

Conference Abstracts

Wildlife Crime: the Need for a Holistic and Interdisciplinary Approach to Investigations

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"Wildlife" is referred to in most dictionaries and reference texts as "animals and plants that are not domesticated, tame or cultivated" but in the "Little Oxford Dictionary" (1986) as "wild animals collectively".

This latter definition is the one that will be used primarily in this lecture. The word "forensic", as defined in the Concise Oxford Dictionary, means relating to, used in, or connected with a court of law. It comes from the Latin word *forensis* which meant public. This in turn was derived from *forum*, which originally was a market and then, later, a place of debate - a reminder that forensic work is carried out in public and is meant to be subject to open discussion and scrutiny. "Crime" is generally considered to be "an act punishable by law" and this can include contraventions of national, regional and international legislation.

Wild animals, both free-living and captive, are increasingly the subject of litigation in Europe, North America, Australasia, Africa and the Far East. They thereby may become the subject of forensic investigation. Wild animals may:

- be the cause of an incident – eg if they injure a person, damage property; or spread an infectious disease;
- be the victim - if they are killed, injured, poached, exported illegally or treated inhumanely;
- provide information that is relevant to an incident – for example, because they were present when a crime was committed and their hair, bones, blood or other material remains as evidence.

Legal cases concerning wildlife require a broad-based approach, with attention paid to the environment as well as to the animal itself. They usually involve a range of disciplines and those working in this field need to collaborate and to share experiences and skills. The reliability of the results of crime scene and other investigations is greatly enhanced if studies are carried out in concert with scientists from other disciplines. These may include members of the medical and dental professions, ecologists, ornithologists, herpetologists, botanists, geologists, molecular biologists, microbiologists, toxicologists, crime scene specialists, rehabilitators and animal keepers and amateur naturalists.

Cooperation in wildlife crime investigation is not only personally and professionally rewarding but is also likely to prove beneficial in terms of the quality of evidence presented in court and thereby the implementation of the judicial process.

Further Reading

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DNA typing in wildlife investigations, DNA and recommendations of the international Society of Forensic Genetics on nonhuman DNA testing for forensic investigations

Prof. Adrian Linacre

South Australian Chair of Forensic Science, Biological Science, Flinders University, Australia

The use of non-human DNA typing in forensic science investigations falls primarily into one of two key areas; species identification or linkage of a sample to a particular organism. There is an ever increasing interest in this area with much work being performed by universities unfamiliar with the forensic science process. The International Society for Forensic Genetics initiated a Commission to make recommendations on the use of non-human DNA in a forensic science investigation. These recommendations include comment on sample collection, the process of species identification, the use of short tandem repeats to identify a particular organism and the framework of reporting. The recommendations are designed to encourage good practice rather than restrict cases being performed. This presentation details these recommendations for the use of non-human DNA in criminal investigation.

Interpreting DNA Evidence for Autosomal and Lineage Markers

Bruce Weir

University of Washington

Attaching numerical strength to matching DNA profiles makes use of population genetic and statistical principles. For autosomal markers, it is helpful to distinguish among three different frequencies for each allele in the profile: the value in the whole population, the value in a sample from that population and the value in a particular sub-population relevant for the present situation. Problems arise with using the second frequency in place of the third when there is relatedness amongst potential sources of the profile and when there is variation among the subpopulations. There is now a good body of theory available to handle these complications, but there is less agreement for lineage markers.

The problem with mtDNA or Y-STR profiles is that it is often the case that the profile of interest is not among entries on a database and it does not seem satisfactory to apply the same strength to, say, a 7-locus Y-STR profile as to a 17-locus profile. Recent publications by Brenner and by Buckleton, Krawczak and Weir will be discussed.

Wildlife Forensics in Western Australia: Problems, Pitfalls and Potential

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Since 2006 our laboratories at Murdoch University have conducted a variety of casework on wildlife forensics samples including ivory, eggs, fur, eggs, traditional Chinese medicines, bone and scats. We have conducted testing for species identification purposes as well as microsatellite markers for relatedness studies in wildlife species. This presentation will showcase some of our casework and discuss issues associated with marker development, low copy number DNA, extraction techniques and new advances in DNA sequencing platforms.

