# A critical review of the New Zealand Law Commission Report 144: *The Use of DNA in Criminal Investigations*

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## Overview

The NZ Law Commission Report 144 *The use of DNA in criminal Investigations* (NZLC R144) proposes a framework for improved regulation of DNA profiling practice in New Zealand (see Box 1 for a timeline of actions). Their central claim is that the existing legislation, *Criminal Investigations (Bodily Samples) Act 1995*, is no longer fit for purpose. Specifically, it has not kept pace with technology and, further, needs to be brought into line with contemporary thinking on Privacy, Human Rights and Treaty of Waitangi obligations (regarding Te Ao Māori and Tikanga).

Reform is a tricky balancing act. All would probably agree that it is high time to review policy and practice in this area. Nothing can be expected to stay adequately up to date on all developments in molecular biology and bioinformatics: e.g., analysis methods for trace and ancient materials or familial searching of DNA profile databases, *aka* DNA databanks. Equally, all would probably agree that it is the very hallmark of a civilised society that it should pay all due regard to matters of Human Rights and Privacy. However, a social contract exists that sacrifices some of these rights for the sake of justice and in the interest of public safety.

DNA profiling is now well understood and widely accepted by the New Zealand public at large. It features in just about every detective story on TV and has an outstanding record of success in the hands of New Zealand Police investigators and the Institute of Environmental Science and Research Ltd (ESR) analysts. Hence it is important to make rules that do not hinder this work (a point well taken by NZLC). Also, it is essential not to create novel and unwarranted concerns in people's minds.

***Box 1. A brief history of NZLC R144***

1. In Oct 2017, NZLC set up a website on DNA Profiling.
2. In Dec 2018, NZLC published their Issues Paper on DNA Profiling (NZLC IP43, 2018).
3. On 20 Oct 2020, NZLC presented NZLC R144 to the Hon. Andrew Little in his role as Minister Responsible for the Law Commission.
4. On 27 Nov 2020, the Hon. Kris Faafoi, Minister for Justice, tabled NZLC R144 before the house.
5. As required, no more than 120 working days later, on 24 May 2021, the New Zealand Labour Government presented their response to the House of Representatives.

The result is a monumental work, 579 pages, with no less than 193 recommendations. This article addresses each of the key areas above as presented in the report from a strictly '*If it ain't broke ….*' perspective. It also examines the central proposal to establish a new DNA Oversight Committee to supervise DNA profiling, casework and databanking [Ch. 5]. This body would have five to seven variously skilled members, at least three of whom should be Māori, plus one person from the Independent Police Conduct Authority (IPCA).

## Structure of the Report

Overall, the text of NZLC R144 is comprehensive, scholarly and inclusive. It provides a full overview of DNA profiling practice in New Zealand in comparison with what is done overseas. It has a strong foundation on *The Criminal Inves-*

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**Geoff Chambers** is presently an Alumnus Scholar in the School of Biological Sciences at Victoria University of Wellington. He joined VUW in 1985 with a mission to establish molecular biology as a new discipline. One of his first undertakings was to set up first generation DNA profiling methods in collaboration with forensic science staff from DSIR Chemistry Division and to train their analysts to work with DNA. His research students collected the first statistical data for case work reporting. Some went on to professional careers and helped to set up the record system that has evolved into today's DNA DataBank. Dr Chambers now shares his DNA profiling experience with academic colleagues overseas and works with the Royal Malaysian Police. He is uniquely placed to comment on this new report from the Law Commission recommending changes to DNA Profiling legislation.

*tigations (Bodily Samples) Act* and its later amendments; hereafter CIBS (1995). Respect for Human Rights issues (particularly Privacy) and the Treaty of Waitangi is evident throughout; see NZLC R144 2.30 – 2.51 for an explanation of Māori cultural values in this regard. Key points are a call to update CIBS (1995) with detailed requirements for new integrated data and legal frameworks managed by a DNA Profiling Oversight Committee (OC).

Each section of NZLC R144 reviews the existing situation and identifies areas where the NZLC Advisory Group saw the need for improvement. Options for reform are presented alongside the results of consultations with interested parties and a survey of comparable jurisdictions. They conclude each chapter by making a set of recommendations and explaining their rationale for each one. This consistent structure throughout aids reader comprehension and makes it easy to locate particular pieces of information.

It is difficult to do full justice to such a large document in a single review. Thus, the author has chosen to select a number of individual topics of particular significance and explore the NZLC R144 recommendations and emergent issues.

## Problems with the existing legislation

The NZLC R144 view on this matter is clearly laid out in Ch. 3, where they raise six areas of particular concern with CIBS (1995). Their original claims are that existing legislation lacks a clear purpose, is not comprehensive, and is rather complex and confusing. These shortcomings alone should be enough to merit a thorough revision of the law. Much can be attributed to the passage of time during which experiences of DNA profiling in action have revealed these deficiencies. For instance, many concerns expressed by NZLC here and elsewhere relate to the increasing use of DNA profiling to solve high-volume property crime. This application has been made possible by new technologies to analyse trace (*aka* 'low copy number' or LCN) DNA evidence. This is found by human contact with objects causing the transfer of skin cells or saliva.

Omissions from CIBS (1995) relating to two central issues, a general failure to accommodate Human Rights and Te Ao Māori[1], are particularly important to NZLC. At the outset NZLC does recognise that there is significant overlap between these two considerations as they entail largely congruent values. However, it may seem clear that the former can be taken care of by closer regulation of DNA profiling and DNA DataBank management. Catering effectively for the latter may be more difficult but is seen by NZLC to be of particular concern because Māori are said to be overrepresented in the DNA testing regime (NZLC R144 3.18 – 3.23). The importance of cultural differences is highlighted in Box 2 and NZLC R144 15.27 shows how tikanga obligations[2] may come into conflict with police operations. For instance, by identifying DNA with whakapapa creates responsibilities at all levels of Māori society to exercise kaitiakitanga[3] because by providing DNA information one person could bring others to the attention of the police.

