Integrated Surveillance

Theme 5 : Ngā Rākau Taketake – Saving our Iconic Trees

New Zealand's Biological heritage Challenge

(Previously named: Mātauranga Maori Framework for Surveillance (MMFS) for plant pathogens)

Information and Data Custody Workshop

Auckland - 20 March 2020

Synthesis report

Background

The M*ātauranga* Māori Framework for Surveillance (MMFS) of plant pathogens is a research project that aims to embed hapū/iwi in Aotearoa's existing surveillance system and provides a platform that enables hapū/iwi to engage more effectively with central, regional and local government agencies. It seeks to enable strategic trust relationships between hapū kaitiaki and rangatira (local environmental guardians) directly with organizations that generate and provide science and research initiatives and investment, with particular focus on providing a platform for *mātauranga* Māori (indigenous knowledge) alongside western science. This research theme has been scoped in accordance with the New Zealand's Biological Heritage National Science Challenge's Ngā Rākau Taketake ('NRT') programme strategic objectives that aims to accelerate the critical research needed to combat the spread of kauri dieback (Phytophthora agathidicida) and myrtle rust (Austropuccinia psidii) in Aotearoa New Zealand.

Effective surveillance of plant pathogens and diseases depends on being able to source high integrity data and information on the identity of suspect organisms and on changes in the presence/absence, severity of the diseases, host characteristics, biotic and abiotic vectors differentially driving pathogenicity (Hulme, 2014; Parnell et al., 2017). Such information can be gleaned from a variety of sources, including from unsolicited reports ("passive surveillance") by members of the public and news media (Hester & Cacho, 2017; Pawson et al., 2020), and through planned surveys ("active surveillance") (IPSM, 2018). Over the past decade, the New Zealand Government has funded a range of passive and active surveillance activities to increase knowledge, awareness and reporting of plant pathogens and diseases within Aotearoa New Zealand (MPI, 2019). Each activity has been funded separately and conducted by a range of key partners including government departments, government-funded crown research institutes, universities, regional councils, commercial companies, nurseries and communities, with data collection and management undertaken on a project-by-project basis (MPI, 2019). With a greater focus on evidence-based decision-making has come increased interest for a nationally consistent data collection and analysis about the diseases state and trend as a means for all partners involved in a surveillance effort to expand their reach. But up-to-date data access and sharing has

not yet achieved its full potential (Allen et al., 2018; Bradshaw et al., 2020), and very few initiatives have integrated or supported indigenous knowledge, approaches and systems (Lambert et al., 2018).

Timely analysis of surveillance data from diverse sources to address in-depth research questions can be impeded by variable and unpredictable data formats, and a reluctance to share by data owners (Campbell & Teulon, 2018). Some of these data are poorly managed and some are at risk of being lost, while others have no funding available for maintenance or future development. The absence of standards guidelines, methods and indicators hampers our ability to report surveillance of plant pathogens accurately and consistently across Aotearoa New Zealand (Sutherland et al., 2020). Academic partners face significant cultural barriers to sharing data and participating in longer term collaborative efforts that stem from a desire to protect intellectual autonomy and a career advancement system built on priority of publication and citation requirements (Susha et al., 2019). Some barriers, like a history of mistrust, tensions in the protection of cultural heritage, concerns about data mining, erroneous secondary analyses of data, and the desire to protect confidential commercial information, present challenges for all partners.

In addition, whether claiming basic rights to identity, asserting rights over appropriated information, responding to the records of unwanted information and exploitation, or myriad of other instances, the issue of data sovereignty is a core (Lovett et al., 2019) but often unrecognized concern of Māori partners. Engaged kaitiaki and rangatira who have been part of the myrtle rust and kauri dieback response, also articulate an ongoing sense of powerlessness and raised a common frustration at the lack of engagement in surveillance effort from the pathogen's point of discovery (Lambert et al., 2018). Many are concerned that surveillance is currently being relegated to communities but report a lack of access to necessary funding, as well as lack of access to necessary data and information: data and information for planning, to get the surveillance right, for supporting evidence, for program implementation and much more. Moreover, the current surveillance data and information seems to obstruct rather than assist indigenous goals (Smith & Knapp, 2001): it focuses on the negative ('risk', 'death' of trees/'diseases') rather than on the health of the natural environment; it is not readily accessible and associated with transparent lines of accountability; and lacks benefit sharing back to Māori collectives.

Hapū/iwi are urgently seeking definitive answers about the presence/absence of plant pathogens in their rohe (area), as are all land-managers. Many Māori partners want to make better use of data, including data sourced by or from Māori (Shortland, 2011; Waipara et al., 2013), and the insights and experiences of participating Māori, many of whom had established networks vital for understanding and combating the threats of pests and diseases affecting Māori bio-cultural interests (Lambert et al., 2018). The challenge is to be able to capture surveillance data and information in a way that is meaningful and enables mana whenua kaitiaki to be part of it. Engaged kaitiaki and rangatira agreed that science or research involving the capture or collection of data on taonga (treasures) species needs to be 'hapū' centric, thereby recognizing the roles of kaitiaki and rangatira, and their cultural authority and 'data sovereignty'.

In March 2020 a group of kaitiaki and rangatira, scholars, industries and government delegates from the Department of Conservation and the Ministry for Primary Industries gathered in Auckland, New Zealand to participate in a workshop. The 'Information and Data Custody for the surveillance of plant pathogens' workshop focused on strategies to facilitate the exchange, protection, curation, permissions and sharing of surveillance data and information between hapū/Iwi and agencies that generate and provide science and research initiatives and investment in surveillance. In particular, the workshop objectives were 1) to examine the benefits/opportunities of sharing of surveillance data from all partners and among these partners, 2) to identify barriers and challenges to sharing

and 3) to explore strategies to address these barriers and challenges, including identifying priority actions. In addition, we tested the idea of developing a 'data vault' designed for long-term historical storage of surveillance data and develop a set of requirements or recommendations for data sharing in and across NRT research projects.

We used plant pathogens myrtle rust and kauri dieback as case studies. Project co-leader Waitangi Wood introduced the *mātauranga* Māori Framework for Surveillance (MMFS) of plant pathogens and the concept of 'Biodiversity Management Areas (BMAs)' as a means to anchor data to its point of origin. She summarized the overlap of data and information within the myrtle rust and kauri dieback response and made the distinction between data sovereignty and custody. Nari Williams (Plant and Food Research), David Milner (Patuharakeke, Rangitane) and Rebecca Ganley (Plant and Food Research) were invited to present two cases studies which demonstrated successful strategies that facilitated the exchange, protection and sharing of surveillance and ecology data between hapū/Iwi and government-funded crown research institutes.

Workshop process and key concepts

The program for the workshop is attached as Appendix 1, and a list of the 21 participants as well as an introduction to the workshop facilitator Steven Tipene Wilson appears in Appendix 2. Presentations were in PowerPoint and can be made available upon request. The hui was not intended to define a universal model for surveillance data sharing, but rather to clarify critical questions and provide space for co-learning among kaitiaki and rangatira, scholars, industries and government delegates from the Department of Conservation and the Ministry for Primary Industries. No consensus was sought or expected. Instead the hui was designed to identify insights and knowledge that could assist future deliberations and aims to inform the development of acceptable approaches to sharing surveillance data and information.

The M*ātauranga* Māori Framework for Surveillance (MMFS) of plant pathogens

One of the founding motivations for developing the MMFS of plant pathogens is to enable strategic trust relationships between hapū/iwi kaitiaki and rangatira, and agencies that generate and provide science and research initiatives and investment in surveillance, with particular focus on providing a platform for *mātauranga* Māori and cultural approaches to environmental management such as *kaitiakitanga* (guardianship) and tikanga (protocols and practices) alongside western science. If Māori are informed by the latest research about incoming non-native pests and diseases they can be better prepared, more easily mobilized and trained, and are able to take an active role in the protection of the species and sites of significance and value to them. The framework is organized around four components to inform effective management and research on plant pathogens. The four components are: 1) symptoms and pathogen not detected, leading to maintenance of healthy forest environment; 2) symptoms present but pathogen not found, leading to increased surveillance; 3) asymptomatic but pathogen present, leading to monitoring surrounding risk and remediation; and 4) symptoms and pathogen present, leading to monitoring severity and remediation. Whilst surveillance is focused on the symptoms and pathogen, the MMFS widens the surveillance practice to give equitable status to the natural environment, forest resilience and supporting natural ecological biodiversity, and work with the environment to protect our taonga species from the risks from biosecurity incursions. Mātauranga authorities, drawing from their intergenerational relationship with taonga and their natural environment, apply their indigenous

knowledge to manage their impact with their environment. Both approaches consider the duality and singular paradigms that can be applied in determining solutions that reinstate the environments natural balance and ecological harmony, informing better environmental management and research investment.

