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NAWEG

Forensic Analysis of Wildlife Crimes

INTRODUCTION

A wide variety of forensic techniques are presently available to help wildlife officers investigating wildlife crimes. As new scientific advances are applied to forensic analysis, the number, capabilities, and potential for application of these techniques are constantly increasing.

Many different types of evidence, both biological and nonbiological, must be dealt with in investigations of wildlife crimes. Effective use of forensic analysis should enhance the ability of wildlife officers to establish a physical link between suspect, victim and crime scene. The purpose of this pamphlet is to give an overview of the types of forensic analyses currently available to officers investigating such crimes. It is not intended, however, as a complete 'how to' manual. The Commission for Environmental Cooperation and the North American Wildlife Enforcement Group (NAWEG), offer this brief introduction in the hope that it will contribute to controlling wildlife crimes throughout all three nations of North America.

A number of topics are covered in this pamphlet:

- **Analyzing biological evidence.**
- **Analyzing nonbiological evidence.**
- **Sample collection and handling and how to ship samples to avoid contamination and spoilage.**
- **Legal requirements for prosecution.**

ANALYZING BIOLOGICAL EVIDENCE

1. Species' identification

Species' identification is possible for a wide variety of organisms, including mammals, birds, fish, insects, plants, reptiles, and amphibians. It has even been used to distinguish living animals from extinct ones. For example, modern elephant ivory can be differentiated from mammoth ivory. Species' identification can be accomplished in many ways using a variety of techniques. The methods chosen depend on the type of sample collected by the officer. All samples cannot be identified by all of the available techniques.

Morphological examination (examining the form and structure of an object) is best suited for samples such as hairs, feathers, hide, skeletal remains, whole or partial carcasses or small parts of animals or birds, whole fish or fillets and scales. It can also be used for insects, plant parts such as leaves, flowers and wood, and skins of snakes or other reptiles and amphibians. Using the unaided eye or a microscope, the evidence sample is studied and then compared to reference samples or to published works such as identification manuals, taxonomic keys and species' monographs. Morphology cannot be used for samples that have no visually recognizable structure such as blood, pieces of meat or other tissue, or samples that have been previously ground or pulverized. For these kinds of samples, a more formal scientific analysis is often the better approach. There are many different ways that samples can be analyzed. Quite often, more than one method will be used. These include protein analysis, chromatography, immunodiffusion, DNA sequence analysis, and mass spectrometry.

Species' identification techniques have been used on many kinds of samples, including seized gall bladders, skins and hides intended for the manufacture of clothing, and other items. It can also help determine the species' origin of blood and meat samples from crime scenes.

NAWEG and the Commission for Environmental Cooperation

When Canada, Mexico, and the United States strengthened economic ties through the North American Free Trade Agreement (NAFTA), they also pledged to undertake a new environmental partnership. In 1993, the three nations signed the North American Agreement on Environmental Cooperation (NAAEC) and created the Commission for Environmental Cooperation (CEC). Among the objectives of the NAAEC is the building of regional cooperation for the conservation, protection and enhancement of the environment. The NAAEC also commits the Parties to the effective enforcement of their respective environmental laws, including those for protection of wild flora and fauna.

Responding to these commitments, the CEC, in 1995, established an Enforcement Cooperation Program to provide a forum for regional cooperation, and to exchange expertise, build enforcement capacity and explore alternative approaches to effective enforcement. The Council of the CEC constituted a North American Working Group on Environmental Enforcement and Compliance Cooperation (EWG) to serve as this forum for regional cooperation. The NAWEG participates as a member of the EWG; it provides guidance in identifying priorities for regional cooperation in work to protect wildlife on the continent.

