Wildlife poisoning in the Great Limpopo Transfrontier Conservation Area: A baseline study

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PHOTO: INTERNATIONAL BORDER NEAR CHICUALACULA AND SANGO BORDER POSTS

WILDLIFE POISONING IN THE GREAT LIMPOPO TRANSFRONTIER CONSERVATION AREA

A Baseline Study

2019

This integrated report on the findings of a baseline study undertaken between November 2017 and June 2019 was completed on request of the Great Limpopo Transfrontier Park and was made possible by the generous support of the American people through the United States Agency for International Development (USAID) and the Peace Parks Foundation (PPF).

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ABBREVIATIONS AND ACRONYMS

ARC-OVR:	Agricultural Research Council-Onderstepoort Veterinary Research
AWPD:	African Wildlife Poisoning Database
CAMPFIRE:	Communal Areas Management Program for Indigenous Resources
CMS:	Convention on the Conservation of Migratory Species of Wild Animals
DCA:	Damaging causing animal
DDT:	dichlorodiphenyltrichloroethane
DEA:	Department of Environmental Affairs
EWT:	Endangered Wildlife Trust
FAO:	Food and Agriculture Organization of the United Nations
GCT:	Gonarezhou Conservation Trust
GLC:	Greater Libombo Conservancy
GLTP:	Great Limpopo Transfrontier Park
GLTFCA:	Great Limpopo Transfrontier Conservation Area
GNP:	Gonarezhou National Park
HHP:	highly hazardous pesticides
JMB:	Joint Management Board
KNP:	Kruger National Park
LEDET:	Limpopo Department of Economic Development, Environment and Tourism
LNP:	Limpopo National Park
PPF:	Peace Parks Foundation
SADC:	Southern Africa Development Community
SOPs:	Standard Operating Procedures
TOPS	Threatened or Protected Species
USAID:	United States Agency for International Development
WHO:	World Health Organization
WWF SA:	World Wide Fund for Nature South Africa
Zimparks:	Zimbabwe Parks and Wildlife Management Authority

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EXECUTIVE SUMMARY OF KEY FINDINGS

The baseline study covered poison incidents that occurred in the Great Limpopo Transfrontier Conservation Area (GLTFCA) from January 1, 2008 to July 18, 2019. The cases and statistics presented in this report are not the official poison statistics for the GLTFCA as such statistics do not exist. Conservation officials in Gonarezhou National Park (GNP), Kruger National Park (KNP) and Limpopo National Park (LNP) provided poison incidents that were on record. In addition, poison incidence data was received from the African Wildlife Poisoning Database, Moholoholo Rehabilitation Centre, Maunge PNR, Wildlife Poisoning Prevention & Conflict Resolution, the Greater Limpopo Carnivore Programme and Karingari.

The poison data was supplemented with fieldwork. Several qualitative research methods, such as a literature and desktop review, semi-structured interviews, group discussions, focus groups, participation in meetings, and participant observation were employed for the fieldwork component of the study while limited quantitative analysis was undertaken on the poison incidence data. The primary research sites were the three parks. Secondary research sites included local communities, concessions, game and nature reserves, commercial farms, cities and small towns in and near the GLTFCA. The researcher also visited border posts, informal markets, hospitals and clinics, police stations and bus and taxi ranks. A total of 172 people were interviewed and another 51 research participants shared their knowledge and experiences during focus groups. Strict ethical guidelines governed the data collection process.

A total number of 155 poisoning and attempted poisoning incidents were recorded in the GLTFCA. Of the three parks, the GNP registered the lowest number of incidents with 24 suspected and recorded poison incidents. Sixty incidents were recorded in the Mozambican section of the GLTFCA. With 71 suspected and recorded poison incidents, the Greater Kruger landscape in South Africa registered the most poison incidents. Of these 71 poison incidents, 39 incidents occurred inside the boundaries of the KNP. The overall death toll through poisoning was 2 082 individual animals, which includes one domestic goat and three domestic dogs that were found at poisoning sites. Twenty individuals (most of them vultures) made a recovery after rehabilitation procedures, thus a total number of 2 062 wild and domestic animals were affected by poisoning.

The primary targets of poisoning in the project area were elephants and lions. While vultures and other birds were the worst impacted by poisoning, they appear not to have been the primary targets. In all the cases where elephants had been poisoned, the tusks were removed, suggesting that these were cases of poison poaching for ivory. Lions were the primary victims of predator poisonings: 43 lions were poisoned between 2008 and 2019. The majority of these poisoning incidents were linked to human-wildlife conflict scenarios and happened in the Mozambican part of the GLTFCA. In five cases, body parts were removed.

The available data suggests that the frequency of wildlife poisoning incidents has increased since 2010. GNP saw a spike in 2014 with incidents ebbing off since then. The trends in and around KNP and LNP suggest that wildlife poisoning continues to pose a serious threat to conservation endeavours. Data for KNP is particularly worrying with wildlife poisoning incidents growing at a slow pace initially (2008-2015) but peaking in 2016 and 2018 to ten incidents per year. Since the beginning of 2019, seven separate poisoning incidents have been recorded, suggesting that 2019 may end with the highest number of poisoning events in recent history. The increase of recorded poisoning incidents over time may well be linked to better detection rates and record keeping.

The data provided was inconclusive in terms of the vehicle of poison administration in many cases; however, lacing meat or fruit was the most common method. In the private concessions south of GNP, two waterholes were poisoned in two separate incidents in May 2015. Data collected for this study suggests that most poisoning events were linked to illegal hunting operations, including elephant poaching. In some instances, the elephants were first shot dead and the tusks removed. Poachers would then cut open the carcass(es) and lace it/them with poison. In other instances, the secondary driver linked to elephant poisoning events was the harvesting of vulture heads and beaks for traditional medicine markets. Human-predator conflict followed by retaliatory poisoning events was particularly pronounced in the Mozambican part of the GLTFCA.

Poison records confirmed aldicarb as the pesticide associated with the greatest number of wildlife deaths in the GLTFCA during the project period. In twenty cases, aldicarb was the confirmed cause of death or pesticide found in laced baits. In a further 19 cases, park officials and/or experts suspected aldicarb but were not able to take samples for toxicology tests. While widely regarded as the most abused pesticide on the African continent, carbofuran was positively identified in the GLTFCA on two occasions. Based on what is known from the region, we expected to find some use of cyanide and other mining chemicals. However, other than strychnine, poison offenders used highly hazardous pesticides in all the cases where toxicology screens were performed. No evidence of traditional or natural poisons was found. The cross-border trafficking of pesticides and agricultural fertilizers is a major issue of concern in southern Africa. The continent as a whole has been at the receiving end of highly hazardous pesticide dumping. These pesticides would have been banned in their regions of origin – the European Union and North America – and are off-loaded in African countries at reduced prices. Due to the relative state of policing inertia in border areas, banned and counterfeit pesticides are smuggled across the subregion's borders. We found evidence that criminal networks were smuggling aldicarb into South Africa from Mozambique and Zimbabwe. The ubiquitous availability of the highly hazardous pesticide in all three countries suggests that there is a well-established transnational supply chain.

Some community members (especially in Zimbabwe) were well aware of the dangers posed by highly hazardous pesticides to livestock and human health. One human death due to pesticide exposure was confirmed, and several unexplained deaths were mentioned but could not be confirmed. Health impacts from eating poisoned meat were noted. Livestock either died or suffered from weight loss after ingesting poisoned water or food sources.

While limited comparable or historic data could be found, the magnitude and frequency of poisoning events in the GLTFCA should be cause for grave concern. Although the annual incident data does not compare with rhino or elephant poaching incidents in the GLTFCA, the impact of poisoning incidents is not only detrimental to targeted wildlife but also to non-target species, vegetation and water bodies near poisoning sites and, thus, potentially more challenging to contain than poaching in the long-term. Furthermore, the impact on humans, their livestock and agricultural crops is worrisome.

SECTION 1: INTRODUCTION AND BACKGROUND TO THE STUDY

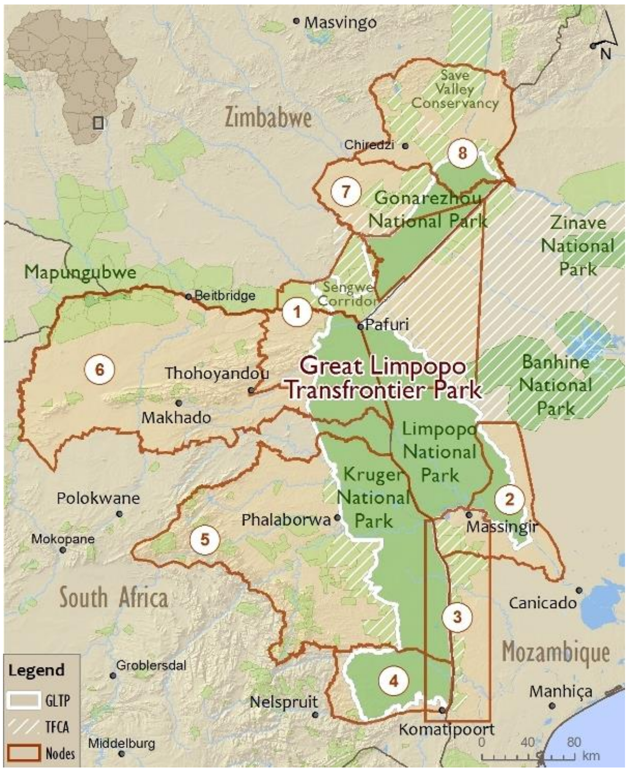
Since 2013 a number of high-fatality poisoning events in the southern African region have not only received international and local media coverage but have caught the attention of concerned conservationists. Conservationists have detected an increase in the frequency of poisoning events and associated wildlife death tolls in southern Africa. For example, in what may have been the biggest vulture poisoning incident in southern Africa on record, the government of Botswana announced that 537 vultures of five different species and two tawny eagles had been poisoned in the Central District of Botswana in June 2019 (Maesela, 2019). In 2013, conservationists labelled the grisly discovery of 500 carrion birds' carcasses in the Zambezi region of Namibia one of the worst cases in the history of southern Africa (Hartman, 2013). In neighboring Zimbabwe, several incidents of cyanide poisoning of waterholes led to far-reaching impacts on wildlife, local ecosystems and local communities (see for example: Muboko et al., 2014). The highest death toll of charismatic megafauna in one cyanide poisoning event in Hwange National Park led to the deaths of 135 elephants, dozens of vultures and other species (Ogada et al., 2016a). According to Chris Brown from the Namibian Chamber of Environment (Namibian Chamber of Environment, 2019), an estimated 10,000 vultures were poisoned in southern Africa between 2014 and 2019.

The deliberate poisoning of wildlife has thus emerged as an environmental crime affecting not only biodiversity conservation and species survival but also broader human welfare, including health, food and water security. The Great Limpopo Transfrontier Conservation Area (GLTFCA) has been the site of multiple incidents of wildlife poisoning over the past decade. Scientists and conservation officials regard the illicit use of pesticides, herbicides and chemical compounds as a great threat to wildlife, ecosystems and local communities. With regards to the three GLTFCA member countries – Mozambique, South Africa and Zimbabwe – poison events further augment the unnatural death tolls of charismatic megafauna, predators and vultures which are already under siege from illegal hunting, changing land use patterns and human-wildlife conflict. Moreover, birds of prey, small animals and plants have died in poisoning incidents.

In 2016, conservation officials in the Great Limpopo Transfrontier Park (GLTP) registered their growing concerns that poison poaching was emerging as a major threat to conservation efforts in the GLTFCA (see Map 1). The worry was that wildlife poisoning was not target-specific but typically impacted different species and multiple individuals. The risks of secondary and tertiary poisoning as well as potential long-term impacts were not well understood. Banned pesticides and poisons are easily accessible and cheap in the sub-region. Prompted by the increase in the deliberate poisoning of wildlife especially elephants, lions and vultures in the GLTFCA, the Joint Management Board (JMB) of the GLTP set up a wildlife poisoning task team on 25 August 2016. The team consists of government and NGO representatives, park and conservation officials and scientists from the three GLTP member states. The primary objective is the development of an integrated wildlife poisoning strategy for the GLTFCA.

In November 2017, the JMB appointed the author of this report to conduct a baseline study on wildlife poisoning in the GLTFCA. Piet Theron, the regional coordinator of the GLTFCA, obtained research funding from WWF South Africa and USAID through the Khetha Program for the Mozambican and South African component. The Peace Parks Foundation (PPF) agreed to fund the Zimbabwean component of the research. The aim of the baseline study is to assist the wildlife poisoning task team in meeting key objectives and goals. The specific objectives of the research are:

- development of a comprehensive database of the current state of wildlife poisoning within the GLTFCA;
- documentation of current workable and appropriate methods to address wildlife poisoning within the project area;
- identification and investigation of potential sources of wildlife poison in the project area;
- identification and investigation of socio-economic benefits accrued as the result of wildlife poisoning;
- identification and investigation of negative socio-economic impacts of wildlife poisoning;
- identification and assessment of options for the development of a systems-based data capture and reporting tool



Map 1: Great Limpopo Transfrontier Conservation Area. Source: PPF (2019).

In line with the program objectives of WWF Khetha and the GLTFCA conservation strategy of integrating ecosystems and people, local communities living near or in the GLTP were identified as crucial research participants and potential beneficiaries of the study. The researcher was hence asked to gain an understanding as to how wildlife poisoning and the ubiquitous availability of poisons affected local communities, their livestock and agricultural crops. In addition, the researcher would conduct a literature review on what is known about wildlife poisoning in the southern African region.

The report is divided into five sections. Section 1 deals with the background to the study. A review of scholarly and policy literature is given in Section 2. The research design, methodology, ethics and challenges are discussed in Section 3. The research data, findings and analysis are presented in Section 4. The report ends with conclusions and recommendations in Section 5. A database of wildlife poison incidents in the GLTFCA acts as support material for the report.

A note on the "poison" concept

The "poison" concept is common parlance in conservation circles in reference to a range of pesticides, herbicides and chemical compounds. While it may make sense to use more specific concepts such as "highly hazardous pesticides" or "toxic compounds" in academic papers, the use of this generic term is widely accepted as an umbrella term for hazardous, toxic, dangerous and often deadly substances and chemical compounds employed to kill wildlife.

SECTION 2: LITERATURE REVIEW: APPROVED USE, MISUSE OR ABUSE? THE MODALITIES OF WILDLIFE POISONING IN SOUTHERN AFRICA

The objective of this section is to provide an overview of what is known about wildlife poisoning in general terms before homing in on African data, insights and perspectives. Key research gaps relate to offender profiles, drivers of wildlife poisoning and the product supply-chain. Separating facts from fiction will be a necessary first step before considering disruptive measures. The findings are derived from an extensive review of scientific and scholarly literatures, so-called grey literature[1] and media reporting.

2.1 DEFINITION: WHAT IS WILDLIFE POISONING?

This section unpacks definitions and understanding of wildlife poisoning. As mentioned in the introduction, this report employs the "poison" and "poisoning" concepts due to common use in conservation circles. In most instances, the "poisons" employed in wildlife poison events in southern Africa appear to be agricultural pesticides that fall under the international classification of highly hazardous pesticides. These pesticides present particularly high levels of acute or chronic hazards to health or environment (Food and Agriculture Organization of the United Nations and World Health Organisation, 2016). The notable exception is the use of mining chemicals, such cyanide, which was for example employed to kill more than 100 elephants in Hwange National Park in Zimbabwe (Muboko et al., 2014). Beyond historical data on poison use by several African peoples, on-line searches to locate information on traditional African poisons were inconclusive.

The occurrence of a wildlife poisoning event is contingent on the species' susceptibility and likelihood of exposure. Acute poisoning occurs after wildlife is exposed to a toxic dosage of a formulated compound. This direct or primary form of poisoning happens through direct ingestion, inhalation or dermal contact with the 'poison'. It is important to distinguish between acute and chronic poisoning. Acute poisoning results from single exposure to highly hazardous pesticides. An organism experiences chronic poisoning though long-term or recurring exposure to one or multiple pesticides. The most common effects of chronic exposure include carcinogenesis, immunotoxicity, endocrine disruption, reproductive failure and altered behavior.

Indirect poisoning (also known as secondary poisoning or relay toxicity) occurs when one organism ingests contaminated or poisoned prey or bait (Berny, 2007: 94). This typically happens when a predator or scavenger eats an animal that has previously been poisoned by a toxic formulation. If the level of toxicity is high enough in the prey or bait, then it will harm the predator or scavenger. Tertiary poisoning occurs when a predator eats another predatory animal that has been secondary poisoned.

[1] Grey literature is a somewhat derogative terminology for policy and technical reports that usually do not undergo standard academic double-blind peer review. This term should not take away from the important role of such reports in terms of informing policy decisions and providing evidence-based research.

Essentially poisons work their way up the food chain. Humans, especially infants and young children, are likewise susceptible to acute, secondary or tertiary poisoning.

Several exposure scenarios are possible such as the accidental poisoning from intended or licensed use and the deliberate poisoning of wildlife. For example, an accidental or unintended poison event occurs when heads of cattle drink water from a poisoned waterhole that was meant to kill elephants. Berny's aetiology of historic cases of wildlife poisoning in the European Union provides a useful typology. He classifies wildlife poisoning into cases of approved use, misuse and abuse (Berny, 2007: 93):

Approved use: Pesticides are used according to the label but accidentally cause mortalities of non-target species. As an example, pesticides employed to deal with locusts, grasshoppers and quelea birds in the Sahel had an unexpected and unintended deadly impact on African raptor species (Keith and Bruggers, 1998).

Misuse: Misuse occurs when a registered product is used for purposes other than indicated on the product label (Berny, 2007).

Abuse or deliberate use: A person engages in illegal use of toxic substances or highly hazardous pesticides when they purposefully apply a banned product, incorrect volumes of a registered product or use the product for purposes other than stated on the product label (Berny, 2007).

Wildlife poisoning through natural toxicants

In well-balanced ecosystems, the co-evolution of wildlife with their natural enemies usually leads to adaptation and resilience of defense mechanisms against other animals, micro-organisms, parasites or toxic plants (Basson, 1987: 219). Those animals that are more susceptible to diseases, parasites or poisonous plants fall prey to predators or die before reproduction. Although certain parts are intensely managed (especially in the KNP), the ecosystems within the GLTFCA are considered well-balanced so unless natural toxicants are introduced to ecosystems, wild animals should have developed resilience or adaptation mechanisms. There have been cases of natural toxicity in the KNP, including a well-documented case where abnormal high winter temperatures, high levels of nutrients caused by urination and defecation of a large resident population of hippopotamus as well as stagnant water played a role in the development of cyanobacterial bloom (compare with Oberholster et al., 2009).

Lead poisoning

Several studies conducted in the European Union (Berny et al., 2015, Guitart et al., 2010, Pokras and Kneeland, 2008) point to what was deemed an emerging problem to birds of prey: lead poisoning. This type of poisoning happens when birds ingest spent lead pellets or sinkers and cause cumulative, long-term toxicity. There is sparse literature on the phenomenon in southern Africa. One study undertaken in Botswana (see Garbett et al., 2018) explored whether recreational hunting was associated with lead exposure in African vultures. The researchers found that lead in hunted carcasses and gut piles represented a dangerous food source for white-backed vultures.

