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Wildlife poaching in Ethiopia: remedy for conservation and preservation

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Abstract
Tremendous efforts are ongoing throughout Africa for the conservation of endangered species. The national and international law enforcement agencies are fight a constant war against poaching. It is difficult to safeguard wildlife because of the ever-growing hazards that poachers pose to the creatures they seek, issues with growing populations and human encroachment, and climate change. An intricate network of illicit activities spanning thousands of miles from Africa to global destination markets includes the killing of an endangered animal. The situation in Ethiopia is not very different from other countries of Africa. Poaching is still continuing in some interior regions unabated. Coping up with the poachers is a challenging job for the law enforcement agencies of Ethiopia. Identification of confiscated animal parts is also another challenge. Molecular diagnostics, pathological tests, and identification of morphological studies are some of the important tools used in wildlife crime scene investigations. While DNA analysis is a powerful tool for animal/plant/wildlife protection and biodiversity conservation, it faces several challenges compared to human forensic. Due to species diversity it is difficult to develop optimal genetic markers compared to the human. Moreover, Ethiopia is a developing country building the infrastructure and expertise required for widespread DNA analysis is not possible. Financial constraints is one of the major driving factors for poaching, proper education and providing alternative means of employment to the local communities may help to reduce the incidence of poaching. Alternately, development of protected wildlife parks is another solution that should be explored.
Keywords: Wildlife, conservation, forensics, poaching, law enforcement, Ethiopia

Introduction

A multifaceted fight to conserve endangered species is ongoing across Africa (Gundu and Adia, 2014). The continent-wide technical arms race between conservationists, law enforcement, national governments, and the international community against poachers has been growing, despite the fact that poaching of endangered, at-risk, and nearly extinct wildlife is not a recent occurrence (Sherriff, 2019). It is difficult to safeguard wildlife because of the ever-growing hazards that poachers pose to the creatures they seek, issues with growing populations and human encroachment, and climate change. An intricate network of illicit activities spanning thousands of miles from Africa to global destination markets includes the killing of an endangered animal. Activities that violate local, national, or international legislation and endanger wild animals, plants, or their habitats are referred to as "wildlife crimes." unlawful take or poaching, unlawful possession, illegal commerce, import, or export, and harm or harassment of protected animals are the four main categories into which wildlife crime is classified. Crimes can vary in severity, from small-scale acts like shooting animals for sustenance without a permission to large-scale crimes like the illegal international trafficking of endangered species (Curtis et al., 2021).

Numerous plants and animals are trafficked annually; in 2016, about 1,000 rhinos were killed for their body parts in South Africa alone, and almost 20,000 African elephants were killed. The world's most illicitly traded mammal is the pangolin. Between 2000 and 2016, an incredible 70,000 animals are thought to have been poached annually on average for the black market (WWF). Many of our most lovable wild animals are among the numerous endangered species whose condition is being severely impacted by the illegal wildlife trade (Ogden and Linacre, 2015). In order to combat the trade, which has drawn attention from all throughout the world, coordinated international initiatives are being made. These efforts include supporting alternative livelihoods in source nations, enforcing the law, and lowering demand for wildlife items in end-user countries. Investigations at many levels are necessary for law enforcement, which ranges from local bush meat poachers to global organized crime groups. To find and apprehend criminals, detectives use forensic science, just as in any other case.

A subfield of forensic science called wildlife forensic science examines and analyzes crimes involving wildlife. In order to find and bring charges against those responsible for crimes against wildlife, scientific procedures must be applied for the collection, analysis, and interpretation of evidence (Sneha, 2023). Wildlife forensics encompasses all of the available analytical techniques that may be employed to investigate crime against wildlife, including ballistics, fiber analysis, toxicology and veterinary pathology (Wallace and Ross, 2012). Molecular genetic analysis has revolutionized forensic science by identifying human evidence, and it is now a standard tool in law enforcement. Questions like species identification, captive breeding, regional origin, and individualization across numerous species are addressed through the analysis and identification of wildlife DNA (Ogden R. et al., 2010).

Poaching Scenario in Ethiopia

Poaching has developed into an international organized crime that poses a serious existential threat to many wild species and is a significant factor in the loss of biodiversity (Tessema et al., 2021). These days, poaching is carried out through extremely well-organized, networked, and technologically advanced methods (Gebretensae and Gebremicael, 2018). Poaching and illegal wildlife trade in Africa has brought many fauna species to the brink of extinction (Meduna et al., 2009). Over time, poaching has become a major worry for the world community since it is recognized as the most direct and urgent threat to wildlife in Africa. Some regions of Ethiopia, such as Gambella, Ethiopian Somalia, and the Afar provinces, have historically used poaching as a means of subsistence farming (Amare, 2015). Hunting is still continuing in these regions unabated (Figure 1). Trophy hunting was very popular in Ethiopia in the 1970s, but since then, there has been a significant decrease in the area used for the sport due to factors like political unrest, encroachment on wildlife habitat, and growing human populations. Hunting trophy animals, such as buffalo or elephants, brings in a lot of money for safari operators and supports rural communities. *Trogelaphus buxtoniis*, or mountain Nyala, is the most popular species utilized by operators to draw in foreign hunters to Ethiopia. However, the population of many large animals and the areas where tourists visit are badly impacted by the overexploitation of wildlife resources.