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2. Individual identification

A variety of empirical or scientific tests can be used for identifying the gender (sex) of a sample, as well as determining if two or more samples originated from the same individual animal or how many different animals are represented in a collection of samples. Physical examination of the size and shape of bones, for instance, can reveal the age, or at least age class (less than a year, yearling, adult), and the gender. The minimum number of animals found at a scene can be determined by counting the parts of animals left at a scene. As an example, the number of legs found at the investigation site can be counted or the number of animals can be estimated by examining the amount of meat found. Matching of samples can sometimes be accomplished by simply placing two parts together physically, like pieces of a puzzle. This is a relatively rapid and inexpensive procedure and is very successful in court. However, if this is not possible, DNA "fingerprinting" can be used. New developments in DNA testing have allowed an increasing number of sample types to be analyzed, including partially degraded samples and those with only small amounts of DNA. DNA testing can also be used to determine the gender of a sample, whether a parental or filial relationship exists with another sample, and also the minimum number of animals found in a collection of samples.

3. Population identification

It is sometimes possible to determine if an animal originated from one specific geographic area as opposed to another. Food animals eat is affected by the minerals in a given area. Certain minerals will be more common in one area than another, and this leads to differences in detectable levels of them. For example, the location of harvest sites of freshwater mussels can be determined by trace metal analysis of shell samples. The natal areas of migratory birds and the geographic origin of African ivory can also be determined by this type of analysis. Fish raised in commercial fish farms are often fed a diet high in a fatty acid called linoleic acid. In contrast, this compound is found only rarely in nature. By measuring linoleic acid levels, it can be determined whether a seized fish was farm-raised or was from the wild.

DNA analysis can also reveal the source population of an animal through genotype studies (see the NAWEG "DNA Analysis in Wildlife Forensics" brochure). Although limited and expensive at present, this technique should increase in usage as more DNA databases are compiled.

4. Cause, manner and time of death

Examination of the carcass of an animal (necropsy) can reveal much useful information. Cause and manner of death can often be determined. If poisoning is suspected, samples can be taken during necropsy and sent to a lab for testing. If wastage or abandonment of the carcass is suspected, bacteriological testing can be done to determine if the meat is spoiled. Necropsy can be used to determine if an animal was killed with a bullet or an arrow, by collision with a vehicle, by trapping, or by predators. The trajectory of the projectile or its direction of entry can be ascertained and can be helpful in confirming a suspect's story (i.e., was the animal shot in self-defense or not?). X-rays can be used to find whole bullets or fragments, which can then be tested by ballistics experts. Stomach contents can shed light on a number of situations: they may reveal if an animal has been causing crop damage, if it has been poisoned, or, in cases where the animal is suspected of an attack on humans or domestic animals, if parts of a victim are present.

Bite mark analysis refers to the examination of victims (either human or animal) of predator attacks, to determine what predator species was involved. Bite mark examination can also be used to determine if a victim was attacked or if an already dead individual was scavenged. This is important, for example, if it is necessary to decide whether compensation should be paid to a livestock owner for a dead animal.

The public has become increasingly concerned with the destruction of animals, even those determined to have caused an attack. It may be important to show that the correct animal was destroyed. DNA from the attacking animal can be isolated from the saliva deposited at bite wounds and tested to see if it matches DNA from a suspect animal. Animal hairs and other evidence may need to be collected from the victim as well, for matching purposes. Because of the sensitive nature of predator attacks, it is best to have sample-handling protocols in place ahead of time to avoid confusion and possible complications through disputes between different jurisdictions.

Carcass examination can also be used to determine the time of death of the animal. After an animal dies, its body undergoes a number of characteristic changes that can be used in estimating how long it has been dead. Time of death can be measured in a number of ways. The temperature of an animal approaches the ambient temperature after death. Charts and computer programs are available to estimate time of death using temperature data. Changes in the appearance of the eyes can also be used. The ability of muscle groups to respond to electrical

stimulation decreases with increasing time after death. The presence and extent of rigor mortis can be detected by manipulation of selected joints. The timing of the above observations is affected by several variables, including ambient weather conditions, size and surface area of the carcass, handling of the carcass (intact or field-dressed, method of transportation, etc.), and behavioral state of the animal at the time of death (relaxed or under stress). The species of insects found on a carcass change over time and, therefore, can also be used to estimate time elapsed after death.