2.2 IS SOUTHERN AFRICA A HOTBED OF WILDLIFE POISONING?

It has been claimed that nowhere in the world is the use of poison as ubiquitous as in Africa (Richards et al., 2018). Although there is a dearth of reproducible scientific and historic datasets, the continent undeniably has a long history of poison use, predating the arrival of colonial settlers. In ancient times, plant-based poisons were employed to harvest wildlife and protect lives and livelihoods. The use of poisons to kill predators was legitimate practice and pervasive during colonial times. For example, British colonial authorities in the Cape colony incentivized predator killings through a scheme, which included wildlife poisoning as a preferred method and the establishment of "wild animal poisoning clubs" (Richards et al., 2018). Historical event data is not readily available as the lines between legal and illegal use of poisons have always been somewhat blurred. To this day, agricultural authorities encourage farmers to use poisons to kill predators and exterminate other "noxious" plant and animals species (Couzens, 2013). Agricultural crops and plantations were regularly sprayed with insecticides including the highly toxic carbofuran, fenitrothion and dichlorodiphenyltrichloroethane (DDT) across Africa in the 1980s. In many instances, farmers and government authorities received subsidies or development aid to deal with mosquitoes and other outbreaks such as the destructive army worm (Lalah and Otieno, 2012a).

Carbofuran, for example, was first imported to Kenya to control rice pests in the 1960s. The pesticide was employed to control soil-dwelling and foliar-feeding insects. Researchers found evidence that the costs of purchasing the pesticide may have been offset by government subsidies, which provided financial assistance for farm maintenance and agrochemicals to farmers (Lalah and Otieno, 2012b). It is unclear what quantities of furadan (a trade name of carbofuran) were employed to deal with various disease and pest outbreaks at the time but there is evidence that carbofuran and its metabolites have been retained or adsorbed in soil or leached into water systems (ibid).

The impact of imported pesticides on non-target specific species including fish, birds, insects and other wildlife has not been formally investigated in Africa (Ogada, 2014). Nowadays the concept of "safe use" for highly hazardous pesticides is deemed a narrative by industry, which is often not supported by empirical evidence. The European Union has determined that exposure levels for some users (including farmers) cannot be accurately assessed. The same is true for countries in the Global South, which have limited capacity for monitoring and enforcement. The EU has chosen a precautionary approach (Plüss, 2019), meaning that where there are threats of irreversible damage, lack of scientific certainty should not be used to delay remedial steps if the balance of potential costs and benefits justifies action (Hanson, 2018). However, the employment of highly hazardous pesticides remains a legitimate method of controlling unwanted wildlife and pests in Africa (Richards et al., 2018). Moreover, the practice of dumping banned pesticides and chemical compounds in African countries has a long tradition, which continues to this day (Food and Agriculture Organization of the United Nations and World Health Organisation, 2016).

A wide variety of highly toxic pesticides are easy to procure, cheap and effective. The majority of poisoning incidents are never detected or reported (Ogada et al., 2016a). African countries import a wide variety of pesticides, herbicides, insecticides, rodenticides and pest control concoctions that have not been classified. Of pesticides imported to Kenya, 20% are in technical form; in other words, the active ingredients are imported, and the pesticide is then formulated locally. The remainder arrives on East African shores as ready-to-use formulated products (Lalah and Otieno, 2012b). Little information is available on the status quo of pesticide imports into the southern African region. The literature deals with the legal and legitimate aspects of the industry and its importance for agricultural prosperity and success.

Historically a range of poisons and pesticides have been used by both the state and farming communities to deal with predators and birds of prey. There are direct and indirect drivers of wildlife poisoning. The primary cause of indirect poisoning is usually the targeting of damage-causing animals (DCAs) which inadvertently will affect non-target species such as vultures, smaller animals, insects, vegetation and water systems (also compare with the earlier section on secondary and tertiary poisoning).

Retaliatory poisoning

Retaliatory poisoning occurs in response to human-wildlife conflict. Wildlife species have been in conflict with humans since the advent of agriculture. In some instances, farmers and rural dwellers use poisons to get rid of predators and crop-raiding elephants, birds and monkeys. While this form of poisoning tends to target wildlife due to perceived levels of danger to people, livestock and crops, there have also been anecdotal reports of poisoning incidents as an expression of anger or resentment. In this instance, someone will use poison to express his or her anger or resentment of policies or practices associated with private reserves or concessions, commercial farmers or park authorities.

Hunting or capturing wildlife for subsistence, bushmeat, the illegal wildlife trade, and *muthi* markets

Known as "pesticide hunting" or "poison poaching", poisons may be used to hunt or capture wildlife (Ogada, 2014). In its most rudimentary form, local people may use poisons to capture wildlife for subsistence purposes. Poachers who have not ready access to hunting rifles and other hunting equipment are believed to be using pesticides to kill high-value wildlife, bushmeat and fish and birds (Ogada, 2014). The difference between subsistence and bushmeat poisoning relates to the existence of highly organized local and international bushmeat markets (Buij et al., 2016, Richards et al., 2018). Others employ the "silent killer" when they do not want to attract the attention of rangers and anti-poaching personnel. A particularly damaging method is associated with the sprinkling of poisons into water holes, salt licks, dams, rivers or springs (Richards et al., 2018).

Another development has been the poisoning of lions, leopards, crocodiles and vultures on the basis of belief-based traditional medicine and witchcraft. The poisoned carcasses or body parts are sold in local *muthi* markets (Ogada et al., 2016b). Poisoning and trade in traditional medicines account for 90% of reported vulture deaths in Africa (Ogada et al., 2016b). The brains, beaks, feathers and bones of vultures are used for a range of purposes in traditional medicine but are believed to be most effective for providing clairvoyant powers, foresight, healing and increased intelligence (Groom et al., 2013, Mdhlano et al., 2018). No published research was found with regards to health impacts on humans when consuming or using poisoned wildlife in traditional medicine or witchcraft.

According to Ogada and colleagues (2016a), poachers have also been using poison to kill elephants or contaminate carcasses to poison vultures across Africa. Between 2012 and 2014, eleven poaching events were recorded across seven African countries (predominantly in southern Africa) where 155 elephants were killed and tusks removed and 2 044 vultures were poisoned (Ogada et al., 2016a).

The poisoning of lions for their bones, teeth and claws appears to be on the rise. Lion bones are believed to be trafficked to Asian markets, where they appear to serve as replacement for tiger bone (Nuwer, 2018, Hübschle, 2016). In a study conducted by the Greater Limpopo Conservation Carnivore Unit between 2011 and 2018 (Everatt et al., 2019 (under review)), the use of poison was identified as the most common cause of unnatural lion deaths. Teeth and claws were the most sought-after body parts in the study by Everatt and colleagues. The same study suggests that lion poisonings may be linked to increased demand for lion body parts in Asia. Recent research studies suggest that legal and illegal markets in China and Vietnam are the main sources of demand for African lion bones and body parts (Williams et al., 2015, Williams et al., 2017).

Sentinel poisoning

Of great concern has been the targeting of sentinel species (vultures) whose presence or behavior may alert conservation authorities to illegal activities including poaching in protected areas (Richards et al., 2018, Mdhlano et al., 2018). Also known as the "bush police", vultures fly in circles above dead carcasses before they descend. The circling behavior may draw the attention of rangers and law enforcement authorities, who are able to target their responses to the area where the vultures are circling (Ogada et al., 2012). Conservation and park officials have recorded cases where poachers purposefully targeted vultures by lacing elephant and buffalo carcasses with poisons. This form of poisoning is known as sentinel poisoning (Ogada et al., 2016a).

Indirect poisoning

Problem animal control is one of the indirect drivers of vulture and birds of prey poisonings. Vultures are often drawn to carcasses laced with poison. The effects of wildlife poisoning have been dire for several species of African vultures: four species had to be re-categorized as "critically endangered" and two as "endangered" on the International Union for Conservation of Nature (IUCN) Red List (Monadjem et al., 2018).[2] Given that vultures are not able to catch and kill their own prey combined with the unreliable supply of suitable forage, they are particularly vulnerable to mass poisoning events (Capon, 2014). Vultures are often the victims of indirect poisoning in cases where poachers target elephants.

A study on vulture mortalities across commercial farmlands in Namibia found that more than 800 vultures had died due to anthropogenic causes between 2000 and 2015 (Santangeli et al., 2017, Kolger cited in Capon, 2014). At the time, aldicarb and carbofuran were the most commonly used poisons. One out of 10 farmers were using strychnine. Worrying was the finding that farmers with large properties and high livestock numbers (particularly goat and sheep who purportedly suffered high livestock losses due to depredation) were willing to use poison in the future.

In some instances, the wider impact of pesticides is not known to users. Pesticides may be used to deal with localized rodent problems but are spread through affected birds of prey, micro-organisms and flowing water.

[2] The IUCN Red List is the world's most comprehensive inventory of the global conservation status of plant and animal species. It uses a set of criteria to evaluate the extinction risk of thousands of species and subspecies. These criteria are relevant to all species and regions of the world. With its strong scientific base, the IUCN Red List of Threatened Species is recognized as the most authoritative guide to the status of biological diversity. The following categories of imperilment are relevant:

- "critically endangered": species face an extremely high risk of going extinct in the wild
- "endangered": species face a very high risk of going extinct in the wild
- "vulnerable": species face a high risk of going extinct in the wild

2.3 LACK OF HISTORICAL DATA

While countries in the northern hemisphere have introduced wildlife poisoning surveillance programs, cases in Africa remain underreported in scientific literature or via annual incidence reports. It is thus not surprising that much of the scholarly and policy decisions are informed by European and North American experiences and case studies. This is problematic because most pesticides were produced in regions of the world that are climatically different from those in southern Africa and it is difficult to predict how these pesticides affect our ecosystems (Berny, 2007).

A handful of studies and datasets on wildlife poisoning in southern Africa predating 2000 were found. The oldest published paper available in online databanks provides a comprehensive account of wildlife poisoning by plants, pesticides, pollutants and other chemicals in the 1980s (Basson, 1987). Three cases of wildlife poisoning in KNP were recorded: In one incident (reported to the author of the paper in 1987), approximately 50 vultures were killed through organophosphate (diazinon) poisoning. This incident happened in the northern sections of the KNP and was a deliberate *muthi* poisoning. In the two other incidents, also in 1987, circa 50 vultures died in one incident, and several types of vultures, birds of prey, one hyena and several jackals in the other. Cyanide was the poison employed in both incidents.

Another study detailed the findings of 370 suspected incidents of wildlife poisoning over a seven year period (1988 to 1995) across South Africa at the Toxicology Diagnostic Laboratory at the Onderstepoort Veterinary Institute (Fourie et al., 1996). Of these incidents, 45% tested positive for poisoning. Failure to make a diagnosis in 55% of the cases was ascribed, amongst others, to death from other causes, differential breakdown rates of certain poisons in carcasses, inappropriate or incorrectly preserved specimens and inability to detect certain chemicals. While laboratory tests and analytical capabilities have greatly improved over the past two decades, scientists and conservationists still face similar challenges in terms of preservation and swift transmission of samples. What stands out in the 1996-study is that synthetic organic pesticides were responsible for 82,5 % of the poisonings, with monocrotophos being the main culprit. Carbofuran and aldicarb caused 14 poison incidents. The researchers also reported of copper poisoning of game in KNP, which was attributed to leakage from a copper mine in Phalaborwa. A more recent study (Botha et al., 2015), also undertaken by scientists of the toxicology laboratory in Pretoria (ARC-OVI), analyzed specimens from 344 cases of suspected organophosphorus and carbamate pesticide poisonings from across South Africa over a six year period (2009-2014). A positive analysis was made in 39% of the cases. In both studies, the majority of cases involved birds including Cape vultures, African white-backed vultures and bateleur eagles. Carbamate pesticides were responsible for 57 incidents of poisoning while organophosphorus pesticide poisonings were caused by diazinon, monocrotophos and methamidophos. While these studies do not contain sufficient data to suggest trends over time, it is noteworthy that carbamate pesticides were the main culprits in the 2015-study. The research findings (see Section 4) show that carbamate pesticides, especially aldicarb, are linked to the majority of wildlife poisoning events in the GLTFCA.

SECTION 3: RESEARCH DESIGN AND METHODOLOGY

3.1 RESEARCH DESIGN

The researcher employed a case study research design. Case studies are useful because they address causal complexity and facilitate the development of new hypotheses (George and Bennett, 2005: 20–22). As the research was undertaken in three distinct geographic settings, the case study research design allowed for cross-comparisons. The methodology made provision for a mixed methods approach; in other words, both qualitative and quantitative research methods were to be used. Several qualitative research methods, such as a literature and desktop review, semi-structured interviews, group discussions, focus groups, participation in meetings, and participant observation were employed for the fieldwork component of the study while limited quantitative analysis was undertaken on the poison incidence data. The high reliance on qualitative methods is linked to the paucity and non-standardized capture methods of poison incident data by the various repositories of information and the lateness of data submissions (discussed below).

3.2 DATA COLLECTION AND RESEARCH QUESTIONS

The semi-structured and open-ended nature of the interviews allowed research participants to explore the questions from different angles. Particularly important in interviews and group discussions with rural livestock and crop farmers and community members was the acknowledgement that as much as the research study dealt with wildlife poisoning and conservation matters, there was genuine concern for community well-being as poison events could be detrimental, even deadly, to people and their livestock. A field researcher who assisted with interviewing local communities in and near the LNP was given an interview guide (Annex 1) and received three days of intense on-the-job training. While the researcher's approach to interviewing was flexible and open-ended, the field researcher relied on a structured interview process where possible. The nature of community-park relations at the time of fieldwork did require additional security precautions and on-the-foot thinking (discussed below).

Although the use of many pesticides is not banned (except for highly hazardous pesticides) in the subregion, the deliberate poisoning of wildlife is considered a punishable offence in all three countries. The researcher and research assistants employed standard academic ethics protocols (see next section on research ethics). The anonymity and confidentiality of all research participants were guaranteed. Most interviews were made in person and lasted on average 45 minutes. As the baseline study took longer than originally anticipated, it was important to revisit key informants to ascertain whether the original data provided was still relevant or needed updating. The second interview thus would typically serve as a follow-up or to fact-check events or assumptions.

The researcher took detailed field notes. In cases where more than one person was interviewed at a time (e.g. focus groups and group interviews) and permission had been granted, the interaction was recorded. The recordings helped the researcher capture important information that may have otherwise been lost in parallel-running conversations. Most interviews were held in English. However, interviews with community members in all three countries and with rangers and conservation officials in Mozambique were held in Shangaan or Portuguese (the latter in Mozambique only). As the researcher has basic knowledge of Shangaan, she used field assistants in all three countries. For the interviews undertaken in local communities, a separate process of seeking permission from the Chief (the Paramount Chief in two instances) to undertake research in her/his community was initiated. The researcher also requested and received permission to speak to local people in the Greater Giyani and Ba-Phalaborwa districts from local community members attending the Hlanganani Forum, a monthly meeting held between Kruger conservation and community liaison officers and members of local communities neighboring the western boundary of the Park. Where research participants were either not available at the time of fieldwork or based abroad, telephonic or Skype interviews were conducted. The researcher also consulted several experts via email.

A set of research questions was developed during the inception period of the baseline study. These questions were meant to guide the research process. As the research process progressed, the questions were adapted to the situation on the ground.

1. What is the status of wildlife poisoning in the GLTFCA?

a. Details of events (general trends, commonalities and differences)
b. Species targeted and secondary poisonings
c. The geographic location of wildlife poisoning events
d. The frequency of events

2. Offenders, drivers and motivations

a. Profile of the offenders (geography, age)
b. Role in the supply chain (opportunistic or linked to organized crime)
c. Modus operandi
d. Drivers and root causes of wildlife poisoning
e. Offender motivation
f. Socio-economic benefits of wildlife poisoning

3. The poison supply chain

a. Poison used
b. Possible source of the poison
c. Accessibility of poison
d. Is there a link to other supply chains (e.g. poaching and wildlife trafficking)?

4. Impact of poisoning on natural and social systems (including secondary and tertiary poisoning)

a. Impact on ecosystems
b. Impact on local communities
c. Broader societal and governance impacts

5. What is the status of current interventions on the ground to deal with wildlife poisoning?

a. List interventions (law enforcement, conservation, supply regulation)
b. Human resources
c. Financial resources
d. Thoughts on innovative methods to deal with the matter

3.3 RESEARCH SITES, SAMPLING AND TRIANGULATION

The primary research sites were the three parks that constitute the GLTP. Secondary research sites included local communities, concessions, game and nature reserves, commercial farms, cities and small towns in and near the GLTFCA. The researcher also visited border posts, informal markets, hospitals and clinics, police stations and bus and taxi ranks.

Both purposive and snowball sampling techniques were employed. Purposive sampling allowed the researcher to access subject experts, conservation officials, rangers and gatekeepers in local communities and government. Gatekeepers and key informants provided introductions or referrals to other persons of interest. Snowballing sampling was particularly helpful in terms of approaching local community members that had knowledge of poisoning events and sources of poison and/or pesticides.

Hübschle interviewed 162 people in individual or group discussions and another 51 respondents interacted with her during focus groups (compare with Table 1). The Mozambican field assistant interviewed an additional ten people during his field trip to communities in and around the LNP. Focus groups were arranged with villagers, conservation, law enforcement and government officials. Gatekeepers and key informants initiated three focus groups; Hübschle organized the others. What differentiates focus groups from plain group interviews is the “explicit use of group interaction to generate data” (Kitzinger and Barbour, 1999: 4). She held six focus group discussions with rural farmers (1), community members (3), conservation officials (1) and rangers (1). The researcher also participated in a one-day seminar on wildlife poisoning in South Africa, which was hosted by the South African Department of Environmental Affairs (DEA) in Pretoria on 2 August 2018.[3] She presented the provisional findings of the study and made invaluable contacts with wildlife poisoning experts.

Table 1: Total sample size

Method	Number of participants
Individual and group interviews	172
Focus groups	51
Total:	223

The research sample for the Zimbabwean component was notably smaller than for the other two countries (compare with Table 2). This is linked to the cancellation of the scoping fieldwork due to the unpredictable political situation in Zimbabwe at the time of Mugabe’s removal from power in November 2017.

[3] Hübschle was subsequently nominated to join the newly- established wildlife poisoning working group. Made up of relevant line ministries and enforcement agencies in South Africa, the Department of Environmental Affairs has invited wildlife poison experts from the private sector, academia and the pesticide industry to join the government initiative aimed at curbing wildlife poisoning nationally.

Table 2: Regional distribution of research participants in individual and group interviews

Region	Number of research participants
Mozambique	57
South Africa	85
Zimbabwe	24
International	6

Included in the research sample were (compare with Table 3):

- Conservation officials and rangers in all three parks
- Community-Park liaison officers
- Government/departmental/ministry representatives
- Veterinarians (state and private)
- Law enforcement officials
- Local community leaders (municipal and traditional) and local community members
- Commercial farmers, concession holders and private reserve owners
- Wildlife professionals including wildlife rehabilitation centres
- Wildlife poisoning experts
- Researchers, scientists and academics
- NGO and civil society representatives

Table 3: Professional affiliation of research participants

Professional affiliation	Number of research participants
Anti-poaching & law enforcement	21
Community members	45
NGOs	9
Park & conservation	63
Private sector	9
Research & science	25

In order to ensure triangulation, multiple qualitative methods were adopted as a strategy to promote scientific rigor. Hübschle used different types and sources of data, approximating fact-checking undertaken by investigative journalists to verify information and sources (Espeland, 2005: 66), as well as multiple methods of data collection. In addition, snowball and purposive sampling led to heterogeneity of the overall sample and ensured that hidden populations received a voice. Thus, the blend of multiple methods, empirical materials and perspectives added "rigor, breadth complexity, richness, and depth" (Denzin, 2012:82) to the study.

