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Review Article

Wildlife crime in Australia

Adrian Linacre

College of Science and Engineering, Flinders University, Adelaide, Australia

Correspondence: Adrian Linacre (adrian.linacre@flinders.edu.au)

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Wildlife crime is on a massive scale by whatever metric is used. The illegal trade in wildlife and related products is leading to the decline and extinction of many iconic species from rhino to tigers. Almost all countries are signatures to CITES and therefore should enforce national legislation if alleged infringements of trade of wildlife occur. No country is immune from this illegal trade although countries like Australia have their own specific wildlife crimes. Australia is home to many reptilian, amphibian and avian species that are highly prized, predominantly as pets. Collection of protected species from the wild is illegal in all jurisdictions yet policing remote areas of the outback, where so much of the native endemic fauna and flora lives, is nearly impossible. The illegal international trade in these species is highlighted by two case studies provided in this review. A further case highlights the issues of each of the six states of Australia having separate legislation, which is compounded when wildlife crime can be inter-state crime. Australia is one of the few countries having an institute, based at the Australian Museum, with an accredited wildlife forensic science laboratory and therefore the capability to undertake forensic testing of seized samples. One way to reduce wildlife crime may be by educating those who buy illegally seized products that there is a direct connection between the dead animal from which it came and the devasting effect this purchase has on the environment.

Scope of wildlife crime

Wildlife crime is a world-wide phenomenon attracting massive financial gain to those that partake of this illegal activity but leads to extinction of many species and pushing others to the brink of extinction. The latest estimate of the monetary value of wildlife crime is $32 billion USD per year, but this does not include the trade in illegally logged timber (~$4 billion USD) and illegal fishing (~$17 billion USD) [1,2]. This compares to an estimate of $55 billion USD for the heroin trade [1,2]. These figures are best estimates as the real scale of the trade is extremely hard to quantify as so much of it goes undetected. One publication reports that the international trade in wildlife crime is second only to controlled narcotics [1]. This is difficult to substantiate but whatever the true figure might be, it would be expected that there are well-developed standard operating procedures to investigate such alleged illegal activities and processes in place to enforce national legislation. Furthermore, the experience of this author is that those leading prosecutions are rarely inclined to divert policing resources to alleged crimes that are not against people and property. Additionally, there are few accredited forensic laboratories undertaking such cases; rather the entire focus in mainstream forensic science laboratories is on crimes against humans and their property.

One recent initiative to be welcomed in the fight against wildlife crime is by the high profile support from the Duke of Cambridge in the establishment of 'United for Wildlife'. This has the aim of bringing together key conservation organisations to combat global poaching. It is committed to increasing public and governmental attention to pressing conservation issues: from the rapid escalation of illegal wildlife trade to the challenges of reducing demand.

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Other initiatives include #endwildlifecrime [3] who aim to bring venture capital funds together to target specific aspects of wildlife trade. Their actions include the following:

"The Initiative will support the development and adoption of a wildlife crime protocol under the United Nations Convention against Transnational Organised Crime (UNTOC), and amendments to the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), the global agreement that regulates international wildlife trade, that would incorporate public and animal health criteria into its decision making." This recent initiative has already gained the support of many organisations.

The World Wildlife Fund [4] and organisations such as TRAFFIC [5] are also prominent in highlighting wildlife crime and also funding projects aimed at reducing either the occurrence or the effects of these illegal actions.

International trade in endangered species

Iconic species grab headlines and are flagship species that illustrate a much greater problem. The plight of the rhino and cost of rhino horn is one such example. Rhino horn on the black market can fetch as much as $65,000 USD per kilogram [6]; this compares to $50,000 USD per kilogram for both platinum and gold. Rhino horn is composed of the same type of protein as fingernails, yet unfounded beliefs in its medicinal powers have helped drive the market for rhino horn [7,8]. The same driving forces are behind the illegal trade in pangolins: these scaled mammals are now the most traded mammal due to the use of scales as a 'cure' for a range of ailments and the foetus as a delicacy [9,10]. Elephant poaching for ivory is an example of another iconic species on a sharp decline due to the desire for ivory-based sculptures and trinkets [11]. These iconic species grab the headlines and serve as examples of the international trade in mammals. Body parts from these species however are rarely reported as encountered in Australia compared with other countries such as in Asia.

