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Rajput N
School of Wildlife Forensic and Health, Nanaji Deshmukh Veterinary Science University, Jabalpur, Madhya Pradesh, India

Tomar MPS
Department of Veterinary Anatomy, N.T.R. College of Veterinary Science, Sri Venkateswara Veterinary University, Gannavaram, Andhra Pradesh, India

Dubey S
School of Wildlife Forensic and Health, Nanaji Deshmukh Veterinary Science University, Jabalpur, Madhya Pradesh, India

Soni G
School of Wildlife Forensic and Health, Nanaji Deshmukh Veterinary Science University, Jabalpur, Madhya Pradesh, India

Jain P
Department of Veterinary Anatomy, College of Veterinary Science and Animal Husbandry, Nanaji Deshmukh Veterinary Science University, Jabalpur, Madhya Pradesh, India

Jawre S
School of Wildlife Forensic and Health, Nanaji Deshmukh Veterinary Science University, Jabalpur, Madhya Pradesh, India

Corresponding Author:
Rajput N
School of Wildlife Forensic and Health, Nanaji Deshmukh Veterinary Science University, Jabalpur, Madhya Pradesh, India

Fake or real claws: Beyond molecular forensic investigations

Rajput N, Tomar MPS, Dubey S, Soni G, Jain P and Jawre S

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Abstract
The illegal wildlife trade poses a serious threat to global biodiversity and ongoing conservation efforts. Across the globe, this trade is increasing daily, overwhelming enforcement agencies with a flood of counterfeit wildlife products. One key challenge for these authorities is differentiating legitimate wildlife derivatives from expertly forged ones. This case report describes a forensic investigation involving a claw suspected to be from a tiger or leopard. The item was seized by enforcement officials and submitted for species identification. A multidisciplinary forensic approach—including molecular analysis, and radiographic imaging—was used. DNA was successfully extracted from keratin and analysed using the universal cytochrome b gene. Radiographic examination revealed a uniform keratin density, unlike the heterogeneous density typical of tiger and leopard claws. The claw was conclusively identified as originating from a domestic goat (*Capra hircus*) based on molecular investigation. This case highlights the sophistication of illegal wildlife trade operations and underscores the critical role of integrated forensic science in wildlife crime investigations.

Keywords: Fake claws, molecular investigation, radiographic analysis, species identification, wildlife forensics

Introduction
Illegal wildlife trade has emerged as one of the most lucrative and destructive transnational crimes, trailing only drugs, arms, and human trafficking in scope [1]. With increasing demand for wild animal parts—ranging from ivory and skins to bones and claws—the burden on forensic and investigative agencies has escalated substantially. In India, the illegal trade of body parts from Schedule I species under the Wildlife (Protection) Act, 1972 amended in 2022, such as tigers and leopards, remains a persistent concern. Among these, claws are often trafficked as talismans, ornaments, or symbols of power and are frequently seized by enforcement agencies [2].

A disturbing trend observed in recent years is the emergence of counterfeit wildlife products designed to mimic those of protected species. These fake items, often crafted from parts of domestic animals or synthetic materials, are intended to deceive both buyers and law enforcement [3]. Given this challenge, wildlife forensic laboratories must rely on a multidisciplinary suite of diagnostic tools—including DNA barcoding, radiographic imaging, and morphological assessments—to reach reliable conclusions.

This report presents a unique case of a suspected big cat claw submitted for forensic verification. We document the investigative methodology, results, and conclusions drawn, underscoring the essential role of comprehensive diagnostic strategies in combating wildlife crime.

Materials and Methods
In 2022, a claw resembling that of a tiger or leopard was seized during a routine inspection by wildlife enforcement officers in central India. The artifact was forwarded to the School of Wildlife Forensic and Health under the Nanaji Deshmukh Veterinary Science University, Jabalpur, Madhya Pradesh for species confirmation. According to preliminary observations by the seizing officials, the morphology suggested a large carnivore claw; however, uncertainties regarding its authenticity necessitated a thorough forensic investigation. Upon receipt, the claw was catalogued, photographed, and assigned a unique case identification

code. Standard chain-of-custody procedures were maintained throughout the analytical process.