Biodiversity management areas

Key to the framework is the development of 'Biodiversity Management Areas (BMAs)'. The BMAs are spatially delimited regions that mana whenua historically managed their biodiversity. These units will provide the foundation for the surveillance of plant pathogens and will link a live repository of shared surveillance and observation data and information. This linking is supported through connecting with 'tangata kokiri' (or key mana whenua technicians) who will be identified across myrtle rust and kauri dieback affected BMAs. These tangata kokiri can ensure that hapū/iwi/whanau values and mātauranga Māori specific to their rohe are explicitly considered in designing and implementing surveillance in the targeted areas. Additionally, the BMAs ensure value creation and benefit sharing by recognizing the cultural sovereign authority of kaitiaki and rangatira, and their 'data sovereignty' across BMAs. Recognising the provenance of surveillance information and data to a BMA, a land base, enables the discussion which inform processes and systems that consider custodian control, access rights, permissions, curation, use of data, information and records.

Distinction between data sovereignty and custody

The MMFS makes a clear distinction between 'data sovereignty' and 'data custody' where:

- Data sovereignty states that the management of data and information is subject to the the laws, practices and governance structures of the nation within which it is stored. Māori data sovereignty states that data is subject to the law of the nation from which is it collected and refers to the inherent rights and interest that Maori have in relation to the collection, ownership and application of Maori data (Kukutai & Taylor, 2016).

- Māori data refers to information or knowledge in a digital or digitisable form that contains any Māori content or association to Māori, including environments, regardless of who collects and controls it (self-generated, generated by others, or a combination of both) (Taiuru, 2020). In a traditional context, the taonga would be the responsibility of a kaitiaki (custodian with geneology to mana whenua) who would monitor access to and use of a specific taonga. Māori values as they relate to taonga should inform policy and practice within all spheres of surveillance (operational, governance, and community engagement). These values should guide the day-to-day collection and disposal of data, governance over the future use of data, engagement with communities and community consent/mandate in support of the research project(s). Within the MMFS, data, information and narrative about taonga[1]' is recognized through its provenance to land/water and tangata Māori (i.e. linked to

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[1] "taonga species are the species of flora and fauna for which an iwi, hapū, or whānau says it has kaitiaki responsibilities". This emphasises the need for relationships with iwi and hapu to understand the bounds of their kaitiaki responsibilities. The definitions of a taonga used by the Waitangi Tribunal mean that any taonga is protected under the guarantees in article 2 of the Māori text of the Te Tiriti O Waitangi which states: The Queen of England agrees to protect the chiefs, the subtribes and all the people of New Zealand in the unqualified exercise of their chieftainship over their lands, villages and all their treasures

a particular BMA). This determines the 'sovereignty' of data/information and narrative informed by the place of origin of the taonga that the data, information and/or narrative is about.

- Data custody refers to the holders or those who have acquired the data and the agreed protocols that regulate the flow of data among potential and existing users, i.e. how the data is being acquired, held, used, curated, protected and shared. The cultural authority arrangements and other developments within the MMFS aim to provide a nexus between data custodians, those holding data/information about taonga and those with recognised data sovereignty, where the provenance and/or whakapapa of information, data and narrative back to whenua or taonga is known and recognised.

Initial questions from the participants

**Question:** The question of Māori data sovereignty is a difficult question for MPI. There is a slow shift within MPI towards recognizing that cultural authority arrangements are critical but there are still a number of high level decisions that need to happen to establish a partnership in which the Crown is entitled to govern and recognise Māori tino rangatiratanga (full authority) over their taonga (treasures) (as stated in the WAI 2.6.2 claim). Why does it looks like to follow the WAI 2.6.2 claim if it is not recognized by the Crown ?

**Dave Milner:** We have a unique opportunity to develop ground up strategies to reshape the Crown-Māori relationship as a partnership in which hapu/iwi are able to fulfill their obligations as kaitiaki towards their taonga which in the long term could support what could happen at a higher legislative level.

**Question:** Why do scientists need to work with Māori and vice versa?

**Waitangi Wood:** Māori have no relationship/intimacy with the new pathogens. The relationship with scientists is needed to achieve an understanding of taonga loss. Māori have relationships with the bio-heritage being protected (Teulon et al., 2015). Tāngata whenua are intimate with their land and taonga in their rohe, and can provide the local knowledge and expertise needed to survey sentinel plants for their growth and health status. This knowledge could feed into a larger repository of information that could serve as a national network of plant health status across BMAs. Collectively, this nationwide network of BMAs may also form an ara (pathway) for two-way knowledge exchange, resulting in increased preparedness for a myrtle rust and kauri dieback incursion and long term response management.

**Question:** What is the purpose of the BMA?s Management of the data or management of The Land?

**Waitangi Wood:** The BMA's achieve both. By recognising provenance to a BMA, the custodian recognises the sovereign authority of taonga.   and the ability to use for better biosecurity response and management.

Benefits/opportunities of sharing surveillance data and information

Data sharing implies making data available for re-use across different contexts and users including, crown agencies, community, local government, industry, researchers and mana whenua. The general consensus supported the sharing surveillance data and information, but challenges became apparent when data and information custody (ie who houses the data) was discussed. Arguments can be classified into two broad and overlapping categories: the first consists of 'practical and scientific arguments', the second of 'moral and ethical arguments'.

Practical and scientific arguments

With sharing surveillance data and information informs comes the opportunity to create high quality multivariate datasets which in turn facilitate and simplify the process of data and information discovery, evaluation, and reuse in downstream studies. These include detecting, correcting and deterring inaccurate information; preventing duplication of work and data loss; clarifying assumptions; allowing a better space to capture meta-data; enabling replication of work and potential resolution of apparently conflicting results; facilitating application of previously generated data to new inquiries; identifying information gaps and prioritizing decisions for funding; identifying best practices to collect and analyze the data; limiting bias in the way we collect and handle data; improving data consistency and accuracy though peer-review; increase the spatial and temporal extent of data, due to data collected and accessed over a longer time sequence; increasing the collective capacity; promoting positive relationships between all parties who are sharing and building on the data; supporting research momentum across projects through time; and facilitating quicker and more processes for implementing management.

Beyond proper collection, annotation, and archival, data stewardship includes the notion of 'long-term care' of valuable digital assets, with the goal that it should be discovered and re-used for downstream investigations, either alone, or in combination with newly generated data. In particular, data collected from several discrete projects can be combined (meta-analysis) to learn more from the results of a single study, giving better problem solving and resolving ability. The inclusion of correct metadata in the collection assures that data recognises the chain of data and information custody from protocol to data to analysis to results. This is particularly significant to using indigenous data. It allows all parties with varied knowledge and diverse capabilities to observe and compare adjoining areas of landscape and research, supporting collaboration and the applications of multiple approaches and synergies across disciplines while recognising the distinctions of custody and sovereignty. Data sharing is not a goal in itself, but rather is the key conduit leading to knowledge discovery and innovation, and subsequent data knowledge integration (evaluation) and reuse by the community for independent re-analysis. Data and information sharing facilitates the cross-validation of different perspectives and methodologies, and was presented as a fundamental mechanism by which scientific evidence is accumulated to support findings, results and temporal application.