3.4 A SHORT NOTE ON DATA ANALYSIS AND INTERPRETATION

A wildlife poisoning database was created in Excel for the purposes of data analysis. Poison records were grouped according to country on separate excel sheets. Data categories included date, region, method of administration, type of poison, reason for poisoning, number of mortalities, species, number of recoveries, data source and comments. When one or more animals ingested the same poisoned bait, then this was classified as a single poisoning event. All three conservation authorities provided incidence data on what appeared to be attempted poisoning events. In such instances, rangers or conservation personnel would find fruit or meat laced with poisons but no carcasses. In some instances, poisoned wildlife may have been removed from the crime scene. In other cases, the animals may have moved off and died away from the poisoned bait. This could be a further explanation for under-representation of the total number of animal deaths. Several rangers said that scat and/or footprints of wildlife and humans were found near the scene but no carcasses (Interviews, 2018, 2019). For the purposes of this report, these wildlife poisoning attempts have been included in the overall count of poisoning incidents. Where conflicting data entries were found (e.g. different counts of poisoning victims), the researcher triangulated data and made follow-up requests to record-keepers. Rangers, private individuals and community members remembered several incidents which had not been captured in official records. Where sufficient details were made available as regards the general location and approximate date, method of administration and affected species, the data was included.

3.5 RESEARCH PROCESS

The baseline study was divided into five distinct phases. The research project commenced in November 2017. The intention was for the project to be completed over a six months period. Due a number of unforeseen circumstances (listed in the next section), the project duration exceeded 20 months.

Figure 1: The research process

Phase 1 comprised a **desktop review** and preparation of the scoping fieldwork. This involved the review of existing research on wildlife poisoning in southern Africa, scholarly and grey literature, as well as media reporting. In addition, the researcher prepared for the scoping fieldtrip, which included the identification of research informants and repositories of information and data.

During the **scoping fieldwork**, the researcher interviewed key gatekeepers including conservation officials, law enforcers and rangers. She made requests for poison incidence data to various data repositories. In addition, several local communities of interest were identified for the fieldwork phase. Where possible, the researcher was going to seek permission, informal research approval or buy-in from local village, traditional and/or political authorities near the research sites. Due to the timing of the scoping trip (close to Christmas), the researcher received research permission from the community leader in Cubo but had to postpone similar processes around Kruger to the following year (2018). Due to political events of November 2017 in Zimbabwe ("the coup that was not a coup"), the researcher did not visit GNP during the scoping phase.

The **fieldwork** phase served the purpose of consolidating wildlife poisoning incidence data, gaining an understanding of offender profiles and their motivations, tracking the poison supply chain, and, in cases where poisoned wildlife was harvested, determining the end user market. Furthermore, the researcher interviewed local community members that live near poisoning sites. The objective was to explore how poisoning might affect local communities in general terms, their livestock and any other impacts. As the GLTFCA is a vast geographic region, insights from the scoping phase informed specific research sites and focal points in South Africa and Mozambique. The community liaison officer for the Gonarezhou Conservation Trust (GCT) assisted in identifying research sites and arranged access to local communities in and around GNP.

An essential part of the research process was time set aside for **data analysis**. The process was detrimentally affected by the robustness, comparability and lateness of incidence data provided to the researcher. At the time of drafting the final report, several data requests were still outstanding (also compare with research limitations).

The final report serves as the primary research **dissemination** tool.

3.6 RESEARCH ETHICS

When researching illegal activities, researchers should consider the impact of their research on the research participants, the social environment, and the emotional and psychological impact on themselves. This research project falls into the category of what is known as "socially sensitive research" (Sieber and Stanley, 1988: 49). Hübschle submitted an application for ethical clearance to the ethics committee in the Faculty of Law at the University of Cape Town in November 2018. The ethics committee approved the application as an addendum to her postdoctoral research project. This section deals with informed consent, anonymity and confidentiality, power differentials between the researcher and research participants, reciprocity and risk of harm.

3.6.1 INFORMED CONSENT

All research respondents consented to participating in the research. Usually an interview, group discussion or focus group was preceded by either a telephonic, email introduction or an introductory visit. Based on previous experience with hard-to-reach populations and sensitive research topics, Hübschle opted for verbal consent. The interaction started with a verbal introduction, which covered the following:

- the objectives of the research;
- the background of the researcher;
- how the research is going to be used;
- how the research might benefit the researched;
- guarantees of anonymity and confidentiality;
- a request to use recording equipment;
- the freedom to withdraw at any point from the interviewing process.

The services of a translator were used in rural communities to ensure that important aspects were not lost in translation. After the introduction, Hübschle sought verbal consent from research participants (see Appendix 2 for Script for Verbal Consent). Hübschle and the field assistants tried to ascertain that the research participants consented to all aspects listed above. Research participants were provided with institutional business cards in case they want to reach out to her after the research process.

Beyond seeking consent from respondents, Hübschle respected the rules of engagement with local communities by seeking permission from traditional authorities prior to commencing the interviewing process. Depending on initial rapport with respondents and due to the sensitivity of the research topic, the use of recording equipment was decided on a case-by-case basis. Where the recording of interviews and focus groups was not possible, the researcher took detailed field notes.

3.6.2 ANONYMITY AND CONFIDENTIALITY

Since the deliberate poisoning of wildlife is illegal in Mozambique, South Africa and Zimbabwe, the assurance of anonymity, confidentiality and data protection was important in establishing trust and rapport with research respondents. Names or personal identifiers were not collected during the research process. Great care was taken to anonymize names and places in interview and focus group data and field notes. In communities with high levels of wildlife crime, no focus groups were undertaken to ensure confidentiality and minimize danger to others.

Confidentiality of responses is ensured through anonymity and restricted access to the data, which will only be seen by the researcher, the supervisor (on request) and research assistants who signed a confidentiality agreement. The field researcher was asked to delete any research data in his possession upon completion of his assignment. Raw and analyzed data is stored in password-protected filing systems on external hard drives that are encrypted and locked away in Hübschle's filing cabinet. Data will not be shared with any third parties, which included the deletion of (social) data sharing clauses in the research agreement with the Scientific Committee of the KNP.

3.6.3 POSITIONALITY OF THE RESEARCHER

There is a need to contextualize the background of the researcher and explain why this may be important in situating research methods, data limitations and validity. A white South African woman with Namibian German roots conducted the research with institutional backing by the three park authorities, and financial support by WWF South Africa and USAID through the Khetha Program and the PPF. There is no doubt that these personal and institutional attributes influenced the research process and outcome. In essence, a person's background, socialization, social capital and personal attributes impacts access in the field, choice of methods and research outcomes. Within the social sciences, a long-standing rift exists between proponents of either 'insider' or 'outsider' research (Merton, 1972).

There is no denying that the researcher was born into "white privilege". It is not unusual for researchers from a privileged background to take top-down, 'self-versus-others' approaches to sampling and interviewing without critically assessing the power differentials between the researcher and the researched (Schmid, 2010: 170-172). Given the legacy of apartheid and colonialism in southern Africa, Hübschle was concerned about acknowledging possible bias. While 'othering' and situational power dynamics can happen unknowingly and subliminally in interpersonal interactions, so can feelings of empathy, understanding, comprehension of attendant life experiences and ideologies contribute to the bridging of cleavages (Weiner-Levy, 2009: 3).

In practice, cleavages based on asymmetrical power relationships persist across southern Africa. Most of the actors involved in wildlife poisoning supply-chain are men, which may lead to a one-dimensional focus on men's lived experiences (Chambers, 1983: 77). Yet, poisoning is embedded in society and thus women were purposefully included to assess how poisoning and the ubiquitous availability of poisons impacted their daily lives. Concerted efforts were made to level the playing field between the researcher and the researched. As mentioned earlier, the principles of informed consent, anonymity, confidentiality and data protection were ethical cornerstones. Moreover, respondents were encouraged to take control of the research process by having the option to withdraw from the interview at any stage, invite others to participate in the interview, direct the flow of information by withholding or only partially answering sensitive questions (Scheyvens, 2014: 9). Due to the unstructured, interactive and narrative - conversational style of the interviews, research participants had considerable and implicit control over the interview process (Corbin and Morse, 2003: 338). Research informants only told their story if they felt at ease with the researcher. Unless there were security concerns, respondents chose the location of the interview and determined how much time they were going to dedicate. When a suitable interpreter was available, research participants were given the option of getting interviewed in their preferred language.

Great care was taken to respect and comply with local customs and traditions. Local research assistants were employed to bridge cultural, social and language divides. Permission to visit and conduct interviews was sought from community leaders, chiefs or community gatekeepers when entering village communities.

3.6.4 RECIPROCITY

The issue of reciprocity provides a difficult conundrum in social research. The benefits of the research will vary for participants and are not likely to be immediate. If, for example, the research leads to improved conservation practices regarding wildlife, human, livestock and ecosystems poison incidents, there may not only be benefits to research participants but there may well be widespread social and conservation benefits.

While Hübschle never compensated respondents for information or interviews, she paid for coffee, lunch or refreshments on occasion. In return for the time and effort of respondents, requests for research materials, advice on general crime and conservation-related issues and calls for progress reports were heeded. Any requests to share research data or findings prematurely were declined.

3.6.5 RISK OF HARM

Hübschle's ethical protocol aimed to minimize risk of harm to research participants. No questions were asked that could lead to harmful consequences to the participants, such as sharing the names of known poison offenders or poachers. Three independent research participants volunteered information on where "poison" could be bought in rural towns in South Africa. Research participants also pointed Hübschle to markets and taxi ranks in rural Mozambique and Zimbabwe where poisons could be purchased. In each case, great care was taken that there would be no harm or consequences to the research participants, field assistants and researcher.

Anonymity and confidentiality were cornerstones of the project. Participants could withdraw from the interview process at any stage. Participants and gatekeepers were asked to recommend a safe venue (where they feel comfortable and at ease) for interviews or focus groups. Extra care was taken to ensure that there would be no negative consequences to participants, such as checking for body language that signals discomfort or fear and signs of involuntary participation in the research process. No minors were interviewed during the research process.

3.7 RESEARCH CHALLENGES AND DATA LIMITATIONS

This section deals with research challenges and data limitations.

3.7.1 LENGTHY RESEARCH PERMISSION PROCESSES

Hübschle met with several section rangers from the KNP during the scoping phase of the research project. One ranger raised concerns about sharing wildlife poisoning data with the researcher due to confidentiality clauses in her employment agreement with the Park. In consultation with members of the SANParks' Scientific Committee, it was suggested that the baseline study be registered as a SANParks research project to allow easy access to conservation officials and rangers. The researcher was advised that an addendum application to a registered research project with the KNP – her postdoctoral research project on community enrolments in legal and illegal wildlife economies – would suffice for the purposes of data collection. An addendum application was submitted in June 2018. After the quarterly meeting in June 2018, the Scientific Committee requested that a full research proposal and application be tendered. The researcher was advised that interviews could proceed without the formal research permit as the research had been solicited at management level by the GLTFCA. However, in light of the need to access datasets which fall under the environmental crime category, the project team decided to wait for research approval. As it turned out, Hübschle still encountered challenges in accessing data once the research permits had been issued (see next section). The lessons learnt here is that a clear distinction needs to be made between academic research projects submitted to the Scientific Committee for research clearance and research studies solicited by the GLTFCA for conservation management purposes.

In order to fast-track the research authorization process, the international coordinator of the GLTFCA sent a letter of support to members of the JMB in August 2018. In response to the letter, the park authorities in Mozambique and Zimbabwe likewise requested a research authorization process to formally recognize the baseline study. The process was less onerous in the case of Mozambique. The research application was never acknowledged nor were follow-up emails answered; however, the research permit was forwarded to the PPF in late September 2018. A research application was also submitted to the Zimbabwe Parks and Wildlife Management Authority (Zimparks) in August 2018. The first application was lost and the outcome of the second application had not been communicated at the time of writing this report. The Zimbabwean leg of fieldwork was completed in July 2018. As the baseline study was solicited by the JMB of the GLTFCA, the research team did not submit a research application at the time.

3.7.2 PROBLEMS WITH DATA VALIDITY, ACCESS AND SHARING

Although wildlife poisoning has been a recurring environmental crime issue, there are few historic and current records available. Conservation officials in the GLTFCA have incomplete and non-standardized records of poison incidents in the parks and surrounding areas. As part of the research assignment, the researcher was asked to collate and collect wildlife poison incidence data from different data repositories, entities and individuals to fill in the gaps where possible. In spite of being in possession of the Kruger research permit, the researcher encountered delays in data transmission and lack of responsiveness from gatekeepers in the KNP.

In some instances, accessing and locating the data proved to be an onerous and lengthy process for those in charge of record keeping. The researcher found discrepancies between what was indeed recorded and what conservation officials remembered in interviews. Moreover, the KNP is in crisis management mode with regards to the ongoing poaching of rhinos, and to lesser degree, elephants. Several key informants were dismissive of the baseline study. Research into wildlife poisoning was seen as a distraction from the 'bigger' poaching issue at hand.

As data capture methods are not standardized across the GLTFCA, the three parks, entities within the parks and individuals capture data in different formats and use different measurements. As an example, only one set of records provided the GPS coordinates of poison incidents.[4] The name of sections or nearby geographical markers were given in the other records. Where poison records were made available, individual records were incomplete or contained different variables. Few records contained detailed information on the type of poison used, the method of administration, reason for poisoning and the findings from post-mortem or toxicology reports. Only one data point differentiated explicitly between primary and secondary poisoning of wildlife. This may have led to biased results as some species may be more or less abundant in certain parts of the GLTFCA.

Discrepancies were noted in the reported data. For example, the reports by first responders sometimes differed from reports submitted by entities that undertook follow-up investigations. In a few instances, vital details such as the method of poison administration or the removal of body parts (upper beaks of vultures or paws of lions) were gleaned from media articles and/or press releases that were published on the circumstances surrounding a specific poison incident. Few samples appear to be taken for toxicology screens or post-mortems. Where samples were taken for testing, the results were often not entered into the poison records or databases. Of all the parks' data records scrutinized, only one record specifically referenced impacts to vegetation.

The final section of this report will recommend a standardized format for capturing poison incidents. The researcher received poison incidence data from the African Wildlife Poisoning Database currently housed at the Endangered Wildlife Trust (EWT), Brian Jones and Nikita Jackson (Moholoholo Rehabilitation Centre), Anthony Marx (Maunge PNR), Tim Snow (Wildlife Poisoning Prevention & Conflict Resolution), Ellery Worth (Karingari) and Kristoffer Everatt (Greater Limpopo Carnivore Program).

3.7.3 TIMING OF FIELDWORK

Due to the delays linked to attaining research authorization and research participants' availability, data collection had to be postponed several times. By the time the researcher entered the field, twelve months had passed since the scoping phase. The delay necessitated the revival of connections and revisiting informal research permissions obtained during the scoping phase. Both the scoping and fieldwork phases commenced in late November 2017 and 2018 respectively. The closeness to the holiday season impacted the availability of some research respondents.

[4] The lack of GPS coordinates in datasets may also be linked to security concerns about sharing such data with third parties.

3.7.4 COMMUNITY ACCESS AND RESEARCH FATIGUE

Upon receipt of the Kruger research permission in November 2018, Hübschle attended the Hlanganani Community-Park Forum to request permission to conduct interviews in local communities living adjacent to the northern sections of the KNP. The forum chairperson provided permission on behalf of the community members present but requested that data collection be moved to 2019. In light of the impending annual holidays, the recommendation to postpone data collection to 2019 made sense. The postponement also suited the Kruger regional rangers for the northern regions. Local community representatives undertook to get in touch with the Kruger community-liaison officer to suggest villages of interest where poisoning had occurred in and around communal land. The community-forum chairperson asked the researcher to provide feedback upon finalization of data collection in the local communities. Feedback was deemed an important aspect of the research process as participants at the Hlanganani Forum had expressed research fatigue, the sense of being "over-researched" and receiving no benefits from researchers who had passed through rural communities in the past. Hübschle was clear that there were no direct benefits of the baseline study other than that the research might assist in highlighting challenges and problems that research participants were encountering or might encounter in the future. The plan to provide feedback on provisional research findings at the Hlanganani Community-Park Forum in May 2019 had to be aborted after the forum meeting was cancelled a day before it was scheduled to take place. It is hoped that another opportunity will present further down the line.

3.7.5 COMMUNITY- PARK RELATIONS IN THE LIMPOPO NATIONAL PARK

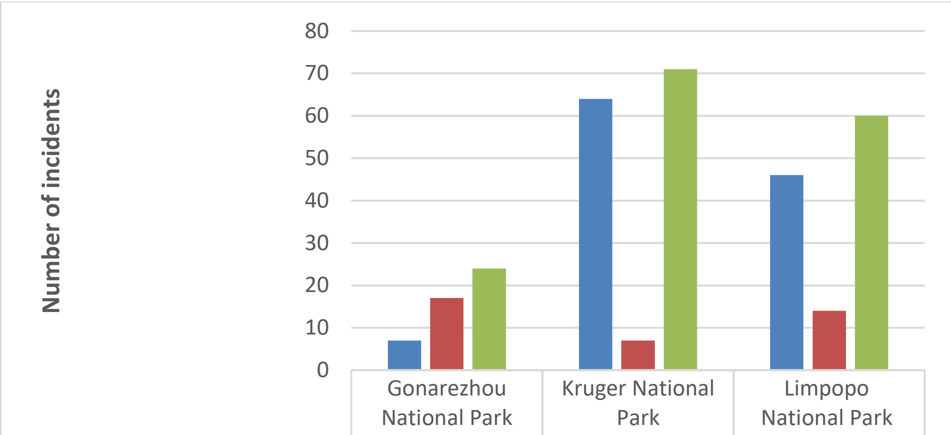
Prior to embarking on the fieldwork mission in Mozambique in November 2018, Hübschle was cautioned by park officials and peers in academia that community-park relations in the LNP had worsened since her previous visit during the scoping phase. A young Mozambican Shangaan-speaking field researcher was hired to assist with data collection and translations. Hübschle trained the researcher and undertook several interviews and one focus group together with him in Massingir and Cubo. The field researcher continued fieldwork on his own, traveling to seven village communities in and adjacent to the LNP. Although the field researcher had previously undertaken fieldwork in the region, the relative short time in the field and the difficult situation on the ground impacted the research process and access. He reported that several villagers were suspicious of him, suspecting that he was working for the Park and spying on them. He managed to collect interview data that show deep rifts between the Park and resident local communities. Prior and throughout the research process, both researchers were aware that the research may have a performative effect on research participants. In other words, the research topic and questions pertaining to wildlife poisoning could alert disgruntled parties to the fact that park authorities were deeply concerned about the phenomenon. As mentioned previously, it was important to make clear that wildlife poisoning also had dire and potentially deadly impacts for people, their children and health as well as livestock and ecosystems.

SECTION 4: RESEARCH FINDINGS AND ANALYSIS

4.1 MAGNITUDE OF THE PROBLEM IN THE GLTFCA

The baseline study covered poison incidents that occurred in the GLTFCA during the period January 1, 2008 to July 18, 2019. The findings listed below need to be read in the context of incomplete datasets with often insufficient details and lack of standardization. The cases and statistics presented in this section are not the official poison statistics for the GLTFCA as such statistics do not exist as yet.

A total number of 155 poisoning and attempted poisoning incidents were recorded in the GLTFCA over the approximately 127-month period (see Figure 2).



	Gonarezhou National Park	Kruger National Park	Limpopo National Park
Confirmed poison incidents	7	64	46
Attempted poison incidents	17	7	14
Total	24	71	60

Figure 2: Confirmed and attempted poisoning incidents in the GLTFCA (January 1, 2008 to July 18, 2019) [5]

The overall death toll through poisoning from July 1, 2008 to July 18, 2019 in the GLTFCA was 2062 individual animals, which includes one domestic goat and three domestic dogs that were found dead at poisoning sites. Twenty individuals (mostly vultures) recovered after rehabilitation procedures, thus a total number of 2 082 wild and domestic animals were affected by poisoning (see Figure 3).

