KAURI CULTURAL HEALTH INDICATORS – MONITORING FRAMEWORK

REPORT

Prepared for the Kauri Dieback Joint Agency Response, Tangata Whenua Roopu

Writers: Juliane Chetham and Tui Shortland, Repo Consultancy Ltd.

Reviewers: Dr Nick Waipara (Auckland Council)

November 2013

HEI MIHI/ ACKNOWLEDGEMENTS

This Methodology Framework is the embodiment of several years of work by the Tangata Whenua Roopu. Many members have contributed their shared learnings and experiences to produce this document.

Special thanks go to Waitangi Wood, Nick Waipara, Tohe Ashby, Kevin Prime, and Hori Parata for their valuable advice, material and guidance.

Table of Contents

EXECUTIVE SUMMARY 4

1. OVERVIEW 5

1.1 Purpose 5
1.2 Introduction 5
1.3 Methodology 6

2 CULTURAL INDICATOR MONITORING FRAMEWORK FOR KAURI NGAHERE 7

2.1 Background 7
2.2 Monitoring Framework Step by Step 8
2.2.1 Step 1: Mana Whenua Community Engagement 8
2.2.2 Step 2: Site Selection 8
2.2.3 Step 3: Stakeholder Engagement 9
2.2.4 Step 4: Assemble Technical and Monitoring Team 9
2.2.5 Step 5: Wananga to Customize Monitoring Framework 10
a) Atua Domains 10
b) Key Values - Tohu/Assessment Elements 13
c) Overall Kauri Ngahere Health Measure – Mauri 14
d) Designing the Sampling System 15
e) Monitoring Frequency/Programme 18
2.2.6 Step 6: Ground Preparation and Organisation of the Team 19
2.3 Step 7: First Fieldwork Period 22
2.3.1 Tikanga and Wairuatanga Protocols 22
2.3.2 Actual Field Work 23
2.4 Step 8: Second Wananga 23
2.5 Step 9: Second Fieldwork Period 24
2.6 Step 10: Third Wananga – Reporting and Evaluation 24

3. CONCLUSIONS 25

4. REFERENCES 27

Appendix 1: Site Record Form/ Mobile Data Collection Application 29

Appendix 2: Species List 30

Appendix 3: Literature/Information Review 31

Appendix 4: Summary Report 54

Appendix 5: Literature/Information Review 66

EXECUTIVE SUMMARY

The Tangata Whenua Roopu (TWR) has been part of the Kauri Dieback Programme since 2009. The TWR have championed the design of a framework to enable the use of cultural indicators in the surveillance and monitoring of Kauri Dieback (KCI) for some time. Mana whenua consider that health of kauri cannot be ascertained by looking at kauri alone, rather a “ngahere”, or kauri ecosystem approach should be taken. This effectively signified that indicators for kauri health must be derived from coexisting species within the forest in addition to kauri.

In conjunction with the initial 2011 report on KCI, a literature review, Matauranga Maori Hui, TWR workshop and field trip and a peer review undertaken by kaumatua and scientists aligned to the programme have informed this methodology framework.

Overarching values Whakapapa and Ngahere/ Tane Mahuta provide the parameters for the framework by demonstrating the holistic kauri ecosystem approach and informing the grouping of species indicators as follows:

- Minor flora,
- Trees,
- Insects
- Birds

The framework is based on nga atua domains and other key attributes including:

- Tinana oranga - bodily health & integrity
- Tawhirimatea – air needed & acquired
- Tamanuitera – light needed & acquired
- Tangaroa – moisture need & acquired
- Whanaungatanga – life stage and abundance (seeds, mature plants, flowering, etc)
- Tumatauenga – Human influence at the site

Given the variance across the kauri catchment in understandings and articulation of these terms and local ecological conditions the framework is flexible and can be customized across mana whenua groups. The framework incorporates tikanga and wairuatanga protocols into the fieldwork and provides for an overall measure of the mauri of ngahere health. A site record form and mobile data collection app template have been developed to populate with the indicators and attributes selected by mana whenua to enable data collection in the field.

The methodology involves a step by step process outlining options and recommendations for community engagement, site selection, team selection, an initial wananga to customize the framework and confirm sampling strategy, monitoring frequency, logistics, equipment and training requirements, fieldwork and data collection, data analysis and suggestions around reporting and evaluation.

Whilst the KCI methodology framework was corroborated and very well received at both the Matauranga Maori hui and TWR workshop, it became evident that supervision, guidance and training would be required at several stages in the process. We recommend that the TWR explore establishing a team to carry out such a supervisory role.

1. OVERVIEW

1.1 Purpose

This work sets out to develop a culturally based monitoring methodology framework for Kauri Ngahere (Forest) Health (hereafter referred to as the KCI Methodology, Framework or Project). The overarching purpose of the monitoring framework for kauri health has been summed up by kaumatua as, “whangaia te mauri/hau o te kauri”. This can be loosely translated as to nurture, feed or nourish the mauri (“life-force”) or hau ora’ (‘the breath of life)’ of Kauri as a reciprocal circle relationship that tangata whenua have with the forest. Key applications of the methodology will be to determine whether there are Cultural Health Indicators (that are measurable, repeatable and duplicable [quantitative or qualitative]) that can:

- Determine the state of health of kauri forests in different parts of the kauri catchment
- Anticipate or predict the presence of PTA; and
- Indicate resilient kauri trees or forests that resist the impact of or susceptibility to PTA.

1.2 Introduction

Kauri Dieback was formally identified in 2008 following a study undertaken by Landcare Research after many dying trees were observed in the Waitakere Ranges. Research shows that the water and soil borne pathogen Phytophthora taxon Agathis (PTA) has been present in Aotearoa New Zealand for at least 40 years but due to incorrect identification in the 1970’s the true threat was not recognised and investigated until recently. The disease effects all lifestages of tree causing bleeding lesions at the base of the tree, defoliation, yellowing, fanning, dead branches and “stag heads”. A significant number of infected sites are spread throughout the Northland and Auckland regions, particularly Waitakere, Trounson Park, Waipoua Forest and Aotea Great Barrier Island. A Kauri Dieback Programme comprised of representatives from the Department of Conservation, the Ministry of Agriculture and Forestry Biosecurity New Zealand, Northland Regional Council, Environment Bay of Plenty, Auckland Regional Council, Environment Waikato and a Tangata Whenua Roopu (TWR) has been in place since 2009.

Since very early on in the development of the TWR work plan, the design of a framework to enable the use of cultural indicators in the surveillance and monitoring of Kauri Dieback has been a research priority. Tangata whenua assert that the use of cultural indicators to complement scientific methodologies is desired in the assessment of kauri health and building resilience to disease. Repo Consultancy produced the report “Cultural Indicators for Kauri Ngahere” in 2011 as the initial phase of this work (hereafter referred to as “KCI Report Phase 1”). This work involved a literature review of national and international examples of cultural indicator research, followed by an extensive interview process with a number of cultural experts in which a robust set of values and indicators for kauri were identified.

An important conclusion reached from discussions with tohunga/kaumatua was that health of kauri cannot be ascertained by looking at kauri alone, rather a “ngahere”, or kauri ecosystem approach should be taken. This effectively signified that indicators for kauri health must be derived from coexisting species within the forest in addition to kauri. The progression of this work is a logical step for mana whenua who have existing and built capacity in this area and have been active in surveillance monitoring and advocacy in regard to Kauri Dieback.

Tangata Whenua recognise that to overcome this affliction facing our taonga, a long- term holistic approach must be taken. The development of a methodology tool or framework based on cultural indicators will provide significant opportunities for potentially inexpensive field techniques and transferral of practice and knowledge that will allow mana whenua to express their kaitiakitanga in a real and tangible way. It is consistent with the overall outcome sought from becoming engaged in protecting kauri from PTA as stated in the Partnership Charter:

"To maintain and enhance the mauri and health of kauri to ensure its special place for all New Zealanders now and into the future".

As far as we are aware this project is one of only two in development in Aotearoa where culturally based monitoring is being utilized in native forests.

1.3 Methodology

The project has entailed the following steps:

a) An information/literature review of the initial Phase 1 KCI report and other cultural indicator work of relevance both in an international and national context, and a brief examination of the ecological science work around Kauri Dieback to set the context for a multiple evidence based approach and establish whether opportunities exist for research and monitoring collaboration in future field work.

b) Engagement to assist in the development and refinement of framework design, involving;
   - A Matauranga Maori hui – with TWR members, Kaumatua/kauri experts and the members of the science fraternity to provide guidance on the framework and indicator selection, along with establishing areas of collaboration and potential gaps in research.
   - A Focussed workshop with mana whenua/TWR members who are currently engaged in the project to provide instruction on how to utilise the framework including an initial field test.

c) Framework Design including the following:
   - Devising an overall framework based on Matauranga Maori (Atua Domains and Key values) in which to express the indicators.
   - Selection of preliminary suite of indicators to populate the framework and test, utilising the list formulated in the initial KCI report and incorporating additional indicators arising from the information review and Matauranga Maori hui processes.
   - A review of contemporary forest monitoring models in New Zealand for comparative purposes. These include; The Forest Monitoring and Assessment Kit (FORMAK), The National Vegetation Survey (NVS) and Reconnaissance (Recce) Sheets, and Helmut Janssen's "Bush Vitality – A Visual Assessment Kit".
   - Design of a site record form and mobile data collection application – including health assessment methods
   - Discussion on a process for the monitoring team selection

- Discussion on a process for site selection
- Recommendations on the proposed frequency of data collection
- Recommendations on data analysis and data management and storage
- Discussion on proposed review and evaluation measures

d) Feedback derived from a Tangata Whenua Roopu Wananga and Field workshop.
e) Peer review. A review of this report has been undertaken by kaumatua along with experienced kaitiaki and scientists aligned to the Kauri Dieback Programme.

2 CULTURAL INDICATOR MONITORING FRAMEWORK FOR KAURI NGAHERE

2.1 Background

While New Zealand has a long history of monitoring forest ecology, the methodologies utilised have not been informed by traditional knowledge. Over the last few decades national and international obligations to document change in forests have driven the desire to implement standardized techniques across government agencies and research institutions. Permanently marked 20 x 20 m (400 m2) plots have emerged as the standard plot size and are currently the most widely applied of all vegetation plot methodologies used in New Zealand and elsewhere[1]. This data is collected and stored in the National Vegetation Survey (NVS) databank managed by Landcare Research and forms a standard operating procedure for Department of Conservation data collection in regards to indigenous forests. Such methods, however, can be time consuming and expensive and require a high degree of technical skill along with specialist equipment. These methodologies also appear to be strongly focused on vegetation with limited attention to fauna and other potential influences on ecosystem health and typically require objective, quantitative monitoring.

Other less complex methodologies have been developed, aimed at use by land owners and community groups that focus on visual assessment tools (Janssen, 2004., FORMAK, 2000). These assessment methods are generally designed to gather information to assist with restoration of bush remnants and align more closely to matauranga maori objectives, employing more holistic, subjective qualitative monitoring. Whilst the KCI methodology framework is structured around cultural values, there are aspects of both of the above types of methodologies that can be drawn upon by mana whenua when monitoring in the field. Some components of the various elements to be assessed are similar or consistent with criteria or terminology utilized in the Janssen and FORMAK models while the NVS/Recce system has options for site selection and sampling design that are outlined in section 2.6 of this report.

Following a rigorous process of interviews with kaumatua and kauri experts during the KCI Project (Phase 1) (Shortland, 2011) and cemented by further discussions at the Matauranga Maori Hui

[1] See http://www.doc.govt.nz/Documents/science-and-technical/inventory-monitoring/im-toolbox-20-x-20-forest-plots.pdf

held in September 2013, a framework structured around indicator species and cultural elements such as atua domains and other key values was developed. The framework serves as a guide for collection and analysis of monitoring data and information for kauri ngahere. The use of Atua frameworks in contemporary Maori environmental management is well entrenched (eg. Nga Tirairaka o Ngati Hine, Nga Ture Mo Te Taiao and the Taumarere Catchment Plan and Ngatiwai Iwi Environmental Policy Document). They allow the various elements of our environment to be observed, for example, Tane Mahuta includes all forest ecology (trees, birds, insects etc) and sub domains therein, Tangaroa includes aspects relating to water, Tawhirimatea – air and wind, and Tumatauenga – enables us to record and measure human-induced impacts or use in forests. The framework's various components, including indicator species and elements against which they are to be assessed are discussed in greater detail in section 2.5 below.

It is important to note that across the Kauri catchment subtle variations in descriptions, names and meanings of the various atua domains, indicators and elements exist. The terminology used in this report is predominantly based on korero from Ngati Hine and some other Tai Tokerau hapu and iwi who contributed during phase 1 of the project and at the Matauranga Maori hui. In the TWR workshop several other interpretations were put forward from Hauraki representatives for certain atua and values. A key feature of this framework is its flexibility to be adapted and customized according to the specific traditions, tikanga and local ecological circumstances of each mana whenua group that use it.

2.2 Monitoring Framework Step by Step

2.2.1 Step 1: Mana Whenua Community Engagement

Engagement involves project leaders and iwi/hapu authorities confirming with mana whenua monitors the objectives, importance of the monitoring project and the methodology to be employed such as following the steps outlined from this section to section 2.9. This is also a chance for parties to identify other participants such as local schools, landowners, etc.

2.2.2 Step 2: Site Selection

For the purposes of this report when we refer to a site it is the area of ngahere that mana whenua wish to ascertain the health status of. There will be a variety of sizes, from potentially small bush remnants through to large blocks across differing types of terrain.

Mana whenua should choose sites they have a good understanding of including the types of vegetation and animals generally found there; the management history of the site, for example have they been used for contemporary or traditional cultural purposes; have they been cleared in the past; has pest management been undertaken and so on.

This will allow mana whenua to get a sense of whether the health of the site is improving or in decline once they have undertaken the initial assessment and they will then be able to measure that trend or changes in that trend as a result of over time.

It is recommended that the mana whenua group compile some background material outlining the above as a part of their kauri ngahere health assessment and management file.

2.2.3 Step 3: Stakeholder Engagement

The project leaders confirm participation and/ or support of the Ministry for Primary Industries, regional council, the Department of Conservation and other stakeholders.

2.2.4 Step 4: Assemble Technical and Monitoring Team

Skills:

Forest monitoring models reviewed (such NVS/RECCE) stipulate that monitors should have sound ecological and technical knowledge to be able to carry out forest assessments. An advantage mana whenua have is an intimate knowledge of their whenua, ngahere and other important sites based on matauranga maori, kaitiakitanga and their regular use of these sites for other purposes. This existing capacity has been enhanced in many instances, as a number of mana whenua groups have also had varying degrees of involvement in kauri dieback surveillance. Several already have other monitoring projects underway within their rohe, for example catchment management monitoring and mapping of sites of significance. Nevertheless, teams should contain at least one member who has a robust knowledge of forest ecosystems and can identify the majority of plant and animal species and has had prior experience with monitoring. A sound grounding in matauranga maori is also appropriate. Earlier cultural monitoring work (Tipa & Tierney, 2003, Chetham & Shortland, 2010) has stressed the importance of ensuring kaitiaki have adequate capacity to deliver for monitoring regimes to be effective. Appropriate resourcing, training and support will also be required to ensure success. The decision needs to be made whether GIS will be utilized, in which case team member/s with appropriate skills will be required. Each team will require a team lead or coordinator/project manager to manage the logistics of the monitoring, particularly during the data analysis phase. The remainder of the monitoring team should also be confirmed at this time.

Number:

There is no magic number that makes up an ideal team size. The NVS/RECCE model suggests a minimum of 4 is required to get a fixed plot assessment done, while FORMAK/Janssen designs could be carried out by an individual, although this method involves less counts and less tohu elements to measure. The amount of work required would be nearer to that of a permanent plot assessment (NVS/RECCE) so 4 might be a more appropriate number.

In our view, teams would require a minimum of two as it is important to be able to korero about what you are seeing and hearing in the ngahere. In CHI studies of freshwater sites in the south island, Tipa (2003) advocated for monitoring teams to contain a spread of tribal members – Kaumatua, Pakeke and Rangatahi, because of the different types of knowledge they could bring (eg. kaumatua would have historical knowledge of the site and it would be a learning experience for the younger ones, as well as them potentially having a different perspective). Other coastal and freshwater projects in Tai Tokerau involved whole whanau right down to young tamariki being involved in the surveys (Chetham & Shortland, 2010) while some actively encourage their kura to get involved in monitoring (Shortland pers comm., 2013). Such monitoring represents an opportunity to educate our young and express our kaitiakitanga. It will be important however, to consider issues around logistics, practicality, funding and equipment constraints.