Contrary to NZLC, the method of DNA profiling *per se* is not itself the issue here because it is only a tool and neutral to ethnicity. Answers must be sought in wider societal understanding. However, one must agree with NZLC that DNA is of special significance to Māori in many aspects (NZLC R144 3.16). For these reasons, and state obligations under the Treaty of Waitangi, it is plain that fullest Māori input should be sought in drafting any future legislation and also extend to any and all future discussions regarding kaitiakitanga partnership over Māori DNA profiles in databanks. This a topic of direct concern to the Māori Data Sovereignty Network | Te Mana Raraunga (NZLC R144 2.32). It is also elaborated on in works on guidelines for biobanking and genomic research from Māori and Indigenous Governance Centre | Te Mata Hautū Taketake, albeit with ambiguous authority. The further matters about Human Rights in general and Human Privacy in particular as seen by NZLC are outlined in Boxes 3 and 4 respectively.

Finally, I note that CIBS (1995) does not make any provision for a DNA profiling oversight committee. This important new proposal in NZLCR R144 is considered in full later.

### *Box 2. Treaty of Waitangi issues*

DNA Profiling is not mentioned in the Treaty of Waitangi because it did not exist at the time, but Treaty of Waitangi *principles* (NZLC 2.17 – 2.29) can be applied. These include partnership, active protection and equity. In this context for NZLC R144 the issues come down to encouraging greater Māori participation in all aspects of DNA profiling and the wider recognition of Māori cultural values (NZLC 2.30 – 2.48). The report contains a valuable explanation of tikanga and its principles of whakapapa[4], whanaungatanga[5], personal tapu and mana and kaitiakitanga in relation to forensic examination. Any revision of CIBS (1995) would be well advised to pay close attention to this source (after NZLC 2.50). There is not space enough in this short review to cover all of these in the detail that they merit, except to point out that many of them overlap extensively with the personal rights issues discussed in the text.

The concept of *Tikanga Māori* deserves special mention as serious misunderstandings may occur because, as NZLC 2.50 states, there are "*some important differences between tikanga Māori and Pākehā values and concepts*" in how they provide sets of guiding ethics for "*doing things right*" (NZLC 2.31 and references). Tikanga principles apply because personal bodily samples and genetic data are considered tapu by Māori because they are taonga and reflect on mana and whakapapa. There are also significant whanaungatanga responsibilities connected with being a relative. Manāakitanga, all due care and respect, must be shown in handling Māori data etc. with respect given to kaitiakitanga, guardianship over all such matters.

[1] The Māori world, *see: Te Ao Māori / The Māori world, Māori ki Te Whare Wānanga o Ōtākou, University of Otago, New Zealand*

[2] Customary system of values and practices, *see: tikanga – Māori Dictionary (*maoridictionary.co.nz*)*

[3] Guardianship, *see: kaitiakitanga - Māori Dictionary* (maoridictionary.co.nz)

[4] To recite in proper order, *see: whakapapa – Māori Dictionary* (maoridictionary.co.nz)

[5] Relationship, kinship, sense of family connection, *see: whanaungatanga – Māori Dictionary* (maoridictionary.co.nz)

### Box 3. Some notes on Human Rights values

These are laid out as regards DNA profiling in NZLC R144 2.52 – 2.83 which recognises that the practice raises some "*important constitutional values and principles*". These list four of these in 2.53 and two further ones in 2.73 – 2.77 and 2.78 – 2.82. these are given below with some brief observations:

(a) *Protection of privacy* – this is covered extensively in the text and Box 4

(b) *Protection of bodily integrity* – minor intrusion is necessary to obtain samples

(c) *Freedom from discrimination* – the technology is not useful for ethnic profiling

(d) *The rule of law* – NZLC R144 points out many areas where CIBS (1995) could be improved.

(e) *The right against unreasonable search and seizure* – this is strictly an operational concern for NZ Police and IPCA

(f) *The right to hold property* – see section on DNA Banking protocols

### Box 4. Privacy issues surrounding DNA profiling data

When any organisation holds personal information about an individual it raises privacy issues. These are generally straightforward:

1. The individual should know what information is held.
2. They should be able to examine it.
3. They should be to challenge the holder if they feel it is incorrect in any way.
4. They should have a reasonable expectation that incorrect data should be changed.
5. They should be informed why it is held and with whom it might be shared.
6. They should know what it might be used for.
7. They should have a reasonable expectation that the data will be removed or destroyed once its retention no longer serves the original purpose.

All of these considerations are easily met by DNA Profiling procedures via the informed consent and DNA Banking protocols described here.

There is one important caveat. Genetic information is not strictly private information because we hold it in common with our relatives. Hence, there is a sense in which they also hold interests in one's DNA profile because reference to it may serve to identify them via a familial search (see text).

## Obtaining casework samples

These processes are the subject of NZLC R144 Ch. 11-13. Samples may be taken directly either from suspects, or from volunteers (for elimination purposes) or as part of a mass screening exercise. They may also be obtained indirectly from crime scenes or discarded items, e.g., cigarette ends. Sampling methods include via buccal swab or fingerprick. These methods are certainly less intrusive than drawing venous blood but are still worrying when they must be taken by force under a court order. Either way it is recognised as important that all those persons providing their biological material should do so with informed consent and have a reasonable opportunity to consult with a lawyer. It would seem prudent that, during the informed consent process, the New Zealand Police should provide the individual concerned with a written notice explaining what will happen to their sample, what information will be obtained from it (i.e., only a DNA profile), and what will (and can) be done with the data obtained (see later). In this regard the principles of DNA databanking may be helpful. These are not discussed explicitly in NZLC R144 but they would seem to be much in line with their thinking. In short, all biological material taken by New Zealand Police would remain the property of the individual from which it came. Owners should be able to request the return or destruction of all such material once it is no longer needed. Such issues may be particularly important for some Māori individuals as all bodily material is considered tapu[6]. Once again, this signals the need for Māori input into formulating any new legislation.

These considerations apply not only to material such as blood samples and swabs, but also to any DNA extracts and the profile data obtained from them. Interestingly, NZLC Recommendation 93 comes out against taking DNA samples from relatives of suspects. This could potentially be a valuable detection tool in some instances. NZLC R144 cites reliability and whakapapa[7] issues as grounds for this recommendation. This author is not fully convinced by their arguments here and, in any case, it would be valuable to have some direct statement(s) on this matter from Māori themselves.