Of the three parks, GNP registered the lowest number of incidents with 24 suspected and recorded poison incidents. In seven out of the 24 incidents, conservation personnel found poisoned carcasses. Poison was found in the bush or on suspected poachers in the other 17 incidents (see later section on GNP).

[5] Note: These numbers include incidents in the GLTFCA outside the boundaries of the National Parks.

In the Mozambican section of the GLTFCA, 60 incidents were recorded. The 23 poison incidents recorded by LNP conservation officials were augmented by records submitted by Anthony Marx, the warden of Maunge PNR,[6] the Greater Limpopo carnivore research unit headed by Kristoffer Everatt, Ellery Worth of Karingani and data captured in the African Wildlife Poisoning Database (AWPD).

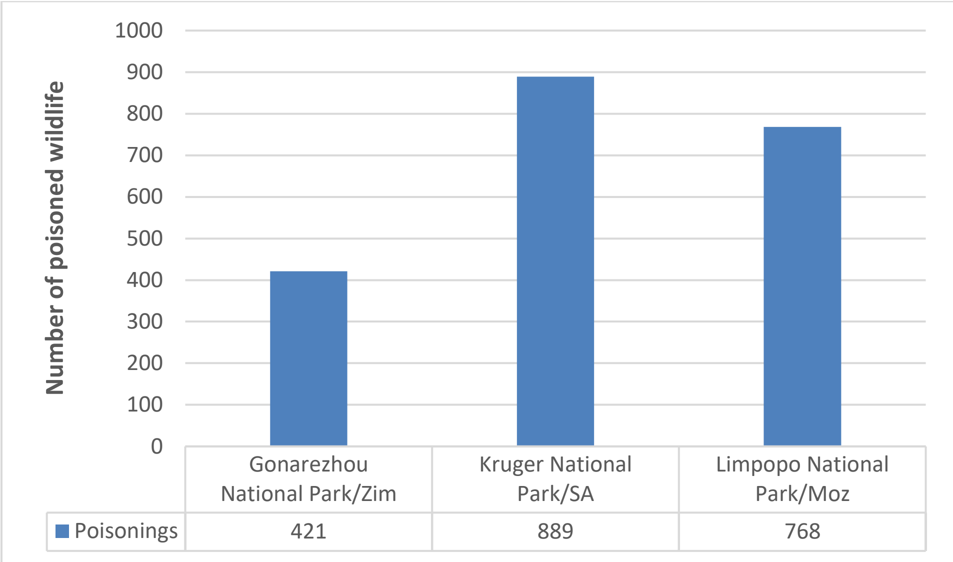


Figure 3: Total number of wildlife poisoned in the GLTFCA[7]

(January 1, 2008 to July 18, 2019)

With 71 suspected and recorded poison incidents, the Greater Kruger landscape in South Africa registered the most poison incidents. Of these 71 poison incidents, 39 incidents occurred inside the boundaries of the KNP. Thirty of these incidents happened in the northern sections,[8] often close to either the eastern or western boundary of the Park (Interviews with rangers, 2018, 2019). Poison incidence data were also supplied by Nikita Jackson and Brian Jones of the Maholoholo Rehabilitation Centre, Tim Snow and the AWPD.

The primary targets of poison offenders were elephants and lions in the project area (compare with Table 4; confirmed in interviews with conservation officials, 2017, 2018, 2019 and as per the data supplied).

[6] Marx is the warden of a hunting concession adjacent to the GNP, south of the border in Mozambique.

[7] The total number of wildlife poisoned in the Mozambican part of the GLTFCA does not include the four domestic animals that were found at poison sites.

[8] Four poison incidents were georeferenced as "Kruger" with no further details captured.

Table 4: Total number of poisoned individuals grouped by species (January 1, 2008 and July 18, 2019)[9]

Species	GNP/Zim	KNP/SA	LNP/Moz
Elephants	32	5	10
Rhinos	0	2	0
Predators	0	19	59
Vultures	386	660	620
Birds of prey	1	17	16
Other birds	0	169	50
Small animals	1	6	5
Buffalos	0	6	0
Antelopes	1	5	8
Domestic animals	0	0	4
Totals	**421**	**889**	**772**

While vultures and other birds were the worst impacted by secondary poisoning, they appear not to have been the primary targets. In all the cases where elephants had been poisoned, the tusks were removed, suggesting that these were cases of poison poaching for ivory. In GNP, conservation officials suspect that monkey fruit, oranges and marula laced with poison were aimed for elephants as they are known to eat these types of fruit. Most poisoned elephants (see Figure 4 for geographic spread), antelopes and buffalos in Kruger were first shot dead, then the carcasses were cut open and laced with poison.

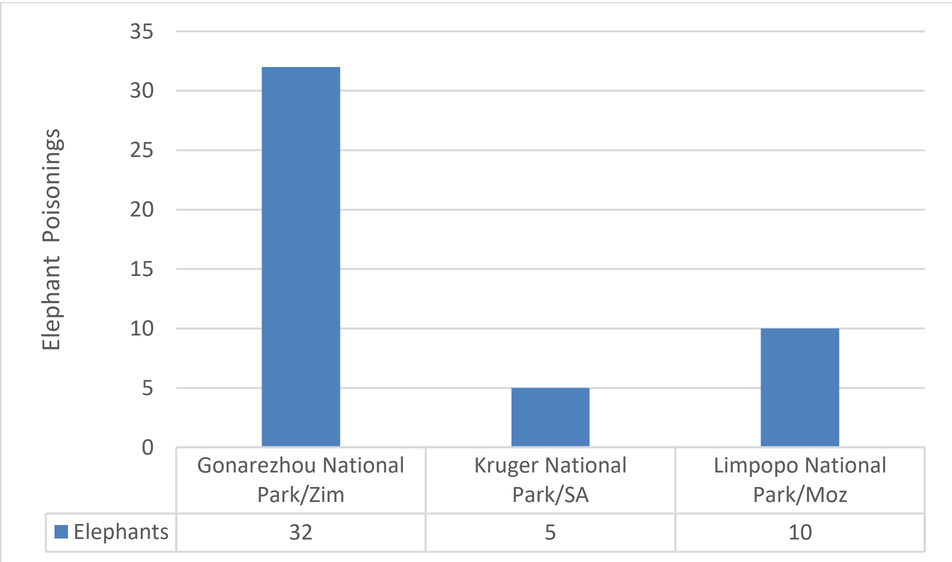


Figure 4: Elephant poisonings in the GLTFCA between January 1, 2008 and July 18, 2019

[9] The total number of wildlife poisoned in the South African part of the GLTFCA includes 20 individuals that recovered after rehabilitation procedures.

Most antelope poisonings captured in the database refer to antelopes that were either shot or snared and then used as bait to attract predators. In one case in the Vlakteplaas section of KNP in December 2015, two rhinos were first poached (shot dead with a hunting rifle) and then poisoned. Small animals such as honey badgers and warthogs were usually victims of secondary poisoning after feeding on a poisoned carcass. Three domestic dogs and one goat were found at poisoning sites inside the LNP. As there are resident villages inside the Park, these domestic animals probably belonged to local villagers.

Conservation officials believe that vultures may have been the primary targets in a few recent cases in KNP. However, the heads or beaks of vultures had not been removed. One explanation might be that rangers found the poisoning sites before the poison poachers could return to fetch their loot. The more likely explanation is that the vultures may have been targeted to conceal wildlife poaching. There were seven poisoning incidents which involved the removal of heads or beaks of vultures. One incident occurred in GNP (compare with Groom et al., 2013) and six cases in LNP. There was anecdotal evidence that the vulture parts were sold to traditional healers and *muthi* markets (Interviews with poisoning and vulture experts and community members, 2018, 2019). Williams reported that she and her team of researchers had observed high volumes of vulture body parts at Faraday market in Johannesburg (also compare with Williams et al., 2014). The traditional medicine market (*muthi*) in Faraday Street in the central business district of Johannesburg is known as one of the biggest markets trading traditional medicines and ingredients in southern Africa.

The researcher could find no empirical proof of an increasing demand for vulture parts in traditional medicine markets or orders made for such parts by traditional healers. Beyond the mass poisonings of vultures, other birds including Egyptian geese and birds of prey (especially eagles and owls) were affected by indirect poisoning (compare with Figure 5). In one incident in Mjejane Private Reserve, 157 Egyptian geese and four other birds were poisoned with the organophosphates metamidaphos & cypermethrin.

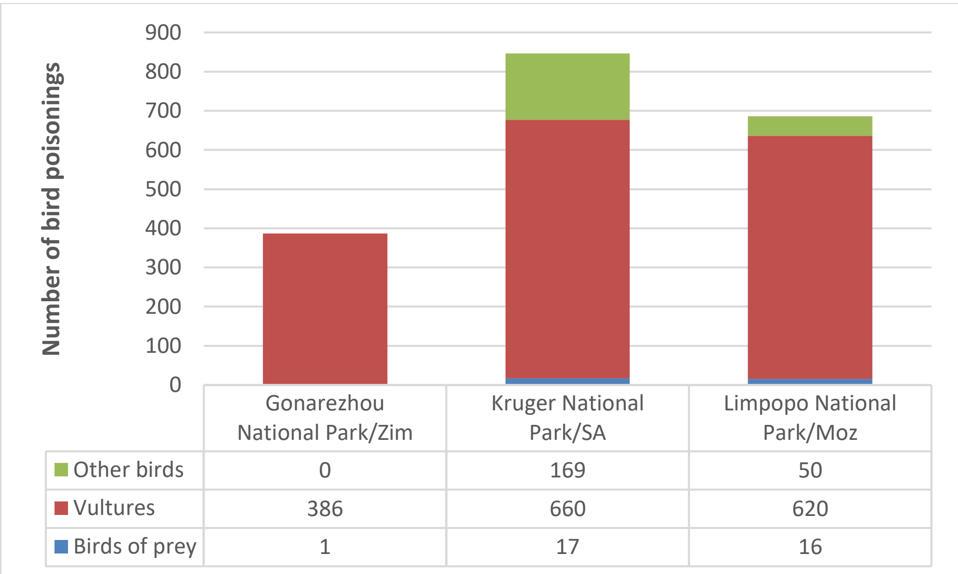


Figure 5: Number of birds poisoned in the GLTFCA between January 1, 2008 and July 18, 2019

A study undertaken by Ogada and colleagues (Ogada et al., 2016a) suggests that the rate of increase in vulture mortality as a result of elephant poaching since 2012, greatly exceeds that with other types of poisoning events. In other words, there were more mass vulture deaths linked to elephant poaching than mass vulture deaths linked to any other poisoning event. Of the 1 656 vulture deaths in the GLTFCA[10] (see Figure 5), 797 (48, 1%) were linked to elephant poaching incidents (compare with Table 5).

Table 5: Cases of elephant poisonings with associated high vulture mortality rates (January 1, 2008 –July 18, 2019)

Date	Region	Country	Vultures	Elephants
2010	Mbabala	Mozambique	63	1
17/07/2012	GNP	Zimbabwe	191	1
28/09/2015	Vlakteplaas	South Africa	44	1
27/02/2016	Vlakteplaas	South Africa	110	1
2017	GNP	Zimbabwe	100	5
20/05/2017	GNP	Zimbabwe	94	1
25/02/2018	Mbashene	Mozambique	87	1
20/03/2019	Vlakteplaas	South Africa	18	1
29/05/2019	Vlakteplaas	South Africa	78	1
01/06/2019	Vlakteplaas	South Africa	12	1
			797	14

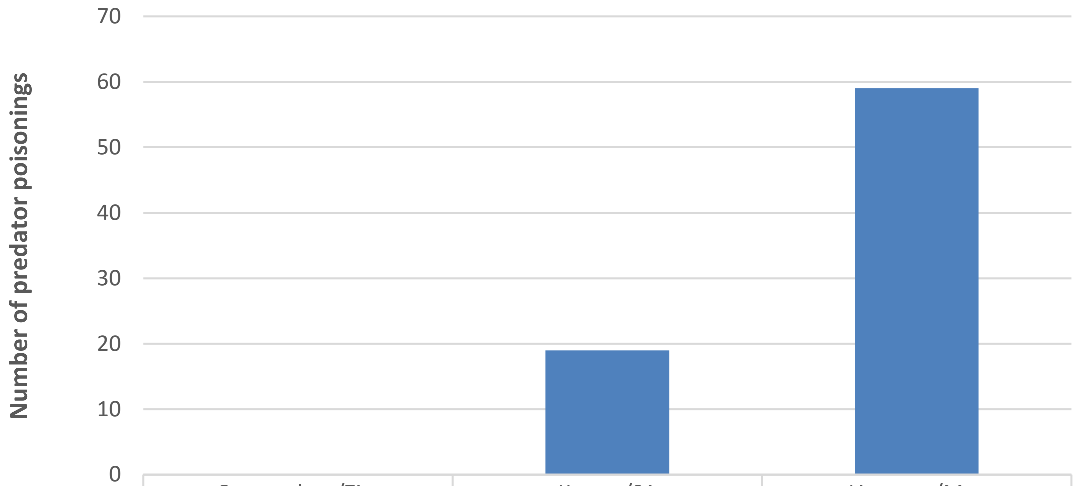
Other poisoning incidents that led to high vulture death tolls include two instances in KNP where poached buffalo carcasses were laced with poison. One incident in the Stolsnek section in 2014 led to the death of an estimated 70 white-backed vultures and two bateleurs. In another incident in July 2019, 117 white-backed vultures, one hooded vulture and one white-headed vulture succumbed to poisoning after ingesting poisoned buffalo meat. There were several mass vulture deaths in the Mozambican part of the GLTFCA. No bait was found at the poisoning scene in some cases, suggesting that the bait had been removed by offenders or scavengers. In other instances, the bait may not have been recorded. The targeted poisoning of predators led to a high vulture death toll in four instances: In one incident, two nyalas, one warthog and one impala were laced with poison near Machampane River. Two lions, fifty unspecified vultures, one giant eagle owl, one yellow billed kite and three fish eagles were fatally

[10] Of the 1666 vultures involved in poisoning incidents in the GLTFCA, 9 were rehabilitated and thus survived the poisoning event.

poisoned in October 2016. According to Kristoffer Everatt (Interview, 2017 and personal communication, 2019), the two lions and 22 vultures were "mutilated" for body parts. The other three cases in Gadzingwe, Mala Mala and an unspecified location in the LNP in 2017,[11] involved the fatal poisonings of five jackals and 45, 49 and 37 vulture deaths respectively. The carcasses of the vultures were intact, suggesting that the motivation for the three poisoning events was illegal hunting.

What is worrisome about the mass vulture deaths is that not everyone appears to be aware of the gravity of such incidents. A request for further information and data verification of an incident obtained the following response: "All it was is that a buffalo was poisoned near the western boundary fence and approx. 70 w/b vultures and two bateleurs were found dead."

Lions were the primary victims of predator poisonings (compare with Figure 6) with 43 lions poisoned between 2008 and 2019.



	Gonarezhou/Zim	Kruger/SA	Limpopo/Moz
Predators	0	19	59

Figure 6: Predator poisonings in the GLTFCA between 2008 and July 19, 2019

The majority of these poisoning incidents were linked to human-wildlife conflict scenarios and happened in the Mozambican part of the GLTFCA (compare with the case study below). Four hyenas, two leopards, six civets and 15 jackals were poisoned in what appeared non-targeted or secondary poisoning events. The predators fed on poison-laced carcasses that had been strategically positioned near sites where lions had previously killed heads of cattle. Lion bones, faces and paws were removed in one case and lion faces, heads and paws were removed in four other cases. The primary driver in the five poisoning events where lion body parts were removed, appears to have been human-wildlife conflict (Interview with park officials, 2017, 2019). Park authorities stamped the events as attempts to prevent further cattle losses by resident communities. Community members living in Mavodze had previously lost 24 heads of cattle to lion predation, which may have triggered one incident where four lions were poisoned. Human-wildlife conflict poses a particularly serious threat to the lives of

[11] These cases were captured in the AWPD.

community members residing inside the LNP, their livestock and food crops. Children fulfil cattle herding functions in the villages. Lions that attack livestock do not only affect food security of local communities but they also pose a grave danger to cattle herders, and villagers whose mobility has been greatly affected by the presence of dangerous predators since the Park's inception and the partial dropping of fences with KNP (Interviews with community members, 2017, 2019). There were no recorded predator poisonings in GNP.

The removal of lion body parts and bones appears to have been opportunistic. The researcher could find no links to established criminal networks or illegal wildlife supply chains. One conservation official explained (Interview, 2018) that the illegal lion bone trade involves a complex logistical process including but not limited to the transportation of heavy lion bones. The illegal lion bone trade is thought to involve highly organized criminal networks. According to the data received by the researcher of this report, lion bones were removed in one poisoning incident. However, lion researcher and long-term resident in the LNP, Kris Everatt and colleagues (Everatt et al., 2019 (under review)) found evidence that suggests that there may be targeted poaching for lion parts to supply Asian and local markets. Everatt et al. (2019) considered data collected from the LNP, Banhine National Park, adjacent community lands and the northern half of the Kruger National Park.

4.2 CASE STUDY: LION POISONINGS IN CUBO

The majority of poisoning incidents triggered by human-lion conflict happened in and around LNP. The small village of Cubo, south of the Massingir Dam, was a lion poisoning hotspot between 2013 and 2017. During this period villagers poisoned 12 lions (confirmed).[12] When the researcher spoke to the community leader of Cubo in December 2017, the community had lost 40 head of cattle to predation by big cats over a 12-month period. By the time of the second field trip, 12 months later, this number had trebled. According to records kept by a community-appointed registrar of livestock losses linked to human wildlife conflict (Interview, 2018), the community had lost 120 heads of cattle to lion predation between 2013 and 2018. The root cause of the problem appears to have been linked to a land dispute between the village of Cubo and the private concession of Karingani (the former Twin City and Xonghile concessions) owned by the luxury tourism brand Singita. According to an interview with a village elder (Interviews in 2017, 2018), the concession reneged on an agreement to fence a stretch along the northern parts of the concession bordering Cubo to prevent cattle predation by the concession's resident predator population. Community members said that the concession holders were planning to incorporate an additional parcel of 3 000 hectares of communal land, which would allow the concession access to the Massingir dam and Elefantes Gorge. The warden of Karingani, Ellery Worth, confirmed that there had been a dispute about land allocation (personal communication, 2019). During a focus group in 2018, community members shared that a trusted community member was tasked to deal with the 'lion problem'. This person was sent to a nearby city (probably Tshokwe) where he bought black granules for 'damage control'. This appears to have been aldicarb. At the time of the focus group in 2018, the dispute had been settled. Karingani brought in negotiators to address the concerns of community members (Interview with community liaison officer, Sabi Sands, 2019) and an agreement was forged regarding the fence line and the payment of compensation for livestock

[12] One conservation officer in Cubo said that a leopard may have also been poisoned but could not remember the details of the case.

losses. Community members were compensated MTS 25,000 per head of cattle for 140 heads of cattle lost until 2019 (personal communication with Ellery Worth, 2019). In return, the community of Cubo agreed to no longer use poison to kill predators. The case study demonstrates the importance of two-way communication and acting upon valid complaints and concerns of neighbors. Relations between Karingani and Cubo had improved by the time of the second field trip and Karingani officer appointed a community-liaison from within the community to facilitate closer cooperation.

