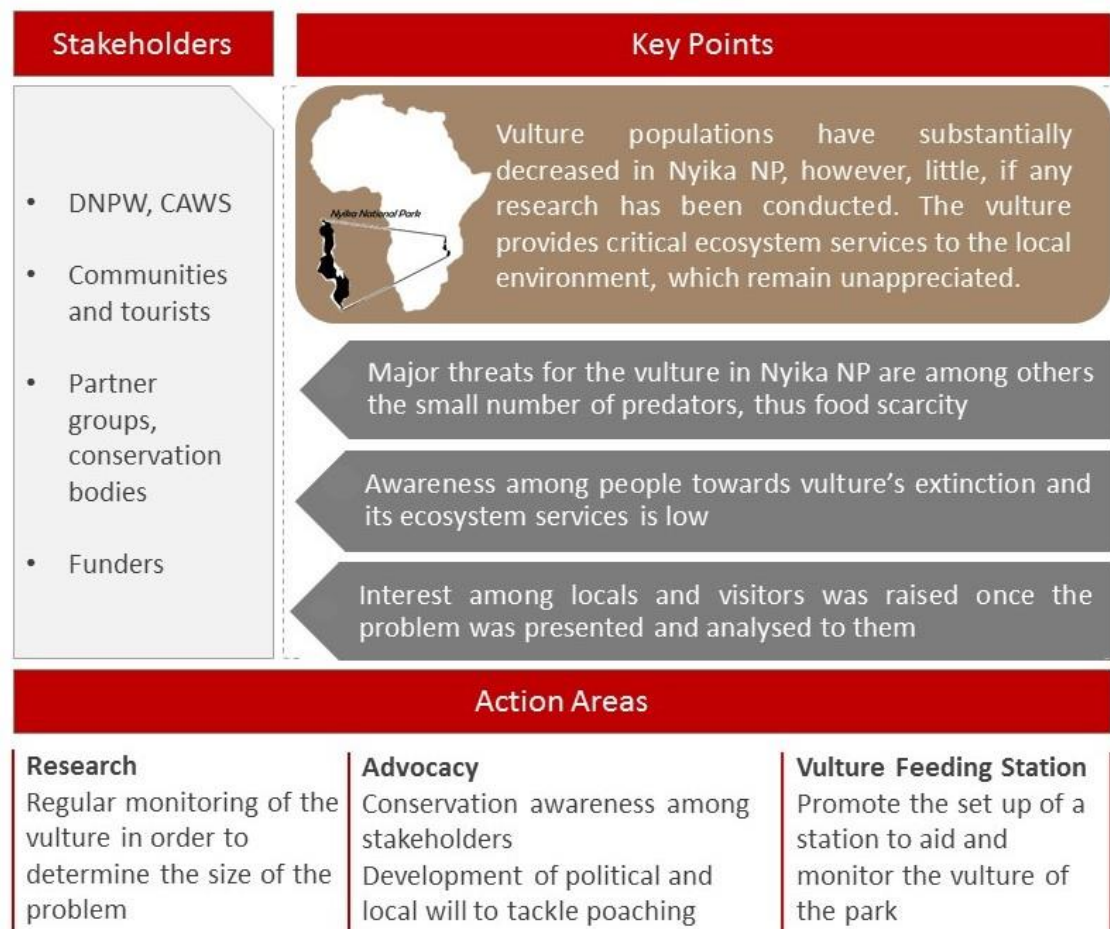
African vulture species are declining rapidly and some species may become extinct in the next 25 years. The study aimed to explore how vultures of Nyika National Park could be protected and numbers enhanced, by identifying and assessing the value of the ecosystem services the bird provides to the local environment. Major threats to the bird in Nyika were also identified. Local communities, authorities, conservation bodies and other stakeholders were interviewed to assess how stakeholders benefit from the scavenger and to determine how conservation policies could be developed to help vulture populations increase. The study showed that vultures provide a range of important ecosystem services, in particular disposal of carcasses, nutrient cycling, pest control and recreational services. The loss of the species would diminish these services, yet, there is little awareness regarding the vulture's potential extinction among local people and visitors and of the potential consequences that this might lead to.

However, it was encouraging to observe the growth in people's interest and willingness to assist the research once the problem was presented and analysed to them. Indeed, the two-week vulture monitoring pilot experiment, which was conducted in the park received a positive response from locals and visitors. Finally, the paper discusses the Vulture Feeding Station as a potential conservation policy for the vulture of Nyika NP.

Keywords:

Endangered species, scavenger, bird monitoring, values, conservation policy, stakeholders

GRAPHICAL ABSTRACT



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LIST OF ABBREVIATIONS

CAWS	Central African Wilderness Safaris
DNPW	Department of National Parks and Wildlife
ICPB	International Centre for Birds of Prey
IUNC	International Union for Conservation of Nature
KfW	Kreditanstalt für Wiederaufbau (KfW Development Bank)
NABU	Nature and Biodiversity Conservation Union
NP	National Park
NNP	Nyika National Park
RSPB	Royal Society for the Protection of Birds
TFCA	Transfrontier Conservation Area
WESM	Wildlife and Environmental Society of Malawi

1 Introduction

Over the past two decades, increasing attention is being given to ecosystem services and their importance for economic and environmental activities. It has been constantly shown that birds, particularly scavenging birds provide crucial ecosystem services that benefit people. According to De Groot et al. (2002) those services are divided into four principal categories, which are presented in this report with regard to the vulture as an avian scavenger.

- Regulating services such as control of pest and disease by disposing of carcasses.
- Habitat services. This category is not applicable in the case of birds as it is linked with natural ecosystems and their role in maintaining healthy habitats through refugium and nursery functions.
- Provisioning services, such as the production of food, fiber, medicines and other.
- Information services, including recreational, spiritual, science and education benefits.

The vulture is a keystone species facing an alarming decrease in numbers globally. Their dramatic decline is followed not only by environmental impacts but also socio-economic and cultural effects (Markandya et al. 2008). Dr. Campbell Mum, Head of Conservation and Research at the Hawk Conservancy Trust, states that: *“Vultures are integral to Africa’s ecological and cultural landscapes, and it is change in cultural practices at multiple levels that is required to reverse this disastrous situation. Without such changes, and the reversal of these declines, the full consequences of Africa’s vultures disappearing cannot be predicted.”* (University of St Andrews, 2015) The first step to their conservation is to understand the link between vultures’ ecological functioning, economics and values. The second step includes the monitoring of the population in order to realize the size of the problem and seek efficient solutions.

Vulture decline and its negative effect on economy, public health and culture has been well-studied in the case of India. The use of the veterinary drug “Diclofenac” by livestock industries has caused an unprecedented decrease in the population of vultures. As a result, carcasses were eaten mostly by other terrestrial scavengers such as wild dogs and rats, a fact that led to large increases in wild

dog numbers, and the incidents of rabies, anthrax and other diseases spread by dogs. As a result, levels of morbidity and mortality climbed. Researchers estimated the monetary value of vultures' decline by using the cost of illness and the statistical value of life. The findings showed that the cost for the Indian government during the years 1992 and 2006 came to \$34 billion (Markandya et al. 2008). Furthermore, the Parsi community in Mumbai was affected culturally as the corpses they ritually place on elevated stone platforms for 'sky burial' took several months longer to be consumed by vultures. Through this practice Parsi community is considered to liberate the souls of the dead.

The vulture crisis between the two continents has fundamental differences: at the time of writing, the decrease rate of the vulture population in Africa has been substantially lower compared to that in Asia, therefore, African governments have time to work against the collapse of this functionally vital group. Another point of difference is that while Asian vultures were exposed to one major threat, a veterinary drug, African vultures face multiple dangers.

More specifically, some of the most common threats include secondary and deliberate poisoning, poaching, mortality caused by collisions with manmade structures, unavailability of food and loss of habitat. Across Africa 61% of vulture's mortality is due to poisoning, trade in vulture heads and brains accounts for 29% and finally 9% of the deaths are caused by collision with powerlines (Ogada et al. 2015).

1.1.1 Aims

The present study aims to explore how vultures of NNP could be protected and their numbers enhanced.

1.1.2 Objectives

The main objectives of the present study are to:

- Determine the ecological, economic and cultural services the vulture provides on the Nyika plateau and understand its most threatening causes of extinction.

- Identify the key stakeholders and the links between them
- Conduct a pilot study based on monitoring techniques, as a mean of assessing the reactions of locals and visitors
- Discuss a suitable conservation policy for the species

2 Method

2.1 Study area

The vultures of Nyika NP are mostly concentrated on the Nyika Plateau, an area of 1800 km². The study site, the Nyika Plateau, is the largest montane complex in south-central Africa.

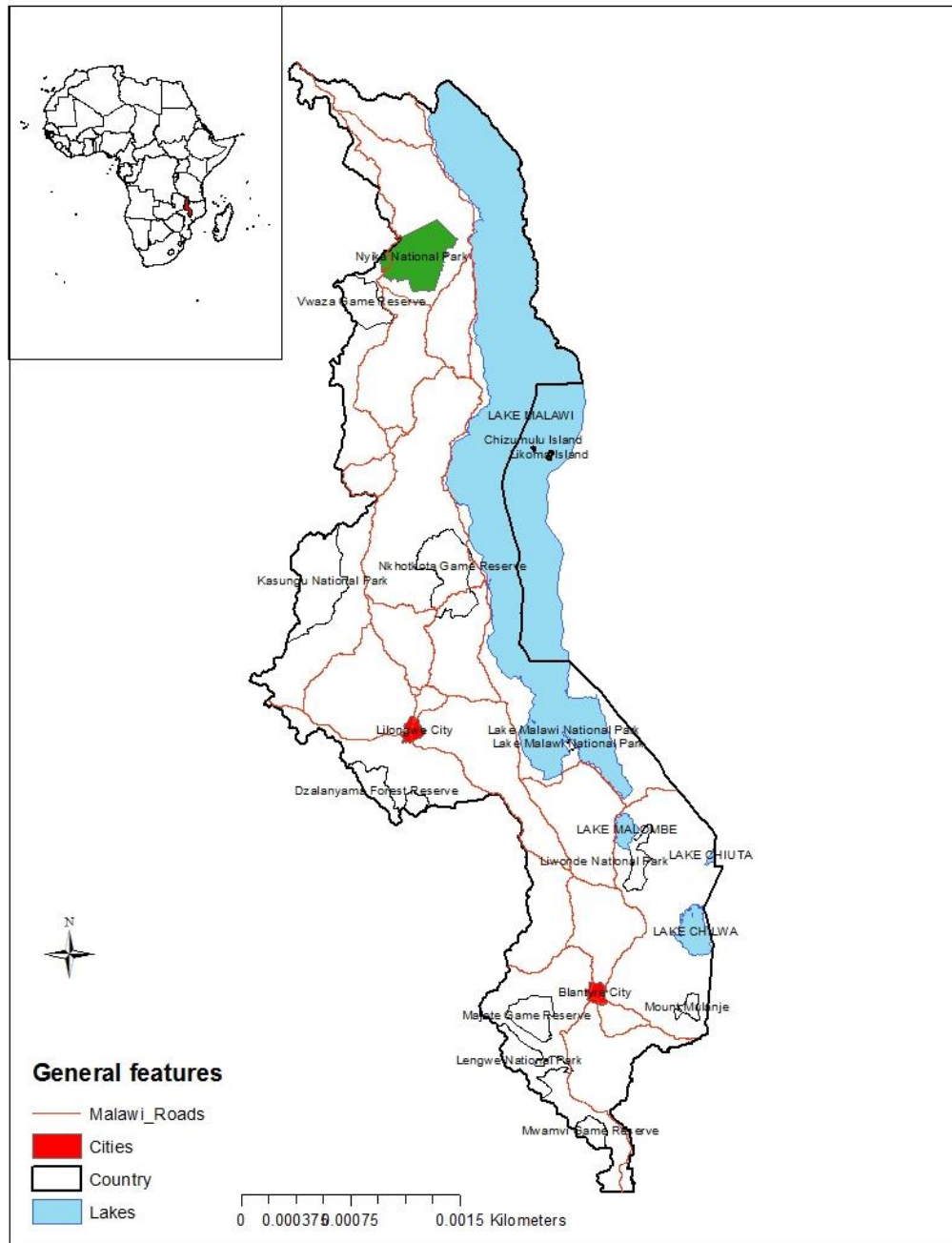


Figure 2-1: Nyika National Park, Malawi

The Plateau is mostly covered by extensive grassland and a small percentage of evergreen forest patches. Uncontrolled fires, however, often sweep up onto the plateau, resulting in the alarming decrease of these small forest patches (Dowsett-Lemaire, 2006). Hence, fire management is one of the main conservation issues for the park. Nyika NP is an important catchment area as it contains the sources of four large rivers draining into Lake Malawi. Maintaining the water bodies in good health is crucial given the fact that the population of Malawi is dependent on the high quality water the lake provides.

Nyika is a niche bird destination, holding approximately 400 out of 600 bird species in the country. Apart from its unique scenery, the park hosts a wide range of ungulate populations including Zebra, Reedbuck, Eland, Duiker and Roan Antelope. The dead wild ungulates make up the vulture's primal diet in the site. During the last decades, a small Elephant population has been moved to the top of the Plateau due to high poaching activity. As the communities surrounding Nyika are extremely poor and highly dependent on natural resources, locals are often involved in poaching. George Nxumayo, Division Manager for the Parks in Northern Malawi, stated that: *"[...] illegal harvesting of bush meat needs to be tackled. Notably, during the 1990s, when laws were laxer, poaching caused a decrease in species populations"*. In fact, through that period poaching incidents rocketed. Donations received contributed to more effective anti-poaching management, as a result of which, illegal operations were reduced. The battle against poaching continues to make positive progress (Mabeti, 2016).