Moral and ethical arguments

Data sharing enables a better use of the data ('maximizing' its use for furthering the common good) which in turn leads to better surveillance and management of plant pathogens and sustaining the health of the environment. It allows us to know where diseases and pathogens occur, to establish a better biosecurity response, and to organize arrangements to encourage data and information sharing with other partners and those that hold data and information. Data sharing allows us to identify data and information gaps, what needs we have for data and information, and how to avoid collection duplication. It allows us to utilize a range of networks and relationships to acquire data that we may not be gathering, but that others are as part of their programmes and it establishes, through provenance, permissions and sensitivities for addressing cultural licence. This data and information could then be used to improve management responses and affect system change. Shared data improves decision making and provides people with clarity and confidence around decisions, pathways taken to reach these decisions, and the reasons why these decisions are made. Incorrect assumptions are minimised or avoided. To affect systemic change, consistent, robust, defendable data is needed to advocate, influence and inform decision makers at national, regional and local levels.

These arguments point to the necessity of fulfilling ethical obligations for sharing the data to the individuals and collectives from which data are drawn, minimizing known risks and potential harm from unnecessary exposure to previously tested management interventions, and honoring the nature of surveillance of plant pathogens as a common good. This argument is particularly significant for mana whenua, kaitiaki and rangatira, who have no relationship with new plant pathogens and may have sacrificed resources or borne some risk to provide access to data on the understanding that their data may benefit their collectives and others and address the pathogens and diseases affecting their taonga.

Data sharing enables a broad oversight to data collection and interpretation (by opposing narrow focused or biased interpretations of the data). It will enable us to see new challenges and identify issues that can be found in existing data sets that one group, already holding the data, might have missed. Data sharing could ensure qualitative data secured from oral history and through observations of mana whenua traditions are appropriately captured and used with integrity. The two contexts should be used together in a complimentary way as a seed to coalesce different perspectives, that enable and contribute to both mātauranga Maori and western science.

Data sharing is not simply the sharing of data, it is also the sharing of practices and interpretation. Sharing data assists in team building and collaboration – generating a culture of inclusivity and collegialism. Trust and meaningful, connected relationships can be built at the beginning of a data supply chain by making custody process or consent agreement a priority. Sharing therefore expands obligations to account for the possibility of implicit and explicit bias and resulting immenent harm. Resulting strategic trust relationships established between parties using the data will discourage people from withholding information. The more data is shared, the better our understanding.

What constitutes 'good data management' is, however, largely undefined, and is generally left as a decision for the data or repository owner. Therefore, bringing some clarity around the goals of good data management and stewardship, and defining simple principles to inform those who publish and/or preserve scholarly data, would be of great utility.

Challenges of sharing surveillance data and information

The operational and ethical dynamics driving us towards ever more data and information sharing also set the stage for sizeable and complex technical, legal, cultural, ethical and operational data challenges.

Technical and operational challenges

Participants have described four major technological ad operational challenges: data dispersion, heterogeneity, provenance and maintenance cost.

Surveillance data is everywhere, typically managed by major research projects, government departments, government-funded crown research institutes, universities, regional councils, commercial companies, nurseries and communities. Unfortunately, only a small fraction of surveillance data ever collected is readily discoverable and accessible, much less usable. Challenges for leveraging surveillance data are many, including disparate practices of individual scientists/agencies; labor and expertise needed to manage and store large amount of data; lack of incentives to release data; variant intellectual property regimes; and competing policies for data release and control.

Data heterogeneity creates challenges due to the breadth of topics studied and the varied experimental protocol used by independent researchers and agencies. Surveillance data are often collected for short-term purposes, and data archiving and sharing is not always prioritized. This is amplified by recurrent staff turnover. Surveillance data also comes in extremely variable and unpredictable formats (e.g. proprietary file formats owned and copyrighted by a specific company; and might require specific or expensive software) and contents (e.g. different units), with often poor adoption of metadata and common standards/practices which limit the reuse and inter-portability of the data. There are challenges around using standard ways of collecting data. Community groups, citizen science, organizations, etc. like to do things their own way, with everyone wanting their own platform or to modify one to fit. While intent on using a standard way of collecting data (e.g. long-term monitoring form for myrtle rust[2]), the person collecting data may not connect with the use and purpose of the form/data collected. For example, if a data field uses a 'zero' to indicate that the pathogen has not been found in a particular location, the person collecting the data needs to understand the importance of noting the 'zero' descriptor so that it can be digitized and used, and also understand the purpose of the field. Without this cognizance, it will be unclear that the space on the monitoring form is an indication of 'no data collected', or if the absence of a 'zero' is related to absence of the pathogen. This will impact the way that the data can be interpreted, recorded, and used.

Metadata heterogeneity is another important challenge. One set of data describes something one way, another set of similar data describes it another way, it may lack the link or commonality that allows it to be interpreted as the same. We would need to find common links through metadata that describe the attributes and commonality across definitions (common fields). This means the design of the descriptions in the metadata will be very important, they must show this consistency between data sets, projects, and organizations through standardization. This standardization will need to be discussed so that shared data has some common fields.

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[2] https://www.myrtlerust.org.nz/what-to-do-if-you-find-myrtle-rust/

Increasingly surveillance data is available from social and open source search feeds (Inaturalist) where volunteers report and collect observations of plants pathogens, and animals, share these reports with other users. This data is also used for scientific research purposes. Data quality (completeness, positional accuracy, thematic accuracy) however is a vital issue in this field. Currently, reports of species or disease observations from citizen scientists are often validated manually by experts as a mean of quality control. These data are often not produced in a systematic way, resulting in (for example) spatial and temporal incompleteness. Also, the nature of the data is not only determined by the natural spatio-temporal patterns of species distribution, but by factors such as the behaviour of contributors or the design of the citizen science project that produced the data.   Most observations consist of at least the species, location, time, and observer, sometimes supplemented with more (project-specific) information. Therefore, methods for quality assurance or plausibility assessment, needing only the four basic aspects of an observation, have the potential to be useful for many different projects and datasets, with data properties carefully examined in any case. For example, a seemingly exact location in the form of coordinates can have a wide range of accuracy, or even represent different types of locations (i.e. an exact location vs. the centre of a map quadrant).

Socio-cultural and legal/regulatory challenges

'Attitude' and 'perceived (positive/negative) outcomes or consequences' were two of the main components argued to affect the intention to share data. People take ownership of data when they collect it (regardless of who collected the data and how it was collected) and this can create possessiveness. It becomes their observations, their data and their organization's or individual's expectations of data collected; particularly if they funded the data collection or provided resources to allow the data collection. This can present a real challenge both in the communities and in science and research for sharing data.

Academic partners, in particular, face significant cultural barriers to sharing data that stem from concerns about protecting the research's right to publish their results first, difficulty in establishing trust in others data, a desire to protect intellectual autonomy and rights, and a career advancement system built on priority of publication and citation requirements over publishing data. Younger researchers could be discouraged if they cannot publish quickly, often a requirement of research employment. This potentially may exclude bright, young people as they do not have the time to build strong relationships. Alternatively it can also enable mentorship through a relationship that is already built between scientists and mana whenua. The scientists that are already involved with mana whenua relationships could act as a connection for the younger scientists. Going forward, young people can work with agencies, organizations, or research institutes that have established a relationship with hapū around the taonga that's involved in the new researchers work. With an existing formalized relationship , and strategic trust relationship in place, new researchercan be connected to hapū, understanding the cultural context and mana whenua expectations of the relationship. This approach is observed from Maori tradition of tuakana-teina, where older generations teach and guide younger generations.

Abuses have also occurred in the research process. Funding and research processes continue to be controlled by university/ crown research institute-based researchers or government initiatives, with little or no input from the community or attention to local ecosystem health priorities. After completion of a project, researchers often disappear, leaving the community with no information about what the research has accomplished. In this context, many terms common in discussions of data sharing, such as "property," "ownership," and "discovery," are red flags for Māori communities

because these terms have historically been used to justify theft of Mātauranga, traditional knowledge and natural resources.

In many instances there is a lack of trust by community in government agencies. Though Maori land ownership is acknowledge there is little understanding of mana whenua authority over traditional land areas that do not recognise crown description of land. This has created a fragmentation in New Zealand's society, as Maori asserting the sovereign authority as the crown partner are marginalisd where crown and local government elevate the status of New Zealsnads citizens.