4.3 THE FREQUENCY OF POISONING EVENTS

While it is difficult to draw definitive conclusions as regards the actual magnitude of wildlife poisoning in the GLTFCA, available statistics suggest that it is a real and growing concern (compare with Figure 7). The likelihood of detection is impacted by the sheer size of the GLTFCA as well as the possibility that some poisoned wildlife carcasses are removed for consumption and trade.

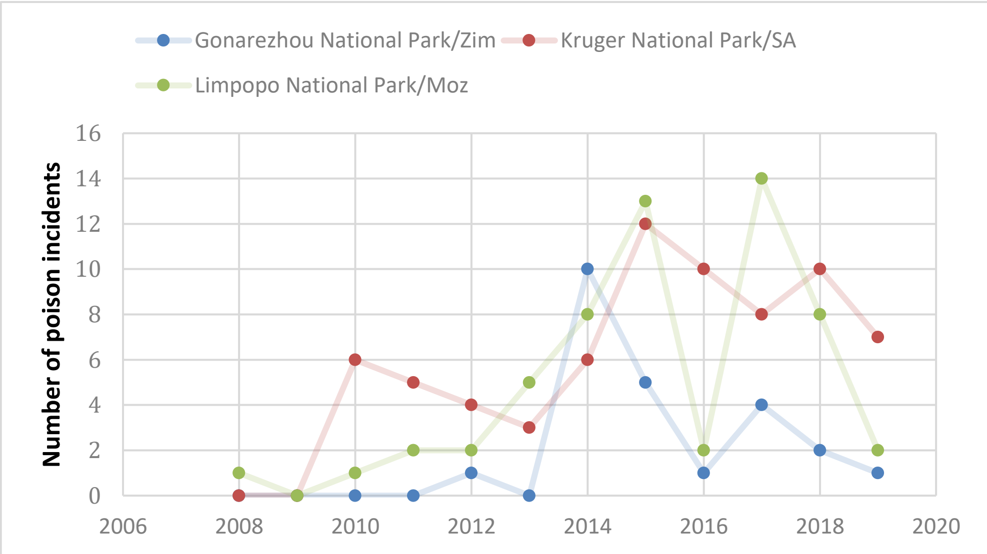


Figure 7: Wildlife poisoning incidents per annum in the GLTFCA (2008 to July 19, 2019)

Although there has not been a linear increase, the available data suggests that the frequency and number of wildlife poisoning incidents have increased since 2010. An alternative explanation might be that the rates of detection and reporting have increased due to heightened awareness of wildlife poisoning. The trends in and around KNP and LNP suggest that wildlife poisoning poses a serious threat to conservation endeavors. The GNP, on the other hand, appears to have seen one spike in 2014 with incidents ebbing off since. Conservation authorities should keep an eye on poisoning trends in the KNP where wildlife poisoning rates appear to have grown at a slow pace initially but peaked in 2016 and 2018. Since the beginning of 2019, seven separate poisoning incidents have been recorded, suggesting that 2019 may end with the highest number of poisoning events in recent history (perhaps ever).

Some conservation officials link the supposed increase of wildlife poisoning to the escalation of wildlife poaching since the early 2000s across southern Africa (Interviews with conservation officials, 2017, 2018, 2019). It is assumed that the same offenders may be involved in both activities with the common goal of harvesting wildlife and wildlife parts for illegal wildlife and traditional medicine markets. Others point to more complexity suggesting that a combination of factors explain the increase and multiplicity of drivers of wildlife poisoning. There is some evidence from East Africa that in countries where firearms are not easy to obtain legally, poisons are employed to control predators and pests, and to illegally harvest bushmeat (Odino and Ogada, 2008). One study speaks to the possible health impacts of contaminated bushmeat consumption by humans (Ogada, 2014) but no scientific analysis appears to have been conducted to document the impact of poisoned bushmeat consumption on food security. However, poison experts and community members interviewed for this research (Interviews, 2018, 2019) reported of abdominal pain, diarrhea and other symptoms linked to poisoned meat consumption (see also the section on community perceptions).

4.4 CASE STUDY: WILDLIFE POISONING IN GONAREZHOU NATIONAL PARK

Poison records for the GNP start in July 2012 when conservation officials recorded an elephant poisoning incident and a mass vulture killing of 191 vultures. The poached elephant had been laced with an unknown poison. The upper beaks of some 57 vultures had been removed. The remainder of the carcasses were undisturbed, suggesting that the poachers left early. Six more poisoning incidents were reported over the project period while seventeen poisoning sites were found and decontaminated. Although no dead animals were found near these sites, these incidents are considered attempted poisonings and thus included in the final tally. According to conservation officials at GNP (Interviews, 2018), poachers may employ a variety of hunting methods including poisoning. A poacher may thus lay a few snare lines, put out poisoned bait and go fishing while waiting for his loot. He is likely to return after a while to check whether he has been successful. Essentially the poacher is maximizing time spent in the park which comes at great personal risk in light of Zimbabwe's shoot-on-sight anti-poaching policy. Of particular concern to Zimbabwean authorities are cross-border poachers from Mozambique. Equipped with excellent tracking skills, individuals living near Chicualacuala are believed to cross into the park regularly, lay poison baits (mostly marula fruits which elephants like) near elephant trails and return to the poison site after a couple of weeks. Park officials related the difficulty of proving probable cause when dealing with poison offenders. In one case, a suspect was arrested near a poisoning site where marulas had been laced with aldicarb. The suspect refused to eat the poisoned marulas and admitted to lacing the fruits with poison. He changed his version of events in court and was released after paying a USD 20 fine. The fine related to illegal entry into the country without a passport as the suspect came from a Mozambican community across the border and not the poisoning incident. Park officials suspect bribery and corruption as the prosecutor had also requested that the fruits be sent for toxicology testing. The onus should be on the accused to prove that the fruits were not poisoned. The sample in question was sent to a laboratory in Harare which does not have the capacity or capability to undertake toxicology screens. The report came back negative after a long delay and the suspected poison poacher walked off with a slap on his wrist – the fine for illegal entry into Zimbabwe.

Chain of custody is key to prosecuting poisoning incidents: Essentially a police officer has to accompany the "evidence" from the crime scene to the laboratory. The carcasses of wild animals suspected to have fallen victim to poisoning are frozen and then sent for toxicology testing. This can be tricky if there is no laboratory located near the poisoning site. In the past, samples arrived rotten on the receiving end. All poisoning cases were reported to the Zimbabwean Police. Due to the economic and political situation, the Police has limited transportation options: police cars have not been serviced and there is often no fuel. Park officials thus have to pick up police officers for trial dates, provide them with accommodation and subsistence. Postponements become a costly matter. As the laboratory facilities are under-capacitated in Zimbabwe, samples were dispatched to a laboratory in the US. However, ethical and proprietary issues arise when samples are sent to private or overseas laboratories. Interviews also revealed that wildlife poison awareness and related crime scene management are not integral to basic ranger training. Private individuals have been providing training at intervals. However, the training is not integrated into other modules and Standard Operating Procedures (SOPs) underpinning ranger activities.

4.5 METHODS: HOW ARE POISONS ADMINISTERED?

In the majority of cases (approximately 52%), the data provided to the researcher was inconclusive as regards the vehicle of poison administration (compare with Figure 8). There are several explanations for this: The victims may have eaten or imbibed the poisoned meat parcels or fruit. Some poisons decompose over time so there may have been no remnants by the time the first responders found the poisoning site. Poisoned baits, vegetation or waterways may also not be obvious to the untrained eye, and thus, may not have been identified as such.

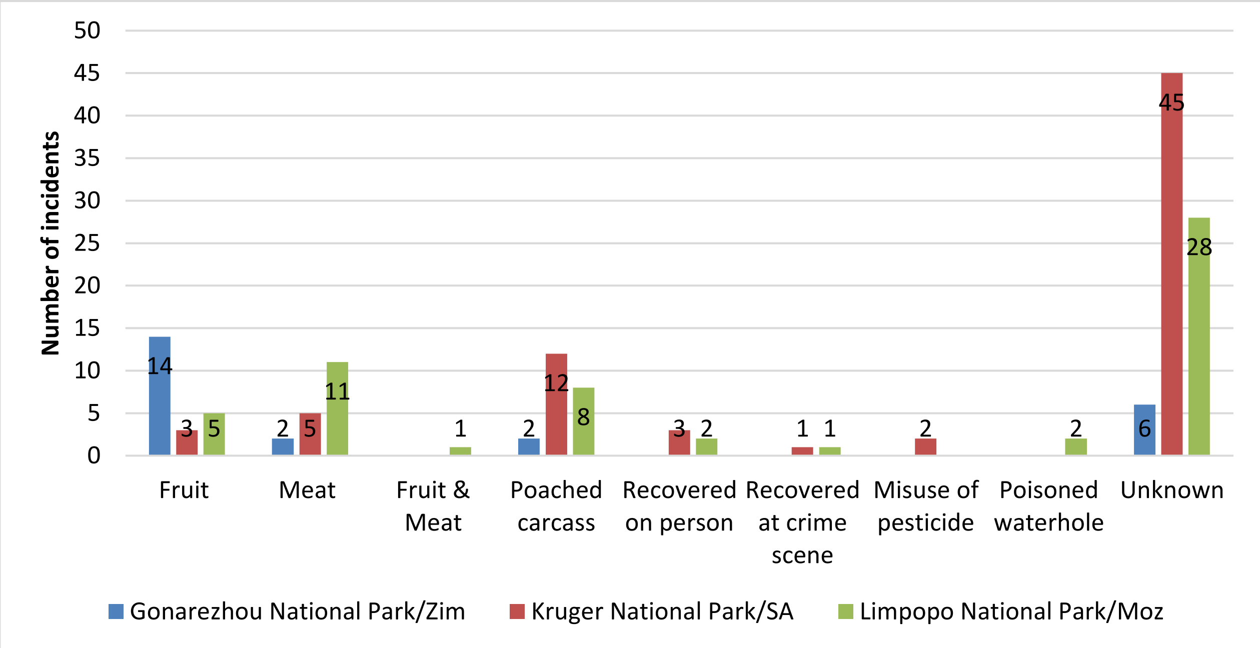


Figure 8: Methods of poison administration in the GLTFCA (January 1, 2008 to July 18, 2019)

A variety of methods are used to poison wildlife, all of which are indiscriminate and not target-specific towards a species. Baited carcasses are worldwide the most common means of killing scavengers and predators (Ogada, 2014). Data from this study confirms this trend: offenders sprinkle an opened carcass or pieces of meat when targeting predators. In instances where retaliatory poisoning was taking place, people would either cut meat pieces from the livestock (usually heads of cattle) that had been killed by predators or lace the carcass with their choice of poison. Bushmeat or game meat, including buffalo and nyala carcasses, were also used to attract carnivores.

In cases of human-elephant conflict and elephant poisoning for the purposes of ivory trafficking, oranges, marula and monkey fruit were used. Elephants are known to have a preference for sweet tasting fruit. Rhinos are likewise attracted to sweet fruits. Kruger rangers reported two attempted rhino poisonings where mangos were laced with poison and used as bait. Both attempts were unsuccessful. These rhino poaching attempts were likely made by amateur rhino poachers who had no access to hunting rifles and tried their luck with mangos but failed (Interviews with rangers, 2017, 2019).

In the private concessions south of GNP, two waterholes were poisoned in two separate incidents in May 2015. One of the waterholes had dried up when the poison was found. No wildlife mortalities were identified. Fifty unidentified birds died in the other poisoning incident.

Salt licks, grains, mielies, sugar cane and termites are other vehicles for poison transmission.

4.6 DRIVERS OF WILDLIFE POISONING IN THE GLTFCA

While findings from data collection outside the Park suggest a range of drivers of wildlife poisoning (compare with Figure 9), there is a clear intention to kill wild animals once someone enters the Park with poison(s). According to park officials (Interviews, 2018), poison is another method in a poacher's toolbox with a devastating impact on wildlife. One official in GNP related how the poisoning of one elephant was more serious than forty elephants getting shot dead by poachers.

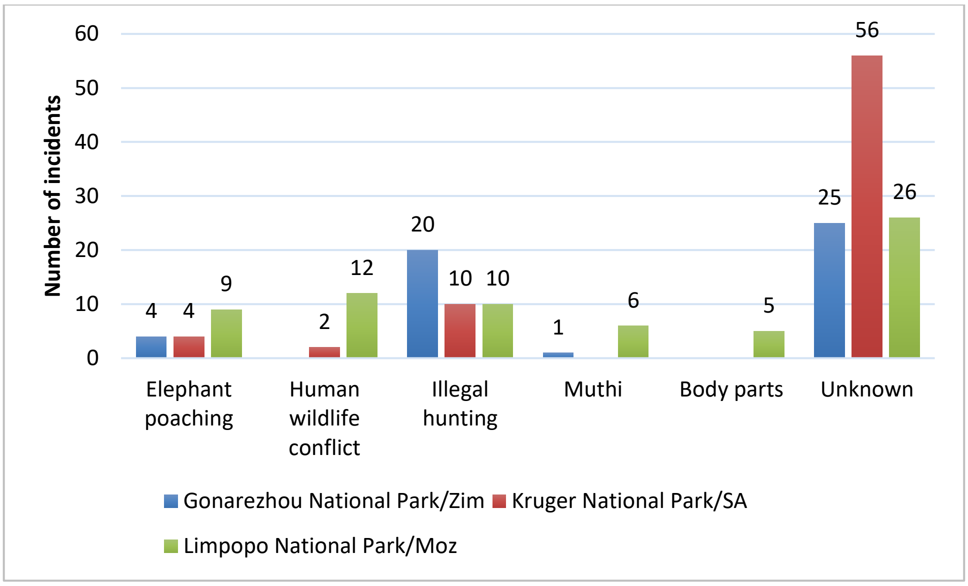


Figure 9: Drivers of wildlife poisoning in the GLTFCA (January 1, 2008 to July 18, 2019)

Data collected for this study suggests that many poisoning events (40) were linked to illegal hunting operations, and another 17 incidents involved the illegal hunting of elephants. In some instances, the elephants were first shot dead and then the tusks were removed. Poachers would then cut open the carcass (es) and lace it/them with poison. In several instances, the secondary driver linked to elephant poisoning events was the harvesting of vulture heads and beaks for traditional medicine markets (compare with earlier section on vulture poisonings).

Human-wildlife conflict followed by retaliatory poisoning events was particularly pronounced in the Mozambican part of the GLTFCA (compare with the earlier section on predator poisoning and the case study on human-wildlife conflict in Cubo). Predators are perceived as dangerous and harmful to rural dwellers. Leopards, cheetahs, hyenas and lions pose grave danger to peoples' lives and livestock. Elephants, birds and monkeys are known for crop-raiding which can have catastrophic impacts on rural farmers' livelihoods. Human-wildlife conflict is happening across many parts of the GLTFCA including the buffer-zones and the LNP where local people and their livestock live inside the boundaries of the park.

In the aftermath of five lion poisoning events involving fourteen lions in Mozambique, lion faces, and paws were cut off from the carcasses. In one incident, lion bones were also removed. Although these five lion poisonings bore the hallmarks of human-wildlife conflict (resident communities had lost livestock to carnivore predation), the removal of body parts and bones suggests that the poison offenders had a connection to illegal wildlife traders (Interviews with conservation officials in LNP, 2017, 2018).

Without arresting the poison offender and probing their reasons for offending, it is difficult to classify or attribute drivers of poisoning behavior to specific poisoning events. Figure 9 shows a high number of "unknown" drivers for poisoning events, which, if they had been identified, may have been captured in the other drivers. However, first responders and record keepers may have erred on the side of caution by not choosing to attribute drivers to specific poisoning events. In a few cases, the primary and secondary drivers were captured and both were included in Figure 9.

4.7 SIX TYPES OF POISONS USED IN WILDLIFE POISONING INCIDENTS IN THE GLTFCA

Aldicarb or formulations containing aldicarb as active ingredient were mentioned as the main culprit by most research participants during the interview process. Often known by one of its former trade names in South Africa *Temik* or the colloquial "Two step", the use of the highly hazardous pesticide is widespread amongst farming communities in the region. The name "two step" is derived from its putative toxicity and the remaining life-span one has after ingesting it: Step 1: ingest *Temik,* Step 2: death. Recorded poisoning data confirmed aldicarb as being associated with the greatest number of wildlife deaths in the GLTFCA during the project period. In 20 cases, aldicarb was the confirmed cause of death or pesticide found in laced baits. In a further 19 cases, park officials and/or experts suspected aldicarb but were not able to take samples and get toxicology tests done.

Officials at KNP have consistently tried to test samples of poisoned carcasses. The existence of local laboratory facilities to undertake toxicology screening at the Agricultural Research Council-Onderstepoort Veterinary Research (ARC-OVR) and several other laboratory facilities in South Africa has assisted. However, testing of samples is expensive – ranging from R 500 to R 2 000 for testing one sample[13] – and correct procedures of sample transmission have to be followed. There is limited capacity to do toxicology screens in Mozambique and Zimbabwe (see case study on GNP), resulting in identification being inconclusive or guesswork (compare with Figure 10). Another explanation for the great number of "unknown" types of poison in the recorded data is that the poison may have broken down or degraded by the time the first responders discovered the site. "Unknown" types of poison include poisons that could not be identified through toxicology tests and incidents where no toxicology screen was undertaken. In the latter scenario, conservation officials would identify poisoning as the cause of death because of circumstantial evidence including secondary poisoning of wildlife and poisons found near the site (Interviews with conservation officials, 2017, 2018, 2019). In some instances, offenders may have employed natural poisons. Attempts were made to glean information on the employment of natural and traditional poisons. Two conservation officials (Interviews, 2018) shared that suspected poachers were found carrying powders, grounded leaves and other organic materials. Traditional healers often provide *muthi* to poachers with the objective of protecting them against detection and wild animals. As mentioned in the section on poison administration, it may not always be clear to the untrained eye what was used as the vehicle for poison transmission.

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[13] Compare with the diagnostic pricelist at ARC-OVR: http://www.arc.agric.za/arc-ovi/Documents/Pricelists/Diagnostic%20pricelist%20BOOKLET.pdf (accessed 2 September 2019)

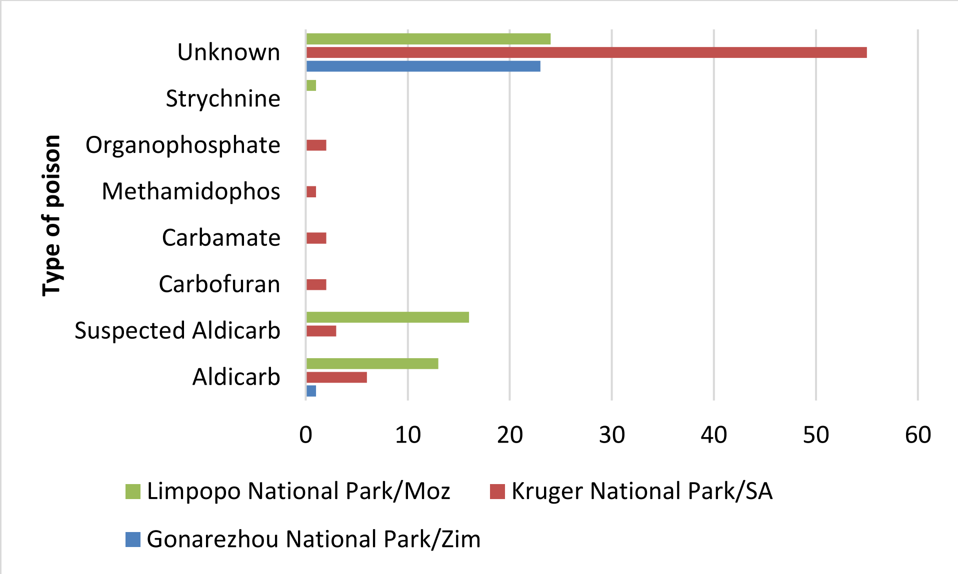

Figure 10: Types of poison used in the GLTFCA (January 1, 2008 to July 18, 2019)

Carbofuran is regarded as the most abused pesticide on the African continent (compare with Ogada, 2014). Our data appears to disprove this trend for our study area: Carbofuran was used to poison wildlife in the GLTFCA on two occasions.