2.2 Study species

Regarding the vulture, four species are normally observed on the Plateau. These are: the White-backed vulture, the Lappet-faced vulture, the White-headed vulture, the Hooded vulture and less often the Palm-nut vulture.

The Palm-nut vulture (*Gypohierax angolensis*) is a not-so-common wanderer from the Lake-shore. It has been spotted once in May, 1980 and again in April, 1995. Additionally, one was recently spotted on the Plateau. The White-backed vulture (*Gyps africanus*) is the most numerously sighted of Nyika's vultures from 1980 to the present (Dowsett-Lemaire, 2006). During the two-week research

expedition in Chilinda Camp/Nyika, White-backed vultures were spotted soaring every other day. Lappet-faced (*Torgos tracheliotus*) and White-headed vultures (*Trigonoceps occipitalis*) are also common species of the study area.

These birds can forage hundreds or thousands of kilometers, thus effortlessly crossing international borders (University of St Andrews, 2015). Taking this into account, concerns about this group are increasing significantly, since their conservation cannot be limited to protected areas only. In fact, when putting together the overall decline of the vulture in Africa, it is apparent how critically threatened vultures have become. The rates of decline, over three decades, for the three vulture species are as follows: White-backed vulture (-90%), Lappet-faced vulture (-80%) and White-headed vulture (-96%) (Ogada et al, 2015). In Africa and especially Malawi there are few baseline vulture population studies. Conservation work that has taken place to date in Africa focuses on monitoring the decline of the species (Bodin, 2014).

According to the IUCN Red List (Red List, 2016), all vulture species observed in Nyika are marking decreasing population trends worldwide. Exceptionally, the Palm-nut vulture seems to have a more stable trend. In particular, the White-backed vulture and the White-Headed vulture are categorized as *Critically Endangered*, whereas the Lappet-faced vulture is considered to be *Endangered*. The Palm-nut Vulture, however, is qualified as *Least Concerned*. The decline in their numbers urgently requires that the most insidious threats to their survival be determined and solutions to these threats be sought.

In the case of Malawi, little is known about the status of vultures. Although it is generally accepted that vulture numbers are decreasing all around the country, little, if any, information has been published (Roxburgh et al. 2012) and thus it is hard to compare past and present surveys. According to the DNPW, populations of all vulture species presented in Nyika are likely to have undergone a decline in the last two decades (Nxumayo, 2016).

2.3 Data Collection

The present research is based on the following methods of data collection: literature review, fieldwork and observation, interviews, questionnaire survey, area search and carcass-based counts. One of the key issues observed throughout the expedition in Malawi was that very limited research has been undertaken regarding the vulture of this country as compared to the species in the rest of the continent. Consequently, extracting results for the trend in vulture populations in Malawi at this stage is unlikely.

2.3.1 Interviews

Face-to-face interviews with key informant were conducted during the research expedition in Malawi between May and October 2016. The interview form was largely structured with open-ended questions, which allowed the interviewer to probe for more information. Usually, however, face-to-face interviews are necessarily limited in the number of individuals that can be engaged, as compared with the possibilities offered by other techniques. To ensure the collection of adequate data, therefore, impromptu interviews were conducted on occasion when the opportunity arose. Further interviews via email were undertaken from 5 May to 10 September 2016.

The aim of this particular method was to collect information from influential players such as employees of the DNPW, staff and tourists of CAWS, locals of the Chilinda, Thazima, Kaperekezi and Uledi Camps and conservation bodies such as PPF. Additionally, the method aimed to identifying the importance of the vulture to respondents. The interviews and the general fieldwork observations helped identify the stakeholders of the vulture in Nyika and their interrelationships between them. This information was analysed using as its base an interest-influence matrix, which is presented later in the paper.

The qualitative data collection shed light on what values vultures provide, as well as explaining how they are perceived by local communities, authorities, conservation bodies and other stakeholders. Finally, the method also assisted in identifying the major threats to the species on the study site.

2.3.2 Qualitative questionnaires

Qualitative questionnaires are a convenient way to gather information on people's beliefs, feelings, activities and so on. The questionnaire (see Appendix 5A.1.2) was developed to provide information on the vulture's likeability by people, rates of sightings of the bird, awareness of vulture's extinction and the environmental and cultural role played by the species. Information collected includes where people come from, age and gender, whether they have ever attended an environmental seminar or course before, as well as their job title. Furthermore, to extract the degree to which tourists are visiting the park in order to enjoy the vulture, respondents were asked their primary interest in visiting NNP from the variety of attributes the site has. The questions were closed-ended with an additional 'Comment' section, in order to allow for extra information to be noted. The questionnaires were distributed to 50 locals and visitors from 5 June 2016 to 20 June 2016, including both weekdays and weekends. A notable challenge was the difficulty of interviewing visitors of CAWS, as most of them were spending very little time on site and were either occupied with activities or resting.

2.3.3 Area search

Area search is one of the methods applied on the Nyika plateau and specifically around Chilinda Camp. Observers were roaming for a fixed time in a specified area every other day for the duration of two weeks in June 2016. Area search is a relatively easy technique, however, standardization of data collection is difficult. The method is an index to the abundance of species and a valuable measure for habitat relations. Area search can be used in the non-breeding season (Nur et al. 1999).

2.3.4 Carcass-based counts

Carcass-based counts took place in June 2016. During the two-week fieldwork period, two carcasses were placed in different areas. Essentially, the method in both counts differed. The first experiment was based on a reedbuck carcass which was found drowned near the Safari Camp (CAWS). The carcass was placed at a distance of 30 meters away from human activity. It was decided to

observe the natural process of its decomposition. Therefore, the researchers did not open the carcass or alter its initial location. As mentioned above, Nyika is a great bird destination and in fact the tourists were not put off, but rather fascinated by the sight of the dead body and the avian scavengers that approached it. Approximately 10 to 12 ravens came near the dead reedbuck, however, they were unable to feed on it as no vultures had arrived to open the carcass and thus were limited to the eyes and anus as food sources. During the night the corpse was consumed by hyenas. No remains were found the following morning. Indeed, vultures did not visit the experimental site that day, even though they were spotted soaring close to the area. This fact is probably explained by the high human activity on the site.

The second count involved a relatively small sized goat which was placed at an open, grassy site, near the second dam of the plateau. Vultures had been spotted quite often in the area, perhaps due to the water body and the small evergreen forest by the dam. The forest patches make an ideal location for the vulture to sit hunched in the trees. The observers were stationed about 30 meters from the carcass, in a place with rocks and bushes so to prevent themselves from being seen by the scavengers. The goat was killed just before 9am and from then on counts were made as the vultures were descending from the sky and landing close to the body.

2.4 Data Analysis

2.4.1 Literature review and thematic content analysis

The literature review took place at an early stage of the research. The process helped in defining and limiting the problem.

The data collected from the interview transcripts were examined by following a time-consuming, yet comprehensive, inductive approach. Thematic content analysis is perhaps the most common method of qualitative data analysis (Burnard et al. 2008). The process involved analysing the transcripts, identifying patterns within this data and collecting examples of those patterns from the text.

Thematic content analysis shed light on issues regarding the case of NNP. Many argue that the literature review can often bias the researcher's analysis. However, it was believed that the early reading could lead the researcher to focus on some aspects of the data, thus narrowing the research during the thematic content analysis (Braun et al. 2006).

Already during the data collection stage, attention was given to themes of meaning and issues of potential interest in the data. Writing was integral from the beginning of the study, hence ideas and potential coding themes were noted. The interviews were transcribed allowing for thematic analysis of the data. It is important to mention that although the transcription convention was not strict, the transcripts retained the information needed for the analysis. The coding of the data was based on colouring the different patterns. In particular, there were nine themes identified as shown in Figure 2-2.



Figure 2-2: The nine themes of the thematic content analysis

2.4.2 Descriptive statistics

The questionnaires were analysed based on descriptive statistics methods, therefore, a summary of the data set describes its basic features. The data collected from the questionnaires were processed in an excel database. After cleaning the data by checking each questionnaire, the information was analysed

and broken down into percentages. The analysis was able to explore the level of awareness of vultures' extinction and the emotional response to the species.

2.4.3 Stakeholder analysis

One of the objectives of this research was to identify the stakeholder network in regard to the vulture species of the site. The ecological-economic analysis requires the identification of how values deriving from this particular natural resource are perceived by individuals or groups. Stakeholder analysis is an essential part of project development. This study investigated the parties involved with the park by following three steps (Reed et al. 2009):

- Identification of stakeholders, a method based on interviews and fieldwork observations
- Categorization of the players depending on the interest-influence matrices
- Investigation of the relationships between the stakeholders

In order to illustrate the influential role different stakeholders play, a Stakeholder matrix has been formed according to a key question: "Who would be interested in an increase of vultures' numbers in NNP?". This is where stakeholders are plotted against two variables: the 'interest' against the 'influence' of the stakeholder. The stakeholder matrix emphasised on the social aspect of the analysis. Particularly, the matrix was concerned with the representation of the key actors, rather than their ideas. The key players were displayed based on their position within the stakeholder matrix, in which boxes A to D represent the different interest-influence levels. Additionally, a colored bullet, which presents a different attribute accompanies each stakeholder within the matrix. The above classification is outlined below:

A-Key Players: This group is highly important as it is characterised by high mobility and essential resources: political, financial, human, economic, knowledge, skill and technical (Mumtas et al. 2013). Therefore, Key Players should be actively involved with the project.

B-Subjects: This group has a high level of interest but less influence.

C-Crowd: There is little need to extensively involve the crowd as it has both little interest and influence.

D-Context Setters: A group with high influence but little interest which could damage the process if not managed properly.

The interest-influence matrix method was selected to assist with the first stage of the stakeholder analysis. The present study attempted to explore only this stage since no conservation plan for the vulture has commenced in Nyika yet. So who are those assigning economic values to vultures? The study identified five groups of stakeholders in the base of their use of the natural resource. These five groups were placed on the stakeholder matrix according to their interest and influence (Figure 3-4).

3 Results

3.1.1 The ecological, economic and cultural ecosystem services of the vulture

By reviewing the literature and conducting interviews, questionnaire surveys and fieldwork at the case study, this paper investigates the environmental, economic and cultural role of the vulture. Vultures provide a number of critical benefits in the framework of all four ecosystem service types (regulating, habitat, provisioning and information). Within these services we meet not only ecological functions but also economic and cultural values. Indeed, the literature on vultures shows a variety of ecosystem services offered by the scavenger. Specifically, Markandya et al (2008) studied and presented an extended work on vulture's ecosystem services. Figure 3-1 presents examples of comments extracted from the interviews, which were distributed according to the ecosystem functions of the scavenger.

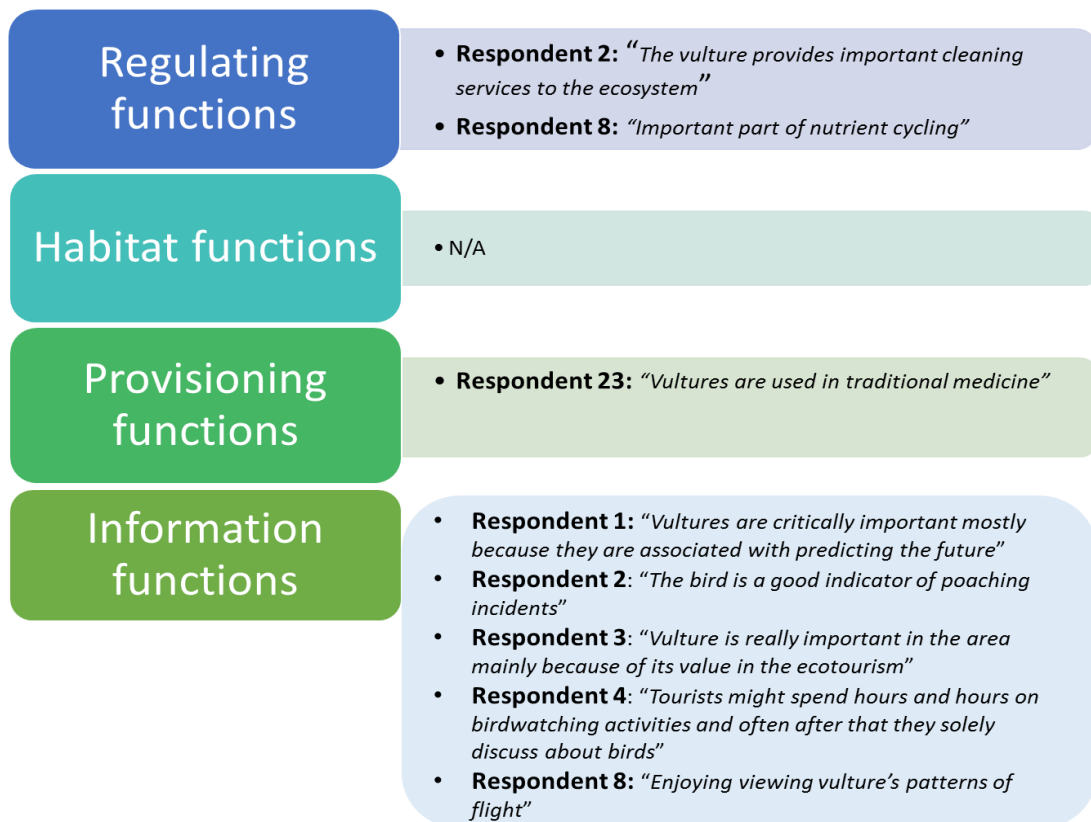


Figure 3-1: Classification of the vulture's ecosystem services through the data collected from the qualitative research methods.