How do we negotiate these struggles around landowners not recognising the cultural authority of Māori and their role as kaitaiki and rangatira? It is also important to consider that cultural and science contexts may come into opposition. Science answers one research question and then may need (or want) to publish in scientific journals, e.g. open access publishing, which may contravene data sovereignty or re-define the mana whenua narrative . Scientists would need to change the way that they publish and exclude some data, e.g. GPS references. More importantly the discussion should be elevated with mana whenua partners for where their Mātauranga Maori authorities wish to engage or even support the publishing journey.

Contracts with funding organizations where the funder owns the data and research, can prevent sharing and legal rules or official policy guidelines that often restrict public agencies (e.g. DOC, MPI) or commercial partners from sharing data with each other can prevent information being publicly available. Because there can be considerable cost associated with acquiring, entering and recording data, agencies and companies are unlikely to perceive data sharing to be in their best commercial interests. For example, contracts with funding organizations may mean that the funder owns the data and research, and can prevent sharing, particularly with mana whenua. Confidential information and trade secrets can be among the most valuable assets commercial partners and industries own. A competitive edge in the market place may rely on commercial partners and industries having certain information which its competitors do not, (commercial value of the data) and are generally not eager to share without compensation or fear of loss of their authority, power or income. Frequently, official guidelines on data sharing simply do not exist, are unclear or inconsistent and maneuvering through data information and application may prove a daunting task. The balance between making data accessible, safeguarding privacy, and protecting intellectual, time and financial investments is often not well regulated or standardized, resulting in protective policies on sharing of surveillance data in general. Future developments will consider the ability of a partner to provide information, permissions around commercially sensitive information.

Privacy and security challenges

Workshop participant were extremely concerned about potential loss of their privacy (do controls on data satisfy regulatory requirements?), security (is the confidentiality, integrity, and availability of data adequately protected?) and sovereignty. A common concern raised was about how surveillance data will be reused once it becomes more accessible: who has access to the data? Is there trust between multiple users? Who has access internationally? If data sets are sent overseas do we have a legal ability to recall data sent overseas? What are the legal ramifications and challenges of sharing data internationally? Is it appropriate to have an exit strategy? People could agree that data can be stored for a period of time, and then only continue to store it (potentially in perpetuity), if the party is happy. Having an exit strategy may reassure groups that are reluctant to share data.

One fear was that data will be misused or misinterpreted if, for example, too little attention is paid to how the data was collected and analyzed or to the nature of the data (private, sensitive or confidential data). As data custodians and stewards move from one organization to another, data and information held by them can be lost or translated differently by different people. This needs good handover processes otherwise data becomes less usable through misinterpretation. There is also a concern about who is allowed to access certain data, especially geospatial data that could be used adversely against people or property. Certain kinds of data or narratives are ecologically or culturally sensitive. For example, hapū wahi tapu, wahi tupuna, and other sites of significance are sacred location, consideration needs to be given to how to protect this special information? This also applies to ecological data when sensitive habitats or endangered species locations are considered e.g. nest or refuge sites. These sites or species would not be safe if the information was put out in the public domain. Custodians must be aware that Māori cultural heritage comprises several complex elements, such as traditional knowledge, technology, ecological knowledge, narratives, etc. regarded as having significant values to Maori, which means that public and unauthorized disclosure is untenable. In fact, Māori "conceptions of sovereignty, ownership and privacy" are challenging the legitimacy of legal and ethical frameworks based on Western philosophies and value systems.

It is apparent that there must be limits on who accesses and controls data, but it is uncertain who should establish the limits, with continued discussions about whether they should be based in law or in regulations and how to meet data obligations in perpetuity. While establishing strong trust relationship between mana whenua and scientists that encourage this goal, tensions and challenges must be addresed in this relationship that consider research and project time frames and investment in relationship building and engagement. Breaches of trust where culturally sensitive or private data gets shared, may be irreparable and both parties must work towards understanding and recognising data sovereignty and its associated expectations.

Ethical challenges and obligations in perpetuity

Lack of consultation and lack of trust was identified as a key issue for Māori at an individual level and at a community level. For example, there is inherent distrust of government organizations and government consultations that have for many years been accused of being selective with Māori they consult (Taiuru, 2020). The myrtle rust hui voiced this across multiple groups at multiple hui. This was also consistent with Maori engaged Theme Leads from Mobilising for Action preliminary research . Trust issues in the kauri dieback space are historic and with current conversation elevating concern around who would manage and look after the data and how would data sovereignty be addressed. These issues include, for example, matters to do with protocols for seeking consent, ensuring the research process is culturally respectful, whether the research environment and methods used are appropriate and participants can freely express their views, and ensuring the research endeavor is mutually beneficial.

If data can be reused indefinitely to discover unpredictable correlations, then controls meant to protect the subject of the datasets should ideally cover a future time-span and possible use of the data during that period with agreed end dates. These include unethical or even illegal use of insights, amplifying biases that exacerbate issues of social and economic justice, and using data for purposes to which its original disclosures and agreed purpose without consent.

Consent to use and collect the data typically occusr prior to collection beginning. There continues to be a troublesome gap between the tolls of data analytics that rely on sharing and the tools used to protect subjects from harms that may be caused by sharing. Data is increasingly used outside

the initial context of collection, and the process of consent and other human subjects protections are largely restrained to the time and context of collection. Participants were particularly interested in how data sovereignty would be recognized and its relationship to who collected the data. This included management and the use, parameters and scope of data.

The question of data sharing also amplified subtle and complex questions of interpretation, transparency, collaboration and trust that are at the heart of data-ethics concerns. Contrary to the common discourse of data as a neutral arbiter of truth, how data is collected and how datasets are structured subtly shapes what the data "means" moving forward, often in ways that are non-obvious and prone to bias (what the explanation of the wording means). The highest priority is to respect both the custodian and sovereignty of the data. Where insights derived from data could impact the human condition, both views; a western view that considers the potential harm to individuals and communities and a mana whenua view that considers the potential harm to natural environments and the relationships with furture generations should be the paramount consideration. Centralizing data can produce compelling insights into management of plant pathogens, but those same insights can be used to unfairly limit an individual's possibilities. Moving forward science and mātauranga Maori authorities need to ensure that privacy, ethics and human rights are safeguarded by regularly peer review to assess for unintended consequences and with an intent to remedy or mitigate emergent issues.

Resourcing, hosting and funding

Resourcing and funding to set up data repositories and ensure proofing maintenance accessibility of data in perpetuity was identified by participants as a significant challenge. Identifying and agreement on a suitable and secure host in perpetuity would prove difficult. There are for example pros and cons to storing data with a government agency: while they are the Te Tiriti partner, the lack of trust that the general public and the science community have of government agencies could be an issue. The organization curating the data will need long term funding and dedicated secure funding. Potential funders, e.g. MBIE, MPI, DOC, and other crown agencies, need to understand the significance and applicability of the data and information. Confident that the database has value, e.g. Statistics NZ, unlike other collections where the significance is not understood, will assure continued investment in data storage and management. Raising the profile of the data in this way, would provide an opportunity to demonstrate evidence of good data use and application. This would support the agency to socialise data and information in addition to improving brand recognition as a high trust agency. Access and application of useable data and information will also assure better research investment, outcomes and opportunities.

Participants discussed the caliber of the person required to facilitate the conversations and relationships in addition to the enormity of the task. The work would require a combination of expertise and skills; efficiency with data usage; a high degree of data and information management expertise; capability to understand and apply the context of stewardship; understanding and co-designing the role of custodian; a keen interest in pulling data and information together; understanding and knowing how data and information systems work; comprehensive working knowledge about sources of data, and the mechanisms and approaches used collect it; the ability to coalesce and synthesize data, then send it out in a usable form or format; able to connect with data contributors and demonstrate how their data has been put to good use; and, able to translate data into outcomes and report back to contributors. A data repository isn't just for collecting data and holding it, it is also about making sure it is distributed in a way that provides benefit to those that have contributed the primary data and information. This person/people would report outcomes to data contributors to show usefulness of data and recognition of the contributors contribution.

