

ANIMAL CSI: AN INTRODUCTION TO VETERINARY FORENSICS IN THE INVESTIGATION OF ANIMAL CRUELTY

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In animal cruelty investigations, it is not always obvious what could be considered evidence. Furthermore, the evidence collected may hold more value than the investigator or prosecutor realizes. With animal abuse the first responder's actions becomes critical for successful collection and analysis of the evidence and ultimately prosecution. Viewing a crime and the crime scene from a veterinarian's perspective will enable you to recognize crucial evidence and handle the case appropriately. It is important that law enforcement treat animal cruelty as a potential felony until proven otherwise. Animal cruelty is similar to crimes against children except the victim cannot testify – we will be testifying for the victim.

RECOGNIZING ANIMAL CRUELTY

There are numerous situations that qualify as animal cruelty: starvation, dehydration, untreated medical problems, failure to provide relief from extreme environmental conditions, hoarding, embedded collars, assault, poisoning, animal fighting, and so on. Any physical abuse cases often have neglect as a component of the crime. Animal cruelty is basically any action or lack of action that results in illness, injury or death of an animal. The rule of thumb taken from the police training video, In the Line of Duty - "if it looks like cruelty to you, it will look like cruelty to a judge."

It is important that veterinarians have a deeper understanding of their animal cruelty laws to they can better assist the investigators and prosecutors in the case. The intent of the offender has to be determined to charge the suspect appropriately in some states or it may be a deciding factor at sentencing. Prosecutors and solicitors can look at the case several ways to determine intent. In Georgia, in order to charge someone with a felony, you have to prove "knowingly and maliciously". In order to prove intent and knowledge, it is important that every piece of potential evidence is collected, investigated, and analyzed for successful prosecution. It takes all parties to fulfill their role in the investigation to prove the elements of the crime.

CHAIN OF CUSTODY

Any evidence related to a crime must follow a chain of custody. This refers to a recording process where the evidence is accounted for at all times. "Evidence" is anything collected at the scene of the crime, from the animal, all samples, all photographs taken, the photo card or negatives, and the animal itself. It is acceptable to make a CD copy of the photo card and hold that as the evidence containing the photographs so that the photo card may be re-used. In all cases of suspected cruelty it should be the police or animal control that transports the body to the veterinarian. All evidence must be labeled with date and time, a description of the item and the person who collected it should initial or sign across the seal. An evidence log must be maintained showing the same information and the location where the item is kept. All evidence should be kept in a locked cabinet with restricted access. If the evidence is transferred to another person, location or laboratory, this must be noted with time and date and time, the purpose of the transfer, and a signature obtained from the recipient. This applies to the body of the animal as well. Human labs already have a system in place to record chain of custody when dealing with criminal cases but most veterinary facilities do not. When sending a sample you need to fill out a "Cruelty Case Samples Packaging" form: record in detail the samples submitted, how it is packaged, by whom, the date and time, the carrier, and the case number. On the testing request form you must note and highlight that this is a criminal investigation of animal cruelty. Send a "Cruelty Case Samples Receipt" form, filling out the top of the form leaving the bottom part for the receiving lab to fill out. This should be faxed back immediately to you on the day the sample is received. This is crucial for the test results to be admissible and stand up to scrutiny in court.

CRIME SCENE INVESTIGATION EQUIPMENT

It is important to have the proper tools to conduct your exam and collect evidence. Do not place evidence in plastic bags because moisture can compromise the integrity of the sample. If an item is wet you may first place it in a plastic bag for transport up to a maximum of 2 hours. Then take the item out to dry before finally placing it in a paper evidence bag.

Examination and Collection Tools

Magnifying Glass	Styrofoam/Wooden Block
Tape Recorder	Paper Envelopes
Trace Evidence Tape	Plastic Forceps
Ruler	Evidence Tape
Evidence Bags	Evidence Labels/Tags

PROCESSING THE CRIME SCENE: THE ENVIRONMENT

Often times the environment holds the key to what happened to the animal or contains vital information that is pertinent to the investigation and the ultimate prosecution of the case. The environment must be investigated either by an investigator or crime scene unit with or without a veterinarian present. It is always best to have a veterinarian on the scene, especially in hoarder situations. You need to consider that more than one type of abuse may have been committed and be thorough. You also need to consider that other crimes may have been committed at the scene. The suspect may have outstanding warrants. At the beginning of every investigation it is imperative to consider all possibilities and gather all the evidence. Whatever statement suspect gives is going to be tested against the crime scene findings and the evidence analysis.