Legislation covering international export and import

Trade of protected species of both plants and animals is overseen by the Convention on the International Trade in Endangered Species of Flora and Fauna (CITES). Australia is a signature to CITES, along with 185 other countries, and has enacted CITES into federal legislation through Part 13A of the Environment Protection and Biodiversity Conservation Act 1999. Signatures to CITES should prohibit international trade in specified species, typically those listed in CITES Appendix 1, and restrict trade in other species listed in Appendices 2 and 3.

Australia has had limited seizures of iconic species and is rarely either a transit country for the wildlife trade or an end-user [12]. It is more the export of species endemic to Australia to markets in Europe, Asia and North America that is an issue to the biodiversity of this country [12]. Australia though is not immune to the trade in high profile mammalian species. The most commonly traded species were first highlighted in a paper published in 2008 [13]. These two authors used data on wildlife seizures by Australian Customs between 2000 and 2007 and prosecutions from 1994 to 2007. Of all the cases, only 1% resulted at that time in a prosecution. Of this 1% of cases, the vast majority involved illegal international trade with 46% being an attempted export out of Australia and 34% for attempted importation to Australia. The seized samples reflected the species here in Australia with reptile species accounting for the highest number of samples seized (43%) followed by exotic bird species (26%).

More recently a different type of 'wildlife crime' was reported based on the presence of protected species as ingredients within East Asian medicines that can be bought in Australia [14,15]. An example of the type of medicine that is encountered is shown in Figure 1. In the DNA analysis of a traditional medicine sample by Coghlan et al. a total of 68 plant species were identified, few of which were listed as ingredients, along with animal species such as the Asiatic black bear (CITES listed) and an antelope species that is also CITES listed. Given that these 'medicines' were imported, CITES related legislation was breached.

Australia might not have rhino, elephant and tigers, but there are exotic reptiles, amphibians and birds that are sought after globally and command a high price on the black market both home and abroad. The pet trade in many countries requires lizards, snakes and bird species such as parrots and cockatoos: all of these are endemic to Australia. Over 80% of the flora and fauna found in Australia is endemic [13], with ∼93% of the snake and 89% of the reptile species found nowhere else [16]. The bright colours and exotic nature of these species make them highly prized such that snakes and reptiles have fetched very high prices, reported as upwards of 10,000

Emerging Topics in Life Sciences (2021) **5** 487–494
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Figure 1. Showing an example of traditional East Asian medicine bought from a shop local to the author.
The item measures 15 cm × 11 cm and contains four individually wrapped plasters. The concept is that placing this on your wrist can reduce arthritis; there is no medical evidence to support this. Image taken by the author.

AUD each [17]. The illegal trade in parrots and cockatoos by the collection of eggs from the wild was highlighted in a paper entitled '*Egg forensics: an appraisal of DNA sequencing to assist in species identification of illegally smuggled eggs*' [18]. Here a group based at Murdoch University, Perth Australia, looked at 99 avian eggs and used a DNA-based technique to identify each to being either a parrot or cockatoo, and therefore protected under state legislation, but also highlighted the need for further data collection to allow robust reporting of the significance of the DNA data. Eggs collected from the wild can be hatched and then sold into the pet trade with little chance of detection or later being able to be traced back to the parent birds in the wild [18].

The illegal trade in reptiles and birds is mostly in the form of eggs as these can be sent by post in secure padded boxes [12]. If this were to be the case, then the sender is not carrying anything illegal and the only chance of detection is if Australia Post or the courier company scan or open the package. An alternative means has been to strap a vest with pockets for eggs to couriers' body: rarely will eggs show up on airport scanners but clearly the carrier puts themself in danger of being found in possession of these eggs. Two case examples illustrate recent cases of wildlife crime.

