THESIS

Author:

Paul Dias Ferreira

Gödöllő

2024

HUNGARIAN UNIVERSITY OF AGRICULTURE AND LIFE SCIENCES

SZENT ISTVÁN CAMPUS

BSC IN WILDLIFE MANAGEMENT ENGINEERING

COMPARATIVE ANALYSIS OF ANTI-POACHING MEASURES IN SOUTHERN AFRICA

Author:

Paul Dias Ferreira

Primary Thesis Adviser:

Prof. Sándor Csányi

Department Head

Institute of Wildlife Management and Nature Conservation

Department of Wildlife Biology and Management

Gödöllő

2024

Table of content

1. Introduction

I am an anti-poaching ranger and have worked in South Africa and Botswana in anti-poaching; this thesis topic fascinates me. All major countries share the importance of wildlife in Southern Africa. This natural heritage provides a source of awe and wonder to city folk, a source of income to those who benefit from its economic value and an upholder to the natural processes that sustain our daily lives.

In short, there are four values, according to (Chardonnet et al., 2002):

1. The socio-cultural significance of wildlife
2. The economic importance of wildlife
3. The nutritional value of wildlife
4. The ecological role/services of wildlife

The World Economic Forum values the illegal wildlife trade to be between 7- 23 billion dollars and as one of the most profitable enterprises worldwide, along with the trade in weapons, human trafficking, and drugs (*Financial Flows Associated With*, 2021).

Firstly, due to the nature of economies and governments in Southern Africa, we face the consequences of inequality and poverty on protected areas and their wildlife, along with human-animal conflicts that stem from human habitat encroachment, agricultural expansion, and deforestation. (Mekonen, '*Coexistence between Human and Wildlife*'). These consequences materialise in direct threats to wildlife, such as illegal hunting (poaching) or revenge killing (Leisher et al., 2020). The illegal removal and killing of the African fauna fuels the internal and international illegal wildlife trade (IWT). The bush meat trade significantly contributes to Southern Africa's fauna's plight. An Africa Geographic research paper found that about 90% of rural inhabitants in the KwaZulu Natal province of South Africa hunted for bushmeat. The most common method of hunting was using snares or traps; this is easily the most wasteful method of hunting as many carcasses are not collected and are left to rot (Geary, 2022). Across South Africa, about 30% to 60% of rural households in communal tenure regions state that they consume bushmeat. This unregulated offtake may affect not only the hunted species but the ecosystem as a whole. Certain species have functions in their community ecology, such as fruit and seed dispersal and nutrient cycles through grazing, browsing or defecation (Steiner, 2020). Unregulated bush meat hunting and trade, along with habitat degradation, fragmentation, and an increasing human population, may destroy and lay waste to many ecosystems in Southern Africa.

Another source of danger for Southern Africa's natural fauna is the belief in witches and herbalists, colloquially known as "Sangomas", with endangered wildlife species often used in potions, spells, or superstition. A study carried out at the Faraday market in South Africa (the most significant cultural and traditional market) found that 87.5 per cent of the animal species that were traded were of least concern using IUCN criteria, but 17 species were of conservation concern. However, a higher-than-expected proportion of traders (62.5%) were selling listed species; this is a matter of concern and should be monitored by the respective conservation authorities in each country respectively (Whiting et al., 2013). The higher price can justify these characteristics surrounding cultural and traditional markets' demand for endangered and rare species with either medicinal or cultural value, such as rhino horn, elephant tusks or lion bones.

2. Goals of the study

Through this comparative analysis, I want to identify and evaluate the most robust and practical techniques to prevent illegal wildlife consumption and removal and protect Southern Africa's natural heritage, wildlife and Game reserves. With anthropogenic effects already causing massive degradation in Sub- Saharan Africa, and the 2020 population estimates sitting at 1.14 billion inhabitants(• *Sub-Saharan Africa - Total Population 2010-2020 | Statista*, n.d.), along with UN future projections seated at a 35 % increase leading to a 2050 population estimate of 1,760 billion (Black et al., 2008). Considering this and the current socioeconomic situation, we need to prepare and update solutions to prevent the illegal hunting of wild animals. I hope that my research may provide individuals working in conservation with valuable ideas and information to understand better what works in a particular situation and what does not according to country, laws and budget. Poaching is highly commonplace in Africa. The core issue is the sheer size of the territories that need to be patrolled and the fact that killing an animal requires a small group of highly motivated criminals. This can be compared to finding a needle in a haystack.

This paper will focus on four Southern African countries: Namibia, Zimbabwe, Botswana, and South Africa.

Figure 1: Southern Africa map

Technological advances have simplified and facilitated communications between different elements of criminal syndicates worldwide, providing the illegal wildlife trade with multiple advantages in acquiring, moving, advertising, and selling their products (Transnational crime and Global Security, 2018). Another challenge in Southern Africa is the highly porous borders due to corruption and inadequate border security. "A high level of porosity makes countries easily penetrable by smugglers of drugs, weapons and contrabands", and reasons for this range from corruption, rapid migration, weak border management and an ineffective borderline (Saps.gov.za. 2022) However Southern African countries have "a history of aggressive anti-poaching policies, along with effective management policies that closely monitor the balance of animal populations"(Padgett, 1995)

Figure 2 provides a rough example of which countries use specific techniques, and I have not differentiated between governmental and private anti-poaching agencies or companies. It is important to note that the anti-poaching techniques and methodologies depend on the country's law. Also important to note is that in this paper, the methodology of Anti-poaching patrols and Women APU units are viewed by me as the same. Gender under the proper training does not make any difference in the effectiveness of patrols. Secondly, RPAS (remotely piloted aircraft systems) are classified as the same as APU heat-sensing drones. The technical difference is that RPAS generally refers to drones designed and manufactured through the military industry of the specified country.

	Anti-poaching Patrols	Community-based APU and Intel	RPAS drones	APU heat-sensing drones	DNA mapping	Woman APUs	Horn poisoning	De-horning	Penalties for poaching	Shoot-to-kill policy	K9 APU
Zimbabwe	Yes	yes	no	no	yes	yes	no	yes	yes	yes	yes
Botswana	yes	yes	no	yes	yes	yes	no	yes	yes	yes	yes
South Africa	yes	yes	yes	yes	yes	yes	yes	yes	yes	no	yes
Namibia	yes	yes	yes	yes	yes	no	no	yes	yes	no	yes

Figure 2: Anti-poaching techniques in 4 southern African countries

3. Literature review: An overview of the poaching problems

I believe it is necessary to explain the procedure of poaching operations from the place of origin in terms of the poaching operations themselves. The information here has been synthesised from the South African Anti-Money Laundering Task Force (SAMLIT) report from November 2021 (*Financial Flows Associated With*, 2021).

SAMLIT has highlighted that poverty is a significant driver for wildlife crime, with most poachers being poorly educated, living within impoverished communities, and struggling to support or sustain their families. A common trend for poachers is to operate at night, preferably with a full moon, as there is enough residual light to track spoor and identify animals. The entry points that poachers prefer are near roads, trails, near villages or known high-activity rhino territories. They will either cut a hole in the fence in an area where the hole can be obscured (thick bushes along the fence) or by climbing over or crawling under it, according to (Mulero-Pázmány et al., 2014).

The modus operandi is to be in groups ranging from two to four, with one man carrying a rifle which may be fitted with a silencer if available, the second man carrying an axe or machete and the third carrying provisions such as food or water. It is not uncommon for one of the poaching party to carry an automatic rifle, most likely an AK47. This serves as protection from dangerous wildlife or to shoot at Anti-poaching units which would help the poachers get away. Cellular devices are very common as they have to communicate with intermediaries who provide the extraction detail once they have gotten their prize. The clothes most commonly worn are jeans and t-shirts with either sandals or running shoes, most common of which are All-star shoes known as Chuck Taylors as they have a very light tread which makes it harder for anti-poaching units to track them Figure3. Poachers will most likely immobilise the animal from close up and use the machete or axe to remove the horn or tusk. More advanced poachers will infiltrate reserves using helicopters, dart guns, high-calibre weapons, or cyanide (Figure 3). Cyanide can be found relatively easily in Southern Africa due to the prominence of mineral mining operations scattered over the country. Cyanide will then be used to poison waterholes, killing not just the rhino but a multitude of other species.

To combat or fight against such adverse action, there exists a plethora of methods to hinder such unlawful activity. Some of the methods used are frowned upon by a few human rights organisations. Dying rhino horns with indelible pink ink allows for high visibility through airport security machines and renders the

consumer very ill (*George Stroumboulopoulos Tonight | Injecting Poison Rhinos' Horns To Fight Poaching*, n.d.). The notorious Shoot to kill policy that Zimbabwe and Botswana have adopted that many consider unethical, yet Botswana's conservation is said to be one of the world's most successful (Mogomotsi & Madigele, 2017).

Figure 4: Caught poachers, interrogation

Another image shows poachers typically wearing – sneakers, jeans and tee-shirts or a jacket. Interestingly they have a rifle with a silencer. Also pictured is the subsistence – food and water.

Figure 4: Poachers paraphernalia

Typical poachers' Equipment. Notably, rifles, a wood/ivory saw, a machete, a small med kit, and the products: elephant tusks with tails.

However, we must understand that the fight against poachers is a war, not one brought about due to "European" ideas but rather the effects of failed governments that lead individuals to seek other revenue streams due to desperation (Lunstrum et al., 2021).

The following are wildlife protection methods that are used in Southern Africa (Mukwazvure & Magadza, 2020):

- Community-based Anti-poaching units or poaching deterrents, as is the case in Zimbabwe.
- Penalties for poachers who are caught and charged with unlawful hunting. (Dissuasion)
- DNA mapping to determine precisely where the animal was killed, ivory or rhino horn
- Anti-poaching heat-sensing aircraft
- RPAS drones (remotely piloted aircraft systems)
- The Shoot to kill policy
- Horn poisoning and dehorning, as with the case of rhinoceros.
- Anti-poaching patrols using rangers
- Woman-only anti-poaching units
- K9 (canine–dog) anti-poaching units

The following is a short insight into why animals are illegally trafficked to understand the issues at hand better.