At the scene, there is so much going on, so much evidence, that it can be difficult to assess all pertinent findings. This is why the scene must be recorded for later analysis using photography. Digital cameras are the preferred way to take pictures. Polaroid photos are not as clear, cannot be enlarged and will fade over time. It is best to take photographs of your own, keeping a photo log as you take pictures. Any evidence you feel is important should be pointed out to the investigators and they should collect it. This usually requires the officer getting a search warrant. Sometimes, you will be taking evidence with you for further analysis. Make sure the evidence is photographed *in situ* prior to collection. It is important to take pictures of the general area, the housing, all areas the animal could have had access to, the animals, any insects on the animal, any fluids, weapons, and so on. Ideally, a video should be taken of the scene and of the animal. It is important to show any weakness, limping, injury, or vocalizing. In starvation cases it is also valuable to show the animal's response when offered food or water. You should receive a copy of all photos taken by others to analyze along with your physical exam findings. Based on the photos you may require the investigator to return to the scene and look for additional evidence or the photos may be inadequate and need to be re-taken. Video should be taken of the crime scene. It is important for the veterinarian to review this video with investigators and/or the prosecutor or solicitor. We view the scene completely differently and see importance in items that would otherwise go unnoticed by others. Do not assume that an animal control worker will recognize what is obvious to you. You are looking for things that support or refute the elements of the crime or the suspect/defendants statement. It is best to talk about what you are seeing as you view the photographs and video – that allows the investigator or prosecutor to see the scene through your eyes. By doing so, they will be able to flag important evidence, especially regarding the intent of the suspect.

You need to note the housing of the animal, the condition of the food and water bowls and the contents of each. All food and water bowls should be retrieved, their contents saved for possible testing. Always ask the owner what food they normally fed the animal – this will be crucial in poisoning cases to compare it to the stomach contents. It is important to find out what and when the animal last ate. You should note if they had access to water. The stomach contents can help estimate time of death. When large buckets are used instead of bowls, you need to measure from the top of the bucket to the level of the food and water. The animal cannot ingest the food or water when it is too far down for the animal's head and neck to reach.

You need to note if there were items that show evidence of being chewed on and collect them as evidence. If the animal was tied up measure the length of the tie and save it, taking care to preserve the knot. There was a case where the dog died from starvation while tied up to a chain. His teeth were worn completely down from trying to chew off the chain - there was nothing else within reach of the dog to have chewed on that would have caused this. Any heavy chain that is used to tether an animal should be removed and weighed. The weight of the chain is a significant piece of evidence. The chain

should never weigh more than 1/3 of the animal's body weight though even ten pound chain on a 40 pound dog is excessive and is not required to prevent the animal from escaping. This is commonly seen with Pitbulls where the heavy chain helps strengthen the animal's neck for dog fighting.

You need to look for blood, note the location and the quantity by taking measurements of the blood stain. Remember, as a general rule animals bleed less profusely than humans. If there is a blood soaked item blood loss can be calculated. Look for a clean similar item for comparison. Samples of any blood should be taken. Take pictures, measurements, and draw a diagram of all blood spatter found. Blood spatter analysis from a dog was able to re-create the crime scene involving a homicide and actually used for conviction.

Animal DNA forensic testing is available at several specialized laboratories. Parentage verification, sex determination and mitochondrial DNA testing is also available. The cost of these tests is not as high as it is for human testing – usually \$100-300 depending on the type of test run. DNA tests may be performed on blood, buccal (cheek) swabs, urine, feces, and many more. The lab will usually want to speak to investigators prior to any samples being submitted. They also want to discuss the particulars of the case to help prioritize what needs to be tested. Animal DNA can help in any crime investigation. Veterinary Genetics Lab will provide buccal swabs free of charge which are easy to use and come with instructions. It is important to have them in order to collect samples if it is warranted. Too often the opportunity is missed to get samples when the owner or caretaker initially gives permission.

You need to look for and note the location of any bodily fluids such as vomit, urine, or feces. The condition of the feces needs to be noted such as diarrhea, formed, or moldy. Animals will lose bladder and bowel control under extreme fear or distress and the stool is often very soft. Samples of urine, vomit, or feces must be taken for possible DNA, toxicology, or parasite analysis. The feces need to be inspected for foreign material. When an animal is starving, he may ingest inanimate objects in order to fill his stomach. After impound, the first bowel movement should be collected and inspected for clues to what the animal had recently ingested.

It is not always obvious what injuries the animal has or what it died from. You need to look for possible poisons including chipmunk and snail bait or antifreeze. You need to look for evidence of any weapons, bullets, and shell casings. If there are burns on the animal you need to look for accelerants or chemicals. You need to look for medications – OTC, prescription veterinary or human drugs that could have been used on the animal. If the medication was prescribed for an animal, the name of the veterinarian, veterinary hospital, animal's name it was prescribed for, the date and the expiration of the drug need to be documented. You need to look for papers related to the animals including veterinary invoices, adoption papers, kennel license, and rescue license. These are crucial pieces of evidence as they may provide the key to proving a felony. You should consider collecting items such as toys, brushes or any property that can be linked directly to the animal through DNA testing or if the location of these items is important to proving an element of the crime.