Can we help stop the budgie smugglers? Wildlife Forensics in 2011 and beyond

*Dr Rebecca Johnson, Manager
DNA Laboratory, Australian Museum, Sydney*

Wildlife crime is an increasingly lucrative trade with rare animals and plants fetching extremely high prices on the illegal market. Wildlife forensics is a young field which uses traditional techniques to help investigate wildlife crime. These techniques, particularly the use of DNA, are being increasingly adopted by authorities in cases where pedigree or species was impossible to determine.

2011 and beyond will see the field of wildlife forensics develop into a mature discipline requiring rigorous techniques, standards and validation. This will ensure evidence of the highest quality is presented in court so that appropriate penalties can be applied to guilty parties, which may even act as a deterrent to others. This will be discussed along with some wildlife forensics case studies from the Australian Museum.

Waiter, is that a Whale on my Plate? - DNA identification of cetaceans on the meat market

*Shane Lavery and (many) others
School of Biological Sciences, and Leigh Marine Laboratory, University of Auckland*

For some years, the whale meat markets of Japan and South Korea have been monitored using DNA forensic techniques. The logistics have required specialised mini-lab and other imaginative approaches in order to successfully achieve correct identifications in limited time-frames. Results from mtDNA and microsatellite analyses have led to important findings that cover three broad areas: 1) species identification, 2) population identification and 3) tracking and counting of individuals. The findings highlight the value of genetically monitoring these markets, the impact of these markets on cetacean conservation, and the need for ongoing access to centralised reference databases.

The application of DNA barcodes to specimen and product identification in fisheries

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Whole fish and shellfish are easy to identify to the species level based on external characters. For fillets and shucked products most of the external characters are lost making identification difficult, and occasionally leading to the substitution of low value species for high value species or quota species as non-quota species. A global DNA-based barcode identification system is being developed for all animal species, and provides a universal tool for the identification of fisheries species and products and replaces previously used protein or gene regions that were order or family specific. The barcode system is based on DNA diversity in the mitochondrial DNA cytochrome c oxidase I gene, COI; suspect specimens and products are identified by comparing their barcode sequences against a database of COI sequences derived from reference specimens. Species recognition is based on the barcode “gap” between intra- and inter-specific variation. In general the barcode “gap” has provided a valuable tool for species identification and for highlighting cryptic species, although substantial overlap between intra- and inter-specific variation has been reported in some marine invertebrates. For marine fishes, around 98% of species tested to date have been distinguished by COI barcodes, and the method is applicable to smoked, cooked, and canned products, although the latter require the use of genus- or family- specific primers to recover short sequences. DNA barcodes are also being applied in the identification of invertebrate and fish larvae and the gut contents of fishes.

Population structure of selected Indo-West Pacific shark and ray species, with applications to monitoring the international shark fin trade

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Cynthia Riginos, School of Biological Science, University of Queensland, Brisbane, QLD, Australia

The Indo-West Pacific region has the most diverse shark and ray fauna and highest shark and ray harvest globally, and is the focal region of both demand and supply for the international fin trade. Identifying the population origin of fins in international trade can provide much-needed data for the management and conservation of shark and ray species heavily exploited in this region. This study describes mtDNA (control region) population structure for up to 10 co-distributed tropical Indo-West

Pacific shark and ray species with marketable fins. These phylogeographic data will be used as the basis for a method to assign likely Indo-West Pacific population origin to traded fins for a few selected species.

Using fins sampled from Australian and South East Asian trade sources, a pilot study will describe species composition and assign likely population origin where possible for selected species. Species identification is integrated by using the same marker. The approach is presented here for the Spot-tail shark *Carcharhinus sorrah*. This study aims to contribute a useful approach for international shark fin trade monitoring in the Indo-West Pacific, integrating species-level enforcement with collection of population-level trade data for a small number of heavily exploited species.

Insights into the Analyses of Human and Animal Hairs in Archaeological, Paleontological and Forensic Contexts

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Spanning four centuries the microscopical study of hairs is a venerable one. Studying the morphological structure of hairs assists in addressing the 'who, what, when and how' questions in relation to a sample discovery. These questions, and the applications to answer them through light microscopy, are equally applicable to whether one is attempting to derive answers from the examination of hairs that are centuries old, or those that are more contemporaneous in nature. In relation to human hairs it is possible, for example, to determine the differences between people belonging to different populations and how individuals differ; in relation to animal hairs it is possible to affect family or species levels of identification and infer the environment the animal inhabited. Whether hairs are human or animal in origin, the microscopical study of human and animal hairs may also yield information in relation to pre- and post mortem morphological changes and attribute the manner in which hairs become damaged. This presentation will showcase a number of studies to illustrate the practical applications, and eclectic nature, of microscopical morphological structure of hairs. Case studies, that range from homicides to customs' seizures to ancient hairs. The presentation will also discuss the utility of hair as a privileged site of DNA preservation in the post-mortem environment and the impacts high throughput sequencing and metagenomics will exert on the discipline.