## DNA databanking

The chain of custody between New Zealand Police and ESR Ltd scientists for biological samples and DNA extracts is complex because these samples come from various sources including crime scenes, suspects, elimination testing, missing persons, and participants in mass screening exercises. Also, one should not forget those from investigative staff and the analysts themselves (two categories not considered by NZLC R144). They pass through many stages, starting from crimes scene examination, through pre-trial retention, to archival (including post-conviction). As NZLC R144 clearly points out, a range of concerns apply to each type at each stage. Equally, data obtained from analyses of all such materials may be classified in the same way and stored in a searchable set of electronic files known as a DNA databank. Here, NZLC R144 suggests that all such data should be held in a common data management environment. This makes excellent sense from a quality assurance and best practice point of view. Under this scheme, each different group of profiles would be classified into a partition called 'an index' – *viz* casework 99/21 for a particular sequential investigation (#99 in date order) carried out in 2021, etc. This can be achieved by tagging each record with an individual code and index identifier in a master hierarchic relational database *aka* the DNA DataBank. As records move through the system, their identifier tags can be updated, but not their code tags.

The main analytical tools used by ESR are called GlobalFiler (for known persons) and Identifier (for crime scenes): see NZLC

[6] Sacred, *see: tapu – Māori Dictionary* (maoridictionary.co.nz)

[7] Genealogy, *see:* https://maoridictionary.co.nz/search?idiom=&phrase=&proverb=&loan=&histLoanWords=&keywords=whakapapa

R144 Ch. 6 for a description. These methods return data from 21 and 15 short tandem repeat sequence (STR) DNA targets, respectively. The resultant profiles are simply lists of the variant forms (alleles) found at target site, i.e., 15 and 10 repeats at target sites 1 and 7, 16 at target site 2, etc. These can be found in Ch. 6.11-6.16 with an informative diagram in Ch. 6.9. A special form of this analysis called Y-STR (Ch. 6.24 – 6.26) is based on male sex chromosome STR markers. It is valuable in sexual assault cases where the conventional methodology might return a mixed signal from offender and victim. Other methods, including MiniSTR (6.28) and mitochondrial (mtDNA) analysis, (Ch. 6.29) are also available. Of special note is the LCN method used for investigation of contact evidence (Ch. 6.30 – 6.34). New techniques are also on the horizon (Ch. 6.38 – 6.46), and their potential future introduction into casework is accommodated by the proposed management scheme.

It is important to have a clear picture of this process and the data structure because the DNA DataBank records can be searched. New casework profiles are entered as 'enquiries' in a system that is much like that used by the global DNA sequence repository known as GenBank (www.ncbi.nlm.nih.gov/genbank/). The search enquiry is then run across the appropriate index or indices with the software looking for full or partial matches. A perfect match is strong evidence of identity between the sample (e.g., a blood stain on a broken window) and the person whose record is in the index (e.g., someone suspected of home invasion). A partial match may indicate a first degree relative of a person known or unknown to the New Zealand Police. The New Zealand public will be familiar with this process through the services of commercial DNA testing companies like Ancestry® (www.ancestry.com.) or TV programmes like 'The DNA Detectives' (www.tvnz.co.nz/shows/dna-detectives).

The DNA profiles themselves are innocent enough, being just a set of allelic character states at a series of otherwise anonymous genetic loci. In short, a person's DNA profile information is seemingly not of use either to the person themselves or to anybody else. This is except for use in identification and for revealing relationships. So, although the information itself may not be of interest or concern, its use(s) certainly are of both interest and concern. These issues extend to first degree relatives since they have a majority of stored DNA profile information in common with the person whose record is on file. This raises special concerns when one considers traditional Māori views on whakapapa and tikanga (see Box 2).

In Ch. 20 of NZLC R144 consideration is given to the storage and retention of DNA DataBank records and would require the removal of some existing records from various indices in the present DNA databank. For instance, it may be deemed '*culturally inappropriate to leave samples and records from living and dead people in the same system*' (Ch. 20.42). Their scheme would seem to be a retrograde step. This is, at least, because considerable resources have already been expended to collect them and a great deal more would be required to remove them. The key question is: What is the risk posed by leaving them *in situ*? This would seem to be that they may be picked up later as full or partial matches in future casework investigations or re-examination of evidence from 'cold cases'. Such events might serve to incriminate some people or their relatives or, more importantly, to exonerate them. In short, by retaining such profiles the state is asking some individuals (and/or their close relatives) to give up their chance of being easier to find in relation to future crimes that they may be involved with or commit. In any case, individuals whose records are presently on the DNA DataBank can, in some circumstances, apply to the New Zealand Policeto have them removed.

## The proposed DNA Profiling Oversight Committee

In Ch. 5 NZLC R144 lays out what it sees as the shortcomings of management under the present system of distributed responsibilities; via New Zealand Police, ESR Ltd etc. (Ch. 5.6 – 5.18). After all the usual NZLC procedures and considerations, they conclude by prescribing a DNA Profiling Oversight Committee (Recommendation 8). This would have a panel of experts from various areas (Recommendations 9 – 12) with a number of advisory roles, some management (approval) functions, and responsibility for engagement activities (Recommendation 13 – 15). In support of these recommendations they describe similar systems operating elsewhere (Ch. 5.68 – 5.79), including UK, Ireland, and Canada, while noting that both Australia and New Zealand stand apart from the others by not having an independent body with exclusive oversight.

A wide range of skills and experience is required among those who would sit on NZLC's new body. These are fully laid out in Recommendation 9 for the seven constituent members and one extra member who must belong to the Independent Police Conduct Authority (IPCA). They conclude (Recommendation 10) with the entirely unsupported assertion that no less than three of the eight must be Māori; see below for further discussion. There is no doubt that the basic concept of a DNA Profiling Oversight Committee has merit as judged from widespread practice overseas. However, there are many reasons for thinking that the idea as presented should be extensively revisited. First, it seems fundamentally unwise to have a body with a mix of advisory and regulatory roles. Second, DNA Profiling is a complex technology, and operational decisions are best left in the hands of the practitioners themselves, e.g., regarding DNA analysis methods (Recommendation 14 a.) or using the DNA DataBank for research purposes (Recommendation 14 d.). The review of complaints (whether general or specific is not made clear) would seem best left to the IPCA or the judiciary. Third, engagement functions (Recommendation 14 i.) should be delegated to specialised technical communications staff recruited for the purpose.