Key Evidence at the Crime Scene:

- Medications – purpose of the medications, name of veterinarian, hospital, date prescribed, expiration date, animal's name, amount of the medication left vs. amount prescribed
- Food/Water - condition of food and water in the bowls, appropriateness of the food for the animal, food on the premises, clues to how recent the food was purchased
- Housing – protection from the elements, size, is animal able to use housing; any reason for housing animals a certain way; confined and unable to get to food/water; evidence under the housing
- Tethers/Collar – length of tether, weight of chain; appropriateness of collar size; measurement of circumference of collar and neck; odor/insects in embedded collars
- Feces/Urine – smell, condition of feces such as moldy, diarrhea, fresh stool, location of feces, condition of litterbox, lack of feces in starvation cases, evidence of pica in the feces, fecal test needed, ammonia smell; evidence of fear defecation/urination (during a traumatic event?)
- Vomit – any presence of vomit; compare stomach contents to food fed
- Blood – the presence of blood soaked objects (need clean control from the environment if possible; blood spatter; blood pools; photos/measurements needed; samples of blood
- Disease/Injury – any evidence of disease and whether it is infectious, secondary, fatal, preventable; treatment required or prevention steps, especially if easily treated/prevented; samples needed; any evidence the owner was aware of the disease/illness/injury and what steps taken to treat/control/prevent

- Live Animals – response to people, weakness, interest in food, injuries; intact animals living together; the presence/lack of puppies/kittens
- Deceased Animals – rigor, lividity, body temperature, decomposition; entomology samples; position of the body, cover over the body or protection from the elements; fluids around the body; evidence of cannibalism; bones – evidence of predation and what animals had access to the bones; evidence of buried bodies

PROCESSING THE CRIME SCENE: THE ANIMAL AT THE SCENE

The animal is part of the crime scene and as such should be handled appropriately. The animal should be transported by an officer to the veterinarian in order to preserve chain of custody. If the animal is deceased and the body must be held prior to transfer to a veterinarian it must be placed in a cooler but *not frozen*. Freezing damages all the tissue which ruins pathology tests.

When you first arrive at the scene, there are crucial first steps the investigator must take to gather crucial evidence. First, the environmental conditions must be recorded, preferably at the level of the animal, including temperature and any rain or snow. You should note if the animal is covered, shaded, or in direct sunlight. Make note of the animal's condition and temperament such as fearful or weak. Next, a rectal temperature should be taken on a deceased animal using a special thermometer that registers low temperatures. The body cools at a certain rate depending on the environmental conditions referred to as algor mortis. You need to take the rectal temperature of the body twice in an hour to determine the rate of cooling or if there is a plateau. Next, you need to record the position of the body to assess lividity. You need to note the presence of rigor and what parts of the body are affected because it may disappear by the time the animal is later examined. Rigor can be broken if the body is handled roughly so care should be taken during transport. (see Time of Death below)

TRACE EVIDENCE

There are some positive and negative attributes of an animal's body and behavior for retention and retrieval of trace evidence versus a human's. Persistence of trace evidence is affected by the size and texture of the material being transferred, the surface on which it is retained and how easily it is removed. The fur can hold imbedded trace just as human hair and you have an entire body to which it could stick. But depending on the density and length of the fur the trace may be more easily dislodged and lost. The human nail has a pocket under which trace evidence may become trapped. In animals this is less likely unless the nail is frayed and the evidence is caught in there or on the fur between the toes and pads of the feet. Other sources of trace evidence may be collars and leashes.

The persistence of trace evidence is also affected by the length of time since the offense was committed and the activity of the suspect or victim. The behavior of an animal after it is injured or frightened is to lick their fur or the injured area removing valuable evidence. They may also rub or roll around and they often tend to run and hide. To preserve trace evidence an animal's body should be wrapped in a white sheet and the feet sealed in paper bags prior to transport. These items should be saved as evidence.

Types of Trace Evidence

Hair	Tape
Fiber	Tape Residue
Paint	Fire Debris
Chemicals	Fire Accelerants
Gunshot Residue	Glass

When examining for trace evidence use a UV light source and an indirect light source (held at an angle) such as a flashlight. Always photograph trace evidence prior to collection. The physical context may be paramount to the value of the results. You should take a control sample of the animal's fur with the root intact including one of each color. Place each item collected in a separate paper envelope. If the item is collected with tape then place it in a box lined with wax paper. There are special "tape lifters" that come with their own wax coated collection paper. Accelerants evaporate and are flammable. These samples should be placed in an airtight non-porous container such as a non-coated paint can or glass jar.

When looking for deeply imbedded trace evidence, place white roll paper on a table and tape it in place. Place the animal on the paper and comb the fur, one section at a time, using a fine tooth comb. Use your light sources to examine the debris. Collect anything obvious and save the remaining debris in a paper envelope. This combing can also help you detect wounds and areas of tenderness.

ENTOMOLOGY COLLECTION

Maggots can aid in determining TOD, location of death and provide DNA and toxicology evidence. Maggots can help determine the time of death by providing the post mortem interval. Flies lay eggs during certain environmental conditions, at certain times of day after an animal has died depending on the species of fly. These eggs then hatch into maggots based on environmental conditions. The larvae develop at a certain rate, depending on the species and environmental conditions, and can be aged by a forensic entomologist. Blow flies are attracted to the body postmortem so by dating the time of colonization (laying of eggs), the time of death can be estimated. It is important to note that in some cases, maggots may be found on live animals, known as myiasis. This is usually due to fecal soiling or wound necrosis present on the animal that attracted the flies. In this case, the time estimate will be for the time of trauma. Other insects are forensically important such as beetles which feed at different times post mortem. A sample of all insects, pupae and pupa casings on the body should be collected noting the location on the body they were found. If there is a mass of maggots, then a temperature of the mass must be taken by inserting a thermometer in the center. The mass of maggots generates heat affecting their rate of development and affecting the entomologist's analysis. In some cases there may be pupae casings present indicating the fly has gone through at least one life cycle and these should be collected. If maggots are present then it is important to get a sample of the adult flies to assist maggot species identification. You should also get a sample of any beetles if present which appear on deceased bodies at certain time intervals after death. Maggot samples should be collected and shipped for testing, taking care to get the largest larvae (see Time of Death section).