Mana whenua will also have to weigh up the risks to kauri ngahere of having large numbers in the bush because of potential damage to the understorey and increased risk of spreading PTA.

We recommend that to start with, mana whenua assemble teams of 2-5 that includes at least one ngahere expert.

2.2.5 Step 5: Wananga to Customize Monitoring Framework

It is envisaged that a wananga would take place where mana whenua refine and populate the framework with the tohu and values they wish to measure. Atua domains, species indicators and values can also be modified to suit local dialects, traditions and ecological conditions. Mana whenua need to be able to articulate what the purpose of their research is, what is of utmost importance or less importance, what the focus will be and so forth in order to aid this process. Following recent experience in developing cultural indicator monitoring frameworks with indigenous peoples to utilise in their forests in South East Asia with the Forest Peoples Programme and the workshop with the TWR, we anticipate that this wananga will need to take place over several days to customize and refine the framework to suit. Designing the sampling strategy is also complex and takes time. TWR representatives at the workshop indicated whanau on the ground would likely require guidance through this process. We recommend the TWR consider forming a team to provide this role. Generally, the wananga needs to cover the following:

- Orientation on the project; explanation of cultural monitoring;

- Data-gathering strategies. This will either involve utilizing the paper based site record form or via mobile data collection application ("MDC app") using a smart phone, toughpad, ipad etc as illustrated in Appendix 1. The monitoring framework has been designed to be "picked up" by anyone, eg. schools etc so depending on capability and resourcing groups may choose to use paper recording forms rather than mobile data collection.

- Assemble existing GIS data or topographical maps.

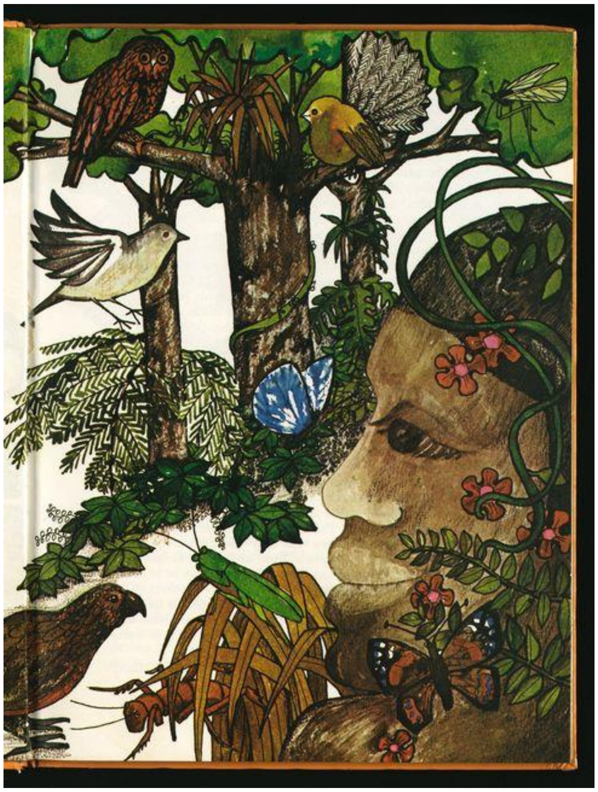
- Tailor the framework by deciding which indicators/tohu, atua domains and elements will be used from the list below to populate the framework and customize the site record form/MDC app; and design the field sampling system.

a) Atua Domains

The Realm of Tane Mahuta

Tane Mahuta is the atua or god of the Forest. The species indicators are children of Tane mahuta. This realm encapsulates the core concept of whakapapa and provides the central focus of the monitoring ie. health of Kauri Ngahere.

Approximately 90 species tohu or indicators were recognised in total as essential constituent parts of kauri ngahere during phase 1 of the project. These indicators have been grouped to reflect the whakapapa of the species living on and around kauri as follows:



Minor Flora
Minor flora includes kauri colonisers such as Rata and Kohia as well as species commonly found around the base of Kauri, such as Mingimingi

- *Trees*

Sub Canopy trees include such species as Horoeka, Tanekaha, Mamaku and Ponga. Canopy trees include of course Kauri, and other key emergents such as Rimu, Totara, Matai and Tawa.

- *Insects, Reptiles*

Species of insects identified in Phase 1 as having a relationship to kauri included Huhu and Kihikihi. We have also included Moko (Skinks and Geckos) as they are known to inhabit Kauri ngahere and would be a useful indicator species to include in the monitoring programme.

Figure 1: *A depiction of Papatuanuku clothed by the children of tanemahuta. This illustrates the interrelatedness or whakapapa of all ngahere species (From Maori Legends for Young New Zealanders by Kataraina Mataira and illustrated by Clare Bowes, 1980.)*

- *Birds*

Manu to be monitored include Kiwi, Tui, Kakariki, and Kereru.

It is the choice of mana whenua to select which species are most relevant to them to monitor. The full species list as developed in Phase 1 of the project is attached as Appendix 2. Additional or alternate species can be listed as required in recognition of the variance in species composition in forests throughout the kauri catchment. In the context of Kauri health, obviously Kauri will be selected. Both the site record form and MDC app allow information to be collected on a single specimen, for example a significant tree, or a range of specimens (eg. a stand of Kauri). Ideally, a broad range of species from each of the species groupings should be monitored. This will allow a more holistic picture to develop over time and is more likely to supply answers beyond determining the state of health of the ngahere, for instance, patterns could emerge in the presence or absence of species that may assist in predicting the presence of PTA and indicate possible reasons for resilience in certain kauri trees or forests.

Papatuanuku

Papatuanuku is earth mother. This element is utilized in the KCI framework to capture information about indicator species access to appropriate earth to grow in kauri ngahere. A range of characteristics can be recorded, for example:

- Leaf litter and dead wood[2]
- Greenery of any kind
- Soil
- Rock
- Other
- Note soil disturbance if any

This aspect is crucial in kauri ngahere because of kauri's unique relationship with the soil and due to PTA being a soil borne pathogen. We have also included the option of utilizing a pH test or taking a soil sample for PTA testing at this stage if mana whenua believe it is warranted. Presently, soil testing for PTA involves taking samples that are dispatched to a laboratory to undergo a costly testing procedure. However, a process for diagnostic testing in the field is currently under development and would complement the matauranga maori based framework considerably once available.

Tangaroa

Tangaroa is the god of seas, rivers and lakes. This element allows us to record the species health indicators due to appropriate access to water/moisture to grow. It is also an important value to monitor as water is also a vector of kauri dieback.

Contemporary forest sampling designs in New Zealand have typically involved systematic placement of plots along randomly orientated transects within catchments. Some members of the TWR have expressed a desire to monitor their kauri ngahere on a catchment basis. This is discussed further in section 2.3. At this stage we have settled on the following characteristics for recording in the site record form and MDC app:

- A description of any water body/course type (awa/ spring etc)
- Proximity to kauri
- Quality (based on classification waiora, waimaori, waikino, waimate)
- Moisture level within ngahere including soil, ferns, moss, etc

Tawhirimatea

Tawhirimatea is the god of wind and air. Using this element we can assess the species indicators access to clean air to breathe and exposure to wind. Wind is an important factor, particularly for kauri as they are reliant on wind dispersal of seed. Yet on the other hand, exposure to wind can be a damaging factor on plant or tree health and regeneration of seedlings for example.

This element is recorded in the site record form and MDC app via a simple yes or no answer with a comment box provided for any additional observations.

[2] Also Known as Pukahukahu mounds – specific kauri forest floor indicator in Waipoua (Nick Waipara, pers. comm)

Tamanuitera

This atua or demigod personifies the sun. Using this element we can assess the species indicators access to light. This descriptor has an obvious role to play in kauri ngahere, as kauri are particularly light demanding.

This element is recorded in the site record form and MDC app via a simple yes or no answer with provision for comment.

Tumatauenga

Tumatauenga is the god of war and tangata (people) and therefore this tohu primarily captures information on the human influence/s at the site.

The site record form and MDC app provide an opportunity to log information on ease of access to, and uses of, the site, (eg. walking trails, tourism, adjacent commercial forestry or farming, hunters etc) as well as traditional and contemporary customary use.

b) Key Values - Tohu/Assessment Elements

The attributes outlined below also appear in the site record form and MDC app. These allow the species indicators of the Tanemahuta realm to be assessed across this range of elements.

Tinana Oranga:

This element describes the bodily health and integrity of key species and includes a series of measures to be recorded that reflect species vitality. These include noting presence (or non-presence) of the following:

- *Trunk condition eg. bark not weeping or unnaturally peeling,*
- *Foliage eg. proper leaf colour, shape and size etc; gaps in canopy*
- *Signs of Disease/ dieback*
- *Presence of Invasive Species*[3] *eg signs of pest browse*

Kauri Dieback:
Presence or absence of a range of symptoms can be assessed. Where we have incorporated indicators of Kauri Dieback, we have attempted to maintain consistency with Kauri surveillance and health assessments undertaken as part of the Joint Agency Response. Therefore in this instance, utilization of PTA symptom assessments[4] carried out by Waipara et al. (2013) are adopted for this framework.

Whanaungatanga:

This element describes abundance of species representing different life stages or

[3] Appendix 2 provides a list of key weed species to be populated during field survey
[4] See: http://www.kauridieback.co.nz/media/6587/kauri%20dieback%20id%20field%20guide.pdf

kaumatuatanga. Percentage or numbers need to be assessed of each species at each life or reproductive stage:

- *Kakano - Seeds,*
- *Matikao - Buds or cones*
- *Puawai - Flowers*
- *Hua - Fruit*
- *Tupu - Seedlings*
- *Mature specimens*
- *Naturally dying off species*

When species are common enough to make counting difficult (potentially minor flora and some understory trees), an estimate of area or percentage cover will be required. As mentioned earlier the MDC app can record key individual trees and their features, but also has the ability to capture stands of trees which allows abundance data to be captured.

c) Overall Kauri Ngahere Health Measure – Mauri

Most cultural health indicator studies have included an overall assessment of health. In most instances this has involved calculation of an index based on numerical rankings (see Tipa, 2003, Walker, 2009). As described in the literature/information review for this report (Appendix 3) this has often been in order to correlate cultural health data to scientific data and thereby validate the data. Our own past experience with CHI programmes along with information arising out of the literature review and Matauranga Maori hui cemented a desire to move away from the tendency to utilize a western scientific rating system to measure cultural health.

The overarching purpose for developing cultural indicators for kauri health as summed up by Dr Manuka Henare during phase 1 was, “whangaia te mauri/hau o te kauri”, which can be loosely translated as to “reciprocal protection or care for the life force or breath of life of the kauri”. We therefore utilize Mauri as the element with which to determine the overall ecosystem health of each kauri ngahere site that is monitored.

Other cultural health indicator studies (eg. Walker, 2009), although not in a forest situation, have included an assessment of smell and sound. We have adopted the sensory assessment as supported by korero from the Matauranga Maori hui where kaumatua imparted the following comments: “Listen and the ngahere will talk to you” (Tohe Ashby, pers comm. 6/9/13) and “be still – then if you feel stillness – eg. you don’t hear the manu, you feel absence or emptiness, that is an indicator” (Kaumatua, pers. comm. 6/9/13).

After debating how to appropriately classify ngahere at the Matauranga Maori Hui, we have adopted the maori classification for water which is well known and understood and should prove simple to apply in the field. In the context of ngahere the classification is as follows:

- Ngahereora (pristine state)
- Ngaheremaori (good health)
- Ngaherekino (poor health)
- Ngaheremate (Dead or dying)

Like other CHI methodologies in Aotearoa this aspect is very much a subjective "gut feeling" decision on the part of the katiaki/monitor. Certainly, it will provide a baseline status of kauri ecosystem health for a monitored site, and enable mana whenua to discern ongoing trends. At the matauranga maori hui a participant mentioned the possibility of using an even more subjective measurement, for instance, "how does this make me feel? - "I feel mauiwi (sick) or pouri (sad)" and so on. While this will ultimately be the prerogative of mana whenua groups, it will be essential that the same descriptors are used upon return to the site for future monitoring to ensure consistency and that trends in health can be identified.

d) Designing the Sampling System

This step is also undertaken as part of the wananga. The first task is to check topographical maps and aerial photos to determine boundaries of the forest site to be monitored. Once the forest is chosen a decision on the area of the forest to be assessed needs to be made and demarcated on the map.

Three types of sampling are discussed below and all have pros and cons. Which type or combination of type used will depend on characteristics of sites, the indicators selected and time and resources.

Ecological Sampling – Quantitative Methodologies

Most contemporary ecological forest monitoring in New Zealand entails locating plots along a grid or transect line.

The grid method involves laying a grid over the top of the map. Random numbers are generated and then assigned to cells within the grid until the desired number of plots is reached. Transect line methodologies are generally considered most efficient and are located within a catchment or sub catchment. Typically the line is run from a watercourse to a ridgeline or similar with plots located at fixed intervals such as every 100 or 200m. An initial field reconnaisance can establish whether plots work in a practical sense, for example, extremely steep terrain might mean a plot needs to be relocated.

The general point of view of ecologists is that the largest number of sample plots possible is preferable in order to get a representative sample and that permanent or fixed plot surveys are considered best for re-measuremen in order to obtain data on the recruitment, growth and mortality rates of specific individual trees over time.

Over the last two decades 20x20m quadrat plots have become the norm for permanent plots and are also what has been employed at Huia in the Waitakeres for long term monitoring of Kauri Dieback (see Waipara, 2013). Reconnaisance descriptions or "Recce" sheets are commonly used to collect data within the permanent plots. The data to be gathered is very comprehensive (ie. Every plant of every tier is counted and all trees diameter and height are measured, some are tagged and a variety of other measurements are taken) but setting up such plots can be expensive and time consuming and specialist skills and equipment are required. However some mana whenua groups may be able to achieve such comprehensiveness with appropriate resources.

Ecological Sampling – Qualitative Methodologies

The Formak and Janssen methodologies use more of a “visual assessment” methodology. They appear to be aimed at smaller fragments or patches of bush and again involve some predetermining of site boundaries by using aerial photos and maps. Janssen suggests determining a transect to walk and vantage points to utilize.

This work involves a “slow and pleasant walk through the bush, making observations.” and scoring a set of indicators. The sampling design is far more subjective than that employed for quantitative surveys, for example, for patches of bush less than 5 Ha, monitors are encouraged to “cover enough ground to assign a score to each section with confidence. For bush patches larger than 5 Ha he suggests drawing up to 5 transect lines on a topographical map (each about 100m long) randomly through the bush patch, then locating these lines in the bush for a reasonable sub sample to score larger bush patches with confidence. FORMAK use a similar approach where monitors pre plan by selecting an area of bush they consider to be representative of a larger bush area. Using a topo map or aerial photo they plan an assessment route to be walked and again identify vantage points for their overview, areas to walk to assess edges and through the main part of the site, observing and making simple counts and assessing percentage cover of various vegetation tiers in the forest.

The subjective and less complicated nature of these methodologies perhaps better aligns to a cultural health assessment, however, they appear to more focused on getting a "snapshot" of a particular bush area in order to make a specific management response. The lack of precision in gathering data means that to observe trends any changes would probably have to be quite significant to be noticeable when the site is re-measured.

Culturally based sampling

The other known national study utilizing cultural indicators to monitor ngahere is being undertaken in Motueka in conjunction with Te Atiawa. Their method does not require identification of a specific tract or plot within a forest, kaitiaki merely "go into the forest, tune in, wander around, korero together and fill in the recording forms" (Dean Walker. pers comm, 2013).

Nga Tirairaka o Ngati Hine focus their field monitoring on known "hotspots" (Tui Shortland. pers comm, 2013), and Te Roroa have indicated a desire to monitor entire catchments or sub-catchments (Will Ngakuru. pers comm, 2013).

Cultural Health Indices developed for fresh water and coastal environments almost always involve a subjective choice of sites chosen specifically because of their cultural significance, for example, mahinga mataitai sites. They are commonly discrete sites and do not involve sample "plots" within sites, although counts are undertaken on a random basis of species such as shellfish.