"*Pangolins are currently the most trafficked wild animal*" (*Financial Flows Associated With*, 2021). The majority of smuggled sources of pangolin products come from Nigeria, Cameroon, and Myanmar (Xu et al., 2016). The species with value to the black market in Southern Africa include the pangolin; 4 species are found in Africa, and only one is found in Southern Africa. The Temminks or Cape pangolin (*Manis temminckii*) are harvested both for their flesh, skin, and scales. It is an easy animal to catch as it will roll into a tight ball and remain static if threatened or disturbed hence the Malay origin of its name, "pengguling", meaning to roll up in a ball. The scales are sold as a remedy against ailments, to increase blood circulation, reduce swelling and improve lactation and as charms to ward off evil spirits. (Xu et al., 2016) The skin is used as leather, and the flesh is also eaten in Africa and Asia and is considered a delicacy. The price for a live pangolin in South Africa was recently estimated at 400000 ZAR or 26000 USD, with the penalty of being caught that can lead up to a monetary fine of only 2000 ZAR. This resulted from a recent judiciary process held in South Africa in 2019 (*Man Arrested for Alleged Sale of Pangolin*, n.d.)

The leopard tortoise (Stigmochelys pardalis), whose shell sports epaulettes similar to the leopard, are eaten and sometimes boiled alive for "muti" used and administered by witch doctors. "The dried blood of tortoises was mixed with other medicines and taken orally by the patient for the treatment of high blood pressure"(Setlalekgomo & Resources, 2015). Different body parts are also used in so-called "black magic", believed to be able to hold influence in the spiritual realm. "The head and the heart of a tortoise are separately used in love potions to keep a partner for a long time or to make someone shy." The carapace, or top part of the shell, is placed outside a hut or building to advertise the presence of a witch doctor (Setlalekgomo & Resources, 2015.)

The Chacma Baboon (*Papio ursinus*) is used for various African traditions. According to a regional study in the Western Cape of South Africa, it is one of the most widely used animal species in traditional medicine and witchcraft (Nieman et al., 2019). The uses include newborn babies snacking on dried baboon meat, which is believed to make the child strong and intelligent. The baboon skull is also a powerful charm used by witch doctors. The Chacma Baboon is listed as a species of least concern, according to the IUCN.

Vervet monkey (*Chlorocebus pygerythrus*) body parts were sold by about 50% of the traders at the Faraday Market. (Setlalekgomo & Resources, 2015) The skin is used as a sign of royalty with its incredibly soft fur, used often in tribal matters to demarcate the chiefs in meetings or discussions. The meat is also used as bushmeat (Lindsey et al., 2013; Paige et al., 2014). These reasons contribute to the high demand for Vervet monkey products. (Turner et al., 2016) Unfortunately, they are regarded as pests and are often shot (Turner et al., 2016).

Leopards (*Panthera pardus*) populations are on the decline in Southern Africa due to unsustainable rates of persecution and a poorly managed trophy-hunting industry. Skins and parts of leopards and other African big cats confer strength to the bearer (Whiting et al., 2013). They are often snared, baited, or shot for their fur or destroyed as a way to protect livestock. Research done in the Western cape province of South Africa found about 15 uses for leopard products in traditional medicine.(Nieman et al., 2019) Two primary drivers for this trade in Southern Africa include the "Shembe Church", which uses leopard skins for cultural regalia and witch doctors. "An estimated 17,240–18,760 illegal Leopard skins are believed to be used for ceremonial church activities and may be replaced every 3 to 5 years due to wear"(Hoffmann & al et., 2004).

The African lion (*Panthera leo*) is being poached to fuel the Asian markets' want for lion claws and teeth. This is a relatively new poaching niche but not a surprise one, lion bones are being used to replace tiger bones. "The two predominant products used were tiger bone plasters (38%) and tiger bone

wine (6.4%)" this was research done by (Gratwicke et al., 2008). Tiger bone plasters being used to treat traumatic injury, cure rheumatism, to replenish calcium and to reduce inflammation, where as tiger bone wine is used to cure rheumatism or to improve sexual capacity. Also stated was that out of 1880 respondents from 6 Chinese cities, 70% preferred wild tiger or lion bones over farmed ones. Apex predators such as leopards, lions, and crocodiles are highly sought after in African traditional medicine to transfer properties of strength and dominance (Nieman et al., 2019)

The crocodile *(Crocodylus niloticus)* has survived on earth for 200 million years, and now it has met its match; the demand for crocodile skin and teeth is an international challenge which reaches from western societies to eastern societies. Crocodiles' natural water habitats are drying up due to being used for irrigation and drinking water for towns, thus pushing crocodiles into artificial dams where they are in closer contact with humans. Villages in rural areas perceive crocodiles as a threat to humans and livestock. They are therefore shot in masse and sold for profit for either medicinal uses or food (Pooley, 2019).

African elephants (Loxodonta africana) are illegally hunted for their tusks. The recent Great Elephant Census found that elephant populations declined by 30% between 2007 and 2014, at the rate of 8% per year (Great Elephant Census final results, http://www.greatelephantcensus.com/final-report/). Poaching methods include the use of high-calibre rifles, automatic rifles and pitfall traps. Their tusks are then sold to Asian countries where the demand is ever-increasing. "Much of this illegal trade is being driven by rapidly growing markets in China and the United States, along with the persistent markets in Japan" (Courable et al., 2003; Martin, 2007; Clark, 2008). Elephant populations in Southern Africa are thought to be around 300000 individuals (Cumming & Jones, 2005), their conservation has seen significant successes. Populations in Southern Africa in the late 1880 were only a couple thousand. The number has now grown significantly, with Botswana holding the largest population – around 150000. The majority of elephant contraband since 2006 originated in just a few wild elephant populations in Africa, none of which are in Southern Africa. Concentrated law enforcement in these areas could greatly reduce poaching activities and help rebuild wild elephant populations in Africa, the use of genetic tools was used to identify the core areas where illegal elephant ivory originated from (Wasser et al., 2015).

The Rhino (*Diceros bicornis* - Black rhino/ *Ceratotherium simum* – White rhino) horn trade is one of the more significant and problematic issues we face in conservation. South Africa holds the most significant number of the world's rhinoceros population(Mukwazvure & Magadza, 2020). It is important to note that "Most of the illegal rhino horn entering the market originates in South Africa, which holds approximately 80% of the world's last remaining rhino" (*Financial Flows Associated With*, 2021). With rhino horns having a value higher than gold for the same weight, a rhino horn in Southern Africa can be

sold for up to 40 000 dollars on the illegal market. The primary destination countries include China, Vietnam and Taiwan with the exception of a few horns being found in America (Emslie et al., 2019). "The average life expectancy of a rhino that wanders from the Kruger Park in South Africa into Mozambique is currently 12-24 hours." (Ives, n.d.)
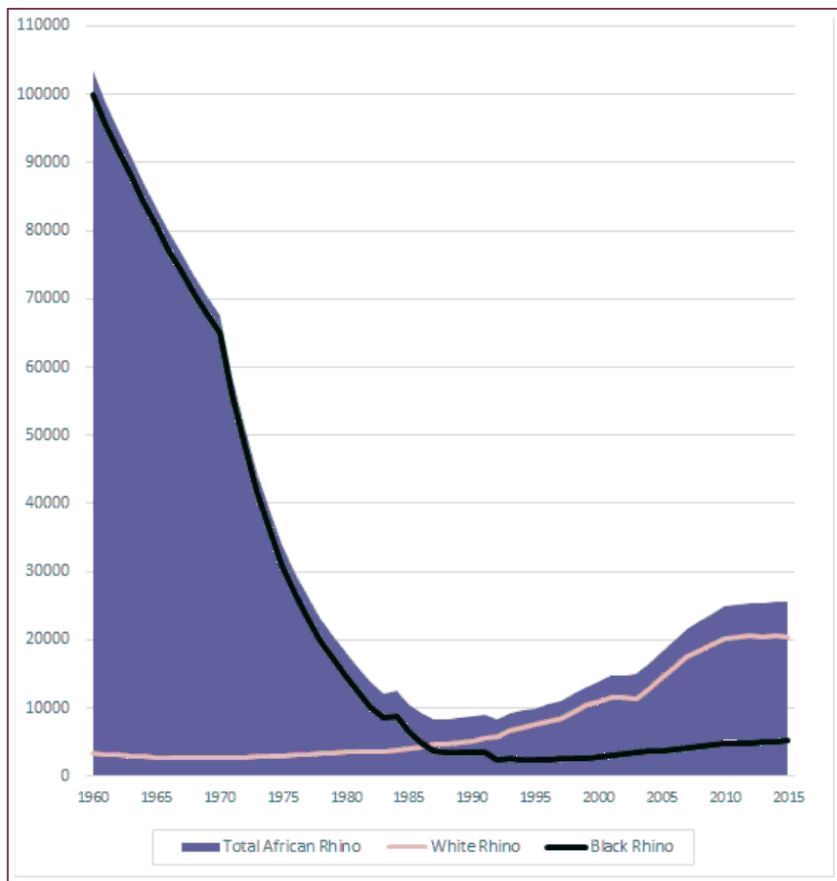

Figure 5: African Rhino population evolution

The graph on the left shows the decline of rhino populations across the African continent. White rhinoceros (Ceratotherium simum) are categorised as Near Threatened on the IUCN Red List (Emslie, 2012a), while black rhinoceros (Diceros bicornis) are categorised as Critically Endangered (Emslie, 2012b). Black Rhinos generally have their first parturition at 3.5 to 5.7 years of age, depending on resource availability and density, and have a gestation period of 15 – 17 months. White rhinos reach sexual maturity around 6.5 -7 years of age and gestation of 16 months.