Forensic entomology analysis is dependent on the ambient temperature readings. Weather data for the past 2-3 wks as well as temperature of where the body had been held prior to examination is needed for accurate analysis. When the body is moved from the scene temperature of the transport vehicle and the time of transport must be recorded. If the body is held in a cooler prior to maggot sample collection, the temperature and time in the cooler must also be recorded. The entomologist needs certain information in addition to the weather data. They need photographs of the animal and the environment it was found in. They need to know if there were any unhatched eggs on the body and the location. They need to know the position of the body when found at the scene – sternal, lateral, curled, anything covering the body, any if the body was in direct sunlight or under shade taking special note of the head and perineal area. It is also helpful to provide them with any information regarding the crime scene and the presumptive cause of death.

Every effort should be made to get a sample of live flies at the scene where maggots or maggot eggs are present for species identification. Blow fly egg masses should first be photographed and their location documented. Using forceps, break a small piece of egg mass off approximately the size of a dime, taking care to collect from the center as the eggs at the edge may be desiccated and no longer viable. Each egg mass collected from each location on the body should be kept separate. The mass collected should be broken in half and one half placed in 75% ethyl alcohol. The other half should be placed in a larval-rearing pouch. These pouches are made taking a piece of aluminum foil and folding it to create a three-dimensional rectangular pouch, crimping the corners together. A small piece of beef or pork liver should be placed inside as a feeding substrate should the larvae hatch. The top should be crimped together sealing the sample. This pouch should then be placed inside a plastic container for shipment with approximately one inch of soil or vermiculite in the bottom and small air-holes punched into the plastic top. This substrate absorbs any fluids that leak from the pouch and, for late stage larval samples, provides a burrowing substrate.

Two labels should be created for the larval feeding pouch with the date and time, case number, location of the sample collected, and the sample number. These should be filled out in pencil to avoid any destruction of the writing. There should always be a double labeling system used where one label is placed inside the plastic container and the other affixed to the outside of the container. For all samples, note the time they were placed in the container and when they were shipped.

When collecting maggots for analysis, you are looking for the oldest (largest) larvae because they are the ones that first hatched and in turn were the first eggs laid. At first, the body and the surrounding area should be examined for prepupal maggots (post-feeding). These will most likely be found off the body but may be found in the fur, carpet, the first 3-5 cm of soil, or up to 50 meters from the body. If none are found then samples of the largest instar larvae should be collected, noting their location on the body. Temperature recordings and time of collection should be documented as described above.

A sample of the collected maggots should be preserved at the scene. Place a sample of the largest maggots and some of the next size down into hot or boiling water for five minutes to kill and

blanch them documenting the time of blanching. They should then be transferred to a vial of 70-85% isopropyl alcohol. They may be placed in 70-85% isopropyl alcohol at the scene if hot water is not available for blanching. The vial should be double-labeled as described with egg masses, with one label in the liquid and another affixed to the outside. Another live sample of the maggots should be preserved for examination using the larval-rearing pouches. Do not put too many maggots in the pouch because they need air and too many could cause the majority or all of them to die.

The migratory larvae and puparia may be found usually within 20-30 feet of the body, depending on the species. They may be found under surface debris, in the top few inches of soft soil, vegetation, under rocks, or on tree trunks. The presence of the empty pupa cases indicates that a complete blow fly life cycle has taken place on the body and indicates a minimum elapsed time since death. These casings are often mistaken for rat droppings. They may be found in the same areas as the prepupal maggots and the pupae. Newly emerged adult flies should be collected in dry vials and a description of their appearance noted, as it will change by the time it reaches the forensic entomologist. As time goes on, there is sequential colonization of the remains by other insects. Analyses of these later appearing insects can help with the estimate of the postmortem interval.

BLOOD EVIDENCE

A specialist should analyze photos of blood splatter. Photographs should include a ruler and yard stick to show the height of the blood stain and its relation to nearby objects at the scene. If at the scene you should draw a diagram. Always take multiple samples of the blood – it could be animal or human.

There are three main categories of blood stains:

Passive: drops formed by the force of gravity alone.

Transfer: formed when something comes into contact with blood and transfers it onto another surface.

Projected: created when an exposed blood source is subjected to a force greater than the force of gravity, either internally or externally produced.

There are certain things you might be able to deduce yourself such as drag marks, smears or blood trails. There are some generalities: when a drop of blood falls to a smooth floor it will remain basically spherical. If it is a rough surface it will be star-shaped, though drops from great heights will also be star-shaped. If blood strikes the wall at a right angle it will be round. At other angles it will be elongated, the more narrow part indicating the direction of travel. It may also splash smaller stains in the opposite direction from which the drop originated from.

Keep in mind an injured animal may be mobile and may shake his head or body causing splatter. Sneezed blood may be diluted or have air vacuoles. Insects may move through blood creating a false blood trail. Note that there are bleeding differences between species of animals - cats do not bleed from their skin like dogs do.