A good technical platform, e.g. ArcGIS (spatial software), allows sharing across groups and levels of protection. However, a lot of players are using different technologies to collect and handle their data and don't necessarily have the capacity to interact with such technical platforms. It is not recommended to use a commercial software such as ArcGIS which encrypts your data and information into a proprietary format that can only be decrypted and accessed by the commercial software and services. This creates a perpetual cycle of a user being bound by a conglomerate who demands an upgrade cycle of software and hardware to support the new software while having to pay a fee to access and store our own data. This also raises conversations around the accessibility of data to everyone. People need to be resourced so that they can manage the quality of the data and information collected across all the work being conducted. For some participants this raised concerns about who would be able to access the data to amend, edit, and clean it (data corruption)? Recognising a need to track what's been done or changed in the data, so we don't lose the information about what's happened over time. We need to share data in different ways with different people. This needs a clear custodian to prevent losing control of the data and its integrity. The database also needs to be agile as it's updated constantly, in addition to the data needing to be added in a functional and organized way as the repository grows and is updated.

Opportunities and solutions for shared data

The high priority is to respect the persons behind the data: building trust, meaningful relationships, and effective consultation channels is critical.

Workshop participants agreed that building trust, meaningful relationship and effective consultation channels is at the heart of making data-sharing efforts happen. It is an ethical practice in any research to include consultation with those who may be directly affected by the research and/or research outcomes whether or not the research involves fieldwork. With this comes expectations of reciprocity, the need to define clearly the parameters of consent (conditions of consent, permission, purpose, parameters, controls, security, and benefit sharing), and the need to establish levels of confidence, control and integrity for participants and community (Lovett et al., 2019; Taiuru, 2020).

Lack of consultation and lack of trust were identified as key issues for Māori both at an individual level and at a community level. Hapū/iwi expect to be consulted about projects that would use or generate information or narrative about taonga species from their rohe. Engagement may involve ensuring the research process is appropriate and culturally respectful, and participants can freely express their views; ensuring that research has appropriate legal and ethical oversight and operates within consent parameters; tracking and auditability for information and data; ensuring the research endeavour is mutually beneficial by reporting on all uses and outcomes, providing access to raw data and reports; ensuring re-consent for future use and participation; and, providing ability to exit the research relationship. Māori values in particular tika (the right way), pono (the honest way), and aroha (the respectful and empathetic way) support the establishment of a trusted data-sharing effort. In addition to these values, recognising and giving effect to kaitiakitanga, traditional management and control of assets including data, and rangatiratanga, recognising the sovereign authority of mana whenua and their relationship and authority of data and information relative to their cultural identity and geneology (Taiuru, 2020).

Currently, data sharing is occurring via direct contacts instead of through formal digital networks or repository platforms. Informal channels such as interpersonal communication and personal connection provide an important mechanism and safe environment for different parties to discuss ideas, identify potential collaborators, and exchange data and information. Having personal interactions help build up trust and stimulate meaningful, connected relationships that encourage openness and sharing.

An interpersonal discussion of data also helps provide context, declare assumptions, disambiguate terminology, clarify jargons, elaborate data structure, and explain variables in a timely, direct, and professional fashion. Such nuanced information is often hard to capture in a public-domain, general-purpose data archive or repository. The interactive, dynamic nature of personal conversation could help different parties quickly pinpoint issues, ask questions, exchange thoughts, gain understanding, reach agreement, and identify points of mutual interest for effective data sharing and productive collaboration. Individual results should be communicated in an appropriate manner to contributors, whānau, and general practitioners with due regard for issues of privacy and confidentiality. Partners have accountablility to each other throughout the entire project and beyond.

Building common cultural arrangements, protocols and contracts but treat every consent and dataset as unique.

Standardized protocols/processes, sharing agreements and cultural arrangements could improve trust and help mitigating institutional and cultural barriers. Rather than creating a contract or sharing agreement from scratch, standardized sharing agreements can save resource-constrained organizations significant time and effort. These standardized sharing agreements need to be established from the initial stage advising purpose, intended use of data and potential outcomes (for all parties, including publication and dissemination of results), how the data will be gathered, who will have access to it, identifying custodial responsibility, data stewardship, potential risks with sharing and accounting for the downstream uses of datasets. Scope and specificity of the consent may include broad unspecified use, disease/pathogen-specific use, unspecified use, specific project use, use and/or use for possible commercialization.

Data and information custodians must respect the cultural property rights of Māori Peoples in relation to knowledge, ideas, cultural expressions and cultural materials (Taiuru, 2020). Protection of mana whenua interests continue to evolved to this conversation as there are well developed protocols around how to protect hidden culturally sensitive data.

The wide variety of possible uses and potential harms for each dataset suggest that there is no "one size fits all" universal criteria for ethical sharing agreements. For example, mana whenua expect that cultural agreements are bespoke to their specific issues and concerns, and include arrangements that reflect their specific relationships with partners to the agreements. In addition, some data, such as genetic data collected on a taonga species, involves a unique set of complex customary and property rights and considerations. Therefore, standardized sharing agreements can build community norms about what best practices and review processes are necessary and complementrary to data sharing. For example, the sharing cultural authority agreements developed by Scion scientists from the Healthy Trees Healthy Futures Project (2016 – 2020) with the Kauri Dieback Programme Tangata Whenua Roopu Executive, presented by by Nari Williams (Plant and Food Research – previously Scion) informed by co-designed 'trigger questions' informed the development of cultural authority agreements as part of a contractual research agreement. Mana

whenua populated parts of the default draft agreement, and both parties negotiated the final agreement. The agreements reinforce how parties working together in the long-term have better outcomes and long-term benefits. Mana whenua nominated values to their cultural authority agreements which were included in the 'relationship' and 'Intellectual Property' sections, improving protection around how Intellectual Property is used, shared, and acknowledged (e.g. no commercial benefit outcomes). A full brief of the research, with full disclosure of the science methodology and research plan was embedded in the cultural authority agreement. This approach demonstrates transparency establishing strategic trust and allowed for mana whenua to negotiate 'stop-goes'. In addition to this informing a stronger communication between scientists and mana whenua, it also assured that the project was safeguarded against staff turnover or redeployment.

The management of intellectual property and how mana whenua is recognised in this arrangement, requires parties to engage with mana whenua. It requires that managers and decision makers, reexamine their own internal systems that aim to protect agency and/or organisation interests and be open to changing the systems or processes that marginalise mana whenua from their IP or IP generated from projects that they are informing.

Identify potential risk of sharing within sharing agreements and develop mutual accountability procedures between data sharing partners during the research project and beyond

Risk mitigation is a critical tool for ensuring that data and information are processed appropriately and the fundamental right and interests of individuals are protected effectively (Lynch et al., 2016). Risk management involves three key elements – 1) the systematic process of identifying and assessing risk and other negative impacts, 2) avoiding or mitigating those that cannot be justified by the benefits and other positive impacts, and 3) accepting and managing the remaining risks. Research has a range of outcomes, and part of the ethical deliberation involves considering the nature of the outcomes (risk versus benefit, short versus long term) and their relative distribution (researchers, participants, communities, society). The ethical deliberation should include a cultural lens, which elevates nature above humans or people and considers the impact on future generations, not the perceived benefits to current generations.

It is often in the transformation of the data (e.g. statistical analysis, mapping, narratives, etc/) that many unintended consequences of data sharing and data collaboration emerges. (Lynch et al., 2016). The best approach to managing data sharing partners expectations around data transformation and use of resulting information is to provide clarity at the time of data collection as to intended and potential future uses. For a data repository, it is also important the repository itself is clear about the range of studies or limitations on studies that the repository will support.