3.1.1.1 Regulating ecosystem services

Waste disposal: Vultures are suspected to have strong immune systems as their feeding habits involve being constantly exposed to pathogens. Their highly acidic stomachs are extremely corrosive and thus allow them to digest carcasses without getting infected. Deadly bacteria like botulism, classical swine fever and anthrax do not contaminate the vulture while it scavenges on carrion (University of Copenhagen, 2014). This biological recycling team plays a vital role in people's health.

Biological control: Despite the rate at which these 'keystone' scavengers are decreasing, little is known about the impact of their disappearance on other scavengers and rates of disease transmission at carrions. Vultures prevent the spread of diseases by rapidly disposing of carcasses. Moreover, vulture's aerial movements often lead other scavengers to carcasses such as jackals and hyenas. However, pathogens such as rabies and canine distemper virus can infect and be transmitted by other scavengers including the aforementioned genets. Vulture extinction may lead to an increase in the diversity of species scavenging on carcasses, thus an increase in rates of disease transmission. Experiments showed that in the absence of vultures not only did the mean carcass decomposition rate triple but also did the mean number of mammals at carcasses, as well as the average time spent by mammals at carcasses. To make matters worse, there was a nearly threefold increase in the mean number of contact between mammalian scavengers at carcasses without vultures (Ogada et al. 2012). In short, hyenas and jackals are both hosting a number of carnivore diseases (Craft et al. 2008), hence increased contact of infected individuals at carrions could facilitate pathogen transmission.

Nutrient cycling: According to Wenny et al. (2011), animal species are also known as "mobile links" given the fact that they provide crucial ecosystem services, increase ecosystem resilience and link habitats as they move between them. Scavengers, in particular vultures, are critical process links that expedite the decay of potentially disease-carrying carrions. Carcasses constitute a vast reservoir of nutrients and energy. By consuming much of the biomass remaining

in the dead body, scavengers significantly contribute to nutrient cycling. The absence of the vulture is slowing the rate at which nutrients are redistributed, thus indirectly affecting other services.

Soil formation: Accumulation of vulture guano in the soil close to nesting and roosting areas has an impact on the soil bacteria structure. In fact, ornithogenic soils generally have increased organic matter, higher nitrogen and lower pH. Hence, the positive change in the structure of soil bacteria communities. By transferring nutrients in their guano, vultures often contribute essential resources to nutrient-deprived ecosystems (Ganz et al, 2012). In short, the role that vultures play as disease vectors transforms more to that of environmental sanitizers.

3.1.1.2 Provisioning ecosystem services

Medicinal resources: In various parts of Africa, traditional medicine that requires animal material is often used. Techniques applied by traditional healers require those who are ill either to drink the vulture's brain, inhale it, smear on the body or rub it thoroughly in the eyelashes.

3.1.1.3 Information ecosystem services

Recreation and ecotourism: NNP is a niche touristic destination. One of the greatest bird-destinations in Malawi as it holds 400 out of the 600 bird species that can be found in the country (Dowsett-Lemaire, 2006). Ecotourism is one of the most powerful driving forces for biodiversity conservation, especially in third world countries where inadequate funds are a common concern. Previous studies indicate that observing birds positively contributes to the welfare of recreational tourists (Boxall et al. 1993). Particularly, a recent study examined the monetary value placed on the griffon vulture in two reserves of Israel. By applying non-market valuation techniques, namely the travel cost method and contingent valuation method the researchers found a willingness to pay £1.03m and £0.48m at Gamla and Hai-Bar respectively. Moreover, the value of each individual vulture was estimated between £4,144 to £38,511, depending on the site (Becker et al. 2004). Although NNP is not entirely based on entrance fees, tourist visits contribute to the total revenue. Improving or at least maintaining the number of the endangered species is important for the touristic value of the park.

Cultural heritage value: The vulture is highly linked to important cultural heritage (Mander et al. 2007). Different superstitions suggest that health, disease, success or misfortune are a result of ancestral spirits. A key limitation of this research was that little was known about these methods. However, recently light was shed on the extent of the trade in animal parts. Mander et al. (2007) showed that vultures are believed to be effective in providing foresight, increased intelligence and clairvoyant powers. Cooking the foot and the beak of a vulture with herbs is believed to bring good luck in gambling. Generally, vultures are mainly supposed to contribute in successful businesses and intelligence in school.

Science and education: Apparently, the DNA of the vulture is often subject to medical science. Research is being carried out in order to utilize the genetic resources of extreme life forms such as the vulture in order to improve human health (BioMed Central, 2015). Based on experiments, thousands of species of bacteria are found on vultures' faces and beaks. However, only a few groups of deadly bacteria survive in a vulture's gut. Some of these include Fusobacteria, which have been linked to colon cancer in humans, and Clostridia, which produce tetanus, gangrene and botulism (University of Copenhagen, 2014). Therefore, maintaining the species is crucial within a wide range of sectors.

In addition, it is important to realize the significance of the vulture in protected areas of Africa. Circling vultures serve as detectors of possible poaching occurrences as they naturally alert field operators by flying around carcasses. Examining the area where vulture kettles¹ are seen is a common practice within the law enforcement departments of NNP. During the interviews it was often mentioned that these groups of vultures might give away illegal hunting incidents and, as such, game rangers are obliged to investigate the targeted location.

¹ A group of vultures resting in trees is known as a "venue" and when the group is seen in the air, circling together it is called a "kettle".

3.2 Threats to vulture populations

The information collected from the literature review, the questionnaire survey and the personal communication with stakeholders contributed to the understanding of the threats vultures face within and around the park.

Although poachers poison intentionally the carcasses throughout Africa, deliberate vulture poisoning is not the case for NNP. Poaching activities on the plateau, however, result in the decrease of the ungulate populations, and thus diminished food sources for the vulture.

According to Nxumayo (2016), the hyena and vulture populations were high in the 1990s, similarly to the rest of the animal species. However, these scavengers faced a dramatic decrease in around 2000. Besides the diminished population of predators (Schröder, 2016) and lack of food caused by intensive poaching, remains of poached animals were often laced with Temick. The drug might not be in use today in NNP, nevertheless, poisoning of wildlife in and around Liwonde NP and other parks in Malawi is still occurring (Roxburgh et al. 2012).

The vulture is highly linked to traditional medicine in parts of southern Africa. The data obtained from the questionnaires suggests that although these beliefs are well known among locals, in and around Nyika, they are not practiced in the region. About 160 vultures are sold per year in South Africa with nearly 59,000 consumption incidents of vulture body parts. To put it differently, 5 to 10% of a traditional healer's income is constituted of the vulture trade. Though, the vulture harvesting is not applied in a sustainable way, which could lead in exhausting the bird's populations in southern Africa between the next 15 to 30 years (Mander et al. 2007). Not surprisingly, under those circumstances, Nyika's vulture is indirectly affected.

Habitat loss is one of the major threats vultures come across. In fact, habitat destruction is a critical issue that concerns Malawi. Rapid human population growth has led to vigorous agricultural expansion and illegal exploitation of forestry and wildlife resources. Violation of protected areas and uncontrolled bush fires, coupled with policy failures are serious problems that urgently seek

solutions if biodiversity is to be protected. Particularly, NNP has a high fire incident rate. Fires are caused either by ingenuous visitors, poachers or by the early burnings² (Nxumayo, 2016). To make matters worse fire is often the cause of the expansion of invasive flora in the plateau such as the Bracken fern (*Pteridium aquilinum*). Bracken is a highly toxic fern, which is undesirable for animals of Nyika as food source. Therefore, invasive species play a significant role in food scarcity for the wild ungulates, hence for the vulture too.

To make matters worse, the vulture is a slow breeder (University of St Andrews, 2015). The low reproductive rates and delayed maturity make the scavenger especially vulnerable to high mortality rates. Indeed, vultures generally breed after the fourth year, tend to have one mate per annum and lay one egg at a time (Phipps et al. 2013).

3.3 Questionnaire survey results

The results from the questionnaire survey showed that 59% of the respondents are just happy to know vultures exist, whereas the 37% is fascinated by seeing vultures soaring or feeding. Finally, a small percentage (4%) would prefer not to see the vulture (Figure 3-2). Visitors and locals of Nyika as well as other individuals or organizations such as the BirdLife International or the RSPB are able to capture existence values from the vulture (Markandya, 2008). *Nonuse* values, such as the existence value, are associated with benefits resulting from simply knowing that a resource is sustained (Turner et al. 2000).

² Early burning is a forest management tool, which is used to limit uncontrolled fires.

Emotional response to the vulture

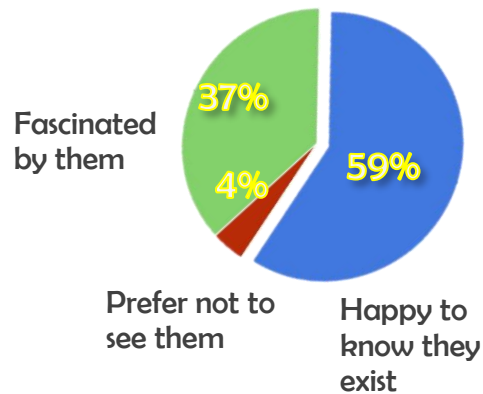


Figure 3-2: Emotional response to the vulture. Results were obtained from the questionnaire design.

The second assumption extracted from the qualitative research supports that Chilinda Camp staff, especially safari guides, managers, parks and wildlife assistants as well as visitors with a high interest in birds, are aware of the most critical ecosystem services the vulture provides. Although there is a certain level of

awareness among these groups, it was observed that local communities surrounding the park such as the Beekeepers in Thazima Camp or residents of Chilinda Camp and a small number of tourists lack knowledge of the services the vulture offers to the ecosystem. Furthermore, the analysis showed that the level of awareness towards the extinction of the species is low. Particularly, only 33% of the respondents is aware of the alarming decline in vulture numbers, while the majority (67%) is not.

3.4 Area search and carcass placement results

Generally, it was encouraging to realise that vultures were spotted soaring nearly every day during the fieldwork. The main species observed were the White-backed vulture in high concentration followed by the Lappet-faced vulture, which was normally seen in a concentration of one or two individuals at a time. Notably, Figure 3-3 illustrates the vulture sightings from April 2016 to August 2016. The population of vultures in Nyika NP is mostly concentrated on the plateau since the grassland makes it easier for them to spot the carcasses. Moreover, the ungulates' population is gathered at the plateau (Mabeti, 2016), which explains

the relatively frequent sightings of vultures in the area. Vultures tend to follow wild ungulate herds (Kendall et al. 2013).

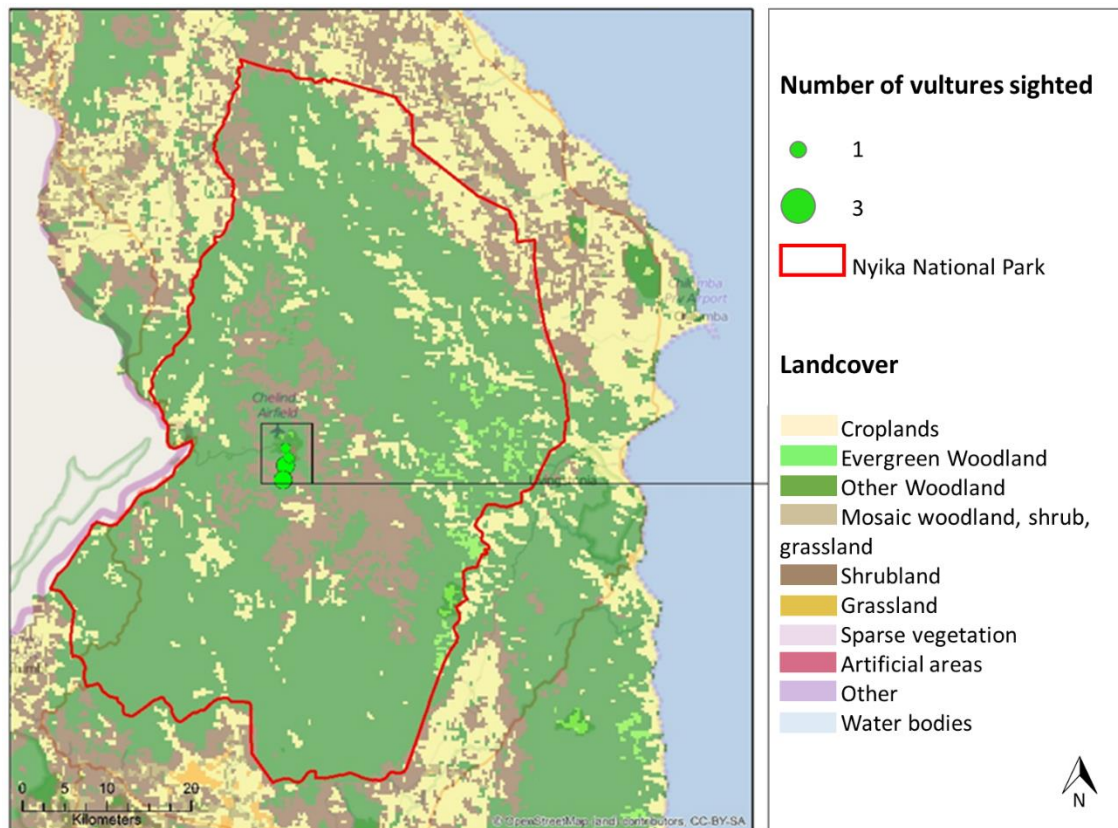


Figure 3-3: Number of vultures sighted, April-August 2016.

The second carcass-based experiment resulted in attracting approximately 25 White-backed vultures that were either feeding on the carrion or soaring in the sky. It is essential to mention that 4 of those were juveniles. Other species that approached the carcass were 4 Lappet-faced adult vultures and a male adult White-headed vulture, which seemed to arrive last. Not surprisingly, the Lappet-faced vultures were dominating the carcass. The current observations suggest that vulture numbers might still be less than the true maximum number, since birds could both come and go within minutes. As mentioned above, the goat was placed just before 9.00am at the targeted location. The first vultures were soaring in the area within minutes. At 9.30am a Lappet-faced vulture approached the carrion while leading the rest of the kettle. Two hours after the goat placement 90% of the dead body had been consumed by nature's clean-up crew.