Recommendations for KCI site selection and sampling

Ultimately this decision should be left up to mana whenua and flexibility will be necessary as ecological conditions, terrain and size of forest blocks and so forth will differ substantially throughout the Kauri Catchment. For mana whenua groups that wish to monitor on a catchment or sub catchment basis setting up transect lines to walk through is a logical step.

At the recent TWR workshop the group walked a loop trail at Arataki in the Waitakere's to trial the methodology framework and MDC app. The generic observations made and walk through worked well for a number of the tohu element assessments and the overall mauri assessment. As a result of this orientation field trip we have made some changes to the MDC app to ensure it captures classes and groupings of trees (and other species) more effectively. It is also effective at acquiring data on singular trees and animals. If mana whenua seek highly accurate species counts, it may be necessary to include plots in the sampling design, whether randomly or subjectively located (ie. near taonga trees or customary sites) to undertake accurate counts. These would not necessarily have to be 20x20m plots, mana whenua could opt for smaller but a larger number of plots or choose a single larger representative plot area to assess. It also became apparent during the field trip that time might be used more productively when counting or assessing abundance if monitors split across the four kauri whakapapa categories for example, one monitor each concentrating on minor flora, trees, manu, and insects/reptiles respectively.

Following the field trip TWR members discussed the overall ngahere health measurement. Individual members logged their classification on the MDC app. As a result you could arrive at a number of differing individual mauri categorizations for the same sample location. This was a frequent occurrence in the freshwater CHI studies undertaken by Tipa and Tierney (2003), and attributed to the age and experience range of monitors. The TWR generally felt it would be useful to debrief after monitoring to discuss and come to a consensus on which classification should be ascribed to a particular site. This could take place at the wananga described at step 8 below. Whichever approach or combination of approaches are utilized, the importance of accurately recording the area that is assessed, including, the entire site boundary, the location of any transects or walk throughs, and perimeters of any plots is paramount in order to precisely measure trends, including subtle changes, over time. Logistical constraints, time, manpower and funding limitations could all possibly have an impact on the size, location and number of forest sites and/or plots to be monitored.

As this is an action research project and by nature an ongoing process of refinement, over time we anticipate that a series of set ngahere monitoring locations will be selected by mana whenua. This will be essential in creating a baseline of data and enabling the gathering of information on longer-term trends in health. Key to this will be a robust pre-planning process.

e) Monitoring Frequency/Programme

Monthly monitoring

The Phase 1 KCI report sets out the Maramataka (12 month Maori Calendar) as the ideal timetable for site monitoring, therefore on a monthly basis. This would likely capture the most information across species for the whanaungatanga element of the assessment. This requires strong commitment in terms of funding and time.

Seasonal monitoring

The FORMAK model does not provide specific guidance on timing and frequency of monitoring. Components of the Janssen bush vitality score sheets however, are arranged to collect data during three seasonal periods based on birds life cycles and their food supply. These are referred to as “survival” (Winter–early spring), “breeding” (spring–summer), and “migration” (autumn). This method has parallels to the maramataka and yet potentially allows a more achievable monitoring frequency.

Annual monitoring

Other culturally based monitoring work in Aotearoa has made use of specific biological events as catalysts for monitoring. Examples include godwit/kuaka migration or tuna migration (Walker, 2009, Nga Tirairaka o Ngati Hine, 2013). For the KCI framework a monitoring timetable could be structured around a variety of process tohu. Attributes in the whanaungatanga element lend themselves well for this purpose. Events in the life/reproductive cyle of kauri could be a trigger, for example, seed maturity occurs around February to March when the female cone is ripe and the scales open, releasing the winged seeds which are borne away by the wind (Owens et al, 1997).

If Kiwi were a species indicator chosen by mana whenua monitors, the months of May and June would be the best time of year to monitor kiwi, as kiwi calling is at its peak. The monitoring regimen would then require further definition as calls need to be recorded during the first two hours of darkness, at or around dusk.

Five Yearly monitoring

NVS/RECCE fixed plot monitoring also contains no specific guidance around the timing and frequency of monitoring. Permanent plots are acknowledged as being time consuming and expensive to establish and re-measure, and, as many are set up as control sites to monitor over the long term (potentially for many decades) it would appear that monitoring occurs much less regularly (ie. 5 yearly or more).

Recommendations for monitoring frequency

In general, how often plots are re-measured will depend on the site and what is happening there and the objectives of the research. As changes are occurring rapidly in kauri ngahere, and particularly in light of the kauri dieback epidemic, a more regular monitoring regime will be required. Certainly the feeling amongst the TWR at the workshop was a desire to get monitoring underway as quickly as possible and often. Several hapu represented on the TWR already have monitoring regimes underway (such as coastal and freshwater) and are generally surveying on a maramataka or at least seasonal basis.

Regardless of the monitoring timetable selected by mana whenua groups, in order to produce comparable data, the monitoring time should be the same every year or season as applicable and needs to bear in mind time of day and weather/climatic conditions in order not to skew results. This information can be recorded in the site record form and MDC app.

2.2.6 Step 6: Ground Preparation and Organisation of the Team

This step involves sorting logistical matters such as assembling field equipment and preparing the team ensuring any necessary training and resources are undertaken, reviewed, and collected.

Standard Field Equipment For Forest Monitoring:

- Topographical Map
- Binoculars
- Plant identification references/ app
- Plant specimen identification folder (if you are taking specimens)
- Aerial Photograph – if available (can be downloaded from http://www.linz.govt.nz)
- KCI site record form - optional to use apps such as, Open Data Kit (Google Maps) or Mobile Data Collection (GIS Cloud) which would require smartphone, ipad, toughpad etc. Otherwise pencils and clip board
- Compass (optional and not required when using most GPS equipment)
- GPS (not required if using MDC app)
- Camera (not required if using MDC app but would provide higher quality photos)

For setting out plots (if desired)

- 20m tape measure
- Location markers
- Plot peg markers

- Plot pegs

Field kits are also available for purchase on the FORMAK website. As mentioned, the use of smart phones or tablets is highly desirable. The Panasonic Toughpad has been proven to be very effective because of its durability. Nga Tirairaka o Ngati Hine equip their monitors with Toughpads and they use an MDC app to record biodiversity data. By using these tools monitors can eliminate the effort of carrying multiple equipment into the forest. This also makes field work much more efficient and significantly reduces time spent on inputting data and data analysis.

If sample sites have been selected on a map prior to entering the field they will need to be located using GPS. The locations of any specific trees or points of interest can be recorded and this spatial data can later be easily compiled and processed, maps can be published and so forth.

A digital camera enhances the assessment as photos can be taken for comparison over time, and species that cannot be identified in the field can be captured for later identification. Photography can also assist with determining levels of foliage cover and canopy condition using photos taken from the ground or from an elevated position at the side of the forest area. Taking photos from a range of vantage points adjacent to the site (will depend on terrain etc) being monitored can provide a panorama of the forest canopy. Smartphones, ipads or similar PDA devices are tools that can be used in the field and will save time as data will not have to be manually entered back in the office. As mentioned previously, apps are available that can assist in the field, for example with plant species identification.

Programs such as GIS cloud which supports the MDC app developed for the KCI framework are available or being developed both nationally and internationally to support ecological monitoring. Monitors essentially use a PDA on surveys of the ngahere to record data electronically. GIS cloud allows data to be queued even when monitors are collecting out of cellphone network range. The data is then uploads automatically once they come into network range and can then be transferred to office computers, where the information can be viewed on a map and used to create reports for future planning and management practices..

However, because of varying levels of capacity and resourcing amongst mana whenua we have attempted to devise the framework so that the site record form can be printed out and used in the field without requiring specialist equipment at this stage.

While it has been pointed out that strong forest knowledge and an environmental background is desirable, a significant amount of training and resources are available through partner agencies and other institutions and a growing number of web sites and smart phone applications that can be used in the field.

Resources

Useful websites for plant identification are:

http://maoriplantuse.landcareresearch.co.nz/WebForms/default.aspx
http://nzflora.landcareresearch.co.nz

Useful Smart phone apps include:

- Flora finder – This recently launched this electronic field guide helps identify New Zealand native plants from photographs of their leaves. You take a photograph of a native plant's leaf using the camera on your smartphone and Flora Finder will instantly identify and provide a description of the plant, and pinpoint and map your location using a live mapping feature. If Flora Finder can't identify the plant for there is a function whereby the photograph is emailed to the team at the University of Otago Botany Department who will undertake the identification. This is currently available for iphone/ipads but an android app is in development.

see: http://phys.org/news/2013-11-identification-snap.html#jCp and https://itunes.apple.com/nz/app/flora-finder/id688613607?mt=8

Depending on the site selection process undertaken by mana whenua, there is a range of resource materials that can be consulted, such as some of the toolkits for methods discussed in this report. Useful websites for field work design and sampling methodologies include:

http://www.bushvitality.org.nz/bv_assessment.htm

http://www.formak.co.nz/default.aspx

https://nvs.landcareresearch.co.nz/Resources/fieldsheets

http://www.groundtruth.co.nz/sites/default/files/documents/nfm_form_surveillance.pdf

http://www.groundtruth.co.nz/sites/default/files/documents/nfm_form_quickplot.pdf

Training Programmes

The Department of Conservation operate a number of training programmes including:

- Plant identification
- Foliar Browse Index
- Five minute bird count
- 20x20m plot and RECCE descriptions

see: http://www.doc.govt.nz/getting-involved/get-trained/field-based-courses/

Depending on the final site selection/sample design that mana whenua decide on, they may wish to undertake all or any of these options available through DoC. As DoC is a partner to TWR in the kauri dieback programme this may be an opportunity for collaboration. FORMAK also provide training courses.

Specific Kauri Dieback Training:

All teams will require training in Kauri Dieback identification and surveillance if they haven't already done so. We envisage working with the Kauri Dieback Joint Response Surveillance Team and/ or Relationship Management Officer to set up a fit for purpose training session. This should involve a field trip to an infected area and will involve identification procedures and hygiene procedures.

Specific KCI Monitoring Framework Training:

As mentioned an initial workshop and fieldtrip to Waitakere has been undertaken with TWR members. This could not be classed as training, rather more an orientation to the framework and how fieldwork could be carried out. The TWR participants were very clear that more in depth guidance at step 5 (customizing the framework and sampling design) would need to occur. In addition specific training on using any technology such as the MDC app, along with the ensuing interpretation, analysis and reporting of the data collected (eg. GIS mapping etc) would also be required. This portion of the training relating to post data collection could occur at Step 8 (see below).

2.3 Step 7: First Fieldwork Period

2.3.1 Tikanga and Wairuatanga Protocols

This element of the framework denotes the appropriate protocols to be carried out before, during and after fieldwork. Although there will be variance between mana whenua groups in the kauri catchment feedback and interviews have demonstrated key protocols as the following:

Figure 2: *A depiction of Rata's waka (a Totara) that was continuously resurrected by the birds, insects and other children of Tane until Rata had carried out the proper rituals prior to cutting it down. This illustrates the significance of abiding by appropriate tikanga when entering or undertaking any activity in the ngahere (From Maori Legends for Young New Zealanders by Kataraina Mataira and illustrated by Clare Bowes, 1980.)*

- Karakia
- Contemporary health and safety protocols and hygiene procedures to stop the spread of

Kauri Dieback

- Wairuatanga –This aspect requires a degree of self-introspection on the part of the monitor prior to beginning fieldwork. One kaumatua labelled this "doing a personal check on your own spiritual health before doing one on the forest…and ensuring that you come informed" (Kaumatua, pers. comm, 6/9/13). Another TWR member related that "we are not separate from the ngahere we are all part of it which is why intuitive sense is so important.

These matters are dealt with in both the site record form and MDC app where they can be marked off.

2.3.2 Actual Field Work

The ngahere site or sites are surveyed by the team to populate the site record form/MDC app. Mana whenua may wish to engage experienced supervisors/trainers to accompany them during the first data collection period.

2.4 Step 8: Second Wananga

This wananga allows for a debrief session where monitoring information is shared and sorted for storage and analysis. It also enables the group an opportunity to reconfirm when the next fieldwork period will be.

Data analysis and reporting undertaken by mana whenua could involve statistical analysis, graphs, and maps with a summary report that draws together the results and provides a conclusion about the health status of the site.

Mana whenua teams will require appropriate computer or laptop hardware at their offices to enable data input, analysis and reporting. As yet, we have not determined what (if any) software is a prerequisite. As mentioned previously, for the purpose of the TWR workshop and field trip we have developed a template to be used as a MDC app supported by GIS cloud. Google Earth and Quantum GIS or QGIS are other options. All of this mapping software is easy to use and does not require any GIS programme training unlike the ESRI software. They are also very low cost and some free online GIS is available that provides analysis options such as heat mapping. Other less technical data storing options are Microsoft Excel or Access.

As mentioned previously, the TWR has indicated a likely need for training to be available for the analysing and editing phase of the work, and particularly if mana whenua wish to use the MDC app (or similar) and associated maps, layers, hyperlinks and so forth. It was stressed at the workshop that teams should choose a suitably skilled data entry/analyst to do this part back at the office, as the data collectors may not necessarily be suitable to carry out this portion of the work.

Monitoring records must be stored in a safe and usable manner. This should include a dedicated file and photocopied back up of site record forms (backups should be held off site). Likewise digital data, analysis such as graphs and maps should be stored appropriately in a computer database.

While it may not be appropriate to store the information collected through the KCI programme on a national database (such as the NVS), the TWR have discussed exploring the possibility of having their own shared database or portal. Protocols will need to be developed on how the information will be reported or shared with the Kauri Dieback Response and any other interested parties. This is discussed further in step 10 below. Whether data is housed with individual mana whenua groups or in a shared space, it will be important to ensure that records and storage are well maintained and consistent protocols are used. This will ensure they can be easily accessed for re-measurement or comparison with other data.

2.5 Step 9: Second Fieldwork Period

Repeat of step 7 above. This step will reoccur according to the monitoring frequency determined by mana whenua for their kauri ngahere site/s.

2.6 Step 10: Third Wananga – Reporting and Evaluation

Once follow up monitoring is undertaken analysis can further examine such matters as, trends or change over time, difference between areas and explore further the relationships between different indicators.

The results of initial pilot monitoring will enable mana whenua to assess immediate threats or risks that need action. This may require the development of specific management plans for areas of kauri ngahere, review or update of existing plans and management responses and the like. For example, they may need to make decisions on any responses required such as increased possum control, lab test samples to be taken for kauri dieback, planting, and fencing as required, and so on.

Mana whenua can choose how to present their information. Ideally, analysis should be kept simple and use of graphs and visuals employed wherever possible. This often better illustrates any differences, changes or relationships measured. Reporting schedules for mana whenua involved in the pilot programme will be attached to milestones as part of the next phase of this project.

As stated in the Partnership Charter for the Kauri Dieback *(Phytophthora* taxon Agathis*)* Long Term Management Programme, the Partnership recognises that any IP provided by a tāngata whenua entity for the benefit of the Partnership and its objectives remains the property of the tāngata whenua entity unless expressly stated otherwise in writing by duly authorised offices of that tāngata whenua entity.

Beyond planning and reporting, the wananga provides an opportunity for community oversight and quality control and can be utilized as an event to present back to stakeholders and evaluate the process.

This framework has been developed to be tested in the field via a pilot monitoring programme. It is acknowledged that further refinement and amendment is likely to result as an outcome of the fieldwork. We would encourage discussion during monitoring and after analysis about what works and what doesn't. We anticipate creating a feedback loop that could involve specific evaluation forms and hui/wananga where problems encountered and potential solutions can be discussed in an open forum between mana whenua groups. A valuable recommendation from the TWR workshop was the suggestion to hold a collaborative wananga annually to achieve the following:

- share reporting and results,
- lessons learned,
- tips for analysis and presentation,
- ideas for shared data storage,
- aggregation of data for kauri catchment wide analysis,

Relationships with the Kauri Dieback Programme partners, other relevant agencies, research institutions, community groups and of course, each other, will need to be strengthened to propel the KCI monitoring programme forward and secure it in the long term. These relationships will also be central to collaboration on management responses to improve the health of kauri ngahere.

A broader evaluation of the entire pilot monitoring programme will also be required to establish commitment, resourcing, support and a process for implementation of the KCI framework for monitoring throughout the kauri catchment.