Blood Loss Calculation: The amount of blood lost by an animal is an important measurement for a criminal investigation. This can be calculated using the animal's hematocrit (Hct) or from the environment.

1. In acute blood loss the body will draw fluid into the blood vessels over time to maintain pressure. Depending on the time elapsed or the administration of resuscitative fluids the Hct will be accurate. If the Total Protein is normal then not enough time may have elapsed for the body to respond. Normal blood volume for small animals is 90ml/kg.

$$\frac{(\text{Lowest Normal Standard Hct} - \text{Current Hct})}{\text{Lowest Normal Standard Hct}} = \text{Fractional Blood Loss}$$

$$\text{Fractional Blood Loss} \times \text{Animal's Normal Blood Volume} = \text{Volume Lost}$$

2. If the blood has soaked into an absorbent surface the item may be weighed and compared to a clean control. The difference will give you volume. A liter = 1 kg. So a weight difference between two identical pieces of carpet, one blood soaked, of 0.4kg = 400mls of blood loss.

DNA: There are three categories of animal DNA evidence: as the victim, the perpetrator or the witness. Sources of DNA include blood, saliva, urine, feces, hair, semen, bones, teeth, organ tissue, muscle and skin. DNA may be obtained from toys, bedding, brushes, bowls or related property to help

identify a particular animal. During the commission of crime animal DNA can be transferred directly or indirectly from an animal to the crime scene or onto another person.

When examining a case of cruelty you need to consider what DNA from the human may have been transferred to the animal. The animal may have bitten or scratched the offender in the struggle thereby retaining human DNA on the teeth or nails. Or the offender may have bled on the animal. You have to consider everything possible and look for it in your initial exam or your evidence may be lost.

Proper sampling technique is paramount for successful DNA determination and the key to the results standing up to scrutiny in court. Strict chain of custody must be followed. It is preferred for the original item to be submitted. Otherwise the item should be swabbed avoiding contamination. Control samples are also needed. See the websites for guidelines.

PATTERNS OF NON-ACCIDENTAL INJURY

Determining accidental vs. non-accidental injury begins with an index of suspicion when the exam findings are not supportive of the initial history. It can be due to abnormal behavior from the owner such as nervousness or apathy, or if their account of the accident continually changes. Whenever something tips you off that things are not adding up then you have to investigate further. It is imperative that you are thorough and document meticulously.

NEGLECT

Neglect comes in many forms: starvation, lack of proper care and filthy living conditions. It is important to determine a time estimate for the injury or condition to have been present to address the degree of suffering. Tufts University has created a body condition scoring system for starvation cases and scoring system for the environment. In neglectful behavior, which is the failure to act, the key issue is implied malice: at what point the person had to have knowledge and still failed to act.

STARVATION

Starvation is the process of the body consuming itself, both fat and protein, which causes vital members of the body to cease to function. It causes immune suppression making the animal more susceptible to infections. You need to get the initial body weight and record the body condition score. It is also important to show the subsequent weight gain in response to treatment, especially if the only treatment was giving the animal food and water. If the animal is wearing a collar and it is loose then you need to measure the circumference of the neck and the collar for comparison. This is especially important if the animal was tethered outside because at some point that collar had to fit or the animal would have got loose. If the collar is loose enough that the dog could slip out, then you have to question what prevented the animal from escaping. Usually it is because the animal was too sick or weak to escape and seek food and water.

It is important to run bloodwork on these cases as soon as possible after they are impounded and preferably prior to initiating treatment. Blood may be drawn at a shelter by the staff and then held pending the veterinarian's instructions. Findings on labwork in starvation cases depend on secondary infection and the state of starvation. They may include: prerenal azotemia, anemia, elevated liver enzymes, increased total protein, increased globulin, low albumin, very high CPK, monocytosis, leukocytosis, stress-leukogram, ketonuria, and electrolyte abnormalities. Low glucose may or may not be seen – the body is doing everything it can to maintain the blood sugar. In the terminal phase of starvation the glucose may be low.

Deceased animals should have a full necropsy including histopathology. There are supportive changes seen in starvation as well as it can rule-out other causes of death. Other necropsy findings include evidence of pica in the feces and stomach contents. Note the presence or absence of ingesta in the intestinal tract, the amount of feces in the colon and if normal consistency. Check for gastric ulcers, occult fecal blood, intestinal parasites and melena. The gall bladder may be full but may empty overtime after death. On histopathology, findings include serous atrophy of fat, hepatic lipidosis and lymphoid depletion. Lymphoid ectasia may be seen in the small intestine which indicates chronic starvation. Extramedullary hematopoiesis may be seen in the lung and/or liver if the animal was anemia prior to death and the bone marrow could not meet the demand to replenish the RBC's.

On post mortem exam you need to note the loss of external and internal fat. The body consumes its own fat stores and muscle protein for nourishment in the state of starvation. The external fat is used first; then deep organ fat (pericardial and perirenal fat). The bone marrow fat is the last place to be used and when low it is indicative of starvation. A Bone Marrow Fat Analysis can be performed at Michigan State University. Normal range is 50-60% and in starvation cases it can be as

low as 0-10% though a normal value does not rule out starvation. Even if an animal is decomposed or most of the internal organs are gone due to insect activity it is still possible to get enough bone marrow for testing. BM fat can become rancid with time but freezing will preserve the fat for up to a year. This test costs \$8.00 and with results in a few days.

