INFOSHEET – JULY 2024

eDNA, DNA reference libraries and Kaitiakitanga

Te Kotahi Research Institute
THE UNIVERSITY OF WAIKATO

Rogena Sterling, Libby Liggins and Maui Hudson

Introduction

Environmental DNA (eDNA) refers to the DNA that is shed or excreted from biological organisms. eDNA may derive from skin, hair, faeces or urine for example, and provides a window into the local biodiversity of the area where the sample is taken. eDNA is increasingly being used as a monitoring tool for biodiversity and conservation purposes by matching small informative fragments of DNA (i.e., DNA barcodes) collected from the environment with reference DNA sequences from vouchered specimens held in digital databases of DNA sequences. In particular, DNA reference libraries are databases purpose-built to enable the identification of species in an eDNA sample by matching it with the digital DNA sequence for known species held in the library (see eDNA Monitoring Info Sheet).

DNA barcodes are unique portions of the genetic make-up of an organism that are used to identify a particular organism/species (see DNA Info Sheet). By generating and storing reference barcodes from known species it is then possible to identify species found in an eDNA sample. Barcodes are useful for species identification, but do not comprise the full genome or information regarding the function of the species, so there is less potential that this DNA information could be exploited. Users of the DNA barcodes for other purposes other than species identification is extremely rare.

Māori are engaging with new biotechnologies such as genomics, and value how these DNA technologies support their work and conservation aspirations. There are varying views on how genomic technologies could be used with conservation uses more strongly supported than other purposes.[1] Some iwi and hapū are exploring opportunities to partner with organisations generating DNA reference libraries and using eDNA.

Sampling of eDNA in the the upper reaches of the Manawatū River:
The identification of eDNA signatures from common species provides a more practical overview of freshwater quality enabling us to tell many positive stories in the catchment alongside indicators from pest species and livestock. The eDNA signature indicated the presence of taonga species such as whio/blue duck, ruru/morepork, kōtare/kingfisher, tuna, kaharore bully, dwarf galaxias and koura, and invasive species including possum, deer, cattle and sheep. Through the use of eDNA detection, species could be detected as present even if no one had physically seen them and therefore enabled conversations with stakeholders and local communities.

eDNA Sampling in the land vested in Te Waiau Mahika Kai Trust:[2]

Te Waiau Mahika Kai Trust undertook eDNA sampling in the Waiau catchment to better understand which native species call the area home. The results were surprising. In the lower Redcliff Creek, the sampling detected kōaro (which are part of the whitebait run and a taonga species and a source of mahika kai for Māori) and lamprey/kanakana (jawless, migratory fish from an ancient lineage that have existed for more than 360 million years).

Three fish species were detected - kanakana, Gollum galaxias, and the Southern flathead galaxias – that are classed as threatened and nationally considered as vulnerable. There were also detections of the furtive wetland-dwelling spotless crake/pūweto in the Jericho valley that were not known to be in the area and have been elusive and relatively infrequently seen.

