Capability building through the Kia Niwha Fellowships

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Impact of land-use on water quality and antimicrobial resistance in Aotearoa New Zealand

Leadership development:

The opportunity to be a Kia Niwha Leader Fellow has been pivotal in my journey as an early career researcher. The Kia Niwha Leader Fellowship has enabled me to foster relationships with our community partners Te Miro Farm and Taiao Ora Contracting, to connect with community groups, apply my microbiology and computational biology skills and develop my leadership skills. This research project and fellowship align with the Te Niwha Kawenata as it is built on strong relationships and partnerships interweaving Mātauranga Māori with Western science that draws together collective knowledge from researchers, mana whenua, kaimahi environmental groups, farmers and community groups. The Kia Niwha Leader Fellows attended a series of wānanga organised and facilitated by Te Niwha that were designed to strengthen our leadership skills. These wānanga have been invaluable in my leadership journey as I have had the opportunity for whanaungatanga, to connect and build hononga and tūhonotanga and learn from many community leaders. Building and fostering these hononga is the essential first building block for any partnership. Through this fellowship and attending the wānanga, I have had the opportunity to extend my networks both within Aotearoa, and through my upcoming international placement, globally too. Having these strong networks with infectious disease researchers is critical for Aotearoa New Zealand (NZ) to be prepared and able to respond to current and emerging disease threats. The opportunities that this fellowship has provided, including leading a research project and presenting to a wide range of community groups, have helped me to develop my leadership skills in a supportive environment and learn from community leaders. These experiences have helped me grow as a researcher, to have tiakitanga for all aspects of research and about being a good research partner.

Research:

Antimicrobial resistance (AMR) is a growing global issue, often described as a 'slow-burning' pandemic, posing risks to human, animal, and environmental health. However, little is known about the environmental transmission of AMR in NZ, which is crucial for protecting public and environmental health. AMR surveillance and biodiversity assessments in freshwater ecosystems are interconnected, both reflecting the impact of land-use and environmental stressors on ecosystem health. Environmental DNA (eDNA) is genetic material shed by organisms (e.g. from contact with skin, hair, feathers, mucous and faeces) that can be used to identify fish, macroinvertebrates, mammals, birds, plants, and microbes in an environment. Freshwater is an ideal source of eDNA, capturing genetic material from the surrounding environment. Freshwater eDNA monitoring can be used for biodiversity assessments, the detection of taonga species or potential biosecurity threats. Recently, māwhaiwhai (spider webs), which can act as passive biofilters and capture airborne eDNA, have been used to assess terrestrial vertebrate communities. Utilising both māwhaiwhai and the awa as a source of eDNA would provide a more holistic measurement of ecosystem health and AMR surveillance in the environment. By comparing urban, agricultural, and bush environments, it offers insights into AMR transmission and risks to public and environmental health.

Together with our community partners Taiao Ora Contracting and whānau from Te Miro Farm, three sites of contrasting land-use (urban, agricultural and native bush) have been sampled twice over a three-month period. Community sampling days and collaborative data interpretation alongside our partners enables the participation and protection of local knowledge. This study uses three approaches to examine the freshwater and māwhaiwhai samples: (i) enrichment and screening of environmental samples for antimicrobial resistant *Escherichia coli*, (ii) long-read metagenomic sequencing to detect waterborne pathogens and AMR genes and (iii) eDNA analysis of freshwater and māwhaiwhai samples by Wilderlab to assess biodiversity and ecosystem health. We recently finished the sample collection for this project and next month we will have a project hui with our partners to socialise the results, explore connections with local Mātauranga and discuss a way forward for future collaborative research opportunities ensuring an enduring partnership. This project and Fellowship support Te Niwha's Mission by providing an early

career researcher the opportunity to apply microbiology and genomic techniques essential for infectious disease research in Aotearoa and use preliminary eDNA data to explore the relationship between AMR prevalence and biodiversity/ecosystem health. It also strengthens collaboration among researchers, communities, and kaimahi environmental groups, contributing to AMR surveillance and biodiversity monitoring.

Figure 1-3: Sample collection with our community partners in February 2025.