

# **A Wildlife Forensic Genetic Toolbox to Combat the Illegal Trade of the Short Beaked Echidna**

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Thesis submitted in fulfilment of the requirements for  
the degree of

**Doctorate of Philosophy**

under the supervision of Dr. Rebecca Johnson, Dr. Greta  
Frankham, Dr. Peter Gunn and Dr. Dennis McNevin

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## Certificate of original authorship

I, Alexandra Summerell declare that this thesis is submitted in fulfilment of the requirements for the award of Doctorate of Philosophy in the Faculty of Science at the University of Technology Sydney.

This thesis is wholly my own work unless otherwise referenced or acknowledged. In addition, I certify that all information sources and literature used are indicated in the thesis.

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## Thesis by Compilation Declaration

The following publication will be included in the thesis titled ‘A Wildlife Forensic Genetic Toolbox to Combat the Illegal Trade of the Short Beaked Echidna’ in the form of a thesis by compilation. Ph.D. candidate Alexandra Summerell researched, wrote, and edited the publication, while Dr Rebecca Johnson, Dr Greta Frankham, and Dr Peter Gunn contributed their guidance, edits and feedback to the article. The publication was accepted and published in Forensic Science International and will be included as Chapter 2 of this thesis.

### **DNA based method for determining source country of the short beaked echidna (*Tachyglossus aculeatus*) in the illegal wildlife trade (Accepted)**

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## Abstract

The international illegal wildlife trade is widespread and affects thousands of species. The illegal trade in ‘captive bred’ animals is one component of this trade, driven by the perceived value of unique species or those that are difficult to breed in captivity. ‘Demand’ for these species is met via poaching wild individuals to supplement ‘captive breeding’. One of Australia’s most iconic species; the short beaked echidna (*Tachyglossus aculeatus*) is one such species impacted by this trade. Echidnas are found throughout Australia, as well as New Guinea, and are notoriously difficult to breed in captivity, with less than 20 bred in Australian zoos in the last five years. However, in 2016 Indonesian breeding facilities listed a breeding quota of 50 echidnas raising suspicion around the origin of these animals. Exposing and combating illegal trade requires the development of robust forensic tools to aid enforcement. This thesis uses conservation genetics approaches to create a forensic genetic toolbox that can be implemented with short beaked echidnas of suspicious origin. *Chapter 2* outlines a validated mitochondrial DNA test that was able to determine source region (i.e. New Guinea or Australia) of short beaked echidnas, including with DNA extracted from non-invasive samples. Mitochondrial DNA provided limited resolution to determine the source finer than region, thus *Chapter 3* presents a single nucleotide polymorphism (SNP) marker set developed to investigate short beaked echidna subspecies, which to date had only been described based on morphology and geographic distribution. Genetic structure within the SNP data were congruent with current subspecies, but significantly wider sampling of echidnas, in particular, island populations and at subspecies overlap zones is needed to reach definitive conclusions. In *Chapter 4* I demonstrated these SNP markers also had the

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power to elucidate relatedness between individuals, and using captive bred individuals, could be used to reconstruct pedigree, which I then applied to assess relationships within a wild population. *Chapter 4* includes a suite of SNPs that once validated could be used for forensic investigations of short beaked echidnas. Lastly, *Chapter 5*, outlines the attempted validation of a real-time PCR sex determination method using previously published methods. This test however failed multiple validation criteria so would require further optimisation before it could be used in a wildlife forensic context. This thesis presents the first set of genetic tools for the short beaked echidna in a forensic context, providing novel information on source region, subspecies and relatedness that can be implemented to combat the illegal trade of this iconic species.