Expectations for ongoing feedback and communication with participants and Māori partners are key for research teams to demonstrate accountability. The best implementations of informed and prior consent, manage consent not just at the beginning of the data supply, but over time time and beyond the duration of the project. The assumption should be that identified risks at the outset of a sharing relationship will not fully realise all risks, and that as risks emerge, data sharing partners will address systemic risk as it occurs. The hardest type of harm to predict and mitigate is that which can result from future re-purposing of data. Data that appears innocuous in one context may potentially be very damaging when combined with other datasets. For mana whenua, this is particularly damaging where the legitimacy of traditional narrative is marginalized without an opportunity to establish a mana whenua perspective. Data-sharing partners should have explicit agreements on the parameters of re-purposing. Re-contact options may facilitate re-consent for

secondary use. Research organizations are accountable to the donors of data held in their systems, and must have regard to those donors about how their data and information is used.

Published research also requires special attention. If research is to be published, all involved parties should agree to the publication in advance, and ensure they have undertaken reasonable attempts to protect the data-subjects from liability and have obtained their informed consent.

Risk management does not alter rights or obligations, nor does it take away organizational accountability. On the contrary, it has proven a valuable tool for calibrating accountability, prioritizing action, raising and informing awareness about risks, and identifying appropriate mitigation measures.

Seek to match privacy and security safeguards with privacy and security expectations

Identifying privacy and security concerns and possible solutions early, will ease uncertainty and encourage parties to take part in a data-sharing effort. Data subjects hold a range of expectations about the privacy and security of their data. These expectations are often context-dependent.

Culturally sensitive data and information including mātauranga, whakapapa and cultural narrative, extra protection. This also applies to ecological data when sensitive habitats or endangered species locations are considered e.g. nest or refuge sites. The basic principle is that we must only collect, process, and store data that is really needed, identify the data fields that contain sensitive information, and explore the reasons for collecting and storing this information. If the data-breach risk is greater than the added value, then it is appropriate to stop collecting and storing this information. When sensitive data is collected, measures such as de-identification, anonymization, encryption, perturbation, aggregation should be implemented and monitored, and access control should be reviewed and redefined accordingly. For example, particular users from a specific BMA could access raw sensitive data associated to their own BMA but only being able to access broad, general, un-defined information on other BMAs or at a national scale. Establishing technical safeguards to protect any sensitive data from unintended recipients. These security processes typically include requirements that the data be stored on a password-protected computer with up-to-date software and regular password updates; that the data are stored on a confidential, encrypted disk; and that only users approved by the data provider may access the necessary files. More elaborate requirements may include two-factor authentication and separate terminals with no internet connection or USB ports. A distinction between encryption of the data as it exists on the servers of either the data-holders or data-receiver (at rest), and when data is being transferred (in transit). In particular, an audit log would be created that stores records when the data is accessed. These measures serve to demonstrate that the protection of sensitive data is a serious concern and tracking and tracing data will be useful if a data leak occurs and the organization needs evidence in their investigation.

Besides privacy protections and security, there is also a need to ensure that people are protected and not harmed, through both the use of primary and secondary data. All datasets and accompanying information carry a history of human decision-making. This history should be auditable. This should include mechanisms for tracking the context of collection, methods of consent, chains of responsibility, and assessments of data quality and accuracy. It also necessitates that the data and information repository keeps an exquisite record of provenance such that the data they are collecting can be accurately and adequately cited. Lack of traceability where data originated from, sharing arrangements and auditability were identified as key issues for Māori partners. New technology-based strategies such as blockchain can assure users that their data is protected not on the basis of where it is stored, but by the mechanisms that encrypt data,

record, and provide proof that exchanges have occurred (Brodersen et al., 2016). A blockchain-based provenance system for surveillance data could prevent against data manipulation by providing a complete, transparent audit trail of all data that is collected, processed, and accessed. Any modifications made to the data would require at least 51% consensus from stakeholders and would be visible to everyone — ensuring high data quality and legitimacy and prevents individuals from acting dishonestly.

Creative commons licensing (https://creativecommons.org/choose/) could be useful or inspirational when thinking of how to licence your work using normal language. It may help when trying to clarify and promote data sharing. It would be challenging to navigate, the data variation if every time data is collected the terms of reference for the data slightly varies. Which bits of data can and can't be used? There might be slightly different language used and different permissions, which would be complicated, especially if written in standard legal, contractual terms. To encourage data use, a relatively simple framework is required. For example, a tiered access system could be used to allow different combinations of rules. Data sharing could be conditional; a framework within a unified scheme could be developed, to allow people to choose the relevant conditions for parties, and for future users to answer data sharing questions easily, using common language and wording and structure. The 'trigger questions' could include inquiries such as; Can I pass the data on? Can I edit the data? Does the data need acknowledgment? Can the data be commercialized? If you use the data for something else, e.g. further analysis queries would be generated. These include supplementary queries such as; do you have to share this with the contributor or the repository? Conditions and parameters for data sharing would be simple to understand, and different groups can specify different levels of access. If this was more localized then the system and protocols could be aligned as easily. Legal-language contracts can lose the human element, these agreements would also be more about ethics, common values, and morals.

Governance practices should be robust, known to all team members and regularly reviewed

According to workshop participants building a framework for data-sharing governance for plant pathogens is informed by four key main elements: establishing governance processes (principles), establishing data sovereignty and custody (guardianship), securing and maintaining legal/regulatory agreements, and addressing the economic and organizational barriers to sustainability.

Participants generally agree that having access to copies of the data would be a better solution nstead of hosting and centralising it in one institute, and therefore trusting that one institute with the acquisition, storage, aggregation, analysis, use, share and maintenance of the data. In this way there isn't a large central organization, just a system through which people can contribute data in a federated way. One potential model from which we may be able to borrow certain aspects is the Global Biodiversity Information Facility (GBIF) (https://www.gbif.org/). A federated database system or integrated data system, i.e. that links individual-level administrative species records from multiple sources. It also holds many Aotearoa New Zealand data and operates under limited custodianship.

It was suggested that a new organization – a non-government organization (NGO), data company, non-political entity or charity – could manage and administer a federated database / repository because it might garner more support than any existing one. Interested parties can form a collective and push their data into the repository, and the central NGO facilitates that process, with each group holding their own data and choosing what they provide – the decision to share could also be reversed. The collective is united by a charter (Terms of reference) that outlines common

sets of values and motivations, sets specific goals for the partnership and considers how various barriers to sustainability (ex. funding, resourcing, hosting) can be overcome. This would need to be a collaborative effort as it is a huge undertaking. Mana whenua informing shared partnerships as part of this would be a better fit and receive more support from a wider community. This organisation could borrow systems ideas from GBIF, iNaturalist, etc, as needed.

A governance board could be established with representatives from contributing parties (Iwi/hapu, CRI, MPI, etc.) and interested parties, overseeing the operations of a data partnership (people, policies, procedures, and technologies); in accordance with a charter and/or contractual agreement that supervise how data and information is collected, organized, protected, shared and maintained. The board would put into practice a governance framework that defines the roles and responsibilities of each of the parties, funding and decision-making mechanisms, the period of time the collective will exist and the process of entering and leaving the collective. Priorities should include comprehensive policy and practice actions that create an enabling environment for Māori engagement in surveillance research with targeted actions that remove barriers and encourage equitable engagement. For example,

1. Data, information and narrative which recognises provenance would be linked to a BMA, recognising data provenance, and 'sovereignty' of data/information. By elevating the whenua (naturescape) into the system, mana whenua linked to the BMA are also elevated and have equitable access to information and data, including control and access rights in data, information and records. Linking information and data to the BMA also enables a foundation for the development of cultural authority arrangements and the recognition of data, information and intelligence sovereignty.

2. Through consent to access certain raw dataset for the benefit of the research community could be negotiated with designated kaitiaki and rangatira, with the intent to collaborate and facilitate respectful relationships.

3. Sharing agreements could require a comprehensive dissemination plan that specifies how researchers will provide information back to communities / data subjects during the project period and following completion of the research, including resources for community meetings and travel to research and dissemination hui for Mātauranga Māori authorities (experts) and researchers.