Cannibalism may be seen in cases of starvation. This will occur when an animal dies and the other live animal is suffering from severe starvation and has no other source of food. Carcass bones should be inspected for evidence of predation by the other animals confined with the carcass.

HOARDERS

It is important to document the physical condition of the animals and run bloodwork. When the animals are sick and/or there are deceased animals present you must determine if there is any fatal, untreatable disease that caused their illness or death. You need to look for evidence of any medications or veterinary treatment and when it occurred. The crime scene must be videotaped and completely photographed. These types of cases are particularly overwhelming and vital evidence is often missed by those on the scene. All the animals must be scanned for microchips to trace where the animals were obtained from; sometimes they are stolen. Ideally, an ammonia meter should be used to document the ammonia levels. Most of the cases will have entomology evidence that needs to be collected.

There may be evidence of starvation and cannibalism. You need to note anything that shows knowledge of the problems by the defendant. Most hoarders do not spay and neuter so you should find puppies or kittens and the lack of puppies or kittens needs to be explained. Under severe distress, sometimes the mother animal will kill her young at birth if there is not enough food or water or there is a perceived threat she cannot escape from. When there are a large number of intact cats living together in a confined space you may see forced mating and genital trauma.

EMBEDDED COLLARS

Embedded collars take several weeks to months to occur. These collars can cause serious disfigurement of the neck, starvation, and septicemia. There is often a severe foul odor associated with these injuries due to the secondary infection and usually noticeable oozing on the fur or swelling around the neck and face all of which were obvious to the owner yet they still failed to act. These embedded collars make it difficult for the animal to swallow, move his head to eat or drink and ultimately can cause such severe injury and infection that the animal dies. The collar should be measured around the neck then compared to the circumference of the neck. Once it is removed it should be saved as evidence which also preserves the odor. The depth and width of the wound should be documented. Granulation tissue grows at a rate of 1mm/day, slowing with time to 1cm/month and time estimate for the condition should be given. Pictures should be taken before and after shaving and treatment.

BLUNT FORCE TRAUMA

Animals do not bruise as easily as humans. External bruising is less common in animals because the skin in animals is thicker, has fewer blood vessels and the fur coat protects it. Therefore, the presence of any bruising is significant. The presence of skin bruising, with or without a fracture, is usually the result of severe blunt force trauma. Bruising can also take hours to form so close monitoring is essential. The fur may need to be shaved to see the extent of the bruising. Most bruising and skin trauma is seen in the subcutaneous tissue, musculature, or body walls. On post mortem exam it is best to dissect and reflect the skin and inspect the underlying tissue. Bruising around the time of death will show little to no inflammatory reaction on microscopic inspection. Since bruising is not common, the only symptom of blunt force trauma may be sensitivity or pain. Animals mask pain extremely well so the symptoms of sensitivity and pain may be subtle such as lying curled up, growling when touched, hiding, guarding painful areas, licking or chewing the area, fixed stare, squinting eyes, whining, arched posture or restlessness.

Full body radiographs should be taken of all animal cruelty cases. These will help determine hidden injuries such as rib fractures, and evidence of previous trauma such as old healing fractures.

In blunt force trauma to the head, it is important to examine the internal ears for petechiae, fresh hemorrhage and ruptured tympanic membranes. Check the mouth for fractured teeth, torn palates, tongue lacerations and foreign material. Examine the eyes, including the fundus, for bleeding, cloudiness, retinal detachment, and luxated lenses. Internal cranial exams are probably best performed by a university necropsy service.

ABRASIONS

Abrasions need to be examined for patterns that can match a potential weapon. Take quality photographs that a forensic weapon specialist could use to make a match, making sure to include a ruler in each shot. Examine abrasions for embedded debris such as glass or gravel which can be supportive evidence that the animal was dragged or tossed. The debris itself is evidence of the scene of injury such as glass that can often be matched to its source such as headlamps. Note the location, size and shape of the abrasions – together they tell the story. What you assume is a simple HBC may actually be due to cruelty therefore your analysis must be complete.

GUNSHOT VICTIMS

There are seven main objectives when analyzing gunshot wounds:

1. Determining entrance and exit wounds
2. Retrieving gunshot residue
3. Retrieving the projectile
4. Retrieving any bullet cartridge or casing
5. Determining trajectory
6. Determining gunshot range
7. Recording injuries

There are some basic rules for determining entrance and exit wounds. In animals we have the advantage of fur being forced in or out, respectively. In general, entrance wounds are smoother and smaller than exit. Entrance wounds may have singed fur or skin indicating direction of travel. Abrasion rings may be found at entrance wounds where the bullet rubs raw the edges of the hole. The ring may be concentric or eccentric if the bullet entered at an angle causing a “bunching up” of skin. Entrance wounds may also have micro-tears at the edges if caused by a high velocity gun. If the bullet entrance is at an area of thick skin or it is a distant gunshot to the head the wound will usually have a stellar appearance. Contact gunshots produce splintered or star-shaped wounds because the bullet has a degree of wobble when first exiting the barrel of the gun.