ANALYZING NONBIOLOGICAL EVIDENCE

1. Footprint and tire tread impressions

Impressions left on a variety of surfaces by shoes or tires can be used for identification purposes. The make of shoe or tire can be identified and sometimes, if there are unique marks, cuts, or signs of wear present on the exhibit, a match between a specific exhibit and the impression can be determined. Reference collections of the makes of shoes and tires are used for comparison. Evidence is usually collected at the scene by the investigating officer and comparisons are done by qualified analysts in a laboratory setting.

Impressions can be photographed or plaster casts prepared. Plaster casts, preferably of dental stone rather than plaster of paris, can even be made of impressions left in soft surfaces such as mud or snow. Casts are preferred to photographs alone, since a three-dimensional cast yields more information. Casts of snow impressions can be made if first treated with a special spray wax prior to casting. Photographs should be taken before and after casting. It is essential that some sort of scale, such as a ruler, be used properly and included in photographs. If not, lack of any standard for measurement may make the evidence useless. Imprints made on dusty surfaces can be photographed and sometimes lifted, using a technique called electrostatic dust lifting. Bloody footprints can be stained and photographed. Collecting footprint or tire impressions must be done as soon as possible so that the evidence is not lost.

2. Ballistics

Bullets or bullet fragments or shell casings are often found at crime scenes and are a valuable form of physical evidence. They may also be collected from carcasses of animals removed from the kill site by hunters. Metal detectors are used to help find bullets and bullet fragments, which are then analyzed in the laboratory. The make, type, and caliber of firearm can often be determined and perhaps even matched to an individual weapon. However, the success of such analysis depends on the condition of samples.

3. Fingerprints

Evidence suspected of bearing fingerprints can be submitted for analysis. Usable fingerprints can be found on a variety of surfaces, including paper (for example, on documents accompanying shipped items), wood, metal, and plastic. One very useful source of fingerprints is the under surface of adhesive tape used to seal packages. Although it is not always possible to get clear, complete prints, even partial prints may be useful. In addition to fingerprints taken from actual suspects, various databases of known fingerprints exist for comparison purposes. Fingerprint evidence has a long case history, especially for non-wildlife crimes, and has proven valuable in court many times.

4. Examining documents of questionable origin

Examination of documents can confirm whether they have been counterfeited, forged or falsified. Handwriting comparisons can connect documents to suspects. The repetitive manner in which documents have been altered can provide strong evidence for a singular origin or suspect. Document examination can also indicate links to other shipments of goods and can provide evidence against a suspect for other offenses.

EVIDENCE COLLECTION AND SUBMISSION

It is vital that sample integrity and evidence continuity be carefully safeguarded if forensic analysis is to be considered legally valid. Evidence collection and handling procedures must be designed to ensure this. If an evidentiary sample is collected, submitted for analysis or handled in any way that allows it to become degraded or contaminated, accurate analysis may be impossible. There are a number of ways this can happen:

1. **Cross contamination of samples during collection.** To avoid any risk of contamination, knives used to cut samples from a carcass must be cleaned between samples.
2. **Degradation of samples due to improper storage and shipment techniques.** Once evidence is collected, it must be stored under conditions that prevent further degradation. Fresh tissue and, especially, wet blood samples are prone to decay if not kept frozen or at least cold. If cooling the sample is difficult under field conditions, then it may be possible to dry the sample. Sample holders are available to handle

wet specimens. It is also possible to store tissue in solutions of ethanol or DMSO/saturated salt at ambient temperatures.

3. **Cross contamination of samples during shipment of evidence.** Forensic samples are often shipped in plastic bags. Although this is acceptable for wet items as long as they are kept frozen or cold, samples with sharp edges, such as knives, pieces of bone, and rocks, may pierce the packaging during transfer. Even pieces of tissue, which do not appear sharp when fresh, are very hard when frozen and can wear holes in packages if allowed to bang against other packages during shipment. Bags that appear intact when the contents are frozen can be surprisingly leaky by the time they arrive at their destination. Dry items shipped in paper containers such as bags or envelopes are subject to the same problems of piercing and mixing.