Some of the reasons that data-sharing collectives have traditionally failed to be sustainable is a lack of flexibility, weak goal alignment between stakeholders, an underdeveloped theory of change that fails to map measurable goals and impact metrics, and a poor sense of the resources organizations have to spare. There should be formalized mechanisms for evaluation and iterative improvement of the platform using impact metrics. Ethical principles, connected to specific actions, are to be enumerated and into both the implementation and review processes. The organization curating the data will need long term funding and absolute funding security. Without committed funding, there will be a lack of confidence in the organisation to fulfill its role. It is unlikely that an organization dependent on short cyclic and uncertain funding, whether it's government or otherwise, will be able to generate confidence and demonstrate security and legitimacy .Kauri dieback and myrtle rust response throughout the last decade provide examples of how lack of commitment to high integrity processes and secure committed funding, affects information and data systems, integrity and confidence. This poses challenges to those agencies, communities, scientists and mana/tangata whenua strongly motivated to work together to find solutions that address plant pathogens and diseases impacting our native bioheritage. Conversations will continue to consider how the protection and curation of data and information can be managed and facilitated.

Reinforce, update and share good data collection practices – open by design, not default.

From an operational perspective, the data collection process can be improved with time. This might include collecting better metadata and documentation, refining and harmonizing data structures, and improving data and security standards to ensure the quality, accuracy and usability of data.

An essential goal of data repository is to facilitate the discovery and access of the available resources. Such process heavily relies on the quality of metadata. While multiple metadata standards have been established, data contributors often use different standards guided by a specific discipline or organization (metadata heterogeneity), as well as various terms and topics to describe similar datasets (semantic heterogeneity). With respect to metadata heterogeneity, it is possible to define/provide a common set of terminology and definitions for the documentation of digital metadata; including mandatory, extended and new elements to capture more specific information. With respect to semantic heterogeneity, it is possible to harmonize a series of key data themes or attributes needed for collaborative planning and management of plant pathogens and diseases in Aotearoa, New Zealand. There are currently no harmonization schemes or organizational models available, providing an opportunity to create and innovate a new model. Clarity of a dataset metadata can be just as important as clarity in the data itself. Structured data dictionaries that specify and define all available fields in the data are particularly important, and will include, format, provenance and chain of custody. This metadata can also include other information that relates to the construction of the dataset, such as data collection methods, sample sizes, and other pertinent information about the dataset's population, bias and narratives.

Collecting the same information from both infected and uninfected plants and across data contributors will mean that in the future, data from different groups will be comparable. This will provide a better understanding of the impact and severity of plant pathogens across regions and nationally. Ultimately data contributors should develop consensus on data collection standards and access protocols to support the collection, curation, storage, analysis, sharing and management of plant disease data. These data standards should be framed as minimum data standards, with data contributors permitted to include as many additional questions on these topics as desired as long as the minimum standard is included. While long term surveillance currently enables trained observers to undertake monitoring of myrtle rust to track its impact on trees and eco-systems over time, ensuring that the right kind of information is consistently being collected between different user groups, we have not had the same success in developing a similar technical agenda on dieback. In addition, very few initiatives have sought alignment, integrated or supported indigenous knowledge, approaches and systems.

In the fight against kauri dieback and myrtle rust, mana/tangata whenua have been seeking solutions that call on their intimacy with host environments, the application of their knowledge systems and understandings of the physical and meta-physical elements of the universe. This includes solutions embedded in the spiritual dimensions of this knowledge, that are vital to the protection and enhancement of their natural environment, often marginalized or ignored by conventional environmental management practices and the Western science knowledge that underpins its decision-making. Utilizing mana whenua relationship with their natural environment and their intergenerational observations of changes in seasons and related environments, mana whenua derived tohu (signals) can indicate presence/absence of a plant pathogens and illness/wellness of taonga and ecosystem resilience and health, elevating maturanga within the surveillance and science system.

Most data repositories followed more or less the same procedure for sharing data: first the data are encrypted and sent to a central repository to be analyzed for obvious red flags related to quality that could indicate invalid elements or errors. If any of these red flags are found, the concern is

relayed to the original (primary) data-holder. Multi-stakeholder working groups may be convened to address these concerns and provide a context for understanding the data. A data dictionary is developed or updated to help understand the data. The data are then cleaned, verified, and linked together. The FAIR principles[3] (Findable - data and supplementary materials have sufficiently rich metadata and are unique and persistent identifier, Accessible, Interoperable, Reusable) and CARE (Collective Benefit, Authority to ontrol, Responsability and Ethics)[4] principles for indigenous data governance are useful frameworks for thinking about sharing data in a way that will assist discovery and reuse[5](Wilkinson et al., 2016), reflecting the crucial role of data in advancing Indigenous innovation and self-determination. Participants expressed these principles throughout the workshop.

Aspire to design practices that incorporate transparency, configurability, accountability, and auditability.

Workshop participants agreed that sharing agreements and standardized processes should be used as launching points to motivate and frame discussion about ethics and thoughtful self-governance instead of being an end in and of themselves. These agreements are necessary, but must be dynamic and constantly improved. Different elements inform a strategic trust relationship. In some cases, people share core values and interests or are committed to a common cause. Participants agreed that relational trust can be built on transparent and consistent rules, and iteration of consent agreements as partners continue to explore value and risks of sharing data.

There is cognizance that building trust requires transparency and auditability, along with recourse and responsiveness when failures occur. Particularly as a data repository matures, data use and reuse may operate in gray areas without much – if any – precedent. Where there is no existing precedent, transparent and consistent decision-making processes are the best buffer against risk and emergent issues and a way to reinforce trust. Fundamentally, good governance arrangements increase participation, strengthen accountability mechanisms and open channels of communication within, and across, data sharing partners. In this way, data sharing partners can be more confident about delivering defined outcomes and being accountable for the way in which results are achieved, especially when trust is lacking and scientific knowledge is not equitably accessible:

Workshop participants agreed that technical challenges to data sharing may be more easily addressed than cultural considerations and low confidence in data sharing. These are significant barriers and will consider how we are change attitudes. We recognise that critical social science would be key in future developments, and an advantage to make linkages to NRT Theme: Mobilising for Action should be formed. Sharing access, sharing knowing, is a step change, and strategic inclusion: mana whenua, CRIs, universities, government, etc. through a social science lens will be of benefit, and help people to shift their way of thinking around working together at multiple levels. Social science would allow us to explore and consider these morals, values, and ethics.

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[3]   https://www.force11.org/group/fairgroup/fairprinciples

[4]   https://www.gida-global.org/care

[5]   https://howtofair.dk/how-to-fair/

Discussion

'Surveillance' has repeatedly emerged as a critical research priority in the management of of plant pathogens and diseases, specifically (but not limited to) those pathogens that cause kauri dieback and myrtle rust disease. To date, data on the presence/absence, severity of these diseases, host characteristics, etc. has been collected by many different organizations using a range of methodologies. But up-to-date data visibility, access and sharing has not yet achieved its full potential (Allen et al., 2018; Bradshaw et al., 2020), and very few initiatives have integrated or supported indigenous knowledge, approaches and systems (Lambert et al., 2018).

Incontestably, data and information sharing offer new opportunities to the surveillance of plant pathogens and diseases, such as increased situational awareness at the local/regional/national scale, better surveillance and management with integrity and continuity of work across space and time, improved communication around decision and pathways taken to reach these decisions. As stated at the outset, good data management and sharing is not a goal in and of itself, but rather a pre-condition supporting knowledge discovery and innovation (Wilkinson et al., 2016). However, given the diversity and complexity of the surveillance data ecosystem (technical, cultural, ethical, organizational and legal barriers to data sharing), the potential of surveillance data and information sharing can only be harnessed if all parties involved in a surveillance effort collectively take responsibility to avoid secondary crises caused by irresponsible data collection, storage, use and reuse. Integrating data responsibility into surveillance operation efforts will require a change in organizational culture, attitudes and practices.

