

Application of Forensic Science in Wildlife Crime

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Abstract

Wildlife crime includes the poaching, illegal hunting or killing and trading of wildlife flora and fauna, or the derivatives obtained from them. Wildlife crime should be investigated thoroughly and is needed very much depend on the current scenario of dramatic wildlife depletion. Various forensic methods which are applicable to the imposition of wildlife jurisprudence consist of: veterinary pathology, in which the personnel is expertise to determine the time of death, cause and manner of death in wildlife cases as in human related post-mortem cases; investigation of scene of crime, to collect & record all the evidences related to both humans and animals, all the relevant data should be recorded in written form. The two important issues discussed to express the different types of wildlife legislations. The first issue is the proficiency in species identification and the second is to determine the proficiency of relating a material from biological origin to a particular individual of that species. The article aims to discuss different approaches of forensic science and its various tool & techniques that can be used in solving the wildlife crimes.

Keywords: Forensic Science, Poaching, Flora, Fauna & Wildlife Crime.

Introduction

Wildlife crime involves the crime against wildlife [1] and is increasing day-by-day and has marked effects with the depletion of various wildlife species. Various approaches of forensic science are taken to fight against the crimes against wildlife and is needed very much in the current scenario depending upon the size and threat to wildlife. [2]

Various forensic methods which are applicable to the imposition of wildlife jurisprudence consist of: veterinary pathology, in which the personnel is expertise to determine the time of death, cause and manner of death in wildlife cases as in human related post-mortem cases; investigation of scene of crime, to collect & record all the evidences related to both the humans and animals [3]. Morphological & anatomical techniques, microscopic examination of hairs, fur and feathers are the first step in species identification. Ballistics is used to compare the bullets and fired cartridge cases found at the scene of wildlife crime with the reference samples on the basis of striations & impressions found on them and also to link it with the suspected firearm used to fire it. Examination of document is done to determine the originality of documents such as license, stamp, signatures of officials used in forging the documents for illegal trading & trafficking of wildlife plants and animals, as whole or their parts, or derivatives. Elemental profiling is done to find the geographical origin on the basis of abundance of elements and analysis of DNA for species determination and to link it to a single individual.

Thus, it should be noted that various techniques of forensic science can be used as safeguard to solve the wildlife crime. Various tools and techniques are applied in forensic science, but depend on the allegations, purpose and nature of evidences the techniques vary. The different

types of evidences that can be encountered in investigation of wildlife crimes highly vary as the source of evidences vary from amphibians to mammalian species, fragments of wood to complete flowers, & from whole skin to oils and powders or any other derivatives. Techniques of testing such evidences varies with the nature of evidences and the allegations made.

Points to be taken care during the investigation of wildlife crime scene are:

1. Accurate knowledge about the facts and events of the alleged offence should be recorded in the written form.
2. Discussion with the personnel involved in reporting the incident, in bringing charges or initiating the investigation. A written statement of all these discussions should be made. [4]
3. Species identification of animal involved in the alleged offence should be done correctly.
4. Crime scene visit or the premises consisting of live or dead animals needed to be observed or their derivatives can be examined.
5. Various environmental parameters such as weather conditions etc. should be recorded immediately.
6. Collection, handling, transportation, storage and submission of trace evidences & evidences should be done properly and all the relevant data should be recorded in written manner.
7. Documentation and record-keeping should be done with care, consisting of photographic records, sketching etc. leading to production of a report.

Analysis of Wildlife Crime and Forensic Techniques

Forensic science is utilized for the assessment of wildlife crime to solve the legal matter associated with crimes against wildlife. Specific characteristics of protected species and seized materials are used for identification of species in laboratories. The list of techniques being utilized now-days for species identification of wildlife are analysis of footprints, morphological studies as microscopic examinations, histological and anatomical studies etc., serological methods and techniques of molecular biology. Inductively coupled plasma atomic emission spectroscopy & radiotracer techniques are most commonly used techniques to determine the geographical origin of the wildlife animals.

Morphological Analysis

The simplest way of identification of wildlife animal is based on their physical or morphological characteristics and is the cheapest methods to use for the purpose. The identification mostly based on their external appearance of wildlife. Species of different flora and fauna usually possess different physical characteristics such as patterned skin coat, different colour of skin, pinna, eyes, tail structure, ivory, teeth etc. Ivory is a form of dentine present in elephants and are usually traded illegally. These have unique features of pattern known as Schreger. An angled pattern of characteristics is also found in ivories that is the basis of species identification among the elephants. [20, 21]. Anatomical, microscopic and morphological analysis are helpful in species identification if whole skeleton or skin is found as an evidence at wildlife crime scene. [22]. Specialised qualification and database made from the known samples are very

important for identification on the basis of morphology. Morphological assessment is the assessment of structure and form of evidences such as feathers, fur, hairs, remains of skeleton, small or whole animal's parts, leaves, birds, twigs, wood, pollens, skins of amphibians, reptiles, scales of fish, insects, other wildlife animals, whole plants, and products made from them. All these evidence samples should be examined and compared with the reference samples provided in monographs & taxonomy keys of the available species. The big problem faced with morphological identification is the non-availability of the whole animal or its part intact and also the morphological assessment is limited to genus level or higher taxonomic levels of animal.

Footprint Analysis

Footprints are prints made up of foot of animals on the surfaces they have walked on or their captivity places. On the basis of footprint patterns and their size the age and type of the identification of species can be done. The problem faced by wildlife investigator in footprint analysis is the non-detectable footprint made on hard surfaces or due to contamination of footprints with the other animals present at the sites of footprint.