3. CONCLUSIONS

The KCI framework has been designed, where possible, to:

- Provide an assessment of the condition and trend of the environmental health of Kauri Ngahere
- Determine whether cultural values are being enhanced or diminished
  Provide the flexibility to acknowledge and accommodate differences in mana whenua understanding and traditions and environmental conditions throughout the Kauri catchment.
- Provide the flexibility to incorporate contemporary scientific data collection systems if required or desired by mana whenua. For example, pH testing of soil or soil testing for PTA.

The framework offers:

- A survey tool that allows field assessment of species tohu against the selected cultural elements/attributes
- A survey tool that requires tikanga and wairuatanga to be observed
- A survey tool that provides for an overall assessment of cultural health - whangaia te mauri / hau o te kauri
- Guidance around ngahere site selection parameters as well as team selection and training requirements,
- Guidance around timing of monitoring based around maramataka or seasonal events (process tohu).
- A foundation based on matauranga maori that also allows the development of new matauranga.

We hope to achieve a tool for use, FOR and BY mana whenua, while exploring ways in which the tool can complement work of the science fraternity currently engaged in Kauri Dieback Programme. We anticipate the presence or absence of certain indicators may enable conclusions to be drawn over time about why some sites are positive and others in the vicinity are unaffected and provide insight into opportunities to build resilience.

At the Matauranga Maori hui and recent TWR workshop and field trip the KCI monitoring framework was very well received. Mana whenua are excited by the prospect of having a strategy for “on the ground” action in their kauri ngahere. We envisage that Phase Three of the project will begin with the collection and collation of baseline data using the KCI framework with 3-5 mana whenua groups. An expressions of interest process will determine which mana whenua groups are chosen to pilot the programme. Analysis of data and refinement of the methodology framework may be required at this stage for ongoing assessment of indicators. It has become apparent that guidance and training will be required at various stages of the methodology process. We recommend that the TWR investigate establishing a team to carry out this supervisory role, at least in the interim pilot project stages until mana whenua representatives are in a position to share the knowledge and experience they have gained with others.

Parallel to this work, conversations between mana whenua, the TWR, the scientific fraternity and other interested parties need to occur in order to continue to explore ways of leveraging off other current and planned surveillance and ecological research to create synergies and also identify potential funding sources for this project going forward.

4. REFERENCES

Owens, J.N., G.L. Catalano, and C.J. Aitken. 1997. The reproductive biology of kauri (*Agathis australis*). IV. Late embryogeny, histochemistry, cone and seed morphology. *International Journal of Plant Sciences* 158: 395-407. Retrieved from http://www.jstor.org/discover/10.2307/2474862?uid=3738776&uid=2129&uid=2&uid=70&uid=4&sid=21102918882103

Shortland, T. (2011). *Cultural Indicators for Kauri Ngahere*. A report prepared for the Tangata Whenua Roopu. Kauri Dieback Joint Agency Response. Whangarei.

Tipa, G. and Teirney, L. (2003). *A Cultural Health Index for Streams and Waterways: Indicators for recognising and expressing Maori values.* A report prepared for the Ministry of the Environment. Retrieved from www.mfe.govt.nz/publications/.../**cultural-health-index**-jun03/

Waipara, N., Hill, S., Hill, L., Hough, L & Horner, I. (2013). *Surveillance methods to determine tree health, distribution of kauri dieback disease and associated pathogens*. Auckland Council Paper. Retrieved from http://www.kauridieback.co.nz/media/32242/063_waipara.pdf

Walker, D., Ataria, J., Hughey,K., Lambert, S. (2013). *Developing a Culturally-Based Environmental Monitoring and Assessment Tool for New Zealand Indigenous Forests.* Conference Paper for the 19th International Symposium on Society and Resource Management**.** Estes Park, Colorado, 4-8 June, 2013.

Walker, D. (2009). *Iwi Estuarine Indicators for Nelson*. Prepared for Nelson City Council. Tiakino Te Taio Occasional Report. Retrieved from http://www.envirolink.govt.nz/PageFiles/425/628-nlcc31.pdf

Websites Visited:

http://www.kauricoast.co.nz/History_The_Kauri.cfm

http://www.conifers.org/ar/Agathis_australis.php

http://en.wikipedia.org/wiki/Agathis_australis

http://www.nzpcn.org.nz/flora_details.aspx?ID=2047

http://www.nzes.org.nz/nzje/free_issues/NZJEcol27_2_207.pdf

https://nvs.landcareresearch.co.nz

http://www.doc.govt.nz/Documents/science-and-technical/inventory-monitoring/im-toolbox-20-x-20-forest-plots.pdf

http://www.bushvitality.org.nz/bv_assessment.htm

http://www.formak.co.nz

http://phys.org/news/2013-11-identification-snap.html

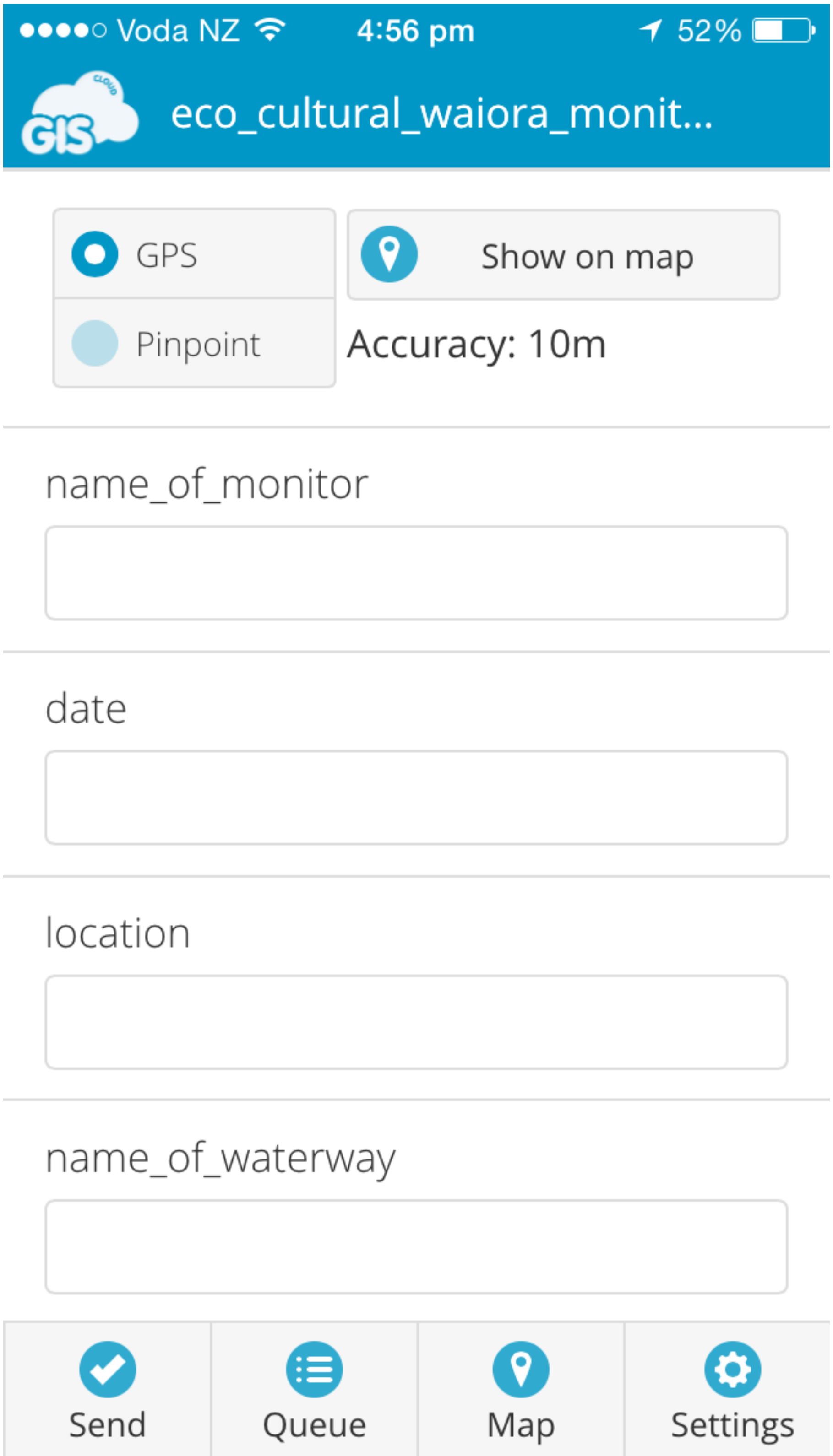
https://itunes.apple.com/nz/app/flora-finder/id688613607?mt=8

http://www.groundtruth.co.nz/services/field-gis-and-data-capture-tool

http://www.giscloud.com

http://www.kauridieback.co.nz/media/6587/kauri%20dieback%20id%20field%20guide.pdf

Appendix 1: Example of Mobile Data Collection Screenshot



Appendix 2: Species List

The full species indicator list can be found at:
https://www.kauridieback.co.nz/media/1367/monitoring-kauri-cultural-health-shortland-et-al-2011.pdf

Note: mana whenua are not restricted to this list and can add or omit species as required. For instance, reptiles such as moko (skinks and geckos) are not included in the above document but are considered valuable indicator species in Kauri Ngahere. Several tree species may not occur in different parts of the Kauri catchment or alternate names may need to be used to reflect local dialects etc.

Invasive Species List[5]

WEEDS:	ABSENT Tick as appropriate	PRESENT Tick as appropriate	ABUNDANT Tick as appropriate
Wandering Jew			
Wild Ginger			
Pampas			
Wattle			
Climbing Asparagus			
Other			
PESTS[6]**:**			
Possum			
Goats			
Pigs			
Stock			
Rodents			
Stoats			
Other			

[5] Again can add or remove species depending on local circumstances
[6] Based on actual observations or “sign” eg. possum faeces, pig tracks, browse etc)

Appendix 3: Literature/Information Review

KAURI CULTURAL HEALTH INDICATORS – MONITORING FRAMEWORK

Literature/Information Review

Prepared for the Kauri Dieback Response, Tangata Whenua Roopu by Juliane Chetham and Tui Shortland, Repo Consultancy Ltd.

August 2013

TABLE OF CONTENTS

1. Introduction

1.1 Purpose

1.2 Background

1.3 Methodology

2. Cultural Indicators - Discussion

2.1 The Use of Cultural Indicators in the International Context

2.2 The Use of Cultural Indicators – Models in Aotearoa

2.3 Current Status of Scientific Work on Kauri Dieback, Ecological Monitoring, Use of Indicators

2.3.1 Surveillance

2.3.2 Other Research

2.4 Studies Regarding Growth Responses By Native Plants to Soil Samples Beneath Kauri Trees

2.4.1 Methodology

2.4.2 Other Studies

2.5 Studies Specific to the Kauri Tree, Unique of Other Conifers

2.5.1 Other Studies

2.6 A Study Undertaken to Decipher the Effect Bark Plays on the Epiphyte Community Living on It

2.6.1 Methodology

3 Conclusions

4 References

1. INTRODUCTION

1.1 Purpose

The goal of this literature review is to support the development of a monitoring methodology framework for Kauri Ngahere Health (hereafter referred to as KCI Methodology) based in cultural knowledge. To further the legitimacy of this goal, all relevant examples of international and national research, undertaken to date, utilising cultural indicators or similar methodologies have been collected. This includes a brief examination of the ecological science work around Kauri Dieback, adding validity to a multiple evidence based approach and examining the possibility of opportunities for research and monitoring collaboration in field work.

1.2 Background

Kauri Dieback was formally identified in 2008 following a study undertaken by Landcare Research after many dying trees were observed in the Waitakere Ranges. Research shows that the water and soil borne pathogen Phytophthora taxon Agathis (PTA) has been present in Aotearoa New Zealand for at least 40 years but due to incorrect identification in the 1970's the true threat was not recognized and investigated until recently. The disease affects all life stages of tree causing bleeding lesions at the base of the tree, defoliation, yellowing, fanning, dead branches and "stag heads." A significant number of infected sites are spread throughout the Northland and Auckland regions, particularly Waitakere, Trounson Park, Waipoua Forest and Aotea Great Barrier Island. A Kauri Dieback Programme comprised of representatives from the Department of Conservation, the Ministry of Agriculture and Forestry Biosecurity New Zealand, Northland Regional Council, Environment Bay of Plenty, Auckland Regional Council, Environment Waikato and a Tangata Whenua Roopu (TWR) has been in place since 2009.

Since very early on in the development of the TWR work plan, the design of a framework to enable the use of cultural indicators in the surveillance and monitoring of Kauri Dieback has been a research priority. Tangata whenua assert that the use of cultural indicators to complement scientific methodologies is desired in the assessment of kauri health and building resilience to disease. Repo Consultancy produced the report "Cultural Indicators for Kauri" in 2011 as the initial phase of this work (hereafter referred to as "KCI Report Phase 1"). This work involved a literature review of national and international examples of cultural indicator research, followed by an extensive interview process with a number of cultural experts in which a robust set of values and indicators for kauri were identified.

An important conclusion reached from discussions with tohunga/kaumatua was that health of kauri cannot be ascertained by looking at kauri alone, rather a "ngahere", or kauri ecosystem approach should be taken. This effectively signified that indicators for kauri health must be derived from coexisting species within the forest in addition to kauri. The progression of this work is a logical step for mana whenua who have built capacity in this area and have been active in surveillance monitoring and advocacy in regard to Kauri Dieback.

Tangata Whenua recognise that to overcome this affliction facing our taonga, a long- term holistic approach must be taken. The development of a methodology tool or framework based on cultural indicators will provide significant opportunities for potentially inexpensive field techniques and transferral of practice and knowledge that will allow mana whenua to express their kaitiakitanga in a real and tangible way. It is consistent with the overall outcome sought from becoming engaged in protected kauri from PTA as stated in the Partnership Charter:

"To maintain and enhance the mauri and health of kauri to ensure its special place for all New Zealanders now and into the future".

1.3 Methodology

Internet research was utilized to gather any and all existing publications or findings related to Cultural Indicators within Aotearoa and those used by indigenous peoples around the world. Special attention was paid to those websites which are known for documenting Cultural Indicators from around the globe.
Known sources of Cultural Indicators that had been prepared in recent years were also reviewed. Key themes were extracted and recorded from all the sources examined. A list of key issues and questions was then prepared to make a comparison of key points found across the Cultural Indicators. All sources were compiled into the Literature Sources list (Section 8). A summary of findings was prepared (Section 4, 5 & 6) and general conclusions formed and documented (section 5).

2. Cultural Indicators - Discussion

2.1 The Use of Cultural Indicators in the International Context

Despite substantial information on social, health and economic indicators for indigenous people, references to environmental indicators remain scarce in the international literature. In the last two decades, organizations such as the United Nations have driven the adoption of outcomes and indicators as tools for environmental management and reporting (Jefferies et al, 2009). The advent of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) has accelerated the growth of research in this area. A range of innovative work on ecosystem service indicators is being driven by an alliance of researchers, such as the Convention on Biological Diversity (CBD) secretariat, World Resources Institute (WRI), the IUCN Commission on Ecosystem Management (IUCN-CEM) and The Resilience and Development Programme (SwedBio) at Stockholm Resilience Centre. A series of international workshops have highlighted the need for national and regional capacity development and lesson sharing on indicator development and use. The Tebtebba Foundation, an indigenous organization in the Philippines, is guiding the International Indigenous Forum of Biodiversity Indicators working group. The indicators developed in that setting are identifying priorities for indigenous peoples and local livelihoods (Norstrom, 2011). These indicators are usually separated into structural, process and outcome indicators and tend to be grouped around matters such as legal and political rights, status of culture, knowledge and language, percentage of territory retained in aboriginal ownership, and access and security of traditional resources and sites (Tebtebba Foundation, 2008). These continue to be relatively high-level regional frameworks and we were unable to locate any examples of local level ecosystem or species specific monitoring using cultural indicators through this Forum that could be applicable to the KCI project.

In terms of the use of cultural indicators in forest management, the Montreal process created at earlier conventions such as UNEP/Rio and the like have resulted in the development of Sustainable Forest Management models and there are a number of Canadian examples where indigenous communities have been involved in criteria and indicator development in this context (Karjala, Sherry, & Dewhurst, 2003; Natcher & Hickey, 2002; Saint-Arnaud, Asselin, Dube, Croteau, & Papatie, 2009). Although these models have proved valuable, difficulties have arisen when attempting to adapt national criteria to local situations. Highly complex frameworks have also proved to be barriers to their utilisation by aboriginal communities (Saint-Arnaud, et al., 2009) and communication, conceptual and political barriers remain, meaning that criteria and indicator approaches by indigenous communities often struggle to be accepted by the mainstream and government authorities (Ellis, 2005). It remains unclear, however, how much input the indigenous communities had in the development of these frameworks and little, if any, of the research appears to have been carried out by the communities being the subject of the research themselves (Jefferies et al, 2009).