Figure 3-4 illustrates the results of the Stakeholder analysis. The key actors were placed in the boxes according to their level of interest and influence towards a potential increase of the vulture's numbers in Nyika. The blue lines represent the links between the stakeholders, who are divided into groups depending on their use of the vulture, as follows:



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the park is efficient, yet not optimal (Mabeti, 2016). Lastly, although it is known that vultures could greatly contribute to the livestock sector, the study has not identified particular farmers surrounding Nyika, who are benefitting from the disposal services of the vulture.

Indirect users include the surrounding communities and the five camps of the park: Chilinda, Thazima, Uledi, Kaperekezi and Njalayankhunda. In this group it is best to include the current and future funders of NNP, considering that they have a highly influential role. The World Bank Project, after approving a Global Environmental Facility trust fund in 2011, has been financially supporting NNP so that the DNPW can afford operational costs, sufficient fuel, patrol trainings etc. (Nxumayo, 2016). Additionally, co-financing commitments were secured from the PPF. PPF will run a five to ten-year project in order to achieve more effective cross-border biodiversity management in the TFCA.

Direct or indirect exploiters are unsustainably harvesting natural resources from the park. They do not possess a form of environmental knowledge, rather they are driven by financial pressures while overlooking the negative ecological externalities their actions entail (Nxumayo, 2016). Poaching incidents were the cause of rapid declines in animal species within Nyika, resulting in food shortages for the vulture.

Nature conservation and amenity groups. Quite recently, considerable attention has been paid to vultures by several organizations. Namely, WESM, BirdLife International, NABU, IUNC, RSPB and Museums of Malawi. The vulture is of utmost importance within the recreational sector. Recreational values are obtained from birdwatchers and other tourists who are visiting the site.

Non-users include mostly institutions, which provide donations for the management of NNP. Such organizations are the KfW, Dutch Lottery and other smaller donors.

4 Discussion

This paper is a modest contribution to the ongoing discussion on the vulture decline among conservationists. Particular attention has been paid to the ecosystem services the scavenger provides. The purpose of this is to highlight the importance of the species, which is often overlooked by influential bodies and the general public. The study also attempted to provide an initial step in monitoring the population of vultures in Nyika.

The study showed that vultures play an important role in local communities. by providing important regulating, provisioning, and information ecosystem services, which by and large are invisible and underappreciated. Given the fact that an individual living vulture has been valued at approximately USD 11,000 to the economy of U.S.A, it would be extremely expensive to replace these services once they are lost (Gacheru, 2015). Dr Darcy Ogada, Assistant Director of Africa Programs, said: *“Large declines of Africa’s vultures should ring alarm bells due to their immense ecological importance. Vultures are a vital component of a healthy environment, especially in Africa, where ‘free’ ecosystem services such as disposal of carcasses and other waste products remain the norm. If we don’t take urgent steps to save these birds, and in particular to curtail wildlife poisoning, we should expect long-term consequences for the environment, as well as for humans in Africa”* (University of St Andrews, 2015).

Although, past studies have attempted to value the scavenging benefits of the vulture, other benefits are yet unevaluated. An interesting indicator of how unappreciated vulture ecosystem services are, is the paucity of studies into nutrient cycling and ecosystem engineering services (Wenny et al. 2011).

Personal communication with stakeholders showed that the vulture provides particular services which are critical for the park. Visitors and tourism employees (lodge managers and safari guides) indicated that Nyika is largely directed at avitourism³. Birdwatching is an ecological sound and sustainable type of wildlife

³ Avitourism is a type of tourism relevant to birding.

tourism. This particular activity highly contributes to the economic development and environmental management of many sites.

Vulture's ability to notify about poaching incidents is highly appreciated by the law enforcement team of the plateau. An increase in the number of vultures in Nyika could be of further assistance to the law enforcement team in their battle against poaching. Vulture is not just a victim of poaching but also a mean of fighting it.

The questionnaire survey revealed that there was low level of awareness regarding the vulture's decline and a limited emotional connection to the bird. Conservation is greatly based on maintaining habitats and changing mind-sets. Hence, improving local opinions towards the raptor and levels of awareness regarding its extinction are important steps to evaluating conservation and management strategies.

However, one of the advantages of the questionnaire design is that it served as a valuable public relations exercise for the vulture. Notably, awareness was raised during the fieldwork among locals of Nyika as they were, afterwards, deliberately searching for vultures and reporting occurrences while on their everyday duties.

The questionnaires were less useful for assessing vulture frequency. The reported vulture frequency occurrence was considered subjective. Vultures are known to fly in great heights, which makes it difficult to observe them with an unaided eye. Therefore, vultures are mostly seen when someone is specifically searching for them. The majority of the respondents had not spotted the bird. Vulture occurrences were largely mentioned by those who have a general high interest in wildlife, particularly birds. Systematic carcass-based counts would better assess the species frequency (Murn et al. 2008).

Sound bird conservation policies require monitoring programs in order to assess the size of the problem and later on be able to observe the progress or failure of the project. The avian monitoring techniques that were demonstrated during the fieldwork in Nyika NP provided the study with an understanding of the case study and species. However, these data are not robust for a bird survey study.

Estimating the relative abundance of the vulture, population size, density and trend requires years of collective monitoring. For example, *area search* can assess relative abundance only after 1 to 3 years of application. Determining population trends require at least 10 years of bird monitoring (Nur et al. 1999). The bird monitoring survey provided the research with a number of interesting observations.

Firstly, the data obtained from the carcass-based count consistent of the vulture species, age category, social interactions and time tracking. Vulture is a bird that depends on thermals to fly and to get a wide view of the plains. Coupled with the fact that the carcass experiment was conducted early in the morning, when the temperature is relatively low, it is possible to conclude that vultures are residents of Nyika. Additionally, about four juvenile White-backed vultures approached the dead body. According to Tiwonge Mzumara-Gawa, former Research Officer for the Wildlife and Environmental Society of Malawi and one of the few Malawian ornithologists, considering that juvenile vultures are not able to cover long distances as the adult ones, it is likely to conclude that the vultures of Nyika NP breed no further than Zambia (Mzumara, 2016). However, additional research on the nest-site occurrences in the area is necessary.

The pilot study, however, provided essential information on public reaction. In a sense, the *area search* technique and carcass-based counts that were demonstrated on the plateau gave an insight on the response towards a potential monitoring programme. It was encouraging to observe people's thoughtfulness and concern once the problem was presented to and analysed for them. There was a positive impact during the expedition across the community. Indeed, locals showed a considerable willingness to participate in the monitoring of the vulture. Chilinda residents became more aware of the vulture's occurrences, and enthusiastic to report sightings of the bird. They also assisted the research by spotting carcasses and locating them accordingly to allow access to vultures. Finally, tourists were not put off, but rather fascinated by the sight of the carrion and the avian scavengers.

Nyika is a niche touristic destination focusing on avitourism. The vulture is a threatened species of the area that seeks protection. These two facts have triggered conservationists such as NABU and BirdLife International to discuss the possibility of a vulture feeding station at the site. In personal communication with Werner Schröder, Africa Officer of NABU, it was pointed out that this particular protection strategy has already been discussed with the park staff and received a positive response. The study, in a sense, explored the possibility of establishing a vulture restaurant within Nyika. The first thing to remember is that the station will provide small portions of carcasses in order to serve as supplementary feeding and not to create dependency. Thus, even the slightest effort would not be considered trivial.

Another key point, which was outlined previously in the paper is that the vulture has a high significance across the ecotourism industry. A noteworthy example is the case of the Victoria Falls Safari Lodge in Zimbabwe. The Lodge has created a “Vulture Culture Experience” for tourists by establishing a vulture feeding station, which offers the opportunity to view, learn about and photograph the bird. This venture provides the endangered species an aid, contributes to avitourism, creates awareness and, finally, allows scientists to monitor the bird by collecting data and apply population counts (Steyn, 2015).

A Vulture Feeding Station is a discussable conservation policy. However, many argue that vulture restaurants do not deal with the root of the problem (Mzumara-Gawa, 2016). The major cause of vulture’s fall in numbers regarding Nyika is the lack of predators and food scarcity, thus tighter law enforcement policies must be implemented in order to tackle poaching. Vulture restaurants are a solution for countries where livestock is a relatively large sector such as South Africa. There are more than 250 established vulture feeding station throughout South Africa (Koenig, 2006). Malawi does not support such a large livestock sector. However, vulture populations increases have been noted within game reserves. Remarkably, in 2011 no vultures were sighted in Majete Game Reserve in Malawi. The species reintroduction programme that was implemented after in the

reserve resulted in attracting a significant number of vultures in the area (Mzumara-Gawa, 2016).

The stakeholder analysis examined the stakeholders' interest and influence on the vulture and the links between them. As Figure 3-4 shows, clearly all stakeholder interests and influences differ, a fact that highlights the need for extensive stakeholder analysis and understanding at a very early stage of any conservation project. Although the study has not explored the key actors extensively, there are key points that need to be emphasised.

It is claimed that stakeholder analysis can empower environmental decisions. George Nxumayo, Division Manager for the Parks in Northern Malawi, stated that the aid projects this country receives are often so fragmented that they do not reflect the impact they could possibly reflect across the communities in order to overcome the issue (Nxumayo, 2016). Livelihood projects are aiming to promote conservation, however, this aspect is normally remaining unnoticed by the locals. Consequently, stakeholder participation is essential for the involvement of those on the periphery of the decision-making framework or community who otherwise might have been marginalised (Reed, 2008).

Approaches of stakeholder participation might vary. Creating awareness and incorporating local perspectives in data collection can lead to successful policy application. Environmental problems are complex and thus flexible strategies that embrace different knowledge and values are important (Reed, 2008). Consequently, raising awareness towards the vulture's importance across the local communities is the first step to a sound conservation policy. Although, the Research Department of Nyika has already multiple advocacy programs, vulture-targeted approaches are highly recommended.

Although deliberate poisoning is not recently observed on the plateau, poisoning incidents can affect the vulture numbers of the site. Several publications indicate that these birds can cover long distances in a short time (250km in a day), therefore the vulture of Nyika is most likely affected by behaviors and trends in neighboring sites (Meyburg et al. 2004). Creating awareness among poachers and mitigating poaching occurrences is critical. The donors play an important role

in the management of the park. It is apparent that the potential of such key stakeholders derives from the availability of funding and the possibility of extra employment in the region. The projects target improvement of livelihoods by providing employment and thus decreasing the poaching activity, which mostly comes from the low-income communities encompassing Nyika.

The stakeholder analysis showed that nature conservation organisations and other environmental bodies are actors with high interest but less influence. By creating alliances and engaging in joint conservation planning the aforementioned bodies can increase their influence and have a positive impact on the park.

Finally, “Payment for Ecosystem Services” are incentives offered to landowners in exchange for managing a natural resource to sustain an ecological function. These incentives could be offered across the region to locals in order to protect vultures’ nests. The present analysis has not investigated the nest-site occurrences. Further research should be conducted in order to identify vulture nests in and around Nyika. Nevertheless, “Payment for Ecosystem Services” Schemes could contribute to the improvement of livelihoods around Nyika but also serve as an awareness service towards the vulture.

5 Conclusions

The aim of this paper is to make policy makers understand the urgent need for targeted conservation plans towards the vulture of Nyika. From the research that has been carried out, it is possible to conclude that within and around the park there is low awareness towards the vulture threats and extinction but willingness to protect the bird as soon as proper information is given to the public.

Moreover, the paper points out the importance of the ecosystem services the vulture provides to the local area and the people, and the need to sustain these services. The scavenger has a high value across the ecotourism sector and an important role in the law enforcement efforts as it alerts wildlife authorities to the location of poaching activities. Therefore, it is important to sustain or increase vultures' numbers by convincing policy makers to include birds' conservation in land-use and development decisions.

Conservation problems are complex and uncertain and typically they affect multiple stakeholders, thus making the stakeholder analysis an essential project management tool. The stakeholder analysis, which was undertaken in the present paper, allowed for the identification of the key actors and their interrelationships concerning a potential increase of vultures' numbers in Nyika.

The pilot experiments clearly showed that a vulture's monitoring programme would be endorsed by the residents of Nyika as well as the local authorities. Lastly, the paper aims to promote the Vulture Feeding Station as an initial step to vulture conservation in the area. This method will aid the species while providing access to scientists for regular monitoring practices.

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APPENDICES

Appendix A Survey instruments

This sector contains material from the face-to-face and key informant interviews with stakeholders, the questionnaire survey and the excel spreadsheet with the data collected.

A.1 Interviews and questionnaires

This particular research will partially be based on interviews with local authorities, locals and tourists. The interviews will be face-to-face, and based on open ended questionnaires. The interviews will be used to collect data on the benefits and value that vultures provide to different stakeholders. The open ended questions used during interviews will be as follows:

A.1.1 Interviews

1. What are the main environmental problems facing Nyika National Park currently?
2. Which conservation measures have local authorities established recently?
3. To what degree is the conservation and management of Nyika National Park based on ecotourism?
4. Are there any challenges associated with conservation and management of the Nyika National Park?
5. What actions are being taken/could be taken to tackle those challenges (e.g. poaching)?
6. Do farmers suffer from livestock loss due to predators?
7. Are any conservation measurements being prevented from taking effect? And if yes, what are the reasons behind this?
8. Is any organization responsible for maintaining the health status of Nyika? (e.g. carcasses disposal of dead animals)?
9. What benefits do vultures provide for local people in the Nyika National Park?
10. Are you aware of any role vultures have in providing food, regulating diseases or pests, or any cultural/social significance that is attached to them by local people or visitors?
11. Are you aware of the consequences of the vulture crisis in India?
12. Do you think the Nyika National Park is better with or without vultures?
13. If “Yes” or “No” to Q10, could you please explain your answer?