Photo 1: Confiscated poison, GNP.

Based on what is known from the region, we also expected to find some use of cyanide and other mining chemicals. However, our data was not conclusive on this front. What stood out was that other than strychnine (used in one incident south of the GNP), poison offenders used highly hazardous pesticides in all the cases where toxicology screens were performed.

Beyond the use of pesticides, offenders have also been using brake fluid, tobacco and snuff to poison wildlife (Ogada, 2014). Antifreeze, a liquid to cool down car engines has also been used in several incidents (pers. Communication with Danny Govender, 2018) but no cases were found in the GLTFCA.

4. 8 THE POISONING SUPPLY CHAIN

The main source of wildlife poisons appears to derive from legal or formerly legal pesticides that are used in farming, mining or standard rodent control in southern Africa (see Appendix 3 for a list of the most abused pesticides in Africa). Our research data suggests that aldicarb poses the greatest danger to wildlife and people in the GLTFCA. Pesticides are easy to source and comparatively cheap. Asian variants of aldicarb are widely available in Mozambique, South Africa and Zimbabwe. The United States, Canada and the European Union have banned or severely restricted the use of many highly hazardous pesticides. The South African Department of Agriculture banned the possession, use and trade of aldicarb in 2016. There was a buy-back scheme with limited success in South Africa (Interview with poison expert, 2019).

Photos 2 & 3: Rat poison in Chicualacuala, Mozambique and straws of aldicarb sold at the old bus rank in Chiredzi, Zimbabwe.

According to key informant interviews in Mozambique and Zimbabwe, aldicarb is stored and accessible in storage facilities on many commercial farms in South Africa. Seasonal workers were said to have access to these stores during harvesting season, from where the pesticide is said to be pilfered and sold to elephant poachers (Interviews with community members and law enforcement officials, 2018). The rural town of Groblersdal and surrounding farmland in the Limpopo Province were fingered as hotspots for illegal aldicarb supply. However, interviews with law enforcement officials and field observations paint a more nuanced picture of the aldicarb supply chain. The researcher was able to buy pesticide samples of what appeared to be aldicarb in all three countries. The poison samples cost very little: 3 grams packaged in straws cost 1 USD at the old bus rank in Chiredzi in Zimbabwe. We asked for a powerful rat poison and no safety warnings were given. However, when the researcher bought another poison sample (a white pill), she was told to be careful as this pill was "so strong it is enough to kill an elephant" (Interview with trader, 2018).[14] We bought a Chinese rat poison at the bazaar in Chicualacuala for 200 Meticais (about 4 USD).[15] What traders described as *temik* was trading for 100 Meticais (about 1 USD). In this instance, the trader gave strict instructions asking us to use gloves and not to touch the poison under any circumstances. We were also asked to handle the poisoned rats carefully and dispose of them as they could kill domestic dogs or chickens if ingested (Interview data, 2018).

While undertaking fieldwork in local communities living adjacent to the northern sections of KNP, research participants mentioned that highly toxic rat poisons were sold in informal street markets and transport hubs (taxi ranks) in most rural villages and towns. Several headmen and one chief expressed their concern about the easy access to the highly toxic poisons and offered to show the researcher several spots where the poisons were traded. Kruger rangers (Interviews, 2017, 2019) likewise mentioned that aldicarb was sold at various taxi and bus ranks in rural settlements adjacent to the KNP. Hübschle was shown several stalls in a small town less than 20 kms from one of the Kruger gates. At least four traders were selling small plastic bags of black granules (ostensibly aldicarb) for R 18/gram. One trader said that he could obtain 50 kg for R 50,000. He would have to contact his boss who had a warehouse nearby.

Knowing that the use and trade of aldicarb is illegal in South Africa, we visited a local police station and asked police officers in the charge office whether they knew about the sale of banned pesticides in town. Although gravely concerned, the police officers had no knowledge that the pesticide was sold illegally a few streets away from the police station and were unsure how to deal with the matter. One officer proposed a joint operation with KNP. The prospects for joint operations are limited as Kruger officials have no jurisdiction outside the Park. However, the creation of a multi-disciplinary task team may be a useful poison intervention. When Hübschle followed up a couple of months later, crime intelligence officers were busying investigating the source of the poison and had identified a warehouse in a nearby town.

According to law enforcement sources (Interviews, 2017 and 2019), the cross-border trafficking of pesticides and agricultural fertilizers is a major issue of concern in southern Africa. As mentioned in the literature review, Africa has been at the receiving end of highly hazardous pesticide dumping. These pesticides would have been banned in their regions of origin – the European Union and North America – and are off-loaded in African countries at reduced prices. Due to the relative state of policing inertia in border areas, banned and counterfeit pesticides are smuggled across the subregion's borders. We found evidence that criminal networks were smuggling aldicarb and aldicarb derivatives into South Africa from Mozambique and Zimbabwe (Interviews with pesticide experts and conservation officials, Mozambique, South Africa, Zimbabwe, 2017, 2018, 2019). The ubiquitous availability of the highly

[14] The pesticide samples were handed over to park officials. Due to limited laboratory capabilities, the samples were not tested.

[15] This price was likely inflated as we were foreign nationals.

hazardous pesticide in all three countries suggests that there is well-established transnational supply chain.

4.9 COMMUNITY PERCEPTIONS AND POISON IMPACTS

The ubiquitous availability of highly toxic pesticides in villages, towns and peri-urban neighborhoods in the GLTFCA has affected local people, their livestock and ecosystems. This section provides a short overview of key findings from interviews and observations.

4.9.1 COMMUNITIES LIVING NEAR GONAREZHOU NATIONAL PARK

Local communities interviewed close to GNP were well informed of the dangers of poisons as a result of various village communities having experienced health impacts (diarrhea) after eating poisoned meat of guineafowls and fish, loss of livestock, sickly or thin livestock and one confirmed human death – all believed to be linked to exposure to poisons (compare with Table 6). The main narrative suggests that Mozambican nationals cross into Zimbabwe with the objective of poaching elephants with poison. Many community members acknowledge that poison is a silent killer. It was suggested that poachers use poison instead of guns when they do not belong to criminal networks (lack of access to a gun) or when they do not want to alert anti-poaching units and rangers on patrol. Community members remembered a number of poisoning incidents that happened in a no-go area – the Magunda area – where landmines had been placed during the civil war. Community members suggested that poisoned elephant carcasses were rotting in the mine fields. During the rainy season, tributaries carry run-off from poisoned elephant carcasses to bigger rivers. The rain thus flushed poisons from carcasses in Magunda to rivers feeding into Malipati Pools. Locals reported a massive fish die-off disaster in the Malipati Pools in 2010 triggered by poisoning upstream. A local NGO, Sapphire, issued a report on the mass fish die-off.[16]

Although there was a lot of finger pointing at foreign nationals – Mozambicans as poison poachers and South Africans as poison suppliers – community members mentioned numerous examples where pesticides were employed deliberately as a response to damage-causing animals. For example, three crocodiles were poisoned after they attacked livestock. Locals have also laced oranges with “two step” ahead of planting season to stop elephants from crop-raiding.

Particularly concerning is the use of toxic poisons as a method of hunting for bushmeat and fish. There is a long history of hunting with natural poisons in the three GLTFCA countries (compare with the literature review). Natural poisons are known to paralyze or disorient an animal for a short time and disintegrate thereafter. Local hunters say that meat hunted with natural poisons is safe for human consumption (Interviews in local communities, 2018, 2019). However, the consumption of meat hunted with toxic poisons can lead to lethal consequences. One paramount chief in Zimbabwe issued a ban against people selling fish at the local business center close to the border crossing with South Africa. This happened after Zimbabwean migrant workers who work on farms in the Limpopo Province in South Africa brought back agricultural pesticides for hunting and harvesting wild animals and fish. These pesticides were used to poison pools in the Limpopo River during the dry season and

[16] Attempts made to secure a copy of the report were unsuccessful.

the resultant dead fish were sold to local community members. The buyers suffered from stomach aches and diarrhea. The chief also reported how people from a neighboring region tried to sell poisoned guineafowls to locals. The traders claimed that they had caught hundreds of guineafowls in traps, but the dead birds' carcasses had turned into a dark red color, which is apparently indicative of poison use (Interview, 2018). The chief had received a message that the birds had been caught using dangerous chemicals, so he did not allow the traders to sell the guineafowls. In several unrelated incidents, dogs ate poisoned game meat and died.

Table 6: Poisoning incidents in and around Gonarezhou National Park

Incident	Impact
Fruit poisoned to deter elephant crop raiding	Seen in a positive light as elephants stopped crop raiding during this season
Elephants poisoned near human settlements in Magunde area	Run-off from poisoned carcasses caused mass fish die-off in Malipati Pools
Crocodiles poisoned in Masukwe Dam after livestock attacks	Water quality
Rangers ate poisoned game meat	Both rangers deceased
Agricultural pesticides used to catch fish in Limpopo River pools during dry season	Community members suffered from diarrhea and abdominal pain (confirmed by Paramount Chief Sengwe)
Unknown chemicals used to catch guineafowls and sell to local people	None as Paramount Chief Sengwe banned the traders from selling the guineafowls
Aspirant elephant poacher dies from pesticide exposure	Death (confirmed by the Paramount Chief Sengwe and local police report)
Community members eat poisoned game meat	Diarrhea and abdominal pain
Domestic dogs eat poisoned game meat	Several deaths reported

The first human fatality linked to suspected aldicarb exposure was reported in the Sengwe Corridor. A local community member who had been working on a farm in South Africa brought back a powdery substance containing black-bluish granules. He was planning to hunt elephants in the KNP. He got waylaid en route to the Park and drank locally brewed maize beer called "djemane". The poison was in his pockets which he appears to have handled before drinking and eating. He died of exposure. The police were called in and buried the man where he had died as his body was decomposing "quickly" (Interview with traditional leader, 2018). Park officials obtained police confirmation of the death by pesticide exposure:

"[Name of person] *aged 42 years from* [name of village], [name of headman], *Chief Sengwe died after exposing himself to a substance suspected to be poison in container labelled "Methomex 900SP Adame Insecticide" It was recorded that the deceased's intention was to poison elephants. Following* *all procedures been complied the deceased was buried at Madzanda area at the scene where he had died in fear of post exposure."*[17]

4.9.2 COMMUNITIES LIVING IN OR NEAR LIMPOPO NATIONAL PARK

The earlier observation of community-park relations worsening in and around the LNP was instructive throughout the research process. Community members had closed down access roads within the park leading to several villages including Machamba, Mavodze and Chimangue. Park officials believe this may be linked to anti-poaching activities by a private anti-poaching group. Dyck's Advisory Group has been operating in the Park since 2017. Research participants questioned their methods and pointed to unintended consequences affecting community-park relations. Interviews undertaken by the field assistant happened in the context of ongoing strikes against the Park and road blockages. The strikes were triggered in part by the impending resettlement of several communities that reside in the LNP and the high rate of human-wildlife conflict and resultant livestock losses. Unlike fieldwork undertaken by Hübschle in Zimbabwe, the field assistant could not find conclusive evidence of community members knowing of wildlife poisoning or being affected by it (Table 7). However, each interview ultimately led to cases of human-wildlife conflict being shared with the field assistant. Negative sentiments against the Park and its management were expressed by research participants. The field assistant was asked to confirm the deaths of two suspected poachers due to poison exposure in Ndala. Park officials had heard about the mysterious deaths through the bush grapevine. Unfortunately, he was unable to obtain verification or more information. However, research participants knew of three incidents where neighbors had suffered from diarrhea and abdominal pain after consuming game meat. Interview participants also remembered that several domestic dogs died after ingesting poisoned game meat. The poisoning records provided by the LNP likewise documented the lethal poisoning of three domestic dogs.

Table 7: Poisoning incidents in and around Limpopo National Park

Incident	Impact
Domestic dogs ingest poisoned game meat	Death (three poisoning events in the LNP involved the deaths of three domestic dogs)
Community members eat poisoned game meat	Diarrheaand abdominal pain
Two suspected poachers are exposed to highly toxic pesticides	Death of two men (anecdotal data)

[17] In line with the anonymity requirements of this research project, personal details were removed from the police report.

4.9.3 COMMUNITIES LIVING NEAR KRUGER NATIONAL PARK

The researcher visited several communities living near the northern sections of the KNP. The northern sections especially Vlakteplaas and Punda Maria were identified as wildlife poisoning hotspots. Community members frequently referred to damage-causing animals during the interviews. There were many concerns about the fairness and equity of compensation schemes. Crocodile poisonings were mentioned during the Hlanganani Community-Park Forum. This incident happened near Ha-Matsika Village on the riverbanks of the Luvuvhu River. Cattle farmers mentioned that their cattle had been affected by a mysterious disease, which led to them shedding weight and looking unhealthy (Focus group, 2019). The farmers also told the researcher about a dangerous rat poison that was sold at stalls near the post office in a small town near the KNP (compare with the section on the poison supply chain). The farmers said that several children might have died due to exposure to the rat poison as they passed away under very strange circumstances that could not be linked to witchcraft or known diseases. Domestic dogs and chicken had also died after ingesting "rat poison" and/or dead rats (compare with Table 8).

Table 8: Poisoning incidents near Kruger National Park

Incident	Impact
Crocodiles poisoned near Luvuhu River	Water quality (LEDET to test carcasses)
Cattle suffer from unexplained disease (thin and unhealthy)	Possibility of secondary poisoning through drinking from a poisoned water source
Aldicarb used to deal with rat problem	Several children died from unexplained mysterious diseases
Chicken and domestic dogs ingest rat poison and/or poisoned rats	Several deaths reported
Fields sprayed with highly toxic pesticides	Local people suffer from respiratory problems
Poisoned game meat sold to local people	Diarrhea and abdominal pain (confirmed by LEDET official)
Mysterious unexplained deaths on quarterly basis at local clinic (suspected poisoning)	Possibly linked to aldicarb exposure

A retired ranger shared details of a historical poisoning event in the early 2000s during which commercial farmers were spraying highly toxic pesticides on their fields. People living in close vicinity suffered from respiratory problems for several months. Another incident relates to an impala that was injected with a mysterious substance to bait a leopard. A ranger ate the meat and hallucinated for many hours afterwards. During a community meeting held by Chief Mhinga, a Limpopo Department of Economic Development, Environment and Tourism (LEDET) official mentioned that he had collected evidence that local people were buying poisoned game meat.[18] The researcher also visited two clinics during fieldwork to establish whether there had been an unexplained deaths or deaths linked to witchcraft. Two nurses said that there was at least one explained death every quarter, which had the hallmarks of poisoning.

4.10 LEGAL RESPONSES TO WILDLIFE POISONING

Several international instruments deal with aspects of wildlife poisoning in Africa: the African Convention on the Conservation of Nature and Natural Resources and the Convention on the Conservation of Migratory Species of Wild Animals (CMS). While both conventions contain important aspects that deal with wildlife poisoning, few penalties exist for non-compliance. At the time of writing, there were 128 parties to the CMS. The level of transposal of the international treaty to domestic law varies considerably amongst parties. At the time of writing the report, Mozambique and Zimbabwe had signed the African Convention on the Conservation of Nature and Natural Resources. South Africa has signed, acceded and deposited. The three GLTFCA member states are parties to the CMS.

Several other treaties exist that aim to reduce risks posed by highly toxic pesticides to human lives. These include legally binding agreements such as the Stockholm Convention on Persistent Organic Pollutants and the Rotterdam Convention of the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade. The Stockholm Convention lists several pesticides that should be eliminated from all uses or should only be used for specific purposes. Pesticides listed under the Rotterdam Convention may only imported to a country after explicit consent has been obtained from national authorities. The two conventions cover many of the pesticides that pose grave danger to humans and wildlife in Africa. Aldicarb, parathion, monocrotophos and methamidophos are listed on the Rotterdam Convention while carbofuran is recommended for inclusion (Richards et al., 2018). Mozambique, South Africa and Zimbabwe have made some progress with regards to the regulation of the above-mentioned pesticides: Mozambique has decided against importing all of the above-mentioned highly hazardous pesticides, Zimbabwe has not taken a decision yet while South Africa has only taken a partial decision (aldicarb has been banned).

The United Nations Food and Agricultural Organization (FAO) and the World Health Organization (WHO) have issued an International Code of Conduct on Pesticide Management, which provides guidelines on how to handle highly hazardous pesticides. This approach is supported by the Strategic Approach to International Chemicals Management, an initiative aimed a re-evaluating the registration status of highly hazardous pesticides (HHPs) in various countries. This may lead national regulators to impose further restrictions and bans on commonly used pesticides in the poisoning of wildlife. Due to porous borders and human and financial resource constraints in southern Africa, national pesticide regulators in southern Africa have collectively put a request to the FAO for technical and financial support for regional strategies to address HHPs in 2016. So far little progress has been made as funding still needs to be secured (pers. communication with Ivy Saunyama, FAO, 2019).

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[18] The researcher attempted to obtain further information from the official but was told that she had to apply for a research permit with LEDET to speak to him.

Beyond international treaties, Mozambique, South Africa and Zimbabwe have a bouquet of national laws, directives, regulations and guidelines that deal with aspects of wildlife poisoning and HHPs.

In **Mozambique**, the 5/2017 Biodiversity Law addresses wildlife poisoning. However, a person in possession of banned pesticide can only be penalized if the state can prove that it was used to perpetrate a crime (pers. communication with Carlos Lopes Pereira, 2019). The government also issued a list of banned pesticides on June 15, 2014.

Highly hazardous pesticides are regulated under The Fertilizers, Farm Feeds, Agricultural Remedies and Stock Remedies Act 36 of 1947 and its supporting regulations in **South Africa**. Although an old piece of legislation, it does regulate the legal manufacture, registration, trade and use of pesticides effectively. It however fails to deter unlawful possession and use of pesticides and the penalties are considered inadequate (Govender, 2016). Regulation No. 1716 prohibits the use of any agricultural remedy for any other purpose or for any other manner than that stated on the label. Effectively this means that using highly hazardous pesticides such as carbofuran and aldicarb to poison wildlife is a contravention of the Act (personal communication with Gerhard Verdoorn, 2019). The Minister of Agriculture, Forestry and Fisheries issued a prohibition notice in 2016, banning the import, export, possession, acquisition, sale, use and disposal of a range of agricultural remedies that contain active ingredients such as aldicarb.

The Hazardous Substances Act of 1973 (Act 15 of 1973) sets out requirements on the prohibition and control of the importation, manufacture, sale, use, operation, application, modification, disposal or dumping of hazardous substances. Hazardous substances are classified into four groups. Anyone who intends to sell or distribute Group I hazardous substances must apply for a license from the health authority first. Industrial chemicals and pesticides fall under Group I. The regulations listing prohibited active ingredients are out of date and the penalties are low. The Act was gazetted for revision (Govender, 2016).