It is clear that long-standing issues remain, both in an international and Aotearoa New Zealand context, around who undertakes research and how it is valued, who sets policy, who determines the state of a resource, and who ultimately decides the appropriate management action? Current wildlife management systems in countries with colonial histories (e.g. New Zealand, Australia, and Canada) are primarily based on Eurocentric scientific principles (Lyver, et al., 2008). Jefferies and Kennedy (2009) concluded that in New Zealand, Māori are excluded from local government resource management processes and their values subordinated to those of the wider community, particularly western scientific values. Indigenous knowledge is still often labelled irrational, superstitious and anecdotal and can only be made worthwhile through scientific validation (Tengo et al., 2012).

The utilization of western science norms makes it difficult for ecologists and resource managers to accept and include culturally based explanations for patterns observed in wildlife populations without hypothesis testing or repeatable ecological reasoning. The common practice has been for scientists or environmental resource managers to select what aspects of traditional knowledge fit with scientific concepts and data requirements and procedures (Ellis 2005; Stevenson 2006). This practice often fails to consider that mātauranga is commonly entrenched within a broader articulated system of knowledge, which includes ecological and nonecological components, and its removal from this context is in effect 'dumbing-down' the knowledge (Stevenson 2006). For ecological management to effectively integrate all elements of mātauranga, the initiative and the guidance for its implementation needs to come directly from the knowledge holders. Similarly, Smith (2012) has critiqued and highlighted the colonising tendencies of the Western scientific tradition, the appropriation of indigenous knowledge and the enduring distrust by indigenous people of scientific research (Walker, 2013).

This situation continues to manifest itself in the cultural indicator space today, even when indicators and methodologies are developed and tested by indigenous people, the need for them to be acceptable to the science fraternity is pervasive. In the following section, we outline national models and discuss some concerns or difficulties that have arisen in designing cultural monitoring programmes in New Zealand. For example, the need (whether real or perceived) for scientific validation of cultural models or the attempts to "integrate" Maori indicators, measures or values into Western planning models have both been difficult processes. In both instances, two schools of thought are attempting to find common ground without giving up any of their own. A recent workshop[7] convened by the Resilience and Development Programme (SwedBio) suggested aims

[7]http://www.dialogueseminars.net/resources/Panama/Reports/Panama-report_Enlish_small.pdf

should be for co-production of knowledge, dual based or multiple evidence based research and similar models where research is conducted in parallel and has its own inherent value with room for equitable exchange and sharing, giving it a greater combined value. This is certainly sympathetic to what the tangata whenua roopu are hoping to achieve through the KCI project, in terms of developing a framework for use, for and by mana whenua, but also exploring ways in which the knowledge gained can complement that being collected by the science fraternity currently engaged or associated with the Kauri Dieback Programme.

2.2 THE USE OF CULTURAL INDICATORS – MODELS IN AOTEAROA

As mentioned previously, the concept of utilizing economic and social indicators to assess health and wellbeing has been around for some time internationally, and the use of cultural indicators is now coming to the fore in international research. The advent of the Resource Management Act 1991 (RMA) spurred the involvement of Maori in mainstream environmental management. The Environmental Performance Indicators (EPI) Programme, continued from 1996 – 2002 and lead to the development of formative models such as the CHI for river and stream heath (Tipa & Tierney, 2003). The Parliamentary Commissioner for the Environment (PCE) notes however, that, since the end of the EPI programme there has been limited progress in the development of good environmental datasets[8]. During a 2010 MfE funded survey aimed at taking stock of Maori participation in environmental monitoring, 55 recent projects were identified. Nevertheless, concerns remain around aspects of these projects, specifically the resourcing, capacity and longevity of them. One major concern is that the majority of these projects tend to be one-off and short term. (Chetham, Shortland, Nuttall, & Newell, 2010). In order to earn validity, projects need to last long enough that their methodologies can be fairly tested. Repetition of each project will also lend them credence by validating their results.

Cultural Environmental Monitoring has been used to monitor the health of specific environmental domains, ecosystems, biological regions (usually catchments) or species and includes frameworks, indicators, methods and assessments (Walker, 2013). Models range from katiaki utilizing accessible, traditional methodologies for monitoring their mahinga kai resources to toolkits or programmes for communities have been produced based on western scientific methods. The comparative table below sets out the key aspects of models and discusses their relevance to the development of a methodology for testing cultural indicators for Kauri Ngahere.

[8] see http://www.pce.parliament.nz/assets/Uploads/How-clean-is-New-Zealand.pdf

Table 1: Comparison of examples of cultural indicators used in Aotearoa/NZ:

Cultural Indicators developed for multiple realms		
Indicators	**Methodology**	**Discussion/Comment**
The development of a Kaupapa Mäori environmental outcomes and indicators framework and methodology by Jefferies and Kennedy under the Planning Under a Cooperative Mandate (PUCM/ Waikato University) banner was undertaken over several years.[9]	Three kete were developed containing the following: • Kaupapa – the overarching value or concept to which outcomes and indicators relate (eg. mana, mauri and tapu); • Tikanga - the high level principle or rule which must be upheld (eg. mana whenua, mauri of waterways, and waahi tapu); and • Outcomes and Indicators eg. for mana whenua, indices were created where the extent to which local authorities and other agencies acknowledge mana whenua could be measured.	It resulted in a tool to evaluate the performance of local authorities and other agencies in their responsibilities to the environment, as well as the ability of tangata whenua to participate and influence environmental management and decision-making. High level and not really applicable to the KCI methodology framework. Relates more to the relationship monitoring framework kaupapa that the TWR have devised for the Joint Agency Programme.
The work by Dr Kepa Morgan has had widespread attention and results. His Mauri model has been utilized by groups such as Ngati Pikiao in successful environment court litigation in regard to Lake Rotoma. A website "Mauriometer" has just been launched centering on assessing the impacts of the Rena disaster on mauri with applications to numerous other subjects[10].	The Mauri model aims to create an holistic assessment of sustainability based on an assessment of indicators grouped under the "4 wellbeings" namely: • economic /(whanau) • social/ (community) • cultural /(hapu) • Environment/(taiao) A weighting that is applied to each aspect that identifies the option under consideration (eg. an infrastructure project) as either enhancing, diminishing, or neutral for the mauri of the aspect being considered.	This model appears advantageous in assessing significant problems eg. Rena, has also been applied to restoring land at Tasman Pulp and Paper Mill, is being trialled internationally by indigenous assessing mining activities etc. As it has proved effective in impact assessments theoretically it could be built into KCI monitoring programme as a means of assessing the impact of kauri dieback and/or other pressures on a site. A beneficial aspect is the assessment of the mauri of the impacted people within these areas and their environs and how iwi and hapū respond. This can

	Assessment of the impact to mauri of each indicator is made on an integer value from -2 to +2, with +2 representing mauri at full potential or fully restored; +1, mauri at partial potential or partially restored; 0, no change; -1, partial degradation; and -2, complete degradation). The impact on the mauri is assessed independently from the weighting applied to each particular aspect. The relative weighting for each aspect is chosen based on matauranga and tikanga. The environment is considered the all-encompassing aspect and is given priority over the other aspects (eg. as illustrated by rahui – this process prioritises the environment ahead of the other aspects until the mauri of that area or resource has recovered. Second on the hierarchy is the mauri of the hapu which takes precedence over that of the community and the whanau (as demonstrated by whakapapa and relationship to rohe). This is because of the relationship that exists between the Hapu and a specific geographic location or rohe. The mauri or well-being of the community takes precedence over that of the whanau.	provide the basis for an evaluation of the contribution of mātauranga Māori in this context, informing disaster/event/threat response thinking and contributing to the increased resilience of iwi and hapū.

[9] http://researchcommons.waikato.ac.nz/bitstream/handle/10289/6101/PUCM%20Maori%20Report%201.pdf?sequence=1

[10] http://www.thesustainabilitysociety.org.nz/conference/2004/Session5/36%20Morgan.pdf

http://www.mauriometer.com

Hauraki Maori Trust Board The original 1999 work as part of MfE's customary indicators for the environment was based on a pressure state response type model. This was updated in their 2004 Environmental Management Plan to structure their strategy via the use of Atua Domains. This template has since been adapted by others (Walker, 2009, 2012, 2013).	Hauraki Maori Trust Board Environmental Management Plan 2004 adopts an approach using Nga Atua as a classification framework for environmental outcomes.	The use of atua domains as a framework was recognised in the KCI report phase 1 as best practice and was supported by the korero of kaumatua and iwi/hapu practitioners interviewed as part of the process. It is therefore acknowledged that this will form the basis of the KCI Methodology Framework. We will explore how the other models reviewed here that are considered useful or applicable can be incorporated into or supplement this framework.
Cultural Indicators developed for the domain of Tangaroa		
Indicators	**Methodology**	**Discussion/Comment**
Freshwater Indicators CHI – River and Stream Health The work by Tipa and Tierney[11] appears to be the seminal work on CHI in New Zealand and the model has since been implemented or adapted by other iwi/hapu groups around the country in wetland, freshwater or marine environments (Harmsworth 2009; Kaupapa Taiao 2004, 2006; Passl & Walker, 2005; MfE & Otaraua Hapu, 2003; Pauling, Lenihan, Rupene, Tirikatene-Nash, & Couch, 2007; Walker, 2007; Chetham & Shortland 2010). The River Values Assessment tool (RIVAs) was developed to provide regional councils with a	This work identified a series of indicators that Ngāi Tahu use to assess the health of freshwater resources. The indicators were developed through extensive interviews with kaumatua and iwi resource managers and devised a framework of three components: • Site status, specifically the significance of the site to Māori • A mahinga kai measure • A stream health measure (involved such indicators as (shape of the river, movement of water, is kai safe to eat?, riparian vegetation, use of river margin, is water safe to drink?. A ranking system for each component provided	This work has enabled valuable datasets to be built by a number of hapu and iwi to assess and manage their catchments and sites on an ongoing basis. This methodology appears to have been widely accepted by the science fraternity, government agencies etc., but is sometimes criticised by iwi and hapu practitioners who see the balance has tipped too far away from matauranga in favour of a western science paradigm. Commonly, issues are raised regarding the ranking and/or "significance" of sites and the use of numerical values. When RIVAs was trialled in Murihiku concerns were raised by tangata whenua as all waterways are considered significant. There was unease about how such information might be used by councils (eg. possibly to grant higher protection to sites with higher rankings). When

[11] See http://www.mfe.govt.nz/publications/water/cultural-health-index-jun03/

system to assess the significance of in-and-out of stream river values in New Zealand. Tipa (2010) provided a modified version largely based on the earlier CHI work to allow for tangata whenua values to be assessed.	quantitative information and an overall classification of stream health. Researchers then compared the cultural stream health component of the CHI with two Western scientific measures of stream health, the Macroinvertebrate Community Index (MCI), and the Stream Health Monitoring and Assessment Kit (SHMAK). The CHI report also extensively covers matters such as site selection, data collection and storage, analysis, field team selection, training programme.	adapting the CHI to a coastal context (Chetham & Shortland, 2010) the significance measure was removed from the framework for that very reason. At a recent presentation on overseas models such as the Environmental Performance Index (EPI)[12] established by Yale University, it was recommended that focus of data collection should be on trends not rankings (Tipene Wilson., pers comm.) Moreover, the data recording sheets have proven to be highly complex and tend to put some kaitiaki off, particularly rangatahi and kaumatua (Meryl Carter, pers. Comm.).
Estuarine and Marine Indicators Maori methods and indicators for marine protection[13] was a collaborative project between Ngati Kere, Ngati Konohi, the Department of Conservation (DOC) and the Ministry for the Environment (MfE) examining Maori methods and indicators for marine protection (Wakefield et al, 2005; Wilson et al, 2007; Gibson, 2006). The key purpose was to inform the management of their recently gazetted rohe moana.	Ngati Konohi identified a series of primary and secondary tohu that signalled that the marine environment was in good health. Primary tohu were further compartmentalized into species focused (eg. observations of the health of the kaimoana) and process focused (eg. natural processes that illustrate the health of the marine environment, maramataka). The secondary tohu were scientific measurements of the kaimoana present and other processes that denote the health of the marine environment (eg. Local authority water quality monitoring results).	Tohu align to the indicators identified for KCI eg. • Species Indicators: Kaumatuatanga, Tinana ora, Tawhirmatea, Tamanuitera, Tangaroa, Whanaungatanga; and • Process indicators = Maramataka/ seasonal flowering of specific plants etc.; and • Secondary indicators eg. invasive species, accessibility of site etc.

[12] http://epi.yale.edu

[13] See http://publ.doc.govt.nz/dbtw-wpd/exec/dbtwpcgi.exe

Tiakina Te Taiao Estuarine Indicators (Walker, 2009) and a Coastal Cultural Health Index (CCHI) for Te Taitokerau (Chetham & Shortland, 2010) were projects where the freshwater CHI was adapted and applied to an estuarine or marine context.	The methodology for both was similar to that employed by Tipa et al (2003) and numerical indices were calculated for sites. Tiakina te Taiao used Atua Domains to group indicators and used specific annual animal events, the annual arrival and departure of Kuaka (Godwits) rather than seasons/ maramataka to schedule when monitoring would take place.	The thinking to date on the KCI Methodology Framework is to depart from a numerical calculation of indices and rankings and measure trend instead. As mentioned previously the mauri model may provide a simpler alternate assessment that could be built in to the tool. The KCI Report Phase 1, identified process type indicators and recommended that maramataka be a feature of the monitoring programme. It will take some deliberation to ascertain how the maramataka can be incorporated into the project, particularly once constraints such as time and resources are taken into account. Any relevant large scale animal events in the ngahere. - analogous to examples such as the Kuaka migration or Tuna migration (Nga Tirairaka o Ngati Hine, 2013) may also assist in devising a monitoring timetable.
Cultural Indicators developed for the domain of Tane		
Indicators	**Methodology**	**Discussion/Comment**
Single Species Indicators To date, most projects have centered on the health of a single species rather than forest ecosystems per se (Lyver, Taputu, Kutia, & Tahi, 2008; Pauling & Stevens, 2007), in this case, Kereru.	Mātauranga from Tūhoe Tuawhenua presented a range of visual (e.g. decreasing flock size), audible (e.g. less noise from kererū in the forest canopy), and harvest-related (e.g. steep decline in harvests since 1950) of indicators used to assess the abundance and	The authors suggest that Long-term qualitative monitoring by Tūhoe Tuawhenua has the potential to guide the restoration of kererū and wider environmental management in Te Urewera. Indeed, they concluded that allowing iwi the self-determination to make management decisions according to their mātauranga would lead to greater application of results and altered practices to

	condition of kererū) in Te Urewera.	achieve sustainability. This statement certainly resonates with us, given that iwi and hapu involved in the kauri dieback response also seek self-determination in management decision-making with regard to our kauri ngahere.
Developing a Culturally Based Environmental Monitoring (CBEM) tool for indigenous forests is a project being undertaken in the Motueka Catchment (Walker, 2012, 2013). http://www.maramatanga.ac.nz/sites/default/files/NPM%20Conference%20Proceedings%202012.pdf	Walker again utilises a Nga Atua Kaitiaki framework inspired by similar frameworks eg. the Hauraki Maori Trust Board and his earlier estuarine work. Cultural Indicators for forest health are derived by populating the framework with traditional narratives, contemporary issues, and appropriate scientific elements. This framework is configured as a hexagon with Tāne placed in the centre of the framework as the focus of this research is within his domain. Papatūānuku and Ranginui are acknowledged in the framework as holding tension and balance in the space surrounding the atua and their connections. Second-order gods can also be populated into the framework. These atua and other offspring whakapapa to the animate and inanimate, including groups of animals, plants and minerals, and form the basis of Māori taxonomy. The process by which the various components are populated into the framework is iterative and the order is not set. It is intended that each indicator deliver the following: (a) inform on the condition and trend of the well-being of indigenous forests and whether cultural values are being	From this process, a draft kete whaihua (toolkit) of indicators, a field guide, forms and a monitoring protocol has been developed and is being tested in the field with kaitiaki in the Motueka catchment. This work is very encouraging and we hope to have extensive discussions with the author throughout the process of the KCI methodology design to discover how we can share knowledge and potentially collaborate.

	enhanced or diminished, (b) have relevance to international biodiversity agreements and national policy and legislation, and (c) have the flexibility to acknowledge and accommodate differences in iwi understanding and traditions.	
KCI Report Phase 1 Cultural Indicators for Kauri initiated in 2011 at the behest of the TWR. Extensive oral interviews with Kaumatua and kaitiaki shaped the values and principles identified and selection of indicators.	Overarching values Whakapapa and Ngahere provide the parameters for the framework by demonstrating the holistic kauri ecosystem approach and informing the grouping of the Kauri Ngahere Cultural Indicators as follows: • minor flora, • trees, • insects, and • birds. Species indicators were selected using the following criteria: • inclusion of species which have been found living on kauri (approximately 60 species) • inclusion of species which have been identified living around kauri (approximately 30 species) • delimitation of species not referred to by interviewees and publications or websites researched The framework is to be based on nga atua domains and other key attributes:	A framework must be devised that incorporates all these attributes. Provision of a toolkit of indicators, field guide, data collection forms and a monitoring protocol is intended as is the case with the Motueka study. There will certainly be differences in the makeup of kauri ecosystems in different parts of the kauri catchment meaning the framework will require flexibility for alternate indicators and monitoring methods to be included or removed depending on the local situation. We anticipate that these matters will be confirmed via a series of intensive hui/workshops with mana whenua piloting the programme prior to fieldwork being carried out. Processes for site and team selection and training will need to be devised as will protocols around the storage, ownership and access to data in collaboration with each hapu/iwi involved in the pilot study.