Finally, the matter of Māori participation requires evaluation. This seems to be catered for in part by Recommendation 9 iv. as a person with expertise in '*te ao Māori and tikanga Māori*'. It is unclear if the '*no less than three members … must be Māori members*' include this person. This requirement is not necessarily a bad thing *per se* but must be justified beyond the vague sentiments expressed about '*The Māori caucus*' in (Ch. 5.90 – 5.92). Also, these persons need to be more closely defined, given the various definitions of ethnicity used by the New Zealand Government and its agencies (see Box 5). Presumably, selecting persons who are both well-known and well-respected would satisfy the criteria.

### *Box 5. Difficulties around the definition of ethnicity in New Zealand*

In several places NZLC R144 expresses reservations about the potential inclusion of ethnicity information in the DNA DataBank (pp. 186 – 191). These are raised by NZLC despite the fact the NZ Police and ESR have advised that population-based information is necessary for the unbiased calculation of exclusion statistics. In part these reservations arise from a misleading notion of 'ethnicity' taken from Statistics NZ (14.22). Here, the term ethnicity has a social science definition of '*cultural affiliation*' (self-determined). In contrast, ethnicity is much better seen as the interface between ancestry and culture. Genetic analysis returns strictly ancestry-based information.

There is little doubt that sets of ancestry informative forensic markers could be obtained to distinguish say those of European and those of Polynesian (including Māori) descent. This is because their gene pools have diverged during thousands of years of geographic isolation. Contrasting population histories means that the latter gene pool contains a more restricted set of genetic information than the former. This information is of crucial medical significance, but it is not the forensic question. This is: Does the DNA DataBank contain an adequate representation of contemporary NZ ethnic groups to provide properly structured statistics?

The author notes in passing that those Māori individuals with whom he has consulted over the years have consistently explained that iwi membership is most often decided on an ancestry basis involving a blood quantum, whakapapa information and in-group approval. This is altogether different from the gold standard Statistics NZ definition (above) which is the one that courtroom evidence requires[8].

## Conclusions

NZLC R144 represents the cumulation of a lot of hard work and detailed thinking. Its approach and layout are exemplary, as outlined in the Introduction. Nonetheless, such a wide-ranging survey cannot hope to get everything right and NZLCR R144 does have some significant problems. Equally, in a short review like this, one cannot expect to cover everything in such a large body of work. Rather, it is better to allow some omissions in an attempt to gain more general coverage and to give special attention to a few detailed areas where comment seems essential.

The new NZLC report is to be commended for recognising the deficiencies in CIBS (1995) and calling for reform. Equally, it performs very well in sticking to its central agenda by focussing on Human Rights issues and insisting on greater recognition of Māori cultural values and requiring greater Māori participation in redrafting legislation and involvement in the management of DNA Profiling. The report is right to give emphasis to Human Privacy issues, but one might fairly think that NZLC R144 is overcautious. In fact, DNA Profiling represents very little in the way of threat to the liberty of the individual New Zealand citizen. It is a tool for identification, much like fingerprints and photographs. This author agrees with NZLC R33 that utmost caution should be exercised in judicial trials where the prosecution depends largely or exclusively on DNA evidence. Its application is now predominantly used for the investigation of high-volume crime rather than murder and other crimes of violence. It will always be necessary to store a lot of DNA profiles because there is, by definition, a lot of high-volume crime. The fact that someone's DNA profile is in our national DNA DataBank can provide their best defence if they later come under suspicion for a crime they did not commit. Retention of DNA profiles may serve as deterrent to those planning future crimes. DNA profile records may prove especially valuable in cases where those earlier convicted of simple home invasion go on to commit more serious offences. The rare use of DNA profile databank entries to track down relatives or to answer enquiries from overseas merits wider public consultation.

A particularly significant proposal in NZLC R144 is to set up an overview body, more or less in line with overseas practices – noting that these can be quite variable (Ch. 5.69 – 5.76). Establishment of such a review body seems particularly valuable, provided that it remains strictly advisory and strictly confined to areas that it is best equipped to handle.

In closing, I note that on 24 May 2021 the Minister of Justice responded on behalf of the New Zealand Government. The response noted the valuable work done by the New Zealand Law Commission and have accepted that the CIBS Act (1995) '*should be repealed and replaced with a new, comprehensive and modern Act*'. They also agree that governance and oversight of the DNA regime would be strengthened by setting up an independent oversight body, but hold that it would be prudent to delay decisions on the structure and responsibilities of such a body until later in the drafting process. It is also clear to all parties that this will be a major legislative exercise requiring multi-agency input and active Māori involvement. The new legislation that will eventually be drafted will have to go through a Select Committee stage as it passes through the House to become law. This process will allow extended time for public submissions and debate.

## Acknowledgements

Geoff Chambers is grateful to Victoria University of Wellington for support in his role as an Alumnus Scholar.

## References

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[8] *See:* (PDF) 'Marrying' demographic and genetic measures? New tools for understanding New Zealand population sub-groups (researchgate.net)

*Podcasts*

# Cambridge University's Centre for Science and Policy podcast mini-series

This Centre for Science and Policy (CSaP) series explores the policy and governance questions being raised by new genetic technologies1.

Published in February 2021, this four-part miniseries explores the science and policy questions, opportunities and challenges posed by advances in genetic technologies. Throughout the series, Dr Rob Doubleday, CSaP's Executive Director interviews guests from areas including crop sciences, policy, agriculture, bioethics, geography, and the history of science.

## Episode 1 - Agriculture

5 February 2021

This episode explores some of the pressing policy questions in genetic technology with University of Cambridge crop scientist Professor Giles Oldroyd, Royal Society Senior Policy Advisor Jonny Hazell, and University of Cambridge Lecturer in History of Modern Science and Technology Dr Helen Anne Curry.