Vulture Species populations in South Africa are under serious threat from poaching and poisoning. With 3 of the occurring nine species being critically endangered and a fourth endangered. Such events are extremely serious because the Kruger National Park contains regionally and internationally important breeding populations of the Critically Endangered white-backed ""*Gyps africanus*" and white-headed vultures "*Trigonoceps occipitalis*", the Endangered lappet-faced vulture "*Torgos tracheliotos*" (Murn et al., Reference Murn, Combrink, Ronaldson, Thompson and Botha2013) and the Critically Endangered hooded vulture *Necrosyrtes monachus*. The extent and amount of vulture parts that are used is not yet fully quantifiable and therefore we do not know how much pressure is being exerted on vulture populations and if it leads to conservation concerns (Whiting et al., 2013). Vultures in Africa are being poisoned deliberately

by poachers to prevent the birds alerting authorities to the poachers illegal activities, thus providing the poachers with more time to remove elephant tusks, saw off rhino horns and time to leave the area of poaching operations without the carcass being discovered (What's Behind the Vulture Poisonings in Kruger and Chobe Parks, 2022). The harvesting and sale of body parts for use in witchcraft is widespread, with the belief that if you sniff dried vultures brain and sleep with a vultures skull under your pillow that you will be able to see into the future (A M P B E L L M U R N And A N D R É B O T H A, 2022). The feet are also worn around the neck as lucky charms. The price for one whole vulture varied from ZAR300 to ZAR1500 (16,66 dollars to 83,30 dollars) on the black market (Mashele,2021.). The paper written by Mashele also estimates that "this association of traditional health practitioners uses 400–800 vultures a year."

Ungulates are the favoured target of bushmeat hunters, from common duiker, blue duiker, bushbuck, scrub hare, bushpig, large grey and water mongoose. The large spotted genet for its furs. Species such as jackals, leopard, caracal and birds of prey are hunted as they are considered as pests and dangers to agriculture.

4. Anti-poaching methods explained

The following review of literature serves as a guideline to understand the current needs of wildlife conservation, specifically the techniques and accompanying policies that are used by APUs and conservationists in Southern Africa. The need for robust, effective, and relatively simple solutions in protecting an ecosystem in Southern Africa is paramount.

4.1. Existing techniques and how do they work

In response to the declining populations of Africa's fauna, methods were introduced to prevent poaching and protect the animals that exists in these natural areas. It is important to identify the incentives when looking for reasons for poaching, and why we want to conserve and protect wildlife. Human decisions concerning conservation and exploitation of natural resources are shaped fundamentally by the incentives (financial and nonfinancial costs and benefits) accrued, as well as culture, norms, beliefs, values, lifestyles, and cognitive factors (Milner-Gulland & Rowcliffe 2007; St John et al. 2015).

There are mainly two types of poaching according to incentive, the first being subsistence poachers who by default needs to support his /her family by using natural resources that are found in the surrounding natural features. "Establishment of protected areas (PAs) and institution of various conservation laws, has systematically, through time, alienated the indigenous people from the right to utilise and manage natural resources." (Nahonyo, 2009). These poachers mainly use snares or homemade weaponry such as bows, crossbows or firearms, in their understanding they are hunting. The second type of poacher is the one who provides rare animal products to larger organised crime syndicates in return for money. This threat has called upon organisations that specialize in Anti-poaching. Not only does it increase the fragility of the ecosystems by removing keystone species but it also impacts the communities that live in and around the protected areas through the loss of iconic species, thus reducing the land's viability for tourism and conservation hunting enterprises, leading to reduced employment opportunities; damage to a communities reputation of being unfairly implicated in this type of poaching; and exposure to social risks as syndicates corrupt individuals in the community and expose youth to drug abuse and sexual exploitation. (Combatting Wildlife Crime, n.d.)

4.2. Anti-poaching Patrols

Anti-poaching patrols are expeditions to keep watch over an area, that maintain a constant presence either inside or directly outside the area of concern. Patrols may be carried out either on foot, on

a patrol vehicle, usually a 4x4 or a combination of both. Reports from anti-poaching operators suggest that foot or horse patrols are more effective than vehicle patrols (Rogan et al., 2015). Motorised patrols create a loud sound signature which alerts the poachers and gives them time to hide. Motorised patrols are also costly, however foot patrols in targeted areas are more cost effective, prioritizing boundary patrols where poachers shoe tracks or cut fences expose incursion points. Along with a greater reliance on man tracking either with the use of dogs or experienced trackers (Rogan et al., 2015). This serves a dual purpose of recognising any anomalies such as spoor (footprints), staging areas for poachers (camps), firepits or smoke, sighting animal carcasses, poaching parties or hearing gunshots and acts as a dissuasive measure against poachers as the APUs can react directly to an incident. Further this allows for effective reaction to intelligence gathered through anti-poaching patrols and informants, this provides the necessary information to set up an ambush to catch and arrest the targeted individuals. (Marton 1998,2001) and (Yonzon 2002) report that increase in law enforcement and increased patrols reduce poaching significantly in the long run and a lack of these increases poaching twofold. Thus, having boots on the ground is the most basic requirement. Anti-poaching patrols (APP's) may be armed with various firearms or none depending on the area of operations and the degree of perceived threat to the rangers themselves. This threat can be the animals they are protecting or the level of danger the poachers present.

Similarly, patrol efficiency can be calculated and increased by correctly planning patrols on a topographic 1:50 000 map, calculating the percentage of land covered during a patrol and the strategic positioning of APPs relative to known and possible entry/infiltration points on a reserve / PA. According to research conducted in the Ruaha National Park in Tanzania, "areas covered during patrols were estimated to determine the effectiveness of the patrols." Nahonyo, 2009). It is also noted that patrol stratagems need to change relatively often so as not to allow poachers or syndicates to pre-emptively identify possible patrol routes and areas; if poachers become familiar with anti-poaching operations, this may lead to an increase in poaching. Changes in operational procedures are also done to prevent an ambush of friendly forces by poachers and apply further stress on a poacher's psyche, which can stress a poacher knowing that at any time, he may come across an APP. The first point is supported by research carried out in Nepal" Adhikari (2002) posits that a change in enforcement halted poaching for many years in Nepal. Therefore, it is necessary to revise anti-poaching enforcement each year. Anti-poaching patrols are, therefore, the absolute backbone of any conservation or protection effort.

The table below shows the necessity of rangers in the bush as they are the primary source of information relating to poaching operations.

PKO - An adult female white rhino carcass was discovered up in the Willem block and both its horns were recovered. This carcass is suspected to have been shot by the same poachers that killed the male
PKO - white rhino bull carcass discovered with the front horn removed. The rear horn was recovered and registered Pre/040/2016. It is suspected that this carcass was about 5 days old upon discovery and t
NWA Carcass: At 08h50 42 C reported that in the area of Hatayi they had found the carcass of a white rhino, with horns still intact. S 24.302268 E 031.9388200 It is believed that this is the rhino that was v
STO - carcass linked to incursion next to the fence on the night of the 22nd. Carcass 150m from boundary fence west of the Nsikazi river.
NWA Carcass: linked to shots reported by 42 D, full details to follow
TSH carcass: Carcass linked to shots reported by 6142 D
Houtboschrand: 1 Rhino carcass found at Gorge block, approximately 6 days old with both horns removed.
Skukuza: 6140 Ranger reported rhino Carcass with intact horns, Cause of death is relating to the shot reported on 22 March 2016 at 18h30.
Skukuza: Field rangers discovered white male rhino Carcass with both horns removed by knife in block 33 relating to the shot reported on 22 March 2016 @ 18h30.
KFI - Tracks from Carcass
Skukuza: 1x Adult Female Rhino carcass found.
KFI Rhino Carcass. Over 6 months old.
KFI Rhino Carcass. shot by Poachers involved in contact. Both horns removed an taken by Frikkie Rossouw.
Malelane - Rhino Carcass for last night old. Field rangers made followup and discovered 3 x tracks all are takkies from West to East and back.
Malelane - 2 X Rhino Carcass, Cow and calf for last night old.
Skukuza: 1x Sub Adult Rhino carcass at Mlaleni block, 5-6 days old with its horns intact.
SKU - Late entry: Following the shot reported, a fresh rhino carcass and tracks were discovered.
Houtboschrand: White male rhino carcass for 1 month old,all horns were removed with an ax, 01 cartridge for rifle 458.
After shots yesterday, chopper recce'd area and found a carcass
Skukuza: White sub adult white rhino carcass at block 60,Transport dam.
MAL - Malelane field rangers found one old rhino carcass in the Muhlambamadvube block at S25.21441 E31.60884, The carcass is more then on month old both horns removed by knife. They also found one
MAL - Field rangers deployed in Mjejane heard two shot around 23H30, they responded to the direction of the shots. They could not see anything in the dark, only hearing the rhinos running, they then put off
Kingfisherspruit: Carcass of adult white rhino observed from the helicopter. Horns removed and signs of hacking of the animal's back visible.
PKO - An adult male white rhino carcass was picked up in Famehlo block and it had both horns removed by an axe. This carcass is estimated to be about 7 days old and it is suspected the poachers infiltrat
PKO - An adult male white rhino carcass was picked up in Famehlo block and it had both horns removed by an axe. This carcass is estimated to be about 7 days old and it is suspected the poachers infiltrat
CRO - White rhino carcass reported close to the old railway line along the H5. The carcass appears to be three days old and the horns were removed with a knife.
STO - 2 x white rhino carcasses (female and sub-qadult male) found. Poachers ran out of bullets and had to hack one of the animals spine to kill it. 2 x full coke bottles found / 1 x white bread / 1 x water bot

Figure 6: Intelligence acquired from the field

Anti-poaching rangers also serve the dual purpose of removing snares or traps, shooting hunting dogs and apprehending bush meat poachers. The use of snares is illegal in South Africa and poachers can be criminally charged under the Nature Conservation ordinance No.19 of 1974 section 29 (d) (Seleka, 2022.). In the Kruger National Park around 100 to 200 snares are removed each month within the reserve itself (ibid). Personally I have experience with snare removal and it is not uncommon for me to have removed 80 to 100 snares in a 100 square meters. The collaring of rhinos with radio emitters allows for faster location of individuals using radio telemetry, often times the Anti-poaching rangers job is to monitor the individuals on a daily basis. Based on personal experience, the reserve of Makalali in the Limpopo province has used this technique to protect its Rhino population, with no animals being lost in the last 5 years (personal experience) , however this is highly resource intensive.