The National Environment Biodiversity Conservation Act of 2004 (Act No. 10 of 2004) and The Threatened or Protected Species (TOPS) Regulations stipulate that the use of poison is an illegal hunting method. The poisoning of wildlife is thus prohibited unless a permit has been issued by the relevant provincial conservation authority. Govender's (2016) management brief provides useful analysis of shortcomings of the South African legislation.

In **Zimbabwe**, several pieces of legislation can be used in cases of deliberate poisoning of wildlife. The Fertilizers, Farm Feeds and Remedies Act stipulates that pesticides may only be sold in official packaging with relevant labelling. The Statutory Instrument 144 of 2012 stipulates that all pesticide retailers and distributors must be registered, import and export of pesticides requires a valid permit and the correct labelling of all pesticides. The Hazardous Substances and Articles Act (Act 22 of 2001), the Environmental Management Act (Act 13 of 2002) and the Trapping of Animals Control Act (Chapter 20:21) provide further restrictions on the use of poisons, poisoned bait and pollution of water and the environment through pesticides.

It is beyond remit of this report to undertake a legal analysis of the law on the books, strengths and shortcomings. However, few perpetrators are arrested and if so, they are often released with no penalty or a slap on the wrist in all three jurisdictions. Ignorance of the law presents one of the key challenges. Weak and inconsistent enforcement presents another hurdle. The final section will provide recommendations on how to streamline national laws by bringing in a regional perspective.

SECTION 5: CONCLUSIONS AND RECOMMENDATIONS

5.1 GENERAL CONCLUSIONS

The data presented in this report depicts poison incidents shared with the researcher and should not be interpreted as "official" statistics. They present a snapshot of recorded data by conservation officials, individuals and private entities. Communication between conservation groups in the private and public realm could be improved as limited sharing of information and data appears to happen (Interviews, 2018, 2019). While there were problems with data collection and validity, it also needs to be noted that records of poison events are invariably incomplete. The events occurred in remote and far-flung areas. In some instances, poisoned carcasses may have decomposed for weeks or months before they were found, and scavengers may have gotten to them first. Once only bones and skin are left, the cause of death may no longer be obvious to first responders. In some cases, the carcasses of poisoned wildlife are removed from the crime scene and disposed of elsewhere or sold to traders in traditional medicine markets or illegal wildlife markets. In general terms, it is believed that conservation authorities, private reserves and NGOs find few carcasses (Lalah and Otieno, 2012b). In short, the data depicted here is likely to reflect the tip of the proverbial iceberg.

Moreover, there is no formal reporting system or central database for suspected and actual poisoning incidents in the GLTFCA. The Peace Parks Foundation is in the process of developing an application for smartphones to start integrating and aligning the reporting of poisoning incidents in the three Parks. The idea is that the data gathered would feed into the three respective park management systems and a central database. Plans are thus underway to introduce a central database.

While limited comparable or historic data could be found dating back to earlier than the late 1980s in South Africa, the magnitude and frequency of poisoning events in the GLTFCA should be cause for grave concern to regional and national authorities, conservation officials as well as the private sector in Mozambique, South Africa and Zimbabwe. Although the annual incident data does not compare with rhino and elephant poaching incidents in Kruger, the impact of poisoning incidents is not only detrimental to targeted wildlife but also to non-target species, vegetation and water bodies near poisoning sites and, thus, potentially more challenging to contain than poaching in the long-term. Furthermore, the impact on humans, their livestock and agricultural crops is very worrisome.

Banning or withdrawing highly hazardous pesticides such as aldicarb will only work as a stopgap. The ubiquitous availability of aldicarb in all three countries suggests that the South African ban and buy-back scheme has only partially worked. Interviews with poison experts who have dealt with wildlife poisoning in other parts of Africa and elsewhere in the world suggest that the banning of pesticides has to be accompanied not only by buy-back schemes and cooperation from the producers, suppliers and traders but also by extensive awareness raising campaigns. While awareness campaigns need to be informative, there is a need to provide alternative pesticides or pest control measures that are environmentally friendly, cheap and easy to procure.

Poisoning has thus emerged as another tool in the poacher's toolbox with devastating consequences for non-target species, ecosystems and people. Human-wildlife conflict persists in all three jurisdictions. Community members commented on the dangers of living near the park and their losses due to predation and crop-raiding, and the imminent danger to themselves and their families when living near dangerous wildlife. The issue of compensation was a bone of contention with government authorities and private game reserves frequently failing to pay compensation or the rules not being explained.

The notion that wildlife is valued more highly than rural people was a common theme in interviews with local communities in the three countries (compare with recent research by Hübschle and Shearing, 2018). A recent study on community perceptions in the GLTFCA (Ntuli et al., 2019) found that local community members in South Africa and Zimbabwe were positively inclined towards the GLTFCA and respected the rules governing the park when they received benefits. The opposite was also true: People that held negative perceptions about the rules of the conservation area tended to have negative perceptions of conservation. They were also more likely to perceive environmental crime as morally acceptable. While the study by Ntuli and colleagues did not include Mozambicans in the sample, we found community-park relations to be at a low point with resident villagers inside the LNP blockading roads and chasing away tourists, researchers and park staff. Interviews indicated disdain for the park, especially for a new anti-poaching initiative.

5.2 ECOLOGICAL IMPACTS

The primary targets of wildlife poisoning in our limited dataset were elephants and lions. Vultures were the worst affected non-target species of wildlife poisoning. While this research has found there was demand for wildlife body parts, including the upper beaks and heads of vultures, most vultures and birds of prey are unintentional victims of poisoning with dire impacts for already endangered vulture populations. Vultures provide important and often under-acknowledged ecosystem services including the removal of rotting carcasses. According to Ogada (2012), the potential consequences of vulture decline are changes in the composition of scavenger communities and increased rates of disease transmissions at carcasses. In the absence of vultures, mammalian scavengers spend more time at carcasses and there is more contact between such species, especially hyenas and jackals. This may increase the risk of pathogen and disease transmission between individuals. Jackals and hyenas are known hosts for carnivore diseases such as rabies and canine distemper.

In interviews with conservation officials, there was widespread concern that vultures and vulture parts were entering local medicine (*muthi*) markets. In fact, seven poison records supplied by park authorities and private entities linked the removal of vulture beaks and heads to *muthi* markets without following the body parts or interviewing the suspected poison poachers. It is important to note that traditional medicine and healers play a significant public health function in the rural and peri-urban areas of southern Africa. The sector per se should not be condemned, denounced or criminalized. Most rural people in southern Africa rely on traditional medicine and believe in its efficacy (Whiting et al., 2013). They buy traditional medicine and consult traditional healers at regular intervals. There is little opportunity to consult with university-trained doctors while traditional healers are far more accessible and affordable to rural people.

The datasets considered in this study found little evidence as regards the impacts of wildlife poisoning on the broader ecosystem, including water bodies and vegetation. One data entry recorded the dead vegetation around a poisoned elephant (see Photo 4). None of the records mentioned insects while small animals were cited in a few incident records only. A study from Kenya (compare with Martins, 2012) warns that non-targeted pesticide applications may have impacts on insects that provide important ecosystem services such as pollination and natural pest control. They are also an important food source for birds.

Photo 4: Dead vegetation around a poisoned elephant carcass and 18 dead vultures in Vlakteplaas section, 20 March 2019. Source: Kruger Ranger Services.

5.3 RECOMMENDATIONS

The recommendations have been sub-divided into two groups. The first group of recommendations deals with data collection and reporting. Regulatory and policy issues are considered in the second set of recommendations.

5.3.1 RECOMMENDATIONS PERTAINING TO DATA COLLECTION AND REPORTING

ACKNOWLEDGMENT BY OFFICIALS THAT WILDLIFE POISONING CONSTITUTES AN ENVIRONMENTAL CRIME

Park, law enforcement and conservation officials in all three parks need to acknowledge that wildlife poisoning constitutes a serious environmental crime. Any incidents need to be treated as such. Proper crime scene management, a forensic investigation, collection of evidence and samples, chain of custody and a judicial process should follow.

ESTABLISH NATIONAL AND REGIONAL GUIDELINES ON HOW TO RESPOND TO ANIMAL, ECOSYSTEMS, HUMAN AND WILDLIFE POISONINGS

There are no clear guidelines on what procedures to follow in cases involving domestic animal, ecosystems, human and wildlife poisoning events. Such guidelines should address issues of information management, necessary actions to take (including first aid and the administration of antidotes or treatments) and legal action. Chap Masterson's *Practical case management for malicious wildlife poisoning in Zimbabwe* and Kenya's *Response Protocol to wildlife poisoning incidents in Kenya* may provide useful blueprints. It is recommended that the GLTFCA develop a set of SOPs that are integrated into basic training of all personnel. Beyond crime scene management, important elements should include procedures that allow for chain of custody to enable prosecution, the collection, storage and transportation of samples for analysis and the decontamination of the poisoning site to prevent further poisoning.

ESTABLISH A REGIONAL CLOUD-BASED DATABASE FOR THE REPORTING OF POISONING INCIDENTS

It is recommended that a regional shared cloud-based shared database is developed or capacitated for the reporting of poisoning events. PPF is in the process of developing an application for smartphones to start integrating and aligning the reporting of poisoning incidents in the three Parks. Poisoning data would feed into the three respective park management systems and a central database. As shown in this report, humans and their livestock have also been impacted by wildlife poisoning. It would be useful to document and record cases of human and broader ecosystem impacts to use as a lobbying tool with entities that produce, trade or dump highly hazardous pesticides in the region.

The African Wildlife Poisoning Database (AWPD) may provide a useful template or the vehicle for a broader public-private cloud-based shared database. The Vulture Specialist Group of the IUCN Species Survival Commission, EWT, the Peregrine Fund and the Gadfly Project established the database in 2017. It is currently housed by EWT. The database allows registered members of the public, conservationists and wildlife veterinarians to upload information into the database through a mobile app or via the website. There may be some proprietary challenges to house a regional database with an NGO, but it is suggested that the wildlife poisoning task force consult with the wildlife poisoning experts behind the AWPD. There are important lessons to be learnt in terms of access, verification and security. Data collection across the three parks should be standardized and improved. There needs to be agreement as to which data to collect and how.

TAKING SAMPLES FOR TESTING

Given the rapid rate of decomposition and predation in our region, it is rare for trained first responders to find carcasses before they are decomposed and eaten by scavengers. Freezers for storing tissue and gut samples are not often available in the bush. Moreover, there is limited laboratory capacity in the three countries, with South Africa having the most options available. However, taking samples and sending them for toxicology screens is absolutely vital for a number of reasons. The Centre for Forensic Science Research and Education in the US has offered their expertise in analyzing samples and submitting a report to the sender. Zimbabwean conservation authorities have sent several samples in the past. The collection and shipping procedures include chain of custody. The Centre uses a simple acetone sample extraction to satisfy US importation requirements. There may be proprietary issues in sending such data to a private institution in the US. However, in the absence of viable, accessible and cheap alternatives in southern Africa, this may be the best route to take for conservation authorities in Mozambique and Zimbabwe. Ultimately it would be advisable to create local/regional capacity to deal with such cases. National authorities should provide or seek funding to establish local capacity in the long-term.

MAINTAINING A CHAIN OF CUSTODY

Maintaining a chain of custody is essential to the successful prosecution of wildlife poisoning incidents. Specimens and other evidence have to be submitted in the correct prescribed manner from the field to the laboratory. As such, samples must be documented, properly packed, labelled and transported, with attention throughout to ensuring the quality and integrity of the material and maintaining the chain of custody.

ESTABLISHMENT OF RAPID RESPONSE UNITS AND REHABILITATION CAPACITY

With the exception of a few private facilities in South Africa, the subregion has limited wildlife rehabilitation facilities and capacity. According to poison experts (Interviews, 2018, 2019), rapid response protocols may lead to higher numbers of poisoned wildlife receiving emergency treatment and surviving poisoning events. Park authorities should consider the establishment of rapid poisoning response units, treatment facilities and release protocols. Veterinary departments at universities and private sanctuaries may be able to assist with poisoning aftercare.

INTELLIGENCE GATHERING ON POISON SOURCES AND SUPPLY CHAIN AND MODUS OPERANDI OF POISON OFFENDERS

Criminal networks are involved in the distribution and trade of poisons with detrimental impacts to humans and wildlife. There has been limited intelligence gathering on the sources and supply chain of wildlife poisoning and the modus operandi of poison offenders. Intelligence gathering capacity to collect such data should be enhanced by law enforcement authorities in all three jurisdictions. While the three parks have intelligence gathering capacity, police crime intelligence units should take the lead here.

FACILITATE MULTI-DISCIPLINARY RESEARCH AND RESPONSE TEAMS

Conservation biologists and scientists rarely have the training to assess anthropological factors linked to wildlife poisoning. The composition of future research and response teams should be multi-disciplinary. Such collaborations should not only involve individuals and communities directly affected by poisoning and natural scientists that study the phenomenon but also social scientists from areas such as psychology, criminology, sociology, economics and anthropology. Conservation authorities and scientific committees should support research projects by encouraging, facilitating and fast-tracking research permissions and opening doors for data collection and sharing.

FUTURE RESEARCH AND ANALYSIS

Recorded data made available for this study did not provide exact spatial coordinates of poisoning events. Data referred to specific sections or well-known tourist sites in and adjacent to the GLTFCA. It is recommended that georeferenced poisoning event data are made available for distribution modelling and statistical analyses. Variables could include level of human activity, availability of prey for predators, vicinity to human settlements, roads and nodal points. Beyond quantitative analyses, social science research is needed on the drivers of wildlife poisoning, the poison supply chain and the role of natural and traditional poisons in wildlife poisoning events.

5.3.2 RECOMMENDATIONS PERTAINING TO REGULATORY AND POLICY ISSUES

IMPROVED REGIONAL COOPERATION, INFORMATION SHARING AND REGULATION

Data collection showed that wildlife criminals were using differences in highly hazardous pesticide regulations in national jurisdictions to smuggle and trade poisons across the region. Improved regional cooperation, information sharing, and regulation are important tools in disrupting illicit poison supply-chains. The Southern African Pesticides Regulators Forum, a technical body under SADC, would be well placed to take the lead on this. National regulators in South Africa and Zimbabwe should follow the lead by Mozambique and ban HHPs observed under the Rotterdam and Stockholm Conventions.

STEWARDSHIP OF COMPANIES AND DEVELOPMENT AGENCIES

Producers and traders of highly hazardous pesticides should accept stewardship for their product. The commonly used adage of "safe use" is questionable when banned pesticides are either dumped or irresponsibly traded in rural areas. Some development aid agencies promote the use of highly hazardous pesticides in agriculture without taking the region's climatic conditions into account or the broader impacts of misuse and abuse associated with HPPs. This should be rectified through consultation with experts, pesticide producers and development agencies.

CONSERVATION POLICIES AND COMMUNITY RELATIONS

To the local communities interviewed during the course of this baseline study, living near protected areas comes at a huge cost and the benefits are not clearly visible or feasible to most. While there are other threats to livestock and crops including diseases, drought and climate change, farmers are able to control predators and other damaging causing animals by spending between 1 to 2 USD for a small portion of poison that can kill a fully-grown elephant. A big body of literature exists on the mitigation of human-wildlife conflict and coexistence. For example, traditional livestock husbandry systems tend to prevent most depredation losses through monitored or close herding by day and enclosing livestock in thornbush bomas at night, which prevent wandering and provide protection from predators (Lalah and Otieno, 2012b). As evidenced in the findings, there were multiple incidences of recurring predation losses to local communities living in or near the GLTFCA. Where predators present a chronic problem, they are typically hunted or removed from the area.[19] Focus groups and key informant interviews with local communities also indicate that livestock losses due to predation can be detrimental to their socioeconomic well-being and survival. While it is too soon to judge whether Karingani's payment of compensation for the loss of 140 heads of cattle to livestock farmers in Cubo has put a permanent end to wildlife poisoning in the concession, it appears to have improved neighborly relations.

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[19] Although the physical removal and geographic translocation of problem animals come with its own set of problems (e.g. territoriality), hunting and killing endangered or vulnerable predator species may not be in an option in some protected areas.

Compensation payments have been fraught with issues of fairness and equity (interviews with park officials and local community members, 2018 and 2019). Clear, transparent and open communication on the amount, who can claim for what and proof of losses are key to ensuring good relationships with farmers and community members. Several studies show that beneficiation (e.g. sharing of tourism revenues) may significantly reduce the frequency and severity of reaction to livestock depredation by lions (Blackburn et al., 2016, Dickman, 2010).

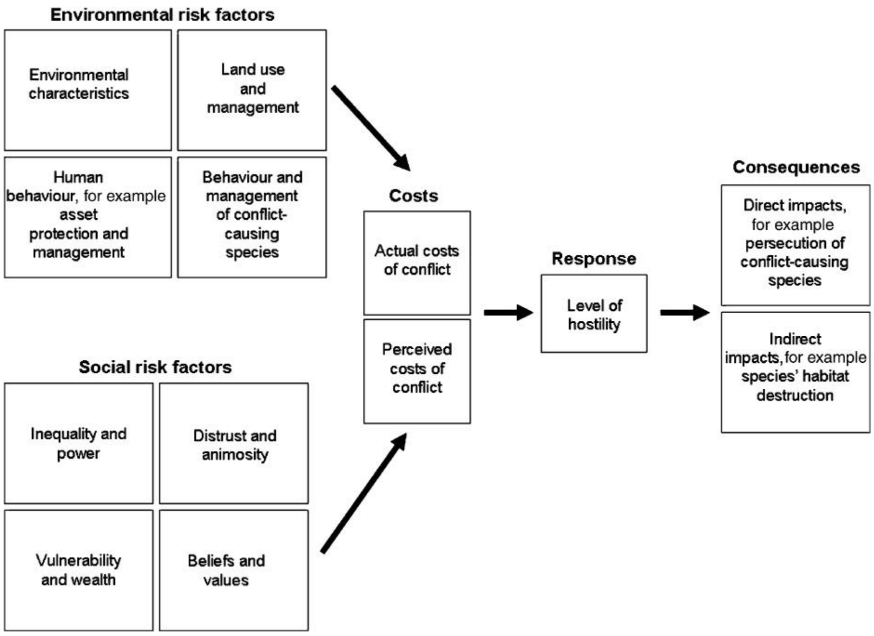

Figure 11: Conceptual framework of a possible set of factors likely to affect human-wildlife conflict (Source: Dickman, 2010).

EMPLOY ALTERNATIVE ENVIRONMENTALLY FRIENDLY PESTICIDES IN FARMING

The ubiquitous use and availability of highly hazardous pesticides for use in farming operations and agro-industry have serious implications for wildlife, people and ecosystems. While there are several examples of bans and buy-back schemes (e.g. aldicarb in South Africa), banning a commercially successful and important agrochemical can be challenging unless there are viable alternatives available (Capon, 2014). Moreover, bans have to be combined with awareness raising campaigns in farming communities. Subsidies enabling farmers to afford less destructive chemicals and educational campaigns are key. National agricultural authorities should consult agricultural, farmer and farm workers associations to study, workshop and develop plans to employ environmentally friendly pesticides in farming.

In South Africa, the Multi Stakeholder Committee on Chemicals Management has established a task team (the Chemicals Management Unit) to develop a chemicals awareness raising strategy and action plan. The South African members of the GLTFCA wildlife poisoning task team should reach out to the Chemicals Management Unit with the view to collaborate in developing awareness raising campaigns.

CREATE PUBLIC AWARENESS ABOUT THE INDISCRIMINATE AND SIGNIFICANT IMPACT THAT WILDLIFE POISONING HAS ON WILDLIFE AND HUMAN SOCIETY

People living in rural areas were largely unaware about the potentially dangerous knock-on effects of wildlife poisoning on human lives and health systems. It would be useful to include the impacts of pesticide poisoning in broader public health training and awareness programs in rural areas near or in the GLTFCA. Poison awareness campaigns should be undertaken in consultation with community leaders (compare with next recommendation).

