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TECHNICAL NOTE

PATHOLOGY/BIOLOGY; GENERAL

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Utilization of Paw Prints for Species Identification in the Canidae Family

ABSTRACT: In this report, the bodies of six skinned animals were submitted to the Oklahoma Animal Disease Diagnostic Laboratory for necropsy examination as authorities were concerned these animals were domestic dogs. Given the condition of the animals, identification of the animal species could not be based on traditional physical characteristics such as size, fur characteristics, and ear characteristics. The paw prints from these animals were characterized based on size, heel pad architecture, and claw characteristics. The length of the forepaws measured 3–3.25 in., four toes were observed and only the claws of digits 3 and 4 were identified, and the heel pad had a pronounced three-lobed rear margin. The rear margin of the heel pad of the hind foot was of circular shape with two slightly forward-pointing crescents laterally. Based on the features of the paw print it was determined that the animals necropsied were coyotes.

KEYWORDS: forensic science, forensic pathology, paw print, dog, coyote, wolf

There are numerous similarities between veterinary forensic pathology and medical forensic pathology with the exception that veterinary forensic pathologists work within numerous animal species including fish, birds, reptiles, and mammals. We present a case of possible animal cruelty towards six canids necropsied at the Oklahoma Animal Disease Diagnostic Laboratory in Stillwater, Oklahoma. The underlying causes and manners of each death are the same in these animals, but species identification of these animals was unknown at the time of necropsy. In this case, species identification is important as legal actions would result if the animals were domestic dogs (*Canis familiaris*) and would not result if the animals were coyotes (*Canis latrans*). In mammals, species identification is often based on fur characteristics (coloration and character), position of the ears (pendulous and erect), adult weights, shoulder height, length, and hoof prints or paw prints. In this case, paw prints were used to identify the canids as coyotes.

Materials and Methods

In February 2009, 12 severed forelimbs and six carcasses presumptively from the Canidae family were found along a river bed in central Oklahoma. According to the investigation, the carcasses were neatly arranged and the forelimbs were found in a pile. The carcasses and limbs were submitted to the Oklahoma Animal Disease Diagnostic Laboratory for necropsy examination. Necropsies were performed simultaneously by three veterinary pathologists. Necropsy findings were similar in all animals and the findings of two animals are discussed below.

Results

Animal 1

The examination of the body of a mature 12.3 kg female canid revealed that the forelimbs were amputated at the level of the mid-antebrachium with no associated hemorrhage (Fig. 1). The animal was completely skinned except for a small amount of fur (tan color) over the distal hind limbs and the perianal region. There was a hole measuring 8 mm in diameter within the dorsal rostral portion of the skull, consistent with a gunshot wound. The hole extended through the skull into the cranial vault. There was mild hemorrhage within the surrounding connective tissue. There were multiple fractures of the bones of the cranial vault. The brain was fragmented. There was marked extradural hemorrhage within the cranial vault. Fragments of metal were lodged in the region of the right occipital condyle. The length of the fore paws measured 3 in., four toes were observed, the heel pad was of triangular shape, and there was an absence of a pronounced three-lobed rear margin.

Animal 2

The examination of the body of a mature 8.6 kg female canid revealed that the forelimbs were amputated at the level of the mid-antebrachium with no associated hemorrhage. The animal was completely skinned except for a small amount of fur (tan color) over the distal hind limbs and the perianal region. There was a hole measuring 8 mm in diameter within the dorsal rostral portion of the skull between the eyes, consistent with a gunshot wound. The hole extended through the skull into the cranial vault. There was