You can read the accompanying news article at: Science, Policy and Genetic Technologies - Networks of evidence and expertise for public policy (cam.ac.uk)

## Episode 2 - Agriculture

12 February 2021

This second episode explores some of the questions facing the plant scientist community and the agriculture sector in the UK wih Dr Tina Barsby, plant geneticist and Director of NIAB, and Dr Jack Stilgoe, a Senior Lecturer at UCL's Department of Science & Technology Studies.

You can read the accompanying news article at: Agriculture and Genetic Technologies - Networks of evidence and expertise for public policy (cam.ac.uk)

## Episode 3 - Gene Editing, Nature, and Biological Risks

19 February 2021

In this episode Dr Doubleday is joined by Professor Bill Adams, Emeritus Moran Professor of Conservation, and Dr Catherine Rhodes, the Executive Director of the Centre for the Study of Existential Risk, University of Cambridge. They discuss gene drives, the implications of genetic technologies for conservation, biological conventions, and biological risks.

You can read the accompanying news article at: Science, Policy & Genetic Technologies: Gene Editing, Nature, and Biological Risks - Networks of evidence and expertise for public policy (cam.ac.uk)

## Episode 4 - Medicine

26 February 2021

In the final episode of CSaP's four-part mini series Dr Rob Doubleday sat down with Dr Jonathan Roberts, researcher in the Society and Ethics Research Group at the Wellcome Campus and a NHS Genetic Counsellor at Addenbrooke's Hospital, the PHG Foundation's Alison Hall, and University of Cambridge sociologist Professor Sarah Franklin to explore some of the regulatory, ethical and societal implications of genetic technologies for the field of medicine.

You can read the accompanying news article at: Science, Policy & Genetic Technologies: Medicine - Networks of evidence and expertise for public policy (cam.ac.uk)

[1] Science, Policy & Genetic Technologies – Networks of evidence and expertise for public policy (cam.ac.uk)

THE CONVERSATION

*The following article is republished from The Conversation, dated 14 April 2021* (https://theconversation.com/forensics-and-ship-logs-solve-a-200-year-mystery-about-where-the-first-kiwi-specimen-was-collected-158410). *As required in this journal's republishing guidelines, the article has not been edited, but we have attributed the authors and their institute.*

# Forensics and ship logs solve a 200-year mystery about where the first kiwi specimen was collected

**Paul Scofield and Vanesa De Pietri**
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The flightless kiwi is an iconic bird for New Zealanders, but all five species are threatened by habitat loss and introduced predators.

Recent genomic analysis focused on one species, the South Island brown kiwi or tokoeka[1], suggests several as yet undescribed lineages. Before these can be fully described and treated as genetically distinct, it is necessary to determine where the first tokoeka specimen was collected.

Any plant or animal specimen used for the first scientific description is called a holotype. Until now, it was a mystery where the kiwi holotype was collected, but our research (Scofield *et al.* 2021) using digitised ship logs and modern forensic techniques, shows there is little doubt the first bird seen by European scientists came from Rakiura/Stewart Island.

This discovery could have repercussions for kiwi conservation.

There are four distinct populations of the South Island brown kiwi today: one in the mountains behind Haast, two in Fiordland and one on Rakiura/Stewart Island. In the past, separate tokoeka populations were found in other parts of the country, but have become extinct since human arrival.

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Māori treasure the kiwi and its feathers are valued in weaving kahukiwi (kiwi feather cloak) for people of high rank. But the bird's first description by European scientists is relatively recent, based on a specimen that made its way to London in 1812.

Following the strict conventions of taxonomy, this first kiwi was named Apteryx australis — belonging to a group of birds "with no wing" (Apteryx) and representing a southern (australis) branch.

## What we knew about the original kiwi

In 1813, George Shaw, the zoology keeper at the British Museum, published a description of the kiwi in his series of encyclopaedias called Vivarium naturae, or the Naturalist's Miscellany.

The holotype specimen of a kiwi, Apteryx australis, held at World Museum Liverpool, came from Rakiura/ Stewart Island. National Museums Liverpool, CC BY-ND

**Paul Scofield** is the Senior Curator of Natural History and Adjunct Professor in Palaeontology in the Geology Department at the University of Canterbury. He has published over 150 scientific papers and is the author of two best selling books The Albatross, Petrels and Shearwaters of the world and Birds of New Zealand: A Photographic Guide.

**Vanesa De Pietri** has a background in evolutionary biology and palaeontology. Her current work investigating the influence of environmental and climatic changes on the ecological diversity of shorebirds over the last 47 million years is funded by a Marsden Grant. Having worked on European fossil sites, she has spent the last five years describing the c.19 million year old fauna from St Bathans, Central Otago, and more recently from the Waipara Region in North Canterbury.

The original illustration of the kiwi, taken from the skin of the specimen, suggests the artist didn't know the bird's posture. Biodiversity Heritage Library, CC BY-SA

Drawings by Richard and Elizabeth Nodder were made from the original specimen skin and suggest a penguin was used as a model.

Shaw mentioned he received the kiwi skin from his friend, Mr W. Evans (possibly a William Evans, a draughtsman and engraver of natural history plates active 1797–1856) who had passed it on from 'captain Barclay'.

We know this was captain Andrew Barclay, of the convict transport ship and privateer *Providence*. He had obtained the specimen during the austral winter of 1811 on a visit to Port Jackson.

New Zealand's European history is considerable shorter than Australia's. Even in the early 19th century, Europeans had not visited large parts of Te Wai Pounamu (South Island) and the southernmost island Rakiura was virtually unknown.

It was even uncertain to many cartographers whether Rakiura was actually an island or part of the South Island, as Captain James Cook had believed[2].

Sealing brought Europeans to southern parts of New Zealand from the 1790s. Most of the early sealing voyages were made out of Port Jackson (Sydney). Between 1792 and 1803, most sealing activity was confined to Fiordland, but seal numbers were so low by 1810 that sealing gangs turned their attention to subantarctic islands and Rakiura.

Records show the *Providence* moored at Port Jackson throughout the winter of 1811, before departing for China and England on October 20 1811[3]. The ship carried a cargo of seal pelts bound for the Chinese market, and we now know the kiwi specimen was probably sold to Barclay by a sealer who had recently returned from southern New Zealand.