Microscopic Examination

Microscopic examination includes the analysis of element, morphology & pattern of cuticular scale of the hair [23]. Hairs are most commonly used for species identification. [24,25]. SEM is commonly applied for the species identification of animals on the basis of hair. [26]. SEM provides high magnification & coupled energy dispersive spectra that leads to the geographical identification of species based on elements present in them such as Na, K, Ca, & S [23,27]. A database of scale pattern of hair of different mammalian species has been made in Australia & Europe [29].

Serological Techniques

This technique bases on the interaction between antigen and antibody such as lock & key model. Species of origin of biological evidences are identified using species specific antibodies. The non-availability of species-specific antibodies is the major problem with serological techniques. It is considered as presumptive test in the forensic science as it has been widely reported that cross-reaction of antibodies in non-target species give positive results. [30-33].

Molecular Biology Techniques

In investigation of wildlife crimes concerned with poaching from protected areas and national parks techniques of molecular DNA is widely used in countries such as Italy and South Korea. [34]. Molecular biology techniques are proved as more reliable techniques compared to others such as morphology, anatomy, serology and microscopic. Random Amplified Polymorphic DNA, Amplified Fragment Length Polymorphism and Random Fragment Length Polymorphism are initially utilised in techniques based on DNA. [35-37]. The major problem with molecular DNA technology is reproducibility and limited database of reference samples. The band patterns are affected by concentration of primer, dNTPs, buffer and template quality. [38]. The work based on DNA marker in the field of forensic wildlife is in advance and needed to explore more for fauna and flora of wildlife.

To detect the origin of ivory of elephant in poaching cases the work on extracting DNA & nuclear &mtDNA amplification have been done. [40]. To identify the species and

establishing relationship between different species DNA markers are commonly used. A report has been made on the merging of genetic biodiversity forensic with biological research in Canada for conservation and to establish NRDFC (Natural resources DNA profiling and Forensic Centre) for DNA profiling & extraction of wildlife. Such organisation is needed in India for DNA profiling and preparation of database of wildlife animals.

The biopolymer such as protein is more stable compared to DNA polymer and hence is a new developing technique for population identification. [42-45].

Infra-Red Techniques

A study reported that spectroscopic range such as mid-IR, near-infrared range & Raman together with techniques of chemometric are efficient enough to distinguish the species & also can identify the geographical origins of wildlife flora used as herbal medicines. [46,47]. Near-infrared is most commonly used spectroscopy due to its cheap rate, high reliability and effortless assessment of biological origin evidences [48-50]. Hence, near-infrared is applicable in wildlife identification.

Inductively coupled plasma atomic emission spectroscopy

This technique is utilized to determine the concentration of different metal ions present in a sample. The concentration of metal ions in samples of animal is in connection with their habitat and is the basis of determination of place of origin. In species identification of burned and fragmented remains due to natural disasters, fires and explosions bones are utilized. [55-58]. Histological assessment is utilised for distinguishing the species as the anatomical features of bone could be damaged. [59]. In such cases, inductively coupled plasma is a good choice to determine the concentration of eight elements such as Al, B, Ca, Fe, Pb, Mg, K, & Na in the fragments of bone. A study reported that the differentiation of dehumanised bones can be effectively done on the basis of presence or absence of plexiform bone, haversian canals, osteons arrangements & its size. [57].

Radioisotopes tracer techniques

Radioisotope tracer techniques used in detection of trace elements in evidential remains of wildlife animals to identify their origin of species. Radioisotopes are copious at different locations & their presence gives the information about their approximate origin on the basis of maps of isotope abundance. Essential and trace elements are the two important elements found in the body. [60]. The inessential elements consist of Al, As, Be, Cd, Cr, Mo, Ni, Pb & Sn [61].

Conclusions

In investigation of wildlife crimes, a meeting is advisable for a planned investigation and to be in a group so that various risks such as insufficient communication can be minimised. [7] The crime scene must be fully examined and during the process evidences and the trace evidences must be taken care of and should not missed or lost. Wildlife crime investigation is not an easy task. Majority of crimes take place in areas which is far away from law enforcement agencies and also lack the basic structure. Developing or under-developing countries faced this situation more as they are inadequately equipped and have very less facilities. Tele-imaging is commonly and widely used methods to diagnose disease of humans and animals at distant places and allow sharing of electronic data anywhere for the analysis.

The condition and growth discussed above signify that wildlife forensic, a new subject in some aspects is not a novel discipline. [2] The procedures and practices applied in this field is similar to those in other fields of forensic science. The principles used in exercises like investigating crime scene, gathering informations, handling samples, collection and preservation of questioned and reference sample, submission of evidences, providing the report and appearance in the court in a wildlife crime and for other fields are similar in nature i.e. in aspects of both theory and practical.

The work of wildlife forensic is emerging at very fast rate and is evolving as a distinct area of study. It provides extraordinary challenges to the personnel practicing in this field. The defined and used practices involved in wildlife forensics are similar to other fields even though it requires more generalization from other all those earlier established fields of forensic science. [2]

Various limitations found in wildlife forensic in serological analysis is the unavailability of species-specific antibodies, the footprints of lower quality or is destroyed by other animals present at the same site, the necessity of well-preserved sample for microscopic analysis, scarcity of taxonomic keys and monographs of wildlife animals. The protection and conservation of wildlife is of high demand with respect to current situations and is needed to prevent the poaching and illegal trade of flora and fauna naturally occurring in wild. Wildlife forensic helps in the conviction of wildlife offenders. In India, this subject is underdeveloped and is poorly equipped. The officers of wildlife are not well trained in using the equipments and techniques required to handle crimes against wildlife. To increase the potential in handling such crimes the basic knowledge about wildlife forensic must be learnt and practiced. In ambiguous cases of identification of wildlife at species level, the proposed method is to combine the outcomes of more than one method. However, molecular techniques individually can identify the species with very high accuracy and specificity, but species-specific markers are not present for all the species. [63]

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