Wildlife forensics & conservation in New Zealand

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Wildlife forensics in New Zealand covers a wide range of applications. At the border, detection of protected species is becoming more frequent due to increased demand for endemic species internationally. Substances are continually being brought into New Zealand that may contain a variety of CITES-listed species, usually associated with traditional Chinese medicines. Within New Zealand, many of our native species are threatened with predation from introduced mammals, including domestic pets such as dogs and cats.

EcoGene™ has been established in 2008 to provide a DNA-diagnostic service that can support government agencies where evidence is required for cases that may result in legal action. Our aim has been to establish a range of DNA-based methods that are ISO accredited, thereby providing the level of quality assurance required for any prosecution cases. This talk will summarise a range of these methods and applications to date.

Recent developments in the application to conservation have been the use of DNA obtained from saliva swabs from eggshells and predated birds in order to identify the predator and in potentially identify the specific individual. This has the greatest potential in the identification of dogs that may be implicated in predation of the flightless endemic kiwi bird. Prosecutions can be made under the Wildlife Act if it is shown that a domestic dog has been allowed to wander into areas that are known as 'kiwi zones' and subsequently killed a bird. Until now, the difficulty has been proving the identity of a dog, even when it has been suspected due to other evidence. We have developed a range of microsatellite markers that can be multiplexed and used to identify individual dogs from DNA obtained by swabbing wound sites during post-mortem examination. We are now establishing a reference dataset of dogs from particular kiwi areas where predation is a problem. It is hoped that publicity of this methodology will be sufficient in raising public awareness and that more dog owners will take advantage of kiwi aversion training that is freely offered.

Egg forensics: an appraisal of DNA techniques to assist in species identification of illegally smuggled eggs

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Parrots and cockatoos are charismatic birds, their plumage and capacity for learning make them highly sought after pets. Unfortunately, the illegal trade in birds poses a serious threat to the survival of native populations, while the introduction of smuggled species also carries with it the potential of introducing disease into native populations. To reduce the logistical difficulties associated with trafficking live birds, smugglers often transport eggs. This creates a problem for authorities in

providing robust species identification. This presentation will discuss the use of mtDNA techniques to identify seized eggs with particular reference to our work on 99 avian eggs illegally seized in Australia. Based on currently available reference data only approximately half of the eggs could be identified with confidence to a species level. Of the eggs that could be assigned, 10 different species were detected in 8 genera, all belonging to the parrot (Psittacidae) and cockatoo (Cacatuidae) families. Clearly the lack of validated DNA reference sequences is hindering our ability to accurately assign a species identity and we advocate that more attention needs to be paid to establishing validated reference databases that can withstand legal scrutiny. Further to the issue of correct species identification, the need to determine relatedness between seized parrot samples is also of importance. This presentation will also discuss our current work in testing and validating microsatellite markers that can be used across a number of parrot species for this purpose.

DNA tools for policing illegal trade and poaching of black-cockatoos and pythons in Western Australia

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Genetic tools are an effective, non-invasive method for gaining an understanding into taxonomy, molecular ecology and biodiversity of endangered species, in addition to policing illegal wildlife poaching and trafficking. This presentation will showcase how the development of nuclear microsatellite markers and the compilation of DNA profiling databases have been used for alleged illegal poaching and trafficking of endangered white-tailed black-cockatoos and pythons in Western Australia with case studies demonstrating the following applications; (1) assisting wildlife enforcement agencies in determining illegal take from the wild; (2) paternity testing of cockatoos and pythons to validate registered claims of successful brooding in captivity; and (3) identification of species and number of individuals from body parts collected from wildlife crime scenes. The DNA profiling tools and databases currently in place has facilitated the successful prosecution of individuals illegally poaching and trafficking in Western Australia. As White-tailed Black-cockatoos face increasing pressures from habitat modification, climate change, invasive species and illegal activity, DNA profiling has become a vital tool in understanding this species biology and more importantly, in the protection of an endemic and iconic species.