4.3. Dehorning

Dehorning is a preventative devaluating measure taken to reduce the risk of rhino poaching syndicates and opportunists in killing a rhino for its horn. Dehorning operations are expensive and demand thorough planning and time. The process requires the sedation via a vetenarian, once the animal has been sedated the horn is removed at the base. The horn must be cut above the germin layer, if the germin layer is damaged the horn base will be damaged and will affect its regrowth. 90 to 91% of the horn is removed yet this is not a sure-fire way to prevent poaching, poachers will still kill rhinos for the remaining 9 or 10 percent of the horn due to its high price tag. "Experts recommend that rhinos should ideally be dehorned every 12-24 months in order to be an effective deterrent." (Dehorning Rhinos | Save the Rhino) .

The Wildlife Justice Commission investigated the following between March 2017 and June 2018 and stated in their report "The price for raw rhino horn ranges from USD 3,604 to USD 17,000 per kilo, calculated to equate to an overall average of USD 8,683 per kilo." (WJC, 2017). With the average combined weight of both horns of the white rhino being around 5-6 kilograms and the black rhino's horns weighing around 1,5-3 kg (Buyers of Rhino Horn | PoachingFacts, n.d.), dehorning drastically reduces the monetary gain that a poacher may receive upon acquiring and selling a substantially smaller horn. Du Toit (2011) alleges that dehorned rhinos have a 29.1% more chance of surviving poaching than horned rhinos. The poachers may not have the same fiscal motivation to risk their lives in poaching an animal that has been devalued, thus logically as a boost to this demotivation and an added disincentive factor, an increase in the monetary fine (Di Minin et al. (2015)) found that it has a stronger effect than increasing the years in prison for poachers. Dehorning rhino has also to be supported by educational and financial gain as mentioned by the (Biggs et al., 2013) "disincentive factor may also include wider influences, such as engaging the rural communities that neighbour wildlife". In early 1990s in Zimbabwe, white rhinos were dehorned in Hwange national park. De- horning and translocating of rhinos from vulnerable areas reduced poaching of black and white rhinos in Zimbabwe (Duffy, 2000). However, a lax in security allowed poachers to kill all the horned and dehorned rhinos. This perhaps shows that dehorning without adequate security produces the same result (Lindsay and Taylor, 2011).

The price of a dehorning operation costs around US$500 where rhinos occurred at high densities in small areas to US$5000 per animal where rhinos are widely spaced and dispersed in large areas (Atkinson,1993). Whereas, in Namibia it was estimated to have costed about US$1400/Rhino to US$1500 to dehorn (Morkel & Geldenhuys, 1993). With the increase in fuel prices it is likely that these prices have increased.

4.4. Horn poisoning

Poisoning of rhino horn was first spoken of in 2010, as a method to deter rhino poaching. The horn would be drilled to create a hole where it will be directly injected with highly toxic ectoparaciticides. The product is used to kill parasites that live on the outside of the host and to prevent harmful infestations or diseases caused by insects and mites (Anses, 2022). This is done in the hopes that it would be a proactive solution to deter rhino horn poachers. According to Save the Rhino.org the aim is to "kill or make seriously ill the person that consumes the final rhino product" yet medical analysis has shown that ingesting these products induce vomiting, nausea and convulsions (dosage dependant). However, the ectoparaciticides are not harmful towards the rhinos themselves as there are no blood vessels in a rhinos horn therefor no way for the poison to spread (Save the Rhino International, 2022).

Additionally, the horns are also injected with a bright coloured dye, so that the poachers have a visual confirmation that the horn has been poisoned. This is thought to remove its ornamental value However, rhinos habitually mud bath completely covering their bodies including their horns in mud, along with "horns getting scuffed and stained by soil and vegetation thus obscuring the coloured dye" (Ibid)

There are a few challenges with this method, horn poisoning and dying (the treatment) was initially started in the Sabie Sand reserve in South Africa to curb poaching as well as having signs posted all around the reserve's fence letting poachers know that the horns had been treated. However this did not stop the poaching as the poaching operations continued. According to Save the rhino Int "the poachers / traffickers / importers won't bat an eyelid if they are harming someone living thousands of miles away who they have never met". The other challenge is that it will increase the rarity and price of rhinos who have not been treated, essentially transforming 1 commodity into 2 thus exacerbating the challenge (Save the Rhino International, 2022). This increases the price for un treated horns and thus increases the incentives for rhino poaching (Ferreira et al., 2014).

4.5. Penalty increases

The countries legislation is responsible for the given penalties of a certain crime in a country. "The SADC (Southern African Development community) countries have good legislation with poor implementation. Legislation needs to include mandatory minimum penalties for poaching. This removes the discretion of the courts to give light penalties. Effective magistrates and prosecutors, not the legislation, determine success."(African & Community, 2020)

The average current penalty paid for bail in the South African justice system if convicted of a wildlife crime pertaining to rhino poaching sits around ZAR 40000 (US$ 4400), if the poachers pay the

fee he walks free. With the average price of rhino horn on the African continent being around USD 8,683 per kilo" (WJC, 2017), often the poacher still has a profit margin. Thus, the demand of rhino horn is still worth supplying. Clarke et al. (1993) conducted research on a penalty structure that constitutes fines only and concluded that while higher fines might have a deterrent effect to poachers, it does not stop poaching because poachers make their decisions about whether to poach based on marginal benefits or marginal fines.

The penalty in Zimbabwe however is substantially higher, with bail if convicted being set around $120000 for both Black and White rhino. This effectively removes any profit margin, if the fee cannot be paid then a suitable prison sentence will be charged accordingly. The following are penalties according the Statutory Instrument 92 of 2009, Parks and Wildlife (Payment for hunting of animals and fish) Notice, 2009, the Ministry of Environment and Natural Resources in terms of Section 104 (a) of the Parks and Wildlife Act, Chapter 20:14 declared that: "The amount specified in the second section of the schedule (below) shall in respect of the species and animal and fish specified in the first column of the schedule, be imposed in terms of section 104 (1) of the Act.' Poaching of a lion: US$5000, Pangolin: US$500, Monkey:US$300, Kudu:US$5000, Elephant:US$20000, Fish eagle: US$100, Guinea Fowl US$50, Water Buck US$500, Zebra US$1000, Buffalo US$6000, Sable US$2000, Ostrich (egg) US$500, All Fish (dried/smoked per kg) US$3, Springbok US$500 (Kruger Park News - StifferPenaltiesForPoaching - Online News Publication). There has been two recent convictions for poaching with sentences of 10 and 36 years, the amendment to the Parks and Wildlife General laws in 2011 stipulates a mandatory sentence of nine years to first time offenders and from eleven to twenty years for repeating offenders (Emslie et al., 2019). This shows a more intense initiative from the Zimbabwean government in relation to protecting their wildlife.

With regards to Botswana, the wildlife law can be found in The Wildlife Conservation and National Parks Act (1992). Under this act, "seven years imprisonment and fine of BWP10,000 (USD 950) for hunting or capture of a protected species and for importing, exporting, re-exporting or transporting through Botswana any wildlife item without a permit and five years' imprisonment and a fine of BWP5,000 for selling or processing unlawfully obtained wildlife items" (Price, 2017).

The information provided here is from (Emslie et al., 2019). Namibia possibly has the most stringent laws pertaining to the illegal wildlife trade, the amendment to their (Controlled Wildlife Products and Trade) in 2017 has allowed for the implementation of cites with fines between 15 – 25 million Namibian dollars and/or an imprisonment of up to 25 years. In the case of repeat offenders, a fine of up to

50 million Namibian dollars and/or imprisonment of up to 40 years. In 2016 four Chinese nationals were sentenced to 14 years in prison (Emslie et al., 2019).

4.6. The shoot to kill policy

The use of military and para-military personnel and techniques in the pursuit of conservation and/or anti-poaching has been described as green militarisation (Lunstrum, 2014), this policy deters poachers by the threat of death. "Arresting poachers does not always stop criminal syndicates. Rhino poaching has continued to rise in South Africa, despite increased arrests" (Milliken et al., 2012). One of the first Southern African countries to adopt this method has been Botswana, outside of Africa the national park of Kaziranga in India has done the same. This was done to reduce the number of Asian rhinos being poached. Rhino populations face extreme persecution in Asia as in Africa, these concerning low population numbers has meant that protecting the natural habitat and the removal of poachers is vital. This method is deemed inhuman by some and necessary by others. As stated by the (Shoot-To-Kill Policies In Conservation | The Great Projects, n.d.) those willing to "live by the gun" should also be willing to "die by the gun".