Emerging Topics in Life Sciences (2021) **5** 487–494
https://doi.org/10.1042/ETLS20200288

High profile wildlife crime

Martin Kennedy was a rugby league player in Australia before his career ceased in 2016 due to a doping ban. In 2018 he pled guilty to six offences including attempting to export shingleback lizards to Sweden, importing alligator snapping turtles and neotropical stingrays from Thailand, and illegally possessing two pythons at his Sydney home. He was jailed for four years for wildlife smuggling, with a non-parole period of two years and six months, after an appeal court ruled a 'good-behaviour bond wasn't a tough enough penalty'.

A District Court judge had earlier ruled he had excellent prospects of rehabilitation and sentenced him to the longest good-behaviour bond available to judges. But 4 months later the NSW Court of Criminal Appeal found his original sentence — a three-year good behaviour bond delivered in June — was far too weak and jail was needed to send a message to the community. The appeal court upheld the case from prosecutors that the sentence was manifestly inadequate. '*This is some of the most serious offending of its kind which has come before the courts*,' Justices Anthony Payne and Elizabeth Fullerton said. The Justices surmised that not imposing a custodial sentence would be an insufficient deterrent to others tempted to indulged in the illegal wildlife trade, and Justice Adamson stated 'I consider general deterrence to be a highly significant factor in the present case'.

It was reported that Martin Kennedy's operation was first detected in July 2016. Four packages bound for an address in Sweden were X-rayed by Australian customs officials and found 24 live shingleback lizards and 10 live turtles wrapped in cloth bags inside plastic food containers.

It was alleged that this was not his only such occurrence of wildlife crime. It was reported that he had travelled in 2016 to Thailand and posted live animals to Australia. The haul was made up of 68 snakehead fish, 23 Chinese soft-shelled turtles, 20 sugar gliders, 15 veiled chameleons, 15 alligator snapping turtles and 11 neotropical stingrays. Some 91 animals died in transit and all surviving specimens were later destroyed. Additionally, it was reported that two foreign non-venomous pythons and $43,550 AUD in cash was seized from Kennedy's home in a March 2017 raid on his property.

Martin Kennedy will be eligible for parole in April 2022.

Case of alleged illegal movement of species Out of Australia

In January 2020, a seizure was made of over 180 animals endemic to Australia from a property in Western Sydney. The animals were predominantly reptilian and were found concealed in boxes bound for Hong Kong and Taiwan. This has led to charges being laid against two individuals, one male and one female, for attempting to smuggle exotic wildlife out of Australia; the 17 offences for which they were charged carries a maximum penalty of 10 years imprisonment and/or a $210,000 AUD fine.

The seizure happened after an investigation into suspicious activities. Officials from the Australian Border Force seized mail parcels in which these exotic species were packaged. As so often is the case, the animals were concealed behind electronic devices in an attempt to shield the animals from standard checking.

The extent of the smuggling operation was uncovered when, after a Department of Environment-led investigation, police executed a search warrant at the property. In total they discovered: 43 lizards, 40 turtles, 30 snakes, 22 tortoises, 22 frogs, 19 reptile eggs and five salamanders.

The destination for these exotic species may assist in targeting countries that are end users and information such as an address on a seized item can clearly aid in further police investigations. A press release at the time noted '*According to the Department of Environment and Energy, Australian reptiles are highly sought after overseas and wildlife crime is now recognised as a specialised area of global organised crime.*'

This story was reported in the Sydney Morning Herald, 20 January 2020.

Both of these cases highlight a number of key points:

- The potential financial gain from exporting, and perhaps to a lesser extent, importing exotic species;
- The minor penalty that can be imposed;
- The value of excellent policing in following up reports of suspicious behaviour; and
- Being vigilant in scanning parcels.

A comment from the author is that this is only one example where the detection and policing was successful, but it is unknown just how often this type of trade goes undetected.

Emerging Topics in Life Sciences (2021) 5 487–494
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Policing the Australian outback

Australia is a vast country with only a population of nearly 26 million. Approximately 40% of Australian citizens live in, or near, one of two cities (Sydney and Melbourne), and 85% of all Australians live within 50 km of the sea [19]. The interior land mass of Australia is the famed Outback. With little rainfall this massive area cannot sustain a large population and is therefore largely unpopulated [20], yet this is the habitat of many highly prized native species which can be collected illegally [16]. Effective policing of the outback is nearly impossible. Snakes and other reptiles, plus the eggs of birds, can be collected with little chance of observation in such a remote area [18]. These illegally captured animals can then be integrated into the pet trade or attempted to be smuggled overseas.