	• kaumatuatanga – length of life • tinana oranga - bodily health & integrity • tawhirimatea – air needed & acquired • tamanuitera – light needed & acquired • Tangaroa – moisture need & acquired • whanaungatanga – seeds, seedlings, mature plants, flowering, etc. Relationship to kauri and customary use has been noted. As mentioned previously maramataka and/or process indicators and human (domain of Tumatauenga) and other pressures should be incorporated into the assessment. These will allow collection of data to illustrate trends over time. An overall health measure could be obtained by using the mauri model.	Long term resourcing for the KCI project will remain a factor critical to its success.

Note: This list is not exhaustive but includes those models which appear to have the most relevance to the KCI Project.

2.3 CURRENT STATUS OF SCIENTIFIC WORK ON KAURI DIEBACK, ECOLOGICAL MONITORING, USE OF INDICATORS

Following the identification of PTA as the causal agent of kauri dieback by the late Dr Ross Beever in 2008, there has been a significant amount of scientific research undertaken. This has involved member agencies of the Kauri Dieback Programme, or associate partners such as Auckland University, Manaaki Whenua and Scion, for example. Research to date has focused on surveillance to detect its presence in forests, studies of potential vectors, the rate and movement of PTA in soil and water, the pathology, biology and origin of the disease and potential treatments. Another strand of investigation has established long term monitoring plots in the Waitakere Ranges to measure kauri health at an ecosystem level.

2.3.1 Surveillance

The first round of surveillance operations were carried out over 30 sites in Northland, Coromandel and Aotea Great Barrier and identified six positive locations. Standard operating procedures involve photographing the canopy and base of tree, recording any special features of site such as water movement, pig sign etc., and soil sampling for laboratory analysis to detect PTA (Kauri Konnect, Issue 19, November 2011). Similar surveillance was carried out in the Auckland Region, specifically the Waitakere and Hunua Ranges, in order to quantify the extent and distribution of kauri dieback (Craw et al, 2010). More intensive survey has been undertaken in Waipoua (Beauchamp, 2012) Surveillance Two aimed to capture a larger number and distribution of sites and utilized aerial survey in addition to ground-truthing.

At the time of writing results from round two were unavailable. The report is due to be published on the Kauri Dieback website in September in order to give landowners time to digest the information and engage with the Programme, ahead of any national release (Ian Mitchell., pers comm.). The results may have some bearing on the development of the KCI Monitoring Framework so will be reviewed once published.

A key concern that has arisen through the surveillance cycle is the inability to accurately detect the presence or non-presence of PTA in the field. Some sites are asymptomatic, yet have proven positive for PTA after soil testing. This has serious implications in that positive sites could be missed (Beauchamp, 2012). Other work is currently underway to develop a rapid method of detection using a one- step, real-time, polymerase chain reaction (PCR) assay (Landcare Research, 2013). Presumably, the KCI framework will incorporate a visual assessment of tree health for symptoms of PTA. Consequently mana whenua will be unable to provide an unequivocal positive or negative determination for a site. As the key objective of the KCI project is to assess the wider health of the kauri ecosystem rather than kauri dieback in isolation, this is but one of many indicators that would be recorded in the field and overall the value of data gathered would not be affected. The research to improve the speed and efficiency of PTA diagnostics will assist and can be added to the monitoring toolkit of kaitiaki in the future.
Tangata whenua have produced a cultural impact report (Waipoua/ ref) and had varying degrees of involvement in surveillance for example, Waipoua, Aotea, and Punuruku. This could possibly influence site selection for KCI monitoring pilot locations, given that baseline data is available on the health of sites (albeit from a western scientific perspective). Secondly, mana whenua that have gained experience and built capacity during the surveillance rounds may be more likely to meet criteria for selection given potentially greater capacity to successfully carry out the mahi. Earlier cultural monitoring work (Tipa & Tierney, 2003, Chetham & Shortland, 2010) have stressed the importance of ensuring kaitiaki have adequate capacity for monitoring regimes to be effective.

2.3.2 Other Research

Long term monitoring plots set up by Auckland Council in the Waitakere ranges are being used to measure overall kauri health in an attempt to identify potential resistance and tolerance of individual trees to the disease. The University of Auckland is setting up larger long-term ecological plots to assess wider impacts to kauri ecosystem (vegetation change, forest succession, health of kauri associated flora and fauna) and kauri survival (e.g. does kauri dieback affect seedling recruitment) (Burns, Wyse & Perry, 2012). This work has probable crossovers with the KCI monitoring framework and is arguably the most relevant to our research.

A variety of other work assessing vectors such as pigs, humans, livestock and the relative risk of waterborne spread of kauri dieback, and where the disease is present in the tree are all underway or recently completed (Craw, 2012). Vectors and the role of water certainly will be considered as potential indicators. The KCI Phase 1 report identifies species indicators grouped by atua domains and concludes that indicators such as pest species and access should be considered in the development of a framework. It may be appropriate to add a domain criterion for “Tumatauenga” to capture human induced pressures in the dataset (after Walker, 2009).

A three-year Joint Agency funded programme undertaken by Landcare Research is soon to be published. The report is expected to describe the origin of kauri dieback and determine its likely genetic introduction to New Zealand. This work will also answer the native versus exotic conjecture and formally name the taxon. Additional matters to be addressed are the rate of disease spread within infested stands and understanding of the distribution of PTA within individual trees. This project also aims to investigate the potential threat that PTA poses to other plant species growing in kauri forests and develop a one- step, real-time, polymerase chain reaction (PCR) assay (Landcare Research, 2013). Aspects of this research such as the rate of spread within stands, distribution of the pathogen within trees and the susceptibility of other species within the kauri ecosystem have parallels to the KCI project and will need to be explored once the report is available.

It should be noted that several of the key researchers undertaking the work summarised above will shortly be participating in the Matauranga Maori hui being hosted by the Tangata Whenua Roopu and Planning and Intelligence streams of the Kauri Dieback Programme. This will avail us of an opportunity to determine potential avenues for collaboration with the KCI monitoring and potentially inform the development and/ or refinement of aspects of the framework design.

2.4 STUDIES REGARDING GROWTH RESPONSES BY NATIVE PLANTS TO SOIL SAMPLES BENEATH KAURI TREES

Trees can play a significant role in the growth and development of plants around them by having an influence on the soil beneath them. Examples of soil aspects that may be affected by trees are pH, soil carbon and nitrogen levels and the assortment of microbials present. Due to the large role soil plays on plant growth, trees effectively work as “ecosystem engineers.”

In northern New Zealand, this relationship is best exemplified by kauri. These trees are the largest that grow in the country as well as the longest living, with a lifespan that can range from 600 to 1700 years. “Kauri Forest” is the most diverse kind of forest found in New Zealand, despite being named after just the one species.

Although disbursed widely throughout a Kauri Forest, their namesake trees have been anecdotally observed to be found with the same pattern of vegetation around it. In 2012, the University of Auckland’s Sarah Wyse conducted a study that sought to find if the kauri’s influence on its surrounding soil played a role in influencing the flora typically found growing alongside it.

2.4.1 Methodology

To test their hypothesis, soil samples were taken from beneath a number of kauri trees spread throughout the designated forest. Five plants native to the kauri forest were also chosen, some of which were associated with growing near the kauri tree, some of which weren’t. Seedlings from a kauri tree were also used.

The five species were then grown in the soil taken from around kauri trees. There were three soil types in total: broadleaf mineral soil, kauri organic soil and kauri mineral soil. The combination seed/soil units were placed in a shadehouse and grown for a year under conditions kept consistent for each.

Highly significant differences in the pH levels were found amongst the three different soil types. The broadleaf samples were found to have more neutral pH compared to the acidic soil found around the kauri tree. The kauri samples were also much higher in NH4-N, whereas the broadleaf had higher amounts of NO3-N. Total nitrogen content, organic carbon content and the carbon to nitrogen ratio were all highest amongst the kauri organic soil.

Of the five species tested, the Mahoe grew the least in terms of size and root the kauri soil. This was to be expected given that Mahoe almost never grows near New Zealand's largest trees. The other plants showed no significant difference in growth over the differing soil types.

While the two plants most associated with growing near kauri, the kauri seedlings and the korokio, showed a tolerance for growing in the soil near kauri, it didn't show that their proximity made growth any easier. The other three samples were inhibited from growth compared to their usual soils. Further research was suggested in order to study other factors that may be at play in affecting why plants that constantly accompany kauri growth do so, given no obvious benefits.

2.4.2 Other Studies

In June, 2013 Wyse did a complimentary study that sought to further investigate the low pH levels of the soil beneath kauri trees. For this study, the team "investigated whether phytotoxic compounds occurred in A. australis leaf litter and organic soil, and whether allelopathy may explain the distinctiveness of plant communities surrounding A. australis."

In order to make this assessment the team took water-soluble compounds from fresh litter below the Kauri and from soil not associated with the tree. They then did bioassays of both seed germination and seed growth. Germination was restrained in all seedlings not associated with the Kauri tree when exposed to the tree's litter. The assumed conclusion is that this litter must contain phytotoxic compounds. The low pH soil beneath the Kauri showed similar effects on seedlings not associated with the Kauri tree. Further bolstering the assumed conclusion was that when the soil samples were neutralized by being exposed to lime, germination was no longer inhibited.

2.5. STUDIES SPECIFIC TO THE KAURI TREE, UNIQUE OF OTHER CONIFERS

Following up on her prior study, Sarah Wyse conducted another in 2013 on the kauri tree's (A. australis) impact on the vegetation around them via the soil they influence. This time the study focused on the composition of plant communities at individual and stand tree scales as compared to those of Dacrydium cupressinum, another large conifer which shares the forest with kauri trees. By doing so they could focus on the effects unique to the kauri tree by eliminating those that were simply specific to large conifers. Where her first study indicated that the soil of the kauri seemed to affect the growth of certain plants, this study would set out to decipher if that was an effect unique to the kauri tree or large conifers in general. This study was conducted over two forests and a multitude of diverse sites, comparing the composition of vegetation as they grew further in distance from these two trees.

The results enhanced her prior study in that they showed a group of plants which were actually dependent on the kauri's acidic soil. A second category was identified as plants which were intolerant of the soil and suffered growth-wise from it and a third category was seen to be unaffected by its proximity to the large tree. Similar categories were not observed relative to Dacrydium cupressinum, adding credence to the theory that the kauri tree is a foundation species of significant influence within its forest.

As with the first study, they found that the kauri tree's effects on the nitrogen content of its soil played a significant roll. "The organic soil formed beneath A. australis individuals was highly acidic, with high levels of NH48N, carbon and total nitrogen, but low levels of NO38N" (Wyse 2013) Expanding on this, the study added that, "the poor decomposability of A. australis litter (29% mass loss over 12 months, compared to 62% for co-occurring Pseudopanax arboreus and up to 98% for Melicytus ramiflorus (Enright and Ogden 1987)), and the complexation of proteins by tannins within the leaf litter, results in immobilization of nitrogen in the large layer of mor8type humus that builds up beneath A. australis trees (referred to as 'pukahukahu' by Māori). (Wyse 2013)

2.5.1 OTHER STUDIES

To assess the level of influence the kari tree exacts at a stand-based level, datasets that described the vegetation native to Waipoua and Russell Forests in Northland were acquired from Landcare Research National Vegetation Survey (NVS) databank. These datasets were comprised of inventories of eighty one forest plots in Russell Forest and 47 in Waipoua Forest which the team used to locate areas of study for their research. Datasets were then analyzed and separated into two groups: those in which the kauri tree were present and those in which the tree was not. As a comparison, the data was then analyzed with the same criteria relative to D. cupressinum. The plants that were studied were also given weight relative to their biomasses and relative weights amongst species so data wasn't skewed because of growth form.

Pearson's product-moment correlation coefficient was used to assign a positive value to those plants which grew in abundance near kauri and a negative value to those plants which grew in abundance when kauri trees were not present.

For the individual tree base effects, the researchers measured 20 m transects from mature kauri trees into the adjacent forest around it (that did not contain kauri) in order to examine the effect an individual kauri tree had on its immediate surroundings. Ten plots were established (2x2) over the course of the 20 m and in each plot, all vascular plants or lack thereof were recorded. Although thirteen of these were done in a variety of topographical areas, the transects never spanned more than one, meaning soil between the kauri area and the non-kauri area would not be affected by changes in environment. This same test was then carried out for D. cupressinum. Environmental data was recorded for each 2x2 plot to identify any characteristics that might unduly augment the data.

Furthermore, soil cores were taken. These samples were 10 cm deep and 11 cm in diameter. They were taken at 1, 10 and 19 m intervals in randomly selected areas for both trees in both forests. After these samples were dried for 48 hours at 35ºC and ground to pass through 2 mm sieve, they were tested for their pH, organic carbon, total nitrogen, mineral nitrogen and phosphorous. Soil moisture content at the time they were sampled was also measured.

The results showed that plants that grow well around the kauri, "are typically species that are common to nutrient poor, drought prone and high light conditions elsewhere" (Wyse, 2013). Those that preferred moister environments, like gulleys, generally did not grow or at least grow well near kauri. On the other hand, "D. cupressinum had no comparable affect on its soil or the vegetation around it" (Wyse, 2013).

In both study sites, plots in which A. australis was present with high importance values occurred in a variety of topographical situations including gullies, plateaux, and ridge crests. This suggests that species associated with A. australis were not simply the result of a shared preference for landscape position. (Wyse 2013)

The study went on to specify which plants reacted best to a close proximity to the kauri tree. Plant species with distributions found to be most positively correlated with A. australis in both datasets collectively represented a range of plant families, with the most common families being the Cyperaceae (four species), Alseuosmiaceae (three species), Myrtaceae (three species) and Podocarpaceae (three species)…With the exception of Phyllocladus trichomanoides and the representatives of the Podocarpaceae and Proteaceae, most of the species found to have distributions most correlated to those of A. australis were shrubs or small trees…The species found to be most negatively associated with A. australis included the palm Rhopalostylis sapida, the small tree Melicytus ramiflorus, and the liane Ripogonum scandens. (Wyse, 2013)

The results of this study can be applied to potential conservation efforts as the study indicates the nature of kauri trees as foundational species plays a necessary role in the survival of certain plants. For the most part, vegetation associated with kauri was found growing without this foundational species near. The one exception, however, was “broadleaved angiosperm dominated forest surrounding A. australis stands” (Wyse, 2013). This suggests, then, that “The potential loss of A. australis through the present dieback event could therefore have more wide8ranging effects on forest composition and diversity than simply the loss of a single species, as habitat and species diversity within these lowland forests could be markedly reduced. This in turn is likely to influence the fauna and other taxonomic groups (e.g. fungi) within these ecosystems, including distinctive invertebrate assemblages that have been recorded beneath A. australis compared to within adjacent broadleaved angiosperm stands.” (Wyse 2013)

2.6 A STUDY UNDERTAKEN TO DECIPHER THE EFFECT BARK PLAYS ON THE EPIPHYTE COMMUNITY LIVING ON IT

Sarah Wyse and Bruce Burns produced a study in March, 2011 that sought to establish whether or not the bark of a tree affects the trunk epiphyte communities. This is one of the first studies of its kind as, although these have been done the world over, few have actually been done on the trees native to New Zealand.