When this policy was implemented in both India and Botswana the number of poached animals decreased dramatically, with the number of dead poachers increasing as well. An example of its efficiency is from Zimbabwe, in the 1980s the "shoot to kill" policy was introduced which had a positive effect on elephant populations which increased from 52000 to 72000 individuals (Padgett, 1995). Botswana justifies it use of special units from the BDF (Botswana defence force) because they view poaching as an act of war, especially as a majority of elephant and rhino poachers come armed from neighbouring African countries. The right to life is protected in terms of Section 4(1) of the Constitution of Botswana, which provides that no person shall be deprived of his or her life intentionally except in execution of the sentence of a court in respect of an offence under the law in force in Botswana of which he or she has been convicted (Project, 2019). However the poacher may forfeit their right to life as is justified in section 4(2)(d) of Botswana's constitution "of the Constitution, which provides that a person shall not be regarded as having been deprived of his or her life in contravention of Section 4(1) of the Constitution if he or she dies in order to prevent the commission by that person of a criminal offence, or if he or she dies as the result of a lawful act of war."(Project, 2019) The policy has also been wholly endorsed by the Minister of Environment, Conservation, Natural Resources and Tourism, and has stated : "That is a position we adopted to send a clear message to say, if you want to come and poach in Botswana, one of the possibilities is that you may not go back to your country alive."(Sustainable & News, 2018)

Usually, a poacher may only be killed in self-defence, rangers killing a poacher due to a direct threat to their life. There is no shoot to kill policy in South Africa, even so in certain national parks rangers get frustrated and poachers do go "missing". This is supported by (Hübschle, 2016) "Most apprehended poachers are acquitted. Where poachers are convicted, they are mainly low level rather than kingpins." The largest population of rhinos is found in South Africa and is a poaching hotspot (Fisher, Target killings, norms and international law.) South Africa is being encouraged to adopt the shoot to kill policy, as more innovative and expensive methods such as dying, poisoning or cutting of rhino horn has had limited effect and is not cost effective (Mogomotsi & Madigele, 2017).

Green militarisation does however have its draw backs, with the most negative effect being increasing the division between the protected area and the adjacent communities. This may counter and degrade the ecological and social aims of conservation itself. Thus observed is the fact that a para-militarised anti-poaching approach may not be successful in the long term (Massé et al., 2017). A grim reality exists with regards to shooting poachers, the massive majority of poachers are poor and are mostly trying to support their families and community , shooting these so called bread winners essentially exacerbates the poverty of that particular region (Lunstrum et al., 2021). However other conservation methods may be more successful in the long term, by creating a rap pore between people and animals so that people may economically benefit from wildlife thus providing them with an incentive to keep the animals alive.

4.7. Community Based Conservation Efforts or (CBNRM) – Community Based Natural Resource Management

4.7.a) Community based conservation efforts

The community-based conservation approach is based on including people living in and around the protected areas, so that they may legally benefit from the natural resources that are available. Community based conservation (CBC) is a relatively new idea but may help to undo the damage caused by the "traditional" idea of conservation, which redefined access and land use rights for the local people, to the extent that it was illegal for local people to utilize wildlife. Colonial legacies including the loss of legitimate forms of access to natural resources may contribute to poaching as a form of protest (Duffy2010). The incentives whether it be (financial, or non-financial costs and benefits) heavily influence the decisions that are made concerning conservation and exploitation of natural resources (Milner-Gulland & Rowcliffe 2007; St John et al. 2015).

Community-based conservation (CBC) programmes seek to achieve conservation goals—including reduced poaching—by either, (1.) increasing the financial benefits individuals receive through conservation, (2.) increasing the opportunity cost of behaviours that are incompatible with conservation or by (3.) instilling normative compliance through providing public goods (Gibson & Marks 1995). It is a multilateral approach which increases the robustness of the program and follows the logic of the common property resource governance theory (Ostrom 1990). It is a common trend that poverty-stricken people across the world face conflict with wildlife, either due to human encroachment on wildlife areas or irresponsible resource management.

Examples of such conflict - 1. Dangers to personal security, crops, and livestock. 2. Competition for resources 3. Disease transmission between livestock and wildlife. Decreasing the costs related to human wildlife conflict may shift incentives away from Illegal Wildlife trade towards favouring conservation (Cooney et al., 2017). Several community based conservation models can be found throughout Southern Africa, the most well-known being the Campfire program in Zimbabwe. Zimbabwe's national parks and protected areas make up about 13% of its land area. The 13% roughly translates to about 50,000 km2 mainly situated at lower altitudes with poor rainfall. There is about 80,000km2 of communal lands situated near to or adjacent to the protected areas (Bond et al., 2007), thus to promote conservation and reduce human animal conflict a program was initiated which involved community members, government officials, sociologists, conservationists, and professional hunters.

The Communal Areas Management Program for Indigenous Resources (Campfire) is a leading program that considers wildlife as renewable natural resource. The Zimbabwean government initiated the Parks and Wildlife Act in 1975, this set a new legal basis that allowed private landowners and communities to make use of wildlife on their land (Vorlaufer, 2002). Under campfire rural communities that live on land that is under communal tenure have the authority to use wildlife resources commercially, and decide how to spend the income (Biggs et al., 2019). The use of wildlife can be consumptive or non-consumptive, unsurprisingly safari hunting is what occurs more often . A recent WWF study found that households that participated in Campfire had an increased income of about 15-25% (The CAMPFIRE Program in Zimbabwe, 2015b). However there have been critiques towards the program, Campfire has been critiqued that the communities are not independent of the government or rural district councils, this is due to the reluctance of government to decentralize power to the community level (Biggs et al., 2019). Thus removing the power from the local communities to take decisions that would best suit them. The second challenge is that conservation laws and programs that have been implemented by government can be subjected to change due to short term electoral and political cycles (Stein, 2001). However even though there are major challenges, this has allowed communities to have a greater appreciation for wildlife as their

perceptions of these animals has been changed to be associated with income and an improved quality of life.

A different approach has been taken in South Africa, "inclusive anti-poaching". People living within or adjacent to protected areas can participate in combating illicit wildlife trade through participation-based approaches such as employing scouts that come from these communities. An example of this can be found in Southern Mozambique on the border of South Africa adjacent to South Africa's Kruger national park, where rhino poaching is the most intense. The Mangalane Community Scout Program as the name suggests employs people as scouts, these scouts in turn benefit from the wildlife they are protecting. The scouts must be accountable to their own communities, (Vundla, 2019) and provide an intelligence gathering capacity in the area outside the reserves. It is important to understand that using poverty as an explanatory mechanism, is a major motivator for poaching and other crimes such as cattle theft, murder and rape (Vundla, 2019). These crimes also effect the communities involved as poverty-stricken people are easy targets, along with the fact that far to reach isolated communities have little to no support from police units. The study found that poverty of income has negative implications on wildlife, but mainly wildlife that is necessary for substance consumption, or trade, to supplement household income. The poaching of high value species such as rhino has no immediate use for the community (ibid). Thus employing known hunters and poachers from these communities can provide more security to both their respective communities and the adjacent protected area. The primary motivation for becoming a community scout is the salary, which sits above minimum wage and the support that they can mobilize through meetings with game rangers and police officials. Cattle theft was completely eliminated in the Mangalane trust area, along with informing rangers and conservation personnel of problem animals in order to reduce human-animal conflict (Massé et al., 2017).

Community scouts also have very important Anti-poaching duties to execute. They patrol and monitor the outer portions of the fence every day and report any anomalies, including entry and exit points of poachers. They also provide invaluable information regarding poacher's activities and their eventual entry into the reserve, or past poaching incidents. The information they gather comes from their respective communities, as they are part of these communities and thus are able to see when poachers prepare an operation (Massé et al., 2017). With the majority of poachers in the Kruger Park coming from Mozambique, and the strategic positioning of these Community Based Anti-poaching units the number of rhinos killed has decreased dramatically, from around 25 killed per year from 2010 to 2015 and dropped significantly to just 3 in 2016. Community scouts are effectively the eyes and ears that provide information to both the anti-poaching units and law enforcement outside the reserve. APU management have strong

convictions and believe that the community scouts has led to more arrests and seizures and frustrate poaching activities.

However there are challenges with Communal Anti-poaching units. Most important of which are reprisals from community members which leads to alienation, and accusations of working for the "white people" along with stealing income from the poachers. Threats to life are not uncommon as scouts have faced death threats and beatings in their own homes. Also noted is the change of direction from community decision making and wildlife management towards the singular job of preventing rhino poaching. It is important to note that the majority of income comes from the Sabie Game reserve where hunting is permitted. The current government framework allocates 20 percent of the hunting licence fees shared amongst 5 communities, in 2015 this amounted to 50 dollars per household. Much less than what would be received from hunting a rhino (Massé et al., 2017).

From my experience with Anti-poaching I have heard stories as to why people from the Mozambique South African border are not afraid to risk their lives in shooting a rhino, long before the current generations fathers and grandfathers would work in the South African Gold mines. Thus risking their lives for an income has always been their way, with the mindset that if their fathers and grandfathers risked their lives so should they.

In Namibia there have been some successful case studies in different reserves around the country, with hindsight these successes started with an amendment of the Nature Conservation Act of 1975 in 1996. This allowed rural Namibians to form conservancies with similar rights to those of private farmers, allowing them to hunt non protected species under the umbrella of a quota system and the ability to operate tourism on these conservancies. These two key factors ensures a strong economic benefit to local residents in conserving wildlife. ('Combatting Wildlife Crime | Community Conservation Namibia'. Accessed 27 September 2022.) Community access to meat and finances derived from trophy hunting has largely stopped subsistence poaching entirely, and as such is no longer a major threat.

4.7.b) Community based intelligence sourcing

Intelligence gathering is a technique that uses paid informants to leak information to the respective authorities in order to prevent a poaching incident, this is highly effective and thoroughly used throughout Southern Africa. This technique has a great advantage of being able to precisely pinpoint a reserve or protected areas resources to achieve relatively great success (Steiner, 2020). It is not resource intensive as the information is generally accurate, the majority of high-profile poaching is generally due to a small number of individuals in the area. Operational security is of vital importance in order to protect the identities of the informers and the operational procedures. Gathering information from informants has been

highlighted as one of the most important points to start any anti-poaching unit or practice (Greef, Anti-poaching manual). The endangered wildlife trust has openly supported private and national game reserves to start their own intel gathering operations.