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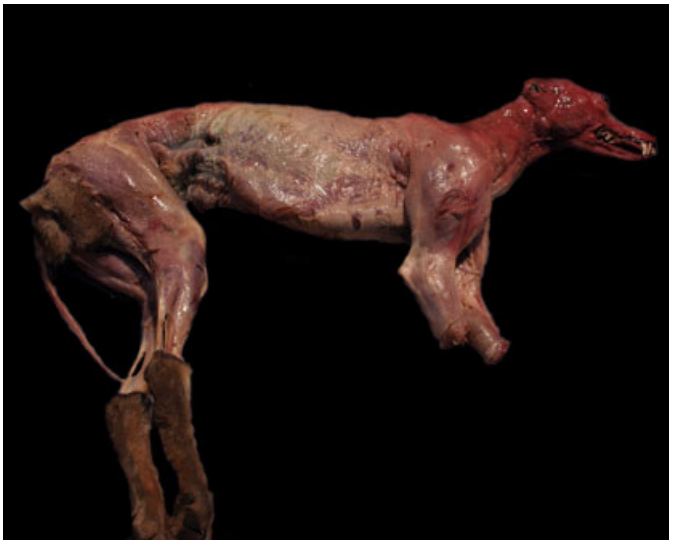

FIG. 1—*Animal #1: skinned animal with lack of subcutaneous hemorrhage and amputated forelimbs.*

marked hemorrhage within the surrounding connective tissue. There were multiple fractures of the bones of the cranial vault. The brain was fragmented. There was marked extradural hemorrhage within the cranial vault. Fragments of metal were lodged in the skull fragments on the lateral aspect of the right side of the head. There was moderate laryngeal hemorrhage. The length of the fore paws measured 3.25 in., four toes were observed, the heel pad was of triangular shape, and there was an absence of a pronounced three-lobed rear margin.

Discussion

Collectively, the scenario and necropsy findings support the theory that these animals were hunted and subsequently harvested for their pelts postmortem, which was evident by the lack of hemorrhage associated with the amputated forelimbs in all animals and lack of hemorrhage associated within the skinning. Each animal had a single gunshot wound to the head, except animal 5 which had two gunshot wounds. Animal 5 had a gunshot wound to the head and within the right side of the neck. Coyotes and wolves that are hunted often are skinned in the field and found in a manner similar to the animals in this case. Given the location where the animals were found, authorities wanted to determine if in fact these animals were of coyote or wolf descent and not domestic dogs. Based on the weight and size of these animals, the lack of fur, and absence of ears we were unable to determine what species the animals belonged to. Examination of the paws was utilized to determine the species of these animals.

Animal paw prints are categorized according to the number of toes that show in a paw print and include the following groups: two toes, four toes, five toes, and four front toes with five hind toes (1). Wolves (*Canis lupus*), domestic dogs, and coyotes belong to the family Canidae. These animals have five toes but only four toes are identified within their paw prints. The first toe (dew claw) is found higher up on the medial aspect of the leg and may vary from being fully developed, articulating with the first metacarpal/metatarsal bone, to being a vestigial structure (2). Domestic dogs often only have forelimb dew claws. The dew claw only registers at high speeds or when prints are found within deep substrates (4).

The paw print of the coyote using the Western coyote as an example measures 2.25–3.25 in. (including the claws), the front