14. Are you aware of the 'Payment for Ecosystem Services' Schemes?
15. What park management policies are being applied in Nyika National Park or other parks in Malawi?

A.1.2 Questions to locals and visitors

These questions will be asked in the form of a questionnaire, addressing mostly locals and visitors in the Nyika Plateau and the surrounding area. The questions might be open or closed.

1. Are you participating in any activities in Nyika Plateau like:
 - i. Walking
 - ii. Hiking
 - iii. Driving
 - iv. Birdwatching
 - v. Cycling
 - vi. Hunting
 - vii. Camping
 - viii. Harvesting (flowers or other plants)
 - ix. Other
2. Do you own land, and if yes, which is the use?
3. How do you appreciate Nyika's animals and plants?
4. What is the most interesting thing for you in the Nyika National Park?
5. Have you ever seen or heard about poisoning incidents in Nyika National Park such as elephant, hyena or lion poisoning?
6. How often do you see vultures in the Nyika National Park (Daily? Weekly? Monthly? Yearly?)
7. For you, what benefits do vultures provide?
8. Do you enjoy seeing vultures? If so what was it about the vultures that you particularly enjoyed?
9. Are you aware of any role vultures have in providing food, regulating diseases or pests? (e.g. nature's garbage disposers)
10. Are you aware of the cultural/social significance that is attached to vultures by local people or visitors? (e.g. witchcraft)
11. Which are the uses of a vulture's body parts in your area, if any?
12. What feelings or thoughts do you have by seeing vultures while eating or flying?
13. Do you think the Nyika National Park is better with or without vultures?
14. If "Yes" or "No" to Q10, could you please explain your answer?
15. Are you aware that the vulture is threatened with extinction?
16. When were vultures or vulture's nests last sighted in this area?

Could you tell us the name of the city/village and country in which you live:

What is your relationship to this area:

- ☐ I live here full time
- ☐ I work here temporally or part time
- ☐ I am a tourist visiting Malawi
- ☐ I currently live and do research here

Gender of participant

Male or female?

- ☐ Male
- ☐ Female

Age last birthday

How old were you last birthday?

- ☐ 0-24
- ☐ 25-44
- ☐ 45-64
- ☐ 65-74
- ☐ 75+

Education

What is your highest education qualification?

Describe:

Education, qualification or informal training related to nature or conservation

Have you ever undertaken any training linked to the natural environment?

- ☐ Yes (please specify):_____
- ☐ No

Employment type

What does the firm or organization you work for (or used to work for) make or do?

Describe:

What type of job do you (or did you) do?

Describe:

A.1.3 Informed Consent form

Consent Form

Research Topic: Vultures' Ecosystem Services Valuation: the case study in Nyika National Park

Vultures provide critical ecosystem services, yet their population is decreasing rapidly worldwide. In the case of Africa and more specifically Nyika Plateau in Malawi, vultures are often victims of poisoning, hunting or poaching (Hurrell, 2015). To make matters worse, Nyika's fauna suffers from habitat loss due to the high population growth and hence the urban exploitation of the remaining forest resources as well as ineffective fire management and more. Lack of awareness about sustainable resource management among stakeholders and policy-makers is a serious concern (Malawi, Environmental Affairs Department, 2014). In fact, regulations deriving from the Malawian government seem rather lax resulting in insignificant improvements. Consequently, the decrease in the number of vultures has reached unprecedented levels.

This thesis project is aiming on specifying an Ecosystem Services Framework regarding vultures in Nyika National Park, generating a stakeholder analysis and determining a policy framework that utilizes 'Payment for Ecosystem Services' schemes to deliver an alternative outcome for vultures. Please fill in the form below if you consent to participating in this study.

Name and contact of respondent:

Name:

Tel:

Email:

1. I confirm that I have read and understood the information sheet for the above study, including the statement about the legal limitations to data confidentiality, and have had the opportunity to ask questions. ☐
2. I understand that my participation is voluntary and that I am free to withdraw at any time, without giving reason. ☐
3. I agree to take part in the above study. ☐
4. I agree/do not agree to the interview being audio recorded (delete as appropriate) ☐

Name of Participant

Date

Signature

.....

A.2 Interview transcripts

A.2.1 Respondent 1: George Nxumayo, Division Manager for the Parks in the Northern Malawi

11 years of experience, Biology BSc in Malawi University and MSc Natural Resource Management in University of South Australia.

Main environmental issues NNP is facing recently

1. **Fire issues**. When the park burns, it does affect the biodiversity of the place. Some species are fire sensitive and other depend on the fire. For instance, evergreen forest patches are greatly affected by fires. A common problem is the invasive species that colonize the plateau as a result of fire burning.
2. **Poaching**. Illegal hunting of the wildlife. Communities surrounding Nyika are extremely poor and their dependent on natural resources is high.
3. **Invasive species**. A recent example is the bracken fern which causes a huge ecological impact as it colonizes the plateau.

George is emphasizing on the link between the problems. Often uncontrolled fire is a result of **poaching activities** within the park and invasive species are mostly grown in burnt lands.

The evergreen forest has certainly decreased in unprecedented levels. In some areas fires have vanished young forest patches. In other areas forest patches are resilient and even after fires they are surviving.

Satisfied by the **management of the park (tackle poaching and fires)**

George feels that a **further comprehensive research is necessary** in order to reach more efficient levels of park management. In the case of fires, it is important to understand the link between Nyika and the environment.

Main sources of fires in Nyika

1. Lightening.
2. **Fires set by poachers**. Those are devastating fires because they are set on the bus when it is too dry.
3. Fire management or **early burning**.

Still fire is fire and has negative impacts. Overall, Nyika is big and the **current resources are in fact inadequate**. Malawi Zambia TFC is running a project in order to tackle common problems such as poaching. According to George progress **towards the battle with poaching is fastidious but improving**. **The World Bank**

project is definitely greatly contributing to the fight against poaching, without this aid poaching management would be more challenging.

The Project is providing funds for operational costs, fuel, patrols trainings, capacity buildings etc. (Malawi-Zambia TFC). They are also funding research, infrastructure such as bridges and roads. This particular project started in 2012 and ends this year, 2016. Government funding is definitely eradicated and not adequate and thus new aid should be supplied.

Nyika National Park cannot be sustainable as it doesn't generate enough revenues. Therefore, external aid is crucial. The entry fee is the only revenue source the government receives from the park itself.

Apart from Malawi-Zambia TFC Project, World Bank is also running a project funded by the Norwegian government, the Global Environmental Facility (GEF) and Peace Parks. In fact, Peace Parks was the pioneer in providing aid to NNP since they started even before the TFC Project. Peace Parks came up with the Malawi Zambia TFC. Their main objective is to create parks to promote peace between neighboring countries. Peace Parks are directly involved in the management of the park's conservation, in our case Malawi-Zambia TFC.

Peace Parks is mostly funded by the Dutch lottery and other smaller sponsors.

The KFW German Development Bank is expected to start in 2016. KFW is a German project which will run for 5-10 years and will focus mainly on infrastructure, the support of operational costs and promotion of sustainability of community livelihoods.

George and his partners believe that if the surrounding communities are supplied with livestock animals such as goats they could decrease poaching to manageable levels.

Policies in Malawi

The conservation policies in Malawi are strong and with good foundation, in fact they were recently reviewed and they soon should be approved. These conservation policies are similar with the ones in neighboring countries, only

slight details are changed in order to adapt to each different case. However, the legislation in Malawi is weak and thus people take advantage of that. The fine for killing an elephant for example is not high enough to prevent poachers from hunting those animals. Even if conservation policies are well-structured, legislation is weak resulting in inefficient management of the parks (Poaching associations). In most cases, poachers are being arrested and are obliged to pay the necessary fine, however, since the penalty amount is so low, they are still better off by continuing the poaching activities. Consequently, legislation should be stricter.

There are now stiffer penalties after the revising of the Act by the help of the German organization GIZ. George hopes that things will change when this Act gets approved by the Parliament. For instance, the revised Act does not call for fines after killing an elephant but directly jail.

Largest employer of the region

The DNPW is the largest employer of the region. There are of course other organizations. DNPW provides casual work to the communities, such as road construction. Apart from direct cash injection to people meaning employing the people, Malawi is the only African state that allows communities to access the parks to harvest resources in order to sustain their livelihoods. An example would be the honey production, wild fruits or fish. Hence, people are able to benefit directly from the park.

Decrease in the animal species number

By taking the baseline of 1990 there is a clear trend that animals numbers have decreased, however, in 2005 the DNPW has noticed if not an increase then a stability in their numbers. From the 70s to the 90s Malawi was almost under dictatorship, which means that rules were more tough, human rights were weak and thus people were scared to not oblige. After the 90s democracy helped people relax in terms of their action including poaching as laws were laxer. During that period poaching incidents rocketed. At that period, donations started being received. Resources were available to somehow patrol the park and so limit

reduce to a certain degree poaching activities. As to now, the battle against poaching is marking positive progress. Poaching is definitely still occurring.

Committies are giving information, the so called 'collaboration management'. Collaboration Management contributed in helping people realize that the resources of the park are also theirs. Before, locals would assume that the benefits of the park are received solely from the government, however, recently they started realizing their one advantages from protecting the land, which after all is their land too.

'Pocket of resistance' is often observed when people are refusing to change their attitude meaning that they still believe the only beneficiary is the government. Extension and Education is a bridge between the communities and the Department as their transfer messages from the one to the other.

The Department is hoping in decreasing the poaching rates. Malawians live under a dollar per day. If the Malawian economy improves then things might change, however, Malawi is still almost 100% on natural resources and thus poaching of animals and vegetation is still high. To graduate from that stage will probably take decades.

Some people have actually accepted the way that they are supposed to live. In fact, ivory poaching is more often than bushmeat and that is even more alarming as it indicates the commercial reasons behind poaching which could have devastating impacts. Commercial poaching is more threatening.

Stakeholders on Nyika National Park

The DNPW, Nyika Vwaza Association and NGOs. Police is also a stakeholder since we are dealing with law enforcements. Ministry of agriculture, since 90% of the communities living around are farmers so when looking at livelihoods it is important to consider those stakeholders. Local government, chiefs (I think he means the town majors) are as well key stakeholders. There are a lot of donors working around Nyika with the communities. The aid projects are so fragmented that they do not reflect the impact that they could possibly reflect across the communities. In order to overcome this issue, recent projects are more delinked

and thus stronger in terms of transferring their message across the communities. People normally do not associate the message an NGO is trying to pass by funding a particular project. Livelihood projects are aiming on promoting conservation, however, this aspect is normally not noticeable by the locals. People do not easily see the link between initiatives of funding with the conservation of Nyika. Donors will follow the park will not follow the people surrounding the park.

The German project GIZ which will run this year was used to run from 1996 to 2005 and it was massive. In fact, the money available were not even used completely. A big part of the amount had to be returned. GIZ is coming back because of Nyika and the park itself. It is important to make the people understand that the different projects are coming for the advantage of the park. When locals understand this they will be able to accept the park's abilities and protect it.

Payment for Ecosystem Services Schemes

Currently PES schemes are applied in Nyika in regards to carbon sequestration. The Department just received 25,000 USD for the carbon sequestration service which is provided by Nyika. The buyers in that case is Microsoft together with Terragrob. Nyika is actually receiving big funds from these schemes.

Vultures

Poachers are not killing or poisoning vultures in Nyika. It is important to emphasize vultures cultural value (George is really insisting on this issue). Vultures are culturally important mostly because they are associated with predicting the future. Poachers might not go directly for the vultures but this does not mean that vultures are not valuable.

In the 90s hyenas and vultures were very high in numbers, together with the rest of the animals. In about 2000 those scavengers decreased in numbers dramatically. The reasons were mostly lack of food but there was also another school of thought. Poachers were often using the medicine Temik and deliberately poison leftover pieces of the poached animal. They were also

poisoning water bodies. At that time, hyenas went missing and vultures decreased in unprecedented levels. Eventually people realized that by eating those poached animals they would be infected by the poison as well. In the north Lilongwa, Zambia they have more numbers of animals probably due to stricter laws and low population density.

A.2.2 Resondent 2: John Charles Mabeti, Head of Law Enforcement in Chilinda Camp

1 year and 8 months experience in Nyika National Park

Parks and wildlife assistant. 4 years as a game ranger. Then selected to work in the department of research for 2 years (collect ecological data)

Nyika is a unique case in Malawi in terms of its landscape. Its grassland scenery requires observation points compared to woodlands. This particular grassland landscape can be handled in terms of anti-poaching only by smart tactics and thus the level of difficulty to catch the poachers increases.

In the grassland game rangers are normally spotting the poaching team and start tracking it. Tracking could last from 4-8 hours until game rangers come close enough so that they can complete the arrests successfully.

Five stations are located in Nyika. They are located in the west part of the park which leaves the east side unattended. Having more resources would allow for the addition of camps in order to increase the coverage. The German construction project foresees the building of extra camps. That would be a strategic way to locate the camps. Having camps close to each other means that you cover more efficient an area with patrol controls even if human resources are limited. With the present distances between the camps additional human resources are necessary in order to prevent poaching.

Chelinda is the biggest camp followed by Thazima. Other camps have approximately 10 people whereas Chelinda is consists of 300 people.

People from the closest communities are illegally cutting down trees. Every patrol is planned according to the observed illegal activities which are noted down on the Patrol data sheet.