Figure 1: Illegal wildlife poaching in the Gambella region of Ethiopia

Based on the 117 skins of leopards that were seized from 2011-2019, it could be inferred that the most poaching-prone areas of Ethiopia are in Metema (the border between Ethiopia and Sudan), Bahirdar, Humera, and Bambasi (Gebretensae and Messele, 2022). Ethiopia has lost about 90% of its elephant population since the 1980s, making the animal critically endangered according to national statistics. There are currently between 1500 and 2000 elephants thought to exist in Ethiopia (Dejene, 2016). Poaching of elephants for ivory and habitat destruction was attributed as the major causes for the disappearance from large areas of Ethiopia. Ethiopia seems to be dealing with an increasing problem of poaching and trafficking in recent times, which is linked to networks of organized crime and cross-border trafficking. The illegal wildlife trade has increased dramatically in recent years due to the high demand for wildlife items, poor institutions, and insufficient preventative measures (Gebretensae and Messele, 2022).

Techniques used in wildlife crime investigations

The illegal seizing, possession, trading, or transportation of animals, plants, or their derivatives in violation of international, regional, or national laws is categorized under wildlife crime (Cooper et al., 2009). An region where an act that led to a wildlife crime occurred is known as a wildlife crime scene. "Every contact leaves a trace," according to Locard's Exchange Principle, is the fundamental tenet of crime scene management (Wildlife Law). Investigating wildlife crime scenes is crucial because it helps identify the offender and establish a link between them and the evidence. There are three different kinds of crime scenes: transportation crime scenes, outdoor crime scenes, and indoor crime scenes. An interior crime scene has less exposure to contamination, is simple to secure, and is straightforward to demarcate. An outdoor crime scene is challenging to secure and demarcate, as it is susceptible to weather and contamination. A transportation crime scene is challenging to explore but is simple to secure, demarcate, and has little contamination exposure.

Partnership for Action Against Wildlife Crime (PAW) is a collaboration of organizations who work together to reduce wildlife crime. This organization offers helpful guidelines for investigating wildlife crimes through the use of forensic and other specialized procedures. Information on specimen identification, taxidermy, forensic veterinary pathology, pesticide analysis and poisoning, DNA technology, and other laboratory-based methods are all included in PAW. Molecular diagnostics, pathological tests, and identification of morphological studies are some of the important tools used in wildlife crime scene investigations (Cooper and Cooper, 2008a). These investigations are the backbone of forensic analysis and aids in accurate identification of confiscated specimens, more about these investigations are discussed here:

i) ***Morphological method*** – a set of recommendations and additional best practices for morphological analysis have been accepted by the professional organization for wildlife forensic practitioners, the Society for Wildlife Forensic Science (SWFS) (Trail, 2021). Accurate identification of animal products or derivatives is essential to all wildlife crime investigations. Occasionally, the species or its components (derivatives), such as a dead parrot, a snake hide, or a deer's antlers, are easily identifiable as belonging to a specific taxon. In these situations, identification typically entails morphological investigations, such as the analysis of bones or hair, in conjunction with DNA technologies, such as PCR and sequencing, to identify specific, particularly cryptic taxa. Taking a variety of pictures (Figure 2) at the beginning makes it easier to identify animals as a whole or as individual pieces (Cooper and Cooper, 2008b). This is especially true for species that undergo fast morphological change during decomposition, like fish, amphibians, and cetaceans. The first step in determining the nature of the samples, ruling out synthetic fiber origins, differentiating between human and animal hair, and attempting to identify the species is the first approached done with microscopic analysis. This method is crucial for comparing

the characteristics of the hair under investigation with those taken from a known individual. When identifying animal hair, it's crucial to pay attention to features such sizes and forms, color banding, cuticular patterns, medulla organization, root structure, and scales. Furthermore, accurate sample identification depends on a sufficient reference collection. In fact, if a complete and precise reference sample of animal hairs are not available then it becomes very difficult to precisely identify the species as there exist a wide differences among animals of the same species. Since visual identification can be used to instruct law enforcement officers in the field to use identification keys or to get first impressions using digital photos and mobile communications, it is a very effective and quick screening test. Its utility in forensic analysis is, however, constrained by the availability of specialists who can carry out a thorough, impartial investigation that satisfies legal requirements. This restriction limits the application of visual identification in wildlife forensics, especially in nations without reputable natural history institutes that have qualified staff members and suitable reference collections. Even while the technique is sound, it does seem that courts are looking more and more for less subjective alternative modes of identification.