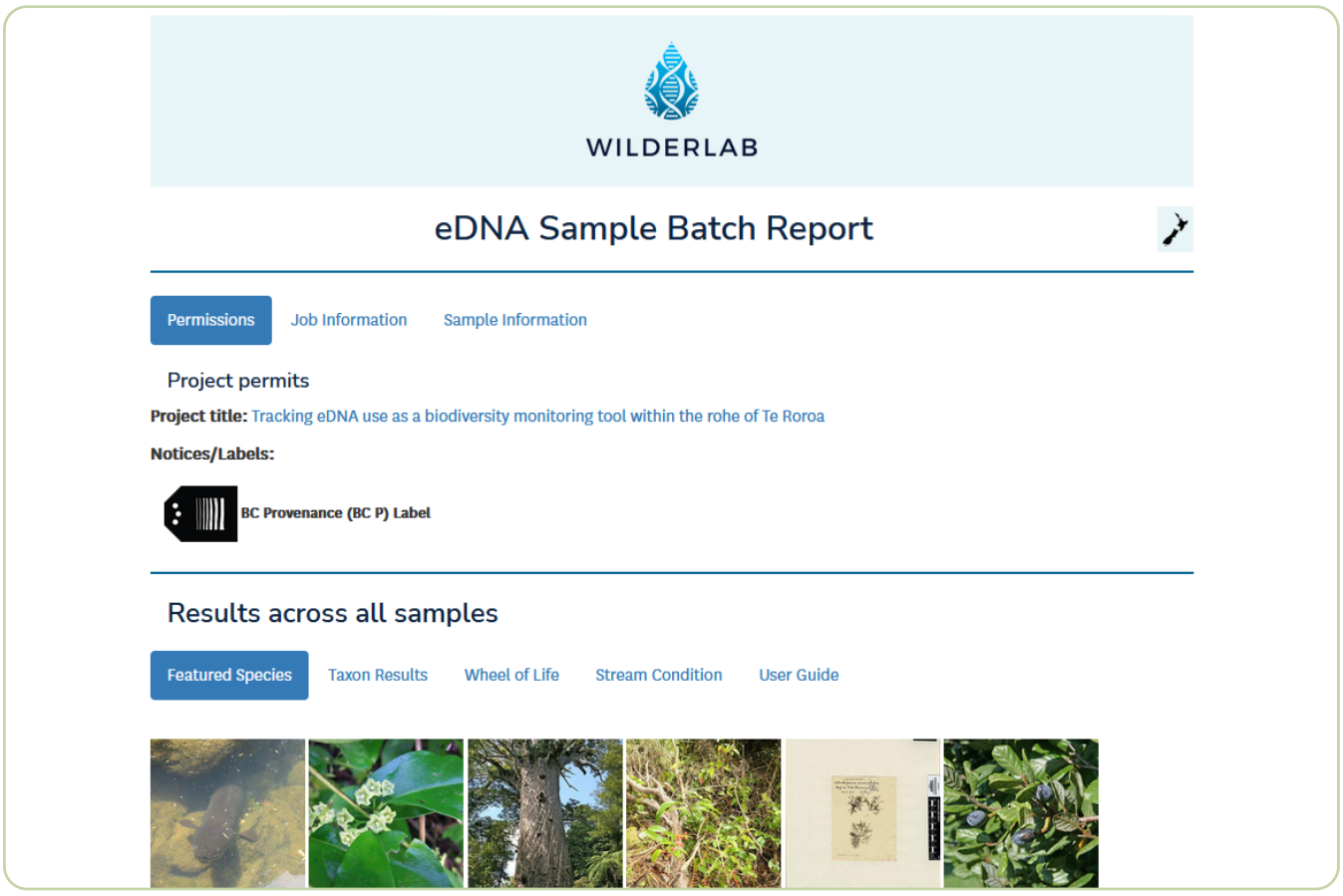

Figure 1. Figure 1 is an example of a report generated from an eDNA sample taken on Iwi land.[3]

This eDNA report in figure 1 identifies species found in the sampled environment, communicated through pictures and a tree of life. The provenance of the samples and generated information is communicated through the placement of a Biocultural Label.[4]

Māori considerations for Collection and Sampling

Sampling of eDNA is a core part of the monitoring process to detect what species are in particular locations. Māori anticipate that appropriate consultation with Iwi has been undertaken for monitoring projects and this may extend to include governance over the collection

of samples and the protocols surrounding them and the data produced from the collection and analysis. Any necessary permissions should be sought from respective landowners and/or kaitiaki. Information shared should include what is being collected, who has access, and how the generated genetic data will be used in the present and potentially the future. The collection process can be guided by kawa and tikanga to ensure appropriate levels of integrity, comfort and control are put in place (see the Te Nohonga Kaitiaki Guidelines Info Sheet). For example different kawa and tikanga may apply when detecting species through barcodes versus other genomic information that would allow for biodiscovery or bioprospecting (see DNA Info sheet).

Monitoring processes can contribute towards fostering relationships built on trust, accountability, and understanding. Sharing information with groups that/who have interests in the collection and sampling of eDNA including iwi/hapū, Māori researchers, CRIs, universities, whare wānanga, regional councils, Māori environmental groups, and iwi resource management units (RMUs), creates greater awareness and understanding about the monitoring programmes and biodiversity. Similarly, contributions towards Māori capacity building and development of new skills, e.g., through the collection and sampling process, are encouraged. Figure 2 "*from the Te Nohonga Kaitiaki Guidelines Info Sheet*" provides some indications of appropriate levels of responsiveness and engagement with Māori.