2.6.1 Methodology

The researchers studied Agathis australis, Dacrydium cupressinum, Knightia excelsa and Vitex lucens in Waitakere and Hunua ranges in the Auckland Region. “The tree species investigated were selected to provide a variety of bark characteristics in terms of texture and peeling patterns. Species selected were Agathis australis (kauri, Araucariaceae, bark smooth and shed in large flakes), Dacrydium cupressinum (rimu, Podocarpaceae, bark rough and shed in large flakes), Knightia excels (rewarewa, Proteaceae, bark smooth and not shed at observable rates) and Vitex lucens (puriri, Lamiaceae, bark rough and shed at low rates). These species are all present in mature forest within the same geographic areas, allowing differences in epiphyte communities between the tree species to be attributable to host-specific rather than environmental factors” (Wyse and Burns, 2011).

Due to their high degree of shedding, it was often assumed that kauri trees would be the least hospitable to epiphytes. The results seemed to actually point to the contrary. While 32% of the 173 trees studied had trunk epiphytes in the sample region, the rate was 44% for the 48 kauri trees studied. “Agathis australis was the only host species on which epiphytes were recorded at a higher density than would be expected if the epiphytes were randomly distributed with respect to the host” (Wyse and Burns, 2011). Overall, though, Vitex Lucens showed the highest amount of growth at 45%.

While the researches do acknowledge that the trees targeted in the study do not necessarily represent objective samples of New Zealand’s forests, the results did suggest that they have a denser population of epiphytes than rainforests found in temperate climates like in Tasmania and southern Australia. In fact, their density is more comparable to tropical climates.

The conclusion Wyse and Burns draw is that when bark is shed, only the parts of the epiphyte which were attached to that piece fall off with it, leaving the rest behind. This leave the surviving portion free to continue growing. This would explain why, on the kauri, although epiphytes were found in mass, they were smaller portions.

3. CONCLUSIONS

The KCI monitoring framework is aimed at providing a tool for mana whenua to record trends in the health of their kauri ngahere. The presence or absence of certain indicators may enable conclusions to be drawn over time about why some sites are positive and others in the vicinity are unaffected and provide insight into opportunities to build resilience. Several of the models reviewed offer useful approaches that with some modification could potentially be applied to this project. This project represents a significant prospect for the utilisation of matauranga maori alongside western science in a multiple evidence based approach to counter this disease afflicting our taonga.

4. REFERENCES

Beauchamp, T. (2012) *Preliminary assessment of the relationships between symptomology and detection probability of the targeted sampling of Waipoua forest for Phytophthora Taxon Agathis*. Joint Agency Kauri Dieback Publication**.**

Burns, B., Wyse, S., & Perry, G. (2012). *Ecological Research on Kauri and PTA at Auckland University*. Unpublished Powerpoint Presentation to Auckland Council. 2012

Chetham, J., Shortland, T., Nuttall, P., & Newell, A. (2010). *Maori Cultural Environmental Monitoring Stocktake*. Whangarei: REPO Consultancy.

Chetham, J., & Shortland, T.,(2010). *A Coastal Cultural Health Index for Te Taitokerau.* REPO Consultancy*.* Ministry for the Environment Contract. Wellington. Unpublished Report.

Ellis, S. (2005). *Meaningful consideration? A review of traditional knowledge in environmental decision making*. Arctic 58: 66–77. Retrieved from http://pubs.aina.ucalgary.ca/arctic/Arctic58-1-66.pdf

Gibson, P. (2006). Maori methods and indicators for marine protection: *A process to identify tohu* *(marine indicators) to measure the health of the rohe moana of Ngati Konohi.* Stand alone publication, Department of Conservation. Retrieved from http://publ.doc.govt.nz/dbtw-wpd/exec/dbtwpcgi.exe

Harmsworth, G. (2009). *Linking scientific and cultural indicators of river health*. Editorial, Catchment Connections: Issue 5. Retrieved from http://icm.landcareresearch.co.nz/about/newsletter/issue5.asp

Jefferies, R. & Kennedy, N. (2009). *A Report to Iwi on the Kaupapa Maori Environmental Outcomes and Indicators Kete.* PUCM Māori Report 8. Hamilton, New Zealand: IGCI, The University of Waikato. Retrieved from http://researchcommons.waikato.ac.nz/bitstream/handle/10289/6105/PUCM%20Maori%20Report%205.pdf?sequence=1

Kaupapa Taiao, Te Runanga o Ngai Tahu. (2004). *State of the Takiwa: A scoping document for developing a culturally based environmental monitoring and reporting system for Ngai Tahu.* Retrieved from http://www.ngaitahu.iwi.nz/Ngai-Tahu-Whanui/Natural-Environment/Environmental-Research/State-of-the-Takiwa.php

Kaupapa Taiao, Te Runanga o Ngai Tahu. (2006). *State of the Takiwa: Cultural monitoring and reporting on the health of our environment: Wairewa Cultural Health Review 2005/06 Preliminary Results.* Retrieved from http://www.wairewa.org.nz/documents/Wairewa_State_of_Takiwa.pdf

Karjala, M., Sherry, E., & Dewhurst, S. (2003). *The Aboriginal Forest Planning Process: A Guidebook for Identifying Community-Level Criteria and Indicators.* Ecosystem Science and Management Program, the University of Northern British Columbia. Retrieved from http://researchforest.unbc.ca/afpp/Aboriginal_Forest_Planning_Process_Final.pdf

Landcare Research (2013). *Specialist Phytophthora Research: Ecology and pathology of PTA.* MPI Contract 11927 to Landcare Research LC1233). In Draft.

Lyver, P., Taputu, T., Spady T., Tahi, B. (2008). *Tūhoe Tuawhenua Mātauranga of Kererū (Hemiphaga novaseelandiaenovaseelandiae) in Te Urewera.* NZ Journal of Ecology. Retrieved from http://www.newzealandecology.org/nzje/free_issues/NZJEcol32_1_7.pdf

Ministry for the Environment (2001). *Environmental Performance Indicators: Confirmed indicators for the marine environment.* Ministry for the Environment Publication. Retrieved from http://www.mfe.govt.nz/publications/ser/marine-indicators-jun01.html

Natcher, D & Hickey, C. (2002). *Putting the Community Back Into Community-Based Resource Management: A Criteria and Indicators Approach to Sustainability*. Human Organization. Retrieved from http://sfaa.metapress.com/content/dem6fx3npep78xaq/

(Norstrom, A. (2011). *Indicators, Ecosystem Services and Stakeholder Empowerment.* Sustainable Development Update Blog. Retrieved from http://sdupdate.org/component/content/article/5-feature/155-indicators-ecosystem-services-and-stakeholder-empowerment

Otaraua Hapu (2003). *Kaimoana Survey Guidelines for Hapu and Iwi.* Prepared in partnership with Shell Petroleum Mining Ltd. A Ministry for the Environment Publication. Retrieved from http://www.trc.govt.nz/assets/Publications/policies-plans-strategies/regional-plans-and-guides/regional-coastal-plan/kaimoanasurvey.pdf

Pauling, C. & Stevens, H. (Eds) (2007). *E kūkū te kererū Oral histories & recent research into the Banks Peninsula kereru.* Te Runanga o Ngai Tahu 2007.

Wakefield, A. and Walker, A. (2005). *Maori methods and indicators for marine protection: Ngati Kere interests and expectations for the rohe moana.* Stand alone publication, Department of Conservation. Retrieved from http://publ.doc.govt.nz/dbtw-wpd/exec/dbtwpcgi.exe

Wilson, C., Freeman, D., Hogan, K. and Thompson, K. (2007). *Maori methods and indicators for marine protection: summary of research findings.* Stand alone publication, Department of Conservation. Retrieved from http://publ.doc.govt.nz/dbtw-wpd/exec/dbtwpcgi.exe

Shortland, T. (2011). *Cultural Indicators for Kauri Ngahere*. A report prepared for the Tangata Whenua Roopu. Kauri Dieback Joint Agency Response. Whangarei.

Smith, L. (2012). *Decolonizing Methodologies – Research and Indigenous Peoples*. (2nd Edition) Zed Books. New Zealand.

St-Arnaud, M., Asselin, H., Dubé, C., Croteau, Y., & Papatie, C. (2009) *Developing Criteria and Indicators for Aboriginal Forestry: Mutual Learning through Collaborative Research*. Chapter 6, Changing the Culture of Forestry in Canada, CCI Press, 2009. Retrieved from https://tout.uqat.ca/mon/personnel/asselinh/SiteWeb/SiteAssets/SitePages/Publications/Saint-Arnaud_et_al_Ch_6_SFMN_2009.pdf

Stevenson M. (2006). *The Possibility of Difference: Rethinking Co-management*. Human Organisation. Retrieved from http://sfaa.metapress.com/content/b2dm8thgb7wa4m53/

Tebtebba Foundation. (2008). *Indicators Relevant for Indigenous Peoples: A Resource Book*. Tebtebba Foundation, Phillipines.

Tengö M. and Malmer P. (eds), Borraz P, Cariño C, Cariño J, Gonzales T, Ishizawa J, Kvarnström M, Masardule O, Morales A, Nobrega M, Schultz M, Soto Martinez R, Vizina Y. 2012. Dialogue Workshop on Knowledge For the 21st Century: Indigenous knowledge, traditional knowledge, science and connecting diverse knowledge systems. Usdub, Guna Yala, Panama,10–13 April 2012. Workshop Report. Stockholm Resilience Centre.

Tengö, M, Malmer, P, Brondizio, E, Elmqvist T, Spierenburg, M. (2013). *The Multiple Evidence Base as a framework for connecting diverse knowledge systems in the IPBES*. Discussion Paper 2012-06-04. Stockholm Resilience Centre (SRC), Stockholm University, Sweden. Retrieved from http://www.stockholmresilience.org/download/18.416c425f13e06f977b11277/Multiple+Evidence+Base+for+IPBES+2013-06-05.pdf

Tipa, G. (2010b). *The River Values Assessment System: Volume 2: Application to cultural, production and cultural, production and environmental values*. LEaP Report No.24B, Lincoln University, New Zealand. Retrieved from http://www.lincoln.ac.nz/Documents/LEaP/LEaPNo24/Chap-8-Tangata-whenua-Southland.pdf

Tipa, G. and Teirney, L. (2003). *A Cultural Health Index for Streams and Waterways: Indicators for recognising and expressing Maori values.* A report prepared for the Ministry of the Environment. Retrieved from www.mfe.govt.nz/publications/.../**cultural-health-index**-jun03/

Tipa, G. and Teirney, L. (2006). *A Cultural Health Index for Streams and Waterways: A tool for nationwide use.* A report prepared for the Ministry of the Environment. Retrieved from http://www.mfe.govt.nz/publications/water/cultural-health-index-for-streams-and-waterways-tech-report-apr06

Tipa, G. and Teirney, L. (2006). *Using the Cultural Health Index: How to assess the health of streams and waterways.* A guideline prepared for the Ministry of the Environment. Retrieved from http://www.mfe.govt.nz/publications/water/cultural-health-index-for-streams-and-waterways-feb06/index.html

Waipara, N. & Craw, J. (2012). *Kauri Health in Regional Parks*. Parks Recreation and Heritage Forum, 13 March 2012 File No.: CP2012/03054. Retrieved from http://www.kauridieback.co.nz/media/19562/parksrecreationheritage20120313.pdf

Walker, D. (2012). *Developing a Culturally-Based Environmental Monitoring and Assessment Tool for New Zealand Indigenous Forests.* Proceedings of the International Indigenous Development Research Conference June 2012. Nga Pae o te Maramatanga. Auckland University.

Walker, D., Ataria, J., Hughey,K., Lambert, S. (2013). *Developing a Culturally-Based Environmental Monitoring and Assessment Tool for New Zealand Indigenous Forests.* Conference Paper for the 19th International Symposium on Society and Resource Management**.** Estes Park, Colorado, 4-8 June, 2013.

Walker, D. (2009). *Iwi Estuarine Indicators for Nelson*. Prepared for Nelson City Council. Tiakino Te Taio Occasional Report. Retrieved from http://www.envirolink.govt.nz/PageFiles/425/628-nlcc31.pdf

APPENDIX 4 - MATAURANGA MAORI WORKSHOP SUMMARY REPORT

Kauri Dieback Joint Agency Response - Tangata Whenua Roopu: Matauranga Maori Hui 6/9/13 Notes

Submitted by Repo Consultancy Ltd

27th September 2013

1. INTRODUCTION

Since 2010 the development of a framework to enable the use of cultural indicators to monitoring the health of Kauri ecosystems (hereafter referred to as the KCI project) has been a research priority for the Tangata Whenua Roopu (TWR) of the Kauri Dieback Joint Agency Response. In 2011 an initial phase of the project was carried out to determine a range of cultural indicators for Kauri ngahere. In 2012 the second phase of the KCI project was included in the annual workplan and budget for the TWR stream along with funding for a Matauranga Maori Hui under the Planning and Intelligence Stream (P&I). In recognition of the opportunities for collaboration between science and matauranga maori, and its applicability to the KCI project, the Matauranga Maori hui was included in the workplan for phase 2 of the project which was initiated in July 2013. The Matauranga Maori hui involved TWR, Kaumatua/kauri experts and the Science Fraternity with the purpose of establishing potential areas of collaboration, gaps in research and provision of input into the KCI project.

This summary report provides an overview of the hui held on 6th September 2013. The hui was hosted by Nga Pae o Te Maramatanga at Auckland University and facilitated by Dan Hikuroa and Tui Shortland.

2. AGENDA

10.30am	Mihi Whakatau
11.00am	Housekeeping
11.10am	Background to Cultural Indicators for Kauri Project and work to date – Juliane Chetham, Tui Shortland
11.50am	Presentation – Developing a Culturally-based Environmental Monitoring and Assessment Tool for New Zealand Indigenous Forests – Dean Walker
12.10pm	Update on Science to date - Nick Waipara
12.30pm	*Lunch*
1.30pm	Shared Pathways – Opportunities for collaboration in monitoring and research –discussion facilitated by Dan Hikuroa
2.15pm	Feedback on methodology outline and suite of indicators
3.15pm	Closing statements
3.45pm	Kapu ti

It should be noted that due to time constraints the original agenda as pre-circulated shifted slightly on the day. We did not wish to disrupt the flow of korero on cultural indicators and as such, decided not to present on the science work undertaken to date on Kauri Dieback.

3. HUI RECORD

ITEM	DISCUSSION
Whakawhanaungatanga and introductory Korero	Te Rangi: Query about Intellectual Property, matauranga, acknowledgements must be given, scientists must reference this group – what information is taken away today. Waitangi: Provided a background to TWR, this is the first hui we have had with all the diverse backgrounds, described how the contributions will be utilized. Any korero used outside of this forum will be referenced to this hui. Cheri: Any korero from the floor that roopu must be engaged in any research that comes out of this. Phil: This roopu – what has been put up in the room has a tapu around it – mandate must come from this group, in this instance Wai and Matua Hori Tui: Explained the purpose of this kaupapa- taking a traditional knowledge approach to a monitoring framework that our hapu and whanau can use in the ngahere. Utilisation of a multiple evidence approach in future This kaupapa will be guided by our kaumatua and kuia.