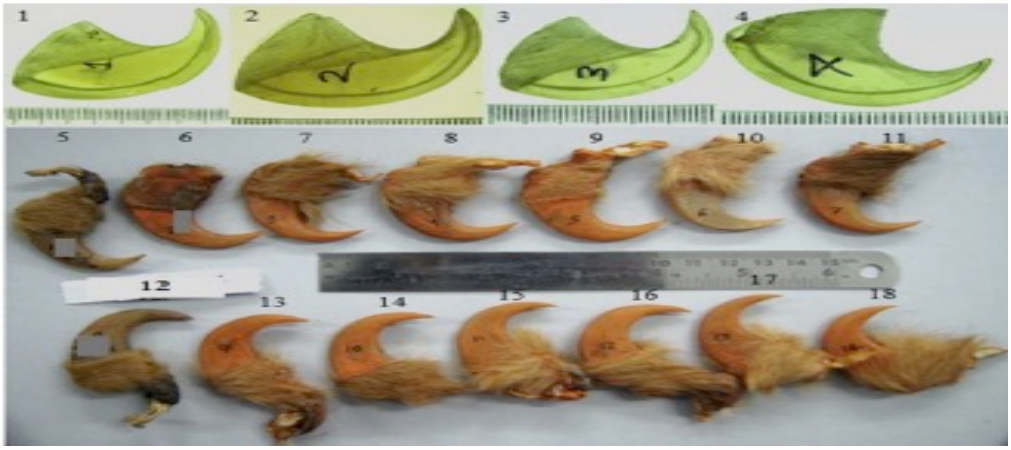

Figure 2. Morphological and structural specimens for investigation

ii.) ***Molecular diagnostics method*** **-** Development of genetic studies of wildlife species (game or protected ones) within the last two decades has only been possible by the support of molecular genetic analyses. The extent of conservation genetics applications was proportional with the development of individual biological disciplines as population genetics, phylogeography and phylogeny as well as molecular ecology and taxonomy. One of the conservation genetics applications is the development of molecular techniques suitable for identification of species and individuals for the purposes of wildlife forensic genetics (Asmelash et al., 2017). Wildlife forensic genetics deals with the proofs of identification of species, populations and relatives, and individuals (Sandoval-Arias et al., 2023). Wildlife forensics comprises of DNA sequencing of both nuclear and mitochondrial, phylogenetics, taxonomy, evolutionary genetics and bioinformatics (Gouda et al., 2020). These techniques have revolutionized the investigation of wildlife crime (McDowall, 2008) and make it possible to identify and distinguish between compounds belonging to various species and supply genetic diversity data that can help with the preservation of threatened animal species (Hogg et al., 2022).

Polymerase Chain Reaction (PCR) makes it possible to identify individuals from miniscule sample such as blood, body fluid, tissue, muscle, etc., is especially useful in forensic investigations. Although PCR is comparatively cheap, it does require expensive equipment and personnel with specialized training. However, it have a very high sensitivity and specificity that can aid in detection of wildlife crime (Mukantayev et al., 2022). This technology is often used adjunct to other identification methods in legal matter. Another molecular tool, RT-PCR provides a fantastic opportunity to further map the species with minimizing disturbance by use feces for analysis (Ripa et al., 2024). However, when collecting biological evidence, it is crucial to be mindful of the fact that DNA evidence is easily contaminated and degrades in certain environments. Thus, it is best to gather samples from a crime scene as soon as feasible.

iii). ***Pathological method*** **-** Certain field investigations aim to determine the cause of death in addition to identifying animal corpses and tissues. Whenever possible, post-mortem exams ought to be carried out by a qualified pathologist (Cooper and Cooper, 2008a; Cooper and Cooper, 2008b). Finding sores, wounds, bruises, abscesses, and scars can be crucial in figuring out how and when a wild animal passed away or how healthy it

was before. In addition to taking samples, pictures must be acquired so they can be used as supporting documentation in court. Digital imaging makes it possible to distribute images to professionals throughout the globe.

It's important to distinguish between wild animals that humans have killed or injured and those that have been attacked by predators, such as domesticated dogs or cats or free-living raptors or mongooses. This may not be easy. Mass kills of ground-roosting or nesting birds may be the result of some mammalian predators; in such cases, detective work, including the detection of traces, will be required to piece together the events that led up to the massacre. The location of the death, such as whether parts of the prey are cached or strewn, may help identify which predator killed the animal, as can tooth, beak, or claw/talon marks.