Māori Considerations for a DNA Reference Library

A key part of identifying species within an eDNA sample is having a comprehensive DNA reference library "*see Environmental DNA Monitoring Info Sheet*". A reference library aims to hold DNA barcodes from known species, and as such is seen to be a taonga that needs appropriate care. The reference library should ensure an appropriate level of Māori participation in governance and be guided by kawa and tikanga to inform protocols

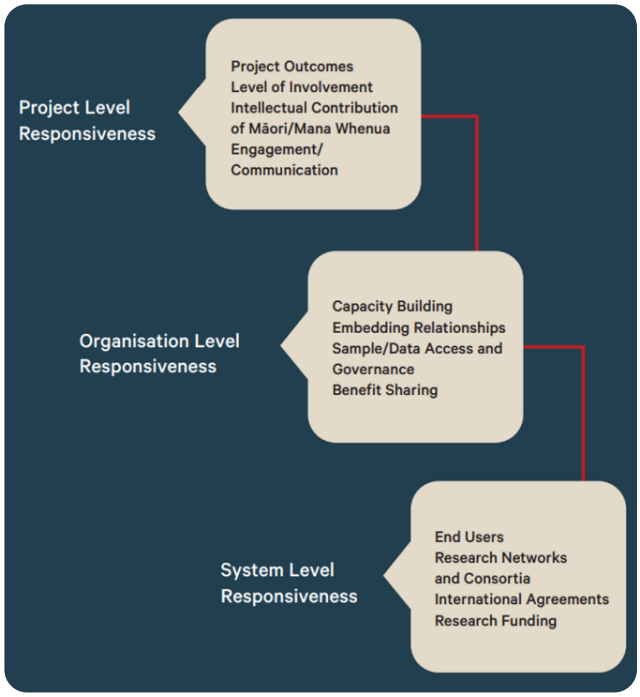

Figure 2. Responsiveness and engagement with Māori

which support access and use. Māori need to be involved in all levels of governance: overall governance of the reference library and any data access committees.

Any reference library should be accountable to kaitiaki, recognise Māori rights and interests as well as encouraging Māori use and capacity building. A major consideration is data management and the application of Māori Data Sovereignty principles as well as the FAIR and CARE principles.[4] Māori expect that processes for sample collection, analysis and data storage should be of a high standard and that appropriate information supporting data management be included. Appropriate metadata fields including provenance, mātauranga (traditional knowledge), location, and Traditional Knowledge (TK)/ Biocultural (BC) Notices/Labels[5] should be included when samples and their genetic data are entered into the library. Information about any consent or permissions should be included and data access must take into consideration intellectual property and use licences (like creative commons) when determining access and/or restrictions. There is an expectation that the use of the DNA reference library will benefit the community and knowledge will be shared with iwi/hapū.