In the investigation of most wildlife crimes, it is rare for laboratory personnel to travel to the scene and collect evidence. Some of the techniques described above, especially time of death measurements or tire and shoe impressions, must be performed in the field. Since officers usually conduct investigations on their own, it is necessary to maintain their expertise. Officers will use some techniques only rarely. Therefore, it is useful to have occasional refresher courses. The local forensic or crime labs should be used as a resource for information and training. Training sessions and other meetings are necessary, as most wildlife officers are not located close to other officers and lab facilities. The Internet will likely play an increasing role in keeping officers informed of new developments in forensic analysis and legal matters.

CONSIDERATIONS FOR PROPER SHIPPING

Evidence must be properly sealed and shipped in appropriate containers. If the items need to be kept cold, insulated containers such as coolers, with ice packs, must be used. A cardboard box containing the evidence items wrapped in newspaper is not suitable. Make sure that whatever is used as the source of cold cannot leak and damage the evidence. Often evidence is shipped to labs via a courier service. Even though these services 'guarantee' shipment within a certain time period, it is wise to prepare for a period longer than expected.

It is not necessary to send it all. If the officer retains part of the evidence, this can be used in the event of loss or damage to the original shipment. In addition, evidence is available if the defense counsel desires to have it tested by an independent lab.

Proper documents must accompany the evidence. This applies to evidence crossing international borders that is subject to inspection by customs officials as well as evidence involving species whose movement is restricted by international agreements or other laws. Take all possible steps to avoid loss of evidence continuity. Have all necessary permits in advance.

Officers should contact the lab prior to shipping any evidence. Lab personnel will be able to discuss the lab's ability to do the required analysis, predict the time it will take, estimate costs, and give advice on the best method of shipment. Labs should also be available to answer questions regarding the collection of evidence. Agree on the method of shipment and confirm the approximate arrival date. This can enable the receiving lab to trace lost shipments before it is too late.

LEGAL REQUIREMENTS FOR PROSECUTION

Evidence submitted for forensic testing is subject to a number of requirements. This includes chain of custody (evidence continuity) and evidence preservation. Failure to maintain a proper chain of custody will likely result in inadmissible evidence. If evidence is not collected and maintained in a proper manner, it is possible that it will not be usable for forensic analysis. Evidence handling procedures, at all stages of an investigation, may be questioned in court. Forensic analysis does not replace proper investigative technique and will not save an investigation if proper procedures are not carried out.

Wildlife officers and laboratories share responsibility in getting proper evidence to court. It is the officer's responsibility to ensure that evidence collection and other portions of the investigation are done properly. It is the forensic lab's responsibility to have properly-trained lab personnel performing the analyses, since it is essential that analysts be able to qualify as expert witnesses should the case go to court. Forensic labs must handle and store evidence properly, maintaining the chain of custody once the lab has received the evidence. These labs have records of how analytical procedures are performed. Wildlife forensic labs are beginning to standardize techniques between labs performing the same types of analyses. Some labs have received accreditation from outside agencies. Others are contemplating such a move, however, even in absence of formal accreditation, labs can take steps to ensure that the work done is able to withstand the scrutiny of the courts.

The legal requirements for the presentation of evidence in court may vary in different jurisdictions. Changes in existing laws

relating to evidence and case law interpreting these laws may affect how investigations are carried out, what evidence is collected and how evidence is presented in court. Officers must be made aware of any new technical requirements.

CONCLUSION

Linking a suspect to a crime scene and a victim is an essential part of any criminal investigation. Wildlife officers have a wide variety of forensic techniques available for use in the investigation and prosecution of wildlife crime. Wider use of these techniques by officials involved in this area should help the successful conclusion of an increasing range of cases.

For more information, contact the following agency in your jurisdiction:

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