Check for gunshot residue, known as GSR, on the body, nearby objects and blown inside the wound. GSR can be accurately identified at a lab using a dissecting microscope. Samples may be collected using a cotton tip applicator moistened with isopropyl alcohol or 5% nitric acid. If you need to clean the wound to examine, first spray with hot water or hydrogen peroxide and let it sit to dissolve and remove blood.

In humans you may see “powder tattooing” of the skin. These are punctate abrasions producing a form of stippling due to gunpowder grains. This may or may not occur in animals due to their fur covering. Insect feeding can resemble wounds. Follow the tract – insects usually only penetrate the subcutaneous tissue.

Exit wounds are usually larger and more irregular. They can be stellar, slit-like circular, crescent or completely irregular. “Shored” exit wounds have abraded margins because the skin was next to something firm when the bullet exited causing abrasions. Exit wounds through tight skin such as the head tend to be larger. Those through loose skin can be small and slit-like.

When retrieving projectiles, care should be taken not to cause damage that will interfere with the rifling marks on the surface of the bullet. These marks can be matched to the gun it was fired from. Use your fingers or cotton wrapped forceps to grab the bullet. In shot gun injuries get a representative sample of the projectiles and any wadding if present. Place items in a paper envelope and then a small box for protection. Ejected cartridges and casing may contain fingerprints. Exercise caution not to compromise their integrity during collection.

All animals with gunshot injuries should have full body radiographs. An exit wound does not necessarily mean the bullet exited. The bullet could have propelled bone fragments and tissue out then rebounded back. Bullet emboli are possible.

Trajectory of the missile can help determine where the shot was fired from and helps re-create the crime scene. When probing the track use a metal rod being careful not to dislodge the bullet or create false tracks. A bullet path creates shearing, compression and stretching causing injuries distant from the path. This can cause fractures without a direct hit, usually rib fractures. With direct hits look for the bone beveling out and sometimes you can see lead deposit on the bone. Consider the animal may have been in motion and move limbs accordingly to match trajectory lines.

There are four categories of gunshot wounds determined by range of muzzle to target:

Contact Wounds: defined by a tight zone of soot and searing from hot gases and flame emitted from the barrel.

Near-Contact Wounds: the zone of searing is wider.

Intermediate Wounds: When the gun is fired from further away but close enough to produce powder tattooing (on the skin of humans).

Distant Wounds: characterized by only the mark of the bullet perforation.

Photograph each bullet wound before and after cleaning the wounds taking long range and close up views. Assign a number to each entrance wound and describe the location with a measurement to a landmark such as nipple, midline and the animal's muzzle. Describe the appearance of the wound, path of the missile, injuries produced and exit or lodgment site. Save any powder grains and describe such as flake, ball or cylindrical. Shave and note powder tattoo patterns, abrasion rings and muzzle imprints. When taking measurements you can use a clock reference identifying the dorsal spine or head as 12 o'clock. Record the injuries created by the missile path.

KNIFE WOUNDS

Knife wounds you may see can be stabbings, lacerations or incisive (e.g. skinning). Stab wounds made with a single edge blade create a slit that tapers to one end. If the knife is withdrawn partially and another stab made it will look like a fish tail with a double taper at the end. A double edge knife will have a taper at each end. It can be difficult to determine if the blade was smooth or serrated unless superficial wounds are present or if there are cuts to the bone.

The track of the stab wound should be probed with a metal rod and measured. The length of the blade cannot necessarily be determined unless there is evidence there was full penetration such as bruising around the wound caused by the knife handle. You can also make a reasonable deduction if you have multiple stab wounds of various depths that all measure the same width. The width of the blade may be estimated but may be difficult depending on how the knife was withdrawn and if the victim moved. It is important to note that in human knife stabbings the perpetrator's hand can slip cutting himself and any blood found should be sampled for analysis. Photograph each wound taking long range and close up views. Assign a number to each wound and describe the location with a measurement to a landmark such as nipple, midline and the animal's muzzle. Describe the appearance of the wound, path of the track, and injuries produced. Record the injuries the same as you do with gunshot wounds.

DOG FIGHTING

Dogs used for fighting are usually suffering from starvation, untreated wounds and blunt force injuries. Signs to look for are heavy chains used as collars, scars on the face, ears, neck and legs. The wounds sustained from organized dog fighting are unique and not the same locations and patterns as those seen with a normal fight between two dogs. These wounds are punctures on the face, ears, cranial chest and legs. Close ear crops are not always present and if they are, it is usually surgery that was not performed by a veterinarian. These dogs should be tested for speed, steroids, hormones, diuretics and analgesics.

TIME OF DEATH (TOD)

Establishing TOD is not an exact science. There are guidelines extrapolated from our human counterparts but more research is needed. In order to determine TOD we have to figure out the Post Mortem Interval. It is imperative that environmental conditions are recorded whenever a dead body is found as well as the condition and temperature of the body.

Liver mortis: This refers to the discoloration of the body due to gravitational blood settling after the heart stops. Lividity may be seen in the light colored external skin of dogs and cats. It is more likely to be seen on the conjunctiva, buccal mucosa, lips, internal organs and body walls. This can help determine the position of the body after death but is not helpful in TOD.