## Enter modern forensics

After Shaw's death in 1813, his collections were sold at auction. Much of his collection, including this skin, made its way to Edward Smith-Stanley, styled Lord Stanley. It was bequeathed along with his entire collection to the City of Liverpool in 1851 and is now deposited in the World Museum Liverpool.

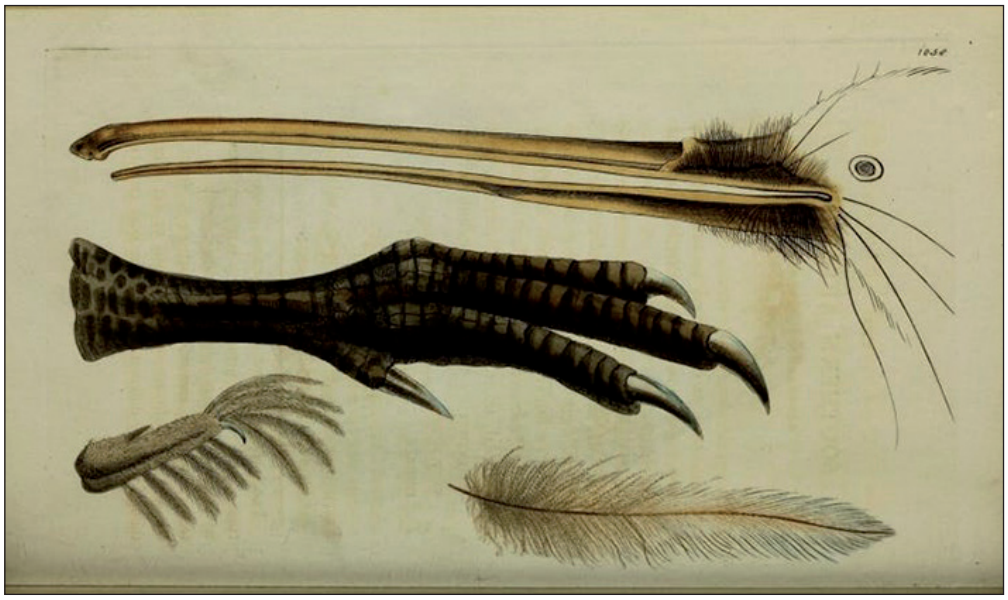
In 2019, we visited the museum and were given permission to take a tiny sample of skin for DNA analysis to determine once and for all where European science's first kiwi was collected.

We used DNA amplification techniques developed for modern police forensics and sequenced both the complete

[2] *See:* James Cook sights Banks 'Island' | *NZHistory*, New Zealand history online

[3] *See:* 06 Jul 1811 - SYDNEY. - Trove (nla.gov.au)

The Providence in full sail. Thomas Whitcombe painted the ship during the period Barclay was captain. National Maritime Museum, CC BY-SA



An illustration by Elizabeth Nodder, published in The Naturalist's Miscellany.



mitochondrial genome and part of the nucleic genome. We then compared our results with data from a study by Weir, J.T., Haddrath, O. *et al.* (2016).

There is little doubt this kiwi came from Rakiura, and we may be able to pinpoint who collected it. Official records for New South Wales indicate two ships arrived in Port Jackson from the sealing grounds of Foveaux Strait in 1811: the Boyd and the Sydney Cove. Either could be the source of the holotype, but the Sydney Cove was sealing close to the South Cape on Rakiura, which seems the most likely type of location.

## Why this matters

In order to get money and public attention for endangered species, it is necessary to show that when two populations exist and one is under threat, the threatened one is truly unique. Distinct populations are generally given scientific names.

Recent genetic work shows each separate living kiwi population in southern New Zealand is indeed distinct and belongs to one of four distinct lineages.

As a consequence of our conclusion that the first kiwi collected by Europeans and named *Apteryx australis* came from Rakiura, we suggest a revision to call the Rakiura tokoeka *Apteryx australis australis*.

This also has implications for the naming of other southern brown kiwi populations. We are working in consultation with Ngāi Tahu, the Māori guardians of this area, to develop a scientific framework to describe the genetic diversity of the South Island brown kiwi they call tokoeka.

## References

Scofield, R.P., Wood, J.R., de Nascimento, L. *et al.* Identification of the type locality of the South Island Brown Kiwi *Apteryx australis*. *Conserv Genet* (2021). https://doi.org/10.1007/s10592-021-01349-y

Weir, J.T., Haddrath, O., Robertson,H.A., Colbourne,R.M., and Baker, A.J. Explosive ice age diversification of kiwi. *PNAS* September 20, 2016 113 (38) E5580-E5587. https://doi.org/10.1073/pnas.1603795113

# The New Zealand Association of Scientists Awards for 2020

Due to COVID-19 restrictions this year's medallists were presented with their awards at their respective institutions and generally in company with internal celebrations at the particular institute. The Shorland medal was announced via a video link with the recipient now at the Nord University, Norway

## The Marsden Medal

The Marsden Medal is awarded for a lifetime of outstanding service to science. It recognises service rendered to the cause or profession of science in the widest connotation of the phrase.

Professor Martha Savage has been awarded the 2020 Marsden Medal for her path-breaking research in the fields of seismology, plate tectonics and volcanology, as well as her distinguished record of service to New Zealand and the global scientific community.

In her pioneering work, Prof Savage used remotely sensed texture—seismic anisotropy—of rocks deep below Earth's surface to fundamentally change how plate-boundary processes are studied and understood. The observations at the heart of her work, separation of seismic waves into components that travel at slightly different speeds, are due to rock textures and, once detected, those textures reveal how tectonic plates move and respond to stresses built up within them. She has conducted comparative studies of deep crustal properties and processes in New Zealand and the western states of the USA, investigated the relationship between time-varying anisotropy and volcanic eruption sequences, and developed new observational approaches and new computational methods to interpret seismic data. Her work showcases New Zealand as a rich natural laboratory in which to develop understanding of globally relevant geophysical methods and processes.

Prof Savage was also a pathbreaker as the second woman to winter-over in Antarctica. Her Antarctic work was focused on cosmic-ray observations at Amundsen-Scott South Pole Station, but she credits it to have also allowed her to learn about the importance of personal character and positive, supportive relationships in science. Professor Savage has a distinguished record of service, to New Zealand and the global scientific community, through review panels, advisory boards, editorial boards and mentorship. She is a Fellow of the Royal Society of New Zealand and is the first New Zealand woman to have been elected Fellow of the American Geophysical Union.