Charles give full instruction of which areas should rangers patrol (he gives coordinates). Klm are not limited to a particular number. This way, the rangers are not restricted to the klm they have to cover. Game rangers are qualified enough to recognize fresh tracks or other hints. The prerequisite to be a game ranger the last diploma of high school.

Each camp is divided in the Law Enforcement part, the research part and extension and education part. Each important to have an overall knowledge of how these three sectors are functioning. By having an experience in the three departments, game rangers are fully integrating the laws of other sectors.

Extension and education: the first is for contacting the communities in order to transmit information about wildlife and sustainable use of natural resources. Education is school visits to raise awareness among youngest.

Main environmental concerns in Nyika:

- 1. Fire issues.** "Fire can be a good server but bad master". Under control fire management can lead to great results as it can contribute greatly to conservation. However, uncontrolled fire incidents caused by poachers or others have dramatic results. Poachers often start fires in order to format the soil. They return to the fire scene two weeks after the action in order to poach antelopes which are grazing in the new sprouts of grass. Therefore, they target the hunting area. Game rangers are aware that poachers will approximately return in two weeks and thus the patrol schedules are formatted based on this information.
- 2. Poaching.** Mostly antelopes are hunted for the bushmeat market. In addition, there is illegal actions towards orchids. In fact, further research must be applied in order to proceed to a market analysis and realize where these orchids are ending. The maturity period of orchids plays a role in the patrol controls targeted to orchid areas. Recently there is a good

relationship between the camps, the police and the justice system. Therefore, poachers are more concerned about the high fines and years of jail. As a result, poaching incidents are decreasing in certain areas.

Tactics' changes are necessary so that poachers will not study the camp's methods. When poachers' arrests are decreasing it's a notification for the need of new tactics. Charles is satisfied by the results of the patrol controls, however, he still believes that man power is not adequate. Game rangers feel proud when they successfully complete arrests. It is also important to be aware of leaking information among the rangers. People from outside also provide the rangers with information concerning poaching activities. For instance, the last January/February arrests were not frequent and so an emergency meeting for new tactics was held.

The research team is focusing on the reasons behind unpleasant situations such as the decrease of species numbers (game counting). With the provided information, managers plan accordingly. The extension team is responsible of holding awareness raising events in the surrounding communities.

Could poachers survive within the ecotourism sector? Probably not as it is a question of life. Their survival is based on natural resources. This is the complexity of wildlife management, often protecting the wildlife had devastating consequences to livelihoods.

To sum up, education will not really make sense to very low income families (life alternative to poaching). It is even more challenging given the fact that the total area of Malawi remains the same (not increasing natural resources) whereas the population is climbing.

3. Invasive species. Invasive species such as the B&F which is taking over a big part of the grassland in Nyika National Park. B&F is not eatable by grazers. Therefore, the availability of food among antelopes and other grazers is decreasing as B&F is increasing.

Chemical impacts on targeted species should be assessed. Machinery experiments have been pretty successful.

Conservation status of species: Zebras, elands and reedbucks appear to increase in numbers. Poachers and leopards do not target the zebras as it is not their preferable meat.

Sponsorships for Nyika: The Malawian Government is responsible for Nyika in the absence of projects. At the moment, World Bank is running a Project (Norwegian government).

Entry Fee: Malawians are paying 450 MK, expats 7 USD and tourists 10 USD. According to the ex-Head of Department of Research, the optimal expenses amount for Nyika was estimated to be 2,000,000 USD per year, however what the park actually receives is 250,000 USD/y. The government is supporting Nyika with 55,000 yearly whereas the rest is coming from donations and projects.

Health status of Nyika: The cleaning of the park/water bodies is coming from nature itself. There is no artificial cleaning process.

Water bodies contamination: 1st dam was intact, before the pine plantation started being eradicated. The pine plantation was actually helping. Bare ground is more difficult to regenerate whereas vegetation ground helps soil development. No water bodies contamination.

Vultures' Ecosystem Services:

The vulture provides important cleaning services to the ecosystem. The bird is a good indicator of poaching incidents. For example, vultures notify other animals hyenas are following normally. Hyenas are even crushing the bones. Rangers are always investigating the reasons behind the death of an animal. Poachers are most of the times taking all the body parts of the animals and so vultures do not really feed on the poaching victims. With the snares animals might get trapped in and since poachers are not all the time waiting on the wire snares animals die and vultures have the time to reach them before the poachers. On rainy seasons wire snares are not efficient. Poachers prefer snares as they are silent, a gunshot could be heard from 5 klm away. When a gunshot is being heard, rangers are

going to the observation points to check all the directions and observe any movements.

Poachers normally pay the fine otherwise they are going to prison for about 3 years. The fine as the entry fee of the park is going to the government.

Nyika's terrain helps naturally to tackle poaching because poachers have to cover a very long distance to reach an animal-rich area. It would be obviously necessary to fence nyika however fence is mostly implied for protection against animals.

Leopard, buffalo, hyenas, elands, elephants are some of the big games that could be found in Nyika. Poachers are not targeting vultures in any way. Generally, there is a decrease in animals' numbers in Nyika (in a period of 30 years perhaps).

DNPW: ask the reports on animals' numbers.

The lodge is the only private company operating in Nyika.

OPERATIONAL COSTS: optimal cost 2.000.000 USD
total Nyika's budget: 250.000 USD, 200.000 coming from World Bank and 50.000 from the Malawian government.

We are currently expecting the German Project. Which are the incentives behind this? Charles does not really know; he assumes that it is because they have a history in funding nyika.

Stakeholders

- Government
- Nyika Vwaza Association (for all the communities that surround Nyika)
a certain percentage that is generated by Nyika entry fee goes by 25% to the communities, 50% to government and 25% to Nyika's management. This is an experimental operation to see whether the 25% for management of Nyika will be sufficient or not
- Community

Overall, to achieve more efficiency nyika needs not only extra man power but also more camps. Fuel should be always adequate. Relationships should also improve, the department between communities and the justice system.

A.2.3 Respondent 3: Micheal Siska, Head of Research Department in Chilinda Camp

Experience: 5 years

Poaching Incidents: A group of poachers ranges from 3 to 10 members. Too often members of the poaching team get away. The patrol team is normally consisted of 4 game rangers, who most of the times are divided in two groups and thus it is challenging to arrest all the poachers.

The patrol Summary illustrates that there were three poaching incidents in January, six in February, three in March and three in April. This is data collected from the station of Chilinda. However, there are four more station within Nyika National Park. Chilinda Camp marks the most poaching incidents per month since it is the station which is located in the middle of the park. Animals which are more preferred by poachers are grazing around Chilinda Camp. Thazima follows second with the highest number of poaching incidents.

Main victims of poaching: Roan antelopes and elands mostly and orchids.

Profile of a poacher: Normally males between 22 years old to 40. Poachers are coming from low income families and thus poaching is a source of income but also source of food for their household. Game meat is always sold in black markets.

Efficiency of Chelinda Camp anti-poaching methods: More Game Rangers are definitely necessary. Most important, however, is to increase the number of the camps. There is a very big gap between some particular gaps (Chelinda-Juniper, Kaperekez-Uleti). These gaps are entry points for poachers.

Reintroduction of species: Decision of reintroduction has not been released. It has not really been discussed yet.

10-year German Project: It is a construction project not only concentrated on fixing the roads but also build more stations.

Employing ex poachers as game rangers is probably not applicable as the game rangers must nowadays be qualified whereas poachers probably have not been to school. Qualification required as a game ranger is now revised, higher level of high school is needed as well as specific grades.

Vultures

Information about vultures are coming mostly from PDF files. What has been noticed from the research department of Nyika is that vultures' population monitoring is crucial. This issue was raised after the visit of NABU on the plateau. It is said that the low or even nonexistent number of big mammals has caused the decrease of the vulture.

A better equipment such as binoculars, camera, even internet access is necessary in order to apply a successful birds monitoring.

What are the most significant ES that vulture provides in Nyika National Park: Vulture is really important in the area mainly because of its value in the ecotourism sector. Most carcasses are eaten by terrestrial scavengers (Micheal might not be aware of the regulation services of the vulture).

No poaching of vultures in NNP.

Why the vultures are decreasing in numbers: No adequate food since there are no big mammals.

No "vulture restaurant" policy has been discussed in the past.

Wildlife Environmental Society of Malawi is one organization which is pushing the DNPW to monitor the population of species. They also examine whether the environment is depleted or general taking care of its conservation.

Another organization which is interested in NNP is the Nature Biodiversity and Conservation Union (and the BirdLife).

Are vultures contributing in detecting the poachers: 75% of the animals which are eaten up by vultures are predated. And thus the 25% could derive from poaching.

Additional Research

Other research projects that are in line: Brakenfence, Game Count (species population monitoring) either by road observations or aircrafts. Funds for these projects are deriving from the PROJECT. The WoldBank Project is GEOFF and Norway government's donations. (ask George) Within this Project the Department suggests problems that might arise. This particular Project is concerned about Malawi and Zambia, and thus transfrontier. Occasionally fish surveys are applied.

Water controls of Nyika: Not really. Nyika initially has just the Plateau without the woodland included. In order to avoid the contamination of this catchment areas the government decided to include the woodland in the catchment area so it can be protected. The immigration of animals during winter from the plateau to the woodland is another reason for the extension of the park. North Rukulo is the biggest river.

Researchers are not so frequent in Nyika, one in February and me now. 10 year German project

Current project is focusing on Law enforcement the next one is going to be focused on Construction.

There is a great will in keep monitoring vultures' numbers.

A.2.4 Respondent 4: Paul Kalem, Manager at CAWS

Wildness Safari Chelinda was reopened as Central Africa Wildness Safari in 2014. Christen Pam is the owner. The camps in Nyika, Mvuu and Chintetchi are directly managed by CAWS but the land is licensed by the DNPW.

FUNDS supporting Nyika

Three Malwian parks are funded by African Parks. These would be Majete, Liwonde and Nkhosang. As a result, they have noted great improvements. There is a possibility that Nyika National Park together with North Liwonde will be under Peace Parks' funding.

Peace Parks organization is based in Cape Town. They are funded among others to a large extent by the Dutch lottery. Both African Parks and Peace Parks are NGO's that have similar functions but different strategies. By using existing resources and infrastructure and bringing in their own. Moreover, both organizations took part in a meeting hosted by CAWS in Nyika National Park in January 2016. This particular meeting consisted of African Parks, Peace Parks, DNPW, Dutch lottery and other sponsors.

CAWS visitors

The occupancy in the facilities of CAWS Nyika is measured by bednights (monthly reporting system). Occupancy percentage in the lodge is about 30% normally. Paul would say that CAWS Nyika hosts about 100-150 guests per month, however, this number is just a rough estimation, it definitely needs to be double-checked.

Main reasons for visiting Nyika

Visitors often choose Nyika national park as their destination given the fact that it is a niche type of holiday. Nyika is not a common national park or game reserve. The contrast between other parks and Nyika is quite strong. People who visit Nyika have generally heard about it. The landscape is definitely one of the reasons together with the orchids. Paul says that the view is often reminding them of some part of their countries. Indeed, Nyika offers an alternative as there are no big mammals in the plateau. However, Nyika supports the highest population of leopards in Malawi.

The majority of CAWS camp guests are either Malawians/expats whereas CAWS Lodge hosts mostly Europeans, especially Germans and Dutch, and often Americans.

Average costs:

- Lodge: full board (food+two games) 200 USD/p/n
- Campsite: 10 USD/p/n
- Rooms: 40 USD/p/n
- Cottages: (a) self-catering 40 USD/p/n no activities included (b) full board 160 USD/p/n +meals+activities

As it was mentioned above the land is owned by the Malawian government and it is licensed to CAWS through the DNPW.

Main conservation issues:

1. **Poaching.** All the game is concentrated about 10-15 km from Chilinda Camp and this is due to the fact that animals sense the poaching activities and so they keep on coming closer to the plateau where they feel more protected. It is apparently crucial to protect the animals as they highly contribute to ecotourism.

Poachers are often spotted while on the game drives: CAWS & DNPW collaboration.

Few initiatives from people: Exeter University organized a project called "A Bicycle Powered Cinema Project" which worked along with the DNPW in order to raise awareness among schools and communities towards the protection of wildlife.

2. **Fire Management.** In fact, fire management is significantly contributing to the health status of the land. It does help not only to get rid of dead plant parts but also regenerates the land.

Many years ago evergreen forests would cover most of Nyika's land. Today only 3% of the plateau is covered by evergreen forests (few patches left here and there). A strategy followed by the DNPW is to burn firebreaks around the evergreen patches. According to Paul Nyika is consisted of 67% forest, 30% grassland and 3% evergreen forest. In particular, the grassland included 90 different types of grasses and vegetables for animals to feed on.

A cohesive fire program is critical to sustainable conservation and of course tourism is playing an important role since it provides higher revenues and thus

supports the conservation management of the park. No revenues means no conservation strategies. In fact, the park fees are not even close to cover the operational cost.

Staff:

There are 46 locals employed from CAWS, from which 6 are seasonal.

Vultures:

In all of Paul's guiding years there has been a constant issue of vulture's population decrease. However, the specifics and numbers are basically unknown. According to Paul people are not even able to identify vultures.

The main species of vultures that are sighted in Nyika plateau are: 1. Lappet-faced 2. White-headed 3. White-backed 4. Palm-nut.

Last time Paul saw vultures in Nyika was 3-4 days ago. He normally sees them weekly.

Nyika is definitely a birding destination. Groups are coming specifically for the bird diversity in Nyika. CAWS hosts a big number of birdwatcher visitors.

Rock Jumper: bird camping company

Tourists might spend hours and hours on birdwatching activities and often after that they solely discuss about birds.