Algor mortis: This refers to the body cooling. It is more accurate in the first 24 hours after death. It can be affected by temperature prior to death, size of the body, dehydration, obesity, edema, body position (curled vs. recumbent), hair coat, humidity, wind, cover and water immersion. When taking the temperature a special thermometer is needed to register low temperatures. Readings may be taken rectally or in the liver. You can make a small cut in the skin and insert the thermometer into the liver or under a lobe to avoid damage. There is may be an initial temperature plateau that occurs in the first 30 minutes to 5 hours but this does not always occur. The normal rate of cooling is 1.5 degrees Fahrenheit loss/hr (rectal) at 75 degree environmental temperature. Take two reading in an hour to get the rate of cooling and confirm you are past any plateau.

Rigor mortis: This refers to a stiffening of the muscles and freezing of the joints. It involves the formation of locking chemical bridges of the muscle proteins actin and myosin. When an animal dies

the muscles are initially flaccid, then stiffen (rigor) then they become flaccid again. The onset is faster and duration is shorter in animals that have decreased glycogen levels seen with starvation, exhaustion, seizures and sepsis and in high environmental temperatures. Rigor sets first in the smaller muscle groups and joints, usually the head, and then moves to the larger muscles. It then dissipates in the same order. Rigor can be forcibly broken with manipulation and will not recur unless it is broken before full development. It is important to ask how the body was handled prior to you receiving it.

Time of Death Estimates in Animals (Dr. Annette Rauch, Tufts University)

Warm, not stiff	0-3 hours	Cold, stiff	8-36 hours
Warm, stiff	3-8 hours	Cold, not stiff	>36 hours

Gastric Emptying Time: Gastric contents and emptying times are helpful in human medicine in determining time of death. For animals, where it is known what and when the victim last ate, you may be able to use that information for TOD estimation. Gastric emptying time is affected by many factors: solid or liquid food, caloric content, water intake, volume, and whether fed meals or free choice. It can be affected by the age and size of the animal. Keep in mind that we need to look at the time range and place it in context with other postmortem findings.

Dogs: Solids 4.7-15 hours Liquid 0.5-3.5 hours

Cats: Solids 4.7-12.5 hours Liquid 1 hour

Average Normal for Dogs/Cats: < 14 hours

Entomology: Maggots can provide the most accurate TOD estimate. (see above: Entomology Collection)

REPORT OF EXAM FINDINGS

Your report should be professional, logically structured and complete. Based on this report the DA's office will decide whether or not and how to prosecute. You may be asked for a preliminary report – this should only contain confirmed findings and pending tests. You cannot retract what is in there later on without a valid reason. In this report you must address the survival period: the time from injury to death. This speaks to the animal's suffering and is important for the prosecution. It can make the difference between misdemeanor and felony charges.

Report Format

Heading: Include name of the agency, the officer/investigator, your name, address, contact info, date of exam

Subject of Exam: Accurately describe the animal – color, sex, intact or not, estimated age

Reason for Exam: Why the animal was brought to you – usually "Animal cruelty investigation"

Crime Scene/Forensic Information: List what you personally observed at the scene or from photos, what the investigator told you or information from his report

Medical History: Any pertinent medical history

Examination Findings: Details of your findings using medical terminology; separate subheadings are: External Exam (weight, coat condition, body condition score, decomposition, ectoparasites, head, chest, abdomen, legs, feet); Evidence of Medical/Surgical Intervention; Radiograph Interpretation; Internal Exam (necropsy- head, thoracic cavity, abdominal cavity, neck, respiratory tract, cardiovascular system, gastrointestinal tract, biliary tract, pancreas, spleen, adrenals, urinary tract, reproductive tract, musculoskeletal system); Evidence of injury (list all pertinent evidence of injury)

Procedures and Results: List all procedures, treatments, samples taken, test results or if they are pending

Entomology Findings: List of insects found, location of what collected, entomology report findings

Summary of Findings: List all pertinent findings

Survival Period: If there was evidence the animal survived for any period after injury

Time of Death: estimate of the time of death based on all findings

Mechanism of Death: The biochemical or physiological abnormality that resulted in death (e.g. shock, sepsis, cerebral edema)

Cause of Death: This refers to the injury or disease which began a sequence of events that ultimately lead to the death of the animal (e.g. gunshot to the head)

Contributory Cause: Any contributing causes towards the cause of death (e.g. clotting disorders)

Manner of Death:

Manner of Death Categories for Animals:

1. Natural
2. Accidental
3. Non-Accidental
4. Undetermined

Conclusion: Where you state your opinion of all the evidence. You may use lay terms for the investigator and prosecutor to understand.

THE VICTIM

In dealing with animal cruelty we must not forget about the victim. It is crucial that their well-being is considered every step of the way. Ask the prosecutor to request the defendant not be allowed to have animals as part of the bond until the case is heard and ask for forfeiture of the animal at the beginning. Since the animal is considered evidence the prosecutor can designate an organization or person to hold the animal so it does not have to stay in a cage. These cases can take months to years to come to trial. The animal should not have to suffer further trauma while waiting for his fate to be decided.

Animal cruelty is a malignancy in our society. We have a duty to uphold the law and protect the defenseless. Doing so will create a better society and preserve the trust these animals so freely give.

References available upon request