## The Shorland Medal

The Shorland Medal is awarded in recognition of major and continued contribution to basic or applied research that has added significantly to scientific understanding or resulted in significant benefits to society. The 2020 recipient of the Shorland Medal is Professor Mark Costello from the Faculty of Biosciences and Aquaculture at the Nord University, Norway.

Prof Mark Costello pioneered the field of 'ocean biodiversity informatics' by leading the formation of two worldwide databases that are now core resources in marine biology. The World Register of Marine Species (https://www.marinespecies.org/) includes names and information on over 240,000 marine species, while the Ocean Biogeographic Information System (https://obis.org/) contains over 50 million field records of marine species. Both databases are continuously updated and edited by experts, and offer free online access to unprecedented amounts of data, enabling a significantly better understanding of our global marine environment. Analyses of these databases have led to notable advances in biological and marine sciences and a rethinking of established viewpoints, including: improved predictions of how many species may exist; documenting the increasing numbers of people describing species new to science; the creation of new data-driven maps of ocean biodiversity; helping pin-point where Marine Reserves are best located; and the discovery of a dip in marine diversity at the equator that is due to climate warming. Moreover, Mark has championed open data and led conceptual thinking that has guided change in the transformation of scientific practice to be more international and collaborative. Alongside this outstanding service to science, Mark Costello's own research is internationally recognised and very highly cited.

## The Hill Tinsley Medal

The Hill Tinsley Medal is awarded for outstanding fundamental or applied research in the physical, natural or social sciences published by a scientist or scientists within 15 years of their PhD. In 2016, the NZAS awarded the first Beatrice Hill Tinsley Medal, which replaced the Association's Research Medal for early-career researchers. The recipient for 2020 is Associate Professor Frederique Vanholsbeeck from the University of Auckland, a physicist whose primary field of research is biophotonics, which focuses on the use of optical and laser technologies for biomedical studies.

Prof Vanholsbeeck's research on monitoring bacteria using quantitative fluorescence spectroscopy – very accurate measurement of the spectral density of the fluorescence signal – has created a better understanding of how to monitor bacterial viability and antibiotic efficiency. She has developed a near-real time, cost-effective and portable fluorometer, the optrode, for quantifying fluorescence signals leading to better food safety and

antibiotic sensitivity testing. She leads a biophotonics lab undertaking both fundamental and applied research, with diverse and varied interdisciplinary collaboration. A further notable aspect of her research has been the extent to which she mentors a vibrant group of early-career researchers and postgraduate research students.

## The Cranwell Medal

The Cranwell Medal is awarded to a practising scientist for excellence in communicating science to the general public in any area of science or technology. In 2017 this medal was renamed from the Science Communicator Medal to honour the botanist Dr Lucy Cranwell. The recipient for 2020 is

Dr Dianne Sika-Paotonu who is the Scientific Lead for New Zealand's Rheumatic Fever and Penicillin Research Programme and the Associate Dean (Pacific) at the University of Otago, Wellington.

Since completing her PhD at the Malaghan Institute in 2015, Dr Sika-Paotonu has maintained a strong record of public engagement with community groups and with students, at secondary, tertiary undergraduate and postgraduate levels. She regularly presents science to non-scientific audiences and has received local and international recognition for her research and science communication efforts. Her awards include the MacDiarmid New Zealand Young Scientist of the Year (Advancing Human Health & Wellbeing category), Colmar Brunton Research Excellence award, and the Australasian Society of Immunology BD Science Communication Award.

Dr Sika-Paotonu is of Pacific heritage and is actively involved in mentoring young Pacific people in the Wellington region. She also holds numerous service and leadership responsibilities within the Pacific community, and is an HRC Pacific Emerging Research Fellow, as well as a recent recipient of the Sir Thomas Davis Te Patu Kite Rangi Ariki Health Research Fellowship from HRC. She is also a member of the Royal Society Te Apārangi Council, the National Science Challenge Healthier Lives Science Leadership Team and the HRC New Zealand Pacific Health Research Committee.

*News*

# 2020 Prime Minister's Science Prizes

The Prizes recognise the impact of science on New Zealanders' lives, celebrate the achievements of current scientists, and encourage scientists of the future.

## The 2020 Prime Minister's Science Prize

The premier award has been awarded to Te Pūnaha Matatini for its COVID-19 response. Te Pūnaha Matatini, hosted at University of Auckland, is a multidisciplinary Centre of Research Excellence; set up to apply complexity science to 'critical issues of our time'. Centre Director Professor Shaun Hendy MNZM FRSNZ, University of Auckland, quickly saw in early 2020 that there was a gap in providing the New Zealand Government with the data science it needed to make informed decisions about responding to the pandemic. He quickly assembled a team who has worked tirelessly to fill this need. The team's response has been multifaceted. Throughout the pandemic, they have developed a series of new mathematical models and ran a multitude of different scenarios to inform the unique situation that New Zealand found itself in.

They have done modelling work and analysis on a wide number of areas including hospital capability, contagion rates and likely disease spread, virus genomic tracing, contact tracing and vaccination. The results of this work were translated for use by the Government policymakers and front-line operators and helped inform the Government's response to the COVID-19 pandemic. Among other actions, this led to the Government's 'Go Hard and Go Early' mantra that resulted in stringent lockdowns - both the country-wide lockdown beginning in March 2020 and the tailored Auckland lockdown beginning in August 2020. Diane Abad-Vergara from the World Health Organization said that the work of Te Pūnaha Matatini on the COVID-19 response has had significant health and social impacts for Aotearoa New Zealand and internationally 'contributing to New Zealand's internationally coveted status as one of only a limited number of nation-states which have eliminated and contained the virus . Right from the beginning, data modelling and experience from previous pandemics made it clear that Māori and Pasifika peoples would be more badly affected if the COVID-19 virus got established in Aotearoa. For this reason, Te Pūnaha Matatini decided to apply an equity lens to all their COVID-19 work. Te Pūnaha Matatini modelling work, together with other scientists' research from around the globe, was actively communicated to the public throughout 2020 – with several of the center's researchers emerging as the nation's most prominent science

communicators during the crisis. This included Associate Professor Siouxsie Wiles who produced a number of graphics with cartoonist Toby Morris for The Spinoff, many of which have 'gone viral' internationally and are being used by governments and the World Health Organisation. Siouxsie was recently named 2020 New Zealander of the Year for this work.