**A.2.5 Respondent 5: Humphrey Nzima, International Coordinator
Malawi-Zambia Transfrontier Conservation Area,
Supported by Peace Parks Foundation**

The Nyika-North Luangwa TFCA component project seeks to contribute to biodiversity conservation in the Malawi-Zambia TFCA by supporting fair access to natural resources and thereby improving the welfare of communities living in and around the TFCA. The purpose of this project component is to improve ecosystem connectivity, efficient and sustainable use and management of shared natural resources for biodiversity conservation and socio-economic development in the Malawi-Zambia TFCA. The project will be implemented through 4 main components:

Component 1: Improved cross border collaboration and management of shared natural and cultural resources whose key activities include investments in infrastructure and equipment, capacity building, and harmonization of policies and management approaches.

Component 2: Socio-economic upliftment of communities living in and around the TFCA whose key activities include infrastructure investment, community engagement in natural resources management and tourism development and promotion of conservation oriented businesses.

Component 3: Ecosystem connectivity secured whose key activities include integrated land use planning and implementation and securing key wildlife migration corridors

Component 4: Integrated tourism development whose key activities include tourism infrastructure investments, facilitation of tourist movements, harmonization of immigration and customs policies, development of a marketing and branding strategy and creating an enabling environment for private sector investment in tourism.

I hope the above gives you an idea about what the new project will be all about. I must stress that detailed project design has not been done yet.

A.2.6 Respondent 6: Tiwonge Mzumara-Gawa, Ornithologist at Museums of Malawi

Past: Research Officer for the Wildlife and Environmental Society of Malawi

Interviewer: During the carcass-based count applied in Nyika National Park, about four juvenile vultures were spotted while approaching the carcass. Is that an indicator of breeding possibilities in the region?

TM: White-backed vultures are normally breeding in trees. Nests have been seen in Liwonde Park, particularly in baobab trees. Nyika has an extensive woodland area which coupled with the mountains in the Zambian part might increase the chances of vulture breeding in the region.

The carcass-based count was conducted early in the morning when the temperature was not higher than 17 degrees. This means that vultures could not have travelled great distances to approach this particular carcass. As we know, vulture is a bird that depends on thermals to reach great heights and get a wide view of the plains. Vultures that appear at 09h00 indicate that nests and even breeding sites exist within the area. They might be coming from Zambia, but not further than that.

Interviewer: What is the progress in vulture's numbers for the case study of Majete Game Reserve?

TM: Majete has had a big reintroduction of species programme quite recently. In 2011 when I visited the park, no vultures were seen. However, after the reintroduction of species and especially predators the vulture sightings have impressively increased. There is an ongoing research, which attempts to explore the breeding possibilities around that area. We are also trying to understand where these vultures are coming from. Vultures in Majete might indeed be residents of the area or might be travelling from Mozambique or elsewhere.

Although there are volunteers who report vulture sightings, no detailed occurrences have even been reported (vultures' species and ages).

Interviewer: What about a vulture feeding station approach?

TM: This is a conservation measure that is often applied in South Africa, but never in Malawi. There are a lot of big livestock farms in South Africa but again not in Malawi. A vulture restaurant could be established mostly in game reserves. However, I personally don't believe this would be a solution to the problem as I support more natural processes. The problem should be solved from its fundamentals. This means reintroduction programs and better law enforcement management in order to protect the wildlife and maintain the species number.

A.3 Qualitative data on the excel spreadsheet

This sector contains the data collected from the questionnaire survey, which were after displayed on an excel spreadsheet.

ID	1. Activities in Nyika	2. Land ownership	3. Appreciation of plants and animals	4. Most interesting thing in NNP	5. Poaching incidents	6. Poisoning incidents	7. How often see vultures in NNP
6	iii) Safari drive	iii) Agricultural	Beautiful	Pine Plantation and scenery	ii) No	ii) No	N/A
7	iii) Safari drive	i) Residential and iii) Agricultural	Big appreciation	Topography, shape of land	ii) No	ii) No	N/A
8	i) Walking, ii) Hiking, iii) Driving, iv) Birdwatching, v) Cycling, vii) Camping	No	Passion	Endemic species of flora and fauna. To observe the different behaviour of certain animals (i.e. leopards)	i) Yes (Orchids and Roan antelope)	ii) No	ii) Weekly
9	iii) Driving, viii) Harvesting fish	No	Beautiful	Landscape	i) Yes	ii) No	N/A

10	iii) Driving, viii) Harvesting fish	No	Big appreciation	Zebras and landscape	ii) No	ii) No	N/A
11	iii) Driving	No	Big appreciation	How comfortable animals were towards humans	ii) No	ii) No	N/A
12	iii) Driving	No	Big appreciation	Zebras	ii) No	ii) No	N/A
13	i) Walking, iii) Driving	No	Big appreciation especially for plants	Plants	ii) No	ii) No	N/A
14	i) Walking, iii) Driving	No	Big appreciation, peaceful	Breathing fresh air	ii) No	ii) No	N/A
15	i) Walking, ii) Driving, viii) Harvesting fish	No	Beautiful	Owls	ii) No	ii) No	N/A
16	i) Walking, iii) Driving, viii) Harvesting fish	No	Beautiful	Scenery	ii) No	ii) No	N/A

17	i) Walking, ii) Hiking, iii) Driving, v) Cycling	i) Residential	Big appreciation	Elephants	i) Yes (mostly antelopes about twice per month)	ii) No	iii) Monthly
18	i) Walking	iii) Agricultural	Big appreciation	Game viewing	i) Yes	ii) No	ii) Weekly
19	ix) Research i) Walking, iii) Driving, v) Cycling, vii) Camping, viii)	i) Residential	Big appreciation	Scenery	i) Yes	ii) No	ii) Weekly
20	Harvesting	i) Residential	Big appreciation	Shape of landscape	i) Yes	ii) No	ii) Weekly
21	i) Walking, ii) Hiking, iv) Birdwatching, vii) Camping	i) Residential	Big appreciation	Birds and plants	i) Yes	ii) No	ii) Weekly
22	i) Walking, ii) Hiking, iii) Driving, iv) Birdwatching, v) Cycling	i) Residential i) Residential, ii)	Big appreciation	Four big rivers supply in Lake Malawi with water by 40%, surrounding communities benefiting from the park	i) Yes	ii) No	ii) Weekly
23	iii) Driving	Agricultural	Big appreciation	Animals, landscape	i) Yes	ii) No	ii) Weekly

24	i) Walking, iii) Driving, vi) Hunting (safari hunting for animal control)	i) Residential, iii) Agricultural	Big appreciation	Importance of water quality. Thus, it is crucial to protect the catchment	i) Yes (grass, trees, orchids, animals)	ii) No	iii) Monthly (In Thazima vultures are not so often seen as it is a dense woodland and
25	i) Walking, iii) Driving, vii) Camping	iii) Agricultural	Big appreciation	The parks provides financial aid to the communities	i) Yes	ii) No	iii) Monthly
26	i) Walking, vii) Camping	i) Residential, iii) Agricultural	Big appreciation	Source of income, ecotourism	i) Yes	ii) No	v) Never
27	ix) Production of honey	iii) Agricultural	Good	Source of good water, good weather	i) Yes	ii) No	iii) Monthly or less
28	ix) Production of honey	iii) Agricultural	Good	Source of good water, good weather	i) Yes	ii) No	iii) Monthly or less
29	ix) Production of honey	iii) Agricultural	Good	Source of good water, good weather	i) Yes	ii) No	iii) Monthly or less
30	i) Walking, iii) Driving, vii) Camping	iii) Agricultural	Big appreciation	Nyika is an income resource for surrounded communities	i) Yes	ii) No	iii) Monthly

31 iii) Safari drive	iii) Agricultural i) Residential and iii)	Beautiful	Pine Plantation and scenery	ii) No	ii) No	N/A
32 iii) Safari drive	Agricultural	Big appreciation	Topography, shape of land	ii) No	ii) No	N/A
i) Walking, ii) Hiking, iii) Driving, iv) Birdwatching,			Endemic species of flora and fauna. To observe the different behaviour of certain animals (i.e. leopards)	i) Yes (Orchids and Roan antelope)	ii) No	ii) Weekly
33 v) Cycling, vii) Camping iii) Driving, viii) Harvesting	No	Passion				
34 fish iii) Driving, viii) Harvesting	No	Beautiful	Landscape	i) Yes	ii) No	N/A
35 fish	No	Big appreciation	Zebras and landscape How comfortable animals were towards humans	ii) No	ii) No	N/A
36 iii) Driving	No	Big appreciation		ii) No	ii) No	N/A
37 iii) Driving	No	Big appreciation	Zebras	ii) No	ii) No	N/A
38 i) Walking, iii) Driving	No	Big appreciation especially for plants	Plants	ii) No	ii) No	N/A
39 i) Walking, iii) Driving	No	Big appreciation, peaceful	Breathing fresh air	ii) No	ii) No	N/A
i) Walking, iii) Driving, viii)						
40 Harvesting fish	No	Beautiful	Scenery	ii) No	ii) No	N/A
i) Walking, iii) Driving, viii)						
41 Harvesting fish	No	Beautiful	Scenery	ii) No	ii) No	N/A

	i) Walking, ii) Hiking, iii) Driving, v) Cycling	i) Residential	Big appreciation	Beautiful landscape	i) Yes (mostly antelopes about twice per month)	ii) No	iii) Monthly
42		i) Residential and iii) Agricultural	Big appreciation	Game viewing	i) Yes	ii) No	ii) Weekly
43	i) Walking		Nyika contributes in malawi's economy	Wildlife	i) Yes	ii) No	ii) Weekly
44	ix) Research	i) Residential					
	i) Walking, iii) Driving, v) Cycling, vii) Camping, viii) Harvesting	i) Residential	Big appreciation	Shape of landscape	i) Yes	ii) No	ii) Weekly
45							
	i) Walking, ii) Hiking, iv) Birdwatching, vii) Camping	i) Residential	Big appreciation	Birds and plants	i) Yes	ii) No	ii) Weekly
46							
	1) Walking, ii) Birdwatching, iii) Driving	No	Big appreciation	Excellent bird diversity and scenery	i) Yes	ii) No	N/A
47							
	1) Walking, ii) Birdwatching, iii) Driving	No	Big appreciation	Excellent bird diversity and scenery	i) Yes	ii) No	N/A
48							

49	Birdwatching, iii) Driving 1) Walking, ii)	No	Big appreciation	scenery	i) Yes	ii) No	N/A
50	Birdwatching, iii) Driving 1) Walking, ii)	No	Big appreciation	Excellent bird diversity and scenery	i) Yes	ii) No	N/A
51	Birdwatching, iii) Driving 1) Walking, ii)	No	Big appreciation	Excellent bird diversity and scenery	i) Yes	ii) No	N/A
52	Birdwatching, iii) Driving i) Walking, ii) Hiking, iv)	No	Big appreciation	Excellent bird diversity and scenery	i) Yes	ii) No	N/A
53	Birdwatching, vii) Camping i) Residential		Big appreciation	Landscape	i) Yes	ii) No	ii) Weekly
54	Birdwatching, vii) Camping i) Residential		Big appreciation	Birds and plants	i) Yes	ii) No	ii) Weekly

8. Benefits of vultures	9. Do you enjoy seeing vultures? What you enjoy more?	9.a. Comment	10. Aware of vultures roles?	10.a. Comment	11. Aware of cultural role?	11.a. Comment	12. Uses of vulture's body parts?	13. Thoughts when seeing vulture?
Natural cleaners of carcasses	ii) No	Scared of been bitten	i) Yes	Quite aware	i) Yes	When people see them in an area they often consider them as bad luck	N/A	iii) I prefer not to see them
Not aware	N/A	N/A	ii) No	N/A	ii) No	N/A	N/A	N/A
Important part of nutrient cycling. Decomposers	i) Yes	Patterns of flight	i) Yes		i) Yes	Brain use in witchcraft to predict future	Brain	i) I am fascinated them
Natural cleaners of carcasses	ii) No	Not really	i) Yes	Knowing about the carrion services	ii) No	N/A	N/A	ii) I am happy to know they exist
Natural cleaners of carcasses	ii) No	Not really	i) Yes		ii) No		N/A	ii) I am happy to know they exist

Natural cleaners of carcasses	i) Yes		i) Yes	ii) No	N/A	ii) I am happy to know they exist
Natural cleaners of carcasses	i) Yes		i) Yes	ii) No	N/A	i) I am fascinated them
Unaware	N/A	Have not seen vultures	ii) No	ii) No	N/A	ii) I am happy to know they exist
Unaware	N/A	Have not seen vultures	ii) No	ii) No	N/A	ii) I am happy to know they exist
Natural cleaners of carcasses	i) Yes		i) Yes	i) Yes	Not particularly aware but believe that everything has a	i) I am fascinated them
Natural cleaners of carcasses	i) Yes		i) Yes	ii) No	N/A	ii) I am happy to know they exist