Inter and intra-state issues

The Australian Federal Police (AFP) have jurisdiction over federal crimes and are in partnership with the Australian Customs and Border Protection who have responsibility at airports and seaports to intercept any illegal movement of wildlife. If anyone has entered Australia by air, then they will be familiar with the strict biosecurity laws and will have witnessed the attendance of the authorities at the airport. Australia consists of six states (Western Australia, South Australia, Queensland, New South Wales, Victoria, and Tasmania) and two territories (Northern Australia and the Australian Capital Territory). Each state has their own legislation regarding wildlife and this can be inconsistent leading to legal issues when persons alleged to have transgressed a law in one state are apprehended in another. This problem was highlighted in a 2009 case [16]. In summary, a resident of New South Wales was apprehended in Queensland, having recently visited Northern Territory, in possession of 56 reptiles alleged to have been taken from the wild (one identified as a species endemic to Western Australia and the other 55 from a range of states). All the species were identified based on their morphology. In this case, there were up to four jurisdictions that could lay charges as there was evidence that the state laws were breached in each of these states. Once a prosecution initiated in Queensland then the right to a fair trial after disclosure and the issue of double jeopardy led to the decision by the other States or Territory not to take any action, even though it was highly likely that state legislation in New South Wales, Western Australia and the Northern Territory had been breached. The result was only charged in Queensland were brought and no cases were initiated from the other states.

Forensic science capability

Typically the types of forensic science required in an investigation of alleged wildlife crime includes: document analysis, as so many samples are traded based on documents or other types of certificates of authenticity to show that the sample does not contravene any legislation; digital I.T. to track communication between those alleged to be involved in this illegal trade and undertake surveillance as needed; forensic accounting, as illegal earnings are laundered to evade detection; morphological analysis if an animal or plant sample is intact or near intact such that identification can be reported with confidence; and lastly molecular biology to identify samples when morphology is not possible — this identification may be to species level, or assignment to an individual, or geographical provenance. Here in Australia there are the required skills of morphology and molecular biology at places such as the Australian Museum, which is fully accredited to ISO/IEC 17025 to perform this work. This institution is one of the very few laboratories with such accreditation in the world. Forensic wildlife capability resides also at a few universities, such as where the author is based.

The skills and capability of document analysis and digital forensic science in general resides either with operational forensic science laboratories, or state police forces, or the private sector. The forensic capability of these laboratories tends to be focussed on crimes against people and property and rarely applied to samples submitted as part of an investigation into alleged forensic wildlife crime. The scientific processes and methodologies would be the same, regardless of the nature of the offence. Thus few, if any, samples are submitted by investigating authorities in such cases. It is also noteworthy that this absence of mainstream forensic science laboratories with the capability of undertaking the examination of any items submitted as part of an alleged wildlife crime investigation, is in contrast with public opinion on the high profile nature of saving wildlife and the environment, as for instance the World Wildlife Fund and the International Fund for Animal Welfare receive much public support and financial contributions. In the experience of the author, this lack of examining items relating to alleged wildlife crime is due to a number of reasons: firstly the lack of initial investigations, which leads to no samples collected and then submitted; and that operational laboratories have backlogs and

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budgetary constraints, therefore priorities are made as to which cases are processed and wildlife crime has a lower priority than cases of alleged crimes against people and property.

Role of wildlife forensic science (DNA technologies)

DNA has opened up the possibility of addressing key questions such as: (i) identifying the species present, as this is relevant to legal restrictions; (ii) linking two or more samples to a specific individual and to determine the size of any seizure; and (iii) determining the most likely geographical location from where the sample originated.

It should be stressed that morphology plays a crucial role, including the comparison of dental material, bones and microscopy of hairs. DNA is a powerful tool when such items are not available. Questions which can now be asked of DNA, and answered, include the following:

Is this sample from a legally protected species?