4.8. Canine Anti-poaching units in Wildlife conservation.

The relationship between dogs and man is one of the oldest relationships that we have with any animal as we have relied on their keen sense of smell as an early warning system to dangers and their agility in helping us hunt. Humans have around 5 million scent receptors in their nose over an olfactory sensing area of 4 square centimetres, however dogs have around 200 million scent receptors over an area of over 170 square centimetres (Bell et al., 2022). This powerful sense of smell allows them to track over prolonged distances for up to 48 hours, K9 anti-poaching units have become central in apprehending poachers in South Africa's Kruger National Park with 95% of arrests being accredited to the use of dogs according to Johan de Beer, K9 manager in the KNP (Kruger National Park) (Import, 2022).

There are three main categories of working dogs:

1. Conservation
2. Patrol
3. Cold scent tracking

Conservation dogs are mainly used to detect animal products or firearm related residues in vehicles either entering or leaving the reserve. Breeds used are usually Bloodhounds, Malinois or Belgian shepherds. Poachers have tried to circumnavigate this challenge by laying the firearms in hiding for several days before the actual poaching operation, however these detection dogs can smell a firearm from about a kilometre away even if it is under ground. (Ives, n.d.)

Patrol dogs are highly versatile as they can accompany rangers on either foot, vehicle or helicopter patrols over the operational area, and can thus provide rangers with information relating to poachers' ingress and egress points into a wildlife area. Along with finding spoor (shoe marks) and firearms or any other tools of the trade that can lead to a successful arrest or conviction through the justice system (Rangers, 2022). Dogs also act as additional security as they can signal another humans presence to the APU rangers by up to 1 kilometre if the conditions are right thereby preventing an ambush situation from poachers on the rangers (Ives, n.d.). Also according to (Ibid), a well-trained dog has a search capability of up to 32 square kilometres which would otherwise take around 60 rangers to conduct without a K9. The tactical advantage is that dogs can also track at night, as the ambient temperature is cooler than during the day when the dogs run the risk of overheating. However, night-time operations in African reserves can be

deadly without providing the rangers with the necessary night time observation equipment in order to avoid bumping into large herbivores or carnivores. Most of which are active at night (Import, 2022).

The third type of dog is the "reactive role", or cold start tracking dogs. These dogs are deployed along with rangers on "callouts" after a shot, or multiple shots have been heard, if a fresh carcass has been found or if poachers have been visually identified in an area. The dogs can pick up a scent and spoor that is up to 48 hours old and greatly increase the possibility of arrest (Ives, n.d.).

Often times tracking dogs can also be trained to chase and intercept a poacher that is on foot, breeds that are usually used for this are Belgian shepherds and Malinois. They have a bite force of up to 240 psi and can pursue a target up to 32 km/h. Another advantage to working with dogs is that they cannot be bribed or corrupted and will happily work seven days a week provided they have the correct nutrition and about 8 hours of sleep between operations. According to (Bell et al., 2022) each dog unit with kennels can cost up to 25 000 dollars a year to operate with costs per square kilometre being around 1,25 to 1,6 dollars. "Compare this cost per kilometre with a patrol car with rangers that costs about $140 per square kilometre" (Ibid)

The dogs need specific equipment, from high quality kennels to keep the dogs safe at night that keep harmful invertebrates and insects away, along with harnesses, leads, goggles and body armour. The adage that says, "we are what we eat stands fast in relation to dogs as well", working dogs require high quality protein foods. Regular vetenary care along with vaccinations against diseases such as k9 distemper and rabies. Preventative care in the form of worm, tick and flea control (Department of Jobs, Precincts and Regions, 2022) The K9 team needs to be equipped with a GPS system in case the handler and dog become separated (Ives, n.d.).

4.9. Drones in Anti-poaching (RPAS-remotely piloted aircraft systems)

The technology originates from the military, it was developed in order to create a higher situational awareness in order for troops to get up to date information on the enemies activity, exactly the same is being done in Anti-poaching but this time the technology serves to protect areas with high value animals to the IWT . Providing real time intelligence of poachers in a protected area is paramount in preventing poaching or catching the poachers. "Eighty percent of poaching happens under the cover of darkness". The two most basic components that are needed is the airframe itself and the ground station in order to process the information from the drone. The drone essentially acts as the sensor to the "boots on the ground" otherwise known as rangers aka the effector. Drones have to be deployed in the most likely areas of concern, "thus flight plans have to be organised so that rangers and the drones can work together and to

speed up the reaction time of rangers on a call out" (Corrigan, 2020). Many game reserves use micro light aircraft to patrol and find the rhinos every day often flying twice a day in order to direct the anti-poaching patrols to the locations of the rhino, however this is expensive, and drones provide a much cheaper option. Also important to note that any poachers who have infiltrated the reserve will be able to hear and see the overhead microlight and thus have time to hide in thick vegetation, this is not the case for drones that emit less sound signature and are smaller. Microlights such as the bat hawk model produce around 90-100 decibels of noise (Queen's Printer of Acts of Parliament, n.d.) (Singh, n.d.), however reconnaissance and commercial drones emit around 70 – 80 decibels of noise (Jin, 2022). Newer drones emit virtually no noise at all and are thus silent.

The drones use onboard FPV (first person view) cameras and sensors to collect information and are propelled by a brushless electrical motor that uses a lithium polymer battery to power it. The drones can relay exactly what the camera sees to the ground station to be processed by the operator there. The drones can operate in three different modes – 1-FPV mode/ 2- Autopilot and 3- manual mode with direct control over the aerial vehicle. Also installed on the aircraft is a GPS logger, barometric altitude sensor and the autopilot piloting system. The ground stations are usually on a wheeled platform such as a van and contains a lcd monitor, control signal emitter and a radio station.

There have been criticism about the use of drones, due to high maintenance costs, fleet logistics as well as the training of individuals to properly maintain and deploy the drones it is therefore a complicated system. Many of the drone models need clear areas for take-off and working with drones in the middle of the night in the African bush has its own sets of problems. "Eighty percent of poaching happens under the cover of darkness" (Murison & Murison, 2018) However drones with VTOL capabilities (vertical take-off and landing) are being developed by Airshepherd (Andrews, 2022). Criticism has also been targeted at the inefficiency of drones compared to K9 Anti-poaching efforts with one drone operator reporting that the K9 units in the Kruger Park in South Africa managed to haul 18 poachers over 1 week, comparing that to the use of drones over the 2 year period they were flying drones at night with only 8 sightings of poachers (Autonomous Anti-Poaching Drone, 2019). Also it is important to note that dog teams can move faster than humans, and most often corner poachers up a tree with all the necessary evidence needed to convict them whilst drones cannot actually apprehend the poachers according to (Maria Salazar, Author At, n.d.).

Drones do however hold a lot of potential in smaller reserves across Southern Africa, according to (Drones Are a Knife in the Gunfight Against Poaching. But They're Leveling Up, 2022) a sector of the Kruger park in South Africa called Pretoriuskop had a constant drone presence for sixteen weeks starting

in October 2014. During this period there was not one poaching incident reported, however the previous month poachers had killed 9 rhinos. This suggests that drones hold a very strong potential as a deterrent to poachers on smaller areas.

In Botswana Air Shepherd conducts reconnaissance flights according to tip offs from local APU units and law enforcement, similarly the drones use optical daytime and heat sensitive night time cameras to observe the activity of poachers (Murison & Murison, 2018). Unfortunately due to the nature of the African climate the heat causes inaccurate readings and alerts, the technology is not accurate enough to differentiate between a human and a similarly sized animal (Autonomous Anti Poaching Drone, 2019).

4.10. DNA mapping

DNA mapping involves identifying the geographical origin of a IWT product seizure, this is paramount when trying to establish whether or not the animal is from a protected area or unprotected. This technique also works when researchers are trying to identify a species based on only parts of an animal or plant either in a mature or immature state (e.g. an embryo) or has been transformed into a product (Wildlife, Forest & Fisheries Crime Module 3 Key Issues: DNA, n.d.). Therefor it is an effective method in identifying the areas where the wildlife is being poached and aides in directing law enforcement to target those areas before more animals are killed. This technique requires elephant dung DNA to be collected through microsatellite techniques from different location across Africa and to be compared to the DNA collected from ivory seizures (Biello, 2007). Also, this effectively prevents countries from denying the poaching problems in the respective countries and exposes countries to CITES and other internationally enforced sanctions if they kill their wildlife illegally. This technology has traced back a seizure of 6,5 tons of ivory in Singapore from 2002 to Zambia. The same technique is being used to trace rhino horn seizures (Mukwazvure & Magadza, 2020).