A starting point for a responsible data approach will be by adopting minimum core standards and characteristics of responsible and ethical data collection, storage and use, in particular by providing ground up strategies to reshape the Te Tiriti giving effect to the relationship in which hapu/iwi are exercise their role as kaitiaki of their taonga (Stewart-Harawira, 2005; Taiuru, 2020). Importantly, participants in the surveillance data ecosystem will need to look beyond their own organization to ensure that their broader environment is adhering to the principles and practices of surveillance data responsibility. Workshop participants suggested that interested parties could form a new collective united by a charter that outlines a common set of values and motivations, sets specific goals for the partnership and considers how various barriers to sustainability (ex. funding, resourcing, hosting) can be overcome. It is envisioned that participating parties push their data into a federate repository, but each group holds their own data and chooses what they elevate into open-source – the decision to share could also be reversed. There are multiple potential solutions that warrant investigation. From here we should outline and explore different scenarios. Foundational discussions would consider, who would hold the data (a government agency or an NGO), consider associated costs and trade-offs, consider the introduction and adoption of processes that encourage cultural license and scenario timeframes.

The development of standards and characteristics of responsible data collection, use and reuse should be seen as a creative space where there is potential for Māori to (re)imagine relations and practices that realize Māori aspirations for data sovereignty (Kukutai & Taylor, 2016; McKemmish et al., 2019; Taiuru, 2020). In particular, the MMFS details the rules by which the provenance of Māori data should be described and recorded. This recommended practice outlines the core parameters for providing and digitally embedding provenance information for Māori data. The recommended practice will establish common descriptors and controlled vocabulary for provenance, including recommendations for metadata fields that can be used across industry sectors. This recommended practice supports proper and appropriate disclosure of originating data information and long-term identification of Māori data for future use, connecting data to people and place, and when appropriate, supporting future benefit sharing options.

Responsible information and data sharing presents an opportunity to decolonize the discipline's ongoing trend of knowledge extraction by challenging our notions of collection, ownership, management, and secondary use of surveillance data; and of the processes surrounding access to data stored in existing repositories (Beaton et al., 2017). Building and maintaining trust, meaningful relationship and effective consultation channels is considered to be at the heart of making data-sharing efforts happen and necessary step for developing ethical sharing agreements (James et al., 2014). Though these consultation channels, Māori partners can express their concerns, which are informed by historical harms associated with past research and policy experiences. Kaitiaki and rangatira can ensure responsible research practices, and impose post-research obligations, where necessary to ensure compliance with the original sharing agreement. As Māori partners prepare for such engagement, several resources are now available to support different parties in regulating research, and negotiating sharing and codes of ethics related to intellectual property rights. Developing data sharing strategies and agreements may be an appropriate step to achieve this objective, but procedures to do so must take into account tribal sovereignty, cultural authority and accountability. Mana whenua may use a range of mechanisms to ensure appropriate oversight of research – e.g., research review committees, review of draft manuscripts, dissemination plan that specifies how researchers will provide information back to mana whenua authorities and ensure mana whenua authorities are involved in the review process for any secondary research uses, etc. The key elements are transparency and confidence in the data-sharing obligations and options, and the opportunity for māna whenua authorities to review and approve research involving Māori centric data. It will be necessary to establish a culture in which Māori laws, traditions and cultural interests are given deference, and an ethic of respectful negotiation is used to recognise the rights of mana whenua and the interests of the research community in promoting forms of knowledge that assure greater outcomes.

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Appendix 1 - Program

Mātauranga Māori framework ***Data and informationcustody Workshop*** ***Teleconference*** 09/03/2020

	Location: Pukeko Room, Jet Park Hotel, 63 Westney Rd, Mangere Auckland

	Agenda
	
	9.30am – 11.00am
	    1. Karakia, whakatau
	    1. An introduction to the Matauranga Māori Framework for Surveillance (for plant pathogens)
	    2. Distinction between data sovereignty and data custody
	    3. Data Custody – case studies
	
	11.00am - 12.30pm
	    4. Workshop 1
	        a. What opportunities are there in shared data?
	        b. What would be the challenges for sharing data?
	        c. Recognising that we have challenges with the custody of data, what are the solutions that enable us to protect, share and use data?. Also, consider where there are n current solutions.
	
	12.30am – 1.30pm Lunch (Break)
	
	1.30pm – 3.00pm
	    5. Workshop 2
	        a. What are the opportunities of centralising surveillance information and data?
	        b. What would be the challenges of centralising information and data?
	        c. Recognising the challenges that come from central information and data, what are potential solutions, and what issues or challenges cannot be resolved ?
	
	3.00pm – 3.45pm
	    6. Next steps
	    7. Karakia

Appendix 2 - List of participants and introduction to the workshop facilitator

Participants (alphabetic order)

Audrey Lustig – Manaaki Whenua Landcare Research
Beccy Ganley – Plant and Food Research
Dave Milner – Perception Planning Limited
Dean Anderson – Manaaki Whenua Landcare Research
Fiona Thomson – Department of Conservation
Ian Horner – Plant and Food Research
James Read – Department of Conservation
John Kean – AgResearch
Jo Peace – Manaaki Whenua Landcare Research
Kevin Collins – Collins Consulting
Lindi Eloff – Department of Conservation
Mahajabeen Padamsee – Manaaki Whenua Landcare Research
Marie McEntee – University of Auckland
Nari Williams – Plant and Food Research
Rebecca Campbell – Plant and Food Research
Rebecca Murrie – Kauri rescue
Rob Beresford – Plant and Food Research
Tom Etherington – Manaaki Whenua Landcare Research
Tracey Godfery – Integrated Surveillance, Working Group
Travis Ashcroft – Ministry for Primary Industry
Waitangi Wood – Wai Communications Ltd

Apologies

Carlton Bidois
James McCarthy – Manaaki Whenua Landcare Research
Kathin Webb – Department of Conservation
Andrew Sanders – Ministry for Primary Industry
Jack Craw – Auckland Regional Council
Maureen O'Callaghan – Leadership Group of the NZ's Biological heritage Challange
Nick Waipara – Leadership Group of the NZ's Biological heritage Challange
Tara Strand – Scion
Aaron Wilton – Manaaki Whenua Landcare Research

Workshop facilitator: Steven (Tipene) Wilson – Maximize Consultancy Limited

Maximize Consultancy Limited

Maximize Consultancy Limited has a focus on maximising opportunity, creating value and building relationships in Māori organisations and in the ability of Corporate and Government organisations to work productively with Māori. Its Chief Executive Officer, Steven Wilson, has extensive experience across a wide range of fields. Steven has a Bachelor of Sciences and is also finalising a dissertation on Governance Models in Māori organisations to complete a Masters in Business Administration from the University of Waikato. Steven has experience in a national management role, his own business, and sales and marketing and is well used to applying current business thinking and theory to market place realities.

Recently these transferable skills have been applied in Māori organisations to support them in achieving innovative, sustainable results, and as part of the Senior Management Team of a non-Māori NGO. Steven is also skilled at working with Corporate and Government organisations so they can form positive relationships with Māori. Fluency in Māori and English serve well in facilitation and dispute resolution roles. Project planning, project management, strategic planning, critical analytical thinking and successful applications for funding are other areas of strength.

Attendees at different wananga that Steven facilitated noted that he was " very sensitive to the communication needs of the people whilst enabling all information to be imparted within the tight timeframes" , and that " he set the scene holistically which lay a foundation for enlightening and productive hui; diplomatic and efficient; clarified issues in both English and Māori." Still another noted that it was " the most relaxed, comfortable and confident I

have ever felt in any Māori training sessions anywhere" "Feedback received from participants indicated that they had a better understanding of the Treaty of Waitangi and learned a great deal from the session. They also highlighted that Steven was an excellent facilitator who was coherent, confident and provided an excellent style of delivery." (Te Putara, Oct 2009, http://www.ermanz.govt.nz/resources/periodicals.html#Te_Putara)

Steven has been involved in the successful development, teaching and roll out of reo, tikanga and Treaty of Waitangi programmes for a Crown Entity.

Steven was the inaugural chair of the Ngāti Tura Te Ngaākau Hapu Trust in Te Arawa and has been chair of Parawai Marae. He is also the inaugural Treasurer of the Ngāti Koroki Kahukura Trust in Waikato/Raukawa and the former secretary of Pōhara Marae. He is currently undertaking projects for his marae and hapu.

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