Background to KCI Project – presentation by Tui Shortland	Kevin: Pupuwhakahaere – kauri snail Te Rangi: Provided korero on "Te hou te kauri or te ha te kauri" and Te Ao marama, wehenga, papatuanuku. Emphasized the need not to lose track of the maori cultural icons, start with pou te ao, human existence, ngahere tuakana linked to us, relationship of an atua cohabitating with nature?. Senior tungane, Punga, ngarara, manu, ika relationship web,water cycle. Karakia – gave Rata korero, time for harvesting, don't miss little subtleties and ensure our foundational whakaaro are in the framework. And remembering there are unique whakapapa through individual iwi/hapu and we need to be able to accommodate them. Phil: Even though from a PTA perspective – it will be a very useful framework also for observational western science no matter where it comes from or how it is grounded. PTA in WA (Jarrah Dieback) large areas have been wiped not just one tree, includeother species and how they may be impacted, secondary infections etc, other species are affected too. Mauri is impacted/compromised not just rakau rangatira but rakau katoa. Cheri: Frameworks tend to concentrate on life – hine nui te po could be incorporated, death indicators, eg, what are the positives of death, ngarara makes new life. Framework could consider including this. Need to acknowledge the benefit of that in the cycle. Put it up there for kaumatua to comment on.
Dean Walker Presentation – Culturally based ecological monitoring in native forest in Motueka	Dean: This project is a collaborative approach between 3 iwi of motueka and Lincoln University, (Te Atiawa, Ngati Tama, Ngati Kuia) Combined kaupapa maori mixed methods approach/ action research – data sheet etc continually developed (would work allow flexibility etc??)

	35 indicators selected. Qualitative and quantitative data generated (scoring) and monitor the learning cycle as well/ evaluation, learning cycle mapped field reports follow each round of field work. Three forests being monitored, trial in some larger forests in upper catchment reports, best way to report back – kaitiaki, DoC, agencies etc Datasheet is grouped according to atua - Tangaroa, tane etc tohu beneath them whakatauki, contemporary whakatauki developed in the field as well. Must be Flexible Using mauri model for health assessment. Tohu – eg. honey eaters, tui, atua, eg, birds give an indication of what the flowering plants are doing etc Generic whakatauki, some more relevant ones come out in the field, rongoa plants etc, process owned by the monitors, they have more and more monitors, tikanga core team, more come along, intergenerational etc Joe Harawira: Tohu are unique to iwi In their project they use paptuanuku and her uri, being affected, mauri diminished – going back to nga uri o Papatuanuku and Ranginui to look for resolutions to cure or resolve the impacts Waka, tohunga identifies tree, does karakia, which continues right through cutting down and carving etc. 4 pou used (he can provide examples if required) Pat Park: Atua framework – you can keep adding atua, whakatauki in to framework Te Aroha – can you mix or merge models, eg matauranga with kawantanga integration vs multiple evidence approach Should we be talking about parity? Colonization, leave it with its own inherent value

	Kevin Prime: Scientific measure (grade or number) vs having the conversations around the issues and making connections Tohu – how to incorporate into a reporting framework Use of Epistemology Te Rangi – take note of differing cycles Cheri – Query – “can I be a scientist and Matauranga Maori practitioner”. Likes Dean’s model - shows human environmental resilience, triangles, add your solutions, stretched rubber bands in hexagonal shapes. Chris McBride: Matauranga Maori relationship between kauri and other plants, Bruce Burns, western science perspective very similar. Different perspectives same result. Dan Hikuroa/Amanda Black Look at what options are available in funding initiative “Vision Matauranga” – interns, secondments – check
Feedback on methodology outline and suite of indicators	Tui: Wai classification – is there an example we can use in the Ngahere (eg. Ngahere ora, kino, mate etc) Te Rangi: eg. kokopu are an indicators of health of puna etc, koura, inanga, tuna (these are the kaitiaki of the oranga of that water) – some there but not others, means there is an imbalance - not some toxins in water, natural occurrence, but if none there = man made impact eg. agricultural run off fertilisers

	Whakapapa based – whats missing is the link Look to the atua for that information Lorna: Example - kupu for weaving, kupu oranga – “te wao” kapata kai te huiarangi Puwhenua (stand of trees) tohora korero Tohe: “Listen and the ngahere will talk to you” Potential to look at Wharetapu model of Durie Do a personal health check on yourself before doing one on the forest (Wairuatanga) – wharetapuwha model, 5th te hou oranga whenua – come informed Kevin: simple tohu – call of the kiwi, kuku etc, possum stillness – you feel it – eg. you don’t hear the manu etc you feel the absence Will: Agrees with concept of checking yourself first – we are not separate from the ngahere we are all part of it – intuitive sense – add on to wairuatanga “OSH” stuff Cheri: Personification – how does this make me feel? Gut feeling Or “I feel mauiwi”, “pouri” etc as a measurement? Phil: Ngahere approach is great because essential to get information on how more than kauri are being affected, more than one

	phytopthera Tui: Question on CBD stuff, inclusion of these indicators TR: Utility as an indicator Tuakana – pacific island, have we looked - we are related they are our tupuna eg. there is a Coconut phtyophthera
Shared Pathways – Opportunities for collaboration in monitoring and research	Phil: Get industry buy-in Approach Foma, Cawthron, NIWA for example Dan: Maintain as broad approach as possible - strong network, kaupapa must remain strong Cheri –more forestry organisations must be involved – sustainable forestry, eg. kauri is being moved around the country to where it wouldn't normally be, arborists need to be educated etc Look at areas where its isn't yet eg. Hunua, Waikato then look at a monoculture kauri system eg. where it is being grown for timber Collaborative approach needs to occur at the political level as well – eg. to ensure we can look at a health rather than just the disease Phil: Imperative to control the data, control the mandate Research providers are gatekeepers and owners of data – we don't want this scenario. Suggestions – he is aware of two apps for recording forest health status, online tools, tree tagger, inaturalist etc

	Utilize modern media tools, GPS with a camera on it, technology is now becoming affordable. Don't forget we are collecting data, qualitative data is very valuable (presence or absence) hierarchy of information. As a geneticist – growing indigenous species in a forestry production system- Kauri Value as good as Douglas Fir, and can be treated growth rates equivalent to Douglas Fir. Kauri is of strategic national value from an economic perspective – card to play. Long term monitoring of areas – particularly plantations. Potential to find asymptomatic trees, question is - are they closely related to another asymptomatic tree in the locality – could be for GENETIC reasons. Therefore kaitiaki could potentially use genetic tools alongside matauranga etc, and this information could be a potential commercial pathway, therefore maintain ownership of the data. Tui: Mapping issues. We don't want GIS to be a barrier but we could use this. Will need capacity building and training etc? Lincoln University Reseachers: COR/CORE Lincoln – Maori Bioprotection team Haven't been able to develop that space. Its now happening, internal funding hopefully coming – they would like to help where they can….soil system, molecular/genetic resistance in species, whakapapa of phythopthera. Also opportunities for collaboration in soil tests, diagnostics. Ngarara must not be underestimated – they are a signifier. Dan: What is science? – any information derived by using the scientific method. Science does not have aroha. Matauranga does Phil: But Matauranga approach very close to –observational ecology

	Dan: Kepa Morgan's korero -First narrative then number/grade Concept translators and culture brokers, people who will unpick maori values ad describe them in emotive terms that others can understand. Juliane: Question on setting site monitoring boundaries. Dean: Suggest small forest blocks, go into forest, "tune in" wander around fill in forms. Tui: Look at "hotspots" Will: Catchments in forests, catchment monitoring, takes in altitude etc Dean: Build it up to be a service to provide and get funding/ center of competence in this space, preferred provider etc?? Phil: Look at Gary Watson - Ngahere monitoring, programme on youtube. Deals with "at risk" rangatahi – are there opportunities for collaboration?

4. NEXT STEPS

Now that the literature/information review and hui has been completed, Repo Consultancy are moving on to the following phase of the project – developing a draft methodology framework for the use of cultural indicators in assessing the health of Kauri ecosystems. Feedback obtained at the hui will be incorporated into the draft model. We will report back, circulating the draft methodology to hui participants, and seek endorsement of the draft via a further workshop with the Tangata Whenua Roopu and key hui participants. Additionally, we will continue conversations with all hui participants about how best to set up a network of researchers (within Maori and Science organisations) to support each other in our practice, and to share knowledge, methodologies, and general support going forward in the quest to reverse the decline of our kauri ngahere.

5. ATTENDANCE LIST

NAME	IWI/HAPU/ORGANISATION	CONTACT
Waitangi Wood	Tau Iho I Te Po Trust, TWR	0211143865
Joe Harawira	Ngati Awa/Te Patuwai/SWAP	Joe.harawira@nash.org.nz
Hori Parata	Ngatiwai/ TWR	021436837
Pat Park	Te Atiawa	0277519861
Phillip Wilcox	Rakaipaaka	021387892
Kevin Prime	Ngati Hine	0276528474
Tohe Ashby	Ngati Hine	
Te Aroha Henare	Ngati Hine	0220287392
Lorna Rikihana	Ngati Paoa	0210305881
Te Rangi Kaihoro	Ngati Paoa	02102308005
Dean Walker	Lincoln University	0211933260
Dan Hikuroa	Nga Pae o te Maramatanga	0212469999
Melanie Mark-Shadbolt	Bioprotection Research Centre	Melanie.shadbolt@lincoln.ac.nz
Amanda Black	Bioprotection Research Centre	Amanda.black@lincoln.ac.nz
Nick Waipara	Auckland Council	Nick.waipara@aucklandcouncil.

		govt.nz
Cheri Van Schravendijk-Goodman	Ngati Rangi/Ngati Apa/Te Atihaunui a Paparangi	cheriv@tainui.co.nz
Rebekah Fuller	University of Auckland/Ngapuhi/Te Rarawa	r.fuller@auckland.ac.nz
Will Ngakuru	Te Roroa/Te Rarawa/TWR	Will.ngakuru@gmail.com
Chris McBride	Kauri Community Engagement Project/Arts Trust	ctmcbride@mail.com
Tui Shortland	Ngati Hine/Repo Consultancy/TWR	tui@repoconsultancy.maori.nz
Juliane Chetham	Patuharakeke/Repo Consultancy/TWR	jchetham@gmail.com

6. ACKNOWLEDGEMENTS

We would like to thank all those who participated in the Matauranga Maori hui, and especially wish to acknowledge the effort of Waitangi Wood in organising the hui and providing logistical support. Nick Waipara was also instrumental in bringing together a wide range of participants from the science fraternity. Our kaumatua and kuia that attended provided a wealth of knowledge and grounded our approach to research and development of the KCI project going forward.

APPENDIX 5 - MONITORING FORM TEMPLATES

Kauri Ngahere Cultural Indicators Site Record Form – Version 1.0

TABLE ONE: SITE INFORMATION

Ngahere Name:	GPS/Grid Reference:	Landowner (eg. Iwi/Hapu, DoC, Council, Private):	Kaitiaki Name:
Site Name:	Date	Site Description eg: • catchment, • remnant, • size of area/ assessment radius • include sketch/photos y/n	Tikanga Protocols Observed: eg: • Karakia y/n • Wairua/self examination y/n •

Site Reference/ Number:	Time of day (eg. dawn or evening – for monitoring kiwi calls):	Weather/climate:	Hygiene/Quarantine Protocols:

<u>TABLE TWO: NGAHERE HEALTH ASSESSMENT – TEMPLATE 1</u>

TANE MAHUTA: TOHU/INDICATOR SPECIES	TOHU/ ASSESSMENT ELEMENT									
Ngahere whakapapa component[14]:	Whanaungatanga		Jan	Feb	Mar	Apr	May	Jun	Oct	Nov
MINOR FLORA: *Found on and around Kauri*										
eg. Kahakaha	Abundance (approximate#)									
	Reproductive stage (Tick as appropriate)									
	Seeds									
	Flowers									
	Naturally dying off									
	Fruit									
	Buds/cones									
	Seedlings									
	Mature specimens									
Other										

[14] A full list of indicator species is included in Appendix 2. The record form above shows just one example. The list is intended to be flexible to allow for differences in both ecology and cultural understandings and traditions amongst mana whenua across the kauri catchment.

TABLE THREE: NGAHERE HEALTH ASSESSMENT – TEMPLATE 2

TANE MAHUTA: TOHU/INDICATOR SPECIES	TOHU/ ASSESSMENT ELEMENT					
Ngahere whakapapa component[15]:	Tinana Oranga	Whanaungatanga	Tawhirimatea	Tamanuitera	Tangaroa	Papatuanuku
TREES (SUBCANOPY OR CANOPY)	Tick as appropriate, or approximate #	Tick as appropriate	Y/N or comment	Y/N or comment	Y/N or comment	Tick as appropriate
eg. Kauri	PTA Symptoms (Tick as appropriate) None Basal lesions (bleeding/ gumming) Defoliation/ sparse canopy Severe defoliation Branch death Dead canopy/ "Stag heads" *Trunk condition eg. bark not weeping or un-naturally peeling,* *Foliage eg. proper leaf colour, shape and size etc; gaps in canopy* *Signs of Disease/ dieback* *Presence of Invasive*	*Seeds* *Fruit* *Buds/cones* *Seedlings* *Mature specimens*	Access to clean air to breathe Access to wind for seed dispersal Describe smell and sound of forest:	Access to light to grow	Access to water/moisture to grow Describe any water course: Type (awa/ spring etc etc) Proximity	Describe ground type eg: Leaf litter and dead wood Greenery of any kind Soil Rock Other Note soil disturbance if any Soil test for PTA

15 A full list of indicator species is included in Appendix 2. Those noted in the record form are considered key species. The list is intended to be flexible to allow for differences in both ecology and cultural understandings and traditions amongst mana whenua across the kauri catchment.

	Species[16] *eg signs of pest browse*				Quality (Waimaori, Waiora etc)	pH test	

TABLE FOUR: NGAHERE HEALTH ASSESSMENT – NGARARA TEMPLATE

TANE MAHUTA: TOHU/INDICATOR SPECIES	TOHU/ ASSESSMENT ELEMENT						
Ngahere whakapapa component[17]:	Tinana Oranga *Describes the bodily health and integrity of key species*	Whanaungatanga *Describes life/reproductive cycle eg. seeds, seedlings, mature plants, flowering etc*	Kaumatuatanga *Describes the length of life of key/rangatira trees*	Tawhirimatea *Atua of wind and air*	Tamanuitera *Atua of light/personification of the sun*	Tangaroa *Atua of sea, rivers, lakes, water*	Papatuanuku *Earth Mother* *Access to soil to grow*
NGARARA: *For the purposes of the Framework refers to insects and reptiles living on or near Kauri*							
Kekereru/Kekerengu/							

[16] Appendix 2 provides a list of key weed species to be populated during field survey
[17] A full list of indicator species is included in Appendix 2. Those noted in the record form are considered key species. The list is intended to be flexible to allow for differences in both ecology and cultural understandings and traditions amongst mana whenua across the kauri catchment.

Hotete/Awheto							
Kihikihi							
Kihikihikai							
Weta							
Moko (Skinks and Geckos)							
Other							

TABLE FIVE: NGAHERE HEALTH ASSESSMENT – MANU TEMPLATE

TANE MAHUTA: TOHU/INDICATOR SPECIES	TOHU/ ASSESSMENT ELEMENT						
Ngahere whakapapa component[18]:	Tinana Oranga	Whanaungatanga	Kai	Calls	Behaviour	Tangaroa	Papatuanuku
MANU[19]: *Found on or near Kauri*							
Kakariki			Food supply for birds and insects (0/-/+)	Bird calls/song (0/-/+)			

18 A full list of indicator species is included in Appendix 2. Those noted in the record form are considered key species. The list is intended to be flexible to allow for differences in both ecology and cultural understandings and traditions amongst mana whenua across the kauri catchment.

19 Either through direct observation or hearing calls/song. With respect to birds it is likely that the best time for monitoring is either at dawn (“dawn chorus”) or dusk 1 hr each side (kiwi calls)

Kereru/Kukupa/Kuku							
Kaka							
Tui							
Kiwi							
Other							

TABLE SIX: NGAHERE HEALTH ASSESSMENT – INVASIVE SPECIES

WEEDS:	ABSENT Tick as appropriate	PRESENT Tick as appropriate	ABUNDANT Tick as appropriate
Wandering Jew			
Wild Ginger			
Pampas			
Wattle			
Climbing Asparagus			
Other			
PESTS[20]:			
Possum			
Goats			
Pigs			
Stock			
Rodents			
Stoats			
Other			

[20] Based on actual observations or "sign" eg. possum faeces, pig tracks, browse etc)

TABLE SEVEN: OVERALL NGAHERE HEALTH ASSESSMENT

Mauri/ Hau o Te Kauri Assessment[21]				
Ngahereora	Ngaheremaori	Ngaherekino	Ngaheremate	Comments:
Tumatauenga Describe access to site Describe use of site (eg. contemporary or traditional customary use, tourism etc).	CBD indicators?			Photo record/ site sketch eg. (photos of trees exhibiting PTA symptoms, Taonga Trees etc, photos, rough sketch of site and boundaries)

[21] Tick which one applies