Quality Management and Expert Opinion: Necessary Bed Fellows in Forensic Science

Dr SallyAnn Harbison

Environmental Science and Research, Mt Albert, Auckland

Quality Management in traditional Forensic Science is well established and there are multiple providers of quality management schemes mainly based around the ISO 17025 standard for testing and calibration laboratories. Additionally, specific additional guidelines are have been available for DNA based testing for criminal casework for many years, reflecting the reliance placed upon such evidence and its perceived “infallibility” by the public at large. By drawing many years of experience in the forensic world, this presentation will highlight important aspects of a robust quality system as it is applied from the crime scene to the court room, demonstrating how to ensure that any evidence identified, collected, analysed and ultimately presented in the court room can withstand the scrutiny of the court and assist in the resolution of wildlife crime.

Law for Wildlife Forensics

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In order to provide effective evidence in forensic work with wildlife (wild animals) it is necessary to have a good understanding not only of the general legal structure within which evidence will have to be presented but also of the law that provides the basis for a particular investigation.

The law relating to wildlife conservation is a specialised area. For those called to carry out forensic investigations in this field there is a need to understand both the general implications of the legislation and the specific aspect of it that is involved in a particular case. This is especially so when the results of an investigation are to be presented as evidence in a court but it is also important when they are to be the basis of a report.

The animals involved are primarily:

- Free-living wildlife
- Non-domesticated species (indigenous or exotic) that are in captivity for some reason such as conservation, education, display or sport, rehabilitation or captive- breeding

- Not living, eg: taxidermy, eggs, derivatives
- Also relevant: habitat used by wildlife

Typical areas of the law relating to wildlife that give rise to investigations and litigation are:

- Species and protection (laws restricting the taking and killing of wild animals or protecting them in specific habitats)
- Habitat protection
- International and national trade in wildlife. Smuggling and illegal possession or commercial use of wildlife often gives rise to litigation
- Animal health controls
- Welfare – in respect of captive wildlife
- Licensing

Forensic investigations may be used to support evidence in all these situations.

Civil actions, requiring forensic evidence, may arise where there has been negligence. Strict liability may arise in respect of non-domesticated species or domesticated animals that are known to the keeper to be dangerous.

Wildlife Enforcement Group – New Zealand Case Studies

Stuart Williamson

Senior Investigator in the Wildlife Enforcement Group (WEG), Auckland, New Zealand.

The Wildlife Enforcement Group (WEG) in New Zealand is a joint agency enforcement unit which focuses exclusively on investigating the national and international illegal trade in wild flora and fauna. WEG Officers hold warrants of authority of all three participating government agencies:

- Investigator for the New Zealand Customs Service;
- Inspector under the Biosecurity Act 1993 for the Ministry of Agriculture and Forestry;
- Wildlife Ranger, Endangered Species Officer and Senior Investigator for the Department of Conservation, which is also the CITES Management Authority in New Zealand.

WEG is a member of the Australasian Environmental Law Enforcement and Regulators Network (AELERT) and the AELERT Wildlife Crime Group, the INTERPOL Working Group as the representative for Oceania. This presentation will summarise the role of WEG and give an overview of a number of recent cases involving illegal wildlife movements both into and out of NZ.

Recent Wildlife Forensic Cases Seen at Massey University

Maurice Alley

New Zealand Wildlife Health Centre, Institute of Veterinary, Animal and Biomedical Sciences, Massey University, Palmerston North

Most of the cases of wildlife crime seen at the New Zealand Wildlife Health Centre fail to reach the stage of prosecution. This is either because suspects cannot be found or there is insufficient evidence to allow the prosecution of any suspects that are identified. Examples of recent investigations include several cases of malicious trauma or shooting of protected birds and animals such as kea, tui, terns and marine mammals. Accidental and malicious poisoning of black-billed gulls, kaka, kea, New Zealand dotterels and several other avian species is not uncommon. The anticoagulant pesticides, as well as lead, zinc, and the organochlorides are the most common poisons involved. Wildlife mass mortalities involving more than 20 individuals are now investigated by MAF Biosecurity, Investigation and Disease Centre, Upper Hutt and oiled wildlife is handled by the Maritime New Zealand, Oiled Wildlife Response Team. Two recent successful wildlife prosecutions involving kiwi and wekas are described.