Wildlife crime and the Society

Despite the tireless efforts of numerous authorities and groups dedicated to wildlife protection, approximately 70% of wildlife violations remain unpunished due to misidentification of species or confiscated materials (Gouda et al., 2020). Wildlife crime is very profitable, has little possibility of being discovered, and carries mild consequences even when caught. Seldom does the maximum fine for the alleged incident equal the possible profits (Li, 2007). It is challenging to determine the precise scope of wildlife crime because so much may go unreported, unknown, or unrecorded. By their very nature, poaching of protected species can take place in secluded, distant locations with no observation. Any form of poaching has the potential to yield large cash benefits, little chance of legal action, and relatively light penalties for those found guilty of crimes involving wildlife. The illicit wildlife trade is a $44 billion annual industry, (Interpol, 2023).

In addition to being an essential component of biodiversity, wild animals are also crucial to ecological processes including pollination, seed distribution, and decomposition. In addition, wildlife serves as a source of food and clothes, is significant for tourism, recreation, and cultural purposes, and is seen as an aesthetic and cultural symbol in the majority of the world (Elisha and Felix, 2020). Many goods and ecosystem services that support human well-being are made possible by biodiversity, such as the production of wood and other wild resources, the cleaning of water and air, oxygen, medicine, and advantages for spirituality and culture. For a number of reasons, many species of wildlife are in danger of being extinct, and we have already lost many species to extinction. The primary reason for these population decreases is habitat loss; other significant factors include pollution, invasive species, overexploitation by humans, and climate change (Hald-Mortensen, 2023). Numerous animal and plant species are being exploited and being destroyed as a result of the illicit trade. This has detrimental effects on socioeconomic conditions both locally and globally. A legal system that protects wildlife and holds organized syndicates accountable for their financial gain from this destructive trade must prioritize the prevention and investigation of wildlife crimes (UNEP, 2016). Wildlife forensics science, is now a recognized forensic specialty is now playing a critical role in wildlife law enforcement (Huffman and Wallace, 2012). As crime rates rise, a variety of forensic procedures are being used more frequently, and their sophistication is only improving. For instance, over the past 20 years, developments in DNA technology have completely changed how many crimes are investigated. Numerous offenses pertaining to animals can also directly benefit from the adoption of these techniques.

Challenges of Wildlife Forensics

While DNA analysis is a powerful tool for animal/plant/wildlife protection and biodiversity conservation, it faces several challenges compared to human forensic genetics: i.) Species Diversity - the vast number of species on earth, compared to the human, makes it difficult to develop optimal genetic markers for all. Each species may require unique markers for accurate identification; ii.) Research Focus - historically, wildlife and plant geneticists haven't collaborated as closely with forensic scientists. This has led to the development of genetic markers and methods that may not meet the rigorous standards required for holding up in court; iii.) Financial Constraints - poaching and illegal wildlife trade often occur in regions with limited financial resources. This makes it difficult to invest in building the infrastructure and expertise required for widespread DNA analysis; iv.) Competing Priorities - unfortunately, crimes against wildlife and plants often take a backseat to crimes involving human victims. This means less funding and overall focus on developing and implementing DNA forensic techniques in this area. As a result, these challenges have limited the application of DNA analysis in protecting biodiversity, except for a select few commercially valuable or domesticated species (Iyengar, 2014).

Conclusion

Conservation of endemic wildlife species of Ethiopia is of utmost important for the country (Desalegn, 2023).

However, poaching of wildlife still continues in certain areas unabated despite all efforts by the law enforcement agencies. Moreover, proper identification of confiscated animal parts is another big issue. Unlike human forensics the wildlife forensics still not have developed universal genetic markers. Despite best efforts from biologists and forensic scientist to produce irrefutable evidence before the law is not always possible. On the other hand poaching has now turned to an organized crime, so catching the main persons in this syndicate is difficult. Moreover, poaching and illegal wildlife trade often occur in areas with limited resources (Knapp et al., 2017), hindering investment in proper forensic facilities and trained personnel in remote locations. Unfortunately, crimes against wildlife often receive less attention compared to crimes against humans. This translates to less funding and focus on wildlife forensic techniques. These challenges limit the widespread application of DNA analysis in protecting wildlife, except for commercially valuable or domesticated species. This has resulted in difficulties to produce evidence for judicial proceedings. Most of the time the perpetrators goes unpunished because of lack of proper evidence. Financial constraints is one of the major driving factors for poaching, proper education and providing alternative means of employment to the local communities who are engaged in this illegal trade may help to reduce the incidence of poaching. Alternately, development of protected wildlife parks is another solution that should be explored. There are no immediate quick fix solutions for poaching, a proper long term planning for Sustainable Development Goals (SDGs) may be a solution to reduce poaching in Ethiopia.

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