Natural cleaners of carcasses	i) No	Not something special for me	i) Yes	Disposal of carcasses	i) Yes	Ability to foresee future. Initially there was no value but started by following other countries beliefs	Brain, legs, wings	ii) I am happy to know they exist
Unaware	i) Yes		ii) No		i) Yes	Local medicines, decoration	Brain	ii) I am happy to know they exist
Unaware	i) Yes		ii) No		ii) No		N/A	ii) I am happy to know they exist
Natural cleaners of carcasses	i) Yes		i) Yes		ii) No		N/A	i) I am fascinated by them
Natural cleaners of carcasses	i) Yes		i) Yes		i) Yes	witchcraft	Brain	ii) I am happy to know they exist
Natural cleaners of carcasses	i) Yes		i) Yes		i) Yes	Mostly there were beliefs coming from Zimbabwe. Witchcraft. Traditional medicine	Brain	ii) I am happy to know they exist
Unaware	i) Yes		i) Yes		i) Yes	Traditional medicine	Brain	ii) I am happy to know they exist

ot	Natural cleaners of the carcasses, cultural services, existing value	i) Yes	i) Yes	Indicators of poachers/carcasses, natural cleaners	i) Yes	traditional medicine	Brain (also found before in poachers' houses)	i) I am fascinated by them
	Unaware	i) Yes	ii) No		i) Yes	Traditional medicine	Brain (also found before in poachers' houses)	ii) I am happy to know they exist
	Unaware	i) Yes	i) Yes	Indicators of poachers	i) Yes	traditional medicine, decoration	Brain, feathers	ii) I am happy to know they exist
	Unaware	i) Yes	ii) No		i) Yes	Traditional medicine	Head	ii) I am happy to know they exist
	Unaware	i) Yes	ii) No		i) Yes	Traditional medicine	Head	ii) I am happy to know they exist
	Unaware	i) Yes	ii) No		i) Yes	Traditional medicine	Head	ii) I am happy to know they exist
	Unaware	i) Yes	ii) No		i) Yes	Traditional medicine	before in poachers' houses)	ii) I am happy to know they exist

Natural cleaners of carcasses	ii) No	Scared of been bitten	i) Yes	Quite aware	i) Yes	them in an area they often consider them as	N/A	iii) I prefer not to see them
Not aware	N/A	N/A	ii) No	N/A	ii) No	N/A	N/A	N/A
Important part of nutrient cycling. Decomposers	i) Yes	Patterns of flight	i) Yes		i) Yes	Brain use in witchcraft to predict future	Brain	i) I am fascinated by them
Natural cleaners of carcasses	ii) No	Not really	i) Yes	Knowing about the carrion services	ii) No	N/A	N/A	ii) I am happy to know they exist
Natural cleaners of carcasses	ii) No	Not really	i) Yes		ii) No		N/A	i) I am fascinated by them
Natural cleaners of carcasses	i) Yes		i) Yes		ii) No		N/A	ii) I am happy to know they exist
Natural cleaners of carcasses	i) Yes		i) Yes		ii) No		N/A	i) I am fascinated by them
Unaware	N/A	Have not seen vultures	ii) No		ii) No		N/A	i) I am fascinated by them
Unaware	N/A	Have not seen vultures	ii) No		ii) No		N/A	ii) I am happy to know they exist
Natural cleaners of carcasses	i) Yes		i) Yes		i) Yes	Not particularly aware but believe that everything has a purpose	N/A	i) I am fascinated by them

Natural cleaners of carcasses	i) Yes		i) Yes	ii) No		N/A	i) I am fascinated by them
Natural cleaners of carcasses	i) No	Not something special for me	i) Yes	Disposal of carcasses	i) Yes	Ability to foresee future. Initially there was no value but started by following other countries beliefs	ii) I am happy to know they exist
Unaware	i) Yes		ii) No		i) Yes	Local medicines, decoration	ii) I am happy to know they exist
Unaware	i) Yes		ii) No		ii) No	N/A	ii) I am happy to know they exist
Natural cleaners of carcasses	i) Yes		i) Yes		ii) No	N/A	i) I am fascinated by them
Natural cleaners of carcasses	i) Yes		i) Yes		i) Yes	witchcraft	ii) I am happy to know they exist

Natural cleaners of carcasses	i) Yes		i) Yes		i) Yes	traditional medicine	head and brain	i) I am fascinated by them
Natural cleaners of carcasses	i) Yes		i) Yes		i) Yes	traditional medicine	head and brain	i) I am fascinated by them
Natural cleaners of carcasses	i) Yes		i) Yes		i) Yes	traditional medicine	head and brain	i) I am fascinated by them
Natural cleaners of carcasses	i) Yes		i) Yes		i) Yes	traditional medicine	head and brain	i) I am fascinated by them
Natural cleaners of carcasses	i) Yes		i) Yes		i) Yes	traditional medicine	head and brain	i) I am fascinated by them
Natural cleaners of carcasses	i) Yes		i) Yes		i) Yes	traditional medicine	head and brain	i) I am fascinated by them
Natural cleaners of carcasses	i) Yes		i) Yes		i) Yes	traditional medicine	head and brain	i) I am fascinated by them
Natural cleaners of carcasses	i) Yes		i) Yes		i) Yes	witchcraft	Brain	ii) I am happy to know they exist
Natural cleaners of carcasses	i) Yes		i) Yes		i) Yes	witchcraft	Head and brain	ii) I am happy to know they exist

14. Aware of vultures extinction?	15. Last vultures nest sighted?	City/Country	Relationship to area	Gender	Age	Education	Natural environment training	Employee company type	Job vacancy	Level of understanding
ii) No	N/A	Lilongwe	tourist	Female	25-44	MSc in Finance Management	No	Tourism	Unknown	Excellent
ii) No	N/A	Lilongwe	tourist	Male	25-44	BSc in Water Management	Yes	Water Treatment Technologies	Unknown	Excellent
y i) Yes	Never seen nests	London	I work here temporarily (Chelinda)	Male	0-24	FGASA Level 2	Yes (wildlife course in Zimbabwe)	Ecotourism	Safari Guide	Excellent
ii) No	N/A	Texas USA	tourist	Male	25-44	MSc in Theology	No	Anglican DIOCESE of fortworth	Priest	Excellent
ii) No	N/A	Texas USA	tourist	Male	0-24	MSc in Theology	Yes	Anglican DIOCESE of fortworth	Priest	Excellent
ii) No	N/A	Texas USA	tourist	Male	0-24	BSc in Medicine	No	Anglican DIOCESE of fortworth	Medical student	Excellent

y ii) No	N/A	Texas USA	tourist	Male	0-24	BSc in Medicine	No	Anglican DIOCESE of fortworth	Medical student	Excellent
ii) No	N/A	Texas USA	tourist	Female	0-24	BSc in Architecture	Yes	Anglican DIOCESE of fortworth	Architect	Excellent
i) Yes	N/A	Texas USA	tourist	Female	0-24	BSc in Advertisement	Yes in high school	Anglican DIOCESE of fortworth	Advertiser	Excellent
y i) Yes	N/A	Texas USA	tourist	Female	45-64	College	No	Anglican DIOCESE of fortworth	Youth Director	Excellent
ii) No	N/A	Texas USA	tourist	Male	0-24	College	No	Anglican DIOCESE of fortworth	Student of Public Health	Excellent

ii) No	ii) A month ago	Rumphi	I live here full time (Chelinda)	Male	0-24	High School	Yes International award	Ecotourism	Administration Officer	Excellent
i) Yes	i) A week ago	Rumphi	I live here full time (Chelinda)	Male	25-44	School	Yes	Department of Wildlife and Parks	Hostel Attendant	Quite Good
ii) No	ii) A month ago	Mzimba	I live here full time (Chelinda)	Male	25-44	High School	Yes	Department of Wildlife and Parks	Prks and Wildlife Assistant	excellent
by ii) No	i) A week ago	Chitiba	I live here full time (Chelinda)	Male	25-44	High School	No	Central Africa Wildness Safaris	Receptioninst	Excellent
ii) No	i) A week ago	Mulanje	I live here full time (Chelinda)	Male	25-44	High School	Yes Member of Wildlife Clubs	DNPW	Game ranger or Parks and wildlife assistant	Excellent
ii) No	i) A week ago (no nests ever sighted)	Thazine	I live here full time (Chelinda)	Male	25-44	Fully trained Safary Guide	Yes	Central Africa Wildness Safaris	Safari Guide	Excellent
i) Yes	i) A week ago	Mzuzu	I live here full time (Chelinda)	Male	25-44	Grade 1 Mechanic	NV Trust	Central Africa Wildness Safaris	Workshop Manager	Excellent

by			I live herefull time			Degree in Wildlife			Parks and Wildlife	
i) Yes	ii) A month ago	Blantyre	(Thazima)	Male	45-64	education	Yes	DNPW	Officer (conservation manager- peter wadi)	Excellent
ii) No (but ave noticed their decrease in numbers)	ii) A month ago	Zomba	I live herefull time (Uledi)	Male	25-44	High school	Yes	DNPW	Assistant of Parks and Wildlife Officer (ranger)	Excellent
i) Yes	N/A	Rumphi	I live herefull time (Kaperekezi)	Male	45-64	Junior high school	Yes	DNPW	Asistand Parks and Wildlife Officer	Excellent
ii) No	N/A	Thalire	I live herefull time (Thazima)	Male	45-65	No	No	Thazima Bee Keepers	Community Members and honey producers	Adequate
ii) No	N/A	Thalire	I live herefull time (Thazima)	Male	45-66	No	No	Thazima Bee Keepers	Community Members and honey producers	Adequate
ii) No	N/A	Thalire	I live herefull time (Thazima)	Male	45-67	No	No	Thazima Bee Keepers	Community Members and honey producers	Adequate
noticed their decrease in	ii) A month ago	Zomba	I live herefull time (Uledi)	Male	25-44	High school	Yes	DNPW	Assistant of Parks and Wildlife Officer (ranger)	Excellent

ii) No	N/A	Lilongwe	tourist	Female	25-44	MSc in Finance Management BSc in Water Management	No	Ministry of Finance	Accounter	Excellent
ii) No	N/A	Lilongwe	tourist	Male	25-44	Management	Yes	Water Management	Water Manager	Excellent
i) Yes	Never seen nests	Malawi	I work here temporarily (Chelinda)	Male	25-44	FGASA Level 2	Yes	Ecotourism	Safari Guide	Excellent
ii) No	N/A	Denmark	tourist	Male	45-64	BSc Engineering	Yes	Unknown	Engineer	Excellent
ii) No	N/A	Denmark	tourist	Female	45-64	College	No	N/A	Not working	Excellent
ii) No	N/A	UK	tourist	Male	25-44	College	No	Blanture Hostel Anglican DIOCESE of fortworth	Manager	Excellent
ii) No	N/A	UK	tourist	Female	0-24	BSc in History	No		Student	Excellent
ii) No	N/A	UK	tourist	Female	25-44	College	Yes	Blanture Hostel	Manager	Excellent
i) Yes	N/A	Malawi	tourist	Male	0-24	Student	Yes in high school	N/Z	Student	Excellent

i) Yes	N/A	Malawi	tourist	Female	45-64	Conservationist	Yes	Lilongwe Wildlife Trust	Trustee	Excellent
ii) No	N/A	Malawi	tourist	Male	0-24	College	No	Tea Business	Worker	Excellent
ii) No	ii) A month ago	Rumphi	I live here full time (Chelinda)	Male	0-24	High School	Yes	Ecotourism Department of Wildlife and Parks	CAWS staff	Excellent
i) Yes	i) A week ago	Rumphi	I live here full time (Chelinda)	Male	25-44	School	Yes	Department of Wildlife and Parks	Guest House Attendant	Good
ii) No	ii) A month ago	Mzimba	I live here full time (Chelinda)	Male	25-44	High School	Yes	Department of Wildlife and Parks	Prks and Wildlife Assistant	excellent
ii) No	i) A week ago	Chitiba	I live here full time (Chelinda)	Male	25-44	High School	No	Central Africa Wildness Safaris	Receptioninst	Excellent
ii) No	i) A week ago	Mulanje	I live here full time (Chelinda)	Male	25-44	High School	Yes Member of Wildlife Clubs	DNPW	Game ranger or Parks and wildlife assistant	Excellent

i) Yes	i) A week ago	Netherlands	tourist	Male	45-64	unknown	unknown	unknown	unknown	Excellent
i) Yes	i) A week ago	Netherlands	tourist	Male	25-44	unknown	unknown	unknown	unknown	Excellent
i) Yes	i) A week ago	Netherlands	tourist	Female	45-64	unknown	unknown	unknown	unknown	Excellent
i) Yes	i) A week ago	Netherlands	tourist	Female	45-64	unknown	unknown	unknown	unknown	Excellent
i) Yes	i) A week ago	France	tourist	Male	45-64	unknown	unknown	unknown	unknown	Excellent
i) Yes	i) A week ago	Netherlands	tourist	Male	25-44	unknown	unknown	unknown	unknown	Excellent
ii) No	i) A week ago	Mulanje	I live here full time (Chelinda)	Male	25-44	High School	Training from the DNPW	DNPW	Game ranger or Parks and wildlife assistant	Excellent
ii) No	i) A week ago	Mulanje	I live here full time (Chelinda)	Male	25-44	High School	Training from DNPW	DNPW	Game ranger or Parks and wildlife assistant	Excellent

A.4 Vulture's sightings in Nyika National Park

This sector contains the information collected from April 2016 to August 2016 regarding the vulture's sightings on the Plateau.

MALAWI VULTURE SURVEY						
Place	Nyika National Park					
Name						
DATE	COORDINATES (UTM)		SPECIES	NUMBER	AGE	ACTIVITY
	Latitude	Longitude			A J C	S P N C
11/04/2016	588664	8829467	White-backed	9	A	C
10/05/2016	588229	8828621	White-backed	70+		C
10/05/2016	588229	8828621	White-headed	5	A	C
10/05/2016	588229	8828621	Lappet-faced	4	A	C
24/05/2016	588765	8829432	White-backed	50+		C
05/06/2016	587827	8827210	White-backed	5	A	S
05/06/2016	587945	8826920	White-backed	2	A	S
05/06/2016	587945	8826920	White-headed	1	A	S
05/06/2016	587945	8826920	Lappet-faced	1	A	S
08/06/2016			White-backed	2	A	S
08/06/2016			Lappet-faced	1	J	S
09/06/2016	588584	8829602	White-backed	3	A	S
16/07/2016	588246	8830682	White-headed	2	A	S
01/08/2016			White-headed	2	A	S
Key: *A Adult, J Juvenile, C Chick ** S Soaring, P Perched, N Nesting, C on carcass						

Figure 1: Vulture's sightings, April to August 2016