Molecular investigation

Keratin samples were meticulously used from the claw surface using sterile tools. DNA extraction was performed using DNeasy Blood and Tissue Kit (QIAGEN, Germany). Extracted DNA was quantified and subjected to polymerase chain reaction (PCR) amplification using the universal primers targeting by using cytochrome b gene universal primers Cyt b1 CCAATGATATGAAAAACCATCGTT and Cyt b2 GCCCCTCAGAATGATATTTGTCCTC [4].

PCR conditions were standardized based on the protocol used earlier [5]. PCR products were visualised via agarose gel electrophoresis. Sequencing was performed in both directions using the Sanger method. The resultant sequences were subjected to a BLAST search against the NCBI GenBank database to ascertain species identity.

Radiographic imaging

The claw was subjected to radiographic imaging using a digital X-ray unit. Radiodensity patterns were analysed and compared with images of known tiger and leopard claws. Specific focus was given to assessing the internal keratin structure and identifying density gradients indicative of natural keratin layering seen in big cats [3].

Results, Discussion and Conclusion

The accurate identification of biological specimens in wildlife crime is critical for prosecution and conservation outcomes. Therefore, forensic laboratories use a multidisciplinary approach to analyse and identify the species of seized articles. In the present case, molecular and radiographic analyses were performed in the laboratory to understand the source and identify the species of seized item.

Molecular analysis

DNA extraction from the keratin was successful, yielding sufficient template for downstream PCR. Amplified fragments of the universal cytochrome b gene was obtained and sequenced. BLAST analysis showed a >99% identity match with *Capra hircus* (Domestic goat). No significant similarity to any feline species was observed.

Radiographic findings

Radiographic analysis revealed a striking uniformity in radiodensity across the claw. In contrast, reference images of verified tiger and leopard claws displayed heterogeneous keratin densities, with dense central regions tapering to less dense lateral margins. This pattern was absent in the submitted sample, suggesting artificial or altered origin (Figure 1).

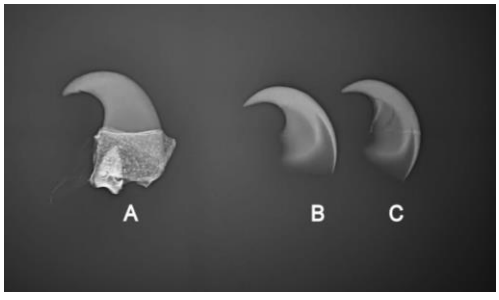

Fig 1: Radiographic images of fake claw (a) and real claws (b-c).

Based on the multidisciplinary approach for forensic investigations, the submitted sample was considered as fake claw. In this case, the suspected tiger or leopard claw was conclusively identified as originating from a domestic goat, highlighting the use of lookalike products in illegal trade. The successful extraction and amplification of DNA from keratinized material further illustrates the robustness of mitochondrial gene-based analysis in forensic contexts. Cytochrome b gene has proven reliable for species-level identification across a range of mammalian taxa [6]. Radiographic analysis added another dimension of confirmation. The unique keratin layering patterns observed in real carnivore claws—likely a result of their evolutionary adaptation to predation and climbing—are not easily replicated [7]. The uniform density of the specimen aligned with artificially shaped keratin fabricated from the biological sample of a domestic goat.

This case underscores the growing sophistication of wildlife trafficking networks and the need for forensic labs to adopt integrative diagnostic frameworks. Reliance on a single method may yield inconclusive results, especially in the face of increasingly convincing forgeries. Combining basic and advanced tools provides a powerful strategy for authentication and it also saves the time of enforcement agencies while dealing with wildlife crime.

The seizure and analysis of this counterfeit article exemplify the pivotal role of wildlife forensic science in addressing the illegal trade. This case report reinforces the necessity of multidisciplinary forensic approaches in identifying wildlife contraband and advocates for broader adoption of such practices by enforcement and research institutions. As illegal wildlife trade continues to evolve, so too must the strategies used to combat it.

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