DNA is extracted from a varying range of biological material such as meat, skin, hair, feathers, bones, teeth, claws, shells, scales, venom, embryonic tissue, urine, faeces, blood, as well as processed products such furs, leather goods, and medicines (Iyengar, 2014; see also, Byrd & Sutton, 2012). However human DNA testing and methodology is much more refined than DNA testing for animals which is underdeveloped, for each species a new methodology and set of genetic markers has to be mapped, developed and validated. The new methods have to be tested to ensure that they produce accurate results. "DNA analysis of animal and plant samples is outsourced to non-government entities" (Linacre & Tove, 2013; Iyengar, 2014). This is a challenge in itself as if the testing is not done by professional and certified

staff, then the rigorousness of the testing can be dismissed and inadmissible in court proceedings (Ogden, 2010) .
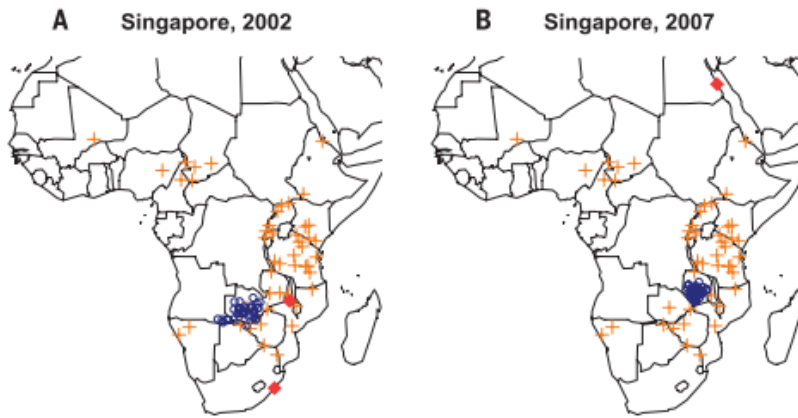
Singapore seizures from 2002 and 2007 were largely assigned to Zambia. The blue circles represent the location of ivory assignments. Orange crosses represent the locations of reference samples. Red diamonds represent transit points before being shipped to destination countries. A – Malawi to South Africa B- Egypt

Error! Reference source not found.A and B come from the "**Genetic assignment of large seizures of elephant ivory reveals Africa's major poaching hotspots**"(Wasser et al., 2015). This is essentially the end result of a successful genetical identification of a seized illegal ivory assignment in 2002 to 2007 in Singapore. It shows how in 2002 the majority of poached elephant tusks came from the Southwestern portion of Zambian territory and how the poaching migrated to the North Western part as soon as anti-poaching efforts got stiffer in the latter. The orange crosses represent sampled elephant DNA sights, blue circles represents where the ivory originated from and the red diamonds show the transit routes in Africa before being shipped overseas. In conclusion researchers demographically identified poaching hotspots from 28 large ivory seizures from 1996 to 2014 due to genetic identification. During this period the two major African Savannah elephant (Africanus Loxodonta) poaching hotspots have been located, namely South-eastern Tanzania and Northern Mozambique (adjacent). The Forest elephant ivory was primarily assigned to the border area between Northern Gabon, Republic of Congo and the Central African Republic (Wasser et al., 2015).

With the majority of elephant poaching being concentrated in Central and eastern Africa the majority of Rhino poaching occurs in Southern Africa, coincidently where the majority of African Rhino still exist. A single compatible global system to identify the origin of rhino horn seizures has been created in South Africa. The system called (RhODIS) Rhino DNA profiling and database system developed through the collaboration of the Kruger National Park and the Pretoria Vetenary Genetics lab has allowed geographic identification of several horn seizures in Vietnam. Vietnam had a record high number of seizures in 2017. A total of 41 samples has been taken from these horns (Wildlife, Forest & Fisheries Crime Module 3 Key Issues: DNA, n.d.-b).

Taxon	Common name	Assessment	Criteria
Diceros bicornis	Black rhino	**Threatened–Endangered**	C2a(i)
D. b. bicornis	Southwestern black rhino	**Threatened–Endangered**	D
D. b. minor	Southern Central black rhino	**Threatened–Endangered**	C2a(i)
D. b. michaeli	Eastern black rhino	**Threatened–Critically Endangered**	D
Ceratotherium simum	White rhino	**Near Threatened (Conservation Dependent)**	A4ad

Figure 8- Rhino species in Africa

The table above identifies the 2 species and 3 subspecies of rhino that is found in South Africa, Lesotho and Swaziland. The DNA analysis will provide invaluable information on the species to which the rhino horn belongs. RhODIS has been proven as an effective tool for investigations into rhino poaching cases and has been used in court prosecutions (Wasser et al., 2015).

Unfortunately this is rather a reactive method and does not directly stop poaching, it only allows for a better understanding of the areas of concern for different species of rhino that are poached, the individual at the end of the day has still been lost. As the conservation Biologist Samuel Wiser put it "Seizing the ivory doesn't save the elephants. We need to shut the market down and keep the ivory in Africa."(Mukwazvure & Magadza, 2020).

5. Conclusions and suggestions

Considering the above discussed elements and case studies there is not one clear solution in preventing poaching, as different countries face different challenges and situations. However, one basic element or method of poaching prevention is also the most basic: having "boots on the ground" an actual presence that presents the poachers with the acute challenge of being discovered and directly targeted. Ground patrols are still the best intelligence source "see figure 6", as if you have no information on the activity of different poaching elements you cannot effectively prevent poaching. Information from the field may be analysed and will disclose information such as: the favoured poaching areas, thus the APUs can effectively increase patrols in that area, the favoured modus operandi of poachers which can allow the APUs to prepare better in case of any eventualities reducing the risk of injury or death or the favoured ingress or egress points where APUs can set up an ambush in order to apprehend the poachers.

As stated by (Lunstrum et al., 2021) poverty is the main driver of poaching across Southern Africa, thus focusing on methods to reduce poverty in the communities surrounding the protected areas should be of utmost importance. According to evidence from (Hartmann 2014) and contrary to popular belief "poor people" are willing and motivated to cooperate with conservation initiatives and authorities to protect natural resources as their livelihoods are highly dependent on the natural environment surrounding them. A well-planned multi-layered approach that is flexible is ultimately required that should be able to respond simply and effectively to differing socioeconomic, cultural and environmental conditions. The most important method should focus on providing the local communities surrounding the reserve with an economic incentive (Simasiku et al., 2008), this effectively translates to a CBRNM style of approach. A successful example that supports this notion can be taken from the Campfire program found in Zimbabwe, where local households that participated in Campfire experienced an increased income of around 15-25% (The CAMPFIRE Program in Zimbabwe, 2015b). It is of utmost importance that communities should have self-organisation of resources that is independent of government (Biggs et al., 2019). In Namibia the Damaraland Camp joint venture effectively built up close to 35 000 US dollars for the communities involved (Jones, 1999). Both of these case studies were successful in providing the local communities with strong proprietorship over their natural resources and increased their resource management capacity.

Whilst community based natural resource management solutions are successful in preventing small scale wildlife subsistence poaching it does not however address the issues pertaining to the IWT in rare or endangered species. The nature of these poachers differs, they are usually linked with wealthy criminal syndicates along with being armed with weapons, and would not hesitate to threaten or harm any

community based antipoaching scouts that are based outside the protected areas, this is supported by (Vundla, 2019). What is generally the case is that under resourced and capacitated law enforcement officers fail to respond to safety concerns of the communities, thus perpetuating a negative relationship between communities and conservation officials. With this knowledge other methods have to be used to protect the parks integrity and safety of the animals, anti-poaching patrols that use armed rangers and specialised K9 units are more successful in detecting and apprehending poachers than the use of expensive drones that require high maintenance and expensive technology that is not refined enough to accurately detect poachers in situ (Autonomous Anti Poaching Drone, 2019). However, on smaller reserves drones do have a highly dissuasive effect on poaching (Drones Are a Knife in the Gunfight Against Poaching. But They're Leveling Up, 2022). Thus, it would be erroneous to write off drones as ineffective but rather as an added dissuasion technique if budget and time allows for it. Dehorning rhinos has been successful in increasing the lifespan of rhinos across Southern Africa, from Zimbabwe, Namibia to South Africa. Dehorned rhinos enjoy a 29.1% higher chance of not being targeted by rhino poaching syndicates than rhinos that have not been dehorned (Du Toit (2011)). Dehorning is an expensive undertaking with the costs thereof increasing with increased reserve size due to the lower population density of rhinos. Costs are less in reserves that are smaller in regard to rhino population density (Atkinson,1993). Along with the fact that dehorning needs to happen every 12 to 24 months. However, it is vital that the reserve or protected area does not solely rely on dehorning to protect their rhinos. An example from Zimbabwe showed that even though the rhinos were dehorned in a particular reserve it did not stop poachers from killing a large majority of rhinos when the anti-poaching unit was disbanded due to disrupted funding (Lindsay and Taylor, 2011). Adequate security is vital and boots on the ground will never be obsolete.

Certain reserves around Southern Africa have dyed and treated their rhinos' horns so that they are unfavourable for consumption or unsuitable for making trinkets and other status objects. This method works on the principle that the poachers would know that the rhino horns are treated, however rhino horns grow, the dye fades and the horns get dirty with blood or dust once the horn has been cut. Ground level poachers do not care about the final user as they would still get paid for the horn by intermediaries, thus rendering this method useless (Save the Rhino International, 2022). This will also increase the price of untreated rhino horn essentially creating 2 commodities from 1, ending up with increased pressure on rhinos with untreated horns.

The method with the best immediate result is the "shoot on sight", poachers are eliminated immediately after a positive visual identification. This method has been accredited to Botswana's successful conservation programs and is considered one of the best in the world. However, ethically charged challenges arise with questions being raised of "does an animals life outweigh a humans?". Court

cases have been opened against anti-poaching units in other areas of Africa as they have essentially taken power into their own hands and in some cases have murdered relatives of poachers or have used their power to settle arguments or fights in the ranger's personal lives. According to (Lunstrum et al., 2021) shoot to kill policies exacerbate poverty in the long run. The only two countries to have the shoot to kill policy on poachers currently is Zimbabwe and Botswana. For this method to work supervision and training has to be of utmost importance to avoid unnecessary death and unjust executions.

In light of the above there is not one best method or policy to prevent poaching, some methods are more effective than others. Links to communities that are directly outside the protected areas or reserves should be valorised, communities should have an economic incentive that valorises the animals that live close to the village. Multiple variations of CBNRM exist, from providing agricultural land that is fenced off for the sole purpose of farming, providing hunting quotas of non-endangered species or employing people from the local area and gradually training them up so that they may hopefully be able to start and run their own business. The first step however would be for every tourist to have to pay 5 to 10 dollars entry fee which goes to a head chief of the community so that the funds may be allocated in bettering the community along with building awareness of what the tourists are actually doing in their country and what the tourists want to see.