# The other prize winners

## The Prime Minister's 2020 MacDiarmid Emerging Scientist Prize

Won by Dr Christopher Cornwall, a Rutherford Discovery Fellow at Te Herenga Waka – Victoria University of Wellington, for his cutting-edge research on how marine organisms will fare under climate change.

Chris studies how warmer and more acidic ocean water affects the ability of calcifying marine organisms to lay down calcium carbonate to grow and make their skeletons. This includes the foundation marine organisms called coralline algae, calcifying seaweeds, which cement reefs together, both in temperate and tropical waters, but also signal to and provide a home for many other species, such as pāua and kina. His cutting-edge research using boron isotopes showed for the first time the pH levels inside the organisms where they lay down this calcium carbonate. This allowed him to identify those species with a greater ability to keep their internal pH constant under ocean acidification. He has followed up with studies to see if these traits to resist ocean acidification can be gained in a lifetime or over many generations. Next, he has led a team to assess and model how 233 tropical reefs will be able to grow and survive at varying levels of carbon dioxide in the atmosphere. Sounding an urgent warning, he says 'these reefs will be badly impacted by both ocean acidification and warming. Our ability to keep $CO_2$ emissions down is really the best way we can protect these reefs for the future.'

## The Prime Minister's 2020 Science Communication Prize

Professor Michael Baker MNZM, an epidemiologist with the University of Otago, Wellington has won the 2020 Prime Minister's Science Communication Prize. He is a Professor of Public Health, Director of the Health Environment Infection Research Unit, and Leader of Co-Search, a Health Research Council funded group conducting multi-disciplinary research to support the Covid-19 response

Michael has been New Zealand's go-to science expert since the start of the pandemic. He has done more than 2,000 interviews since January 2020, contributing over 30% of the total science outputs recorded for the 70 commentators tracked by the Science Media Centre. Michael describes the period at the start of March 2020 just before New Zealand went into lockdown as the 'the most intense period of my working life'. Michael says he developed a concept of Covid-19 elimination and concluded that it was the optimal response strategy. He also concluded that New Zealand needed an intense lockdown to stamp out the virus and give the country time to build the capacity to manage the pandemic. Michael promoted these ideas actively through multiple forms of science communication in early March and was hugely relieved when they were adopted by the Government.

## The Prime Minister's 2020 Science Teacher Prize

Queenstown teacher Sarah Washbrooke is the first technology teacher to win the Prime Minister's Science Teacher Prize. Her hands-on approach to teaching technology is so engaging for her students that they often remain unaware of the depth and range of learning they are doing. Sarah ensures her students remain engaged by making sure to offer them real life authentic projects and also involves the wider Wakatipu community in setting challenges.

She hopes that by following the design-thinking process, her students develop empathy and that 'they can learn to learn for themselves and they can learn to solve problems and go back again and be prepared to try again, then those skills are going to set them up for life in the future'. The selection panel was most impressed with the way that Sarah's work is increasing student participation and engagement in technology at her school and also within the community, and also by how she develops and shares resources to the wider New Zealand technology teaching community.

## The Prime Minister's 2020 Future Scientist Prize

James Zingel, a former student of Bethlehem College in Tauranga, has been selected as the 2020 Prime Minister's Future Science Prize Winner. James' research project used a breast cancer dataset run through both a classical computer and a quantum computer in an effort to see which is superior in analysing the data and determining the type of breast cancer present. James has spent hundreds of hours delving into this project and has learnt so much in terms of quantum physics and machine learning. Being able to go from a general understanding of quantum physics theory, to describing it in maths, and finally coding it in a language that generates coherent results has been a fantastic progression that he has loved completing. His findings showed that, at the moment, the classical method worked better than the quantum one, but excited about the possibilities of quantum computing, he said 'I think the quantum algorithm will much outperform the classical one in the very near future'. The selection panel was impressed with the way he applied himself wholeheartedly to this complex project and his enthusiasm for quantum computing.

Riddet Institute
ADVANCING FRONTIERS IN FOOD SCIENCE

# High-Value Nutrition Ko Ngā Kai Whai Painga


## 28-29 September 2021, The Cordis, Auckland.

Foodomics 2021 will bring together experts, researchers, and businesses across New Zealand's Food & Beverage (F&B) industry. The conference will showcase multiple F&B research projects underway and highlight future opportunities for industry to benefit from cutting-edge research. Industry experts and researchers will be in attendance to present how high-value nutrition (HVN)-funded projects can pave the way to higher value and a competitive edge in international markets.

There is also a poster competition, which will give attendees an opportunity to showcase the incredible research that is taking place across the HVN Challenge.

## CONFERENCE PROGRAMME OUTLINE

### Day One – Tuesday 28 September 2021

Keynote Speaker — Professor Lisa Wood, Head of School of Biomedical Science and Pharmacy, University of Newcastle, Australia

Session 1: Translating Research to Market

Session 2: Research and Innovation

### Day Two – Wednesday 29 September 2021

Keynote Speaker — Aroha Te Pareake Mead, Chair Emeritus, IUCN Commission on Environmental, Economic and Social Policy

Session 3: Development Grants (to focus on business story)

Session 4: Novel Foods and Food Ingredients

Keynote Speaker — Shay Wright, Co-Founder, Te Whare Hukahuka & Nuku Ltd

***Register on, or before, Thursday 1 July 2021 to take advantage of early-bird registration rates***

Full details at: https://www.highvaluenutrition.co.nz/news-and-events/5316-2/

# NZAS
## New Zealand Association of Scientists

## Why not consider joining NZAS?

Members include physical, natural, mathematical and social scientists, and the Association welcomes anyone with an interest in science education, policy, communication, and the social impact of science and technology.

Please complete this form and return it with payment to:

Membership Secretary, New Zealand Association of Scientists, PO Box 1874, Wellington

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### NZAS is an independent organisation working to:

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- Debate and influence government science policy
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