REWARDS FOR DETECTING BANNED PESTICIDES AND POISONED BAITS

Conservation authorities and other stakeholders in the landscape may want to consider an incentive scheme for information that leads to arrest of people in illegal possession of poisons or selling of poisons. Such an initiative would have to run parallel to an educational campaign. Interviews with traditional leaders and community members indicated deep concern for the dangers associated with the ubiquitous availability of poisons in rural and urban marketplaces. Canvassing support by local communities in the fight against wildlife poisoning might be one of the most effective "lines of defense".

APPROACH NATIONAL GOVERNMENTS, DONOR AND CONSERVATION ORGANIZATIONS TO IMPLEMENT FINDINGS OF THIS REPORT

Members of the wildlife poisoning task team should approach the relevant government departments in their home country, donor and conservation organizations to implement the findings of this report. The report may also be a useful tool to solicit funding for further research and funding for implementation.

APPENDIX 1: INTERVIEW GUIDE

Background to the study: it's a baseline study to verify whether wildlife poisoning is a problem/provides dangers/impacts to local communities. There have been several big cases in Kruger, Gonarezhou and LNP. In Zimbabwe, one person lost his life while handling poison. People have fallen ill after eating guineafowls and fish that had been caught with poison. Cattle have grown thinner after drinking poisoned water. In some cases, livestock has died. So the problem of wildlife poisoning is not only about the parks and wild animals but also about local communities, people's health, livestock and water security.

Poisoning impacts at community levels

1. Have any livestock died under mysterious circumstances/died from poisoning?
2. Is the Livestock healthy? Have there been any changes after possibly ingesting/drinking poisoned water/food?
3. Have any people fallen sick after eating bushmeat/fish/birds – diarrhea, puking?
4. Have there been any unexplained deaths in the community?
5. Has any wildlife died from poisoning including fish, birds and vultures?

Reasons for poison use

1. How are the relationships between people and parks, private concession holders, etc?
2. Have there been cases of human-wildlife conflict/problem/damage causing animals?
3. Have there been cases of people/outsiders using poison for hunting, *muthi* or wildlife supply chains?
4. Why do people use poison rather than traditional/conventional methods of killing animals?
5. Is anything known about people who use poison? Who are they? Where do they come from?

Poison

1. What type of poison?
2. Where is from? How do you buy or swap it?
3. Who sells it? For how much?
4. Is it legal/legitimate/illegal? Is it easy to get by?
5. Since when has this poison been used?

Responses to poisoning

1. Are there any traditional methods to deal with problem/damage causing animals?
2. What are the traditions around poison use?
3. What poisons are used to deal with rats and other vermin?
4. Is poison use a problem for the community? Do they want some action/responses/awareness?

OVERALL RESEACH QUESTIONS FOR THE RESEARCH

1. What is the status of wildlife poisoning in the GLTFCA?

    a. Details of events (general trends, commonalities and differences)
    b. Species targeted and secondary poisonings
    c. The geographic location of wildlife poisoning events
    d. The frequency of events

2. Offenders, drivers and motivations

    a. Profile of the offenders (geography, age)
    b. Role in the supply chain (opportunistic or linked to organised crime)
    c. Modus operandi
    d. Drivers and root causes of wildlife poisoning
    e. Offender motivation
    f. Socio-economic benefits of wildlife poisoning

3. The poison supply chain

    a. Poison used
    b. Possible source of the poison
    c. Accessibility of poison
    d. Is there a link to other supply chains (e.g. poaching, *muthi* markets, lion bone trade and wildlife trafficking)

4. Impact of poisoning on natural and social systems (including secondary and tertiary poisoning)
    a. Impact on ecosystems
    b. Impact on local communities
    c. Broader societal and governance impacts

5. What is the status of current interventions on the ground to deal with wildlife poisoning
    a. List interventions (law enforcement, conservation, supply regulation)
    b. Human resources
    c. Financial resources
    d. Thoughts on innovative disruptive methods

APPENDIX 2: SCRIPT FOR VERBAL CONSENT

Step 1: Icebreaker

Greeting and small talk in participant's home language (Researcher has basic language skills in Shangaan and Zulu)

Step 2: Introduction

My name is Annette Hübschle. I am a researcher who is doing a study for the GLTFCA on wildlife . (Further background on my upbringing and research if deemed necessary to establish rapport)

Step 3: Research objective, methods and benefits

I am doing research to gain a better understanding of wildlife, livestock, human and ecosystems poisoning in and around the Park.

I would like to have a conversation with you, asking a few questions. I am not going to ask you for your name or the name of others. I am using what you say only for this research. This means I'm not sharing your personal information with anyone else. Once I have collected information from everyone, I will write a report on wildlife poisoning in the GLTFCA. The report may contribute to a better understanding of how poisoning impacts people, livestock and wildlife. There is no direct benefit to you by participating in this research.

Step 4: Seeking verbal consent

Our talk is voluntary, and you can walk away at any stage. There will be no harm to you if you choose not to talk to me.

Do you feel at ease to talk with me? Would you like to talk in your home language?

Do you have any questions you would like to ask about me, or the research? Please feel free to interrupt at any point if you have a question.

If you don't want to answer a question or continue our conversation, I will take no offence.

Step 5: Seeking consent to use recording equipment

Do you mind if I take some notes? The notes help me to remember our conversation.

(Depending on rapport, I will request permission to record the conversation)

APPENDIX 3: LIST OF MOST ABUSED PESTICIDES IN AFRICA

CLASSIFICATION	NAME	COUNTRY
Acaricide	Amitraz	Kenya
Alkaloid	Strychnine	Botswana, Namibia, Niger, South Africa, Tanzania
Carbamate	Aldicarb	Botswana, Malawi, Namibia, South Africa, Zambia
Carbamate	Carbofuran	Botswana, Ghana, Kenya, Namibia, South Africa, Uganda
Carbamate	Carbosulfan	Kenya
Mitchondrial toxin	Cyanide	South Africa, Zimbabwe
Organochlorine	Dieldrin	South Africa
Organochlorine	Endosulfan	South Africa
Organochlorine	Lindane (Gamma BHC)	Cameroon, South Africa
Organofluorine	Compound 1080	South Africa
Organophosphate	Chlorpirifos	South Africa
Organophosphate	Diasinon	South Africa
Organophospahe	Dichlorvos	South Africa
Organophosphate	Dicrotophos	South Africa
Organophosphate	Dimethoate	South Africa
Organophosphate	Fenamiphos	South Africa
Organophosphate	Fenthion	South Africa
Organophosphate	Isazophos	South Africa
Organophosphate	Malathion	South Africa
Organophosphate	Methamidophos	South Africa
Organophosphate	Monocrotophos	South Africa
Organophosphate	Parathion	South Africa
Organophosphate	Profenofos	South Africa
Pyrethoid	Cyhalothrin	Kenya
Pyrethoid	Cypermethrin	South Africa

Source: Adapted from Ogada (2014)

REFERENCES

BASSON, P. A. 1987. Poisoning of wildlife in Southern Africa. *Journal of the South African Veterinary Association,* 58**,** 219-228.

BERNY, P. 2007. Pesticides and the intoxication of wild animals. *Journal of Veterinary Pharmacology and Therapeutics,* 30**,** 93-100.

BERNY, P., VILAGINES, L., CUGNASSE, J.-M., MASTAIN, O., CHOLLET, J.-Y., JONCOUR, G. & RAZIN, M. 2015. Vigilance poisoning: Illegal poisoning and lead intoxication are the main factors affecting avian scavenger survival in the Pyrenees (France). *Ecotoxicology and Environmental Safety,* 118**,** 71-82.

BLACKBURN, S., HOPCRAFT, J. G. C., OGUTU, J. O., MATTHIOPOULOS, J. & FRANK, L. 2016. Human–wildlife conflict, benefit sharing and the survival of lions in pastoralist community-based conservancies. *Journal of Applied Ecology,* 53**,** 1195-1205.

BOTHA, C. J., COETSER, H., LABUSCHAGNE, L. & BASSON, A. 2015. Confirmed organophosphorus and carbamate pesticide poisonings in South African wildlife (2009–2014). *2015,* 86.

BUIJ, R., NIKOLAUS, G., WHYTOCK, R., INGRAM, D. J. & OGADA, D. 2016. Trade of threatened vultures and other raptors for fetish and bushmeat in West and Central Africa. *Oryx,* 50**,** 606-616.

CAPON, S. 2014. Vulture poisoning in Southern Africa. Zimbabwe: Malilangwe Trust

Frankfurt Zoological Society.

CHAMBERS, R. 1983. *Rural development: Putting the last first,* London, Longman.

COOPER, J. E., COOPER, M. E. & BUDGEN, P. 2009. Wildlife crime scene investigation: techniques, tools and technology. *Endangered Species Research,* 9**,** 229-238.

CORBIN, J. & MORSE, J. M. 2003. The unstructured interactive interview: Issues of reciprocity and risks when dealing with sensitive topics. *Qualitative Inquiry,* 9**,** 335-354.

COUZENS, E. 2013. CITES at Forty: Never Too Late to Make Lifestyle Changes. *Review of European, Comparative & International Environmental Law,* 22**,** 311-323.

DENZIN, N. 2012. Triangulation 2.0. *Journal of Mixed Methods Research,* 6**,** 80-88.

DICKMAN, A. J. 2010. Complexities of conflict: the importance of considering social factors for effectively resolving human–wildlife conflict. *Animal conservation,* 13**,** 458-466.

ESPELAND, W. 2005. Thinking about standards in qualitative research. *In:* LAMONT, M. (ed.) *Workshop on interdisciplinary standards for systemic qualitative research.* Arlington, Virginia.

EVERATT, K. T., KOKES, R. & PEREIRA LOPEZ, C. 2019 (under review). Evidence of a further emerging threat to lion conservation: targeted poaching for body parts. *Biodiversity Conservation*.

FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS & WORLD HEALTH ORGANISATION 2016. International Code of Conduct on Pesticide Management: Guidelines on Highly Hazardous Pesticides. Rome.

FOURIE, N., BASSON, A. T., BASSON, K. M., FERREIRA, G. C. H., VAN DEN BERG, H., SMITH, J. C. S. & LABUSCHAGNE, L. 1996. Poisoning of wildlife in South Africa. *Journal of the South African Veterinary Association,* 67**,** 74-76.

GARBETT, R., MAUDE, G., HANCOCK, P., KENNY, D., READING, R. & AMAR, A. 2018. Association between hunting and elevated blood lead levels in the critically endangered African white-backed vulture Gyps africanus. *Science of The Total Environment,* 630**,** 1654-1665.

GEORGE, A. L. & BENNETT, A. 2005. *Case studies and theory: Development in the Social Sciences,* Cambridge, Massachusetts, MIT Press.

GOVENDER, D. 2016. Deliberate poisoning of wildlife. Unpublished management brief: Kruger National Park.

GROOM, R., GANDIWA, E., GANDIWA, P. & VAN DER WESTHUIZEN, H. 2013. A mass poisoning of White-backed and Lappet-faced vultures in Gonarezhou National Park. *Unspecified,* 59**,** 5-9.

GUITART, R., SACHANA, M., CALONI, F., CROUBELS, S., VANDENBROUCKE, V. & BERNY, P. 2010. Animal poisoning in Europe. Part 3: Wildlife. *The Veterinary Journal,* 183**,** 260-265.

HANSON, J. 2018. Ethics. *Encyclopedia of the Anthropocene.*

HARTMAN, A. 2013. 500 birds poisoned. *The Namibian*, 9 August 2013.

HÜBSCHLE, A. 2016. A Game of Horns: Transnational Flows of Rhino Horn. Cologne: International Max Planck Research School on the Social and Political Constitution of the Economy.

HÜBSCHLE, A. & SHEARING, C. 2018. Ending wildlife trafficking: Local communities as change agents. Geneva: Global Initiative against Transnational Organised Crime.

KEITH, J. & BRUGGERS, R. 1998. Review of hazards to raptors from pest control in Sahelian Africa. *Journal of Raptor Research,* 32**,** 151-158.

KITZINGER, J. & BARBOUR, R. 1999. Introduction: The challenge and promise of focus groups. *In:* KITZINGER, J. & BARBOUR, R. (eds.) *Developing focus group research: Politics, theory and practice.* London: SAGE Publications.

LALAH, J. O. & OTIENO, P. O. 2012a. 3.3 Background on pesticide use and environmental planning in Kenya. *In:* RICHARDS, N. (ed.) *Carbofuran and wildlife poisoning : Global perspectives and forensic approaches.* Chichester, West Sussex ; Hoboken, NJ: Wiley-Blackwell.

LALAH, J. O. & OTIENO, P. O. 2012b. Background on pesticide use and environmental monitoring

in Kenya. *In:* RICHARDS, N. (ed.) *Carbofuran and wildlife poisoning : Global perspectives and forensic approaches.* Chichester, West Sussex ; Hoboken, NJ: Wiley-Blackwell.

MAESELA, N. 2019. Poachers poison 537 endangered vultures. *City Press*, 23 June 2019.

MARTINS, D. J. 2012. 3.7 Repercussions of pesticides (including carbofuran) on nontarget, beneficial insects and use of insects in foreinsic analyses in Kenya. *In:* RICHARDS, N. (ed.) *Carbofuran and wildlife poisoning : Global perspectives and forensic approaches.* Chichester, West Sussex ; Hoboken, NJ: Wiley-Blackwell.

MDHLANO, S. F., GANDIWA, E., MUBOKO, N. & MASHAPA, C. 2018. Local knowledge and perceptions of vulture conservation in communities living adjacent to the northern

Gonarezhou National Park, Zimbabwe. *Vulture News***,** 1-10.

MERTON, R. K. 1972. Insiders and outsiders: A chapter in the sociology of knowledge. *American Journal of Sociology,* 78**,** 9-47.

MONADJEM, A., KANE, A., BOTHA, A., KELLY, C. & MURN, C. 2018. Spatially explicit poisoning risk affects survival rates of an obligate scavenger. *Scientific Reports,* 8**,** 4364.

MUBOKO, N., MUPOSHI, V., TARAKINI, T., GANDIWA, E., VENGESAYI, S. & MAKUWE, E. 2014. Cyanide poisoning and African elephant mortality in Hwange National Park, Zimbabwe: a preliminary assessment. *Pachyderm,* 55**,** 92-94.

NAMIBIAN CHAMBER OF ENVIRONMENT 2019. Vulture poisoning. Facebook.

NTULI, H., JAGERS, S. C., LINELL, A., SJÖSTEDT, M. & MUCHAPONDWA, E. 2019. Factors influencing local communities' perceptions towards conservation of transboundary wildlife resources: the case of the Great Limpopo Trans-frontier Conservation Area. *Biodiversity and Conservation,* 28**,** 2977-3003.

NUWER, R. L. 2018. *Poached: Inside the Dark World of Wildlife Trafficking*, Hachette UK.

OBERHOLSTER, P. J., MYBURGH, J. G., GOVENDER, D., BENGIS, R. & BOTHA, A.-M. 2009. Identification of toxigenic Microcystis strains after incidents of wild animal mortalities in the Kruger National Park, South Africa. *Ecotoxicology and Environmental Safety,* 72**,** 1177-1182.

ODINO, M. & OGADA, D. L. 2008. Furada use in Kenta: a survey of the distributors and end-users of toxic Carbofuran (Furadan) in pastoralist and rice growing areas. Unpublished research report: Kenya Wildlife Trust.

OGADA, D. 2012. 3.5 Threats of secondary Furadan poisoning to scavengers, especially vultures, in Kenya. *In:* RICHARDS, N. (ed.) *Carbofuran and wildlife poisoning : Global perspectives and forensic approaches.* Chichester, West Sussex ; Hoboken, NJ: Wiley-Blackwell.

OGADA, D., BOTHA, A. & SHAW, P. 2016a. Ivory poachers and poison: drivers of Africa's declining vulture populations. *Oryx,* 50**,** 593-596.

OGADA, D., SHAW, P., BEYERS, R. L., BUIJ, R., MURN, C., THIOLLAY, J. M., BEALE, C. M., HOLDO, R. M., POMEROY, D., BAKER, N., KRÜGER, S. C., BOTHA, A., VIRANI, M. Z., MONADJEM, A. & SINCLAIR, A. R. E. 2016b. Another Continental Vulture Crisis: Africa's Vultures Collapsing toward Extinction. *Conservation Letters,* 9**,** 89-97.

OGADA, D. L. 2014. The power of poison: pesticide poisoning of Africa's wildlife. *Annals of the New York Academy of Sciences,* 1322**,** 1-20.

OGADA, D. L., KEESING, F. & VIRANI, M. Z. 2012. Dropping dead: causes and consequences of vulture population declines worldwide. *Annals of the New York Academy of Sciences,* 1249**,** 57-71.

PLÜSS, J. D. 2019. Pesticide companies ‘seriously deficient’ on human rights, says UN toxics expert.

POKRAS, M. A. & KNEELAND, M. R. 2008. Lead poisoning: using transdisciplinary approaches to solve an ancient problem. *EcoHealth,* 5**,** 379-385.

RICHARDS, N. L., OGADA, D., BUIJ, R. & BOTHA, A. 2018. The Killing Fields: The Use of Pesticides and Other Contaminants to Poison Wildlife in Africa A2 - Dellasala, Dominick A. *In:* GOLDSTEIN, M. I. (ed.) *Encyclopedia of the Anthropocene.* Oxford: Elsevier.

SANTANGELI, A., ARKUMAREV, V., KOMEN, L., BRIDGEFORD, P. & KOLBERG, H. 2017. Unearthing poison use and consequent anecdotal vulture mortalities in Namibia’s commercial farmland – implications for conservation. *Ostrich,* 88**,** 147-154.

SCHEYVENS, R. 2014. *Development fieldwork: A practical guide,* London, SAGE Publications.

SCHMID, J. 2010. Reflections on and of Self in South Africa. *Qualitative Social Work,* 9**,** 169–184.

SIEBER, J. E. & STANLEY, B. 1988. Ethical and professional dimensions of socially sensitive research. *American Psychologist,* 43**,** 49-55.

WEINER-LEVY, N. 2009. When the hegemony studies the minority—An Israeli Jewish researcher studies Druze women: Transformations of power, alienation, and affinity in the field. *Qualitative Inquiry,* 15**,** 721-739.

WHITING, M. J., WILLIAMS, V. L. & HIBBITTS, T. J. 2013. Animals Traded for Traditional Medicine at the Faraday Market in South Africa: Species Diversity and Conservation Implications. *In:* ALVES, R. R. N. & ROSA, I. L. (eds.) *Animals in Traditional Folk Medicine: Implications for Conservation.* Berlin, Heidelberg: Springer Berlin Heidelberg.

WILLIAMS, V., NEWTON, D., LOVERIDGE, A. & MACDONALD, D. 2015. Bones of contention: an assessment of the South African trade in African lion Panthera leo bones and other body parts. *TRAFFIC & WildCRU Joint Report.*

WILLIAMS, V. L., CUNNINGHAM, A. B., KEMP, A. C. & BRUYNS, R. K. 2014. Risks to Birds Traded for African Traditional Medicine: A Quantitative Assessment. *PLOS ONE,* 9**,** e105397.

WILLIAMS, V. L., LOVERIDGE, A. J., NEWTON, D. J. & MACDONALD, D. W. 2017. A roaring trade? The legal trade in Panthera leo bones from Africa to East-Southeast Asia. *PLOS ONE,* 12**,** e0185996.