The process of reporting on the species present is now a relatively routine practice and uses many standard procedures that allow the work to be accepted by a court. The most common approach is to use sections of the mitochondrial genome, such as the gene encoding Cytochrome *b* [21–27] or that encoding Cytochrome Oxidase I [28–33]. The mitochondrial genome has advantages in that there are very many copies of the DNA in each cell (typically hundreds to tens of thousands) compared with two copies of nuclear DNA; hence if the material is at really trace levels such as in hairs, horns, feathers or claws, mitochondrial DNA typing can still generate data whereas the chances of obtaining a nuclear genotype is less likely[22–26,34]. Mitochondrial DNA is inherited solely down the maternal line: this can be an advantage when linking samples together or can be a disadvantage as two samples can have the same DNA type due only to a recent common maternal relative. A recent example that highlights this type of testing in Australia is the mitochondrial DNA typing of echidna [35]. This methodology allows non-invasive DNA testing of live animals yet still yields valuable data.

Is this sample from a specific member of a legally protected species?

For instance, linking pieces of ivory to the same dead elephant [11,36], showing how many poached pangolins contributed to a seizure [10], or linking a rhino horn to a slaughtered corpse [26,37]. The science is very much analogous to that used in human DNA profiling dentification. Crucial differences lie in the biology of the species (e.g. is it polygamous and does it migrate) and in the evaluation of any matching DNA profiles (e.g. whether the population is highly inbred). Recently work on the carpet python has shown the potential to perform the same DNA profiling used in human identification, such as association to an individual or to member of the same family group [38]. The carpet python a species that is commonly kept as a pet by those that keep snakes, yet anecdotal evidence suggests many are collected from the wild. This type of work is incredibly laborious and expensive as it requires the following: whole-genome sequencing to identify hypervariable loci; isolating these loci; confirming their variability; mapping together to one or more multiple reaction (called a multiplex); gathering all the types seen to create an allelic ladder to allow inter-laboratory comparisons; and creating a reference database to determine the occurrence of the various DNA types encountered (along with a multitude of other statistical tests to ensure the test meets standard forensic practice). It is not surprising therefore that few examples exist of such a DNA test for species in Australia.

Is this sample from a specific population or geographical region?

Assigning a sample to a particular discrete population is becoming increasingly important and more frequently requested [39]. High profile examples include the determination of poaching hotspots and common areas where illegal logging [40] or poaching of elephant occurs [11,36]. Population assignment has been used largely for investigative purposes and is currently in the early stages of validation.

Conservation and education

Forensic science is very much part of the enforcement of legislation. The ideal scenario is to reduce criminal activity and therefore reduce the need for forensic science. Reducing crime can be idealistic and not achievable — one aspect of wildlife crime is supplying body parts for spurious medicinal reasons, and in the case of ivory, for ornaments and jewellery. Educating those that purchase items derived from the illegal trade in wildlife that their actions may make a difference, with examples including: linking a poached/slaughtered rhino with horn removed by a chainsaw to 'medicine', or a dead elephant associate with a trinket make from the ivory. Zoos can very much play a role not only in international captive breeding programs for CITES listed wildlife, but play a crucial role in displaying the deadly effect of ivory ownership or consuming rhino horn for instance. Further zoos, such as the zoo local to the author, play a crucial role in education of the public, often with a focus on the young, to play a role in conservation of the natural world.

Summary

- Wildlife crime is highly organised and leading to the decline and extinction of iconic species
- Australia is home to many highly sought after reptilian and avian species
- Enforcement of legislation is an effective means of reducing this type of crime
- There are legal issues in Australia with its state-based constitution

Further Reading

Wildlife Forensics: methods and applications. Editor Jane Huffman and John Wallace, Willey-Blackwell, 2012
Wildlife DNA Analysis: applications in forensic science. Adrian Linacre and Shanan Tobe, Willey-Blackwell, 2013

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Author Contribution

This is a contribution by a single author.

Abbreviations

AFP, Australian Federal Police; UNTOC, United Nations Convention against Transnational Organised Crime.

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