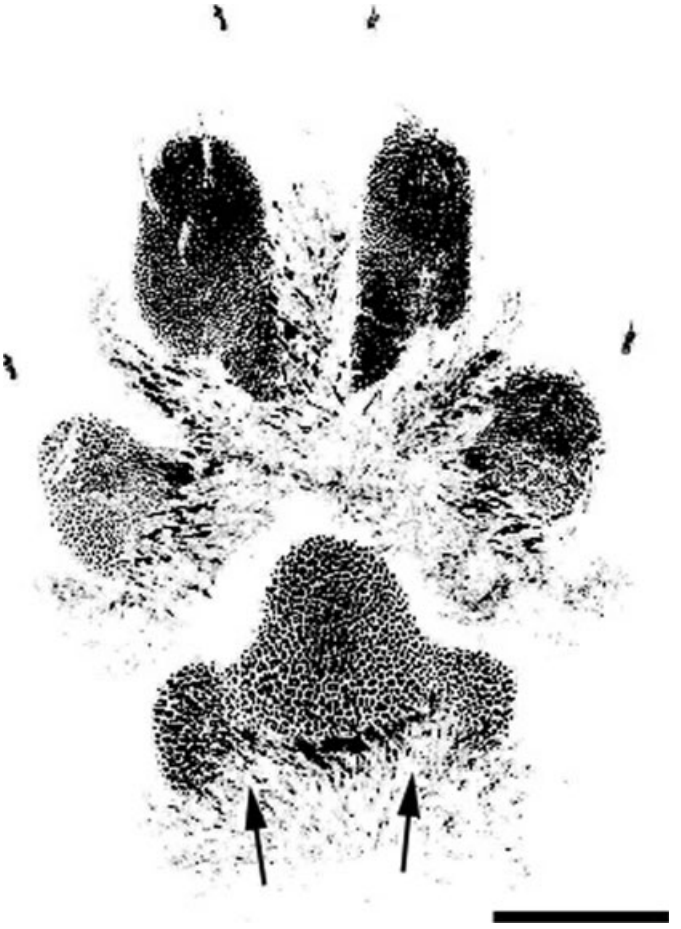

FIG. 2—*Paw print from the hind limb of a domestic dog. Note the four claw marks and three-lobed rear margin of the heel pad (denoted by arrows). Bar = 1 inch.*

claws are often close together and not attached to the toe marks, and the claws of digits 2 and 5 often are not identified in the paw print (4,5). The heel pad of the forelimb has a pronounced three-lobed rear margin (3). The rear margin of the hind foot heel pad is of circular shape with two slightly forward-pointing crescents laterally (3). The paw prints of a wolf are similar to that of the coyote as the claw marks are not attached to the toe marks and the front nails are often close together. Significant differences between the wolf's paw print and the coyote's paw print can be identified and include the length of the paw print which ranges from 3.75 to 5.75 in. (including the claws), the toe marks are more rounded than the coyote, and four claws often register (4). The heel pad of the forelimb is arrowhead shaped and the two lateral lobes point rearwards. This is a distinctive feature as no known wild canid has this feature (3). The heel pad of the hind foot had a pronounced three-lobed rear margin (4).

The paw print of the domestic dog has several similarities to both the wolf and/or the coyote. Similar to the wolf, four claw marks often register in the dog and the rear heel pads of the dog have a pronounced three-lobed rear margin (Fig. 2) (4). Given the variable sizes of dogs, the size of the paw prints can overlap the size ranges of both the coyote and wolf. The paw print of a small breed dog is 2–2.5 in. in length (including the claws) and the paw print of a medium to large breed dog can measure 3–4 in. in length (including the claws). The claw marks are distinct in the dog when compared to the coyote and wolf as the inner claws of a dog often spread outwards (5).

The forepaws examined in this case had the following features. The length of the paws measured 3–3.25 in., four toes were observed and only the claws of digits 3 and 4 were identified, and the heel pad had a pronounced three-lobed rear margin. Additionally, the rear margin of the heel pad of the hind foot was of circular shape with two slightly forward-pointing crescents laterally. Based on these features it was determined that the animals necropsied were coyotes.

No animal tracks associated with these animals were identified or examined at the site where these animals were found. If tracks were available for examination, animals in the Canidae family have two track types, direct register and double register (1,4). The trail pattern of the domestic dog is typically sloppy as the domestic dog typically does not walk in a straight line and the dog has a double register. A double register is a walking pattern where the animal's hind paw does not fall directly on the front track. Coyotes and wolves walk in a straight line and have direct register (1,4). Direct register is a walking pattern where the animal's forepaw is overprinted by the hind paw.

The case discussed identifies the importance of being able to accurately identify the species involved as legal implications can result from such cases. The animals were determined to be coyotes based upon examination of the animals' paws. Given that the animals were coyotes and not domestic dogs and according to Oklahoma law coyote hunting is permitted year round, the investigation of this case ceased and no charges were filed. When coyotes are hunted and subsequently skinned it is not uncommon for the distal aspects of the forelimbs and/or hind limbs to be removed as this allows for easier removal and preservation of the pelt. If the results of the paw pad examination had been inconclusive hair samples would have been submitted for genetic testing.

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