



Wildlife Forensics

DNA analyses of large pangolin scale seizures: Species identification validation and case studies

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ABSTRACT

Pangolins are the most trafficked mammal in the world, and all eight species are listed under CITES Appendix I. DNA-based wildlife forensic techniques are recognized as an important component of investigating a pangolin seizure. In particular, determining the species of pangolin in a seizure will 1) confirm the presence of pangolin to establish the legality of any trade, and 2) ensure appropriate laws are applied to their fullest extent in a prosecution. Furthermore, valuable intelligence data, such as determining the geographic provenance of samples, can be produced through analysis of pangolin seizures. Despite the immense scale of the pangolin trade, standardized wildlife forensic techniques for testing pangolin seizures are in their infancy. To address this, here, we present a standardized genetic marker suitable for species identification of all eight pangolin species, and outline practical strategies for sampling large-volume pangolin scale seizures. We assessed the repeatability, reproducibility, robustness, sensitivity and phylogenetic resolution of this species identification test. Critically, the assay was tested in four wildlife forensic laboratories involved in testing pangolins. Additionally, we demonstrated the test's utility to conduct geographic provenance analysis of *Phataginus tricuspis* samples. We analysed five large-volume pangolin scale seizures in Malaysia, which elucidated key target species, poaching hotspots, and trafficking routes. *Phataginus tricuspis* was the most commonly identified species (88.8%) from the seizure samples, and 84.3% of these *P. tricuspis* individuals were likely sourced from western central Africa. We expect the implementation of the techniques presented in this paper will improve enforcement of pangolin trafficking crimes.

1. Introduction

Pangolins (family Manidae) are the most trafficked mammal in the world. They are primarily poached for their keratinous scales for use in traditional medicines, and for their meat, which is consumed as a delicacy or as bush meat [1,2]. All eight pangolin species, comprising four African species and four Asian species, are listed under CITES Appendix I

(<https://www.cites.org/>), prohibiting international trade of pangolins and their derivatives. Although the eight species are currently characterized into three genera, *Phataginus* (*P. tricuspis* and *P. tetradactyla*), *Smutsia* (*S. gigantea* and *S. temminckii*) and *Manis* (*M. javanica*, *M. culionensis*, *M. pentadactyla* and *M. crassicaudata*) based on phylogenetic studies [3], CITES (and often subsequent wildlife legislation) follow the nomenclature adopted by Wilson and Reeder [4], which

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