In order to prevent the poaching of protected and rare species different techniques have to be used, I would strongly recommend the use of anti-poaching units paired with K9s, dogs superior sense of smell allows for rapid and accurate tracking of poachers. The use of K9s has been extremely effective in the South Africa and Zimbabwe. Rhinos should be radio collared and dehorned, this will both allow for relatively easy tracking to monitor the animals on a regular basis and as an added dissuasive factor. Poachers may not have the same incentive to risk their lives poaching an animal with a decreased value.

The following is what I would recommend as a step-by-step prevention of poaching on a reserve or protected area.

1.   Select and train anti-poaching personnel from the surrounding communities, this process has to be extremely rigorous in order for trust to be established. Patrols have to be carried out in areas where the presence of poachers would be most likely. Other options include contracting private Anti-poaching operators, this has the advantage of employing professionals who are highly effective at preventing and apprehending poachers. These companies come with all the necessary equipment, the better option being to contract companies that utilise K9s.

2.   Proactive information gathering from the adjacent communities, through the use of paid informants. This will help apprehend the poachers before they arrive in situ to carry out the poaching. Or

to direct the APUs and police to compounds or poachers camps where bushmeat or other animal products are being hidden before it is sold.

3.   Deployment of Anti-poaching rangers based on the information received.

4.   Apprehension and prosecution of the poachers, thorough knowledge of law is expected if poachers are to be effectively apprehended and prosecuted, evidence needs to be handed over to the respective authorities e.g., weapons, ammunition, cell phones, wildlife products .

5.   Rhinos should be dehorned rather than having the horn poisoned and dyed, as the latter creates more issues than positive outcomes.

6.   A community based natural resource management system needs to be put in place, so that local communities can benefit from the wildlife directly providing the local people with an invaluable incentive to protect the natural resource.

7.   Meetings should be held with the surrounding communities in order to identify key points that the reserve/PA can help with. E.g. human /animal conflicts, poverty alleviation or providing meat .

8.   In extreme cases where the poaching threat is dangerous to the rangers themselves, a shoot to kill policy should be initiated, however it cannot be done if the countries laws do not provide for this.

6. Acknowledgements

An Anti-poaching ranger's best friend, the invaluable k9. This is a picture of me in 2017, helping defend the defenceless.

Figure 10: A man's best friend

A rhino that has been shot by poachers however the horn has not been removed. Vetenary services have stepped in to dart the animal and investigate its chances of survival.

Figure 10: A poachers victim with a grim chance of survival

7. Bibliography

https://www.nationalgeographic.com/animals/article/wildlife-watch-illegal-trade-lions-teeth-claws-poaching

https://www.researchgate.net/publication/277140144_Ethnozoological_survey_of_traditional_medicinal_uses_of_tortoises_in_Lentsweletau_and_Botlhapatlou_villages_in_Kweneng_district_of_Botswana_MR_Setlalekgomo [accessed Nov 07 2021].

https://www.iol.co.za/saturday-star/man-arrested-for-alleged-sale-of-pangolin-28440750

Andrews, C. (2022, August 18). How Drones Can Help Save Elephants and Rhinos from Poachers. IEEE Spectrum. Retrieved October 4, 2022, from https://spectrum.ieee.org/drones-wildlife-poachers-africa

Autonomous anti poaching drone. (2019, March 8). ArduPilot Discourse. Retrieved October 4, 2022, from https://discuss.ardupilot.org/t/autonomous-anti-poaching-drone/25344/98

Biello, D. (2007, February 26). DNA Test Pinpoints Elephant Poaching, Aiding Conservation. Scientific American. Retrieved October 4, 2022, from https://www.scientificamerican.com/article/dna-test-pinpoint-elephant-poaching-aiding-conservation/

Biggs, D., Ban, N. C., Carlos, J., Gelcich, S., Mills, M., Gandiwa, E., Etienne, M., Knight, A. T., Marquet, P. A., & Possingham, H. P. (2019). Insights on fostering the emergence of robust conservation actions from Zimbabwe ' s CAMPFIRE program. Global Ecology and Conservation, 17, e00538. https://doi.org/10.1016/j.gecco.2019.e00538

Bond, I., Goredema, L., & Taylor, R. (2007). Empowering Rural Communities to Manage Wildlife : Lessons learned from WWF SARPO ' s Support to CAMPFIRE Project 1993 - 2002 Empowering Rural Communities to Manage Wildlife : Lessons learned from WWF – SARPO ' s Support to CAMPFIRE Project 1993-2002. Development, 14, 1–28.

Cooney, R., Roe, D., Dublin, H., Phelps, J., Wilkie, D., Keane, A., Travers, H., Skinner, D., Challender, D. W. S., Allan, J. R., & Biggs, D. (2017). From Poachers to Protectors: Engaging Local Communities in Solutions to Illegal Wildlife Trade. Conservation Letters, 10(3), 367–374. https://doi.org/10.1111/conl.12294

Cumming, D., & Jones, B. (2005). Elephants in southern Africa: management issues and options. WWF-Sarpo Occasional Paper Number 11, Harare. i–98. http://d2ouvy59p0dg6k.cloudfront.net/downloads/cumming___jones__2005__elephants_in_sthn__africa___mgmt_options___issues__wwf_sarpo_occ_.pdf

Emslie, R. H., Milliken, T., Talukdar, B., Burgess, G., Adcock, K., Balfour, D., & Knight, M. H. (2019). Status, conservation and trade in African and Asian rhinoceroses. Traffic, 10(2018), 10–14.

Ferreira, S., Hofmeyr, M., Pienaar, D., & Cooper, D. (2014). Chemical horn infusions: A poaching deterrent or an unnecessary deception? Pachyderm, 55(55), 54–61.

Financial Flows Associated With. (2021). November.

Hübschle, A. (2016). Security coordination in an illegal market: the transnational trade in rhinoceros horn. Politikon, 43(2), 193–214. https://doi.org/10.1080/02589346.2016.1201377

Jones, B. T. B. (1999). Policy lessons from the evolution of a community-based approach to wildlife management, Kunene Region, Namibia. Journal of International Development, 11(2), 295–304. https://doi.org/10.1002/(SICI)1099-1328(199903/04)11:2<295::AID-JID583>3.0.CO;2-U

Lunstrum, E., Givá, N., Massé, F., Mate, F., Lopes, P., Lunstrum, E., & Massé, F. (2021). The rhino horn trade and radical inequality as environmental conflict. https://doi.org/10.1080/03066150.2021.1961130

Massé, F., Gardiner, A., Lubilo, R., & Themba, M. N. (2017). Inclusive anti-poaching? Crime Quarterly, 60, 19–27.

Mogomotsi, G. E. J., & Madigele, P. K. (2017). Live by the gun, die by the gun: An Analysis of Botswana's 'shoot-to-kill' policy as an anti-poaching strategy. South African Crime Quarterly, 60, 51–59. https://doi.org/10.17159/2413-3108/2017/v0n60a1787

Mukwazvure, A., & Magadza, T. B. H. T. (2020). A Survey on Anti-Poaching Strategies. June 2014, 1–4.

Mulero-Pázmány, M., Stolper, R., Van Essen, L. D., Negro, J. J., & Sassen, T. (2014). Remotely piloted aircraft systems as a rhinoceros anti-poaching tool in Africa. PLoS ONE, 9(1), 1–10. https://doi.org/10.1371/journal.pone.0083873

Ogden, R. (2010). Forensic science, genetics and wildlife biology: Getting the right mix for a wildlife DNA forensics lab. Forensic Science, Medicine, and Pathology, 6(3), 172–179. https://doi.org/10.1007/s12024-010-9178-5

Padgett, B. (1995). The African Elephant, Africa, and CITES: The Next Step. Indiana Journal of Global Legal Studies, 2(2), 9.

Project, C. C. (2019). Portugal's Constitution of 1976 with Amendments through 2005. 1–110.

Rogan, M. S., Lindsey, P., & McNutt, J. W. (2015). Illegal Bushmeat Hunting in the Okavango Delta, Botswana: Drivers, Impacts and Potential Solutions. In Report (Issue February).

Simasiku, P., Simwanza, H., Tembo, G., Bandyopadhyay, S., & Pavy, J. (2008). The impact of wildlife management policies on communities and conservation in Game Management Areas in Zambia: Message to policy makers. Edited by CL Buus, ..., April, 4 pp. http://www.aec.msu.edu/fs2/zambia/resources/Final _NCRF.pdf

Stein, A. (2001). Participation and sustainability in social projects: The experience of the local development programme (PRODEL) in nicaraguna. Environment and Urbanization, 13(1), 11–35. https://doi.org/10.1177/095624780101300103

Steiner, K. W. (2020). Green Eyes: the current role of intelligence in African counter-poaching. African Security Review, 29(2), 202–222. https://doi.org/10.1080/10246029.2020.1781671

Sustainable, A., & News, C. (2018). News, analysis and comment on conservation and wildlife issues in Africa Kenya – can electrict fences stop human- elephant conflict in Laikipia? June.

Vorlaufer, K. (2002). CAMPFIRE - Die Politische Ökologie der Armutsbekämpfung, Wildtiernutzung und des Biodiversitätsschutzes in Zimbabwe. Erdkunde, 56(2), 184–206. https://doi.org/10.3112/ERDKUNDE.2002.02.06

Vundla, N. L. (2019). Mangalane community's perceptions of poverty as factors influencing involvement

in rhino poaching: A case study of Mozambique. April, 99. https://scholar.sun.ac.za

Wasser, S. K., Brown, L., Mailand, C., Mondol, S., Clark, W., Laurie, C., & Weir, B. S. (2015). Genetic assignment of large seizures of elephant ivory reveals Africa's major poaching hotspots. Science, 349(6243), 84–87. https://doi.org/10.1126/science.aaa2457

Xu, L., Guan, J., Lau, W., & Xiao, Y. (2016). Xu et al_ 2016_An Overview of Pangolin Trade in China.