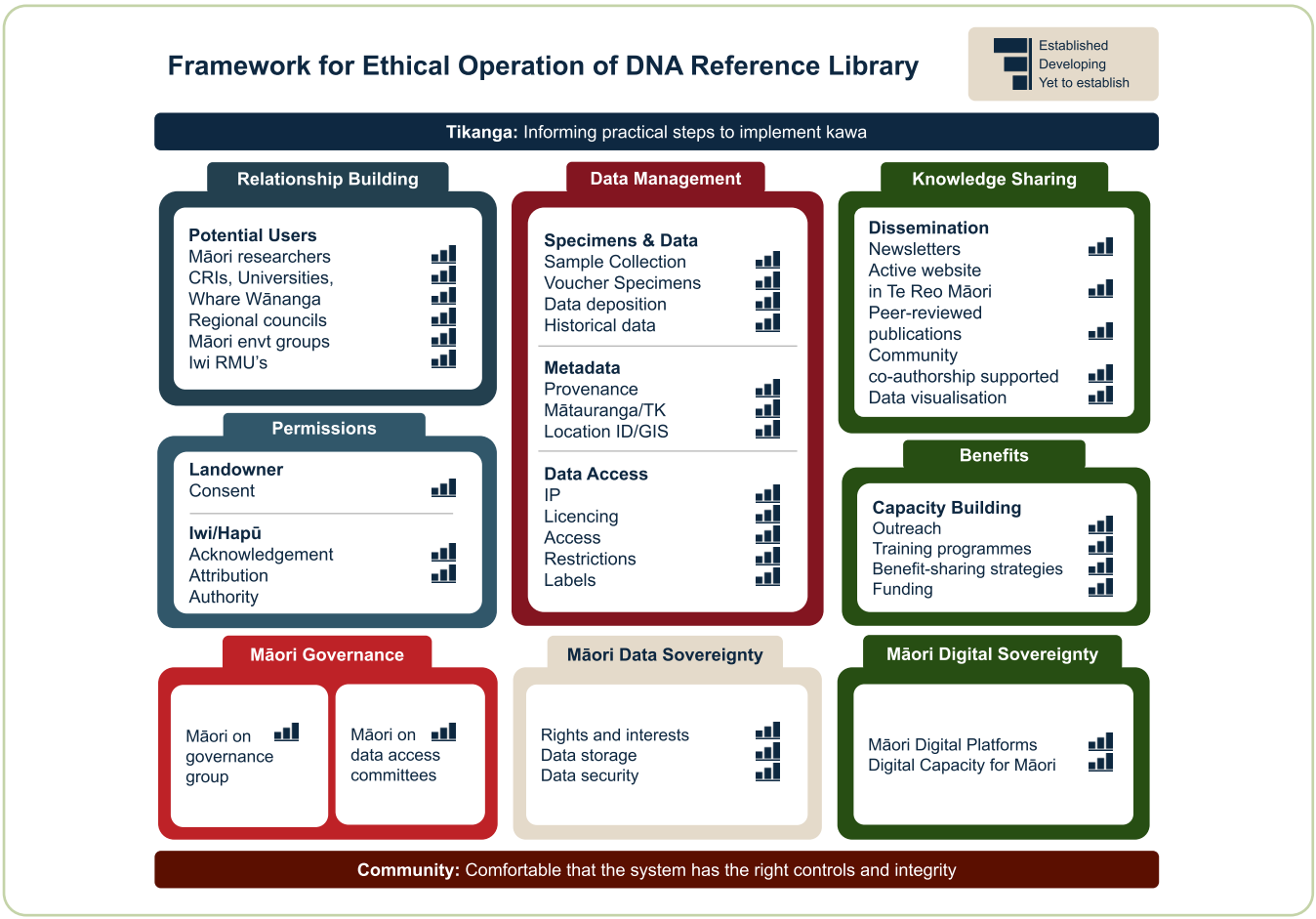

Figure 3. Proposed framework to guide ethical operation of a DNA reference library.

Some of the potential benefits include outreach, training programmes, enhance conservation and biosecurity efforts, and access to funding to support kaitiaki work. Knowledge sharing can occur in various forms, including websites, newsletters and other publications (including in peer-reviewed publications) with community and/or their representatives as co-authors. Ideally, these should be in both te reo Māori and English. Recent discussions with Māori about eDNA highlighted a range of issues that they felt were important to address.

The framework in Figure 3 positions kawa and tikanga as informing practical steps to ensure the ethical operation of a DNA reference library through relationship building, permissions, Māori governance, data management, Māori data sovereignty, knowledge sharing, benefits and Māori digital sovereignty. The framework indicates the level of maturity in each area and guides the governance of DNA reference libraries.

References

1. Kathlene, L., Munshi, D., Kurian, P., & Morrison, S. L. (2022). Cultures in the laboratory: mapping similarities and differences between Māori and non-Māori in engaging with gene-editing technologies in Aotearoa, New Zealand. Humanities and Social Sciences Communications, 9(1). https://doi.org/10.1057/s41599-022-01104-9
2. Elusive animals detected in Southland/Murihiku restoration area. (2024, July 31). Open Waters Aotearoa. https://www.epa.govt.nz/community-involvement/open-waters-aotearoa/newsletter/elusive-animals-detected-in-southlandmurihiku-restoration-area/
3. Report on fish and frog monitoring in freshwater environments. (n.d.). Wilderlab. https://s3.ap-southeast-2.amazonaws.com/wilderlab.openwaters/reports/911a6c62172fedd2.html
4. GIDA Global. (n.d.). CARE. Global Institute for Digital Agenda. https://www.gida-global.org/care
5. Local Contexts. (n.d.). Notices. Local Contexts. https://localcontexts.org/notices/
   Local Contexts. (n.d.). Labels. Local Contexts. https://localcontexts.org/labels/

Funded by: Ministry for the Environment
Published by: Te Mata Punenga o Te Kotahi | Te Kotahi Research Institute, University of Waikato, Private Bag 3105, Hamilton 3240, New Zealand. Email: rangahau@waikato.ac.nz
DOI: 10.15663/i56.28917
Citation: Sterling R, Liggins L, and Hudson M. 2024. eDNA, DNA reference libraries and Kaitiakitanga. Te Kotahi Research Institute.

Te Kotahi Research Institute
THE UNIVERSITY OF WAIKATO

IDIA
Indigenous Design & Innovation Aotearoa